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

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

3.4 Subsidence Monitoring Program

3.4.1 Program Description

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

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

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

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

3.4.2 2011 Results

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

graphs show a one-time jump in ground surface elevation in Fall 2006. This is because when the program was started, Site A1-9.0 was believed to be on stationary bedrock. However, measurements taken up to the 2007 Water Year suggested that the site had actually been moving elastically. Therefore, starting with the Fall 2006 dataset, the data calculations were readjusted so that A1-9.0 elevations could vary.

Table 3.4-2 shows the most recent (Fall 2011) measurements and includes the elevation changes since the Fall 2010 and Spring 2011 measurements. Figure 3.4-7 shows that during the 2011 Water Year, most of Zone 7's survey benchmarks have shown a less than +/- 0.010 change from Fall 2010 to Fall 2011. One area, Line B-5 in the Camp Subbasin, had a decrease in elevation in all four points (-0.018 to -0.024). These points are not located near any municipal supply wells and do not appear to be related to groundwater elevations. All changes in land surface elevation for the 2011 Water Year are within the range of elastic subsidence observed over the life of the monitoring program. Elevation changes from Spring to Fall 2011, which varied from -0.056 to -0.001, were also within the range of elastic movement. During the 2011 WY, site B1-11 was destroyed during a well destruction and will no longer be in the subsidence program. Site B4-1.0N is located near a stream channel and was under water during the survey. As a result there are no Fall values for B1-11 or B4-1.0N

3.5 Mining Area Monitoring Program

3.5.1 Program Description

Zone 7 monitors conditions and activities in the Chain of Lakes area because the gravel mining operations have an appreciable effect on groundwater levels, groundwater quality, and salt loading in the Main Basin. Many of the quarry pits have been dug deep into the Upper Aquifer, creating "windows" into groundwater basin, and exposing groundwater to large evaporative loses. Groundwater is also pumped from some of the pits and discharged to others or to the arroyos to facilitate the gravel mining occurring in the active pits. The Mining Area Monitoring Program includes water level measurements and water quality sampling of the mining area pits. The program also maps and documents current mining activities, locations of discharge lines, the filling of old pits, and the locations of flow barriers created by the pits that are lined or backfilled with silty-clay mining spoils.

The table below identifies the previous owners, current owners, and current mining operator associated with each pond prefix and pond number as shown on Figure 3.5-1.

Table: Mining Pond Operators and Owners

Pond Prefix*	"K" Ponds	"R" Ponds	"C" Ponds	"P" Ponds
Previous Owners	Kaiser Sand & Gravel Hanson Aggregates	Rhodes & Jamieson Calmat	Cal Rock	Pacific Coast Aggregates RMC/Lonestar
Current Owners	PGC (K28) Legacy (K9-K14) EBRP (K15, K18) Zone 7 (K30, K37)	PGC (all R's except 3,4,12) Vulcan (R3,4,12)	PGC (all C's)	Cemex (all Ps except P12) EBRP (P12)
Current Operator	Hanson Aggregates (K28)	Vulcan (all Rs)	Vulcan (all Cs except C5)	Cemex (all Ps except P12)

* Prefix for pond names (e.g., K37)
PGC Pleasanton Gravel Company
EBRP East Bay Regional Parks

All of the ponds in the program are measured semi-annually for water surface elevations. The semi-annual measurements are collected at the same time as the semi-annual groundwater measurements.

All of the ponds in the program are sampled annually. Zone 7's laboratory analyzes these samples for a general mineral analysis that is consistent with the analyses performed for the groundwater monitoring program.

All stream discharges are metered, and the volume of water discharged from the Valley is computed by prorating the flows after accounting for any re-percolation back into the groundwater basin.

This program also includes the tracking of pond evaporative areas, total monthly evaporative losses for the ponds, and an estimate of groundwater lost due to the export of moist gravels. Mining area evaporation accounts for a large portion of the "Demand" component for the annual hydrologic inventory calculation; second only to "Municipal Pumping."

3.5.2 2011 Results

Mining activities continued for Vulcan Materials (formerly Calmat) and Cemex (formerly RMC and Lonestar). Vulcan Materials continued their mining in R28 (future Lake D), utilizing the tunnel and conveyor line built under Stanley Boulevard in 2006, and continued limited operations in R24 (future lake E). Cemex continued mining in P42 (Lake B, Figure 3.5-1). A summary of mining pit conditions including their areal extent and elevations are shown on Table 3.5-1.

For the 2011 Water Year Vulcan Materials discharged 7,116 AF into the Arroyo Mocho, of which 2,838 AF re-percolated back into the groundwater basin and 4,277 AF was lost as basin outflow. Zone 7 staff has begun collaborating with Vulcan Materials on a project that will capture their pit de-watering operations discharge in one of Zone 7's Chain of Lakes for subsequent recharge back into the aquifers. This project would eliminate water normally lost due to Mining Area discharges now being made to the Arroyo Mocho (2,000 to 4,000 AF annually).

Cemex did not discharge into the Arroyo Valle during the 2011 Water Year.

Zone 7 resumed its cooperative off-site recharge program with East Bay Regional Parks District and diverted approximately 400 AF to Shadow Cliff's lake from July to October 2011. As a result, water levels in Shadow Cliffs were maintained between 331 and 333 ft in elevation through most of the year.

Water elevations were measured in most of the pits that contained water during the 2011 Water Year, and the results are shown on Figure 3.5-1 and Table 3.5-1. The water elevations measured in the mining area ponds that are in direct communication with the upper aquifer are included in the Groundwater Monitoring Program's dataset used for the upper aquifer groundwater elevation contour maps (Figure 3.2-4 and Figure 3.2-5)

Water quality was also monitored in certain mining ponds (Table 3.5-2). Salt concentrations, measured as TDS, in the mining area pits ranged from below 300 mg/L in the pits along the Arroyo Valle to over 1,000 mg/L in Cope Lake [K30]. The high TDS in Cope Lake is due to evaporation which concentrates the salts in this clay-lined pond. The TDS, nitrate and boron concentrations measured in the mining area ponds that are in direct communication with the upper aquifer are included in the Groundwater Monitoring Program's dataset used to create the upper aquifer concentration maps (Figure 3.2-9, Figure 3.2-10, and Figure 3.2-11).

3.6 Land Use Monitoring Program

3.6.1 Program Description

Zone 7 monitors land use changes in the Valley as part of the long-range groundwater basin management program. The purpose of the program is to map and quantify Main Basin land use for areal recharge calculations (e.g., rainfall recharge, applied water recharge, and unmetered groundwater pumping for agriculture). The program identifies changes in land use with emphasis on impervious areas and the volume and quality of irrigation water that could impact the volume or quality of water recharging the Main Basin. Land use data are derived from aerial photography (when available), permit applications, field observations, and City Planning documents. In addition, all areas receiving untreated water from Zone 7 are mapped.

This year, as part of the revisions to the areal recharge spreadsheet model (described in Section 4.1), Zone 7 modified the land use categories as follows:

Table – Revised Land Use Categories

Previous Categories	New Categories
Urban	Urban – Commercial Urban – High Density Residential Urban – Low Density Residential Urban – Park
Irrigated/Agriculture	Agriculture – Vine Agriculture – Other
Gravel Mining Area	Mining Area – Pond Mining Area – Pit (dry) Mining Area – Other
Golf Courses	Golf Courses
Unclassified	Open Space

Each of the land use polygons are also catalogued with the source of the water that supplies that area:

- Delivered (municipal) water,
- Groundwater, or
- Recycled water

Also, starting in 2011, land use categories are no longer quantified by DWR nodes in the Main Basin, and instead are assigned spatially to groundwater model cells, which are the spatial units used for the areal recharge calculations.

In order to run the revised areal recharge spreadsheet model for prior years, staff also updated the land use map for 2001, the earliest year for which digital aerial photographs were readily available to staff.

3.6.2 2011 Results

For the 2001 and 2011 Water Years land use areas were re-mapped and quantified for each of the revised land use types. Figure 3.6-1 shows the map of the geographic information system (GIS) layers produced in 2011. For the 2011 Water Year land use over the Main Basin remained relatively unchanged from the 2010 Water Year, and in fact is very similar to the land use in 2001. Development continues to be slow due to the effect of the poor economy.

3.7 Groundwater Production Monitoring

3.7.1 Program Description

Zone 7 collects and compiles data for all large capacity pumping wells within the Main Basin. This includes daily and monthly pumping totals from the retailers. The relative locations of these municipal

supply wells are shown in Figure 3.7-1. All Zone 7 and retailer municipal supply production wells are metered. Retailer wells are read by retailer staff and reported monthly to Zone 7 as required by their treated water contracts with Zone 7. The treated water contracts also allow each retailer to pump a certain volume of groundwater each calendar year from the Main Basin without charge. These volumes are referred to as their Groundwater Pumping Quota [GPQ]. Zone 7 charges the retailers a "recharge fee" for groundwater pumped over their respective annual GPQ unless the retailer has sufficient carry-over credit from a previous year of un-pumped GPQ allocation. Such carryover is limited to 20% of the GPQ.

Records of other pumping wells are obtained from well owners when available. Pumping records from significant wells without meters are estimated from utility records or from the associated land use (e.g. number of acres irrigated). Zone 7 obtains these records as part of the Groundwater Monitoring, Land Use and Untreated Water Contracts programs.

3.7.2 2011 Results

For the 2011 Water Year about 13,523 AF of groundwater was pumped from the Main Basin for municipal and agricultural uses (Table 4.2-4). Zone 7 pumped approximately 6,264 AF of groundwater for the 2011 Water Year (about 80% of average, 5,448 AF for the Calendar Year), of which approximately 6,209 AF was delivered to Zone 7's retailers (5,399 for the Calendar Year). This includes the 2,131 AF of water (3,142 AF for Calendar Year) that was sent through the reverse osmosis membranes of the Mocho Groundwater Demineralization Plant (MGDP, Section 5.2.3).

In addition to the nine municipal wells operated by Zone 7 in Pleasanton, CWS operated 12 wells in the Livermore area, and the City of Pleasanton operated three wells in Pleasanton in 2011. Production volumes from the municipal wells (total pumped minus the pumped-to-waste volume) for the 2011 Water Year and Calendar Year are presented in Table 3.7-1 and discussed further in Section 5.1.3.

