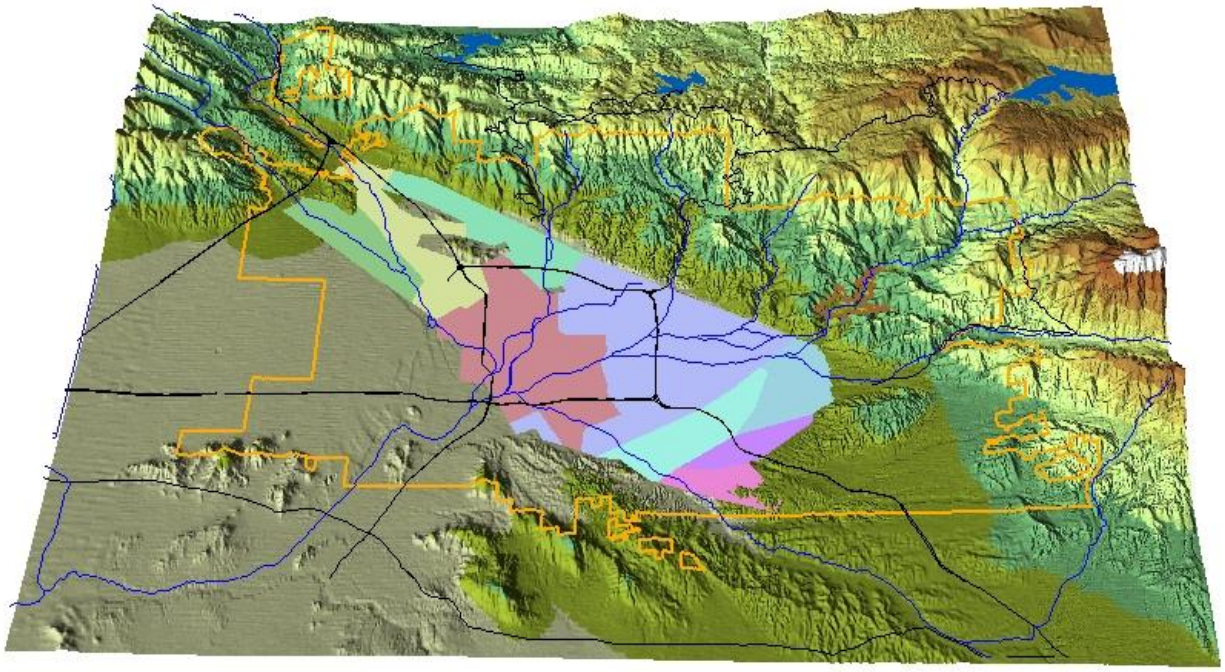
Change in Groundwater Storage for the San Bernardino Basin Area

Calendar Years 1934 to 2011



April 2012

SAN BERNARDINO Valley MUNICIPAL WATER DISTRICT

Change in Groundwater Storage for the San Bernardino Basin Area
Calendar Years 1934 to 2011

EXECUTIVE SUMMARY AND APPENDIX

April 2012

San Bernardino Valley Municipal Water District

Robert M. Tincher
Manager of Engineering and Planning

Steve Luhn
GIS Coordinator

Dan Borell
GIS Coordinator

ACKNOWLEDGMENT

Many public and private water agencies and various individuals have cooperated with the San Bernardino Valley Municipal Water District in furnishing the essential information upon which the Change in Storage Calculation is based.

Change in Groundwater Storage
For the San Bernardino Basin Area
1934 – 2011
EXECUTIVE SUMMARY AND APPENDIX

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EXECUTIVE SUMMARY

The San Bernardino Valley Municipal Water District (SBVMWD) has been calculating the change in groundwater storage for the San Bernardino Basin Area (SBBA) since 1970. The first calculation was completed for the years 1934 – 1960 by the State of California Department of Water Resources (DWR) and the results were summarized in Bulletin 104-5, Meeting Water Demands in the Bunker Hill-San Timoteo Area, Geology, Hydrology, and Operation-Economics Studies, Text and Plates (Olson, pp. 90 – 92). The DWR change in storage values were calculated using the Specific Yield Method (Olson, pp. 85 – 98) and a mathematical model developed by TRW, Incorporated, Redondo Beach, California (TRW). In 1980, SBVMWD updated the change in storage calculation to include the years 1961 – 1980 (Van Gelder). In the early 1990's, SBVMWD created a new change in storage model (SBVMWD Model) using software developed by Environmental Systems Research Institute (ESRI), Redlands, California (For an explanation of how the model works see **Appendix: SBVMWD Change in Storage Model**). Results from the SBVMWD Model are presented to the SBVMWD Board of Directors and are being released in a report format.

Like the earlier DWR model, the SBVMWD Model calculates the change in groundwater storage (volume) for the SBBA using the Specific Yield Method. In addition to the DWR and SBVMWD models, the San Bernardino Valley Water Conservation District (SBVWCD) and the U.S. Geological Survey (USGS) have created models for computing the change in storage for the SBBA. Although all four models use slightly different data sets and calculate the change in storage using different computer methods, their calculated values and results track remarkably well (Figures 1.1 and 1.2).

The cumulative change in groundwater storage (CCIS) is a measure of the volume of water lost or gained in the SBBA as compared to the base year of 1934. The year 1934 was selected as the base year to correspond with the first year of the DWR base period, 1934-35 through 1959-60 (Motokane, pp. 123 – 129). The annual change in storage (ACIS) is simply a measure of the volume of water lost or gained in the basin during a year. This report presents the results from the SBVMWD Model for calendar years 1934 to 2011.

Figure 1.1. Comparison of DWR FORTRAN Model, SBVWCD EI and SBVMWD GRID Model Results

