

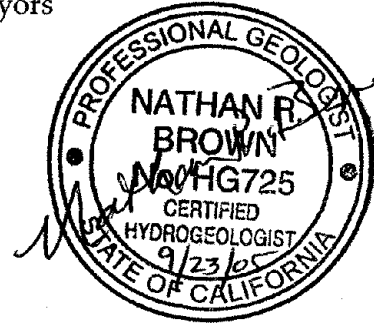
Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California

PREPARED FOR: The Santa Clarita Valley Water Purveyors

PREPARED BY: John Porcello/CH2M HILL
Nate Brown, P.G./CH2M HILL

DATE: August 2005

PROJECT NUMBER: 178973.A4.02



Introduction

The Santa Clarita Valley Regional Groundwater Flow Model (hereafter referred to as the Regional Model) is a three-dimensional, numerical model of groundwater flow in the Santa Clara River Valley Groundwater Basin, East Subbasin, which is located in the northwestern portion of Los Angeles County, California. As shown on Figure 1, the Regional Model simulates groundwater flow for the area occupied by the local groundwater aquifers, which consist of the shallow Alluvial Aquifer and the deeper Saugus Formation (tables and figures are located at the end of this technical memorandum). The Regional Model was developed as part of the work scope contained in an August 2001 Memorandum of Understanding that was entered into by the Upper Basin Water Purveyors (hereafter referred to as the Purveyors¹) and the United Water Conservation District, located downstream in Ventura County.

The construction and calibration of the Regional Model are described in detail in the *Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California* (CH2M HILL, 2004a). As discussed in that report, calibration of the Regional Model was performed for the period 1980 through 1999. This technical memorandum describes a recent extension of the model to simulate observed conditions in the basin during the period from January 2000 through February 2005. The purpose of the simulations was to update and test the model's calibration against an independent data set consisting of the recently observed hydrologic and pumping conditions in the basin. Following are discussions of the design of the simulation for this extended period and the findings.

¹The Upper Basin Water Purveyors consist of the Castaic Lake Water Agency (CLWA), the Santa Clarita Water Division of CLWA (formerly called the Santa Clarita Water Company [SCWC]), the Newhall County Water District (NCWD), and the Valencia Water Company (VWC).

Simulation Design

The calibration update process consisted of transient modeling that simulated monthly variations in pumping from, and recharge to, the Alluvial Aquifer and the Saugus Formation during the period January 2000 through February 2005. As with the original calibration effort, simulation results were compared to measured fluctuations in groundwater elevations and streamflows in the Santa Clara River.

Hydrologic input data for the calibration update simulation were as follows:

1. Groundwater pumping data were provided by the Purveyors for each production well. Tables 1 and 2 show annual pumping for the Alluvial Aquifer and Saugus Formation, respectively, from 1980 through 2004. As with the initial model calibration effort, the monthly distribution of pumping was defined from information on the monthly distribution of urban and agricultural water demands, as listed in Table 3.
2. Groundwater recharge was defined using a Surface Water Routing Model (SWRM) that was written specifically for the Regional Model during the original model development effort (see Appendix C of CH2M HILL, 2004a). The SWRM defined recharge from applied water use (i.e., irrigation)²; direct precipitation within the model domain (see Table 4); Santa Clara River flows into the valley as measured at the Lang stream gage (see Table 5); SWRM-estimated stormwater inflows into the model domain along ephemeral streams that are tributaries to the Santa Clara River; measured volumes of treated water discharge into the Santa Clara River from two Los Angeles County Sanitation District water reclamation plants (WRP) (see Tables 6 and 7); and water released from Castaic Lagoon into Castaic Creek by the California Department of Water Resources (see Table 8).

As discussed in two recent reports (CH2M HILL, 2004b and 2005) that were prepared after the model development report (CH2M HILL, 2004a) was completed, the boundary condition in the Alluvial Aquifer at the Lang gage was converted to a constant-head boundary shortly after completion of the model development report. This change was made based on field reconnaissance that was performed in April and May 2004, when the Santa Clara River was dry at the Lang gage. At that time, groundwater was locally discharging from the bed of the Santa Clara River in isolated locations where the riverbed intersects the water table, then seeping back into the riverbed nearby. Significant phreatophyte growth was also present along the riverbed in this same area (just downstream of the Lang gage). Additionally, water was present and actively flowing in the river east (upstream) of the Santa Clarita Valley, in the area between the Santa Clarita Valley and the upstream Acton Basin. Based on these observations, a specified groundwater elevation of 1,746 feet was established in the Alluvial Aquifer at the eastern boundary of the Regional Model to simulate subsurface flow beneath the channel of the Santa Clara River at the Lang gage. This specified elevation was held constant throughout the simulation period. Because of this change to the Regional Model, the simulation was performed for the entire calibration period (January 1980 through February 2005).

²Infiltration of applied water was simulated in the same locations as in the original model calibration effort, and at the 1999 rates described in the model development report (CH2M HILL, 2004a). These rates were 24.7 inches per year (in/yr) for irrigated agricultural land, 2.2 in/yr for residential areas, and 1.0 in/yr for retail/industrial lands and golf courses.

The simulation results were compared with hydrographs of measured groundwater elevations at production wells and other wells with long-term groundwater elevation data; measured flows in the Santa Clara River at the west end of the basin (at the County Line gage; see Table 9); and estimated volumes of groundwater discharge to the Santa Clara River (see Table 10). These comparisons are discussed in the following section.

Simulated and Measured Groundwater Elevations Trends

Simulated groundwater elevation trends were compared with data collected at specific Alluvial Aquifer wells (see Figure 2) and Saugus Formation wells (see Figure 3) where long-term records of groundwater elevations were available. These wells are referred to herein as target wells. As discussed in the model development report (CH2M HILL, 2004a), the calibration goal at target wells was to simulate groundwater elevations that were higher than the pumping elevations and as close as possible to the static elevations. Therefore, the hydrographs show the model-simulated groundwater elevations, the measured static groundwater elevations, and, for production wells, the measured pumping groundwater elevations. Additionally, the comparison of time-varying simulated and measured groundwater elevations was equally focused on the slopes of the hydrographs, not just the absolute values of the groundwater elevations at any given time.

Figures 4 through 8 show simulated and measured groundwater elevation hydrographs at target wells in specific geographic areas where the Alluvial Aquifer is present. The hydrographs and principal observations about the calibration quality in each area are as follows:

1. Along the Santa Clara River, west of Interstate 5, Figure 4 shows that simulated groundwater elevations were generally stable in this area during both the original calibration period (1980 through 1999) and the calibration update period (January 2000 through February 2005). However, few groundwater elevation measurements are available in this area for evaluating calibration quality during the latter period.
2. Along the Santa Clara River between Interstate 5 and Soledad Canyon, Figure 5 shows that the Regional Model closely simulates the trends at the three wells where data were collected before and after January 2000 (wells VWC-I, VWC-N, and VWC-Q2). This includes the general decline in groundwater elevations from 1998 through 2003, the more stable elevations in late 2003 and much of 2004, and the steep rise in elevations that began at the end of 2004.
3. Along the Santa Clara River in Soledad Canyon, Figure 6 shows that in the western portion of the canyon, the Regional Model simulates somewhat less decline in water levels during 2003 and 2004 than was observed at three wells (SCWC-Stadium, SCWC-Honby, and VWC-T2). However, the Regional Model simulates the steep declines seen elsewhere in the canyon in most of the production wells (such as SCWC-Mitchell and SCWC-Lost Canyon 2), including at the production wells where pumping has historically been reduced when groundwater elevations decreased during local drought periods. At these wells, the hydrographs show that the Regional Model closely simulates the slopes in the groundwater elevation hydrographs during dry and wet periods, and does not overestimate groundwater elevations during droughts.

4. Along Castaic Creek, Figure 7 shows that the Regional Model simulates groundwater elevations that are too high in early 2001 at three wells located in the upper reaches of the valley (production well NWCD-Castaic3 and other wells 6980E and 6981D). However, the subsequent declines in simulated groundwater elevations at these wells are similar to observed declines. In the lower reach of the valley, the simulated groundwater elevations and elevation trends at well VWC-D closely match the measured data.
5. In other tributary canyons to the Santa Clara River, Figure 8 shows a good match between simulated and measured groundwater elevations at well VWC-W6 in San Francisquito Canyon through May 2002, when data collection ended at this well. In Bouquet Canyon, the simulated groundwater elevations are too high in production well SCWC-Clark beginning in 1997, but agree more closely with observations at well 7066D, located farther downstream in the canyon. Farther east, well 7188A in Sand Canyon shows agreement between simulated and measured groundwater elevations and elevation trends.

In the Saugus Formation, the target wells are located along the South Fork Santa Clara River, as shown on Figure 3. Figure 9 shows the simulated and measured hydrographs for the Saugus Formation target wells. In general, the Regional Model simulates the trends in groundwater elevations quite well at each Saugus production and monitoring well. The trends (hydrograph slopes) are particularly close in the NCWD wellfield at observation well 5851 and NCWD production wells 10 through 13. Farther downgradient, the Regional Model tends to slightly over-predict groundwater elevations in the VWC and SCWC production wells (VWC-157, VWC-201, SCWC-Saugus1, and SCWC-Saugus2). However, the Regional Model closely simulates the groundwater elevation trends at each of these locations, which is the primary consideration for evaluating the quality of the transient calibration process in the Saugus Formation.

Simulated and Measured Flows in the Santa Clara River

Figure 10 compares the simulated and measured total flows of the Santa Clara River at the County Line gage. The figure contains both a linear and a semi-logarithmic plot to better illustrate how the simulated and measured flows compare during low-flow periods in the river. The figure shows that the Regional Model adequately replicates seasonal cycles of low and high river flows during the calibration update period (January 2000 through February 2005), as it did for the original calibration period (1980 through 1999), although seasonal low flows during the summer months are slightly over-predicted.

Figure 11 compares the model-simulated groundwater discharges to the river with the discharges that have been estimated from hydrograph separation techniques (see Section 2.6.2.5 of the model development report [CH2M HILL, 2004a]). Because of uncertainty in the amount of treated water that infiltrates the streambed, Figure 11 displays a range for the estimated values, varying according to how much treated Saugus WRP water is estimated to infiltrate to groundwater as it travels down the Santa Clara River. As with the analysis in the model development report, it was estimated that the infiltration could be negligible (blue line) and would be unlikely to exceed 75 percent of the Saugus WRP discharge (green line). As shown on Figure 11, the Regional Model predicts higher rates of

groundwater discharge during the driest months of the year than those estimated from the County Line gage data. However, the Regional Model simulated the predominantly low total river flow (Figure 10) and groundwater discharge (Figure 11) that occurred from mid-1998 through most of 2004. As discussed in the model development report, it is likely that differences between modeled and measured total river flows and measured versus estimated groundwater discharges result from uncertainties in both the Regional Model and the gage data at the County Line during periods of low river flows.

Water Budget

Table 11 summarizes the groundwater budget for each year of the 25-year transient model simulation period (1980 through 2004). Figures 12 and 13 show the annual groundwater recharge and groundwater discharge rates, respectively. Figure 14 shows the change in groundwater storage each year, and Figure 15 shows the cumulative change in groundwater storage during the simulation period. The plots show that groundwater recharge from rainfall and stream leakage were generally less during the calibration update period than during the mid-1980s and several years during the 1990s. Year-to-year fluctuations in groundwater discharge continued to be less variable than year-to-year fluctuations in groundwater recharge. The volume of groundwater in storage generally declined from mid-1998 through 2004 because of the below-normal rainfall that occurred during this period.

Conclusions

The Regional Model calibration was extended an additional 62 months (from January 2000 through February 2005) to update and test the model's calibration against an independent data set consisting of recently observed hydrologic and pumping conditions in the basin. Additionally, the simulation was repeated for the initial calibration period (January 1980 through December 1999) because of a change in the boundary condition at the east end of the basin in the Alluvial Aquifer.

Examination of groundwater elevation hydrographs for the Alluvial Aquifer and the Saugus Formation indicates that the Regional Model has a similar overall ability to simulate conditions during the calibration update period as for the preceding 20-year period to which it was originally calibrated. Specifically, the transient model simulates trends in groundwater elevations and Santa Clara River flows that are generally well matched with observed trends. In Soledad Canyon, where local droughts have sometimes affected the Upper Basin Water Purveyors' ability to pump groundwater from the Alluvial Aquifer, the Regional Model simulates the trends in groundwater elevations particularly well and does not over-predict groundwater elevations. In the Saugus Formation, the groundwater elevations and elevation trends are closely matched at most wells where data are available. Consequently, the process of updating the Regional Model's calibration for the most recent 5-year period has confirmed that the model is suitable for its intended applications, which are evaluating groundwater management strategies, groundwater sustainability, artificial recharge options, and restoration of contaminated water supplies.

References

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Tables

TABLE 1

Annual Groundwater Pumping from the Alluvial Aquifer
 Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California

Owner	Well Name	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
VWC	D	289	269	164	163	240	41	0	305	588	614	510	680	239	173	494	403	454	1,134	1,209	921	880	646	772	687	833
	I	214	200	122	121	177	181	95	0	91	132	73	108	1	0	1	0	0	0	0	0	0	0	0	0	0
	K2	0	0	0	0	0	0	0	0	0	0	0	982	1,134	1,708	2,089	1,155	1,305	1,076	1,489	1,420	861	669	954	364	0
	L2	9	8	5	5	7	91	0	0	0	0	0	838	526	996	1,236	818	961	308	190	532	494	349	490	71	0
	N	1,475	1,376	840	833	1,223	1,093	1,472	1,420	1,473	1,177	792	976	697	66	0	24	263	808	768	1,036	935	591	700	622	587
	N3	0	0	0	0	0	0	0	0	0	0	0	10	999	1,536	29	943	1,325	1,034	1,093	1,057	778	226	857	255	0
	N4	5	5	3	3	4	65	0	0	0	0	0	847	248	133	911	1,329	1,328	1,185	772	894	710	458	909	248	0
	N7	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
	N8	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
	Q2	440	411	251	248	367	461	838	893	512	1,483	1,398	1,783	335	548	1,348	1,126	1,385	1,462	1,655	1,288	1,387	923	1,167	1,451	1,096
	S6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	515	1,490	1,320	2,134	2,301
	S7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	111	564	419	1,095	471
	S8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	327	190	409	153
	T2	621	580	354	351	515	704	894	913	1,007	1,030	643	662	379	0	3	280	733	837	941	726	984	700	696	1,014	822
	T4	160	150	91	91	133	54	167	0	0	0	0	163	687	3	1	975	1,258	804	523	892	625	690	831	799	747
	U3	1,476	1,378	841	834	1,225	1,278	1,033	638	323	823	1,254	1,199	369	1	2	765	987	851	560	702	1,126	956	572	823	0
	U4	1,306	1,220	744	738	1,084	665	668	606	696	567	551	584	42	3	2	7	742	789	529	828	1,073	942	796	934	625
	W6	0	0	0	0	0	0	0	146	145	0	0	217	260	204	224	365	615	493	355	416	445	182	0	0	0
	W9	0	0	0	0	0	0	0	0	0	0	11	902	699	444	507	508	1,077	915	627	1,111	1,176	806	939	764	566
	W10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	1,537
	W11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	123
WHR	1	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
	2	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
	3	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
	4	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
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	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
	10	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,229	1,376	772	1,104	1,204	1,352	760	614	1,229	1,131	1,010	1,000	1,000	1,000	2,000
	11	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
	15	137	137	137	137	137	137	137	137	137	137	91	102	57	82	89	100	56	46	91	84	75	74	72	173	74
	16	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
	17	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	680	762	427	612	666	748	421	340	680	627	559	530	530	1,100	1,031
	18	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
	1A	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
Total Pumping (NCWD)		1,170	1,350	1,178	1,147	1,549	1,644	1,842	2,127	2,283	2,367	1,936	1,864	1,994	1,977	2,225	1,675	1,803	2,309	1,761	1,676	1,508	1,641	981	1,265	1,582
Total Pumping (SCWC)		9,460	7,109	4,091	4,269	6,057	6,242	5,409	5,582	5,079	5,785	5,983	5,593	8,288	12,016	10,996	10,217	10,445	11,268	11,426	13,741	11,529	9,941	9,513	6,424	7,146
Total Pumping (VWC)		5,995	5,597	3,415	3,387	4,975	4,633	5,167	4,921	4,835	5,826	5,232	9,951	6,615	5,815	6,847	8,698	12,433	11,696	10,711	11,823	12,179	10,519	11,612	11,706	9,861
Total Pumping (All Purveyors)		16,625	14,056	8,684	8,803	12,581	12,519	12,418	12,630	12,197	13,978	13,151	17,408	16,897	19,808	20,068	20,590	24,681	25,273	23,898	27,240	25,216	22,101	22,106	19,395	18,589
Total Pumping (NLF)		11,331	13,237	9,684	7,983	11,237	9,328	8,287	6,512	5,951	6,243	8,225	7,039	8,938	8,020	10,606	11,174	12,020	12,826	10,250	13,824	12,087	12,652	13,513	10,999	10,778
Total Pumping (WHR)		3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	2,000	2,240	1,256	1,798	1,959	2,200	1,237	1,000	2,000	1,842	1,644	1,604	1,602	2,273	3,105
Total Pumping (Others)		500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	932	932	932	932	953	890	909	1,071
Total Alluvial Aquifer Pumping		31,456	30,793	21,868	20,286	27,318	25,347	24,205	22,642	21,648	23,721	23,876	27,187	27,591	30,126	33,133	34,464	38,438	40,031	37,080	43,838	39,879	37,310	38,111	33,576	33,543

Notes:

All pumping volumes are listed in acre-feet and are from records maintained by the Upper Basin Water Purveyors.

N. = north

WHR = Wayside Honor Rancho, owned by the Los Angeles County Waterworks District

TABLE 2

Annual Groundwater Pumping from the Saugus Formation

Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California

Owner	Well Name	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NCWD	7	404	396	350	348	355	384	271	260	332	242	242	274	180	268	321	364	332	288	280	172	0	0	0	0	0
	4	440	449	319	385	315	369	222	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	119	227	115	138	1	0	5	1	1	0	4	1	1	0	1	0	0	0	0	0	0
	10	790	906	1,287	1,300	1,007	997	731	888	613	453	644	343	351	61	0	1	0	0	2	0	0	0	0	0	0
	11	729	870	716	754	1,159	1,278	2,209	2,371	1,265	1,280	1,252	1,034	428	730	614	522	353	81	14	0	0	0	0	0	0
	12	0	0	0	0	0	0	0	0	1,830	2,713	2,603	3,342	2,807	1,956	1,918	2,264	2,140	1,798	1,909	1,155	1,767	1,242	1,758	1,013	1,833
	13	0	0	0	0	0	0	0	0	0	0	0	0	1,393	2,053	2,246	1,623	2,045	3,001	2,351	1,295	419	1,190	1,637	1,500	1,906
NLF	156	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	266	445	426	479	374	300	211	122	268	
SCWC	Saugus1	0	0	0	0	0	0	0	0	31	0	0	1,690	437	1,226	1,333	0	410	451	0	0	0	0	0	0	0
	Saugus2	0	0	0	0	0	0	0	0	32	0	40	3,091	2,476	1,675	2,530	1,726	1,766	617	0	0	0	0	0	0	0
VWC	157	635	604	529	239	387	314	581	483	1,223	1,146	635	1,005	570	436	616	403	46	80	0	0	0	0	0	0	0
	159	0	0	0	0	0	0	0	0	0	0	3	63	65	74	147	68	3	0	0	0	91	0	30	9	
	160	1,571	1,725	368	372	467	571	846	822	1,077	1,326	839	1,325	580	920	957	585	206	401	133	95	1,332	707	347	864	1,526
	201	0	0	0	0	0	0	0	0	0	57	2,039	2,249	1,170	752	845	530	71	35	16	11	295	128	495	168	148
	205	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	101	0	123	511	813	
	206	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
Total Pumping (NCWD)		2,363	2,621	2,672	2,787	2,955	3,255	3,548	3,657	4,041	4,688	4,746	4,994	5,160	5,068	5,103	4,775	4,871	5,168	4,557	2,622	2,186	2,432	3,395	2,513	3,739
Total Pumping (SCWC)		0	0	0	0	0	0	0	0	63	0	40	4,781	2,913	2,901	3,863	1,726	2,176	1,068	0	0	0	0	0	0	0
Total Pumping (VWC)		2,206	2,329	897	611	854	885	1,427	1,305	2,300	2,529	3,516	4,642	2,385	2,182	2,565	1,586	326	516	149	106	1,728	926	965	1,573	2,496
Total Pumping (All Purveyors)		4,569	4,950	3,569	3,398	3,809	4,140	4,975	4,962	6,404	7,217	8,302	14,417	10,458	10,151	11,531	8,087	7,373	6,752	4,706	2,728	3,914	3,358	4,360	4,086	6,235
Total Pumping (NLF)		20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	266	445	426	479	374	300	211	122	268	
Total Pumping (Others)		0	0	501	434	620	555	490	579	504	522	539	480	446	439	474	453	547	548	423	509	513	513	513	513	513
Total Saugus Formation Pumping		4,589	4,970	4,090	3,852	4,449	4,715	5,485	5,561	6,928	7,759	8,861	14,917	10,924	10,610	12,025	8,560	8,186	7,745	5,555	3,716	4,801	4,171	5,084	4,721	7,016

Note:

All pumping volumes are listed in acre-feet and are from records maintained by the Upper Basin Water Purveyors.