For the 2011 Calendar Year (January to December), Pleasanton, which had carried over 668 AF from 2010, pumped 3,503 AF, which is just above their GPQ (3,500 AF), and carried over 665 AF into the 2012 Calendar Year. CWS, which has a GPQ of 3,069 AF, pumped 2,816 AF and carried-over 253 AF into the 2012 Calendar Year. Zone 7 pumped DSRSD's GPQ (645 AF) and Livermore did not pump their GPQ. All other groundwater production was about normal for the basin.

3.8 Wastewater and Recycled Water Monitoring Program

3.8.1 Program Description

Zone 7 compiles and reviews data on the volume and quality of wastewater collected and recycled water used within the watershed from the City of Livermore Water Reclamation Plant (LWRP), DSRSD Water Reclamation plant, and the Veterans Hospital sewage treatment plant. While salt and nutrients are the primary constituents-of-concern for wastewater and recycled water applications over the Main Basin, several other potential constituents-of-emerging-concern (CECs) and their surrogates are being considered by the State for future basin monitoring plans requirements.

Zone 7 also reviews Septic Tank Use Applications located within the Valley for compliance with Zone 7's Wastewater Management Plan. Zone 7 must approve all onsite disposal systems for new commercial developments or any residential system that will potentially exceed the loading allowed for the site. See Section 5.3.2 for a summary of Zone 7's 2011 Water Year activities relating to individual onsite wastewater treatment/disposal systems.

3.8.2 2011 Results

The results of the Zone 7 Wastewater Monitoring Program for the 2011 Water Year are presented in the following table. The two largest wastewater collection and treatment agencies (Livermore and DSRSD), which treat over 99% of the wastewater in the Valley, are listed first, followed by the much smaller Veterans Administration (VA) Hospital and the Main Basin Septic Tanks. The third row ("Volume Recycled") shows the volume recycled within the watershed. The fourth row ("Main Basin") shows the total volume of effluent that is applied over the Main Basin. The final two rows present average nitrogen (measured as Total Kjeldahl Nitrogen [TKN]) and TDS concentrations in recycled water.

Table: Wastewater Monitoring Results for 2010 Water Year

	Livermore (LWRP)	DSRSD	VA Hospital	Septic Tanks in Main Basin	Total
FLOW VOLUMES (AF)					
Total Influent	7,848	13,114	50*	80*	21,092
Volume Exported	4,397	10,120	0	0	14,517
Volume Recycled	1,421	2,462	0	0	3,883
Applied to Main Basin	963	0	50*	80*	1,093
WATER CHEMISTRY OF APPLIED WASTEWATER (mg/L)					
TKN	39-44	18-28	5.7-15	30-40*	
TDS	550-570	568-748	280-550	500-700*	

* Estimated
TKN Total Kjeldahl Nitrogen
TDS Total Dissolved Solids

The table helps illustrate the relative magnitude of different sources of recycled water use and wastewater disposal on the basin and watershed. Moreover, only the portion of the water applied as irrigation eventually makes its way to the groundwater supply; most of the applied water is evaporated, taken up by plant roots or bound to the unsaturated soil. In total, less than one percent of groundwater supply is from wastewater or recycled water origin.

In 2011, 21,092 AF of wastewater was produced as compared to 19,660 AF in 2010. About 18% of the wastewater was recycled for irrigation projects; 1,421 acre-feet by City of Livermore and 2,462 acre-feet by DSRSD. About 68% (963 acre-feet) of the recycled water produced by LWRP was applied over the Main Basin; whereas all of DSRSD's recycled water was applied on areas outside of the Main Basin, primarily on fringe basin areas. Zone 7 staff continues to investigate the hydrogeologic relationship

between the fringe and Main basins as part of its Salt Nutrient Management Plan (SNMP) work to quantify the inflow of groundwater and salts from the fringe basins to the Main Basin., The remainder not used for irrigation was exported from the valley through the LAVWMA (Livermore-Amador Valley Water Management Agency) export pipeline.

Livermore's application over the Main basin in 2011 exhibited a slight increase over their 2010 application; from 845 AF in 2010 to 963 AF in 2011. All of DSRSD's recycled water was applied over fringe basins and upland areas north of the Main Basin.

The recycled water from both plants met the State Department of Public Health "Title 22" water quality standards for irrigation uses during the 2011 Water Year. TDS concentrations in the portion applied directly on the Main Basin ranged from 550 to 570 mg/L, while Total Kjeldahl Nitrogen (TKN) concentrations ranged from 39 to 44 mg/L. About 542 tons (less than 5%) of the Main Basin's gross salt loading (12,830 tons) was attributed to recycled water use over the Main Basin during the 2011 Water Year.

There is a small amount of non-recycled wastewater that is applied over Main Basin in the form of leachate from onsite domestic wastewater systems (septic systems) and from the VA Hospital wastewater treatment system located in southern Livermore. The contribution to the groundwater supply (130 AF) is estimated using "typical" wastewater flows since actual discharges are not monitored. There have been virtually no changes in land uses or septic system densities over the Main Basin that would change the estimated water contribution from these sources in recent years. Leaking sewer lines are also a potential source of recharge for the Main Basins; however no estimation of its quantity is made here by Zone 7.

The ranges of nitrogen (measured as TKN) and TDS concentrations for each applied recycled water and wastewater component are shown in the table above. TKN represents the nitrogen content potentially available for conversion to nitrate as the water percolates through the soil. However, from a practical standpoint, some of the nitrogen will be removed from the percolate through soil denitrification and plant uptake processes. Conversely, Zone 7 assumes that all of the salt mass in the applied water is carried downward by the percolate and eventually reaches groundwater. This leads to a conservative (potentially high) estimate of the salt loading attributed to their applications. See Section 5.1.6 for further discussion on the contribution of salts from these recycled water and wastewater applications.

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TABLE 3.4-1

Zone 7 Water Agency
Subsidence Monitoring Program
Survey Points and Descriptions, 2011 Water Year

Sites Monitored by Kier & Wright

Site ID	Well ID	Survey Points	Description
A1- 1.0		G972	Brass disk located in sidewalk
A1- 2.0		Foot-La-Pos	Chisel mark on brdge footing
A1- 3.0		C972	Brass disk mounted on bridge platform
A1- 4.0		Mocho-Chabot	Brass disk located on access road
A1- 5.0		Mocho-Tass-W	Brass disk located on access road
A1- 6.0		Mocho-Tass-E	Brass disk located on access road
A1- 6.05		Mocho TP48	
A1- 6.1		Mocho_CB	Chisel mark on catch basin
A1-10.0		Vine-Pipe	Brass disk in concrete
A1-12.0		Mohr-RR	Spike at Mohr Ave and RR
A1-13.1		COP RE 25281	Replaced A1-13.0 on 4/13/09
A1-14.1		Bush-Valley	
A1-15.0		D8	Brass disk on bridge foundation
A1-15.1		BM-P929 Reset	
A1-16.0		V1	Brass disk
A1-17.0		K2	Brass disk (?) NGVD Benchmark
B1- 1.0		Mocho-san MP3	Disk located on bridge platform
B1- 2.0		Mocho-san MP2	Disk located on bridge platform
B1- 3.0		Mocho-san MP1	Disk located on bridge platform
B1- 4.0	3S/1E 8H 3	Army Well 2, Floor	Chisel mark on pumphouse floor
B1- 5.1	3S/1E 8H18	STP640 MN/W	Replaced B1-5.0 on 4/13/09
B1- 6.0	3S/1E 8H 2	Army Well 1, Floor	Chisel mark on pumphouse floor
B1- 7.0		Mocho-Stone MP1	Disk located on bridge platform
B1- 8.0		Mocho-Stone MP2	Disk located on bridge platform
B1- 9.0		Mocho-Stone MP3	Disk located on bridge platform
B1-10.0		Mocho-Stone MP4	Disk located on bridge platform
B1-11.0	3S/1E 8H 4	Army Well 3, Floor	Chisel mark on pumphouse floor
B1-12.0	3S/1E 8H13	Obs. Well, Casing	Chisel mark on casing
B1-13.0	3S/1E 9M 4	Mocho 3, Shiner	Shiner at entrance door
B1-14.1	3S/1E 9M 2	Mocho 1, Floor	
B1-16.1	3S/1E 9M 3	Mocho 2, Floor	
B2- 1.0		Tass-Las-Pos MP1	Disk located on bridge platform
B2- 2.0		Tass-Las-Pos MP2	Disk located on bridge platform
B2- 3.0		Tass-Las-Pos MP3	Disk located on bridge platform
B2- 4.0		Tass-Las-Pos MP4	Disk located on bridge platform
B3- 1.0		Mocho-Park	Brass disk on concrete vault
B3- 2.0		1H ALA	County Benchmark
B3- 3.0	3S/1E 17D12	Hop 9 BM	Benchmark, rod in access road
B3- 4.0		MP1 (Disc)	
B3- 5.0		MP2 (Disc)	
H7- C	3S/1E 17D10		Hopyard 7 Well (Punch)
B4- 1.0 S		AMP-Ctl S	Brass Disk on Control
B4- 1.0 N		AMP-Ctl N	
B4- 2.0	3S/1E 9B 1	Stoneridge, Floor	Chisel mark at entrance door
B5- 1.0		OSRR-BC	New Monument disk
B5- 2.0		OSRR-Andrew	New Monument disk
B5- 3.0		OSRR-Cafe	New Monument disk
B5-4.0		Tass-Rose	Disk on bridge foundation (formerly A1-8.0)
B6- 1.0		5608 Belleza	New Monument disk
B6- 2.0		FLORA-end	New Monument disk
B6- 3.0		Belleza-Verd	New Monument disk
B7- 1.0		Larame-Larame	New Monument disk
B7- 2.0		Suttr-Larame	New Monument disk
B7- 3.0		Suttr-Jones	New Monument disk