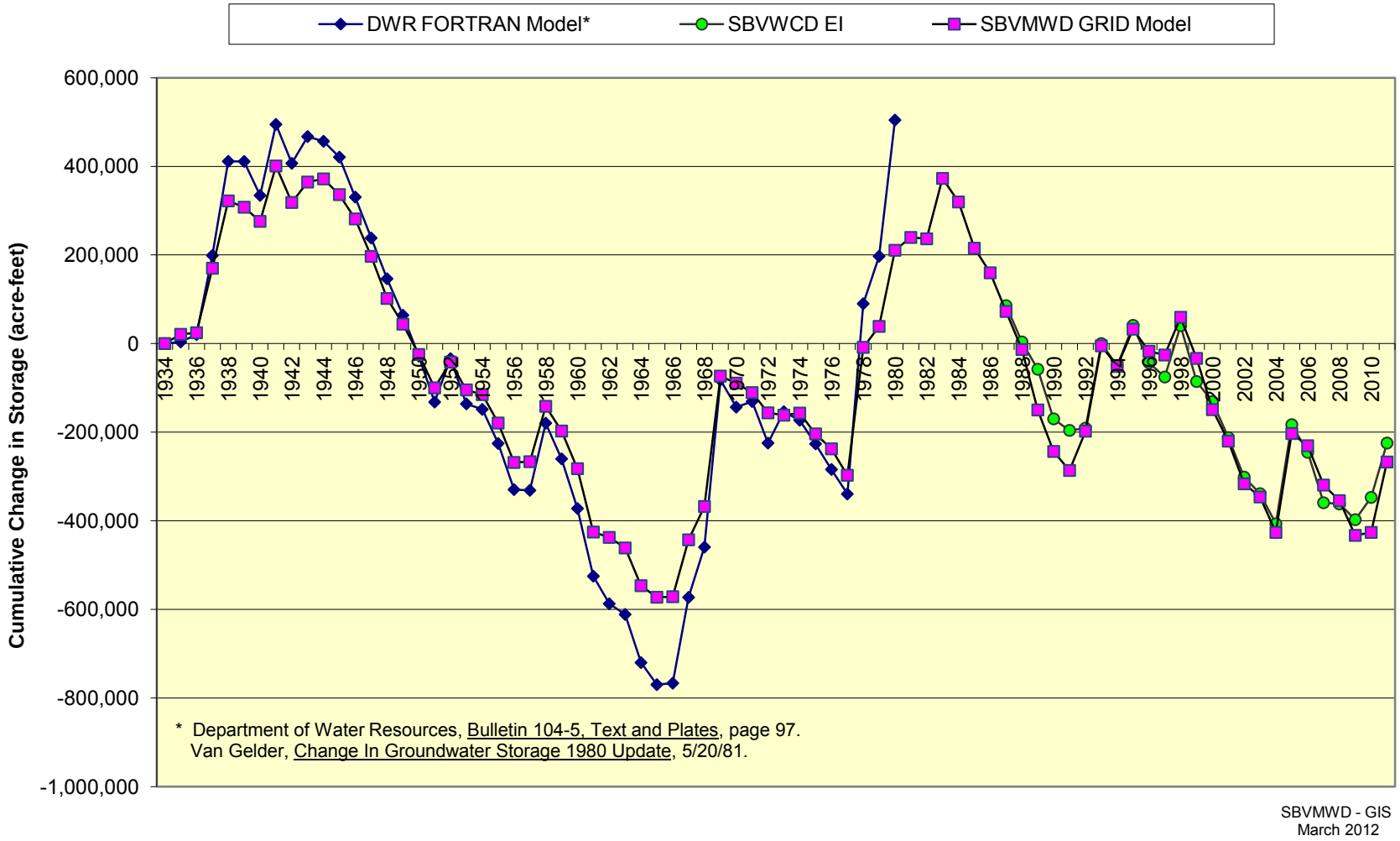
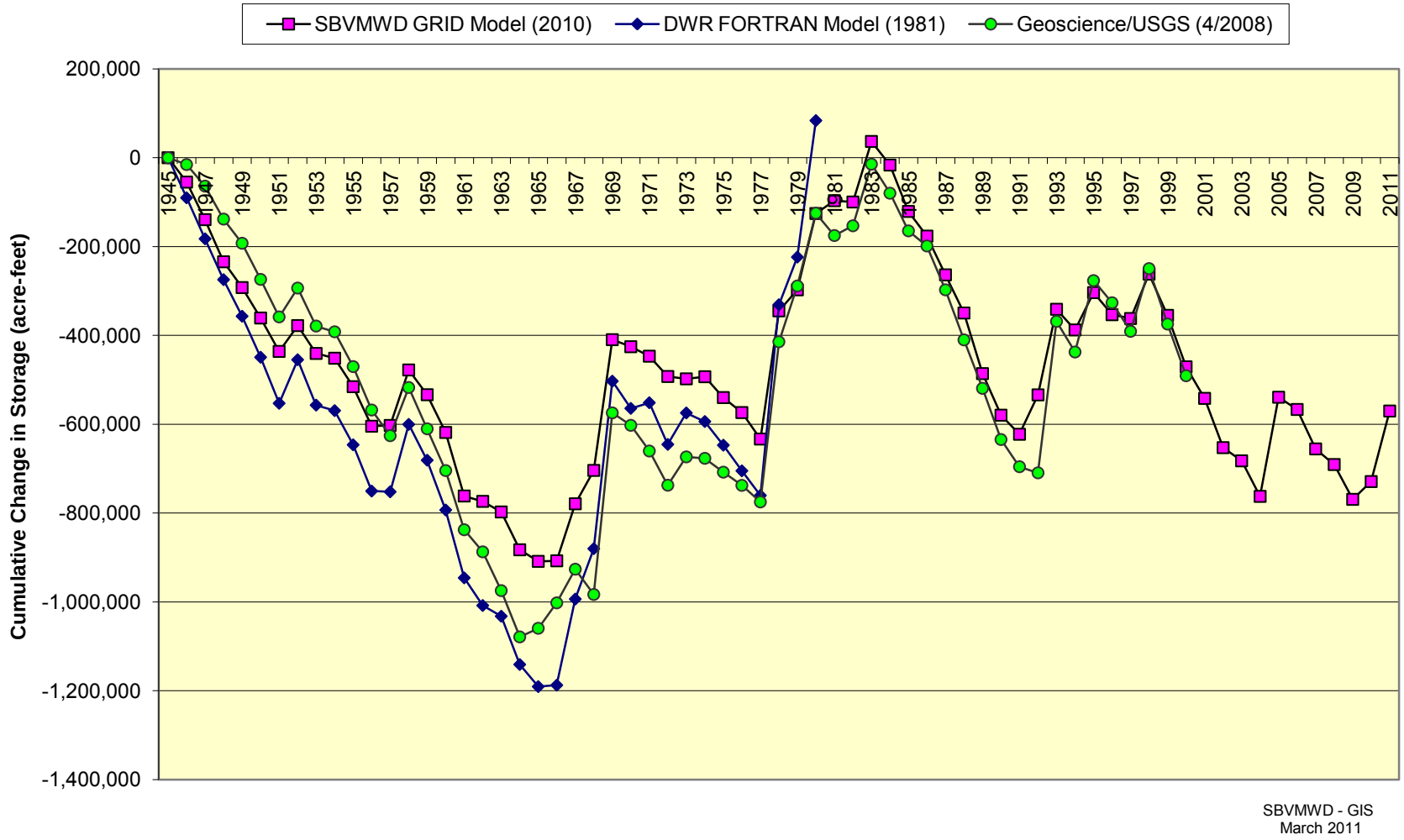


Figure 1.2. Comparison of DWR FORTRAN Model, USGS MODFLOW Model and SBVMWD GRID Model Results



The SBVMWD Model uses the calendar year instead of the water year (October through September) to correspond with the United States Geological Survey MODFLOW groundwater model, which is dependent upon local pumping records kept by calendar year.

