# 4 Basin Evaluation Programs

## 4.1 Recharge Calculations

### 4.1.1 Introduction

Main Basin aquifers are recharged by a combination of factors, including (but not limited to): partial percolation of rainfall, applied water (irrigation), stream flow, and subsurface inflow. Zone 7 calculates the recharge for each of these natural and artificial sources as follows:

- **Stream flow recharge** includes the following 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** – 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 produce the amount of recharge that would have occurred if Lake Del Valle had not been constructed.

  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.

  The synoptic discharge measurements performed on the Arroyo Las Positas in the 2012 Water Year (Section 3.3.2.4) indicated that the maximum recharge rate was about 1.5 cfs, which is about half of what it was believed to be previously. As a result, the stream recharge in the Arroyo Las Positas was recalculated going back ten years to the 2002 Water Year when the current method for calculating recharge was first used.

- **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 the 2011 and 2012 Water Years,

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 the much smaller groundwater model cells (500 ft by 500 ft), allowing more precise estimates.
- Geographic information systems (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 1998-2012. 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 2012 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.

For the 2011 Annual Report, other variables 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. However for this Annual Report (2012), some of these variables, particularly the pervious area and impervious runoff to pervious area, were updated using data created during a Northwest Hydraulics Consultants study that updated Zone 7's hydrology maps based on 2007 land-use data. The revised and updated areal recharge spreadsheet model was then used to recalculate rainfall recharge and applied water recharge for all water years from 1998 to 2012. The values reported in this report supersede those reported previously in older annual reports.

- **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. Subsurface inflow into the Main Basin is only thought to be significant from the Dublin and Camp fringe basins. For the annual hydrologic inventory, it has been assumed to be a constant 1,000 AF per year since the 2000 Water Year.

### 4.1.2 2012 Water Year Recharge

The updated monthly areal recharge, updated ALP stream recharge, and other monthly recharge volumes (e.g., stream recharge from other streams, subsurface inflow) are shown on Table 4.1-1 and are summed for the previous two water years below.

**Table: Recharge Volumes for 2012 and 2011 Water Years**

| SOURCE | 2012 Water Year (AF) | 2011 Water Year (AF) | Sustainable Average |
|---|---|---|---|
| **Natural Stream Recharge** (not including Arroyo Valle Prior Rights) | 1,618 | 6,361 | 5,700 |
| **Arroyo Valle Prior Rights** | 601 | 1,768 | 900 |
| **Artificial Stream Recharge** | 8,778 | 4,555 | 5,300 |
| **Rainfall Recharge*** | 1,462 | 5,771 | 4,300 |
| **Applied Water Recharge*** | 2,435 | 2,172 | 1,600 |
| **Subsurface Inflow** (constant)** | 1,000 | 1,000 | 1,000 |
| **TOTAL RECHARGE** | 15,894 | 21,627 | 18,800 |

* Calculated using revised areal recharge spreadsheet model
**Estimated

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 the 2000 Water Year, the difference between the storage volumes from these two methods began to increase. Starting in the 2008 Water Year, both the GWE and HI methods have been improved in an attempt to reconcile the difference between the two techniques. During the 2012 Water Year the areal recharge calculations have been updated 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 2012 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 to/subtracted from 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 |
| Pipe leakage | Groundwater basin overflow |
| Applied water recharge | |
| 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 2012 Water Year are presented in Table 4.2-4 and discussed below in Section 4.2.4.

### 4.2.4 2012 Water Year Storage Calculations

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 Water Years 1963 to 1991. Table 4.2-3 shows the groundwater elevations and storage volumes for Water Years 1992 to 2012 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 2012 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 HI method for the 2012 Water Year are shown in Table 4.2-4. Historical HI method results from Water Years 1974 to 2012 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 Water Years 1998 to 2012 (described above in Section 4.1).

The GWE method resulted in a total storage of about 228 TAF at the end of the 2012 Water Year (235 TAF in 2011). Comparatively, the HI method indicated a storage decrease of 12 TAF from the 2011 Water Year, resulting in a total storage of about 207 TAF for the end of the 2012 Water Year (219 TAF in Water Year 2011). Consequently, the 2012 Water Year total groundwater storage used by Zone 7, which is calculated as the mean of the two methods, is 217 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 used. "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. Groundwater available in storage at the end of the 2012 Water Year is about 89 TAF, which is about 71% 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 the 2012 Water Year. This year, Zone 7 updated its areal recharge spreadsheet model as described in Section 4.1. These revisions resulted in revised inflow estimates for both rainfall and applied water recharge. Also starting in the 2012 Water Year Zone 7 staff estimated leakage from water and sewage pipes into the groundwater basin (Section 4.2.5). The net result of these revisions 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 calculating average nodal groundwater elevations using the same method as that has been 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.

### 4.2.5 Pipe Leakage

Starting in the 2012 Water Year, Zone 7 staff estimated the volume of water leaking from all underground water pipes into the Main Basin. The following summarizes the concept of unavoidable losses and leakage from underground pipe leakage (CH2MHill in association with CDM, March 2004, *Task C: An Evaluation of Unaccounted-for Water*, a report for the Detroit Water and Sewage Department).

> *This concept of "unavoidable losses" was first developed and calculated by Emil Kuichling in 1897 and has recently been defined as that portion of underground system leakage lost but considered not economical to locate and repair or too small to detect using current technology. Kuichling's calculations have determined that most systems lose 1,000 to 3,000 gallons per day (gpd) per mile (gpd/mile) of main. A 1987 AWWA Research Foundation (AWWARF) study questioned the adequacy because Kuichling excluded the effects of water pressure, pipe material, and pipe age. The International Water Association (IWA) has conducted further research and is working with AWWARF to develop more accurate formulae for the calculation of unavoidable losses. Another source of calculating these unavoidable losses comes from AWWA standards for testing new pipes before they are placed in service. However, these are for new pipes and neglect the effects of age. Other formulae have been developed which assign losses per mile per diameter of pipe for both mains and services. Use of these formulae on water systems, while more accurate for specific systems, have yielded results that still fall within the 1,000 to 3,000 gpd/mile of main most often quoted as unavoidable losses.*

Unfortunately, water system construction details (e.g., water pressure, pipe materials) are not available for many of the pipes in the Livermore Valley. As a result, the more accurate formulae described above could not be used to calculate pipe leakage. Therefore, Zone 7 estimated pipe leakage from water supply and sewage pipes into the Main Basin by modifying the Kuichling estimates to include pipe age by:

1. Obtaining GIS layers of both water supply and sewage pipes from the cities of Dublin, Livermore, and Pleasanton; and water supply pipes from CWS.

2. Calculating the length of all pipes inside the Main Basin.

3. Calculating the age of the pipes. If none was available the pipe was assumed to have been constructed in 1960.

4. A pipe's leakage is estimated to increase approximately 50 AF per year starting at age 10 up to a total of 3,000 gpd/mile. This translates to the following formula:

Leakage = Minimum (3,000, Minimum (0, Pipe length x 50 x Pipe Age – 500).

Using the above formula, total pipe leakage into the Main Basin was estimated for the entire hydrological inventory period (Water Years 1974 to 2012, Table 4.2-5). For the 2012 Water Year total pipe leakage into the Main Basin is estimated to be approximately 1,050 AF.

# 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 HI. In general, salts are added to the Main Basin through the recharge and application of water from:

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

Salts are removed from the Main Basin through:

- Municipal pumping, including brine export from the MGDP;
- Agricultural pumping;
- Mining area discharges and wet gravel export; and
- Groundwater basin outflow.

Some of the salt removed from the Main Basin by municipal groundwater pumping is:

- exported from the Valley as wastewater,
- enters the MGDP and is exported as brine; or
- is reapplied to Livermore Valley soils, inflow calculated as applied water (irrigation) recharge.

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. Artificial recharge with State Project water dilutes the Main Basin salt concentrations while adding some salt 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 TDS concentrations of each inflow and outflow component of the HI.

### 4.3.2 2012 Water Year Salt Loading

Hydrologic conditions and water operations in the 2012 Water Year resulted in a net calculated decrease of approximately 6,800 tons of salt from the Main Basin (-384 tons in the 2011 Water Year), after accounting for the 4,064 tons of salt removed by Zone 7's demineralization plant (Section 5.2.3). The weighted average TDS concentration of all the waters recharging the Main Basin's aquifers in the 2012 Water Year was 566 mg/L, whereas the average TDS of the extracted groundwater was 507 mg/L. The inflow/outflow water and salt loading calculations for the 2012 Water Year are summarized on Table 4.3-1. Historical salt loading results from Water Years 1974 to 2012 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.