Additional Well Sites Monitored by Zone 7

Site ID	Well Id	Survey Points	Description
AW1-P	3S/1E 8H 2	Army Well 1, Pedestal	Army Well 1 well pedestal
AW1-RP	3S/1E 8H 2	Army Well 1, RP	Army Well 1 reference point
AW2-P	3S/1E 8H 3	Army Well 2, Pedestal	Army Well 2 well pedestal
AW3-Diff	3S/1E 8H 4	Army Well 3, Pedestal	Army Well 3 pedestal to ground difference
AW3-P	3S/1E 8H 4	Army Well 3, Pedestal	Army Well 3 well pedestal
H6-C	3S/1E 18A 6	Hopyard 6, Casing	Hop 6 casing / flange
H6-D	3S/1E 18A 6	Hopyard 6, Drain	Hop 6 drain
H6-Diff	3S/1E 18A 6	Hopyard 6, Pedestal	Hop 6 pedestal to ground difference
H6-F	3S/1E 18A 6	Hopyard 6, Floor	Hop 6 chisel mark on pumphouse floor
H6-P	3S/1E 18A 6	Hopyard 6, Pedestal	Hop 6 well pedestal
H6-RP	3S/1E 18A 6	Hopyard 6, RP	Hop 6 reference point
H9-T	3S/1E 17D12	Hopyard 9, Transformer	Hop 9 transformer pad
H9-C	3S/1E 17D12	Hopyard 9, Casing	Hop 9 casing / flange
H9-Diff	3S/1E 17D12	Hopyard 9, Pedestal	Hop 9 pedestal to ground difference
H9-F	3S/1E 17D12	Hopyard 9, Floor	Hop 9 chisel mark on pumphouse floor
H9-P	3S/1E 17D12	Hopyard 9, Pedestal	Hop 9 well pedestal
H9-RP	3S/1E 17D12	Hopyard 9, RP	Hop 9 reference point
M1-C	3S/1E 9M 2	Mocho 1, Casing	Mocho 1 casing / flange
M1-P	3S/1E 9M 2	Mocho 1, Pedestal	Mocho 1 well pedestal
M1-RP	3S/1E 9M 2	Mocho 1, RP	Mocho 1 reference point
M1-T	3S/1E 9M 2	Mocho 1, Transformer	Mocho 1 transformer pad
M2-Diff	3S/1E 9M 3	Mocho 2, Pedestal	Mocho 2 pedestal to ground difference
M3-C	3S/1E 9M 4	Mocho 3, Casing	Mocho 3 casing / flange
M3-Diff	3S/1E 9M 4	Mocho 3, Pedestal	Mocho 3 pedestal to ground difference
M3-P	3S/1E 9M 4	Mocho 3, Pedestal	Mocho 3 well pedestal
M3-RP	3S/1E 9M 4	Mocho 3, RP	Mocho 3 reference point
M3-T	3S/1E 9M 4	Mocho 3, Transformer	Mocho 3 transformer pad
M4-C	3S/1E 8H18	Mocho 4, Casing	Mocho 4 casing / flange
M4-Diff	3S/1E 8H18	Mocho 4, Pedestal	Mocho 4 pedestal to ground difference
M4-P	3S/1E 8H18	Mocho 4, Pedestal	Mocho 4 well pedestal
M4-RP	3S/1E 8H18	Mocho 4, RP	Mocho 4 reference point
M4-T	3S/1E 8H18	Mocho 4, Transformer	Mocho 4 transformer pad
S-C	3S/1E 9B 1	Stoneridge, Casing	Stoneridge casing / flange
S-D	3S/1E 9B 1	Stoneridge, Drain	Stoneridge drain
S-Diff	3S/1E 9B 1	Stoneridge, Pedestal	Stoneridge pedestal to ground difference
S-P	3S/1E 9B 1	Stoneridge, Pedestal	Stoneridge well pedestal
S-RP	3S/1E 9B 1	Stoneridge, RP	Stoneridge reference point

Monitoring Frequency

Circuit	Frequency	Last Measured	Next Measurement
A1 Circuit*	Semi-annually	Fall 2010	Spring 2011
B1 Mocho loop	Semi-annually	Fall 2010	Spring 2011
B2 Tassajara loop	As needed	Fall 2007	as needed
B3 Hopyard wells loop	Semi-annually	Fall 2010	Spring 2011
B4 Stoneridge well loop	Semi-annually	Fall 2010	Spring 2011
B5 Tassajara - Rosewood	Annually	Fall 2010	Fall 2011
B6 Verona loop	As needed	Apr-04	as needed
B7 Suttergate loop	As needed	Apr-04	as needed
Municipal Wells	As needed	Oct-07	as needed

Legend

*	Not including the A1 North Segment, which was discontinued in 2007
	Probable bedrock sites

Table 3.4-2
Zone 7 Water Agency
Subsidence Monitoring; Kier & Wright Survey Measurements
2011 Water Year

Site	Site Description	Elev Fall 11 (Sep 29-Sep 30) (ft NAVD88)	Elev Spr 11 (Apr 26-Apr 29) (ft NAVD88)	Elev Fall 10 (Sep 29-Oct 9) (ft NAVD88)	Change in Elevation (ft)	
					Fall 11 - Spr 11	Fall 11 - Fall 10
A1- 1.0	G972*	365.705	365.705	365.705	0.000	0.000
A1- 2.0	Foothill and Las Positas	405.441	405.464	405.451	-0.023	-0.010
A1- 3.0	C972	330.590	330.592	330.584	-0.002	0.006
A1- 4.0	Arroyo Mocho at Chabot Crk	324.033	324.038	324.03	-0.005	0.003
A1- 5.0	Arroyo Mocho at Tassajara Crk West	327.133	327.151	327.151	-0.018	-0.018
A1- 6.0	Arroyo Mocho at Tassajara Crk East	327.795	327.804	327.812	-0.009	-0.017
A1- 6.05	Arroyo Mocho at Tassajara Crk East	329.357	329.358	329.337	-0.001	0.020
A1- 6.1	Arroyo Mocho Pleasanton Control	332.629	332.653	332.645	-0.024	-0.016
A1- 7.0	M1257	341.873	341.898	341.878	-0.025	-0.005
A1-10.0	Vineyard Pipeline at Santa Rita Rd	340.924	340.947	340.932	-0.023	-0.008
A1-12.0	Mohr Ave at Iron Horse	347.509	347.528	347.513	-0.019	-0.004
A1-13.1	COP RE 25281	349.977	349.993	349.986	-0.016	-0.009
A1-14.1	Busch and Valley	356.857	356.867	356.867	-0.010	-0.010
A1-15.0	D8	367.004	367.013	367.013	-0.009	-0.009
A1-15.1	BM-P929 Reset	361.477	361.493	361.471	-0.016	0.006
A1-16.0	V1	367.019	367.032	367.011	-0.013	0.008
A1-17.0	K2*	399.808	399.808	399.808	0.000	0.000
B1- 5.1	Mocho 4	336.679	336.705	336.689	-0.026	-0.010
B1-11.0	3S/1E 8H 4	NA	337.988	337.972	NA	NA
B1-12.0	3S/1E 8H13	336.989	337.011	336.995	-0.022	-0.006
B1-13.0	3S/1E 9M 4	336.445	336.464	336.448	-0.019	-0.003
B1-14.1	3S-1E 9M 2 New	341.022	341.049	341.028	-0.027	-0.006
B1-16.1	3S-1E 9M 3 New	341.810	341.841	341.831	-0.031	-0.021
B3- 1.0	MOCHO-PARK	323.168	323.183	323.165	-0.015	0.003
B3- 2.0	1H ALA	320.581	320.595	320.592	-0.014	-0.011
B3- 3.0	HOP9-BM	321.586	321.642	321.566	-0.056	0.020
B3- 4.0	PLEASANTON CANAL	323.615	323.618	323.607	-0.003	0.008
B3- 5.0	HOP7 MP1	322.564	322.579	322.569	-0.015	-0.005
H7-C	Hop7 Casing	324.869	324.873	324.868	-0.004	0.001
B4- 1.0 S	AMP-CTL S	322.046	322.063	322.044	-0.017	0.002
B4- 1.0 N	AMP-CTL N	NA	322.203	322.185	NA	NA
B4- 2.0	Stoneridge Wellhouse	344.780	344.796	344.783	-0.016	-0.003
B4- 3.0	GUZMAN PKWY	343.886	343.900	343.888	-0.014	-0.002
B4- 4.0	TREVOR PKWY	346.492	346.502	346.495	-0.010	-0.003
B5- 1.0	OSRR-BC	344.000	NA	344.02	NA	-0.020
B5- 2.0	OSRR-ANDREW	343.068	NA	343.089	NA	-0.021
B5- 3.0	OSRR-CAFÉ	344.508	NA	344.532	NA	-0.024
B5- 4.0	Tass-Rose	349.628	NA	349.646	NA	-0.018

* Fixed reference point
Elev Ground Surface Elevation
NM Not Measured
NA Not Applicable/Available