The annual change in storage for calendar year 2011 was calculated to be approximately 158,805 acre-feet. Nearly 50% (74,704 acre feet)[3] of this increase was due to artificial recharge. Most of this artificial recharge occurred in the City Creek sub basin which had the 3rd highest annual change in storage on record. Table 1.1 summarizes the distribution of the 2011 annual and cumulative change in storage among the various sub-basins (Figure 1.3), as defined in Bulletin 104-5 (DWR, Plate 14, Basin Groundwater Storage Data). The cumulative change in storage for calendar year 2011 was calculated to be approximately -267,404 acre-feet which is an increase of 125,532 acre-feet from the previous year.

Table 1.1 also provides a "basin index" for each sub-basin. The basin index is the average, annual water level change for the sub-basin for the given year. For example, a basin index of -5.0 indicates that the average water level for the named sub-basin decreased 5.0 feet for the given year. For 2011, the Lytle Creek sub-basin saw the largest change in water levels as it increased 45 feet, closely followed by City Creek at 43 feet. The Divide sub-basin saw the largest decrease of 4 feet. The average change in water levels for the SBBA was an increase of 19 feet.

Table 1.1. Annual and cumulative change in storage for 2011 by sub-basin.

	Sub-basin	Wells used in 2011 Model	Area (acres)	2011 Annual Change in Storage	2011 Cumulative Change in Storage	Basin Index (ft)
1	Cajon	4	9,833	12,439	-47,279	25
2	Devil Canyon	12	7,105	2,648	-36,759	10
3	Lytle Creek	10	5,899	27,617	-13,819	45
4	Pressure Zone	21	15,965	12,742	-122,774	4
5	City Creek	16	21,284	82,409	-112,208	43
6	Redlands	6	5,113	840	-1,091	-3
7	Mill Creek	9	7,299	19,938	49,643	41
8	Reservoir	6	2,177	708	8,717	6
9	Divide	2	2,634	-537	8,165	-4
		86	**77,309**	**158,804**	**-267,405**	

The District and the primary water purveyors in the SBBA provided fall 2011 water level data for the model. The static depth to groundwater data were contoured and plotted in Figure 1.4 the “Depth to Groundwater Status Map Fall 2011”.

Figure 1.5 compares the 2011 depth to groundwater to the low water levels of 1965. Areas shaded in red are those that are lower than 1965.

Liquefaction potential can be measured based upon water levels. The threat of liquefaction is reduced for water levels lower than 50 feet below ground surface (SCEC Report, March 1999, page 7). Figure 1.4 shows that fall 2011 water levels are generally below this threshold with the exception of a small area south of the Santa Ana River (Figure 1-4b). The shallower water levels in this vicinity are likely due to the close proximity to the San Jacinto fault (causes underground flow to pool up behind it), the recharge from the Santa Ana River and the inflow from Warm Creek and San Timoteo Creek.

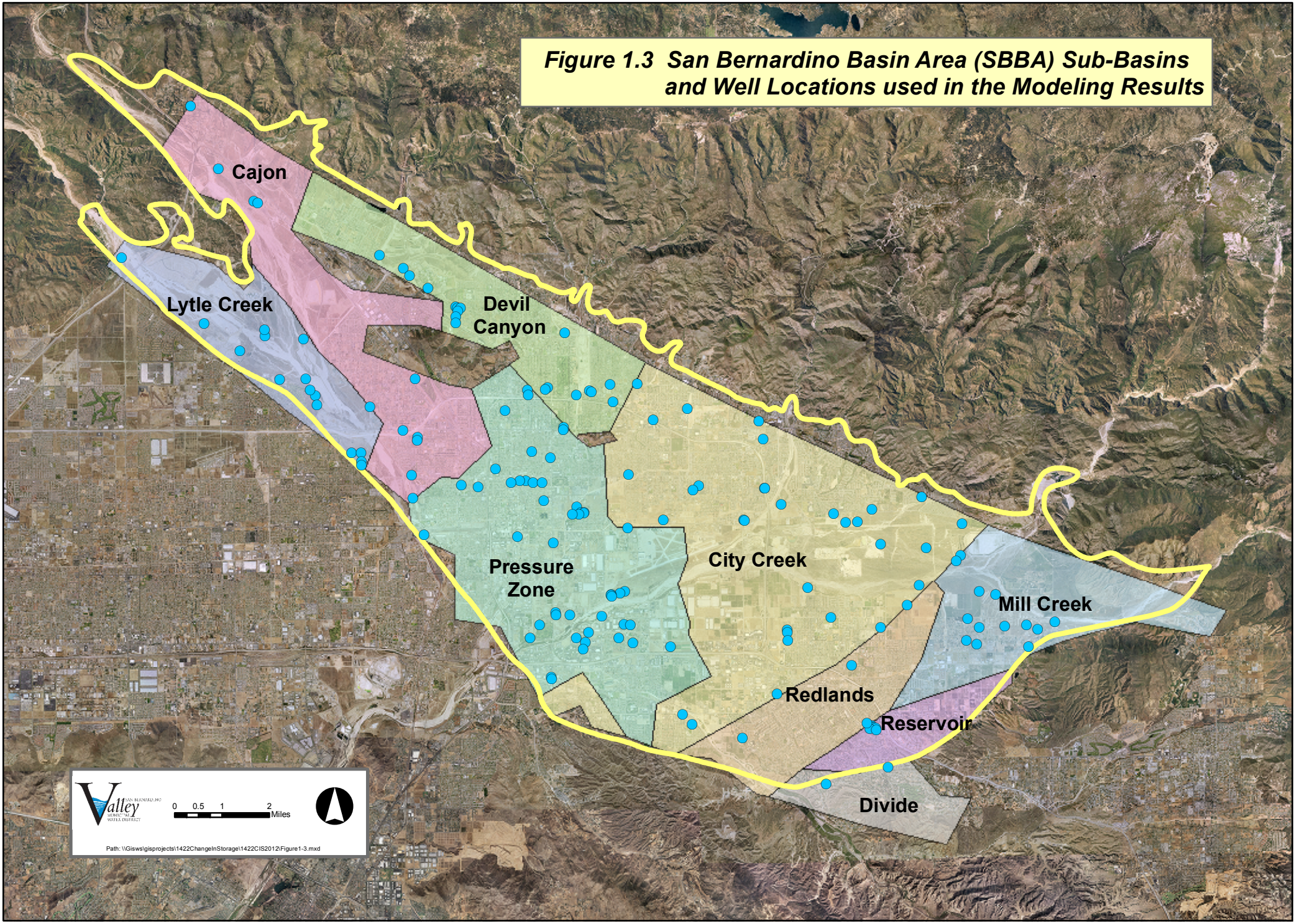


Figure 1.3 San Bernardino Basin Area (SBBA) Sub-Basins and Well Locations used in the Modeling Results
Cajon
Lytle Creek
Devil Canyon
Pressure Zone
City Creek
Mill Creek
Redlands
Reservoir
Divide
Valley
0 0.5 1 2
Miles
Path: \\Giswss\gisprojects\1422ChangeInStorage\1422CIS2012\Figure1-3.mxd