TABLE 3
Allocation of Pumping, by Month, for Agricultural and Urban Production Wells
Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California

Month	% of Annual Water Use, Agricultural	% of Annual Water Use, Urban	% of May through October Water Use, Urban
January	3.8	5.2	
February	5.1	3.7	
March	6.6	5.2	
April	9.1	6.6	
May	10.6	8.7	13.2
June	11.4	10.4	15.8
July	14.1	13.0	19.7
August	12.9	13.6	20.6
September	10.2	10.9	16.5
October	7.5	9.3	14.1
November	5.0	7.1	
December	3.8	6.3	
Total	100.0	100.0	100.0

TABLE 4

Monthly Precipitation Measured at the Newhall County Water District Rain Gage

Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	10.36	14.63	4.84	0.36	0.40	0.00	0.00	0.00	0.00	0.00	0.00	1.36	31.95
1981	4.76	1.66	5.50	0.46	0.00	0.00	0.00	0.00	0.00	0.58	3.62	0.22	16.80
1982	3.33	1.21	9.50	1.09	0.13	0.00	0.00	0.00	1.02	0.25	5.34	2.95	24.82
1983	8.67	6.85	13.07	4.61	0.20	0.00	0.00	1.17	1.85	1.74	5.04	5.13	48.33
1984	0.00	0.00	0.27	0.07	0.00	0.00	0.00	0.00	0.05	0.16	3.87	8.13	12.55
1985	0.78	1.20	1.04	0.14	0.07	0.00	0.06	0.00	0.12	0.54	5.11	0.70	9.76
1986	5.84	6.65	5.39	0.88	0.00	0.00	0.05	0.00	1.78	0.68	1.55	0.24	23.06
1987	2.10	0.61	1.69	0.14	0.00	0.00	0.09	0.02	0.00	3.47	3.84	4.80	16.76
1988	3.27	3.39	1.16	3.98	0.09	0.00	0.00	0.00	0.10	0.00	0.92	7.14	20.05
1989	0.89	4.13	1.30	0.30	0.00	0.00	0.00	0.00	0.62	0.86	0.37	0.00	8.47
1990	2.89	4.23	0.22	0.48	0.88	0.00	0.00	0.00	0.00	0.00	0.63	0.01	9.34
1991	1.11	5.72	11.33	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	5.95	24.61
1992	3.28	16.64	9.73	0.15	0.34	0.00	0.30	0.00	0.00	1.55	0.00	7.25	39.24
1993	17.11	11.73	4.27	0.00	0.00	0.65	0.00	0.00	0.00	0.57	0.75	1.00	36.08
1994	0.48	5.31	2.33	0.42	0.00	0.00	0.00	0.00	0.00	0.78	0.71	1.94	11.97
1995	21.98	1.93	8.30	0.72	0.26	0.76	0.00	0.00	0.00	0.00	0.00	2.33	36.28
1996	2.97	6.73	2.08	0.13	0.68	0.00	0.00	0.00	0.00	1.30	1.06	8.70	23.65
1997	6.67	0.23	0.00	0.00	0.00	0.00	0.05	0.00	0.53	0.00	3.73	6.72	17.93
1998	3.49	22.00	3.98	2.28	5.50	0.06	0.00	0.00	0.21	0.33	1.36	1.39	40.60
1999	2.08	0.65	3.00	3.78	0.00	0.48	0.00	0.00	0.01	0.00	0.00	0.05	10.05
2000	1.21	9.43	3.15	2.10	0.00	0.00	0.00	0.31	0.00	1.13	0.00	0.00	17.33
2001	5.84	10.76	3.38	2.56	0.00	0.00	0.00	0.00	0.00	0.22	3.18	1.30	27.24
2002	1.55	0.51	0.38	0.05	0.12	0.01	0.00	0.00	0.02	0.00	3.01	5.85	11.50
2003	0.00	9.03	2.38	2.35	1.70	0.00	0.02	0.00	0.00	1.10	0.63	2.57	19.78
2004	0.65	8.07	0.37	0.20	0.00	0.00	0.00	0.00	0.00	4.79	0.64	8.54	23.26
2005	17.06	16.69											

Note:

All precipitation values are measured in inches.

TABLE 5

Monthly Streamflows Measured in the Santa Clara River at the Lang Gage

Calibration Update of the Regional Groundwater Flow Model for the Santa Clara Valley, Santa Clarita, California

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	1,310	7,449	1,213	568	218	78	6	0	37	274	467	553	12,175
1981	594	98	339	240	107	18	18	12	338	321	258	394	2,739
1982	333	1,420	785	283	238	0	0	0	0	95	178	855	4,188
1983	1,922	16,971	2,755	2,576	958	523	639	512	0	0	0	0	26,855
1984	0	596	405	240	143	166	228	411	154	220	904	578	4,044
1985	483	461	274	215	77	0	0	0	12	179	221	301	2,224
1986	483	1,138	488	283	107	6	0	12	6	12	80	129	2,744
1987	117	117	65	31	12	0	0	0	0	0	258	516	1,116
1988	222	209	506	117	77	68	0	0	0	0	12	25	1,236
1989	50	111	60	25	6	0	0	0	102	94	34	18	499
1990	212	276	230	46	46	5	0	0	0	27	36	147	1,025
1991	162	775	879	736	145	142	14	0	45	69	62	263	3,291
1992	336	534	429	398	117	84	16	5	108	144	498	1,446	4,115
1993	14,709	5,336	1,194	530	239	110	54	10	64	145	264	281	22,937
1994	388	493	497	319	163	80	20	7	37	102	193	941	3,239
1995	1,211	1,421	954	802	268	156	62	8	6	1	27	189	5,104
1996	666	896	730	315	151	46	7	0	54	154	307	510	3,836
1997	517	346	140	85	33	5	4	50	66	240	566	809	2,859
1998	18,997	8,508	3,837	961	667	347	81	91	70	139	190	186	34,074
1999	92	85	204	224	197	107	80	46	52	54	31	80	1,252
2000	117	117	65	31	12	0	0	0	0	0	258	516	1,116
2001	333	1,420	785	283	238	0	0	0	0	95	178	855	4187
2002	50	111	60	25	6	0	0	0	102	94	34	18	500
2003	666	896	730	315	109	0	0	0	0	0	0	0	2,716
2004	0	30	0	0	0	0	0	0	0	23	0	1,849	1,902
2005	26,052	20,243											

Note:

All monthly streamflows are measured in acre-feet. Values in bold italicized font are estimated from regression techniques, because (1) the Lang gage was out of service from November 1989 through April 2003 and (2) the gage was flooded during several days in January 2005 and February 2005.

TABLE 6**Monthly Treated Water Discharge Measured at the Valencia Water Reclamation Plant***Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California*

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	266	258	257	239	247	212	219	219	212	228	239	247	2,844
1981	248	220	249	235	244	237	253	255	248	263	285	270	3,006
1982	275	247	284	271	277	269	275	268	254	266	271	284	3,241
1983	286	261	301	288	296	277	287	296	282	286	276	295	3,432
1984	303	281	304	294	321	315	320	317	314	322	315	319	3,723
1985	309	283	316	316	333	331	354	359	348	361	357	341	4,006
1986	350	341	374	359	377	380	415	454	446	440	421	445	4,801
1987	455	415	472	489	550	567	603	594	579	633	600	624	6,582
1988	622	557	588	587	603	537	575	606	587	608	600	602	7,072
1989	622	593	695	666	671	708	714	731	668	678	673	676	8,095
1990	698	644	725	695	666	693	725	714	692	700	658	680	8,290
1991	715	662	702	627	668	646	647	691	709	743	717	748	8,276
1992	777	777	819	813	824	800	853	869	818	828	811	786	9,775
1993	778	733	863	858	869	925	910	846	816	834	818	858	10,107
1994	722	729	809	776	802	761	771	764	739	763	735	760	9,132
1995	889	777	935	887	884	848	853	814	826	834	823	855	10,225
1996	893	838	935	890	902	876	903	891	886	817	810	816	10,456
1997	815	713	866	829	852	879	860	851	824	826	778	775	9,867
1998	778	787	955	955	984	965	1,136	1,139	1,020	993	911	906	11,529
1999	930	868	962	953	985	968	1,003	1,018	961	1,020	1,040	987	11,695
2000	1,010	956	1,027	1,015	1,066	1,076	1,149	1,140	1,009	1,076	1,033	1,011	12,568
2001	964	916	1,044	1,013	1,082	1,049	1,120	1,105	1,059	1,107	1,053	1,064	12,576
2002	1,107	1,001	1,120	1,100	1,186	1,164	1,211	1,246	1,213	1,200	1,141	1,154	13,843
2003	1,159	1,083	1,205	1,311	1,367	1,339	1,416	1,423	1,374	1,346	1,316	1,321	15,660
2004	1,315	1,263	1,345	1,296	1,343	1,331	1,371	1,414	1,284	1,416	1,371	1,397	16,146
2005	1,519	1,468											

Note:

All monthly releases are measured in acre-feet.

TABLE 7
Monthly Treated Water Discharge Measured at the Saugus Water Reclamation Plant
Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	362	365	419	414	419	387	362	362	350	362	359	371	4,529
1981	382	337	390	398	444	412	417	429	431	434	412	460	4,945
1982	445	399	456	444	446	434	434	421	415	434	431	438	5,196
1983	460	421	514	541	562	545	520	477	458	481	477	534	5,990
1984	558	505	499	485	476	443	458	456	451	467	474	519	5,791
1985	503	461	505	458	448	444	452	459	452	470	460	498	5,610
1986	498	475	528	501	499	483	481	476	500	511	518	552	6,023
1987	524	475	542	487	425	383	391	403	395	397	411	430	5,264
1988	443	411	439	434	440	430	445	457	435	464	436	460	5,294
1989	462	410	441	450	464	436	476	479	462	471	451	466	5,468
1990	463	403	432	426	483	492	513	504	489	493	508	512	5,718
1991	495	423	479	427	491	516	557	525	486	474	470	493	5,835
1992	488	507	530	472	489	476	493	521	492	498	452	514	5,931
1993	595	534	616	581	615	587	622	604	578	609	567	567	7,075
1994	601	606	694	677	687	644	642	645	619	663	655	685	7,817
1995	657	578	676	705	699	631	641	635	617	613	568	581	7,602
1996	532	504	525	501	517	506	511	525	532	579	558	583	6,375
1997	564	516	515	461	469	417	442	474	475	503	521	553	5,911
1998	529	541	544	511	617	587	426	399	457	501	521	533	6,166
1999	542	485	551	391	544	512	547	532	521	527	487	514	6,153
2000	493	487	501	490	503	467	457	509	585	555	514	596	6,157
2001	592	531	572	510	500	490	485	519	510	527	553	560	6,349
2002	520	459	518	493	491	526	564	551	518	552	556	567	6,315
2003	551	500	528	343	352	332	328	335	325	326	325	352	4,597
2004	360	360	384	373	376	362	378	374	397	406	371	396	4,537
2005	409	359											

Note:

All monthly discharges are measured in acre-feet.

TABLE 8**Monthly Releases of Water from Castaic Lagoon to Castaic Creek***Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California*

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	0	0	0	0	0	834	1,052	919	0	0	0	0	2,805
1981	105	0	0	1,490	46	0	0	0	0	0	0	0	1,641
1982	0	0	0	0	0	667	842	735	0	0	0	0	2,244
1983	0	0	0	0	0	1,168	1,473	1,287	0	0	0	0	3,928
1984	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	105	0	0	1,490	46	0	0	0	0	0	0	0	1,641
1987	105	0	0	1,490	46	0	0	0	0	0	212	0	1,853
1988	0	0	809	341	900	0	0	0	0	0	0	0	2,050
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	66	66
1992	0	0	580	3,052	667	127	24	0	0	0	0	0	4,450
1993	0	140	186	3,031	1,901	635	341	337	813	0	0	341	7,725
1994	210	0	0	2,979	93	0	0	0	0	0	0	0	3,282
1995	0	0	0	0	0	1,668	2,104	1,839	0	0	0	0	5,611
1996	0	0	0	4,961	671	0	0	0	0	0	0	0	5,632
1997	0	0	8701	873	0	0	0	0	0	0	0	310	9,884
1998	1,186	19,545	10,747	4,566	7,561	47	1,370	436	464	302	652	926	47,802
1999	612	691	0	3,187	1,191	149	0	0	0	0	0	0	5,830
2000	0	660	855	0	2,087	3,484	0	0	0	0	0	0	7,086
2001	0	389	1,218	0	0	0	0	0	0	0	0	0	1,607
2002	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	2,286	418	315	0	0	0	0	0	0	3,019
2004	0	59	1,004	0	0	0	0	0	0	0	0	60	1,123
2005	32,391	37,514											

Note:

All monthly releases are measured in acre-feet.

TABLE 9**Monthly Streamflows Measured in the Santa Clara River at the County Line Gage***Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California*

Calendar													
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	8,428	43,565	18,125	8,551	3,792	3,963	1,202	1,111	1,668	1,470	1,452	1,884	95,211
1981	3,376	1,533	5,415	1,815	1,662	1,279	942	906	1,139	1,488	2,138	2,539	24,232
1982	2,826	2,358	5,572	7,091	3,909	1,749	1,694	1,392	1,597	1,621	3,449	3,229	36,488
1983	7,787	9,122	67,712	11,240	10,320	3,828	2,102	2,678	2,053	3,443	5,040	5,911	131,236
1984	5,691	3,931	4,084	4,530	2,309	1,607	1,224	1,511	1,464	1,624	3,237	8,067	39,279
1985	3,116	2,561	2,852	1,974	1,694	1,365	1,178	1,365	1,551	1,880	2,102	2,828	24,466
1986	3,955	13,991	10,616	3,328	2,612	1,622	1,454	1,482	1,870	1,896	2,606	2,590	48,024
1987	2,485	2,325	2,575	1,841	1,908	1,710	1,650	1,470	1,412	2,309	2,057	4,457	26,198
1988	3,421	2,981	3,025	3,172	2,636	2,231	1,734	1,494	1,605	1,904	2,027	10,381	36,611
1989	2,644	3,340	2,584	2,055	1,740	1,920	1,732	1,345	1,535	2,146	1,964	1,795	24,799
1990	2,709	3,247	2,269	1,898	1,730	1,545	1,478	1,751	1,668	1,660	1,924	1,593	23,472
1991	2,051	3,219	15,981	1,837	1,519	1,113	1,144	831	912	948	1,014	4,332	34,901
1992	3,737	37,636	9,576	4,439	1,964	1,533	1,377	1,085	1,129	1,329	1,496	3,277	68,577
1993	47,199	44,749	25,738	9,459	4,860	3,324	2,797	2,771	2,949	3,005	2,686	3,247	152,783
1994	3,281	3,437	3,501	3,533	3,519	2,200	1,640	1,400	1,192	1,855	2,263	4,219	32,039
1995	31,125	3,828	19,662	8,452	3,901	2,527	1,843	2,192	1,855	1,716	2,075	3,235	82,409
1996	3,604	10,669	7,678	6,073	3,584	1,678	1,640	1,579	1,509	2,625	1,590	5,701	47,930
1997	5,375	3,913	7,884	3,370	1,680	1,240	1,571	1,371	1,230	1,662	2,636	4,848	36,780
1998	5,875	104,388	25,377	9,378	34,992	5,312	3,935	3,537	2,579	2,450	2,890	4,427	205,139
1999	4,328	4,128	4,322	6,526	4,760	3,590	1,125	1,439	2,164	1,888	2,243	2,434	32,382
2000	2,470	12,210	6,400	2,910	3,610	5,250	1,890	1,490	1,560	1,950	1,890	2,290	43,920
2001	3,680	5,430	7,370	2,970	2,650	1,890	1,520	1,100	970	1,510	2,310	3,220	34,620
2002	2,980	2,060	2,610	2,390	1,730	1,680	1,600	772	1,010	1,440	2,490	4,330	25,092
2003	2,690	5,540	3,910	5,470	2,810	2,150	1,670	1,280	1,600	2,491	2,688	3,816	36,115
2004	4,046	7,204	4,262	2,003	1,851	1,853	1,339	1,646	1,438				
2005													

Note:

All monthly streamflows are measured in acre-feet. Because reported flows appear highly uncertain beginning in October 2004, they are not listed in this table.

TABLE 10

Estimated Annual Groundwater Discharge to the Santa Clara River
*Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley,
 Santa Clarita, California*

Calendar Year	Flow in Castaic Creek (acre-feet)	Flow at County Line (acre-feet)	Estimated Non-Storm Flow at County Line (acre-feet)	WRP Flows (acre-feet)	Estimated Groundwater Discharge to River (acre-feet)
1980	16,785	95,211	57,593	7,372	50,221
1981	6,519	24,232	21,172	7,949	13,223
1982	9,102	36,488	32,531	8,436	24,095
1983	67,058	131,236	55,878	9,420	46,458
1984	13,787	39,279	35,215	9,512	25,703
1985	2,619	24,466	24,089	9,614	14,475
1986	4,945	48,024	31,327	10,822	20,505
1987	911	26,198	23,663	11,844	11,819
1988	2,415	36,611	24,934	12,363	12,571
1989	Unavailable	24,799	23,453	13,560	9,893
1990	0	23,472	21,772	14,006	7,766
1991	65	34,901	18,702	14,108	4,594
1992	4,450	68,577	23,601	15,703	7,898
1993	7,725	152,783	65,054	17,179	47,875
1994	Unavailable	32,039	31,239	16,946	14,293
1995	5,611	82,409	51,001	17,824	33,177
1996	5,632	47,930	36,366	16,831	19,535
1997	9,885	36,780	27,521	15,778	11,743
1998	47,803	205,139	81,744	17,695	64,049
1999	5,830	32,382	27,176	17,847	9,329
2000	7,007	43,920	30,131	18,721	11,410
2001	1,607	34,620	27,900	18,925	8,975
2002	0	25,092	23,243	20,158	3,085
2003	3,019	36,115	28,835	20,257	8,578
2004 ^a					

^aAnnual volumes of groundwater discharge could not be calculated because of uncertainties in streamflow data at the County Line stream gage in late 2004.

TABLE 11
Annual Water Budgets Calculated by the Calibrated Regional Model for 1980 through 2004
Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California

Calendar Year	Precipitation Infiltration	Infiltration of Applied Water	Streambed Infiltration	Castaic Dam Underflow	Subsurface Inflow from Acton Basin	Total Recharge	Pumping	Groundwater Discharge to Streams	ET	Subsurface Outflow at County Line	Total Discharge	Change in Groundwater Storage	Cumulative Change in Groundwater Storage
1980 to 1981	35,608	3,375	46,386	1,705	16,122	103,197	35,542	32,667	16,722	18,362	103,293	-96	-96
1981 to 1982	9,454	3,871	15,958	1,700	16,513	47,497	35,209	22,673	10,589	18,115	86,586	-39,089	-39,185
1982 to 1983	46,064	3,022	46,009	1,700	16,279	113,073	24,918	26,469	13,072	18,367	82,827	30,247	-8,938
1983 to 1984	168,155	2,657	83,635	1,700	15,437	271,584	23,169	56,932	29,067	18,802	127,969	143,615	134,677
1984 to 1985	959	3,606	10,778	1,705	16,281	33,328	30,645	33,670	21,482	18,198	103,995	-70,667	64,010
1985 to 1986	0	3,279	9,123	1,700	16,607	30,709	28,963	25,845	11,466	18,059	84,333	-53,624	10,386
1986 to 1987	37,673	3,211	36,076	1,700	16,398	95,057	28,658	28,066	13,770	18,335	88,828	6,229	16,615
1987 to 1988	9,288	2,991	12,575	1,700	16,947	43,501	27,085	24,232	9,896	18,115	79,327	-35,826	-19,211
1988 to 1989	23,720	3,075	23,369	1,705	16,892	68,761	27,571	23,426	10,431	18,315	79,743	-10,982	-30,193
1989 to 1990	0	3,393	7,925	1,700	17,340	30,358	30,415	20,932	7,499	18,125	76,970	-46,612	-76,805
1990 to 1991	0	3,787	9,073	1,700	17,592	32,152	31,652	18,242	5,055	18,141	73,090	-40,937	-117,742
1991 to 1992	45,055	3,397	36,390	1,700	16,884	103,427	41,067	19,864	7,434	18,238	86,603	16,824	-100,918
1992 to 1993	119,272	3,850	67,935	1,705	16,009	208,772	37,567	30,452	15,003	18,558	101,580	107,192	6,274
1993 to 1994	102,692	3,773	61,563	1,700	15,751	185,479	39,741	45,991	24,538	18,564	128,834	56,645	62,919
1994 to 1995	554	4,415	12,629	1,700	16,466	35,763	44,120	22,265	13,478	18,072	97,935	-62,172	747
1995 to 1996	103,734	4,517	61,628	1,700	15,935	187,514	42,009	36,348	21,081	18,567	120,006	67,507	68,254
1996 to 1997	40,468	5,205	37,922	1,705	16,303	101,602	45,574	26,784	17,501	18,474	108,334	-6,732	61,523
1997 to 1998	14,265	5,267	20,537	1,700	16,547	58,316	47,051	21,205	13,598	18,237	100,091	-41,775	19,748
1998 to 1999	126,481	4,758	86,384	1,700	15,692	235,014	42,043	45,379	26,261	18,678	132,360	102,654	122,402
1999 to 2000	4	5,343	13,716	1,700	16,446	37,209	46,867	24,011	15,442	18,101	104,420	-67,211	55,191
2000 to 2001	692	5,343	17,472	1,705	17,158	42,369	43,664	19,733	10,284	18,247	91,927	-49,558	5,633
2001 to 2002	57,816	5,343	51,538	1,700	16,359	132,755	40,406	23,390	14,233	18,410	96,439	36,317	41,950
2002 to 2003	305	5,343	9,900	1,700	16,969	34,216	42,120	17,517	9,380	18,128	87,144	-52,928	-10,979
2003 to 2004	22,496	5,343	24,812	1,700	17,072	71,423	37,229	19,022	9,214	18,369	83,834	-12,411	-23,390
2004 to 2005	38,619	5,343	38,288	1,705	17,449	101,403	39,545	19,319	10,125	18,523	87,512	13,891	-9,499
Minimum	0	2,657	7,925	1,700	15,437	30,358	23,169	17,517	5,055	18,059	73,090	-70,667	-117,742
Maximum	168,155	5,343	86,384	1,705	17,592	271,584	47,051	56,932	29,067	18,802	132,360	143,615	134,677
Average	40,135	4,140	33,865	1,701	16,538	96,179	36,513	27,457	14,265	18,324	96,559	-380	9,335
Median	23,720	3,850	24,812	1,700	16,466	71,423	37,567	24,011	13,478	18,315	91,927	-10,982	5,633

Note:
All flow volumes are listed in AF/yr.