Before Zone 7's demineralization plant was constructed in 2009, approximately 84,264 tons of salt had been added to the Main Basin since 1973. This is equivalent to an average increase of about 2,161 tons of salt per year and a total theoretical TDS increase of about 261 mg/L since 1973. Since 2009, there has been a net reduction in Main Basin salts by approximately 9,872 tons of salt. However, during this same period, the average basin-wide TDS increased by about 16 mg/L, due to several years (especially in Water Years 2009 and 2012) of reduced natural rainfall and stream recharge, due to the dry hydrologic conditions. Wet or normal years with average recharge would have reduced the basin-wide TDS. The net reduction of water in storage during the 2012 Water Year was also a contributing factor to why the average TDS increased while the total mass decreased (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 the Annual Report for the Groundwater Mangement Program – 2005 Water Year (*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).

Thus far, the groundwater model has been used to evaluate and simulate salt loading and mitigation options for the SMP, water supply well siting and planning for Zone 7's WMP; and demineralization plant siting for Zone 7's additional groundwater demineralization planning. Zone 7 last used the groundwater model in 2009 and 2010 to support long-term planning for 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. In 2013, Zone 7 plans to use the groundwater model for its SMP update.

## 4.4.2 2012 Water Year Groundwater Modeling

In the 2012 Water Year, Zone 7 submitted a grant application (DWR Local Groundwater Assistance Program, funded by Proposition 84, up to $250,000 per application) to update the groundwater model so that it can better evaluate future groundwater management and salt mitigation strategies. It appears that Zone 7 will receive about $200,000 in grant funding from this program. The scope of work for the model update 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.

The Hydrologic Inventory of the Main Basin necessitates calculating various inflows and outflows for the groundwater basin and watershed. This "mass balance" approach considers both surface water and

groundwater, as well as their interrelationships. In terms of future improvements to the associated modeling, staff plan that the updated groundwater model will be capable of incorporating data from Zone 7's watershed modeling software.

# TABLE 4.1-1
# GROUNDWATER RECHARGE
# (in Acre-Feet)
# 2012 WATER YEAR

| Name | Site Id | Oct 2011 | Nov 2011 | Dec 2011 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | 2012WY Total | *2011WY Total* | Sustain-able | 2012 % Sust |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **STREAM RECHARGE** | | | | | | | | | | | | | | | | | |
| AV Natural Recharge | AV_RN | 29 | 40 | 0 | 29 | 37 | 222 | 142 | 31 | 29 | 6 | 11 | 5 | 581 | *2,914* | 1,800 | 32% |
| AV Artificial Recharge | AV_RC_Z7 | 352 | 220 | 193 | 39 | 614 | 181 | 0 | 252 | 318 | 466 | 496 | 482 | 3,613 | *768* | 1,637 | 221% |
| AV Recharge Prior Rights | AV_RC_PR | 0 | 0 | 0 | 126 | 78 | 127 | 219 | 51 | 0 | 0 | 0 | 0 | 601 | *1,768* | 900 | 67% |
| AM Natural Recharge | AM_RN | 20 | 63 | 29 | 79 | 68 | 120 | 164 | 28 | 10 | 2 | 0 | 0 | 583 | *3,008* | 2,600 | 22% |
| AM Artificial Recharge | AM_RC | 558 | 220 | 0 | 0 | 403 | 516 | 552 | 499 | 568 | 565 | 449 | 729 | 5,059 | *3,671* | 3,531 | 143% |
| ALP Natural Recharge | ALP_RN | 31 | 28 | 19 | 34 | 36 | 51 | 44 | 47 | 38 | 38 | 39 | 49 | 454 | *439* | 1,300 | 35% |
| ALP ArtificialRecharge | ALP_RC | 27 | 8 | 0 | 0 | 0 | 0 | 0 | 1 | 19 | 22 | 22 | 7 | 106 | *116* | 132 | 80% |
| **Total Natural Stream Recharge** | | **80** | **131** | **48** | **142** | **141** | **393** | **350** | **106** | **77** | **46** | **50** | **54** | **1,618** | ***6,361*** | **5,700** | **28%** |
| **Total Prior Rights** | | **0** | **0** | **0** | **126** | **78** | **127** | **219** | **51** | **0** | **0** | **0** | **0** | **601** | ***1,768*** | **900** | **67%** |
| **Total Artificial Recharge** | | **937** | **448** | **193** | **39** | **1,017** | **697** | **552** | **752** | **905** | **1,053** | **967** | **1,218** | **8,778** | ***4,555*** | **5,300** | **166%** |
| **TOTAL STREAM RECHARGE** | | **1,017** | **579** | **241** | **307** | **1,236** | **1,217** | **1,121** | **909** | **982** | **1,099** | **1,017** | **1,272** | **10,997** | ***12,684*** | **11,900** | **92%** |
| **RAINFALL RECHARGE** | | | | | | | | | | | | | | | | | |
| Rainfall Recharge | RC_RR | 175 | 191 | 12 | 267 | 99 | 455 | 262 | 0 | 0 | 0 | 0 | 0 | 1,462 | *5,771* | 4,300 | 34% |
| **APPLIED WATER RECHARGE** | | | | | | | | | | | | | | | | | |
| Urban - Municipal | RC_AW_U_MU | 119 | 50 | 80 | 66 | 87 | 94 | 168 | 275 | 298 | 319 | 288 | 218 | 2,061 | *1,849* | 1,280 | 161% |
| Urban - Recycled Water | RC_AW_U_RW | 12 | 12 | 10 | 12 | 9 | 13 | 14 | 15 | 13 | 16 | 14 | 18 | 159 | *133* | 26 | 610% |
| Agricultural - Municipal (SBA) | RC_AW_AG_MU | 7 | 3 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 16 | 12 | 68 | *61* | 92 | 74% |
| Agricultural - Groundwater | RC_AW_AG_GW | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 3 | 2 | 13 | *11* | 12 | 105% |
| Golf Courses - Groundwater | RC_AW_G_GW | 4 | 2 | 3 | 2 | 3 | 3 | 5 | 9 | 10 | 10 | 9 | 7 | 65 | *59* | 146 | 45% |
| Golf Courses - Recycled Water | RC_AW_G_RW | 3 | 1 | 0 | 2 | 2 | 2 | 4 | 11 | 12 | 13 | 12 | 9 | 70 | *59* | 44 | 159% |
| **TOTAL AW RECHARGE** | | **145** | **68** | **99** | **82** | **101** | **112** | **190** | **309** | **333** | **389** | **342** | **265** | **2,435** | ***2,172*** | **1,600** | **152%** |
| **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* | 100 | 0% |
| **TOTAL NATURAL RECHARGE (SY)** | | **485** | **474** | **243** | **701** | **502** | **1,172** | **1,105** | **550** | **494** | **519** | **472** | **399** | **7,116** | ***17,072*** | **13,400** | **53%** |
| **TOTAL ARTIFICIAL RECHARGE** | | **937** | **448** | **193** | **39** | **1,017** | **697** | **552** | **752** | **905** | **1,053** | **967** | **1,218** | **8,778** | ***4,555*** | **5,300** | **166%** |
| **TOTAL RECHARGE** | | **1,422** | **922** | **436** | **740** | **1,519** | **1,869** | **1,657** | **1,302** | **1,399** | **1,572** | **1,439** | **1,617** | **15,894** | ***21,627*** | **18,700** | **85%** |

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

# TABLE 4.2-1
# GROUNDWATER STORAGE PROGRAM
# 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 ($ft^2$) | 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 |

# TABLE 4.2-2
# 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

# TABLE 4.2-2
# 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

# TABLE 4.2-3
# GROUNDWATER STORAGE - NODAL GROUNDWATER ELEVATION METHOD
# GROUNDWATER ELEVATIONS (ft MSL) AND STORAGE (Acre-Feet)
# 1992 TO 2012 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 |

**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 |

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 STORAGE - NODAL GROUNDWATER ELEVATION METHOD
# GROUNDWATER ELEVATIONS (ft MSL) AND STORAGE (Acre-Feet)
# 1992 TO 2012 WATER YEARS

**UPPER AQUIFER**

| WATER | NODE 33 | | NODE 34 | | NODE 35 | | NODE 36 | | NODE 38 | | NODE 39 | | NODE 40 | | NODE 41 | | NODE 42 | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | Upper |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |

**LOWER AQUIFER**

| WATER | NODE 33 | | NODE 34 | | NODE 35 | | NODE 36 | | NODE 38 | | NODE 39 | | NODE 40 | | NODE 41 | | NODE 42 | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | GWE | Storag | Upper |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |

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
# GROUNDWATER STORAGE
# HYDROLOGIC INVENTORY (HI) METHOD
# 2012 WATER YEAR
# (Acre-Feet, except where indicated)

| | WATER YEAR | Sustainable Average | Percent of Sust Avg |
|---|---|---|---|
| **INDICES** | | | |
| Rainfall at Livermore (inches) | 8.80 | 14.51 | 61% |
| 8 Station Rainfall Index (Northern CA)(inches) | 0.00 | 50.08 | 0% |
| Evaporation at Lake Del Valle (inches) | 73.23 | 66.30 | 110% |
| Arroyo Valle Stream flow (AF) | 1,557 | 21,449 | 7% |
| **SUPPLY TOTAL (AF)** | **16,943** | **19,800** | **86%** |
| **Stream Recharge** | **10,997** | **11,900** | **92%** |
| [1] Natural Stream Recharge | 1,618 | 5700* | 28% |
| *Arroyo Valle* | *581* | *1800* | *32%* |
| *Arroyo Mocho* | *583* | *2,600* | *22%* |
| *Arroyo Las Positas* | *454* | *1,300* | *35%* |
| [1] Arroyo Valle Prior Rights | 601 | 900* | 67% |
| [3] Artificial Stream Recharge | 8,778 | 5,300 | 166% |
| *Arroyo Valle* | *3,613* | *1,640* | *221%* |
| *Arroyo Mocho* | *5,059* | *3,530* | *143%* |
| *Arroyo Las Positas* | *106* | *130* | *80%* |
| [1] **Rainfall Recharge** | **1,462** | **4300*** | **34%** |
| **Pipe Leakage** | **1,048** | **1,000** | **105%** |
| [1] **Applied Water Recharge** | **2,436** | **1600*** | **152%** |
| Urban - Municipal | 2,061 | 1,280 | 161% |
| Urban - Recycled Water | 159 | 26 | 612% |
| Agricultural - Municipal (SBA) | 68 | 92 | 74% |
| Agricultural - Groundwater | 13 | 12 | 108% |
| Golf Courses - Groundwater | 65 | 146 | 45% |
| Golf Courses - Recycled Water | 70 | 44 | 159% |
| [1] **Subsurface Inflow** | **1,000** | **1000*** | **100%** |
| **DEMAND TOTAL (AF)** | **28,880** | **18,800** | **154%** |
| **Municipal Pumping** | **20,463** | **13,700** | **149%** |
| [4] Zone 7 | 12,105 | 5,940 | 204% |
| [2] *Zone 7 pumping for DSRSD* | *656* | *645** | *102%* |
| *GW through Demin Membranes* | *4,672* | - | - |
| *Demin Permeate to Z7 Distribution System* | *3,665* | - | - |
| [2] City of Pleasanton | 3,900 | 3500* | 111% |
| [2] California Water Service | 3,333 | 3070* | 109% |
| [2] SFWD | 482 | 450* | 107% |
| [2] Fairgrounds | 318 | 310* | 102% |
| [2] Domestic | 90 | 200* | 45% |
| [2] Golf Courses | 236 | 225* | 105% |
| [2] **Agricultural Pumping** | **95** | **400*** | **24%** |
| Calculated | 95 | 400 | 24% |
| [2] **Mining Use** | **8,322** | **4600*** | **181%** |
| Mining Discharges (Export) to Stream | 4,676 | 700 | 668% |
| Evaporation | 2,946 | 3,200 | 92% |
| Processing | 700 | 700 | 100% |
| [1] **Subsurface Overflow** | **0** | **100*** | **0%** |
| **SUBTOTALS (AF)** | | | |
| **Sustainable Yield - Natural Recharge [sum of [1]]** | 7,117 | 13,400 | 53% |
| **Sustainable Yield - Demand Components [sum of [2]]** | 17,431 | 13,400 | 130% |
| **Zone 7 - Artificial Recharge (Stream) [sum of [3]]** | 8,778 | 5,300 | 166% |
| **Zone 7 - Municipal Pumping [sum of [4]]** | 12,105 | 5,300 | 228% |
| **NET RECHARGE (Supply - Demand)** | **-11,937** | **1,000** | **-1194%** |
| **TOTAL STORAGE (AF)** | **2012 WY** | **2011 WY** | |
| **Hydrologic Inventory (HI)** | 207,085 | 219,022 | |
| **Nodal GW Elevations (NGE)** | 227,746 | 235,032 | |
| **Average Storage: (HI + NGE)/2** | 217,416 | 227,027 | |
| **Available Storage: Avg Storage - Reserve (128K AF)** | 89,416 | 99,027 | |

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

# TABLE 4.2-5
# LIVERMORE VALLEY MAIN GROUNDWATER BASIN
# HYDROLOGIC INVENTORY AND STORAGE
# 1974-2012 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** | **1996** | **1997** | **1998** | **1999** | **2000** |
| **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 |
| 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 |
| 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 |
| 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 |
| **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** | **22,698** | **24,333** | **27,357** | **20,942** | **23,379** |
| **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** |
| 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 |
| *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* |
| *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* |
| *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* |
| 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 |
| 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 |
| *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* |
| *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* |
| *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* |
| **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** |
| **Rainfall Recharge** | **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** | **10,692** | **5,540** | **5,924** |
| **Pipe Leakage** | **56** | **64** | **75** | **87** | **101** | **116** | **133** | **150** | **169** | **189** | **209** | **230** | **251** | **273** | **295** | **316** | **338** | **360** | **384** | **408** | **433** | **459** | **486** | **514** | **542** | **572** | **602** |
| **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** | **1,709** | **1,743** | **1,960** |
| 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 | 1,472 | 1,549 | 1,743 |
| 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 |
| 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 | 104 | 57 | 64 |
| 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 | 26 | 11 | 12 |
| 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 | 42 | 49 | 55 |
| 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 |
| 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 |
| **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** |
| **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** | **25,342** | **25,691** | **27,185** |
| **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** |
| 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 |
| *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* |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| *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* |
| *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* |
| *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* |
| **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** | **73** | **81** | **231** |
| 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 |
| 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 |
| 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 | 73 | 81 | 91 |
| **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** |
| 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 |
| 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 |
| 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 |
| **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** |
| **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** | **2,015** | **-1,242** | **2,015** | **-4,750** | **-3,806** |
| **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** | **227,655** | **226,413** | **228,428** | **223,678** | **219,872** |

[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** | **1996** | **1997** | **1998** | **1999** | **2000** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 228 | 226 | 228 | 224 | 220 |
| 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 |
| **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** | **225** | **223** | **226** | **222** | **220** |
| **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** | **97** | **95** | **98** | **94** | **92** |



E:\MONITOR\GWStorage\2012wy\2012HydroInv.XLS; Tbl5-HIAll
3/28/2013

# TABLE 4.2-5
# LIVERMORE VALLEY MAIN GROUNDWATER BASIN
# HYDROLOGIC INVENTORY AND STORAGE
# 1974-2012 WATER YEARS (in Acre-Feet, except where indicated)