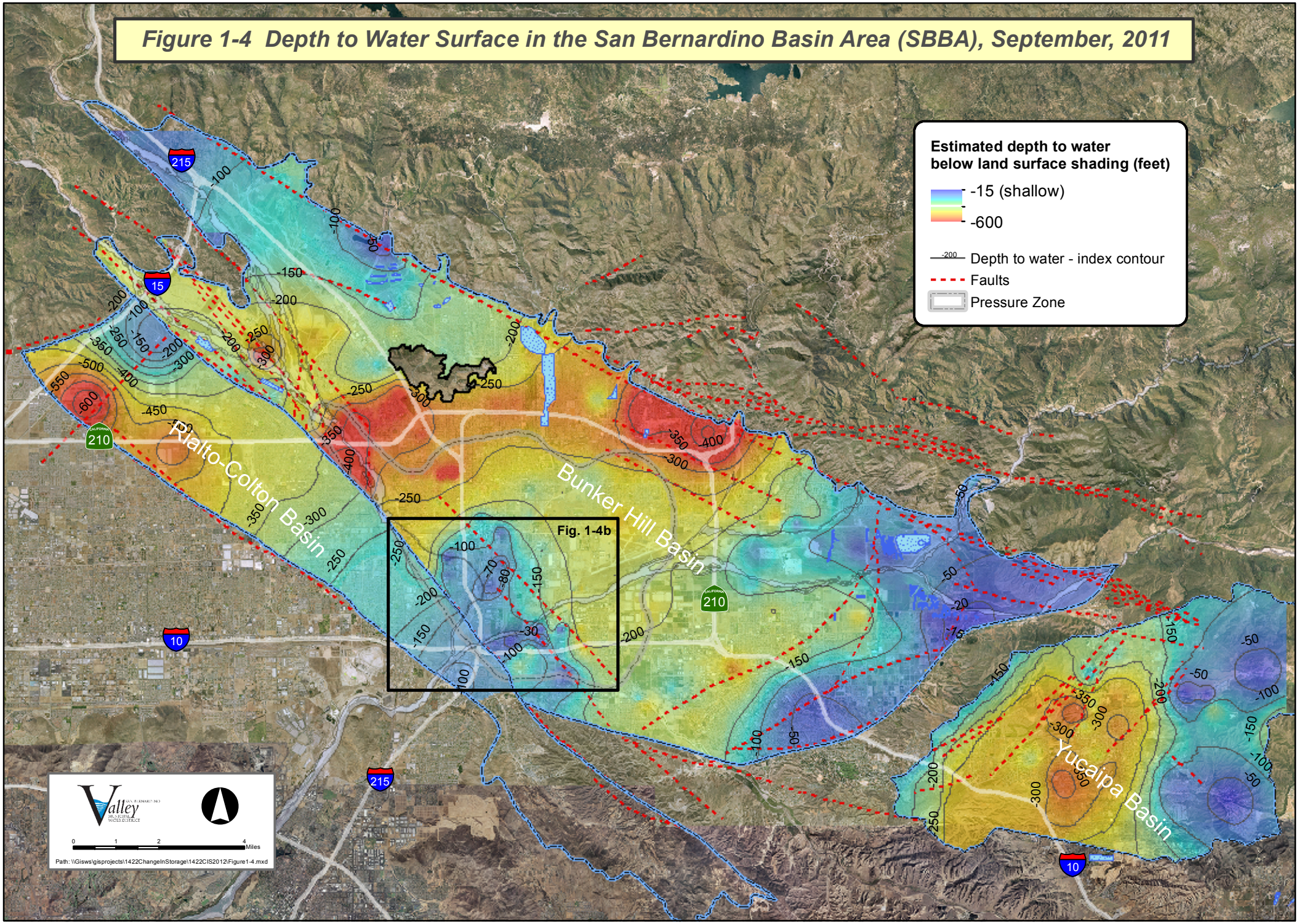


Figure 1-4 Depth to Water Surface in the San Bernardino Basin Area (SBBA), September, 2011
Estimated depth to water below land surface shading (feet)
-15 (shallow)
-600
-200 Depth to water - index contour
Faults
Pressure Zone
Rialto-Colton Basin
Bunker Hill Basin
Yucaipa Basin
Fig. 1-4b
215
15
210
10
Valley
0 1 2 4 Miles
Path: \\Gisws\gisprojects\1422ChangeInStorage\1422CIS2012\Figure1-4.mxd