Table 3.5-1
Mining Area Monitoring Program - Water Level Data
2011 Water Year

PIT #	Chain of Lake Name	Frequency		Contact with Aquifer	Orig Grnd Elev	Deepest Mined Depth		MINING USE	Pond Elevation (ft MSL, NAVD88)	
		Levels	Quality			Elev	Depth	2011	Spring 11	Fall 11
CALROCK/RHODES & JAMIESON/VULCAN/PLEASANTON GRAVEL COMPANY/CALMAT										
C 1	C	SA	A	C	410	360	50	Unused		
C 2	C			N	410	360	50	Clay Storage		
C 3				N	410	360	50	Clay Storage		
C 4				N	400	390	10	Clay Storage		
C 5				N	400	290	110	Clay Storage		
C 6	C			N	400	385	15	Unused		
C 7	D			N	400	330	70	Clay Storage		
C 8A	D			C	410	330	80	Unused		
C 8B	D			C	410	340	70	Unused		
C 9	D			N	410	310	100	Unused		
R 3		SA	A	CP	370	240	130	Water & Clay	328.47	335.62
R 4		SA	A	CP	380	240	140	Water Storage	307.1	313.57
R 5				N	380	240	140	Clay Storage		
R 8	G	SA	A	CP	365	260	105	Same as R22	NM	362.66
R10				N	380	370	10	Clay Storage		
R11				N	390	370	20	Clay Storage		
R12				N	370	240	130	Clay Storage		
R13				N	370	270	100	Clay & Debris		
R21				N	380	280	100	Water & Clay		
R22	F	SA	A	CP	380	290	90	Water Storage		
R23		SA	A	CP	380	270	110	Water Storage	NM	359.82
R24	E	SA	A	C	390	280	110	Active Mining		
R25	E			-	395	300	95	Inactive Mining		
R27				N	380	300	80	Water Storage		
R28	D	SA	A	CP	400	320	80	Active Mining	319.6	NM
KAISER GRAVELS/HANSON										
K 1				N	350	325	25	Backfilled with clay		
K 2				N	350	325	25	Backfilled with clay		
K 4				N	350	315	35	Backfilled with clay		
K 5				N	350	315	35	Backfilled with clay		
K 6				N	350	325	25	Backfilled with clay		
K 7				N	350	320	30	Backfilled with clay		
K 8				N	350	320	30	Backfilled with clay		
K 9				N	360	305	55	Backfilled with clay		
K10				N	370	355	15	Backfilled with clay		
K11				N	370	315	55	Backfilled with clay		
K12				N	370	275	95	Backfilled with clay		
K13				N	370	275	95	Backfilled with clay		
K14				N	370	275	95	Backfilled with clay		
K15	Sh.Cliff	SA	A	C	360	265	95	Water Storage	331.08	333.16
K18		SA	A	C	360	330	30	Unused	346.19	350.76
K19					350	335	15	Backfilled with clay		
K24				N	360	220	140	Clay Storage		
K28	H	SA	A	C	360	220	140	Water Storage	NM	291.4
K30	Cope	SA	A	N	370	240	130	Water & Clay	NM	318.97
K32				N	360	335	25	Backfilled with clay		
K33				-	360	335	25	Unused		
K37	I	SA	A	C	360	220	140	Water Storage	NM	291.23
PACIFIC AGGREGATE/RMC/LONESTAR/CEMEX										
P 1					380	360	20	Clay Storage		
P 2				CP	380	360	20	Water Storage		
P 3					400	360	40	Clay Storage		
P 4					400	360	40	Clay Storage		
P 6					380	280	100	Clay & Debris		
P 7					380	280	100	Clay & Debris		
P 9					400	380	20	Clay Storage		
P10		SA	A	C	400	340	60	Unused	373.13	366.78
P11		SA	A	C	380	340	40	Unused	349.8	NM
P12		SA	A	C	360	330	30	Unused	346.42	351.08
P13				C	380	300	80	Water Storage		
P21					380	240	140	Clay Storage		
P27		SA	A	C	390	250	160	Water Storage	302	300.9
P28	A	SA	A	CP	420	360	60	Water Storage	401.9	401.07
P34					380	270	110	Clay & Debris		
P39	B				410	380	30	Inactive Mining		
P40		SA	A	C	390	260	130	Water Storage	NM	304.82
P41	A	SA	A	CP	410	370	40	Water Storage	409	408.89
P42	B	SA	A	CP	380	310	70	Active Mining	284.6	287.8
P43				N	390	240	150	Water & Clay		
P44		SA	A	CP	390	250	140	Water Storage	322.7	322.8
P45				CP	380	310	70	Water Storage		

A = Annual; SA = Semiannual

C = in contact with GW; CP = GW contact but subject to pumping; N = no contact with GW.

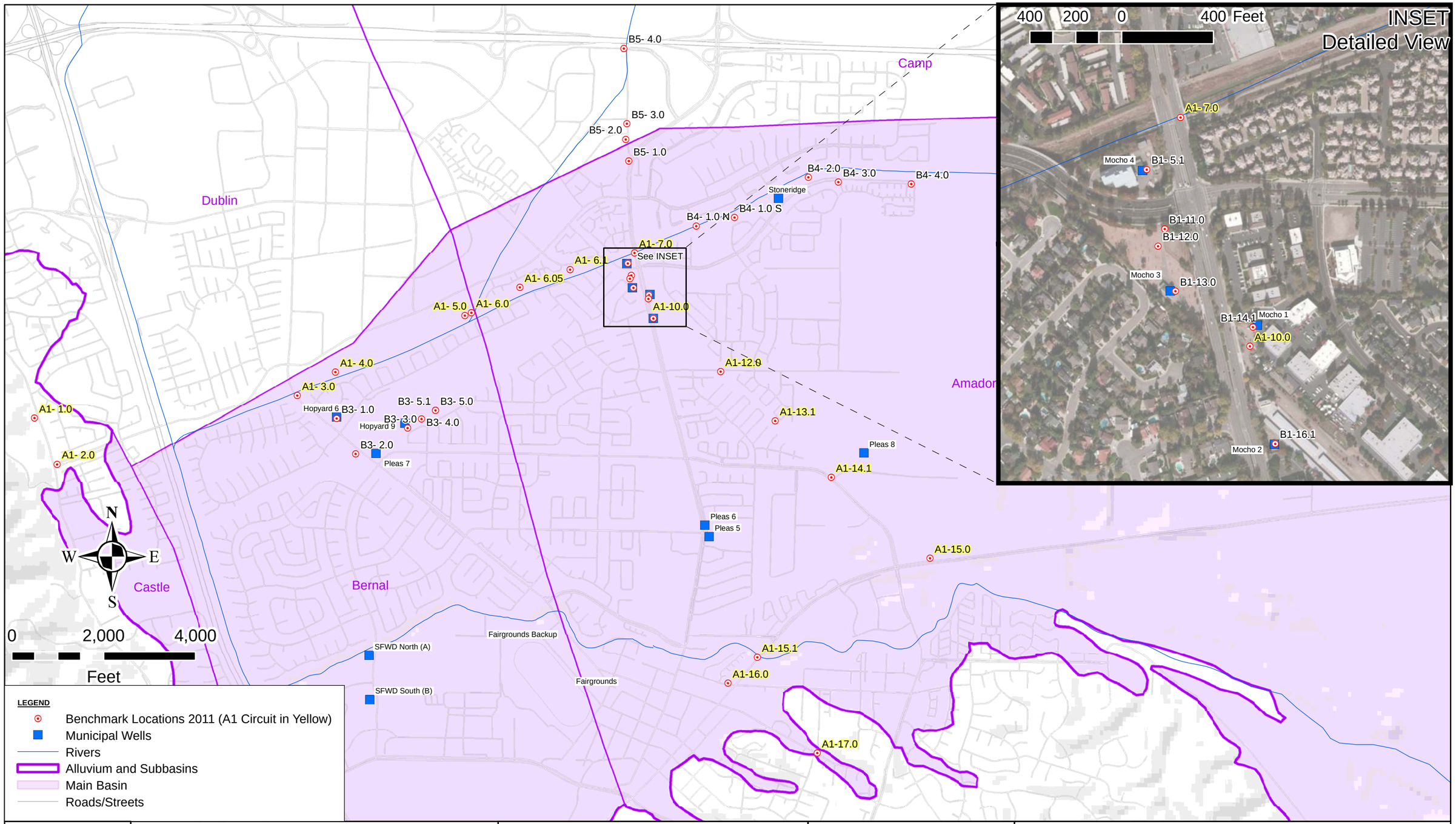
TABLE 3.5-2
ZONE 7 WATER AGENCY
WATER QUALITY RESULTS FOR MINING AREA WATER SAMPLES
2011 Water Year

		TEMP.	EC		Mineral Constituents (mg/L)									Select Metals (mg/L)				TDS	Hard
SITE ID	DATE	°C	umhos/cm	pH	Ca	Mg	Na	K	HCO3	SO4	Cl	NO3	SiO2	B	As	Fe	Mn	mg/L	mg/L
MA-C01	26-Oct-10	19.0	1303	8.9	22	81	164	4.1	345	90	206	<0.44	7.8	1.1	0.013	0.22	0.017	770	390
MA-K15	26-Oct-10	20.4	704	8.4	29	35	67	3.6	207	47	95	<0.44	8.9	0.46	0.0042	0.056	<0.01	392	217
MA-K18	26-Oct-10	19.4	475	8.2	33	20	36	2.5	190	29	34	<0.44	7.7	0.25	0.0013	<0.05	0.021	258	164
MA-K28	26-Oct-10	20.4	925	8.2	28	56	82	2.2	292	52	120	<0.44	12.6	0.79	0.0023	1.1	0.066	501	302
MA-K30	26-Oct-10	20.9	1823	8.7	24	102	212	2.9	317	161	350	<0.44	2.7	2.14	0.012	1.3	0.036	1025	480
MA-K37	26-Oct-10	20.9	938	8.5	24	60	95	2.6	281	60	138	<0.44	3.5	0.93	0.0044	0.38	0.012	530	308
MA-P10	26-Oct-10	17.8	504	7.7	39	17	41	2.4	180	29	42	<0.44	14.0	0.27	<0.001	0.19	0.063	274	169
MA-P11	26-Oct-10	14.0	515	7.7	38	17	45	2.7	168	29	60	<0.44	15.2	0.24	0.001	0.06	0.031	290	166
MA-P12	26-Oct-10	19.1	507	8.0	40	19	37	2.6	204	26	37	<0.44	10.4	0.26	0.0016	0.12	0.057	274	180
MA-P27	26-Oct-10	20.0	672	8.5	32	35	53	1.6	163	52	97	<0.44	7.5	0.45	0.0023	0.081	0.013	363	224
MA-P28	26-Oct-10	19.8	879	8.3	25	46	87	2.7	199	49	141	<0.44	5.0	0.41	0.0049	0.25	0.011	457	254
MA-P40	15-Apr-11	18.0	609	9.0	30	32	52	0.7	187	42	82	<0.44	0.0	0.50	0.0026	0.053	<0.01	348	206
MA-P41	15-Apr-11	18.8	748	8.6	42	35	54	2.7	216	34	104	<0.44	1.8	0.27	0.002	0.24	0.074	388	249
MA-P42	15-Apr-11	18.7	576	8.1	52	21	39	1.6	217	36	62	<0.44	12.1	0.29	<0.001	0.33	0.036	333	216
MA-P44	15-Apr-11	20.0	594	8.4	49	20	41	2.2	180	42	77	<0.44	7.7	0.31	0.0013	0.25	0.017	332	205
MA-R03	15-Apr-11	20.3	626	8.5	38	33	36	2.8	208	38	77	<0.44	8.7	0.28	0.0019	3.5	0.095	342	228
MA-R04	15-Apr-11	17.6	707	8.5	40	37	38	2.1	223	39	79	1.28	5.0	0.30	0.0012	0.092	0.02	358	255
MA-R22	15-Apr-11	19.2	689	8.6	40	45	38	2.5	242	45	92	3.94	9.8	0.32	0.0025	4.3	0.11	404	286
MA-R23	15-Apr-11	17.7	675	8.8	34	45	37	1.8	217	41	83	2.44	<1.1	0.31	0.0011	0.13	0.013	364	272

Table 3.7-1
Groundwater Production From Municipal and Other Supply Wells
2011 Water Year (in Acre-feet)