| | WATER YEAR (Oct - Sep) | | | | | | | | | | | | 1974 - 2012 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COMPONENTS** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **AVG** | **SUST*** | **TOTAL** |
| **INDICES** | | | | | | | | | | | | | | | |
| Rainfall at Livermore (in) | 10.95 | 11.21 | 17.03 | 13.07 | 19.3 | 17.49 | 9.66 | 10.68 | 11.39 | 14.82 | 16.21 | 8.8 | 15 | | |
| 8 Station Rain Index (N. CA)(in) | 32.97 | 46.32 | 59.7 | 47.25 | 57.4 | 80.1 | 37.28 | 34.94 | 46.84 | 53.57 | 72.8 | 0 | 52 | | |
| Evap at Lake Del Valle (in) | 68.49 | 73.17 | 69.87 | 72.14 | 63.58 | 68.614 | 68.904 | 72.67 | 71.566 | 63.95 | 64.49 | 73.23 | 66 | | |
| Arroyo Valle Stream flow (AF) | 8156 | 7848 | 19648 | 11410 | 26930 | 28325 | 2027 | 18059 | 11231 | 12914 | 28634 | 1557 | 25869 | | 1,008,910 |
| **SUPPLY** | **15,864** | **24,240** | **30,023** | **19,966** | **31,215** | **24,160** | **13,608** | **15,634** | **17,716** | **23,406** | **22,634** | **16,942** | **19,710** | **19,800** | **768,701** |
| **Stream Recharge** | **8,601** | **16,205** | **21,483** | **12,885** | **21,025** | **13,418** | **7,558** | **7,612** | **10,088** | **14,943** | **12,684** | **10,997** | **11,607** | **11,900** | **452,659** |
| Natural Stream Recharge[1] | 4,512 | 4,486 | 8,462 | 3,458 | 9,589 | 6,905 | 1,940 | 5,077 | 4,857 | 8,170 | 6,361 | 1,618 | 5,474 | 5700* | 213,479 |
| *Arroyo Valle* | *2,440* | *2,259* | *4,397* | *1,447* | *5,980* | *3,043* | *660* | *2,843* | *2,947* | *5,517* | *2,914* | *581* | *2,147* | *1,800* | *83,721* |
| *Arroyo Mocho* | *961* | *1,279* | *2,980* | *1,082* | *2,854* | *3,104* | *543* | *1,428* | *820* | *1,738* | *3,008* | *583* | *2,384* | *2,600* | *92,977* |
| *Arroyo las Positas* | *1,111* | *949* | *1,085* | *929* | *755* | *758* | *737* | *806* | *1,090* | *915* | *439* | *454* | *943* | *1,300* | *36,781* |
| Arroyo Valle Prior Rights[1] | 660 | 1,131 | 1,612 | 1,343 | 293 | 1,930 | 807 | 306 | 1,247 | 0 | 1,768 | 601 | 919 | 900* | 35,832 |
| Artificial Stream Recharge[2] | 3,428 | 10,588 | 11,409 | 8,084 | 11,143 | 4,583 | 4,811 | 2,229 | 3,984 | 6,773 | 4,555 | 8,778 | 5,214 | 5,300 | 203,347 |
| *Arroyo Valle* | *1,476* | *1,831* | *1,547* | *1,670* | *2,277* | *1,216* | *2,879* | *2,229* | *2,104* | *2,459* | *768* | *3,613* | *1,609* | *1,640* | *62,752* |
| *Arroyo Mocho* | *1,930* | *8,755* | *9,862* | *6,414* | *8,698* | *3,205* | *1,932* | *0* | *1,880* | *4,314* | *3,671* | *5,059* | *3,475* | *3,530* | *135,540* |
| *Arroyo las Positas* | *22* | *2* | *0* | *0* | *168* | *162* | *0* | *0* | *0* | *0* | *116* | *106* | *130* | *130* | *5,056* |
| **Injection Well Recharge** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **68** | **0** | **2,670** |
| **Rainfall Recharge** | **3,644** | **4,239** | **4,899** | **3,192** | **6,378** | **6,969** | **1,987** | **3,782** | **3,375** | **4,315** | **5,771** | **1,462** | **4,536** | **4300*** | **176,895** |
| **Pipe Leakage** | **634** | **667** | **701** | **736** | **773** | **810** | **848** | **887** | **926** | **967** | **1,007** | **1,048** | **457** | **1,000** | **17,817** |
| **Applied Water Recharge[1]** | **1,985** | **2,129** | **1,940** | **2,153** | **2,039** | **1,962** | **2,214** | **2,353** | **2,327** | **2,181** | **2,172** | **2,435** | **2,060** | **1600*** | **80,325** |
| Urban - Municipal | 1,770 | 1,888 | 1,749 | 1,926 | 1,834 | 1,747 | 1,983 | 2,124 | 2,064 | 1,894 | 1,849 | 2,061 | 1,385 | 1,280 | 54,029 |
| Urban - Recycled Water | 19 | 30 | 10 | 14 | 15 | 26 | 24 | 7 | 52 | 84 | 133 | 159 | 23 | 26 | 896 |
| Agricultural - Municipal (SBA) | 59 | 67 | 66 | 64 | 63 | 63 | 62 | 68 | 68 | 67 | 61 | 68 | 150 | 92 | 5,866 |
| Agricultural - Groundwater | 11 | 13 | 12 | 12 | 12 | 12 | 12 | 13 | 13 | 12 | 11 | 13 | 138 | 12 | 5,389 |
| Golf Courses - Groundwater | 56 | 60 | 56 | 61 | 58 | 56 | 63 | 68 | 65 | 60 | 59 | 65 | 22 | 146 | 872 |
| Golf Courses - Recycled Water | 69 | 72 | 47 | 75 | 58 | 59 | 71 | 74 | 66 | 64 | 59 | 70 | 59 | 44 | 2,299 |
| Others | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 281 | 1000* | 10,973 |
| **Subsurface Basin Inflow[1]** | **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** | **18,800** | **38,336** |
| **DEMAND** | **27,740** | **23,722** | **21,069** | **24,794** | **19,419** | **16,418** | **19,494** | **20,358** | **24,586** | **21,319** | **20,397** | **28,880** | **19,836** | **13,700** | **773,619** |
| **Municipal Pumpage** | **17,806** | **19,307** | **17,123** | **19,635** | **14,686** | **11,697** | **12,681** | **13,516** | **18,022** | **16,064** | **13,430** | **20,463** | **11,364** | **5,940** | **443,194** |
| Zone 7 (includes for DSRSD[2]) | 9,864 | 11,047 | 8,379 | 11,820 | 6,858 | 3,802 | 4,791 | 6,855 | 10,084 | 8,919 | 6,264 | 12,105 | 4,026 | 645* | 157,026 |
| *DSRSD* | *0* | *0* | *645* | *645* | *645* | *645* | *645* | *645* | *645* | *645* | *646* | *656* | *166* | *-* | *6,462* |
| City of Pleasanton[2] | 3,112 | 3,579 | 3,674 | 3,688 | 3,604 | 3,587 | 3,638 | 2,387 | 3,660 | 3,280 | 3,435 | 3,900 | 3,210 | - | 125,197 |
| Cal. Water Service[2] | 3,707 | 3,458 | 3,979 | 2,911 | 3,166 | 3,106 | 2,971 | 3,143 | 3,123 | 2,844 | 2,673 | 3,333 | 2,894 | 3500* | 112,872 |
| Camp Parks[2] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 226 | 3070* | 8,819 |
| SFWD[2] | 472 | 448 | 423 | 481 | 436 | 467 | 494 | 492 | 446 | 417 | 442 | 482 | 421 | 450* | 16,406 |
| Fairgrounds[2] | 318 | 423 | 327 | 365 | 284 | 441 | 443 | 289 | 335 | 284 | 301 | 318 | 292 | 310* | 11,398 |
| Domestic[2] | 109 | 134 | 134 | 167 | 131 | 93 | 96 | 109 | 123 | 112 | 107 | 90 | 109 | 200* | 4,235 |
| Golf Courses[2] | 223 | 218 | 208 | 203 | 207 | 199 | 249 | 241 | 250 | 208 | 208 | 236 | 186 | 225* | 7,241 |
| *3S/1E 1P3* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *3* | *4* | *129* |
| *Castlewood* | *193* | *193* | *193* | *173* | *191* | *177* | *222* | *213* | *222* | *188* | *187* | *214* | *171* | *198* | *6,669* |
| *Tri-Valley Golf* | *30* | *25* | *15* | *30* | *16* | *22* | *27* | *28* | *28* | *20* | *21* | *22* | *11* | *23* | *442* |
| **Agricultural Pumpage[2]** | **227** | **119** | **93** | **92** | **88** | **88** | **87** | **96** | **95** | **94** | **85** | **95** | **1,143** | **400*** | **44,595** |
| SFWD | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 156 | 0 | 6,071 |
| Concannon | 143 | 25 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 0 | 1,047 |
| Calculated | 84 | 94 | 93 | 91 | 88 | 88 | 87 | 96 | 95 | 94 | 85 | 95 | 961 | 400 | 37,477 |
| **Mining Use[2]** | **9,706** | **4,295** | **3,853** | **5,067** | **4,645** | **4,633** | **5,804** | **5,542** | **6,275** | **5,161** | **6,882** | **8,322** | **6,899** | **4600*** | **269,057** |
| Stream Export | 5,461 | 143 | 0 | 163 | 150 | 487 | 594 | 523 | 1,493 | 1,996 | 4,277 | 4,676 | 3,886 | 700 | 151,573 |
| Evaporation | 3,545 | 3,682 | 3,303 | 4,218 | 3,795 | 3,446 | 4,510 | 4,319 | 4,082 | 2,465 | 1,905 | 2,946 | 2,323 | 3,200 | 90,578 |
| Production | 700 | 470 | 550 | 686 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 690 | 700 | 26,906 |
| **Subsurface Basin Overflow[1]** | **0** | **0** | **0** | **0** | **0** | **0** | **921** | **1,205** | **194** | **0** | **0** | **0** | **430** | **100*** | **16,773** |
| **NET RECHARGE (AF)** | **-11,876** | **518** | **8,953** | **-4,828** | **11,797** | **7,742** | **-5,886** | **-4,724** | **-6,870** | **2,087** | **2,237** | **-11,938** | **-126** | **1,000** | **-4,918** |
| **INVENTORY STORAGE (AF)** | **207,996** | **208,514** | **217,467** | **212,639** | **224,436** | **232,178** | **226,292** | **221,568** | **214,698** | **216,785** | **219,022** | **207,084** | **221,808** | **13,400** | |

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

| **STORAGE CALCULATION** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| INVENTORY (Rounded to TAF) | 208 | 209 | 217 | 213 | 224 | 232 | 226 | 222 | 215 | 217 | 219 | 207 |
| GW ELEVATIONS (Rounded to TAF) | 202 | 210 | 219 | 212 | 234 | 236 | 230 | 230 | 233 | 234 | 235 | 228 |
| **AVERAGE STORAGE (TAF)** | **205** | **210** | **218** | **212** | **229** | **234** | **228** | **226** | **224** | **225** | **227** | **217** |
| **AVAILABLE STORAGE (TAF)** | **77** | **82** | **90** | **84** | **101** | **106** | **100** | **98** | **96** | **97** | **99** | **89** |