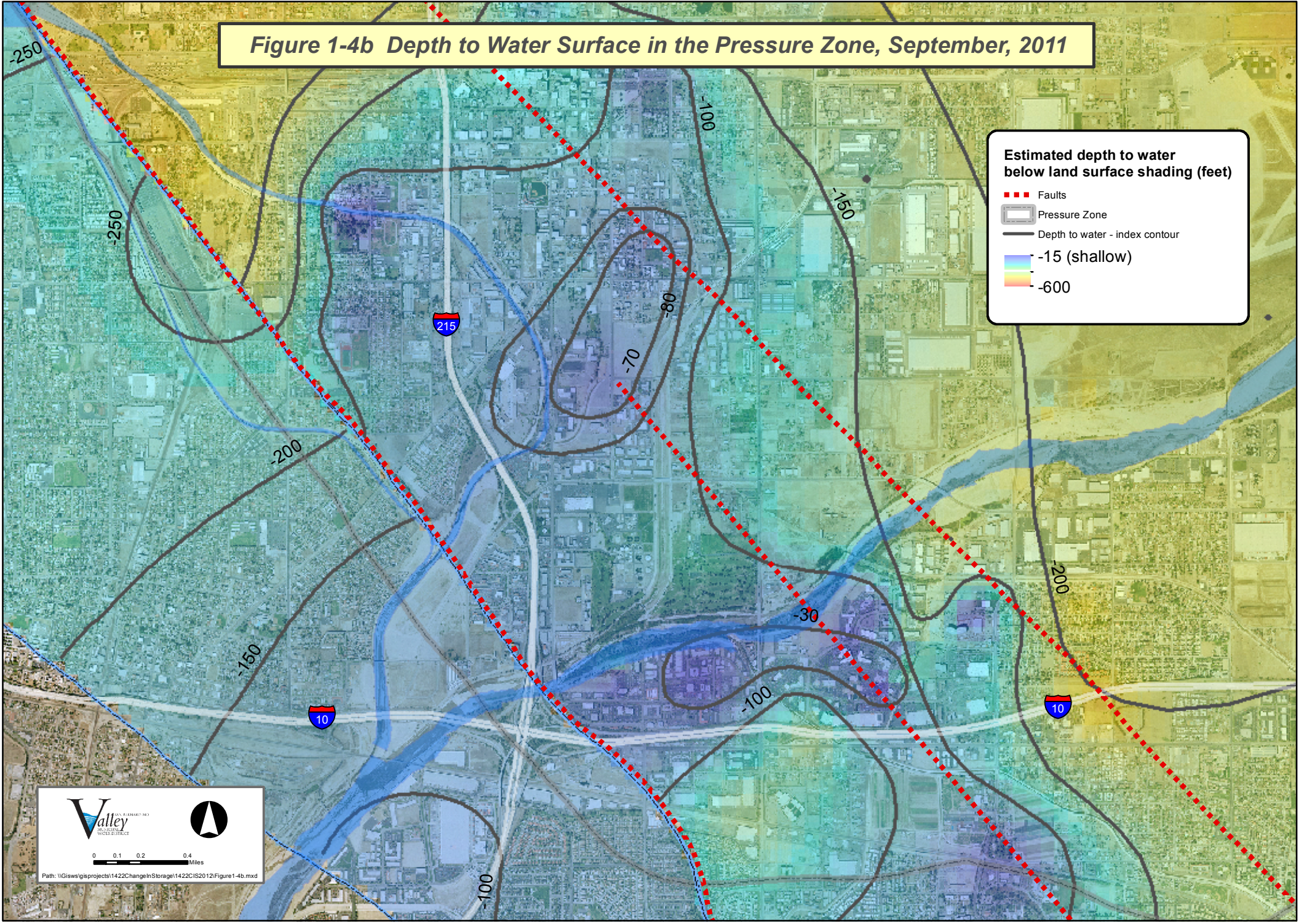
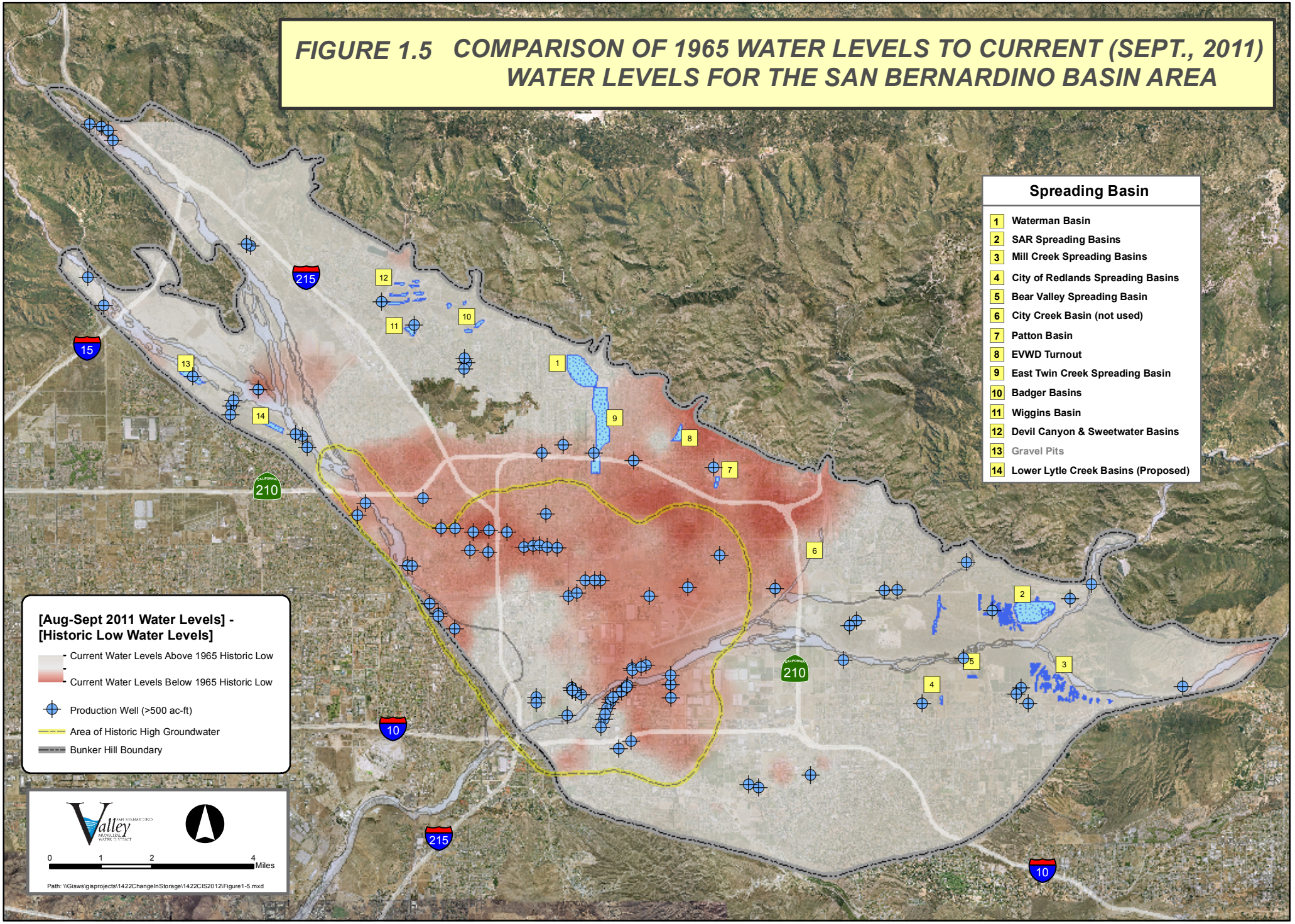


Figure 1-4b Depth to Water Surface in the Pressure Zone, September, 2011
Estimated depth to water below land surface shading (feet)
Faults
Pressure Zone
Depth to water - index contour
-15 (shallow)
-600
-250
-250
-100
-150
-80
-70
-200
-150
-30
-100
-200
-100
215
10
10
0 0.1 0.2 0.4
Miles
Path: \\Giswss\gisprojects\1422ChangeInStorage\1422CIS2012\Figure1-4b.mxd

FIGURE 1.5 COMPARISON OF 1965 WATER LEVELS TO CURRENT (SEPT., 2011) WATER LEVELS FOR THE SAN BERNARDINO BASIN AREA



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University of Washington (UW) web site:
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APPENDIX

Change in Groundwater Storage for the San Bernardino Basin Area
1934 - 2011

Data Changes in the SBVMWD Change in Storage Model
Since April 2011 Report

Cajon Sub-Basin and Wells:
No Changes.