Figures

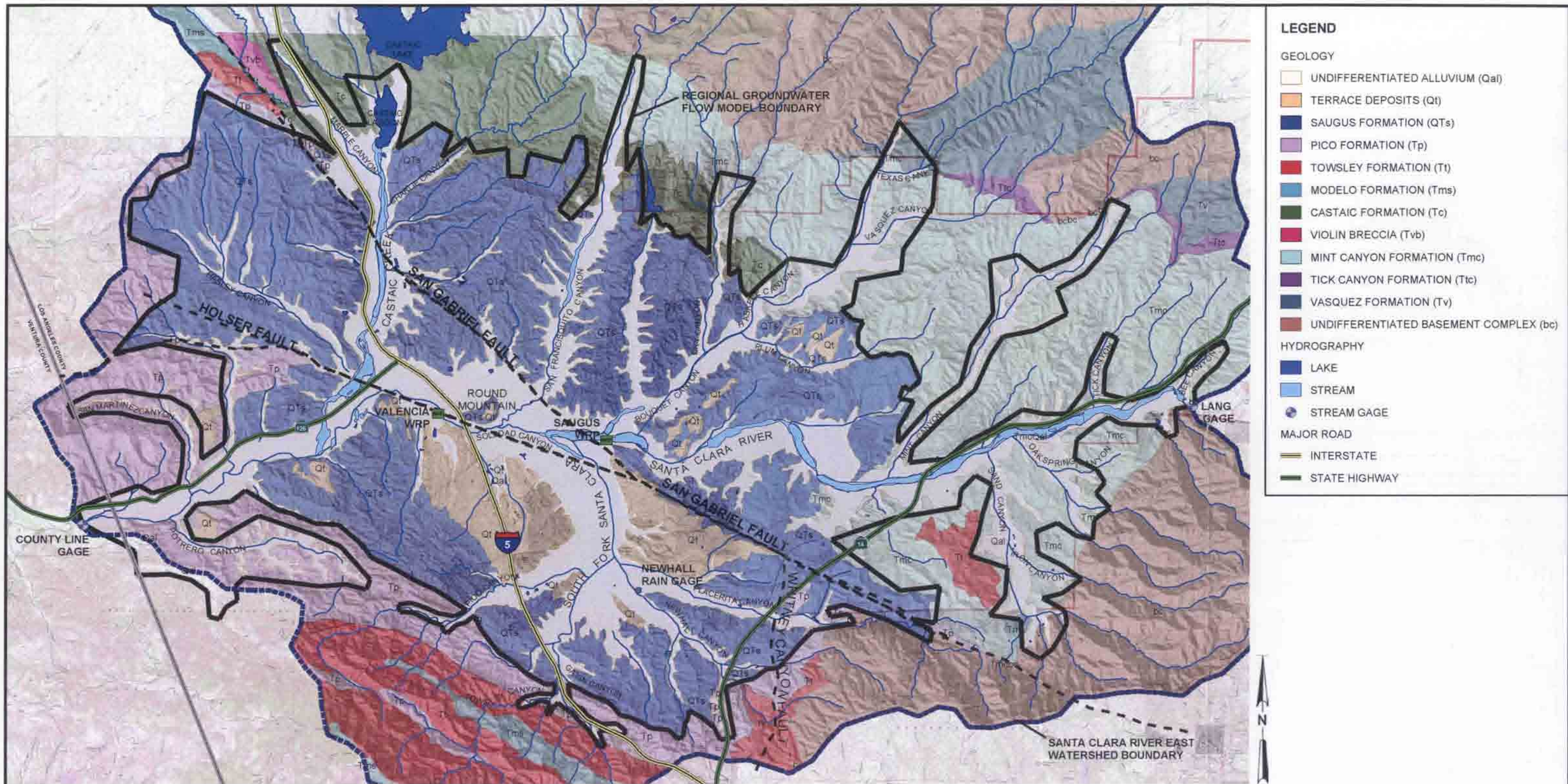
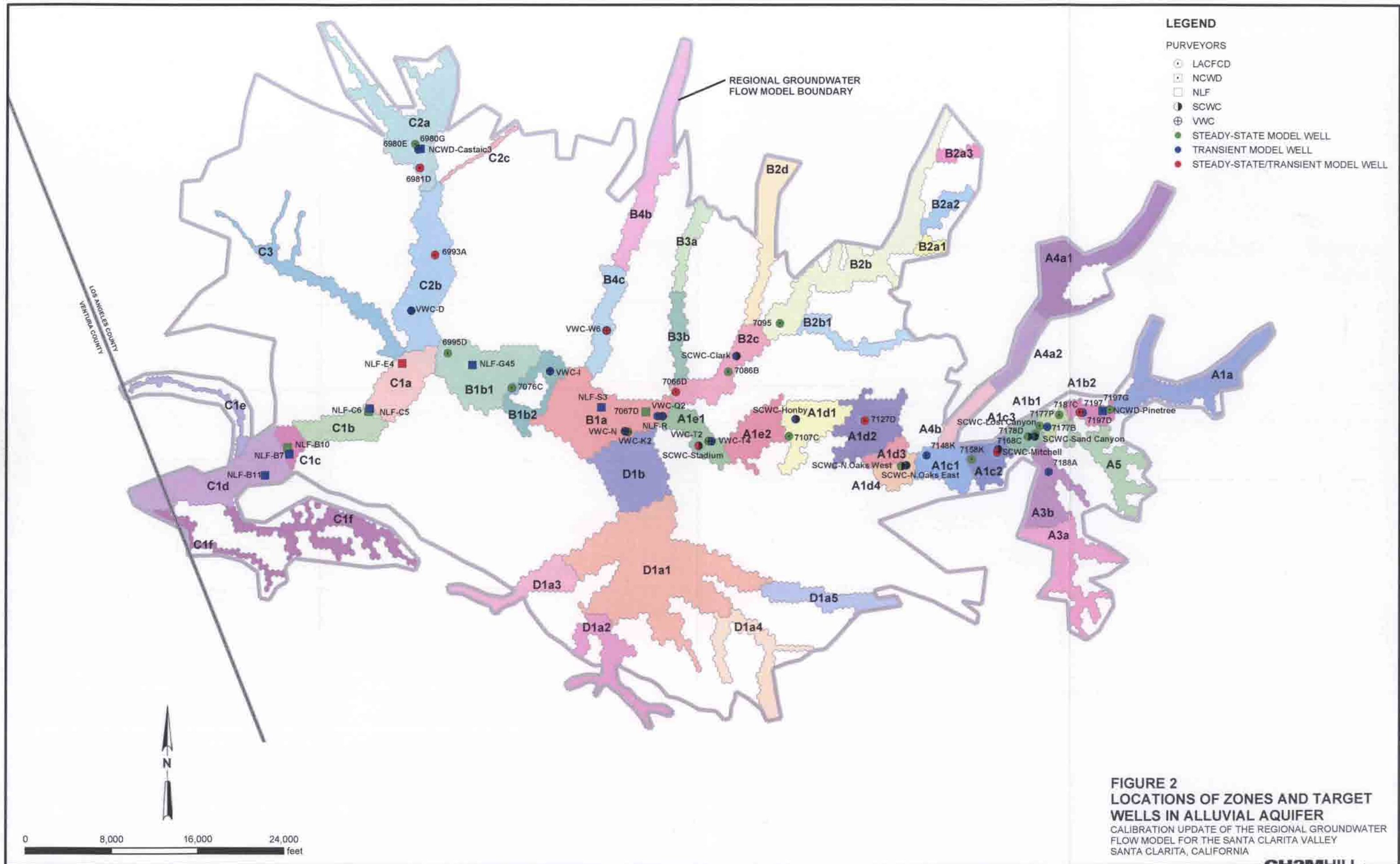


FIGURE 1
BASIN GEOLOGIC MAP
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA



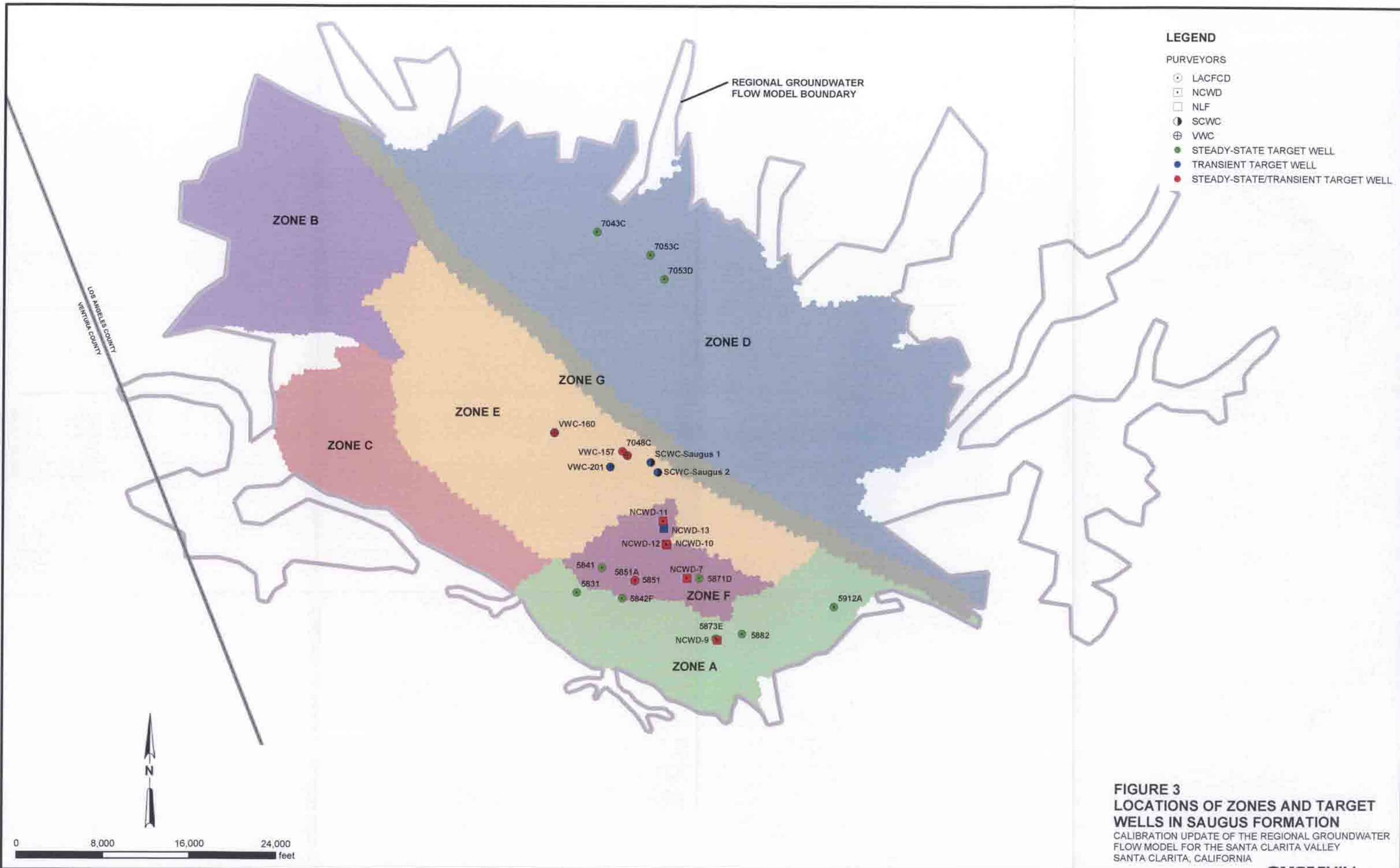
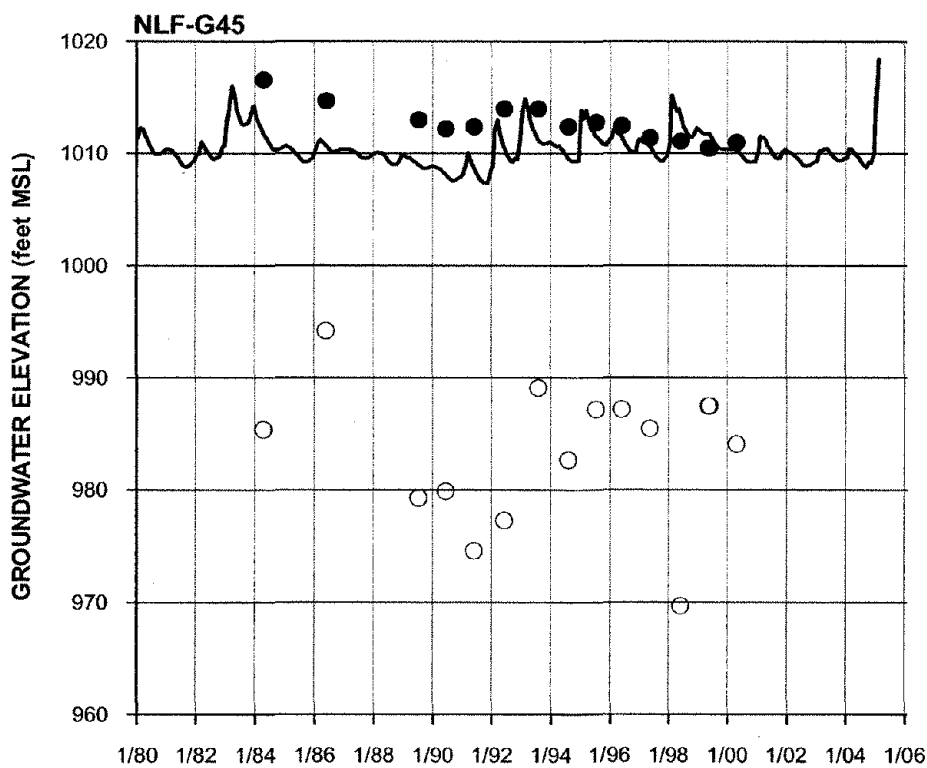
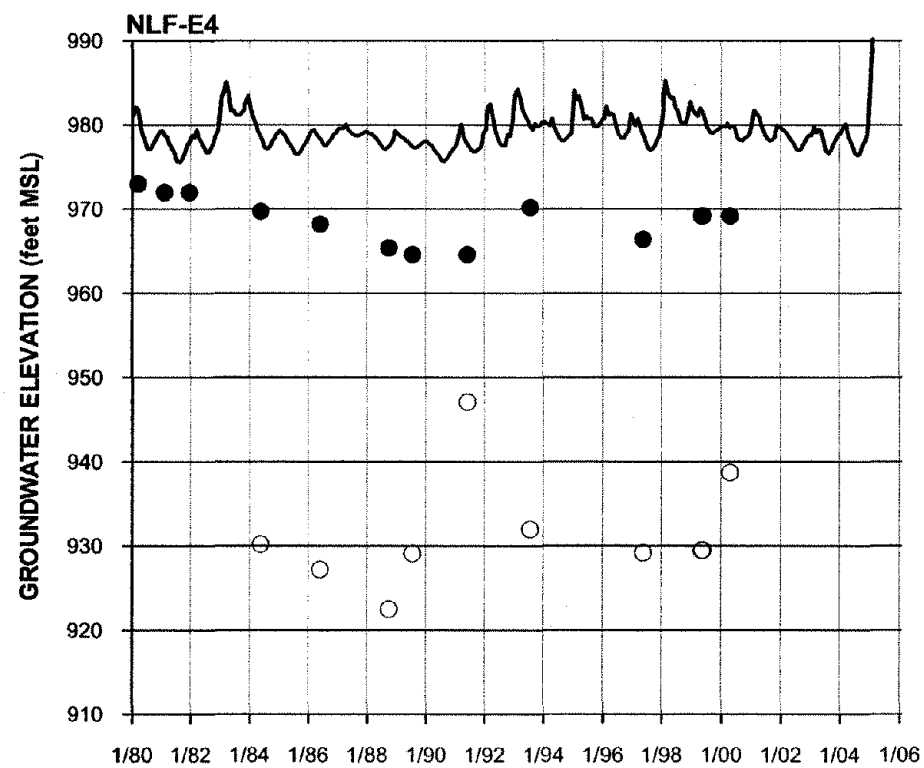
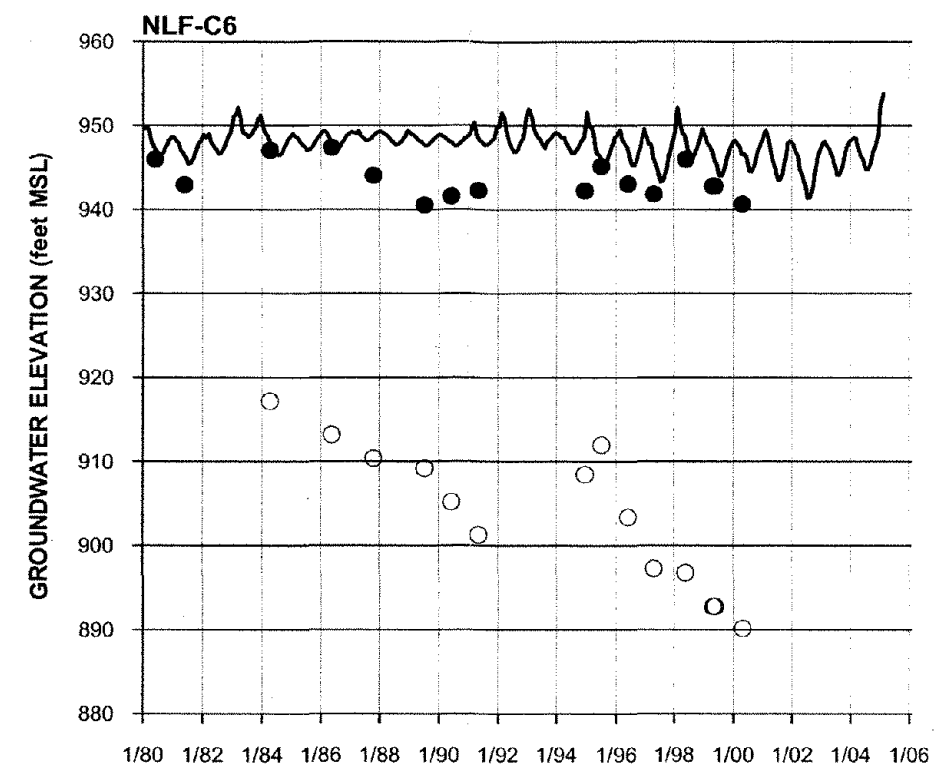
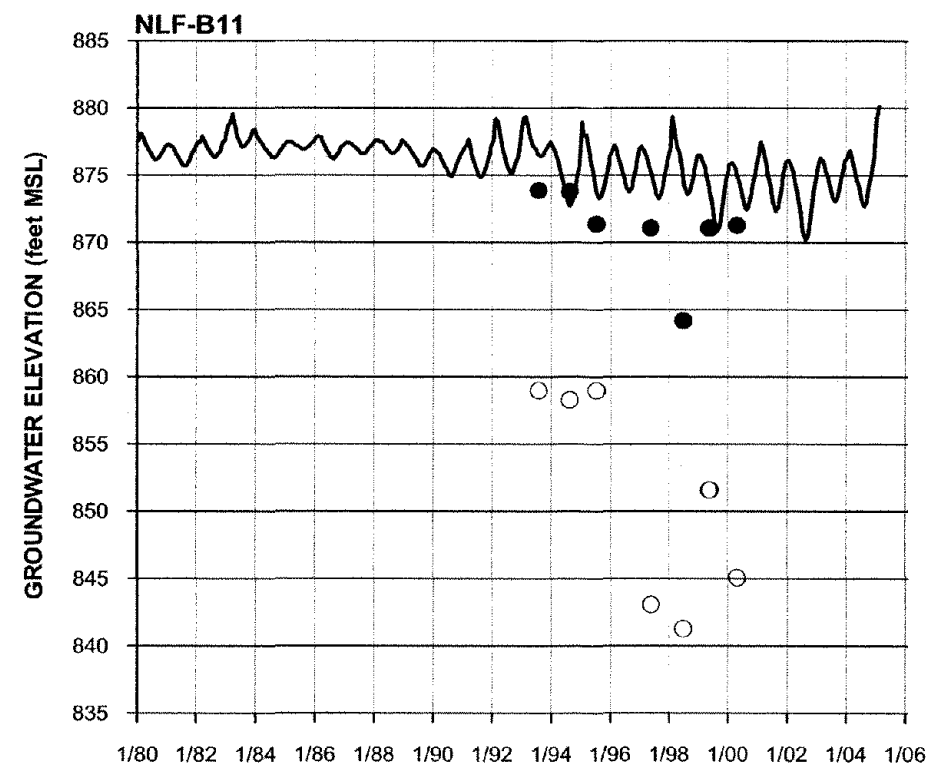
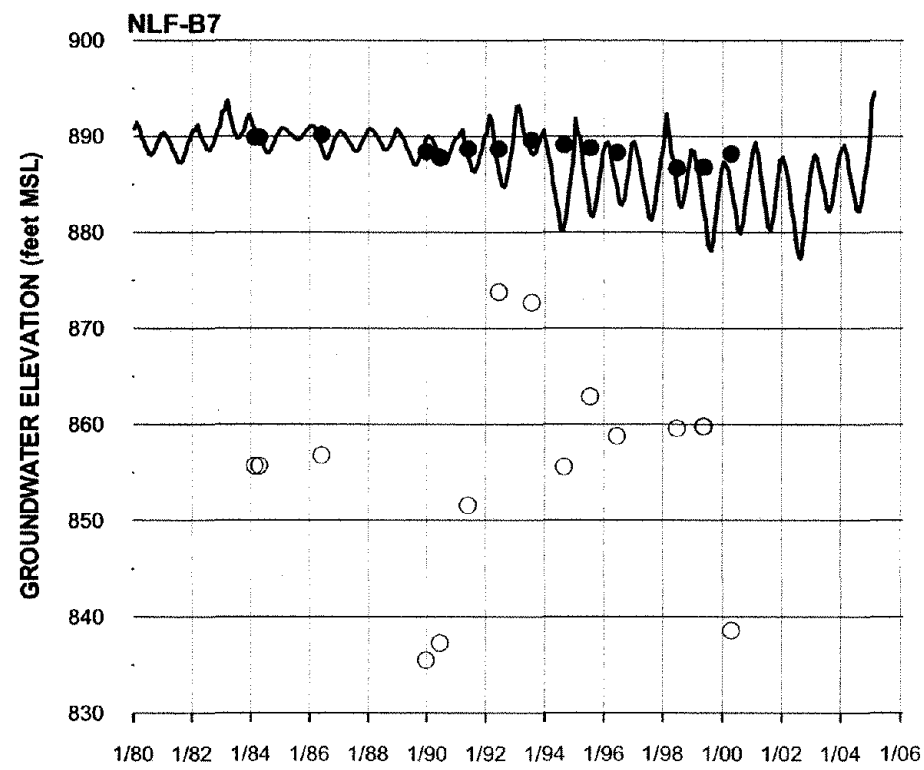