# TABLE 4.3-1
# MAIN BASIN SALT LOADING CALCULATIONS
# 2012 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** | **9,158** | **502** | **18%** | **1,618** | **502** | **1,167** | **720** |
| **Arroyo Valle** | **2,876** | **163** | **20%** | **581** | **163** | **192** | **330** |
| Flood releases recharge | 0 | 238 | 0% | 0 | 238 | 0 | 0 |
| Natural inflow (above AVNL) | 269 | 229 | 76% | 204 | 229 | 63 | 310 |
| Natural inflow (below AVNL) | 2,608 | 250 | 14% | 378 | 250 | 128 | 340 |
| **Arroyo Mocho** | 862 | 570 | 68% | **583** | **570** | **451** | **770** |
| **Arroyo Las Positas** | 5,419 | 850 | 8% | **454** | **850** | **524** | **1,150** |
| **ARROYO VALLE PRIOR RIGHTS** | **1,557** | **240** | **39%** | **601** | **240** | **196** | **330** |
| **ARTIFICIAL STREAM RECHARGE** | **12,324** | **239** | **71%** | **8,778** | **239** | **2,851** | **320** |
| **Arroyo Valle** | 6,671 | 240 | 54% | **3,613** | **240** | **1,178** | **330** |
| **Arroyo Mocho** | 5,205 | 240 | 97% | **5,059** | **240** | **1,649** | **330** |
| **Arroyo Las Positas** | 448 | 170 | 24% | **106** | **170** | **24** | **230** |
| **INJECTION WELL RECHARGE** | **-** | **-** | **-** | **0** | **0** | **0** | **0** |
| **RAINFALL RECHARGE** | **15,251** | **0** | **10%** | **1,462** | **0** | **0** | **0** |
| **LEAKAGE** | **-** | **-** | **-** | **1,048** | **500** | **712** | **680** |
| **APPLIED WATER RECHARGE** | **13,011** | **343** | **19%** | **2,435** | **1,835** | **6,069** | **2,490** |
| **Urban - Municipal** | 10,303 | 330 | 20% | 2,061 | 1,651 | 4,620 | 2,240 |
| **Urban - Recycled Water** | 793 | 546 | 20% | 159 | 2,732 | 588 | 3,710 |
| **Agricultural - Municipal (SBA)** | 1,235 | 247 | 5% | 68 | 4,493 | 414 | 6,110 |
| **Agricultural - Groundwater** | 70 | 594 | 18% | 13 | 3,302 | 57 | 4,520 |
| **Golf Courses - Groundwater** | 261 | 368 | 25% | 65 | 1,471 | 131 | 2,000 |
| **Golf Courses - Recycled Water** | 350 | 546 | 20% | 70 | 2,727 | 259 | 3,700 |
| **SUBSURFACE BASIN INFLOW** | | | | **1,000** | **1,540** | **2,092** | **2,090** |
| **TOTAL INFLOW** | | | | **16,942** | **566** | **13,087** | **770** |

| OUTFLOW COMPONENTS | WATER EXTRACTED | | | SALT REMOVED |
|---|---|---|---|---|
| | Volume Removed (AF) | TDS Conc (mg/L) | Salt Removed (Tons) | (Tons/TAF of Export) |
| **MUNICIPAL PUMPAGE** | **20,463** | **603** | **16,749** | **820** |
| **Zone 7 Wells - Hop, Stone, COL** | **3,907** | **527** | **2,795** | **720** |
| **Zone 7 Wells - Mocho** | **8,198** | **737** | **8,204** | **1,000** |
| *Demin Salts Exported from Valley (subset of Zone 7 - Mocho)* | *935* | *3,198* | *4,064* | *4,340* |
| **Other** | **8,358** | **506** | **5,750** | **690** |
| **AGRICULTURAL PUMPAGE (all salt is reapplied)** | **95** | **594** | **77** | **810** |
| **MINING USE** | **8,322** | **271** | **3,064** | **370** |
| Stream Export | 4,676 | 420 | 2,665 | 570 |
| Evaporation | 2,946 | 0 | 0 | 0 |
| Processing Losses | 700 | 420 | 399 | 570 |
| **GROUNDWATER BASIN OVERFLOW** | **0** | **520** | **0** | **0** |
| **TOTAL OUTFLOW** | **28,880** | **507** | **19,890** | **690** |

| | |
|---|---|
| **NET RECHARGE IN 2012 WY (acre-feet)** | **-11,938** |
| **NET SALT LOADING IN 2012 WY (tons)** | **-6,803** |

# TABLE 4.3-2
# HISTORICAL SALT LOADING (in tons)
# 1974 TO 2012 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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** |
| **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** |
| Flood releases recharge | | 100 | 344 | 0 | 0 | 216 | 0 | 128 | 0 | 271 | 624 | 20 | 0 | 415 | 0 | 0 | 0 | 0 | 98 | 0 | 528 | 0 |
| 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 |
| **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** |
| **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** |
| **AV PRIOR RIGHTS** | | **361** | **418** | **31** | **0** | **494** | **267** | **386** | **251** | **502** | **381** | **236** | **328** | **286** | **283** | **325** | **356** | **125** | **290** | **151** | **276** | **321** |
| **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** |
| 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 |
| 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 |
| Arroyo Las Positas | | 353 | 530 | 530 | 530 | 509 | 530 | 231 | 125 | 60 | 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** |
| **RAINFALL RECHARGE** | | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **LEAKAGE** | | **38** | **43** | **51** | **59** | **68** | **79** | **90** | **102** | **115** | **129** | **142** | **156** | **171** | **185** | **200** | **215** | **229** | **245** | **261** | **277** | **294** |
| **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** |
| 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 |
| 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 |
| Agricultural - Municipal (SBA) | | 202 | 304 | 437 | 890 | 485 | 331 | 416 | 519 | 427 | 332 | 438 | 512 | 718 | 434 | 598 | 367 | 445 | 370 | 311 | 234 | 246 |
| 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 |
| Golf Courses - Groundwater | | 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 |
| **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** |
| | | **14,303** | **15,382** | **14,051** | **17,252** | **19,344** | **16,089** | **14,579** | **11,895** | **13,030** | **13,950** | **12,035** | **11,008** | **13,538** | **10,447** | **12,369** | **13,317** | **13,752** | **15,822** | **13,479** | **16,068** | **13,164** |

| OUTFLOW COMPONENTS | YEAR | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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** |
| **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** |
| **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** |
| *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* |
| **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** |
| **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** |
| **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** |
| **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 |
| **Evaporation** | | 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 |
| **GROUNDWATER BASIN OVERFLOW** | | **0** | **0** | **0** | **0** | **0** | **-173** | **-612** | **-635** | **-2,494** | **-3,418** | **-2,587** | **-1,386** | **-693** | **-693** | **-462** | **-122** | **0** | **0** | **0** | **0** | **0** |
| | | **-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** |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NET SALT INFLOW (Tons)** | **3,671** | **5,604** | **5,178** | **8,961** | **11,815** | **6,542** | **5,323** | **635** | **783** | **-3,624** | **51** | **-322** | **-1,059** | **2,380** | **1,901** | **3,773** | **4,800** | **3,217** | **3,378** | **7,775** | **4,236** |
| **CUMULATIVE SALT INFLOW (Tons)*** | **3,671** | **9,275** | **14,453** | **23,414** | **35,229** | **41,771** | **47,094** | **47,729** | **48,512** | **44,888** | **44,939** | **44,617** | **43,558** | **45,938** | **47,839** | **51,612** | **56,412** | **59,629** | **63,007** | **70,782** | **75,018** |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Net Basin 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 |
| Basin Storage (HI Method)(AF) | 212,000 | 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 |
| Total Salt in Main Basin (tons) | 129,598 | 133,269 | 138,873 | 144,051 | 153,012 | 164,827 | 171,369 | 176,692 | 177,327 | 178,110 | 174,486 | 174,537 | 174,215 | 173,156 | 175,536 | 177,437 | 181,210 | 186,010 | 189,227 | 192,605 | 200,380 | 204,616 |
| Main Basin TDS Concentration (mg/L) | 450 | 464 | 471 | 498 | 544 | 554 | 560 | 557 | 560 | 536 | 506 | 514 | 534 | 534 | 560 | 589 | 615 | 648 | 686 | 721 | 697 | 709 |
| Cumulative Increase in TDS Conc (mg/L)** | | **14** | **21** | **48** | **94** | **104** | **110** | **107** | **110** | **86** | **56** | **64** | **84** | **84** | **110** | **139** | **165** | **198** | **236** | **271** | **247** | **259** |