Devil Canyon Sub-Basin and Wells:
No Changes.

Lytle Creek Sub-Basin and Wells:
No Changes.

Pressure Zone Sub-Basin and Wells:
No Changes.

City Creek Sub-Basin and Wells:
Well No. 41 not used due to lack of water level data.

Redlands Sub-Basin and Wells:
No Changes.

Mill Creek Sub-Basin and Wells:
No Changes.

Reservoir Sub-Basin and Wells:
No Changes.

Divide Sub-Basin and Wells:
No Changes.

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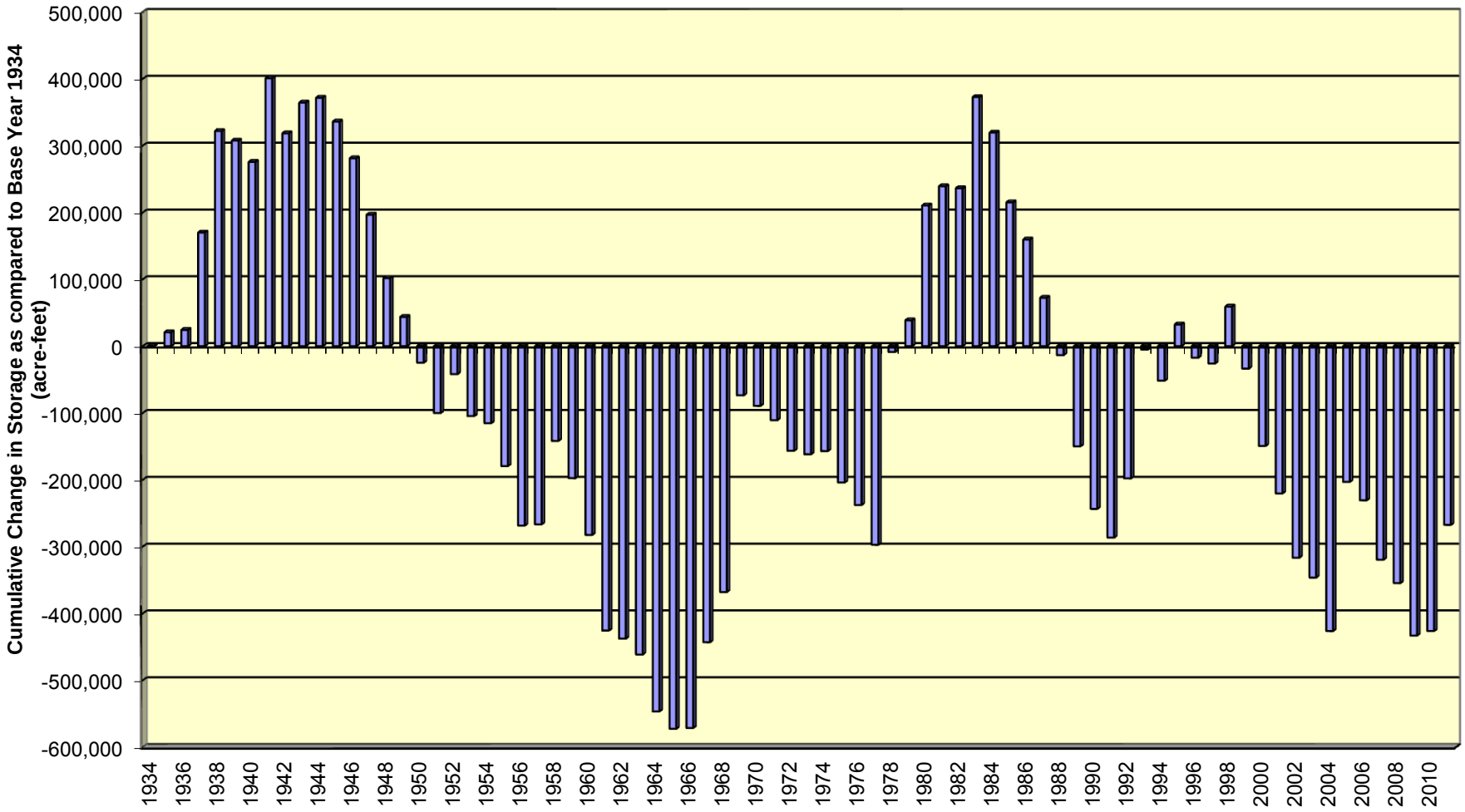
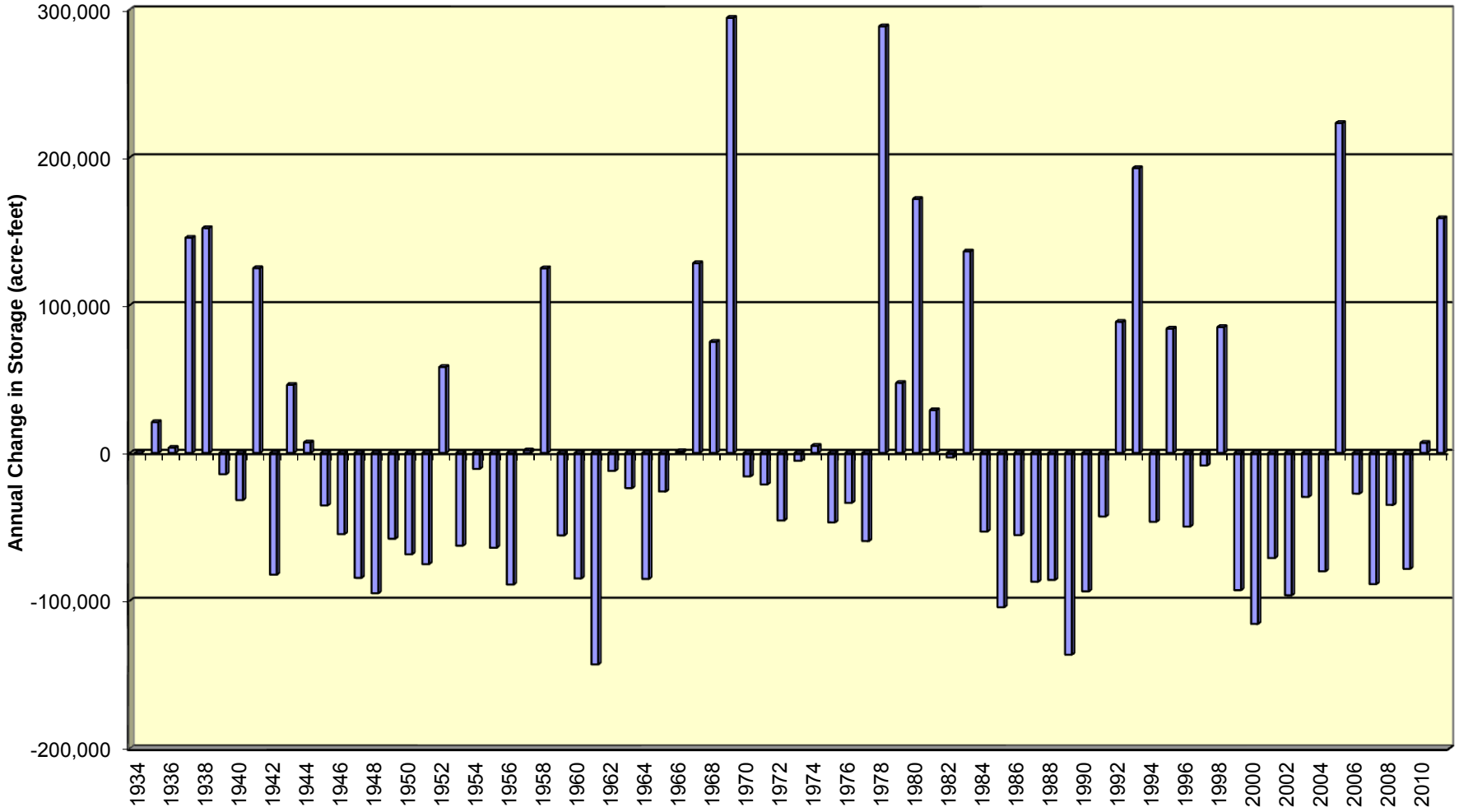
Cumulative Change in Storage for the San Bernardino Basin Area