Station ID	Well	Common Name	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	WY*	CY**
Owner: **Zone 7**																
COL 1	3S/1E 10K 3	COL 1	125	42	33	115	48	7	2	12	11	1	0	3	**399**	**206**
COL 2	3S/1E 11M 3	COL 2	73	82	177	45	105	23	5	31	15	2	1	2	**562**	**234**
HOP 6	3S/1E 18A 6	Hopyard 6	55	2	1	180	20	25	25	10	0	35	0	45	**398**	**359**
HOP 9	3S/1E 17D12	Hopyard 9	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**
MOCHO 1	3S/1E 9M 2	Mocho 1	175	99	0	0	0	1	35	165	171	222	228	266	**1362**	**1804**
MOCHO 2	3S/1E 9M 3	Mocho 2	162	134	123	0	98	55	10	213	182	132	0	0	**1109**	**849**
MOCHO 3	3S/1E 9M 4	Mocho 3	141	16	34	254	0	0	1	1	16	80	0	98	**641**	**486**
MOCHO 4	3S/1E 8H18	Mocho 4	123	121	106	419	217	0	0	0	7	104	29	90	**1216**	**1063**
STONERIDGE_1	3S/1E 9B 1	Stoneridge	28	91	8	224	43	55	21	27	1	0	0	25	**523**	**398**
TOTALS															**6209**	**5399**
Owner: **Pleasanton**																
PLEAS #5	3S/1E 16L 5	Pleas 5	56	0	0	28	0	0	0	21	67	81	262	185	**701**	**770**
PLEAS #6	3S/1E 16L 7	Pleas 6	74	0	0	28	5	0	0	39	35	131	269	68	**649**	**683**
PLEAS #8	3S/1E 16A 2	Pleas 8	270	200	132	98	86	87	164	155	140	179	323	252	**2085**	**2050**
TOTALS															**3435**	**3503**
Owner: **California Water Service**																
CWS# 5(16B1)	3S/2E 16B 1	CWS STA 5	20	3	0	0	0	0	0	17	22	24	23	23	**132**	**183**
CWS# 8(8P 1)	3S/2E 8P 1	CWS STA 8	20	4	0	0	0	0	0	33	30	12	16	21	**136**	**163**
CWS# 9(9Q 1)	3S/2E 9Q 1	CWS STA 9	32	36	3	0	0	0	31	20	40	33	39	10	**244**	**189**
CWS#10 (8F1)	3S/2E 8F 1	CWS STA 10	34	32	4	21	32	50	68	65	59	59	18	0	**444**	**431**
CWS#12 (9P1)	3S/2E 9P 1	CWS STA 12	0	0	0	0	0	0	0	0	0	0	0	1	**1**	**49**
CWS#14 (8N2)	3S/2E 8N 2	CWS STA 14	62	53	22	56	4	73	54	0	0	19	88	88	**519**	**622**
CWS#15 (16C1)	3S/2E 16C 1	CWS STA 15	42	1	0	0	0	0	0	51	50	47	23	0	**214**	**171**
CWS#17 (9L1)	3S/2E 9L 1	CWS STA 17	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**
CWS#19 (8G1)	3S/2E 8G 1	CWS STA 19	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**
CWS#20 (18B1)	3S/2E 18B 1	CWS STA 20	4	2	0	0	0	0	0	27	32	38	46	1	**150**	**144**
CWS#24 (7P3)	3S/2E 7P 3	CWS STA 24	58	36	3	0	41	23	57	69	62	65	62	11	**488**	**414**
CWS#31 (7R3)	3S/2E 7R 3	CWS STA 31	68	34	0	0	0	0	0	0	15	83	74	72	**346**	**451**
TOTALS															**2673**	**2816**

* Water Year - from October 2010 to September 2011;
** Calendar Year - from January 2011 to December 2011;
Does not include pumped volume to waste.



ZONE 7 WATER AGENCY
100 North Canyons Parkway
Livermore, CA

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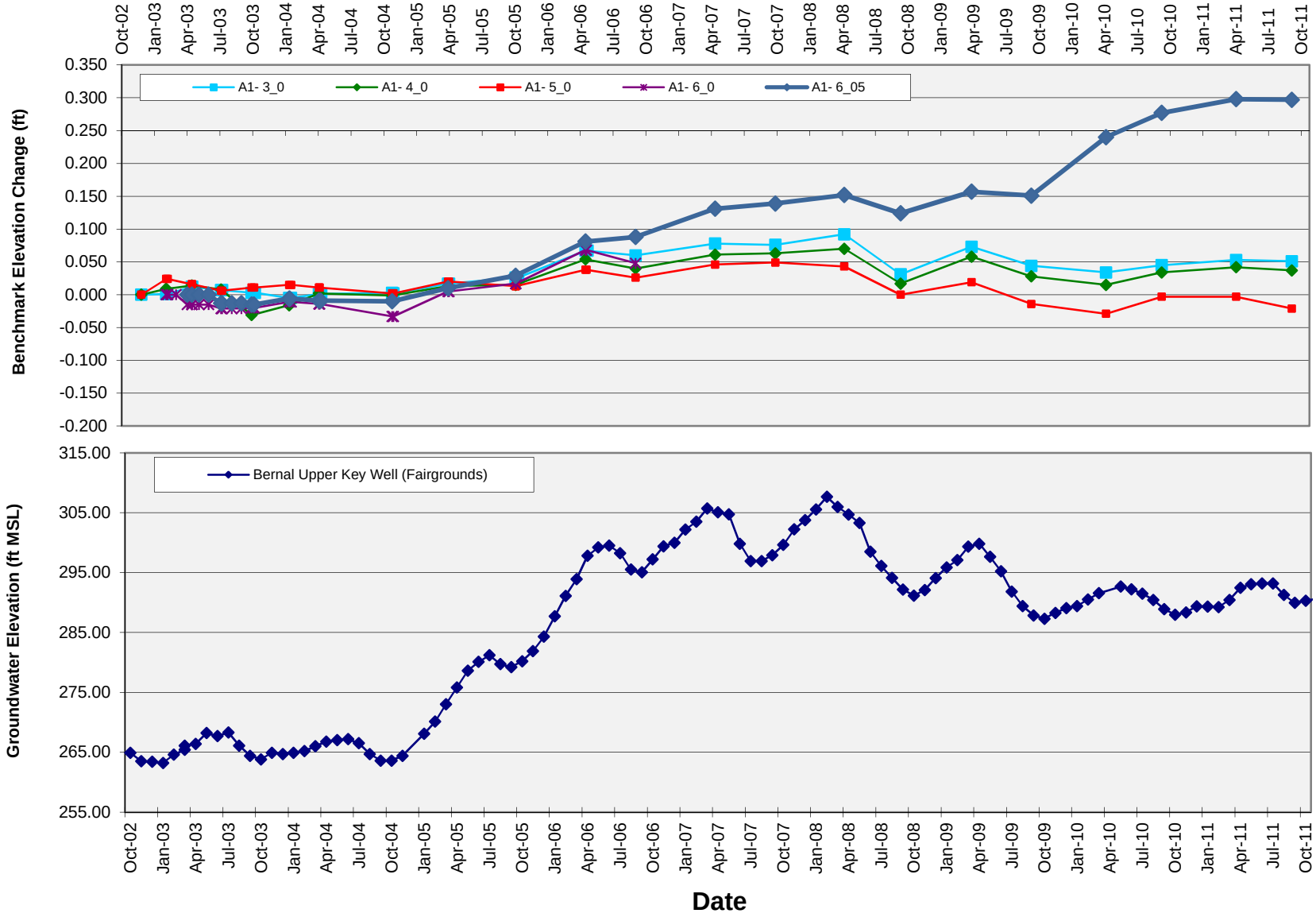
REVIEWED: TR	DATE: Mar 28, 2011
FILE: E:\MONITOR\EM\2011wy\Annual\Figures\Fig3.4-1-EMBasemap2011.mxd	

Figure 3.4-1
Benchmark Locations
2011 Subsidence Monitoring Program
Livermore Valley Groundwater Basin

Figure 3.4-2
Cumulative Land Surface Elevation Changes Since Start of Program
Bernal Subbasin



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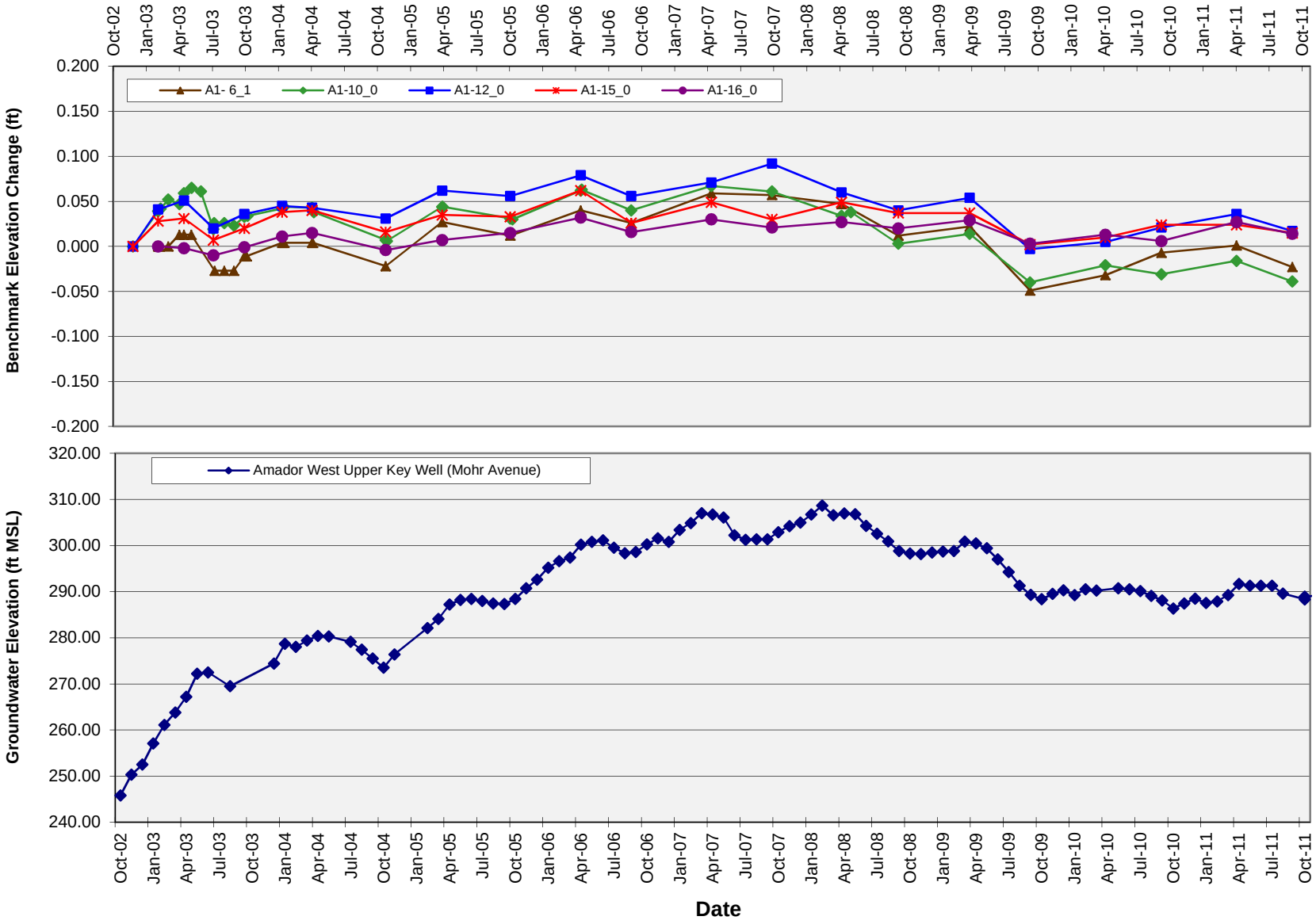
5/28/2012