* Basinwide salt buildup since 1973

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

# TABLE 4.3-2
# HISTORICAL SALT LOADING (in tons)
# 1974 TO 2012 WATER YEARS

| SALT INFLOW COMPONENTS — YEAR | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | AVG | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NATURAL STREAM RECHARGE** | **4,376** | **4,331** | **4,639** | **5,704** | **3,727** | **3,409** | **3,666** | **3,278** | **7,097** | **3,105** | **5,796** | **4,962** | **1,995** | **3,292** | **3,631** | **4,039** | **4,044** | **1,167** | **3,660** | **142,744** |
| **Total Arroyo Valle** | **1,034** | **400** | **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** | **192** | **1,068** | **41,647** |
| Flood releases recharge | 472 | 336 | 183 | 524 | 0 | 55 | 0 | 193 | 302 | 0 | 731 | 0 | 0 | 327 | 0 | 1,383 | 150 | 0 | 190 | 7,400 |
| Non Flood Natural Inflow | 562 | 64 | 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 | 192 | 878 | 34,247 |
| **Arroyo Mocho** | **1,580** | **2,627** | **1,741** | **2,292** | **996** | **857** | **575** | **886** | **2,996** | **838** | **1,241** | **1,813** | **531** | **504** | **456** | **826** | **2,697** | **451** | **1,366** | **53,290** |
| **Arroyo Las Positas** | **1,762** | **1,304** | **1,448** | **1,751** | **1,370** | **1,596** | **1,268** | **993** | **1,268** | **1,186** | **903** | **875** | **971** | **1,007** | **1,273** | **895** | **364** | **524** | **1,226** | **47,807** |
| **AV PRIOR RIGHTS** | **306** | **87** | **93** | **188** | **149** | **175** | **224** | **399** | **416** | **383** | **80** | **524** | **219** | **100** | **407** | **0** | **384** | **196** | **267** | **10,398** |
| **ARTIFICIAL STREAM RECHARGE** | **1,026** | **491** | **1,325** | **500** | **1,352** | **2,276** | **1,351** | **3,503** | **2,811** | **2,480** | **1,949** | **1,266** | **1,359** | **727** | **1,248** | **1,690** | **882** | **2,851** | **1,591** | **62,065** |
| Arroyo Valle | 49 | 31 | 472 | 107 | 321 | 242 | 501 | 647 | 399 | 476 | 619 | 330 | 782 | 727 | 686 | 635 | 167 | 1,178 | 486 | 18,952 |
| Arroyo Mocho | 977 | 460 | 853 | 393 | 1,031 | 2,034 | 839 | 2,855 | 2,412 | 2,004 | 1,300 | 914 | 577 | 0 | 562 | 1,055 | 698 | 1,649 | 1,016 | 39,610 |
| Arroyo Las Positas | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 1 | 0 | 0 | 30 | 22 | 0 | 0 | 0 | 0 | 17 | 24 | 90 | 3,503 |
| **INJECTION WELL RECHARGE** | **0** | **0** | **0** | **0** | **497** | **498** | **0** | **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** | **0** | **0** | **0** |
| **LEAKAGE** | **312** | **330** | **349** | **368** | **389** | **409** | **431** | **453** | **476** | **500** | **525** | **550** | **576** | **602** | **629** | **657** | **684** | **712** | **310** | **12,101** |
| **APPLIED WATER RECHARGE** | **3,323** | **4,071** | **4,887** | **4,367** | **3,479** | **4,314** | **5,074** | **5,606** | **4,618** | **5,090** | **4,824** | **3,223** | **5,157** | **6,258** | **6,152** | **5,079** | **4,295** | **6,069** | **5,762** | **224,715** |
| Urban - Municipal | 2,700 | 3,207 | 3,927 | 3,744 | 2,841 | 3,489 | 4,217 | 4,559 | 3,884 | 4,217 | 4,142 | 2,501 | 4,337 | 5,208 | 5,060 | 3,975 | 3,107 | 4,620 | 3,912 | 152,570 |
| Urban - Recycled Water | 352 | 460 | 385 | 274 | 40 | 83 | 79 | 136 | 44 | 60 | 40 | 107 | 96 | 30 | 202 | 327 | 542 | 588 | 583 | 22,754 |
| Agricultural - Municipal (SBA) | 183 | 274 | 420 | 280 | 241 | 302 | 308 | 378 | 294 | 300 | 293 | 249 | 230 | 474 | 416 | 323 | 240 | 414 | 375 | 14,635 |
| Agricultural - Groundwater | 88 | 130 | 155 | 69 | 34 | 54 | 49 | 53 | 54 | 57 | 42 | 42 | 42 | 46 | 45 | 45 | 50 | 57 | 748 | 29,181 |
| Golf Courses - Groundwater | 0 | 0 | 0 | 0 | 102 | 123 | 137 | 147 | 139 | 140 | 154 | 84 | 163 | 188 | 172 | 160 | 113 | 131 | 50 | 1,953 |
| Golf Courses - Recycled Water | 0 | 0 | 0 | 0 | 221 | 263 | 284 | 333 | 203 | 316 | 153 | 240 | 289 | 312 | 257 | 249 | 243 | 259 | 93 | 3,622 |
| **SUBSURFACE BASIN INFLOW** | **2,017** | **1,875** | **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** | **2,092** | **2,025** | **78,976** |
| | **11,360** | **11,185** | **12,679** | **12,778** | **11,121** | **12,927** | **12,716** | **15,209** | **17,388** | **13,528** | **15,687** | **12,834** | **11,480** | **13,193** | **14,173** | **13,462** | **12,313** | **13,087** | **13,641** | **531,994** |