Annual Change in Storage for the San Bernardino Basin Area



San Bernardino Valley Municipal Water District

Change In Storage for the San Bernardino Basin Area 1934 - 2011

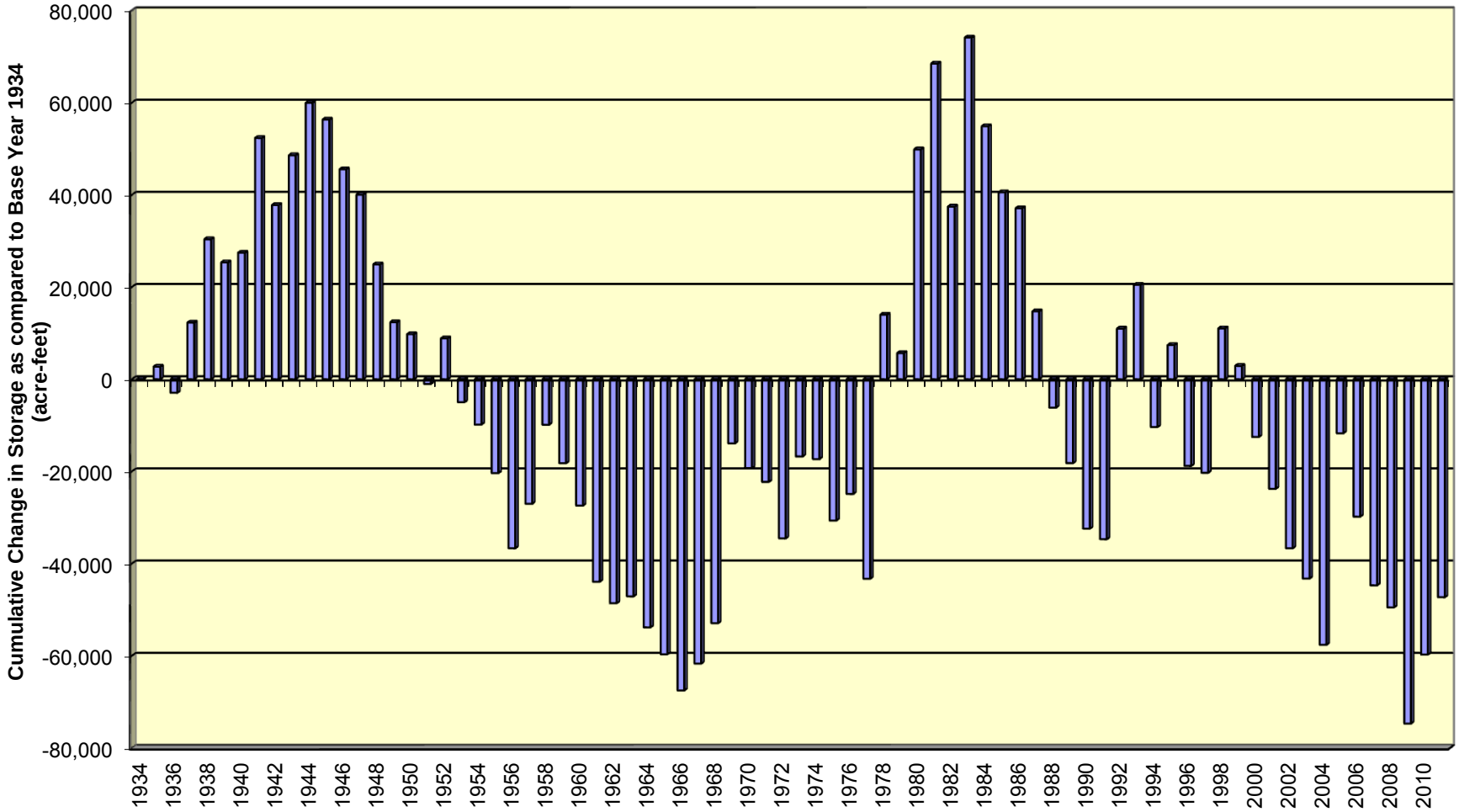
(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1934	n/a	n/a	0
1935	6	20,870	20,870
1936	2	3,523	24,393
1937	23	145,589	169,982
1938	22	152,096	322,078
1939	3	-14,377	307,701
1940	-5	-31,859	275,842
1941	17	125,012	400,854
1942	-11	-82,317	318,537
1943	7	46,073	364,610
1944	0	7,091	371,701
1945	-5	-35,507	336,194
1946	-9	-54,920	281,274
1947	-12	-84,528	196,746
1948	-16	-94,909	101,837
1949	-9	-58,045	43,792
1950	-14	-68,538	-24,746
1951	-12	-75,214	-99,960
1952	11	58,167	-41,793
1953	-7	-62,735	-104,528
1954	1	-10,727	-115,255
1955	-11	-64,100	-179,355
1956	-14	-89,030	-268,385
1957	0	1,777	-266,608
1958	20	124,903	-141,705
1959	-8	-55,773	-197,478
1960	-13	-84,913	-282,391
1961	-18	-143,069	-425,460
1962	4	-12,103	-437,563
1963	-6	-23,803	-461,366
1964	-12	-85,205	-546,571
1965	0	-26,059	-572,630
1966	4	1,190	-571,440
1967	19	128,403	-443,037
1968	9	75,169	-367,868
1969	39	294,367	-73,501
1970	2	-15,864	-89,365
1971	-4	-21,340	-110,705
1972	-7	-45,689	-156,394
1973	1	-5,303	-161,697
1974	1	4,776	-156,921
1975	-5	-46,965	-203,886
1976	-6	-33,740	-237,626
1977	-9	-59,633	-297,259