Figure 3.4-3
Cumulative Land Surface Elevation Changes Since Start of Program
Amador Subbasin



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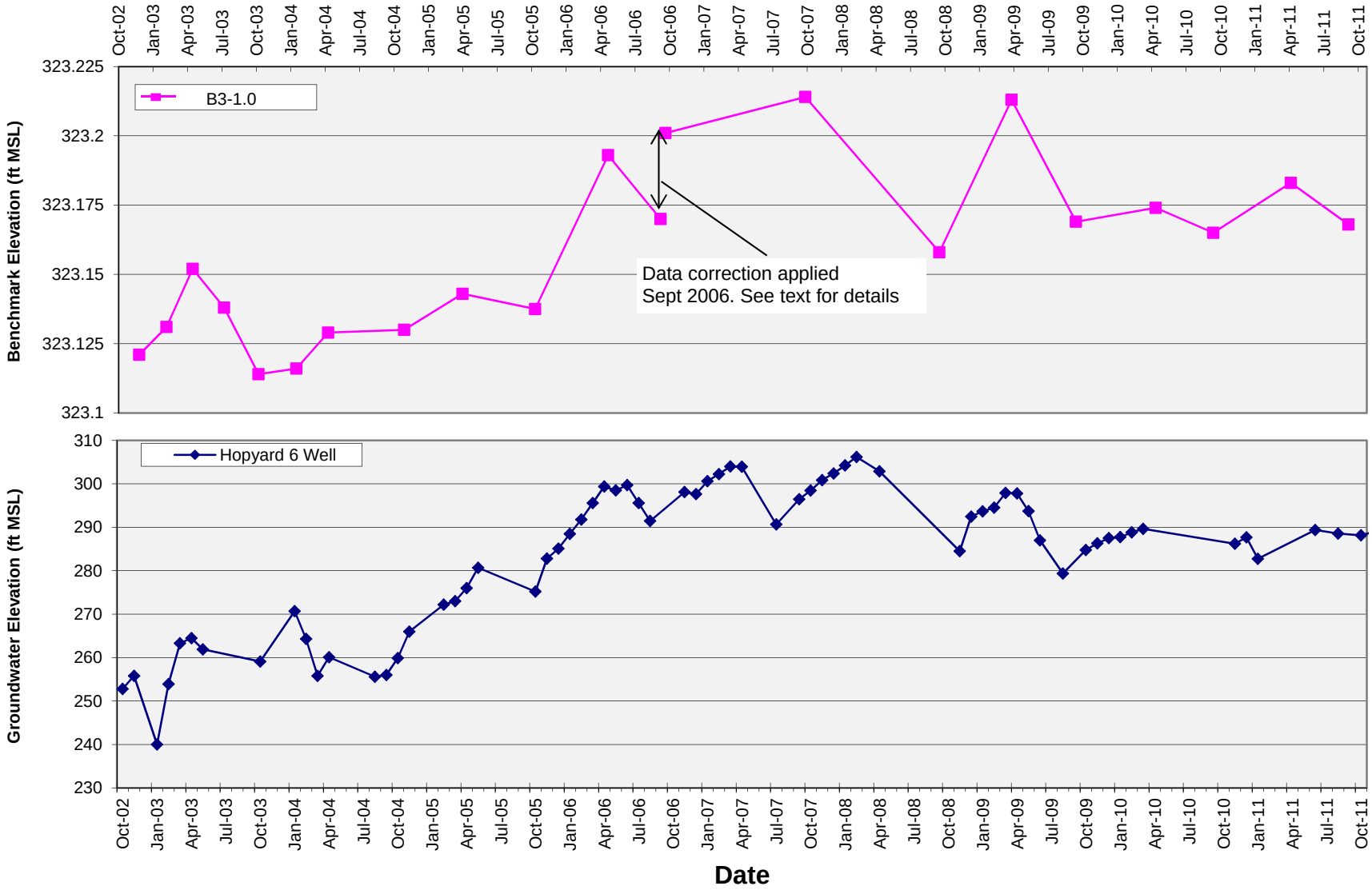
5/28/2012

Figure 3.4-4
Graphs of Land Surface Elevation and Groundwater Elevation Versus Time
Bernal Subbasin - Hopyard 6 Well



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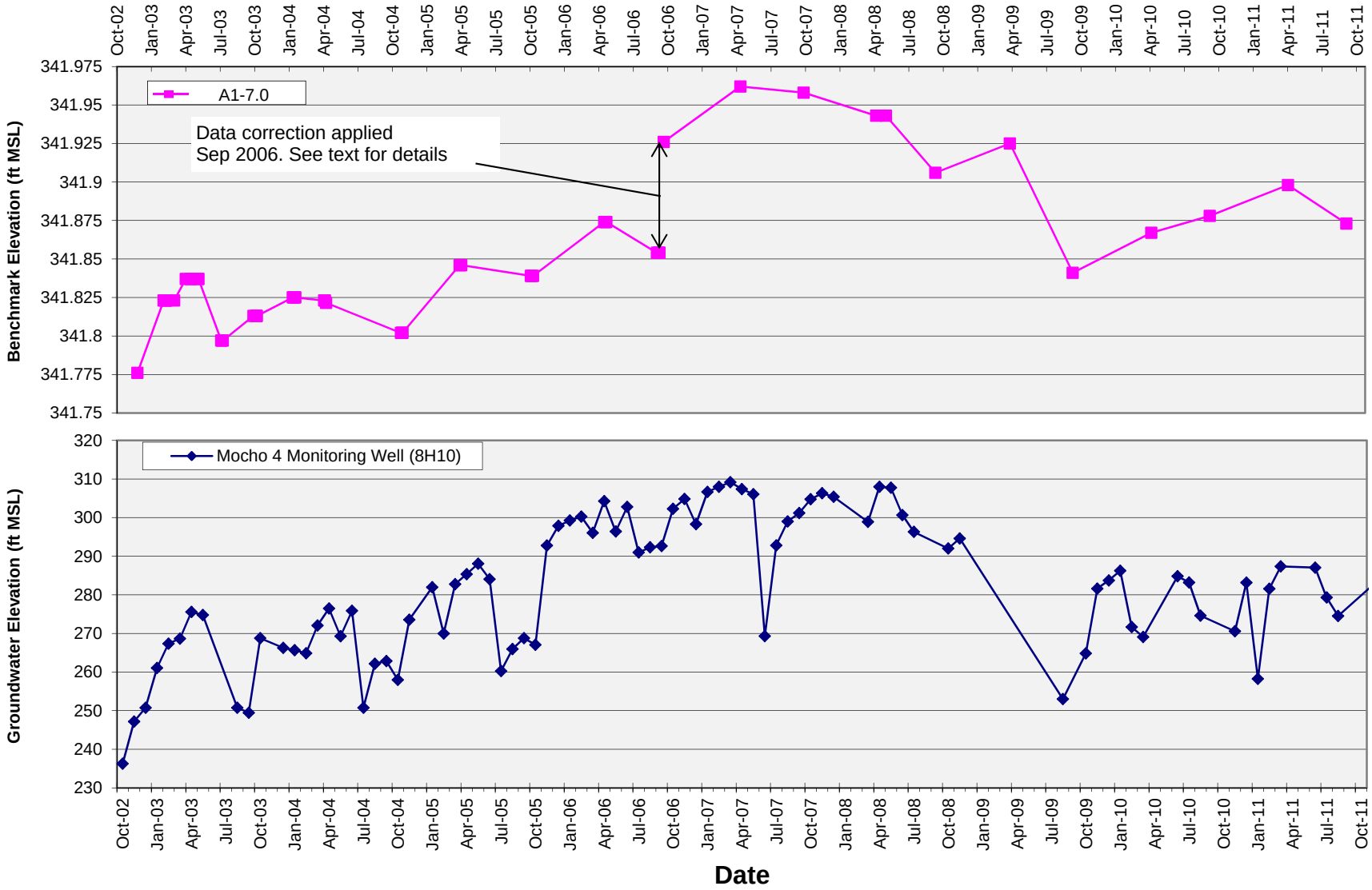
5/28/2012

Figure 3.4-5
Graphs of Land Surface Elevation and Groundwater Elevation Versus Time
Amador Subbasin - Mocho Wellfield