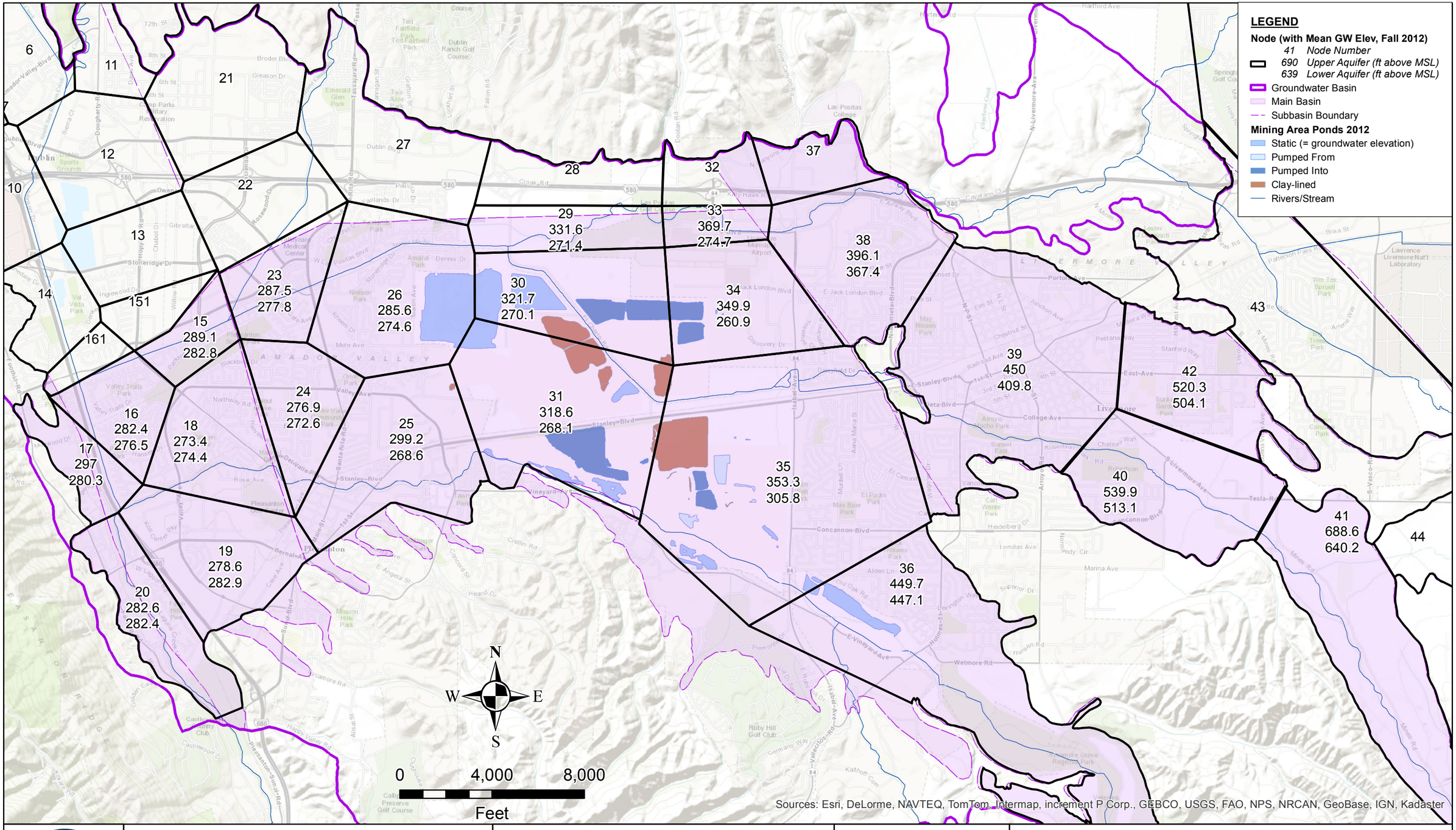
| OUTFLOW COMPONENTS — YEAR | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | AVERAGE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MUNICIPAL PUMPAGE** | **-2,667** | **-3,877** | **-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** | **-9,873** | **-16,749** | **-10,420** | **-262,752** |
| **Zone 7 Wells - Hop, Stone, COL** | **-90** | **-757** | **-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** | **-2,795** | **-2,644** | **-37,020** |
| **Zone 7 Wells - Mocho** | **-125** | **-767** | **-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** | **-8,204** | **-3,100** | **-43,405** |
| *Demin Salts Exported from Valley* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *-798* | *-2,760* | *-3,154* | *-4,064* | *-276* | *-10,776* |
| **Other Pumpage** | **-2,453** | **-2,353** | **-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** | **-4,625** | **-5,750** | **-4,675** | **-182,327** |
| **AGRICULTURAL PUMPAGE** | **-88** | **-130** | **-155** | **-47** | **-46** | **-188** | **-182** | **-94** | **-73** | **-79** | **-80** | **-46** | **-43** | **-68** | **-68** | **-73** | **-68** | **-77** | **-756** | **-29,475** |
| **MINING USE** | **-6,883** | **-7,507** | **-9,983** | **-9,588** | **-8,642** | **-5,792** | **-4,520** | **-475** | **-276** | **-438** | **-94** | **-218** | **-274** | **-714** | **-1,341** | **-1,428** | **-2,756** | **-3,064** | **-2,978** | **-116,159** |
| **Stream Export** | -6,408 | -7,041 | -9,460 | -9,084 | -8,081 | -5,316 | -4,006 | -111 | 0 | -84 | -94 | -218 | -274 | -305 | -913 | -1,057 | -2,368 | -2,665 | -2,585 | -100,817 |
| **Evaporation** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Processing Losses** | -475 | -466 | -523 | -504 | -561 | -475 | -514 | -364 | -276 | -354 | 0 | 0 | 0 | -409 | -428 | -371 | -388 | -399 | -393 | -15,342 |
| **GROUNDWATER BASIN OVERFLOW** | **-226** | **-968** | **-960** | **-998** | **-482** | **-175** | **0** | **0** | **0** | **0** | **0** | **0** | **-738** | **-1,080** | **-171** | **0** | **0** | **0** | **-489** | **-19,073** |
| | **-9,864** | **-12,482** | **-16,295** | **-17,143** | **-15,278** | **-14,716** | **-15,319** | **-12,672** | **-11,505** | **-13,005** | **-10,265** | **-5,837** | **-9,496** | **-11,141** | **-16,206** | **-14,114** | **-12,697** | **-19,890** | **-11,738** | **-457,781** |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NET SALT INFLOW (Tons)** | **1,496** | **-1,297** | **-3,616** | **-4,365** | **-4,157** | **-1,789** | **-2,603** | **2,537** | **5,883** | **523** | **5,422** | **6,997** | **1,984** | **2,052** | **-2,033** | **-652** | **-384** | **-6,803** | **1,903** | **74,213** |
| **CUMULATIVE SALT INFLOW (Tons)*** | **76,514** | **75,217** | **71,601** | **67,236** | **63,079** | **61,290** | **58,687** | **61,224** | **67,107** | **67,630** | **73,052** | **80,049** | **82,033** | **84,085** | **82,052** | **81,400** | **81,016** | **74,213** | | |

| TDS Concentration Calculations | 1973 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Net Basin Recharge (AF) | | 13,194 | 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 |
| Basin Storage (HI Method)(AF) | 212,000 | 225,640 | 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 |
| Total Salt in Main Basin (tons) | 129,598 | 206,112 | 204,815 | 201,199 | 196,834 | 192,677 | 190,888 | 188,285 | 190,822 | 196,705 | 197,228 | 202,650 | 209,647 | 211,631 | 213,683 | 211,650 | 210,998 | 210,614 | 203,811 |
| Main Basin TDS Concentration (mg/L) | 450 | 672 | 662 | 654 | 634 | 634 | 639 | 666 | 674 | 666 | 683 | 665 | 665 | 688 | 710 | 726 | 716 | 708 | 724 |
| Cumulative Increase in TDS Conc (mg/L)** | | **222** | **212** | **204** | **184** | **184** | **189** | **216** | **224** | **216** | **233** | **215** | **215** | **238** | **260** | **276** | **266** | **258** | **274** |

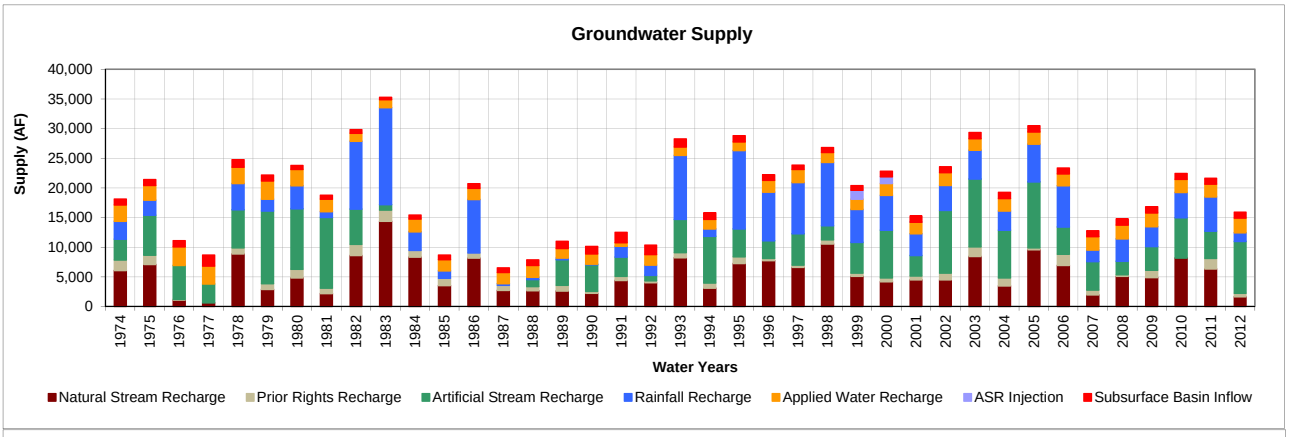
* Basinwide salt buildup since 1973

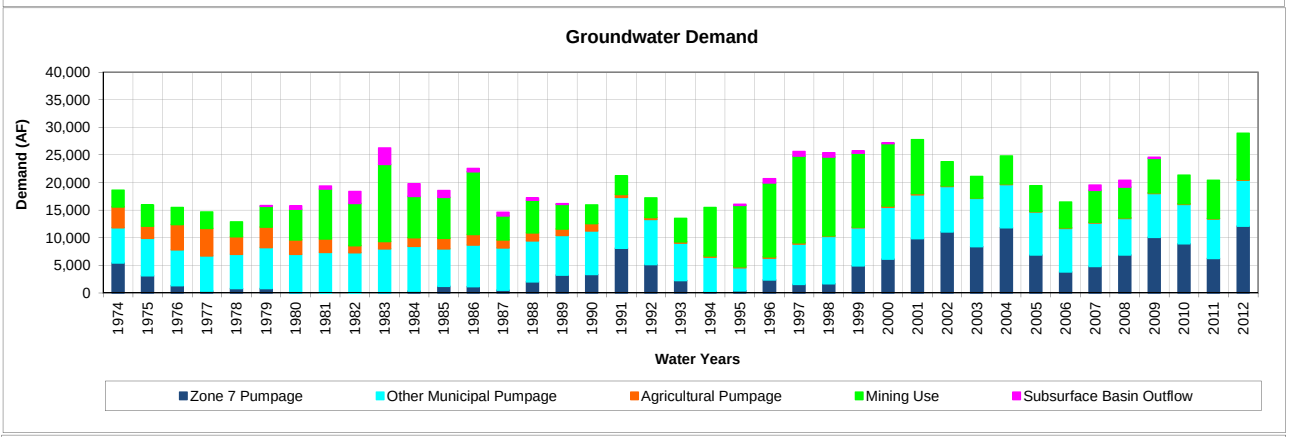
** Basinwide TDS concentration increase relative to 1973 value of 450 mg/L