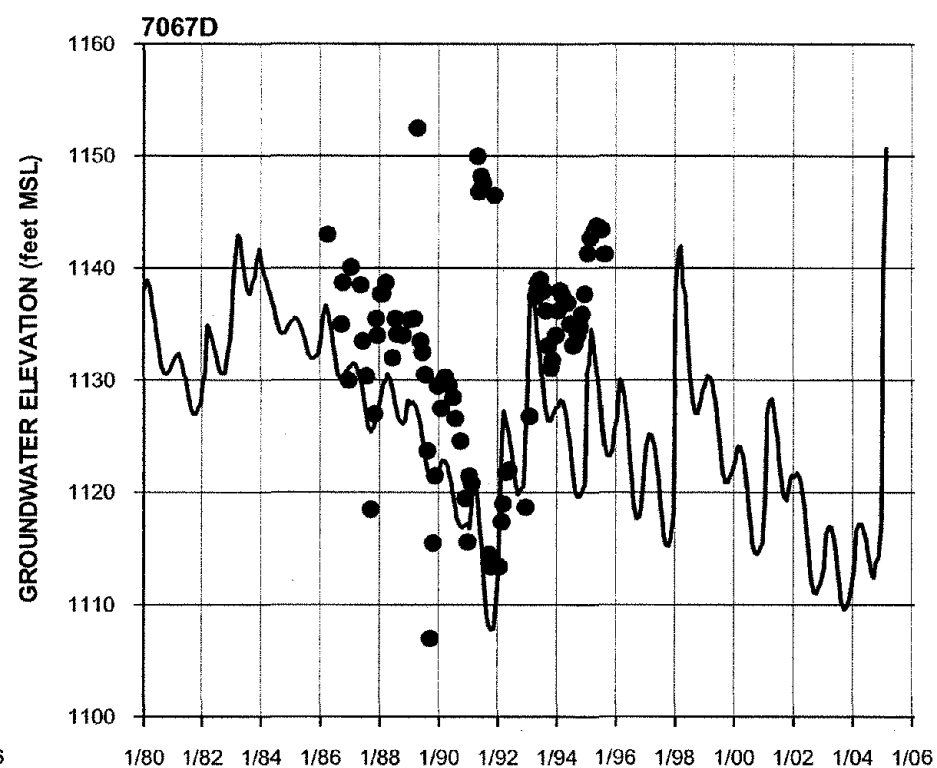
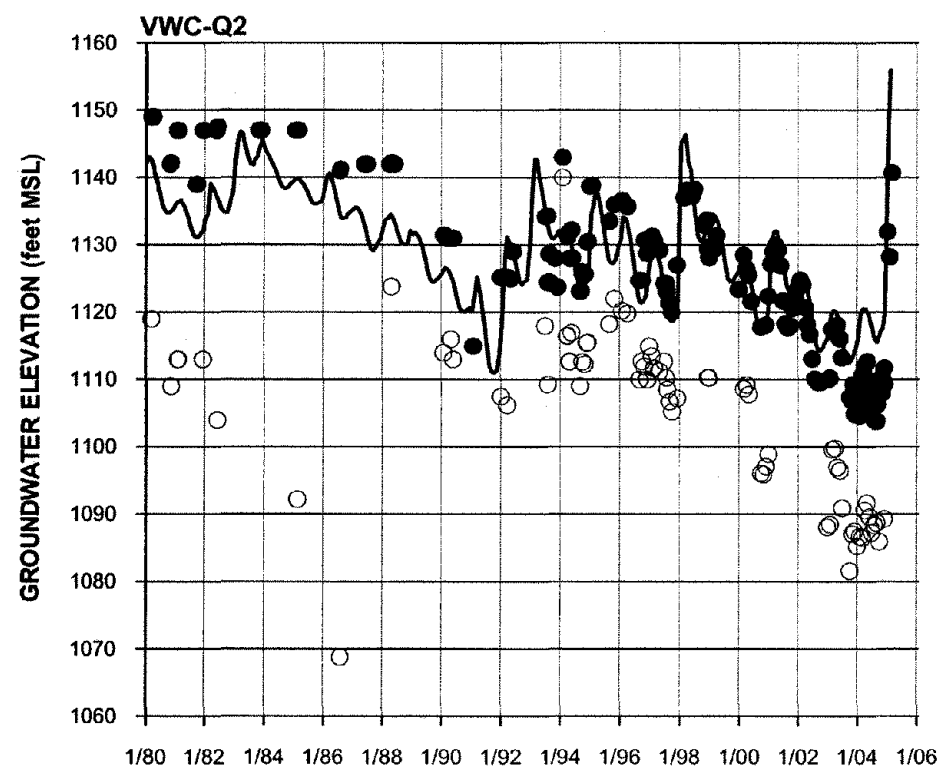
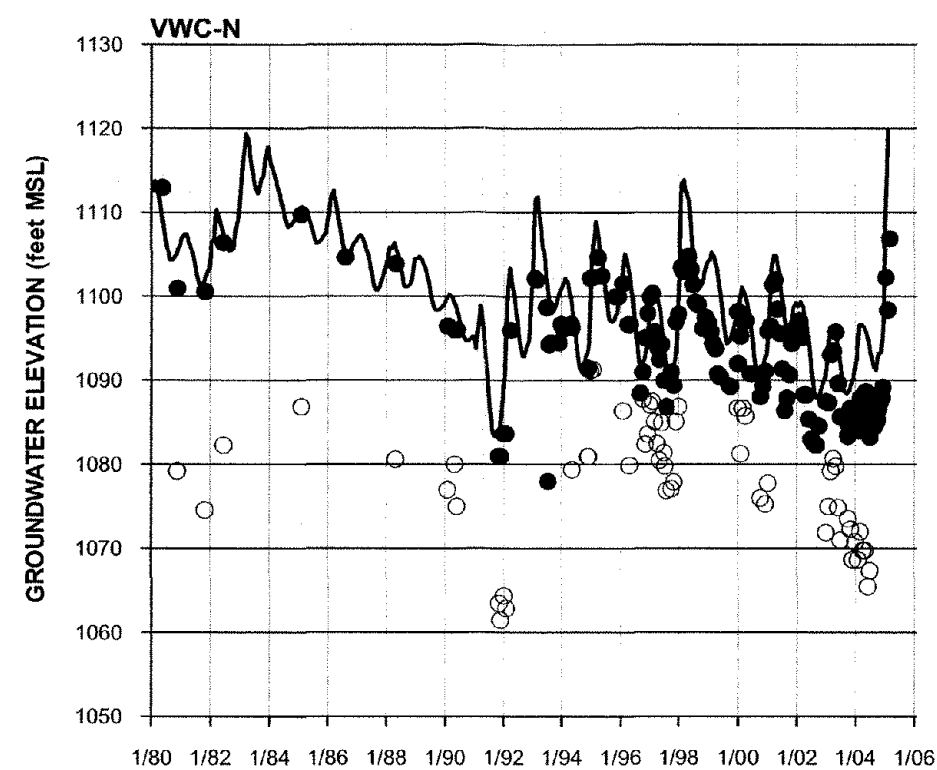
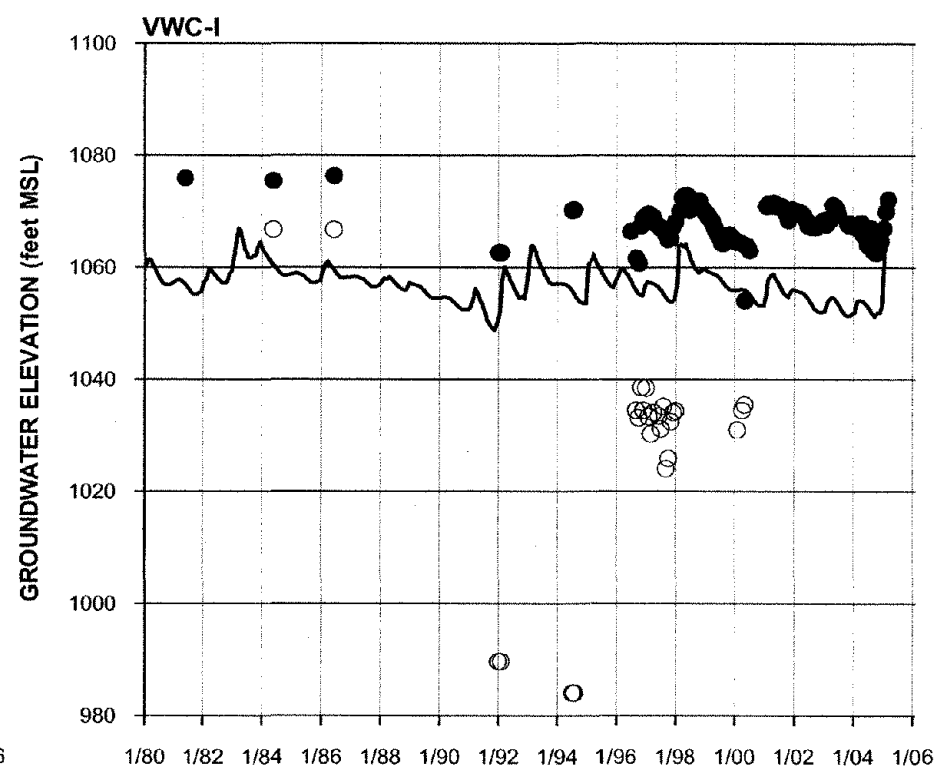
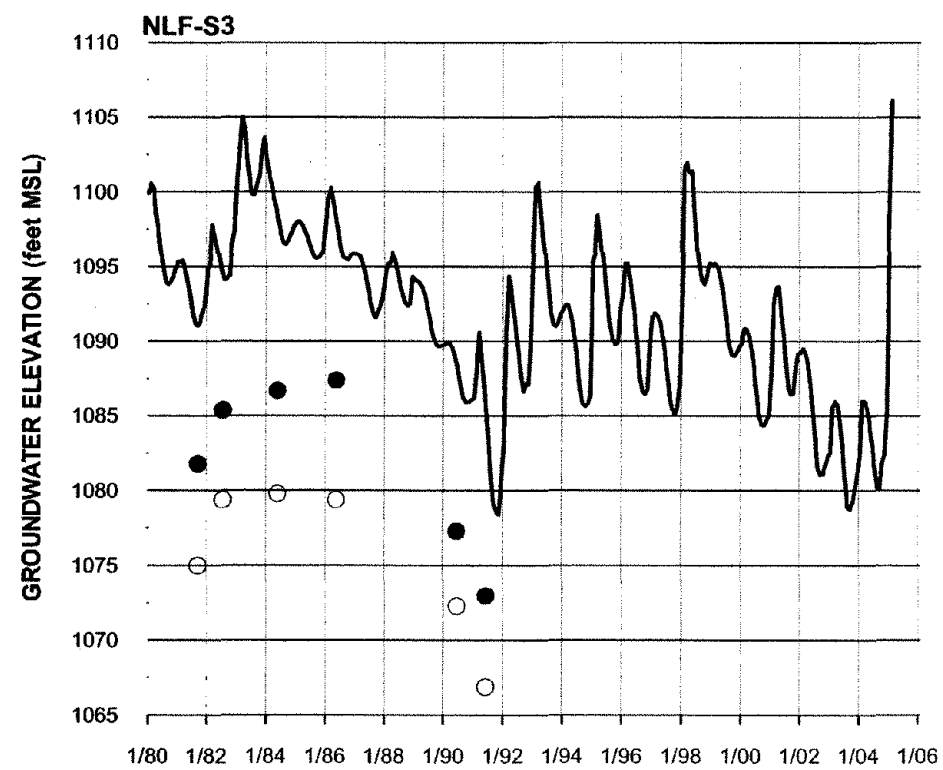
FIGURE 3
LOCATIONS OF ZONES AND TARGET
WELLS IN SAUGUS FORMATION
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA



LEGEND

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- MEASURED STATIC (NONPUMPING) ELEVATION
- MEASURED PUMPING ELEVATION

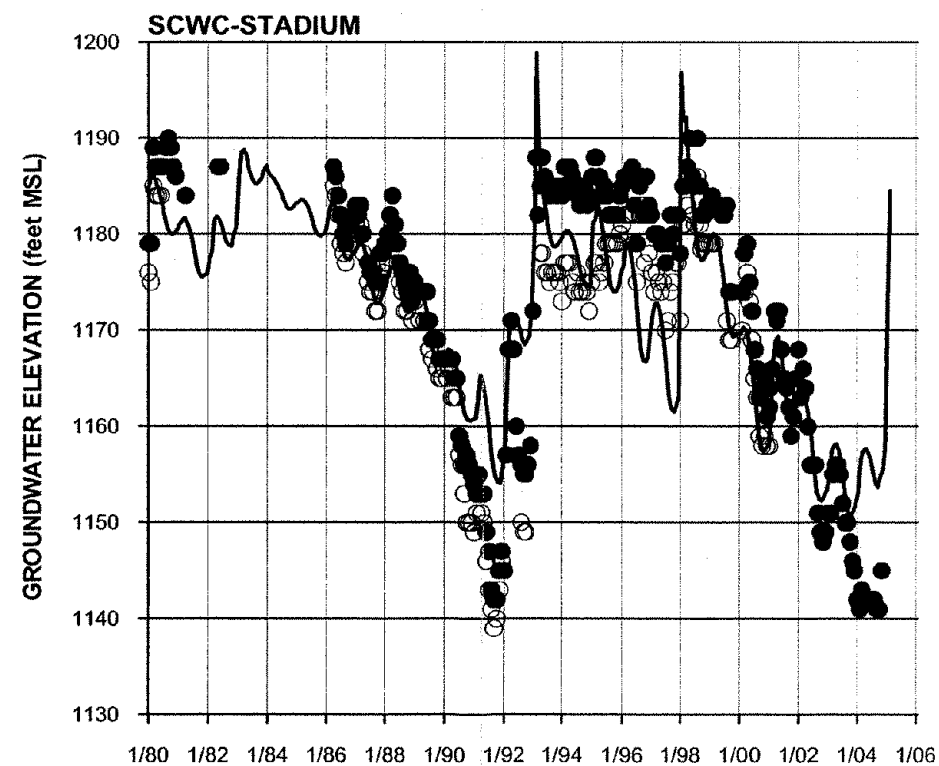
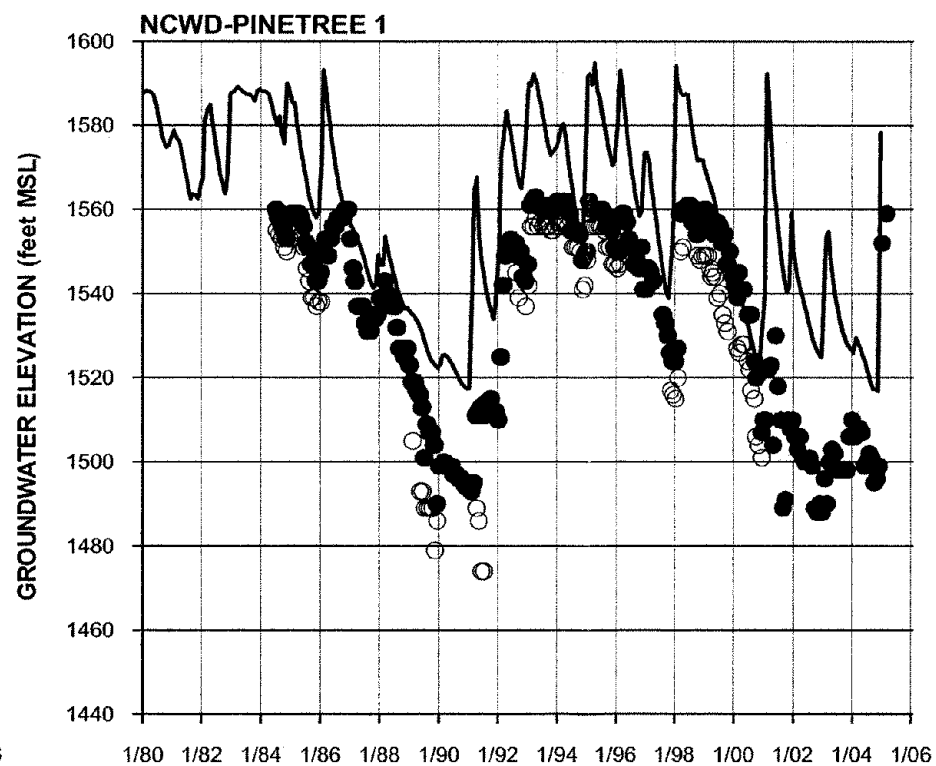
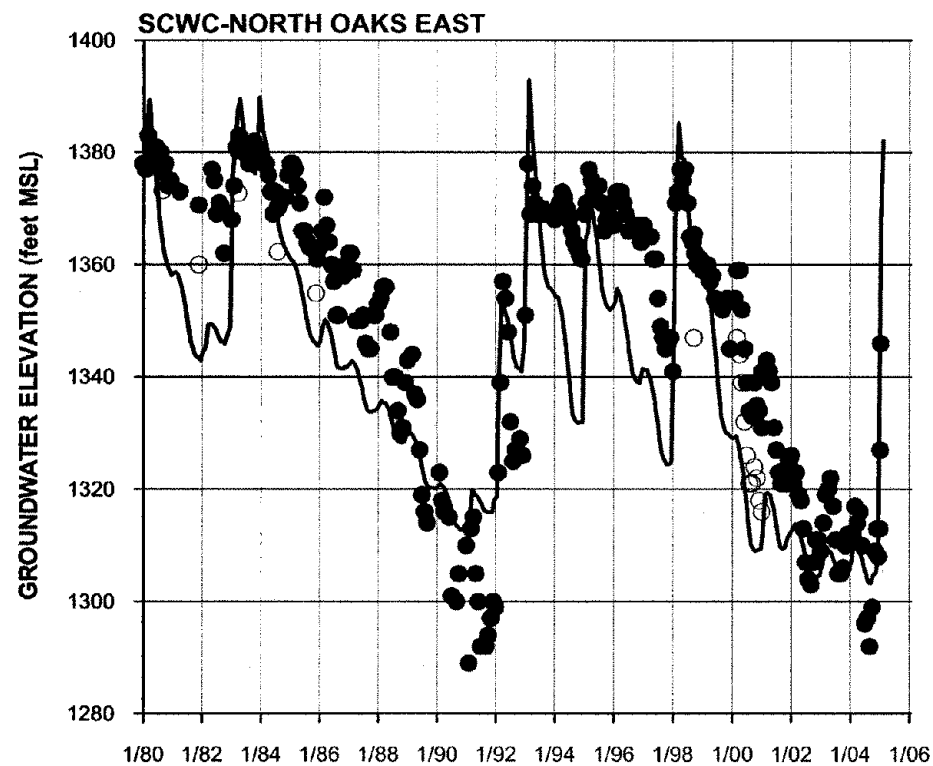
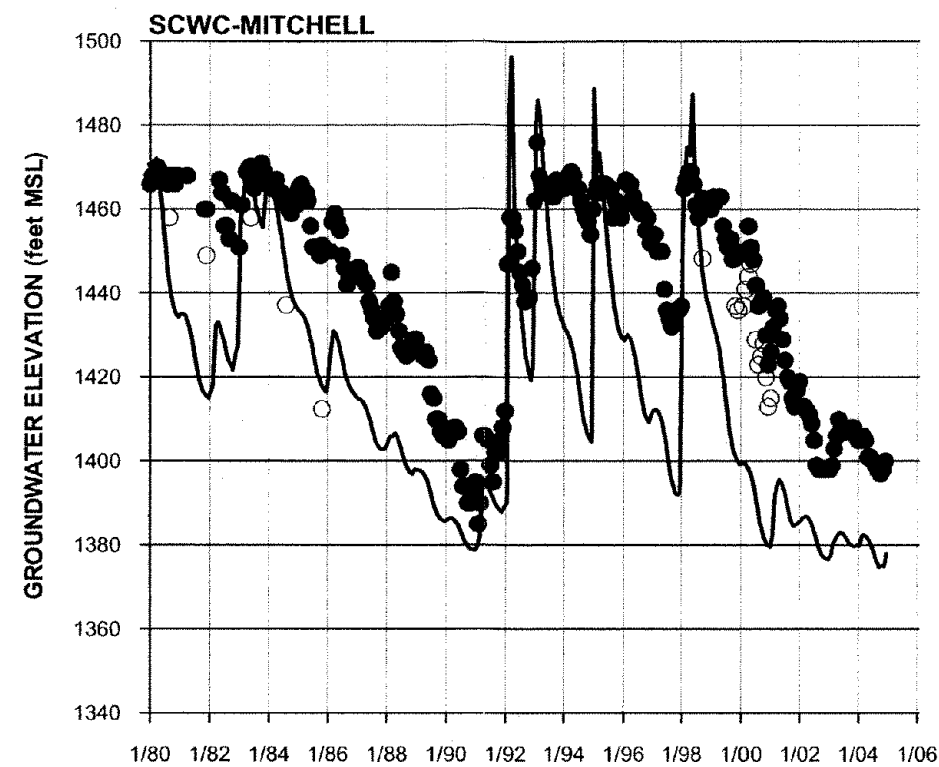
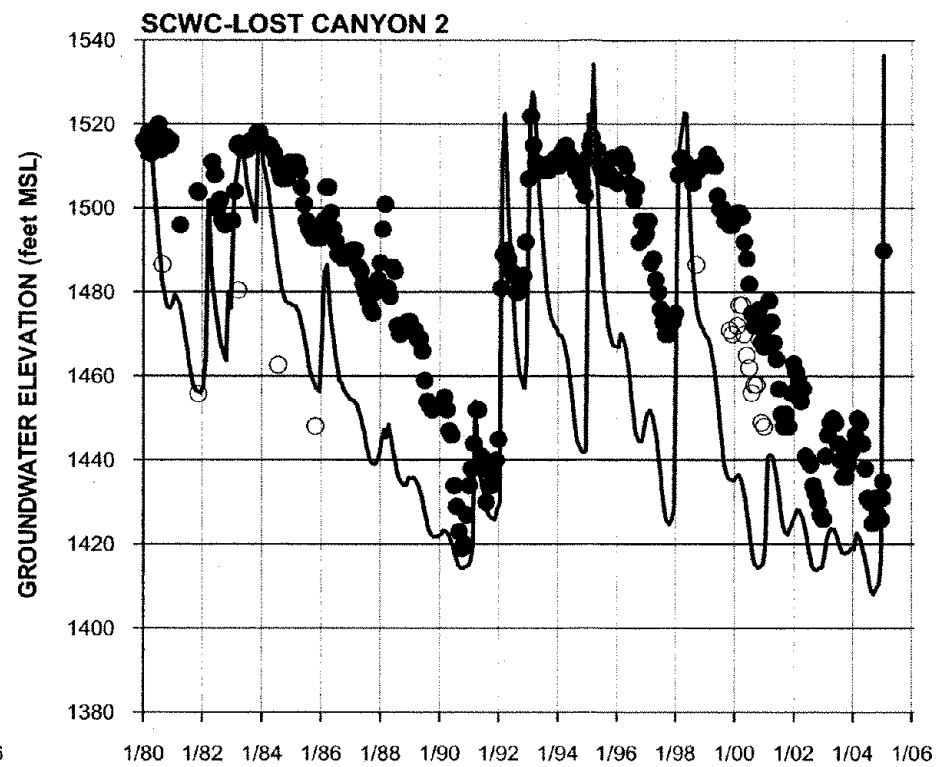
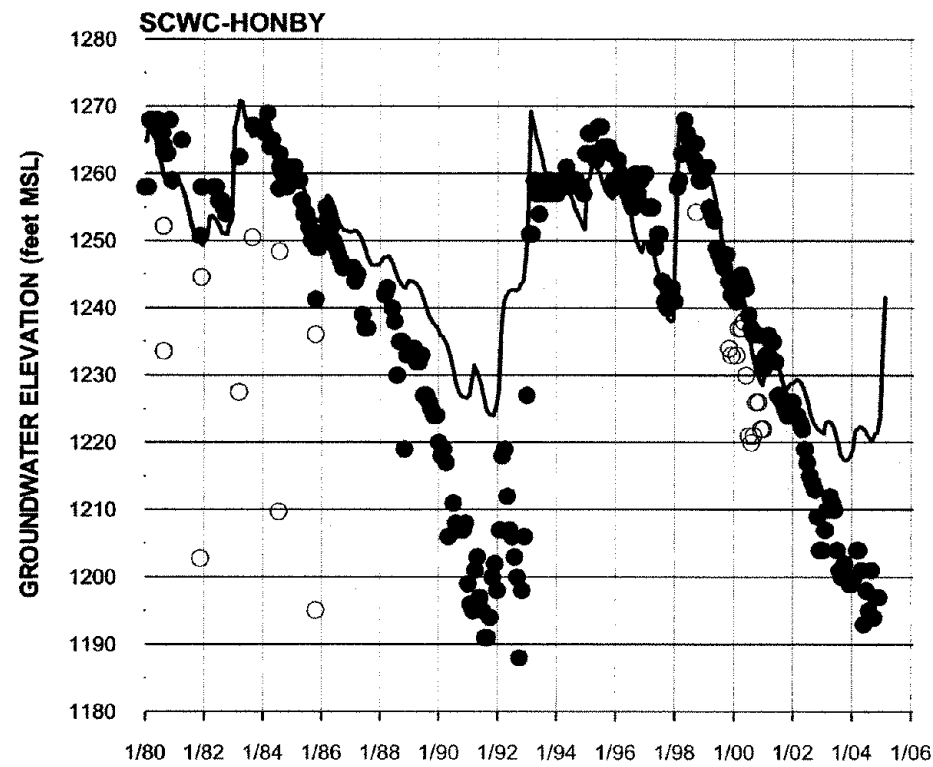
FIGURE 4
SIMULATED AND MEASURED GROUNDWATER ELEVATIONS IN ALLUVIAL AQUIFER WELLS WEST OF INTERSTATE 5
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA



LEGEND

- SIMULATED ELEVATION
- MEASURED STATIC (NONPUMPING) ELEVATION
- MEASURED PUMPING ELEVATION

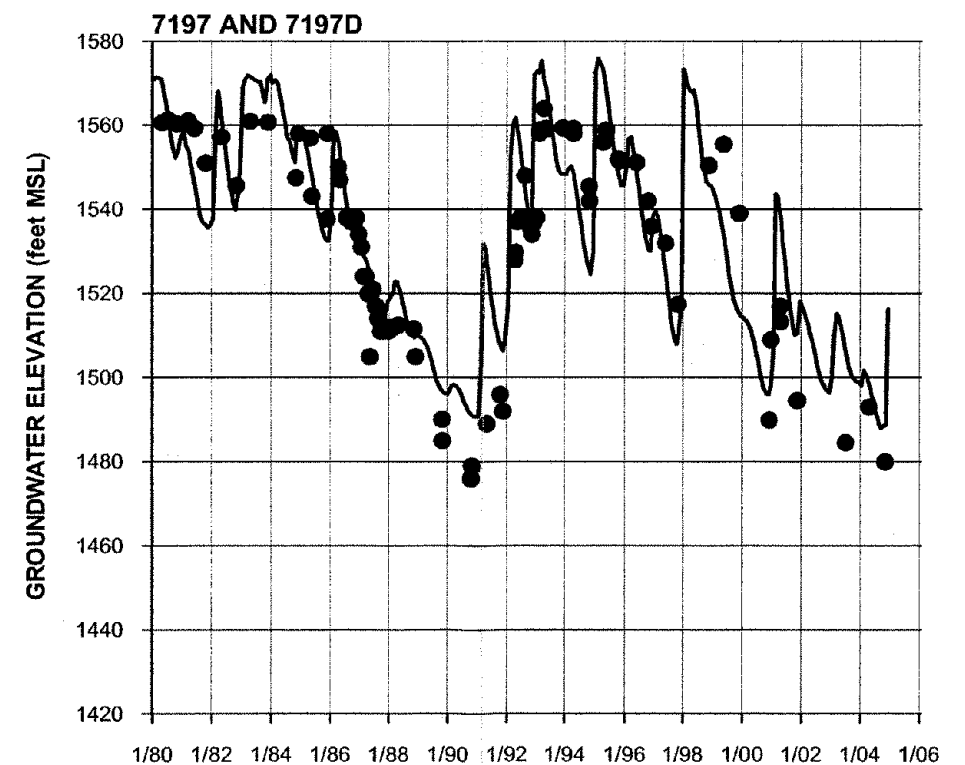
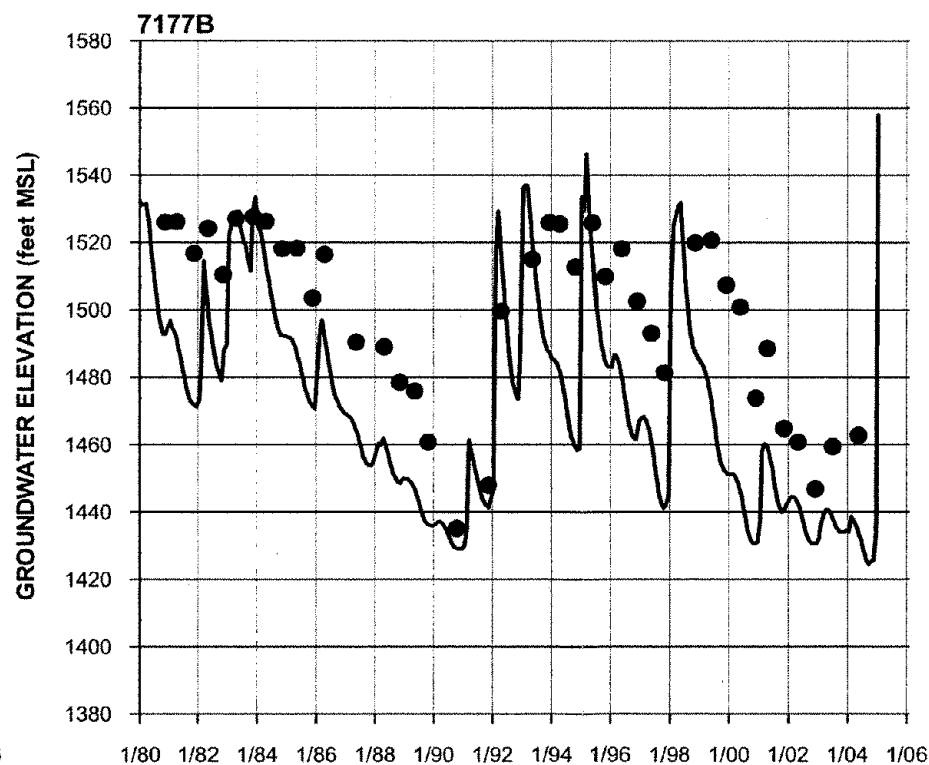
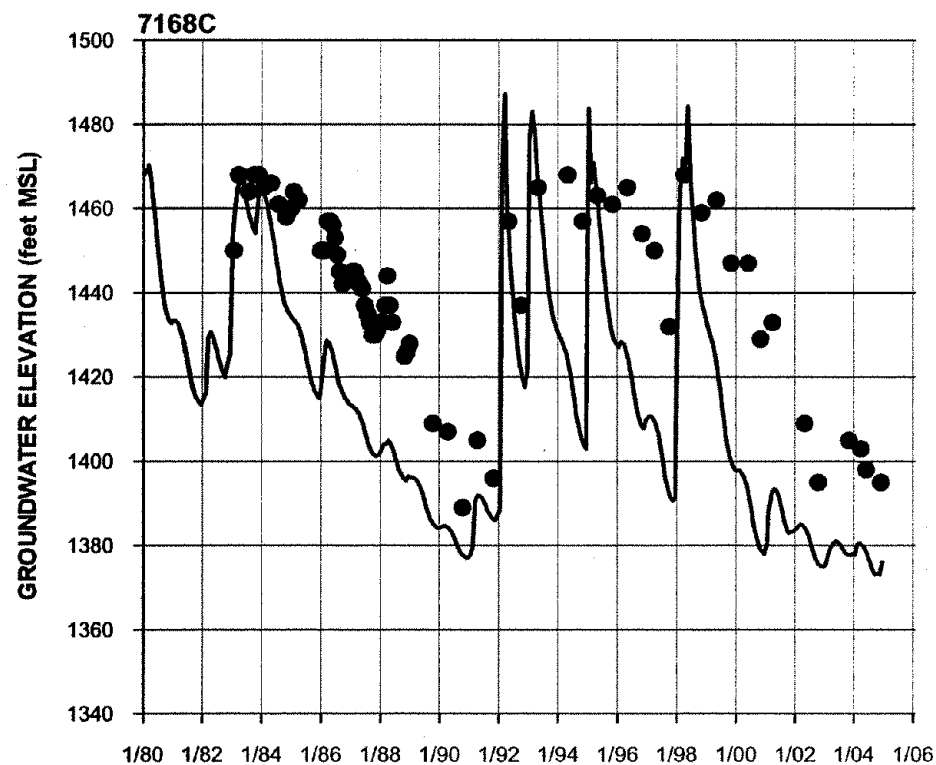
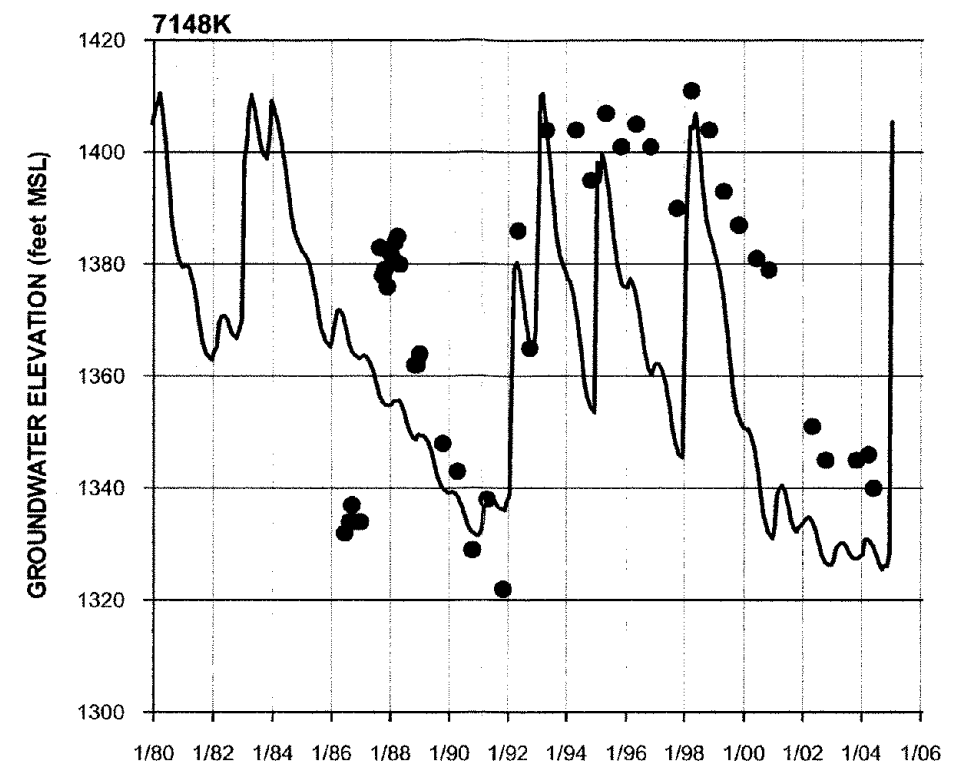
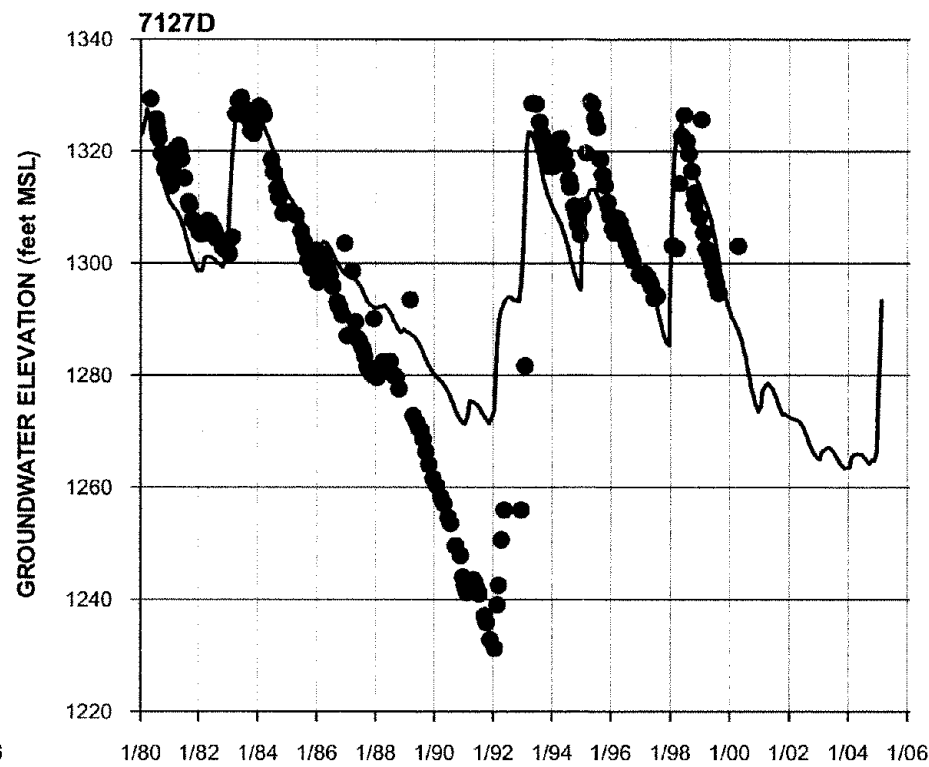
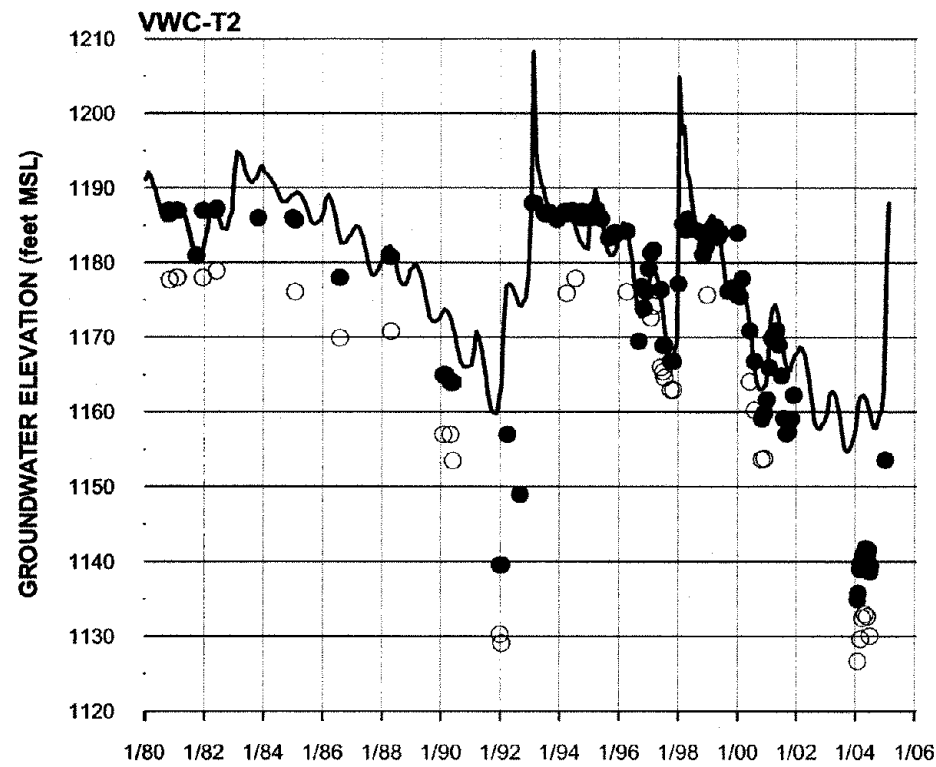
FIGURE 5
SIMULATED AND MEASURED GROUNDWATER ELEVATIONS IN ALLUVIAL AQUIFER WELLS BETWEEN INTERSTATE 5 AND SOLEDAD CANYON
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA



LEGEND

- SIMULATED ELEVATION
- MEASURED STATIC (NONPUMPING) ELEVATION
- MEASURED PUMPING ELEVATION

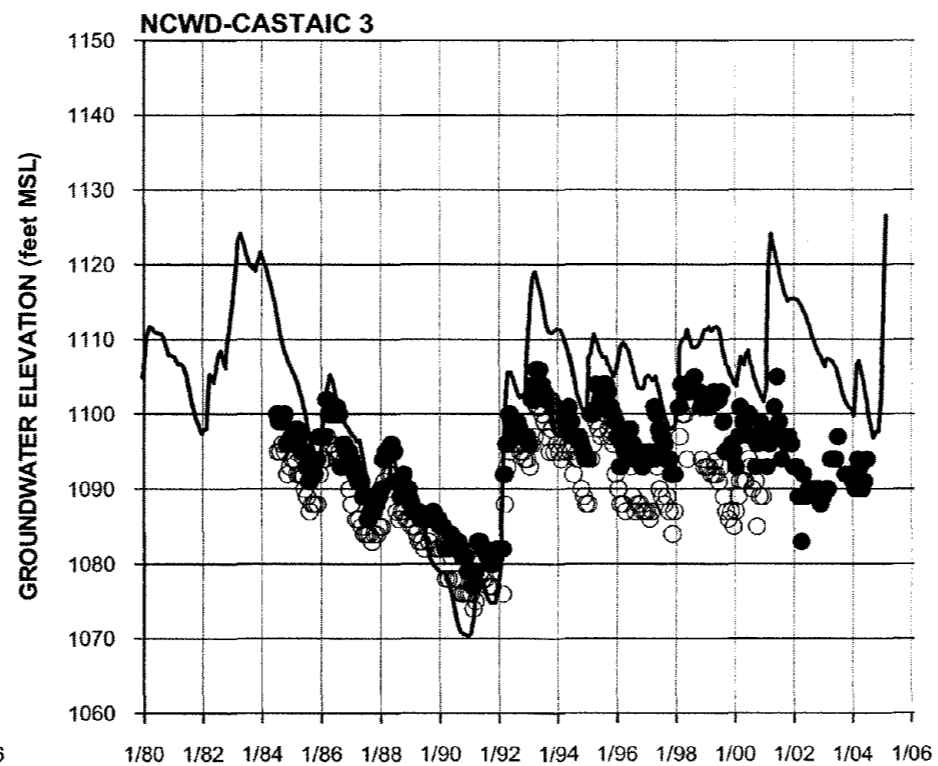
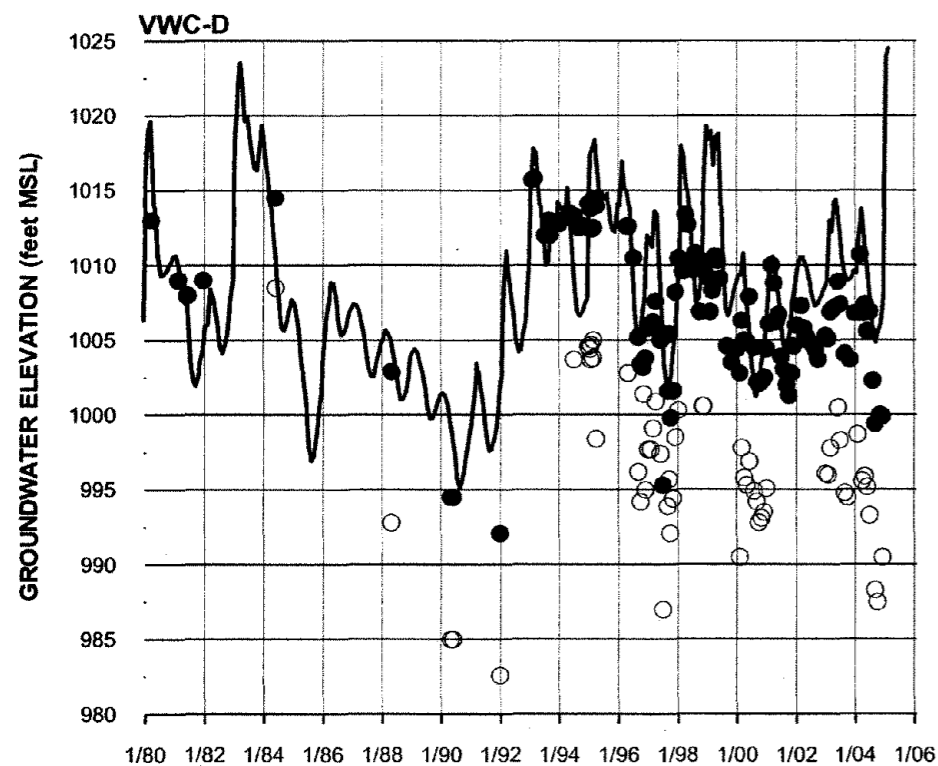
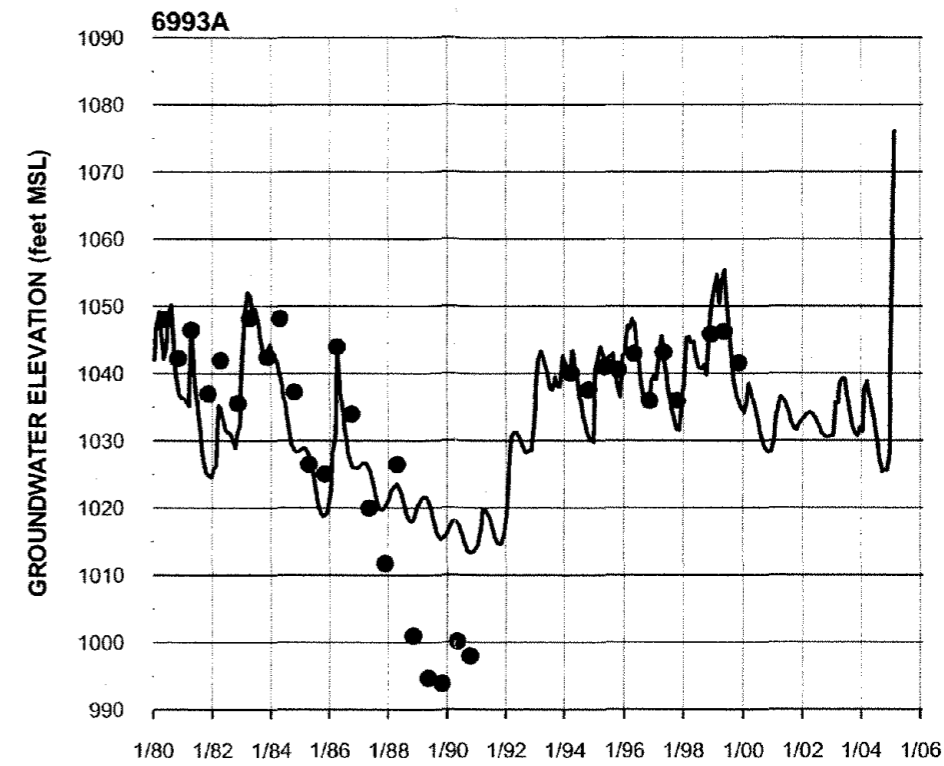
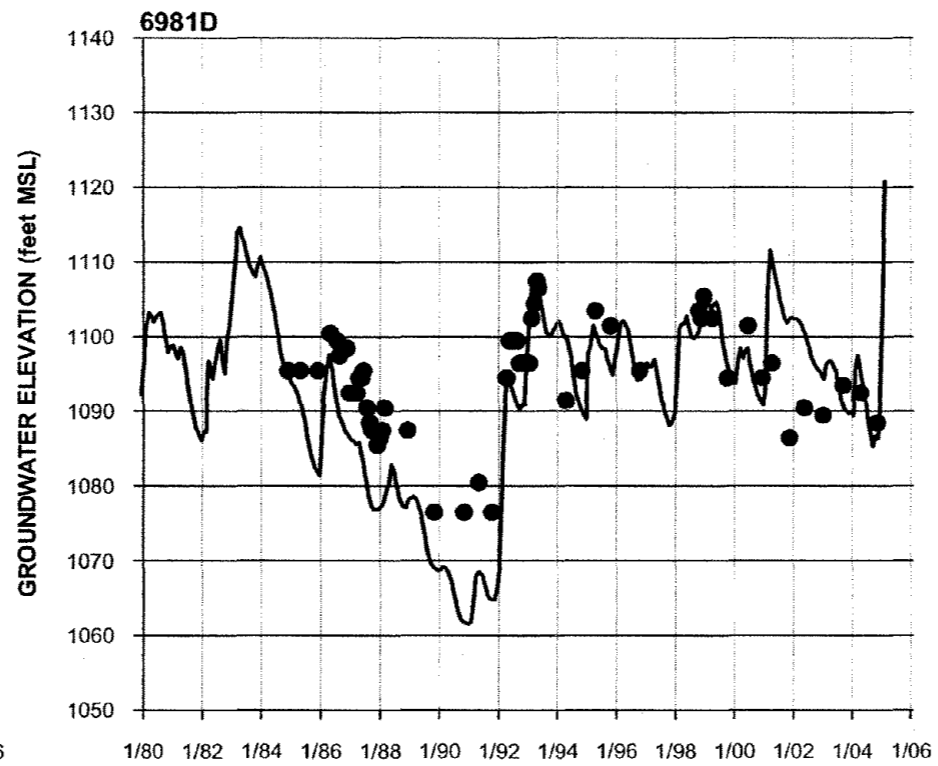
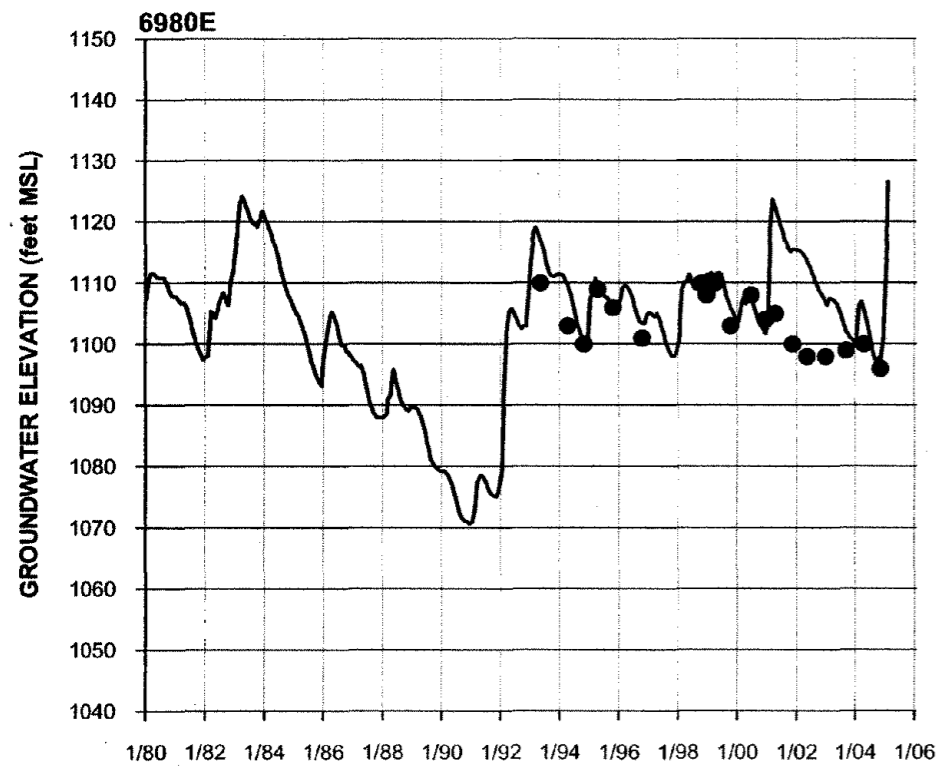
FIGURE 6
SIMULATED AND MEASURED GROUNDWATER ELEVATIONS IN ALLUVIAL AQUIFER WELLS IN SOLEDAD CANYON (PAGE 1 OF 2)
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA



LEGEND

- SIMULATED ELEVATION
- MEASURED STATIC (NONPUMPING) ELEVATION
- MEASURED PUMPING ELEVATION

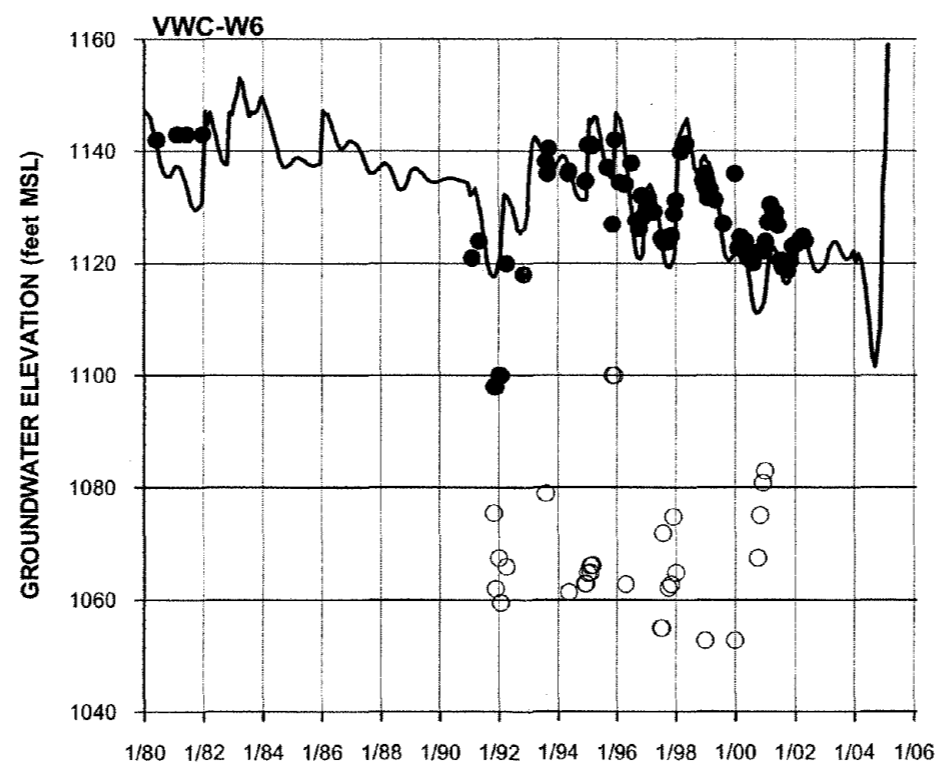
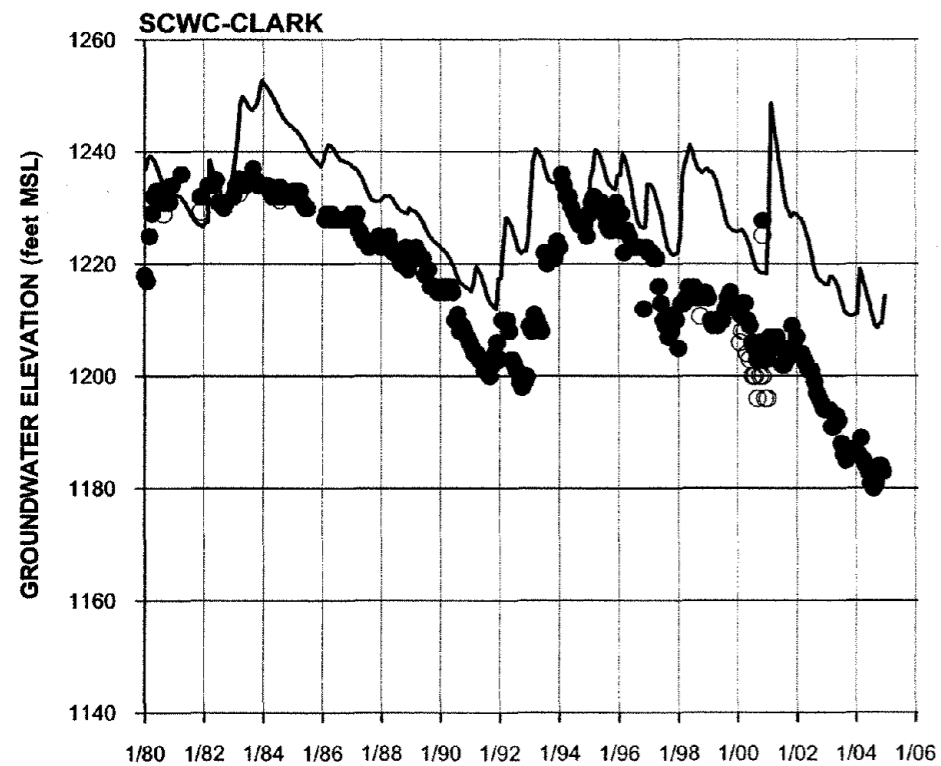
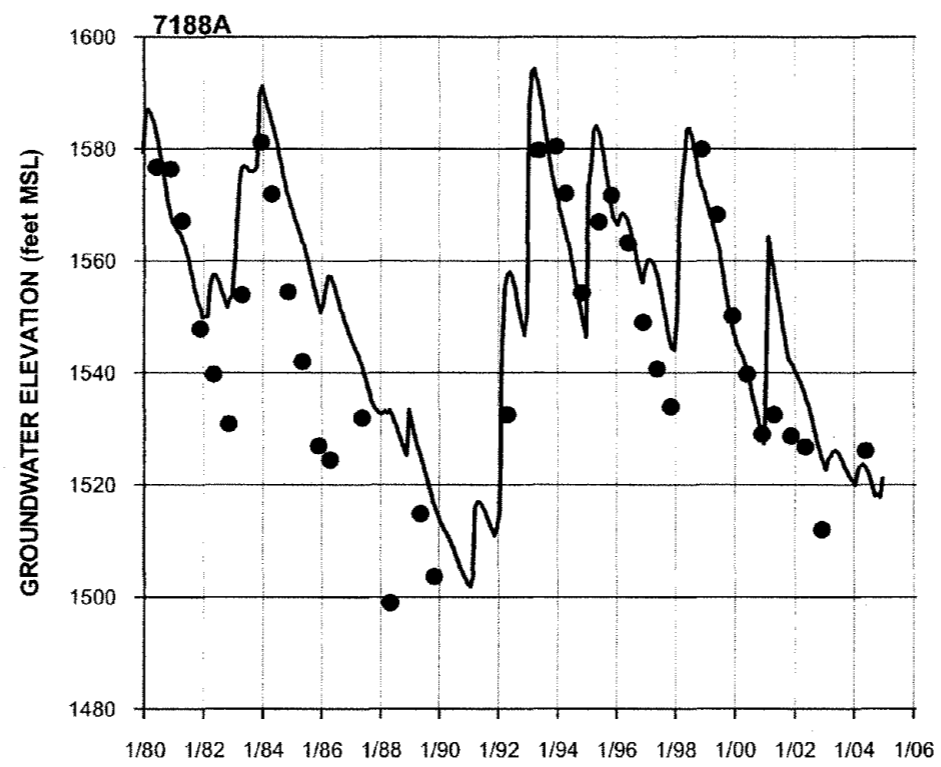
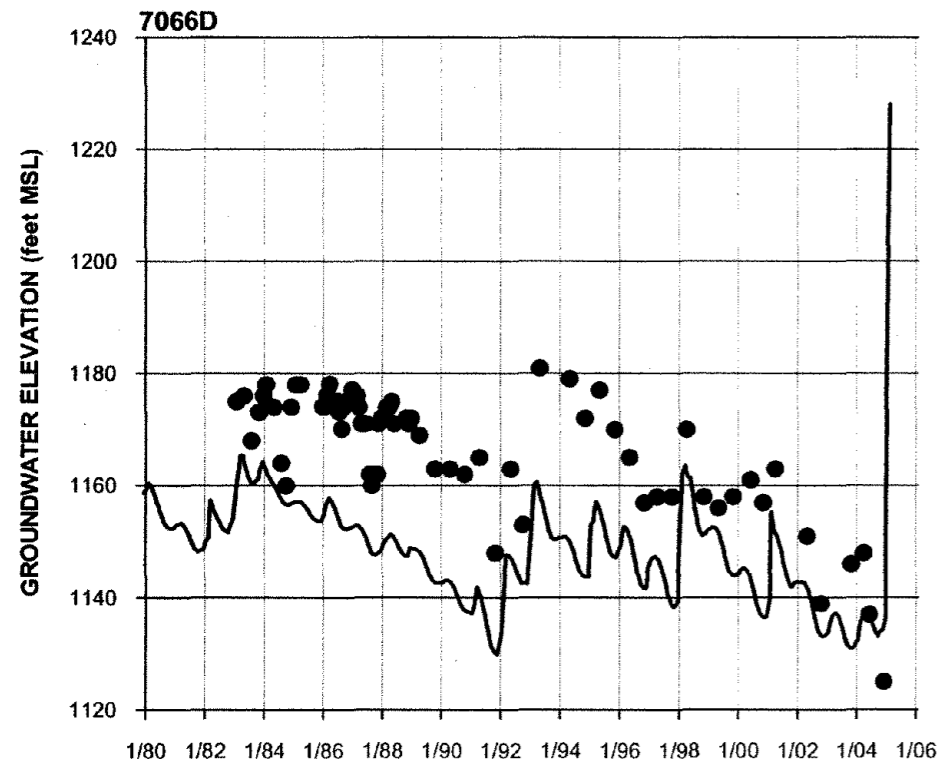
FIGURE 6
SIMULATED AND MEASURED GROUNDWATER
ELEVATIONS IN ALLUVIAL AQUIFER
WELLS IN SOLEDAD CANYON (PAGE 2 OF 2)
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA



LEGEND

- SIMULATED ELEVATION
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- MEASURED PUMPING ELEVATION

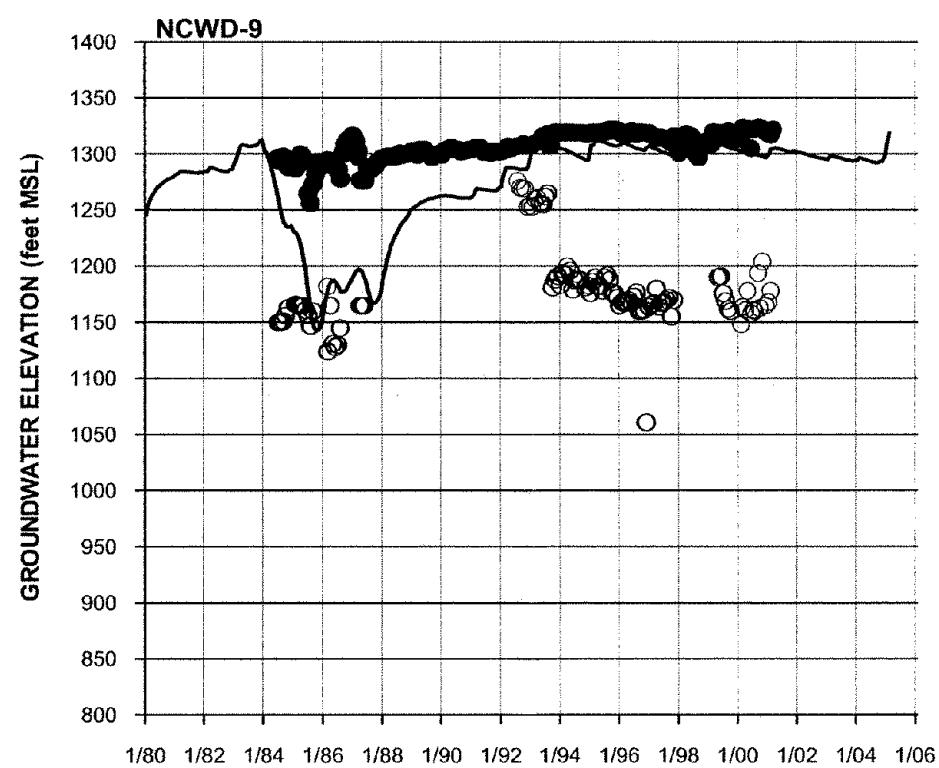
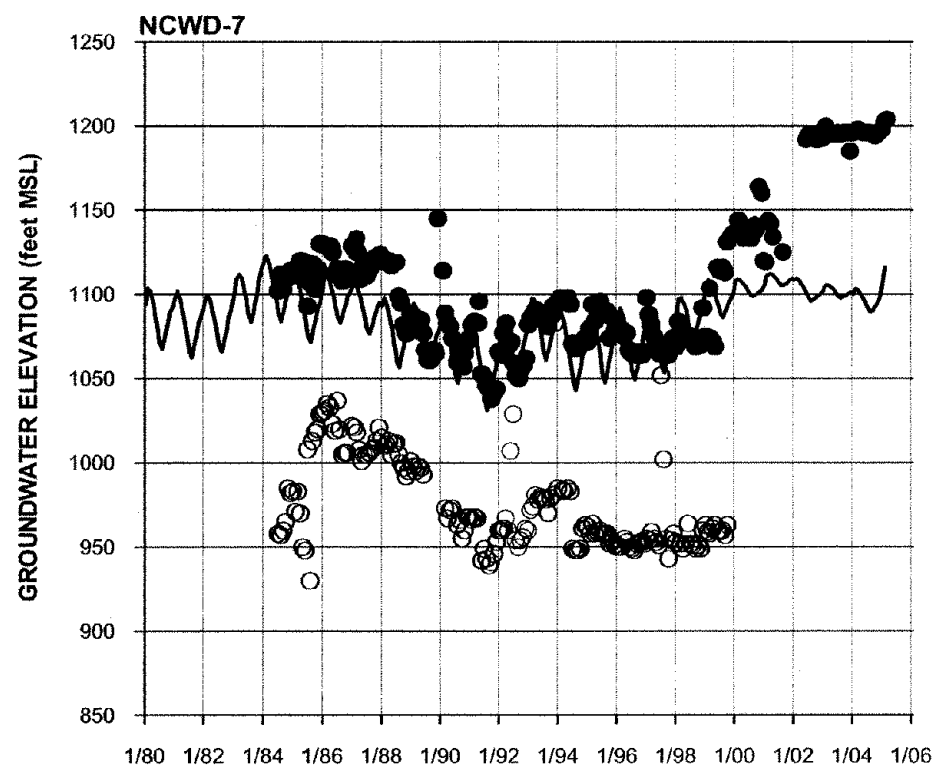
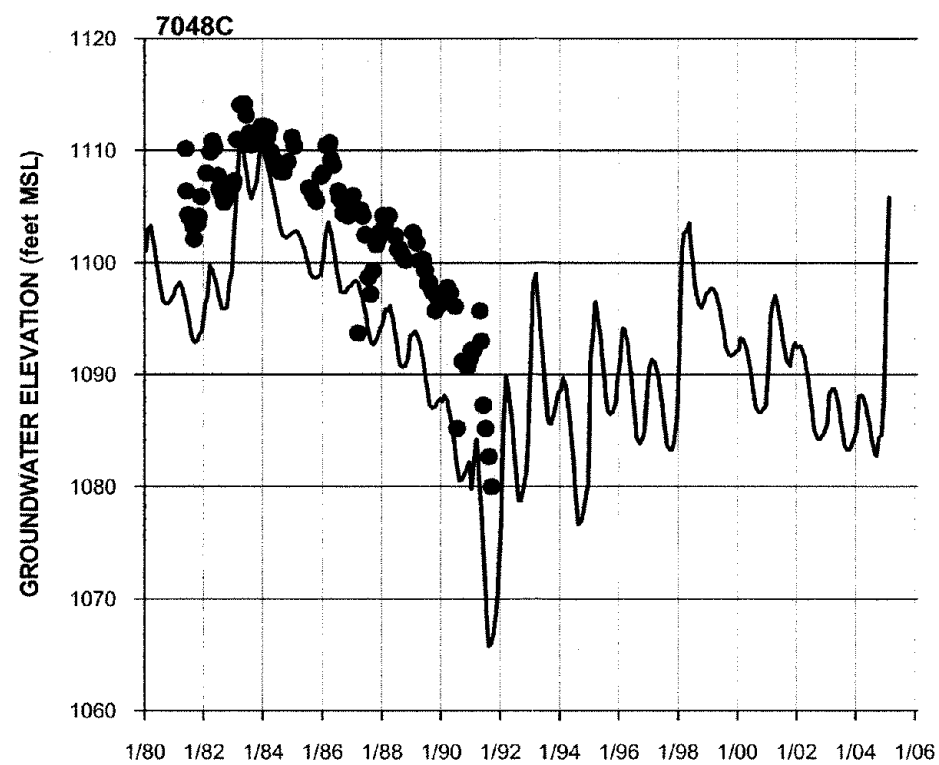
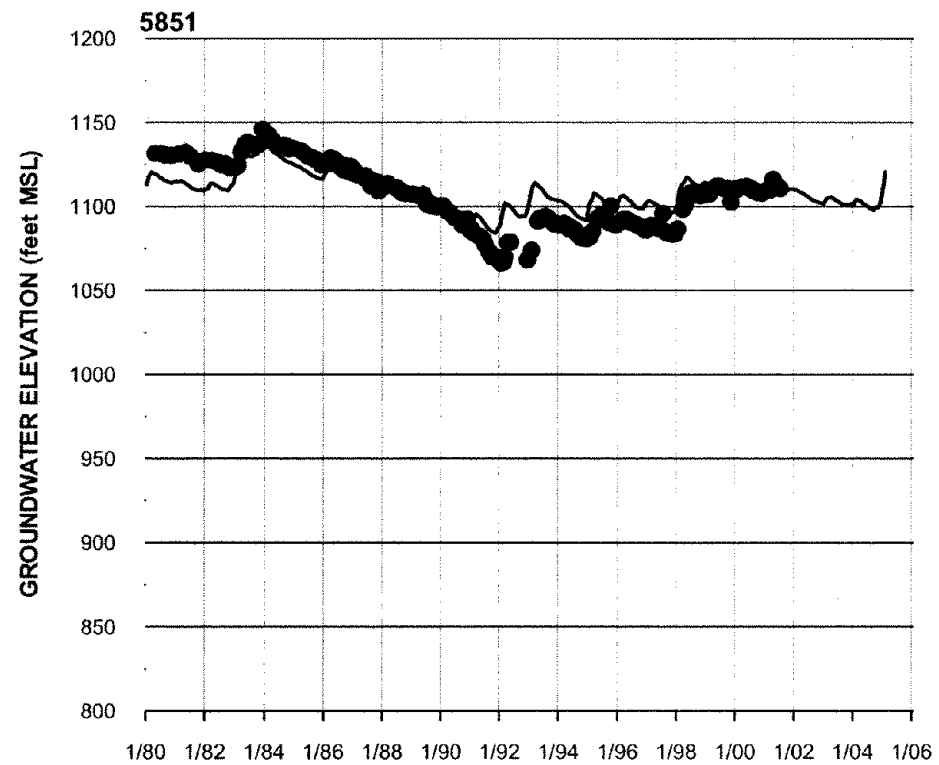
FIGURE 7
SIMULATED AND MEASURED
GROUNDWATER ELEVATIONS IN ALLUVIAL
AQUIFER WELLS ALONG CASTAIC CREEK
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA



LEGEND

- SIMULATED ELEVATION
- MEASURED STATIC (NONPUMPING) ELEVATION
- MEASURED PUMPING ELEVATION

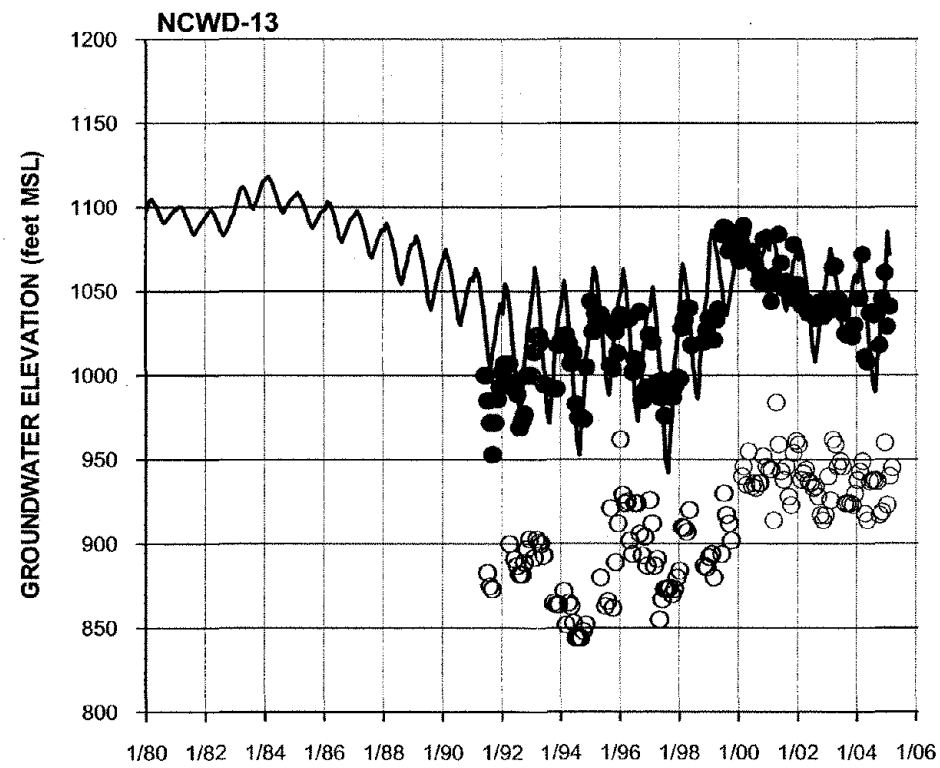
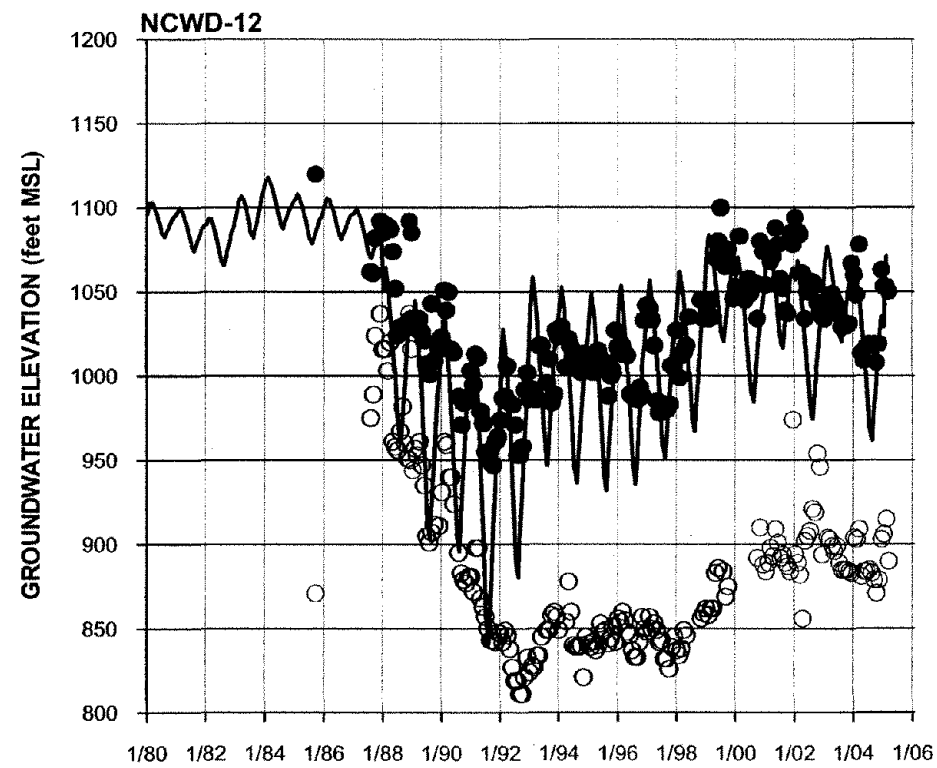
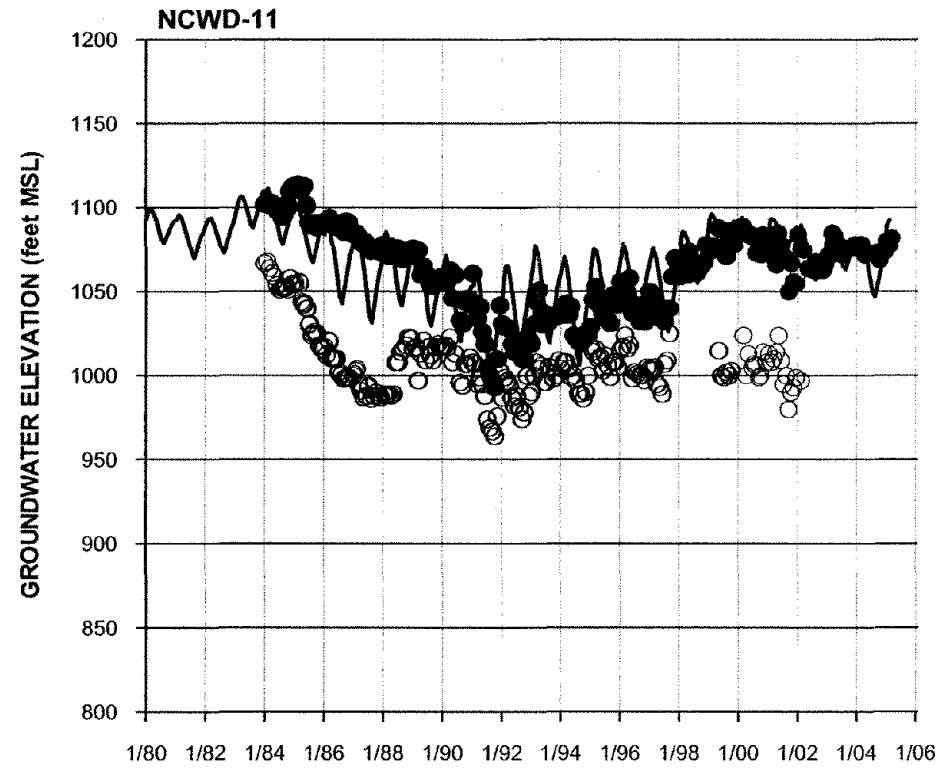
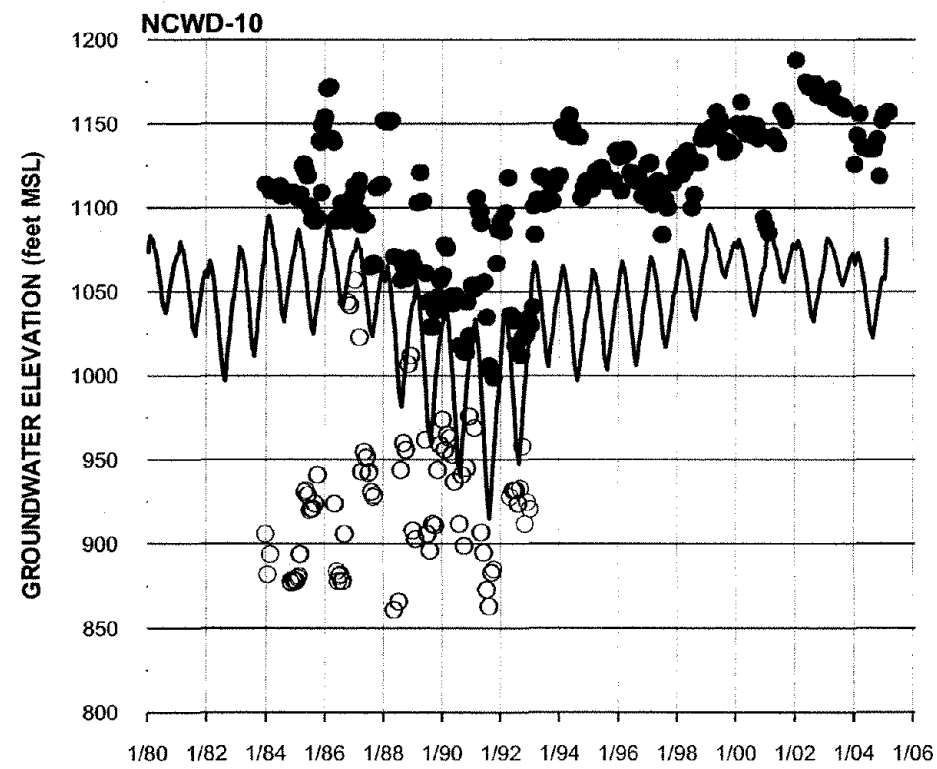
FIGURE 8
SIMULATED AND MEASURED GROUNDWATER ELEVATIONS IN ALLUVIAL AQUIFER WELLS IN OTHER TRIBUTARY CANYONS TO THE SANTA CLARA RIVER
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA



LEGEND

- SIMULATED ELEVATION
- MEASURED STATIC (NONPUMPING) ELEVATION
- MEASURED PUMPING ELEVATION

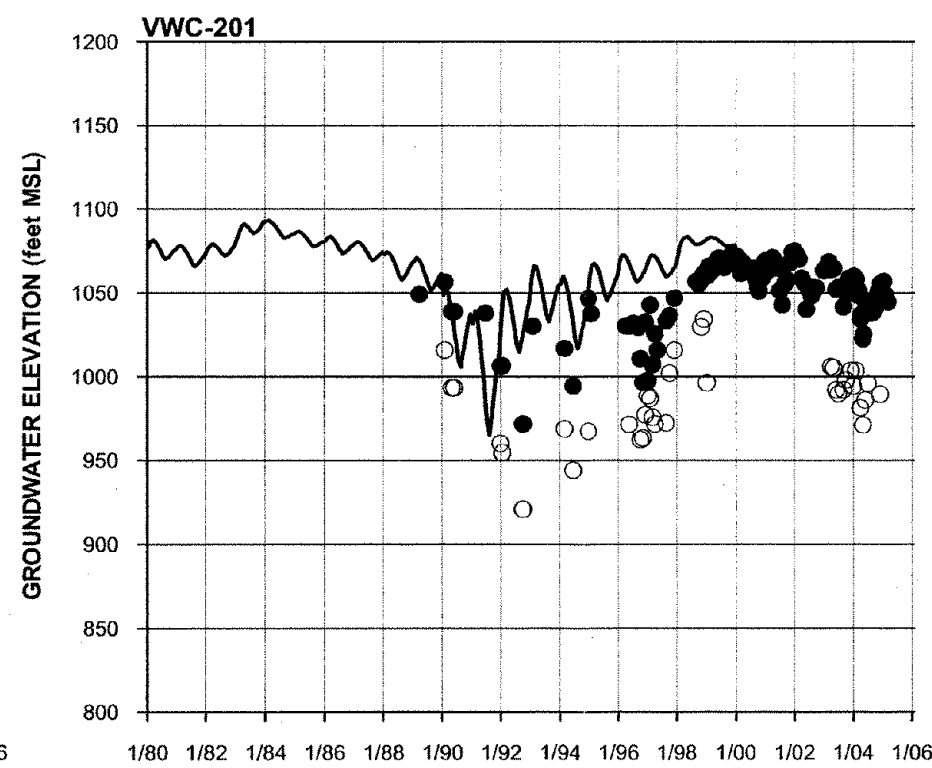
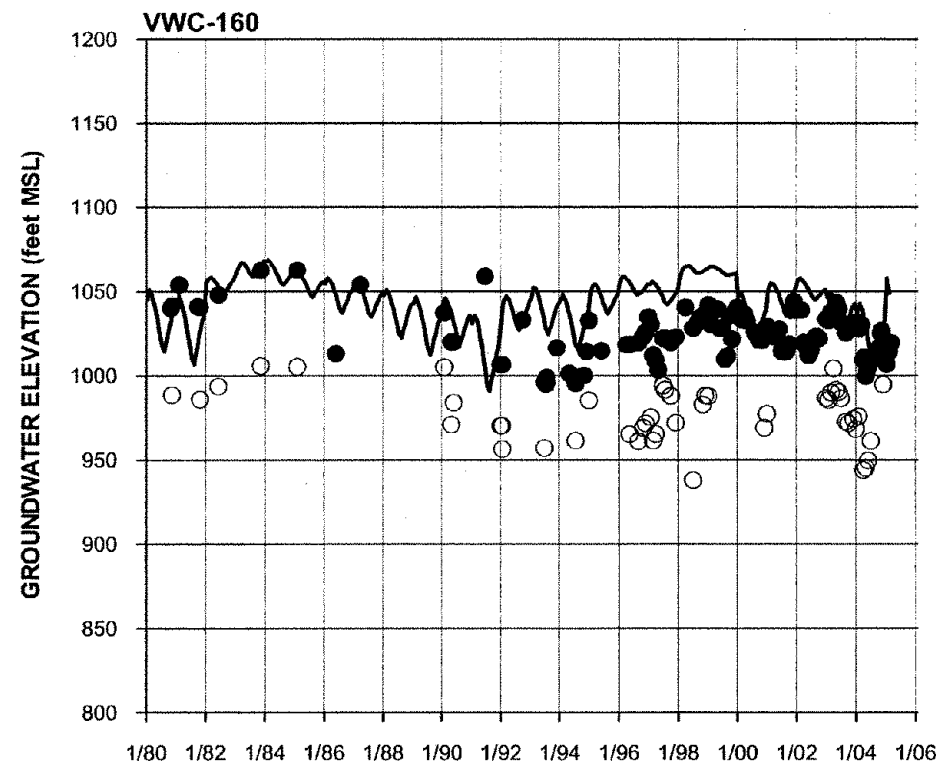
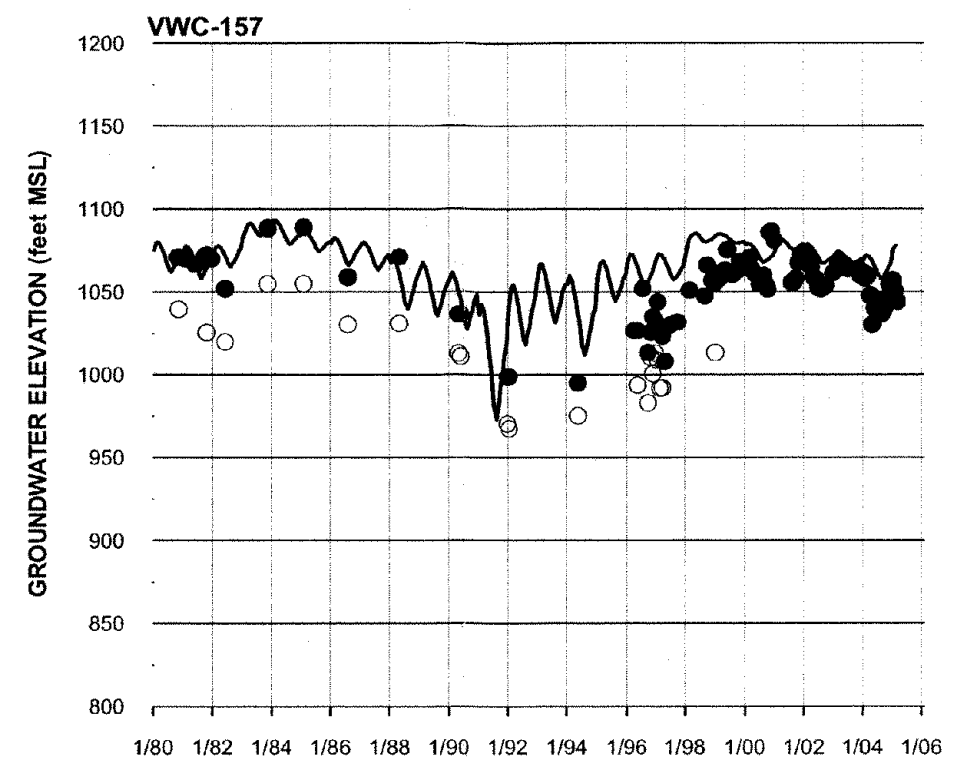
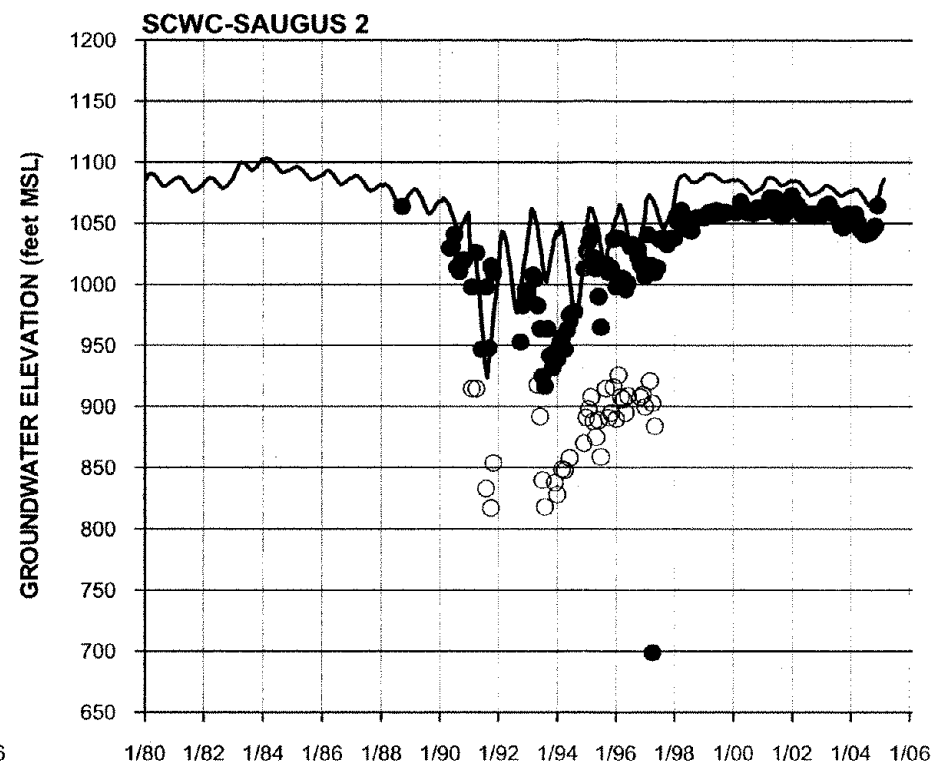
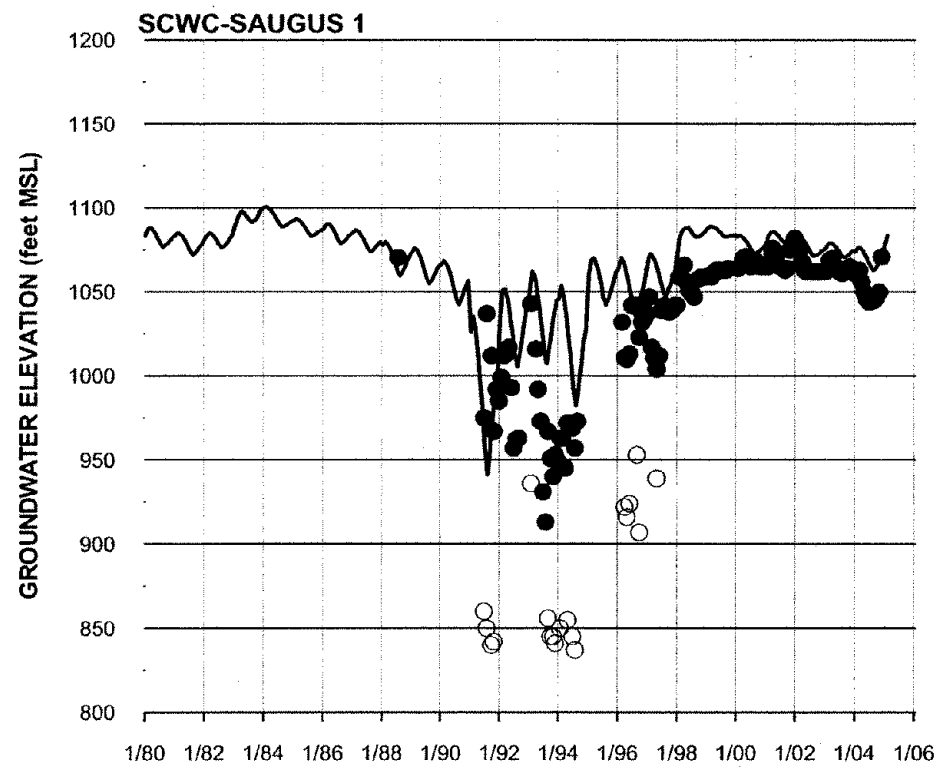
FIGURE 9
SIMULATED AND MEASURED GROUNDWATER
ELEVATIONS IN SAUGUS FORMATION WELLS
(PAGE 1 OF 3)
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA



LEGEND

- SIMULATED ELEVATION
- MEASURED STATIC (NONPUMPING) ELEVATION
- MEASURED PUMPING ELEVATION

FIGURE 9
SIMULATED AND MEASURED GROUNDWATER
ELEVATIONS IN SAUGUS FORMATION WELLS
(PAGE 2 OF 3)
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA



LEGEND

- SIMULATED ELEVATION
- MEASURED STATIC (NONPUMPING) ELEVATION
- MEASURED PUMPING ELEVATION

FIGURE 9
SIMULATED AND MEASURED GROUNDWATER
ELEVATIONS IN SAUGUS FORMATION WELLS
 (PAGE 3 OF 3)
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA

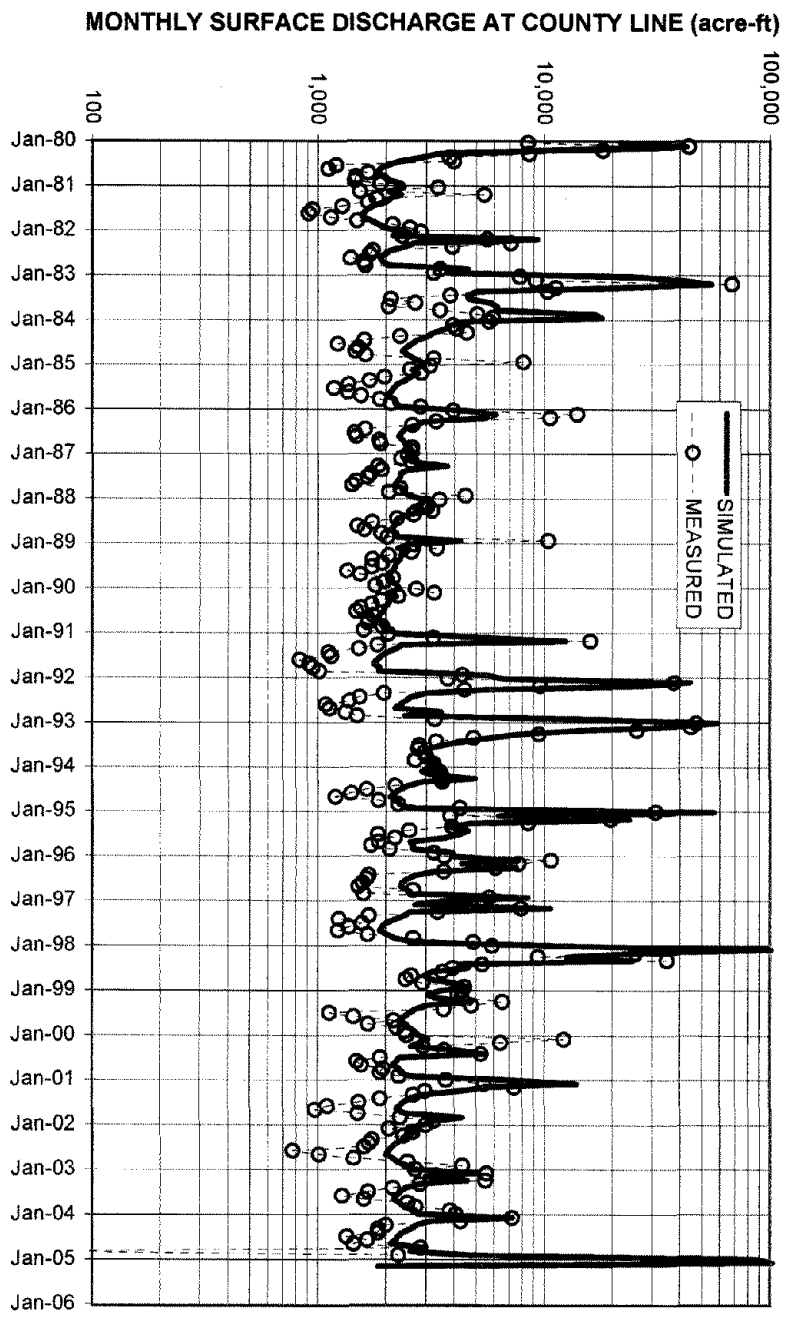
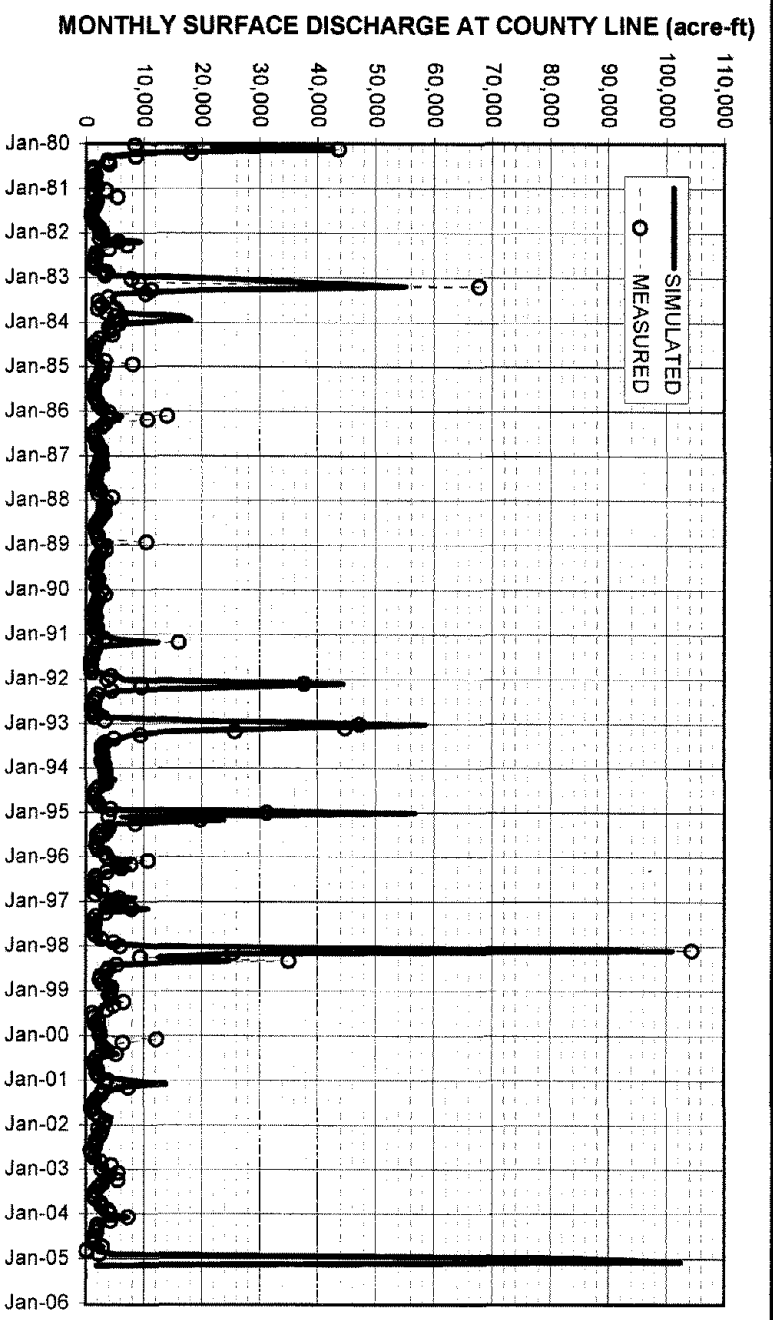


FIGURE 10
SIMULATED VERSUS MEASURED
HYDROGRAPHS OF SANTA CLARA
RIVER FLOW AT COUNTY LINE
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA

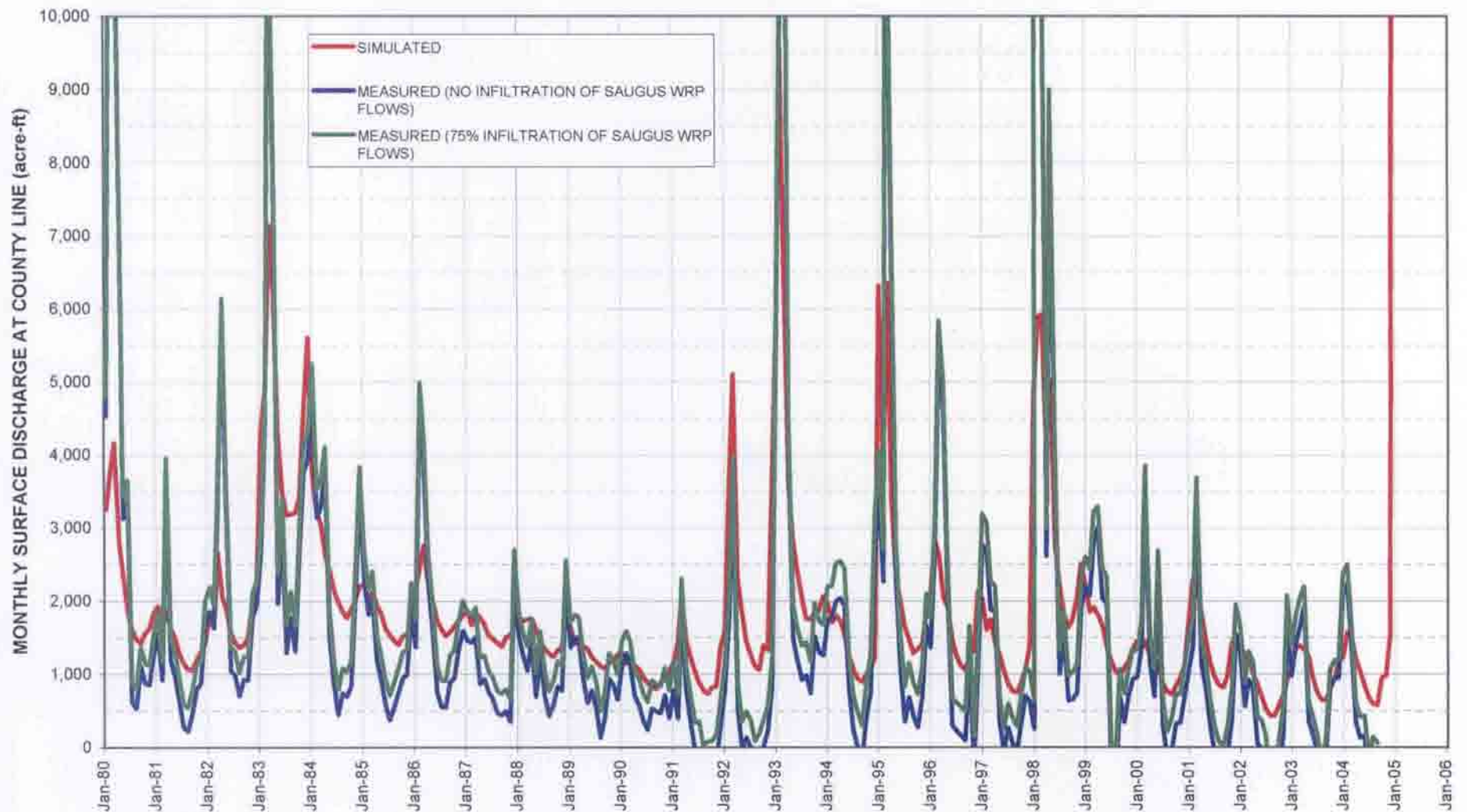


FIGURE 11
SIMULATED VERSUS MEASURED
HYDROGRAPH OF GROUNDWATER
DISCHARGE TO SANTA CLARA RIVER
 CALIBRATION UPDATE OF THE REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA

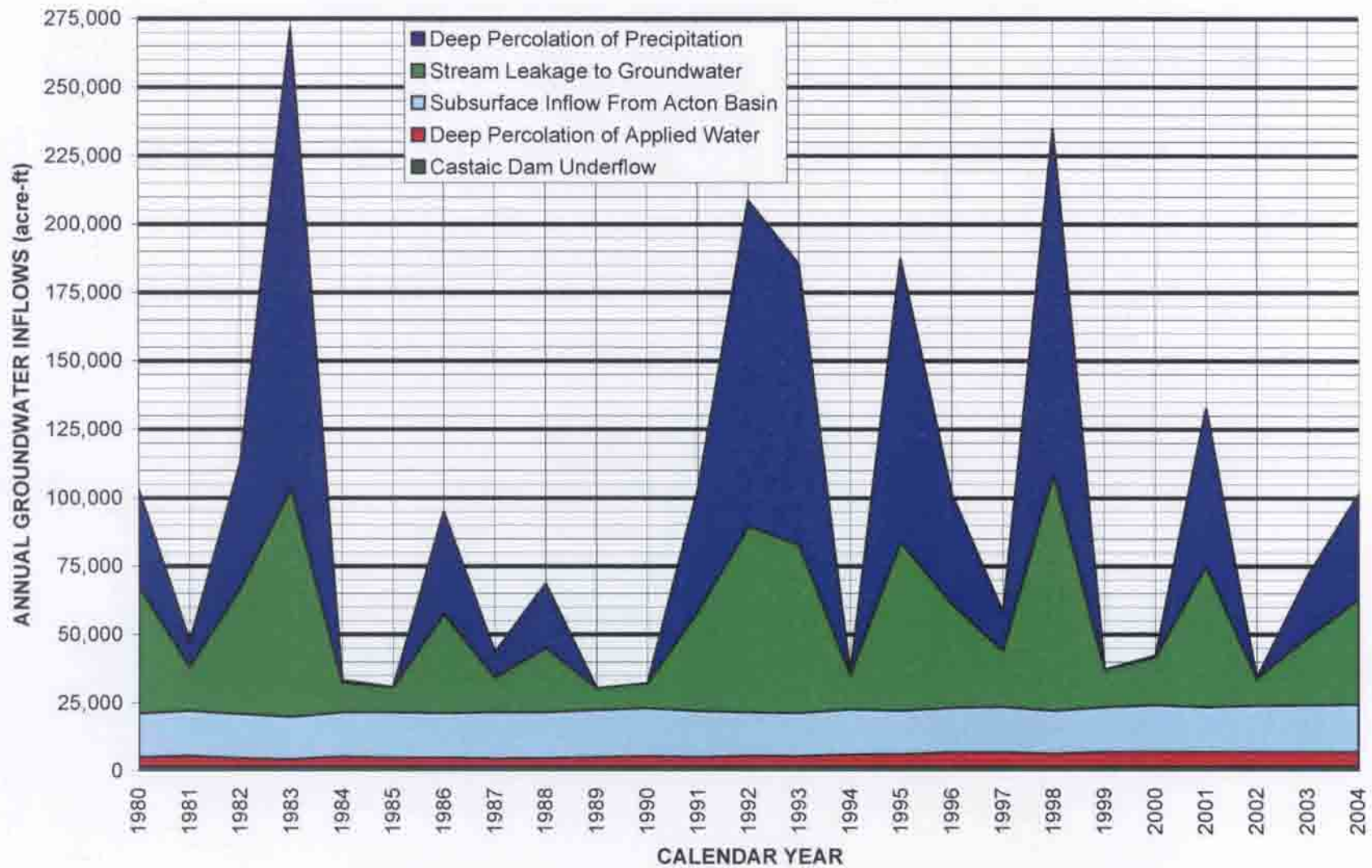


FIGURE 12
SIMULATED ANNUAL
GROUNDWATER INFLOWS

CALIBRATION UPDATE OF REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY

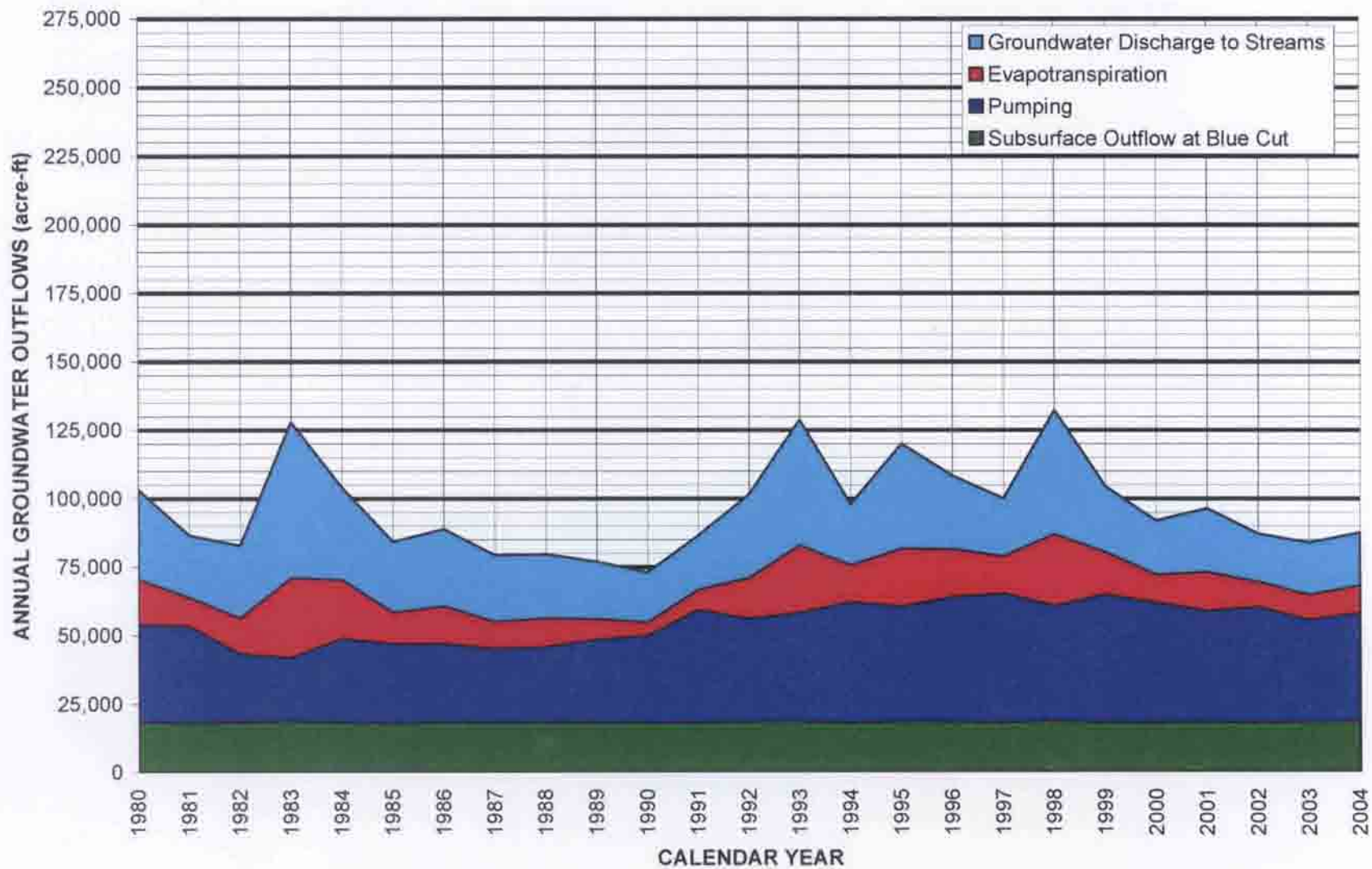


FIGURE 13
SIMULATED ANNUAL
GROUNDWATER OUTFLOWS
 CALIBRATION UPDATE OF REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA

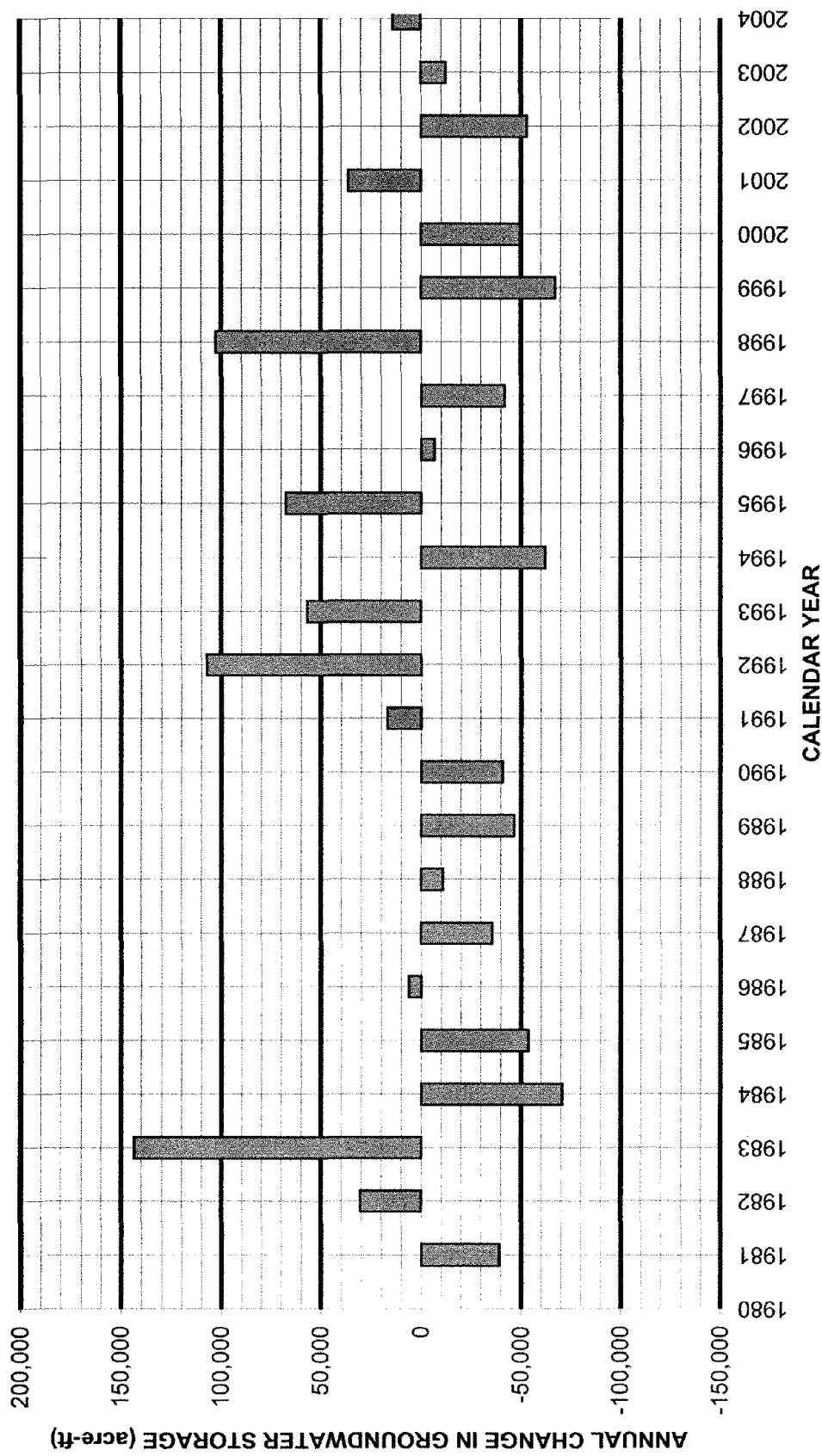


FIGURE 14
ANNUAL CHANGE IN SIMULATED
GROUNDWATER STORAGE
 CALIBRATION UPDATE OF REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA

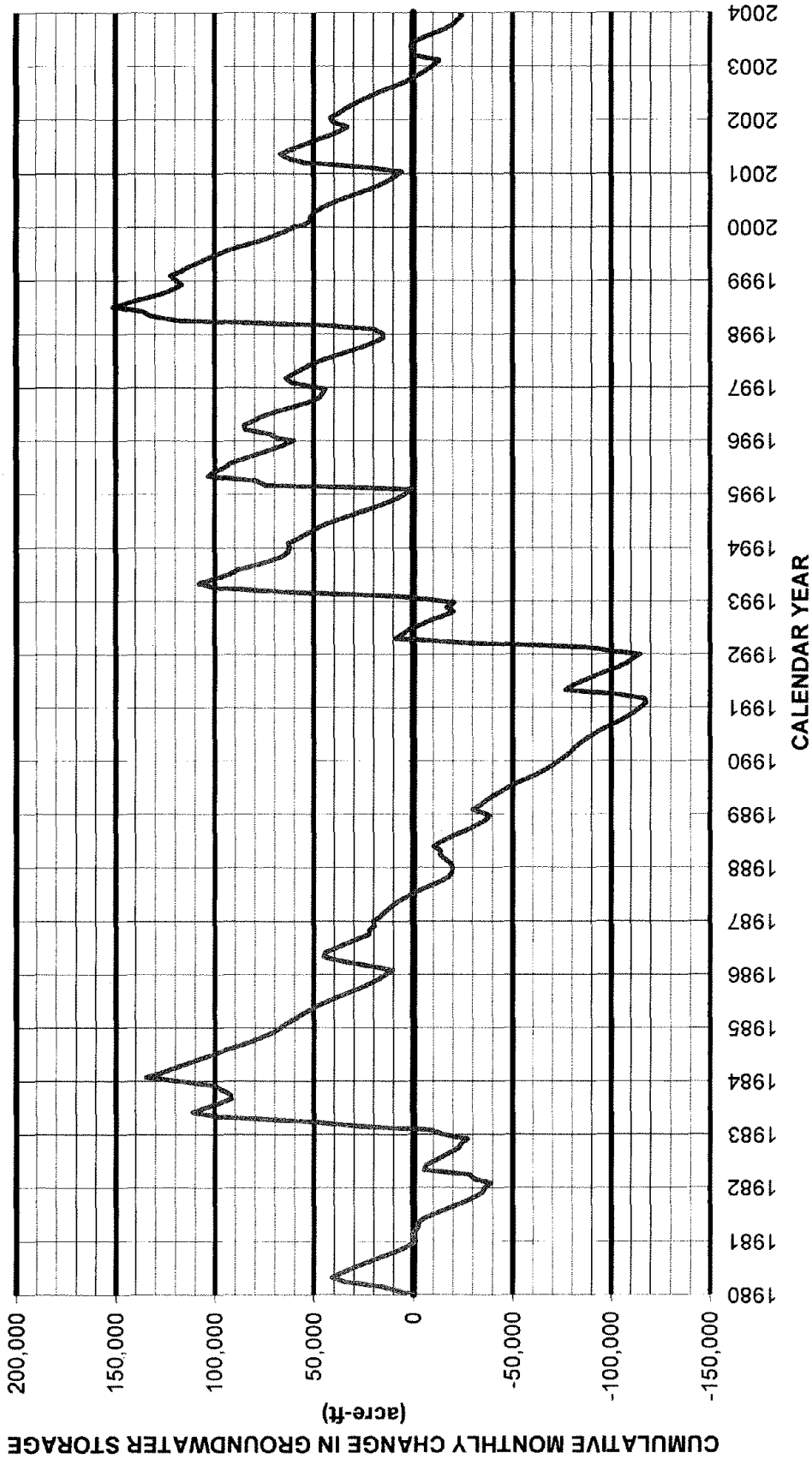


FIGURE 15
CUMULATIVE CHANGE IN SIMULATED
GROUNDWATER STORAGE
 CALIBRATION UPDATE OF REGIONAL GROUNDWATER
 FLOW MODEL FOR THE SANTA CLARITA VALLEY
 SANTA CLARITA, CALIFORNIA