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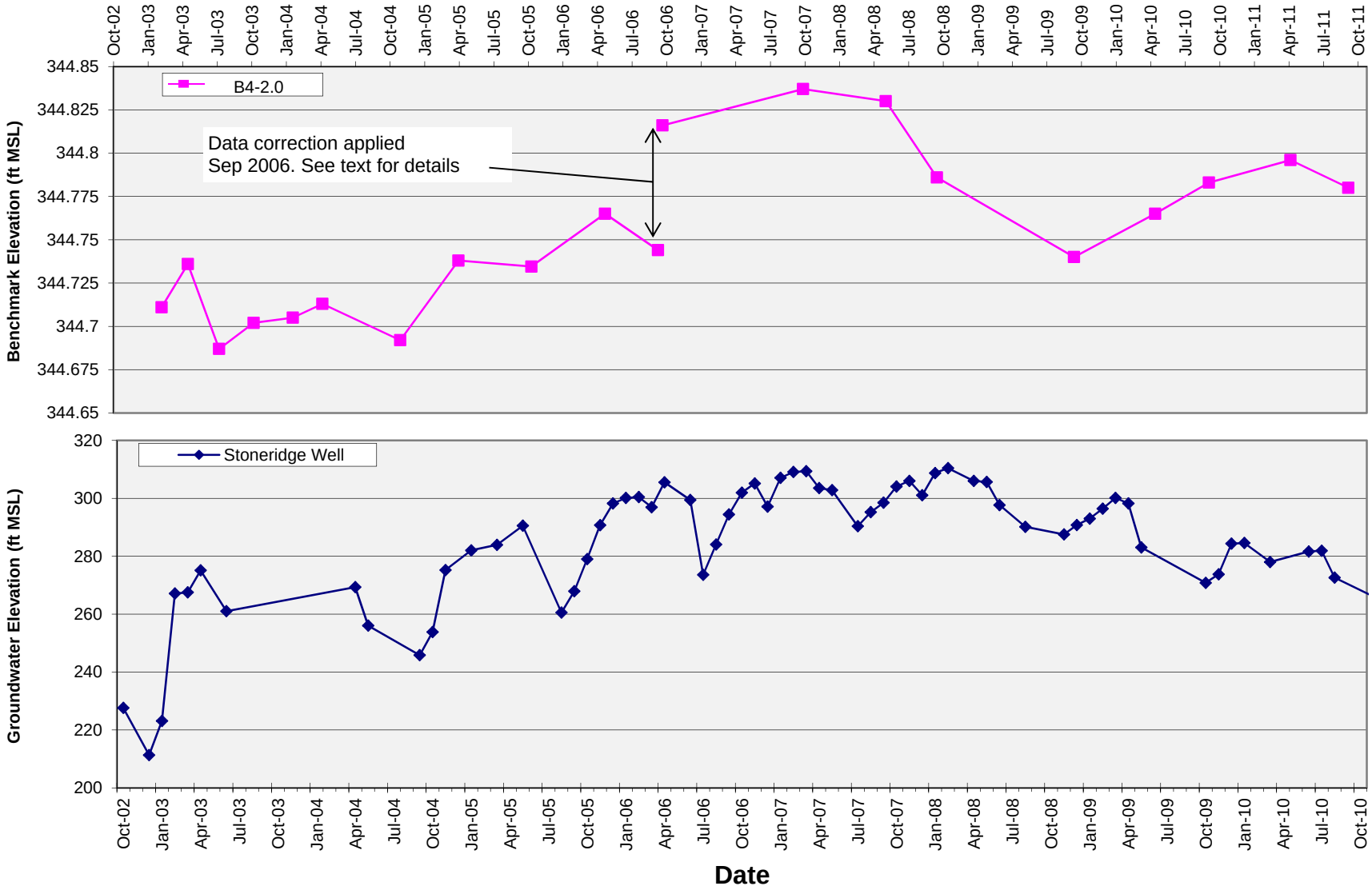
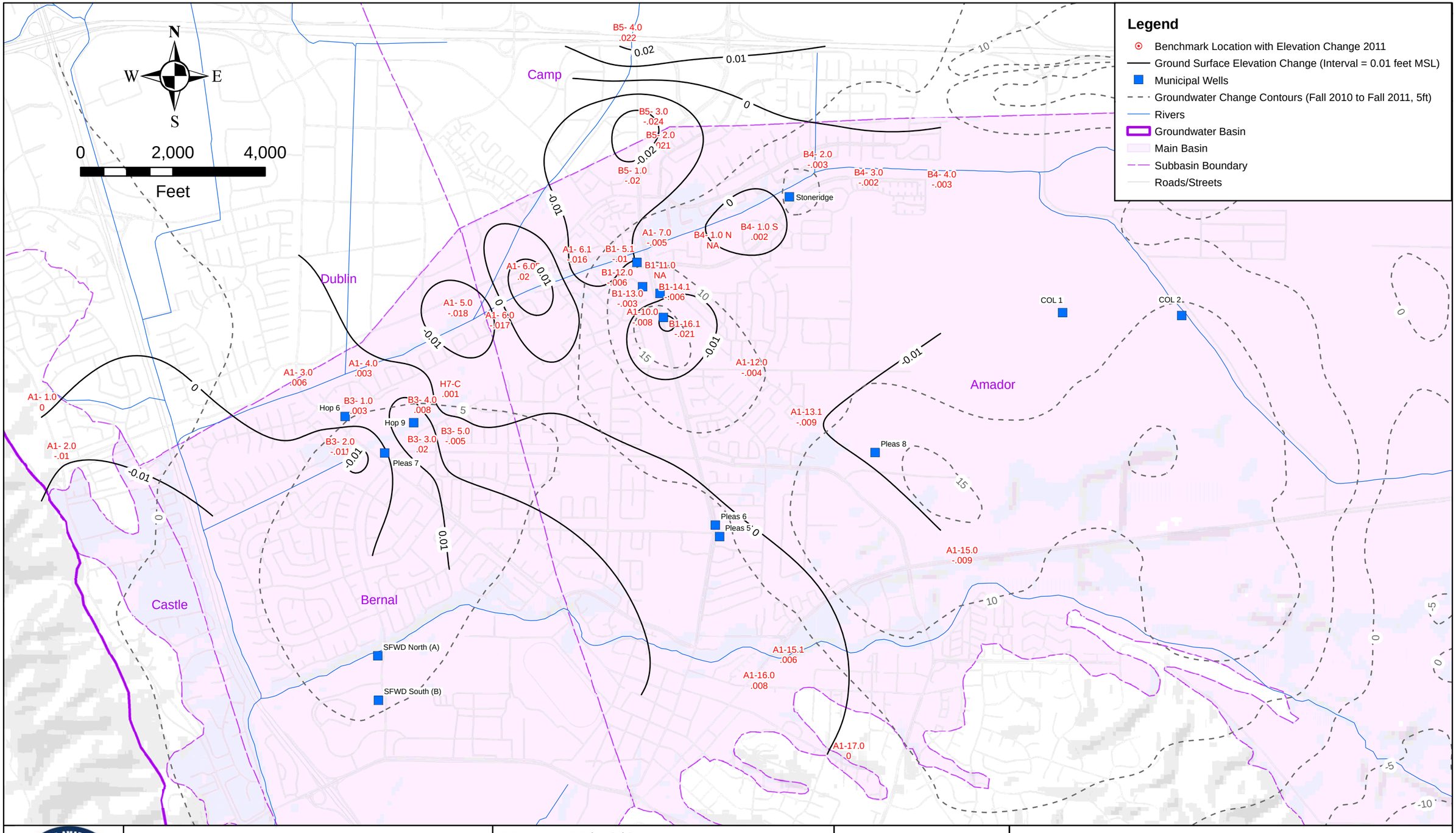
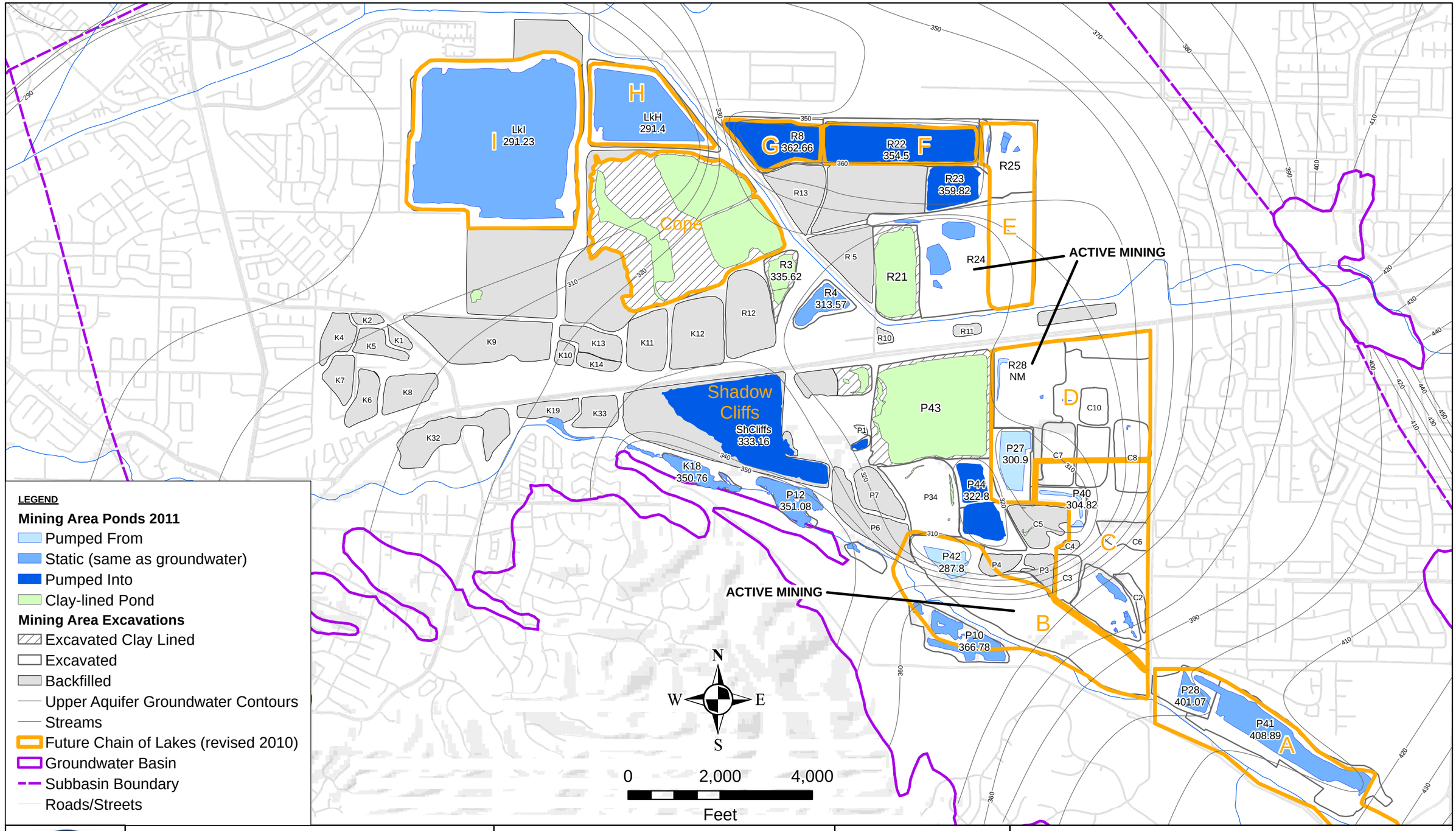
5/28/2012