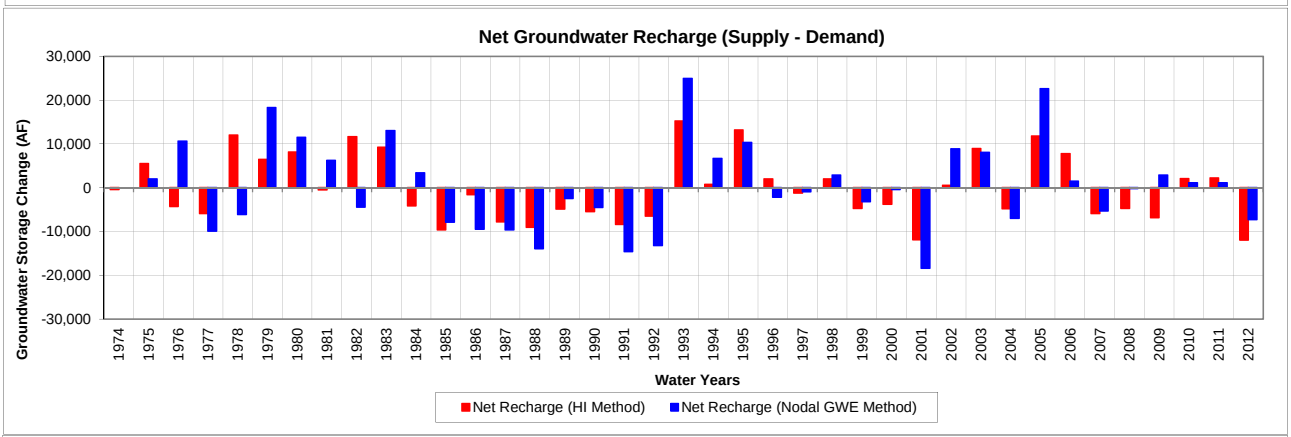


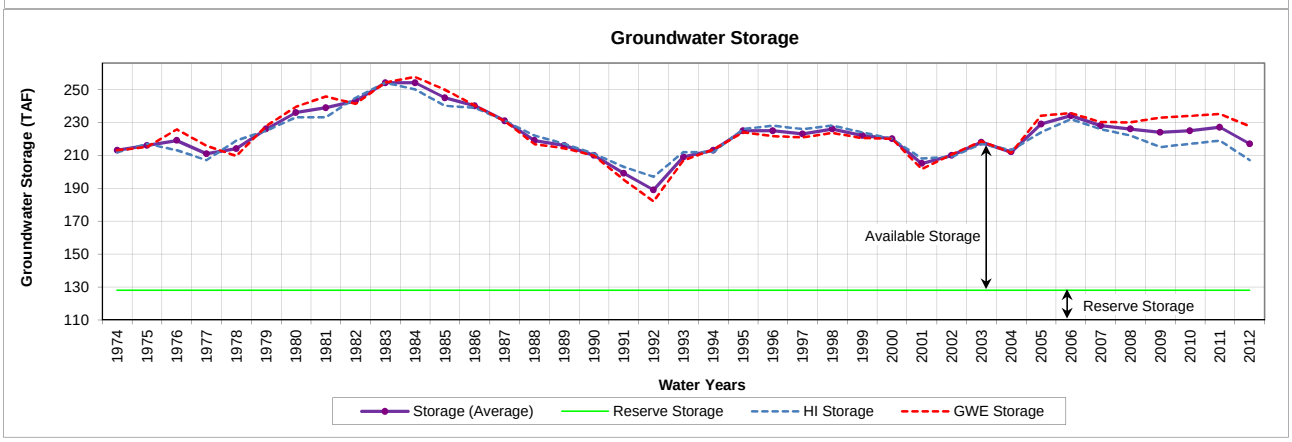

| | | | |
|---|---|---|---|
| ZONE 7 WATER AGENCY<br>100 North Canyons Parkway<br>Livermore, CA | DRAWN: TR | SCALE: 1 in = 4,000 ft | **Figure 4.2-1**<br>**Mean Groundwater Elevation By Node**<br>**Upper and Lower Aquifers, Fall 2012**<br>**Storage - Groundwater Elevation Method** |
| | REVIEWED: TR | DATE: May 2, 2013 | |
| | FILE: E:\MONITOR\GWStorage\2012wy\Fig4.2-1-NodalGWE12.mxd | | |

# FIGURE 4.2-2
# GRAPHS OF HISTORICAL MAIN BASIN HYDROLOGIC INVENTORY
# 1974 TO 2012 WATER YEARS

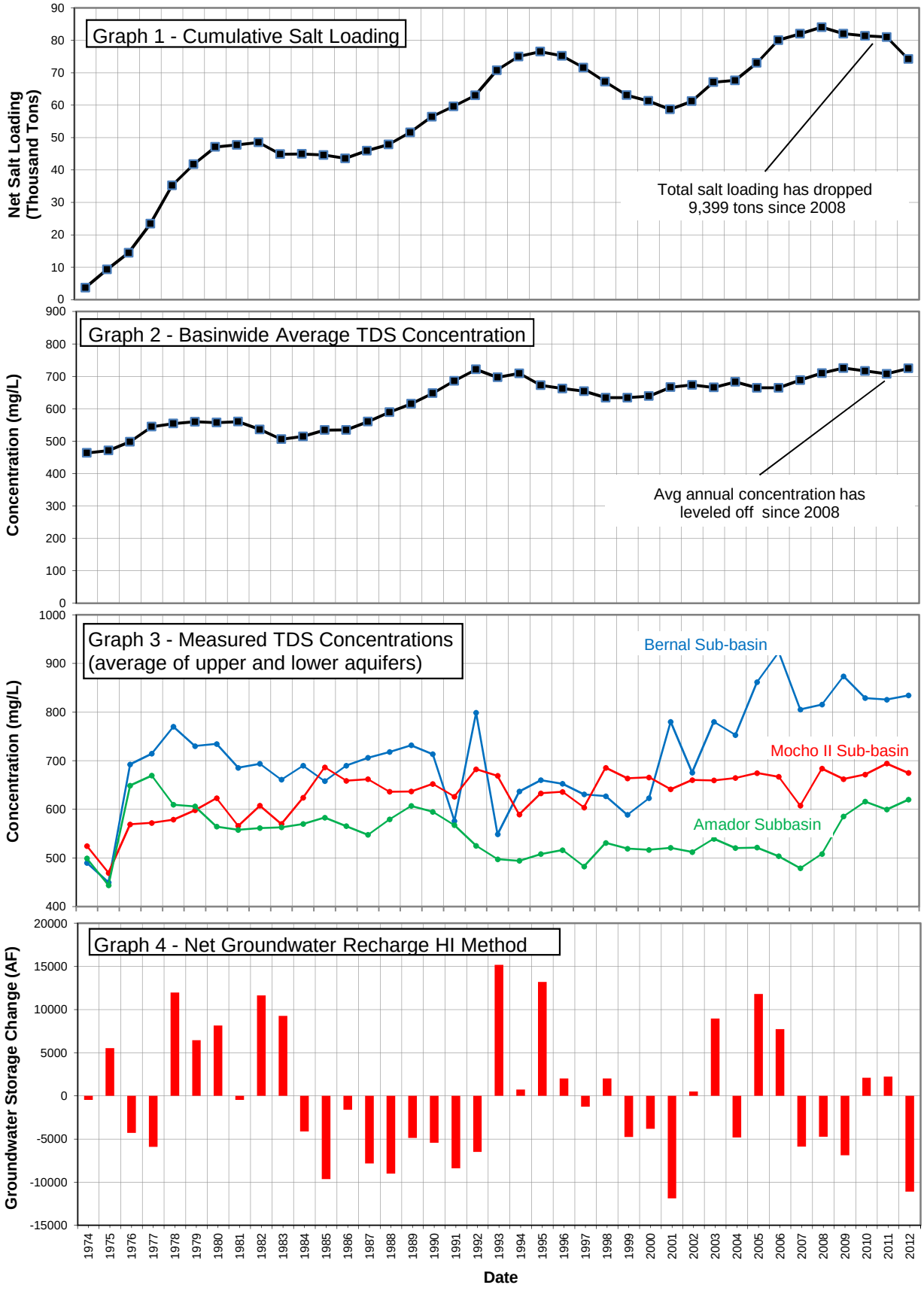


# FIGURE 4.3-1
# GRAPHS OF SALT LOADING AND CONCENTRATIONS
# 1974 TO 2012 WATER YEARS




E:\MONITOR\SaltBalance\2012WY\SaltBalaceCalcs2012.xls\Fig1-Graphs
5/3/2013