Figure 3.4-6
Graphs of Land Surface Elevation and Groundwater Elevation Versus Time
Amador Subbasin - Stoneridge Well





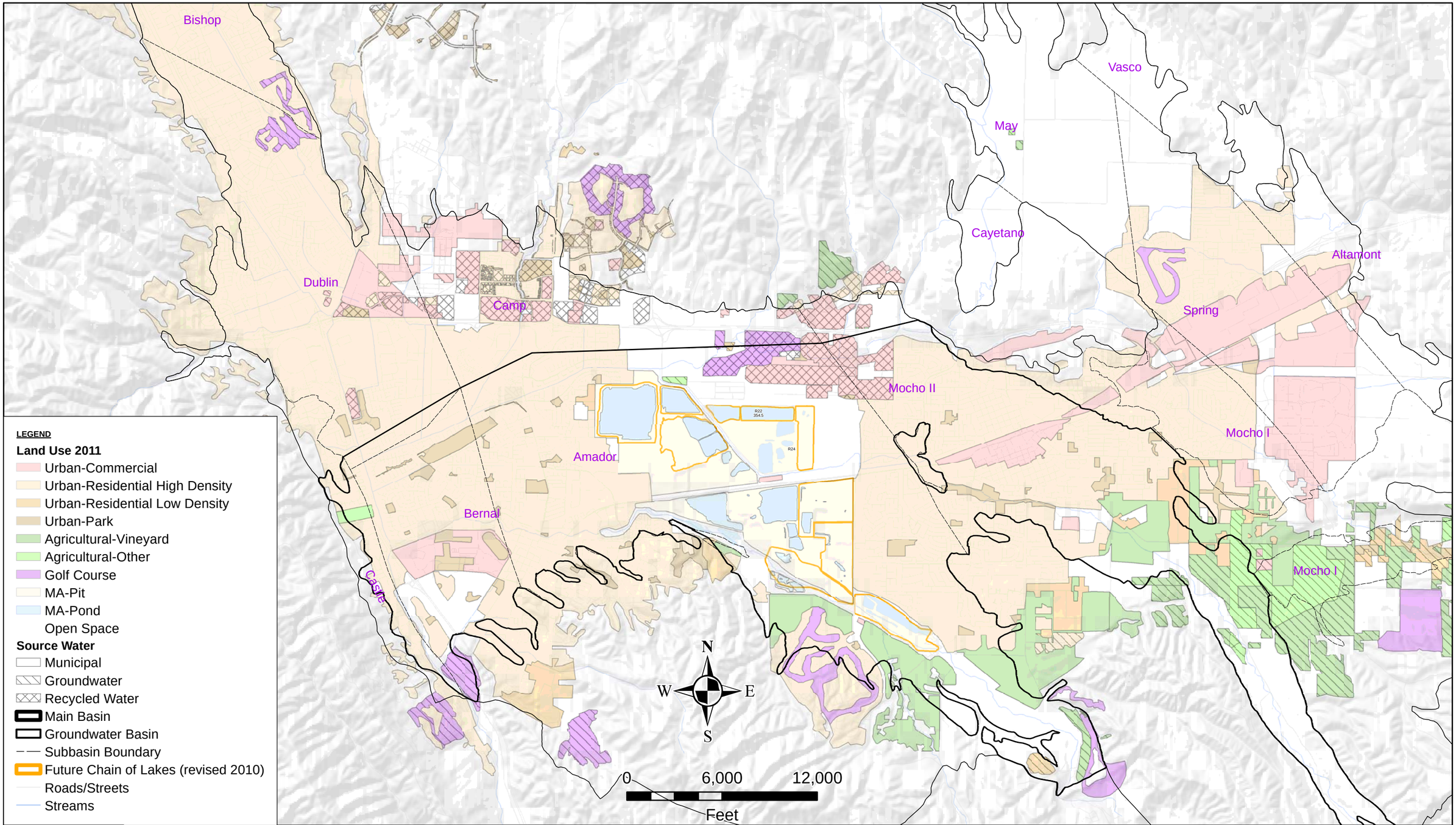
ZONE 7 WATER AGENCY 100 North Canyons Parkway Livermore, CA	DRAWN: TR/MG/CW	SCALE: 1 in = 2,000 ft	**Figure 3.4-7** **Ground Surface Elevation Change (ft)** **Fall 2010 to Fall 2011** **Livermore Valley Groundwater Basin**
	REVIEWED: TR	DATE: May 28, 2012	
	FILE: E:\MONITOR\EM\2011wy\Annual\Fig3.4-7-EMFall10toFall11.mxd		



ZONE 7 WATER AGENCY
100 North Canyons Parkway
Livermore, CA

DRAWN: TR	SCALE: 1 in = 2,000 ft
REVIEWED: CW/MK	DATE: May 28, 2012
FILE: E:\MONITOR\MA\2011WY\Fig3.5-1-MiningArea2011.mxd	

Figure 3.5-1
Location of Gravel Mining Pits
2011 Water Year
Livermore Valley Groundwater Basin



LEGEND

Land Use 2011
- Urban-Commercial
- Urban-Residential High Density
- Urban-Residential Low Density
- Urban-Park
- Agricultural-Vineyard
- Agricultural-Other
- Golf Course
- MA-Pit
- MA-Pond
- Open Space

Source Water
- Municipal
- Groundwater
- Recycled Water
- Main Basin
- Groundwater Basin
- Subbasin Boundary
- Future Chain of Lakes (revised 2010)
- Roads/Streets
- Streams

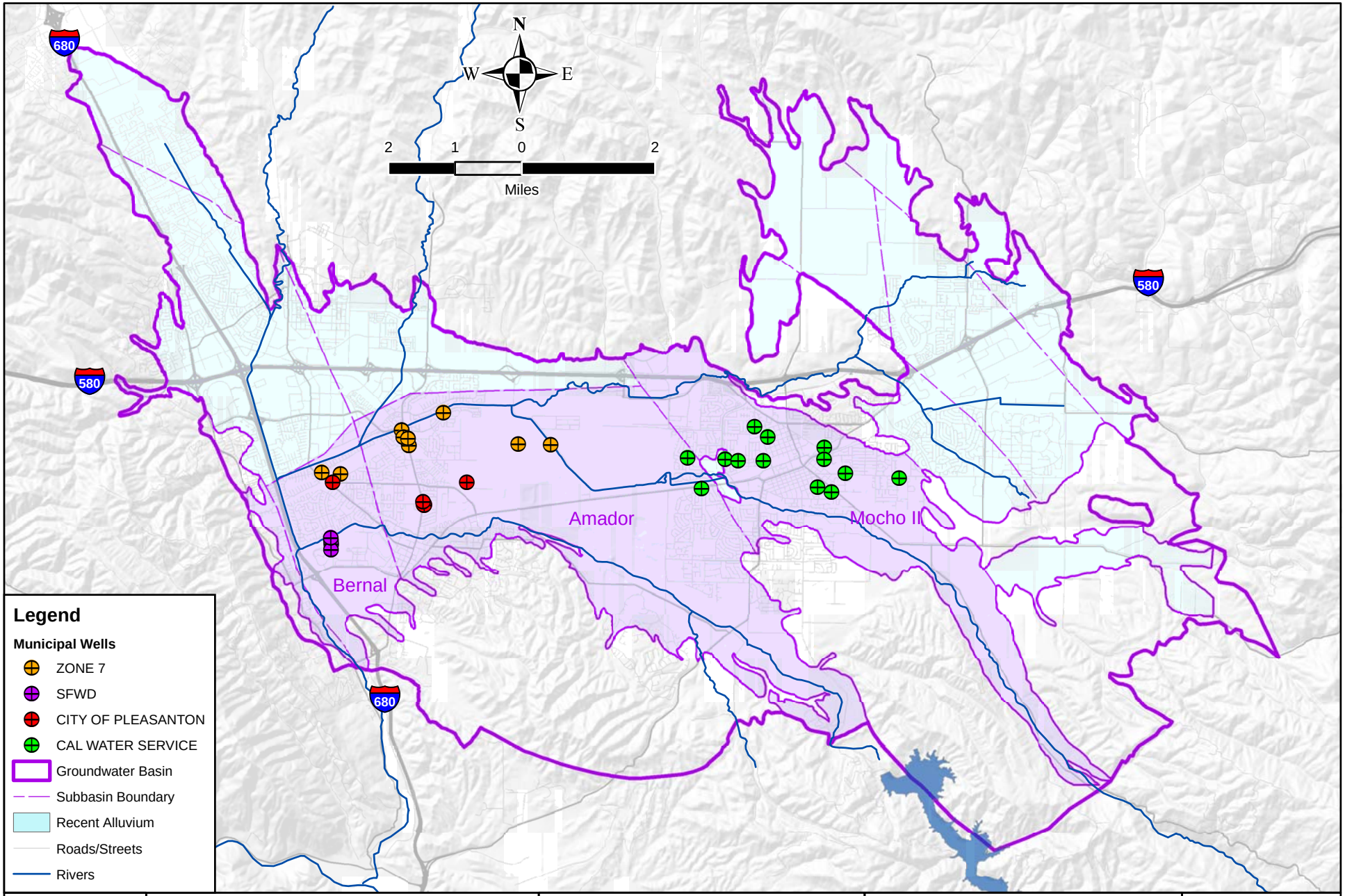
ZONE 7 WATER AGENCY
100 North Canyons Parkway
Livermore, CA

DRAWN: TR | SCALE: 1 in = 6,000 ft

REVIEWED: TR | DATE: May 28, 2012

FILE: E:\MONITOR\LU\2011WY\Fig3.6-1-LU2011.mxd

Figure 3.6-1
Livermore Valley Land Use
2011 Water Year



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

DRAWN: TR

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Fig3.7-1-BasinSubbasins.mxd

LOCATIONS OF SUB-BASINS AND MUNICIPAL WELLS

Scale: 1" = 2 Miles

Date: May 28, 2012

Figure 3.7-1