San Bernardino Valley Municipal Water District

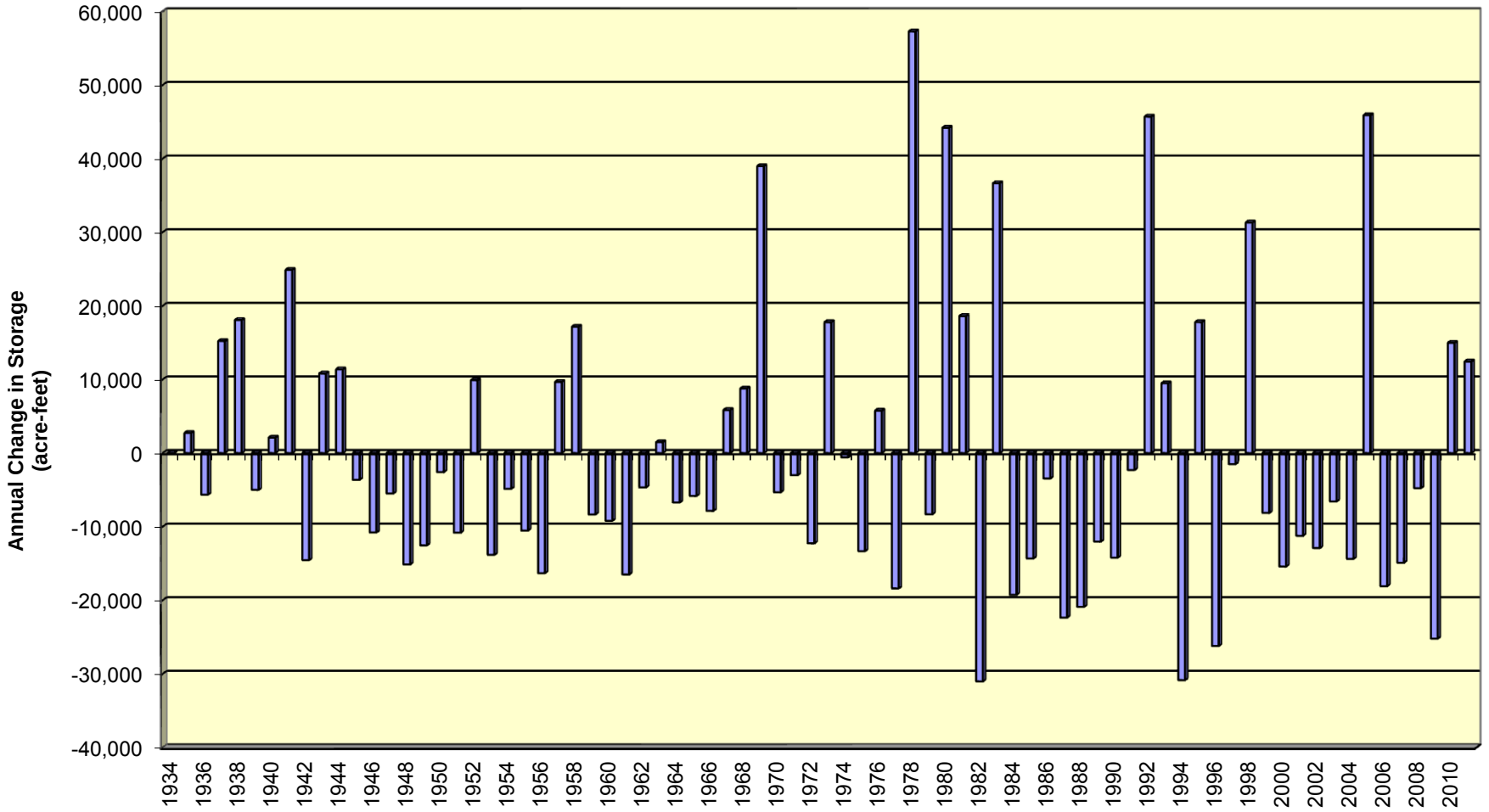
Change In Storage for the San Bernardino Basin Area 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1978	38	288,634	-8,625
1979	5	47,368	38,743
1980	21	171,822	210,565
1981	2	28,937	239,502
1982	1	-3,042	236,460
1983	16	136,343	372,803
1984	-7	-53,164	319,639
1985	-13	-104,413	215,226
1986	-8	-55,577	159,649
1987	-12	-87,184	72,465
1988	-12	-85,879	-13,414
1989	-16	-136,477	-149,891
1990	-13	-93,632	-243,523
1991	0	-42,951	-286,474
1992	11	88,692	-197,782
1993	30	192,725	-5,057
1994	-6	-46,564	-51,621
1995	13	84,107	32,486
1996	-3	-49,809	-17,323
1997	-1	-8,523	-25,846
1998	4	85,136	59,290
1999	-11	-92,827	-33,537
2000	-15	-115,680	-149,217
2001	-9	-71,069	-220,286
2002	-14	-96,300	-316,586
2003	-6	-29,706	-346,292
2004	-8	-80,017	-426,309
2005	33	223,178	-203,131
2006	-3	-27,539	-230,670
2007	-16	-88,767	-319,437
2008	-2	-35,158	-354,595
2009	-9	-78,417	-433,012
2010	6	6,803	-426,209
2011	17	158,805	-267,404

Cumulative Change in Storage for the Cajon Sub-Basin



Annual Change in Storage for the Cajon Sub-Basin



San Bernardino Valley Municipal Water District

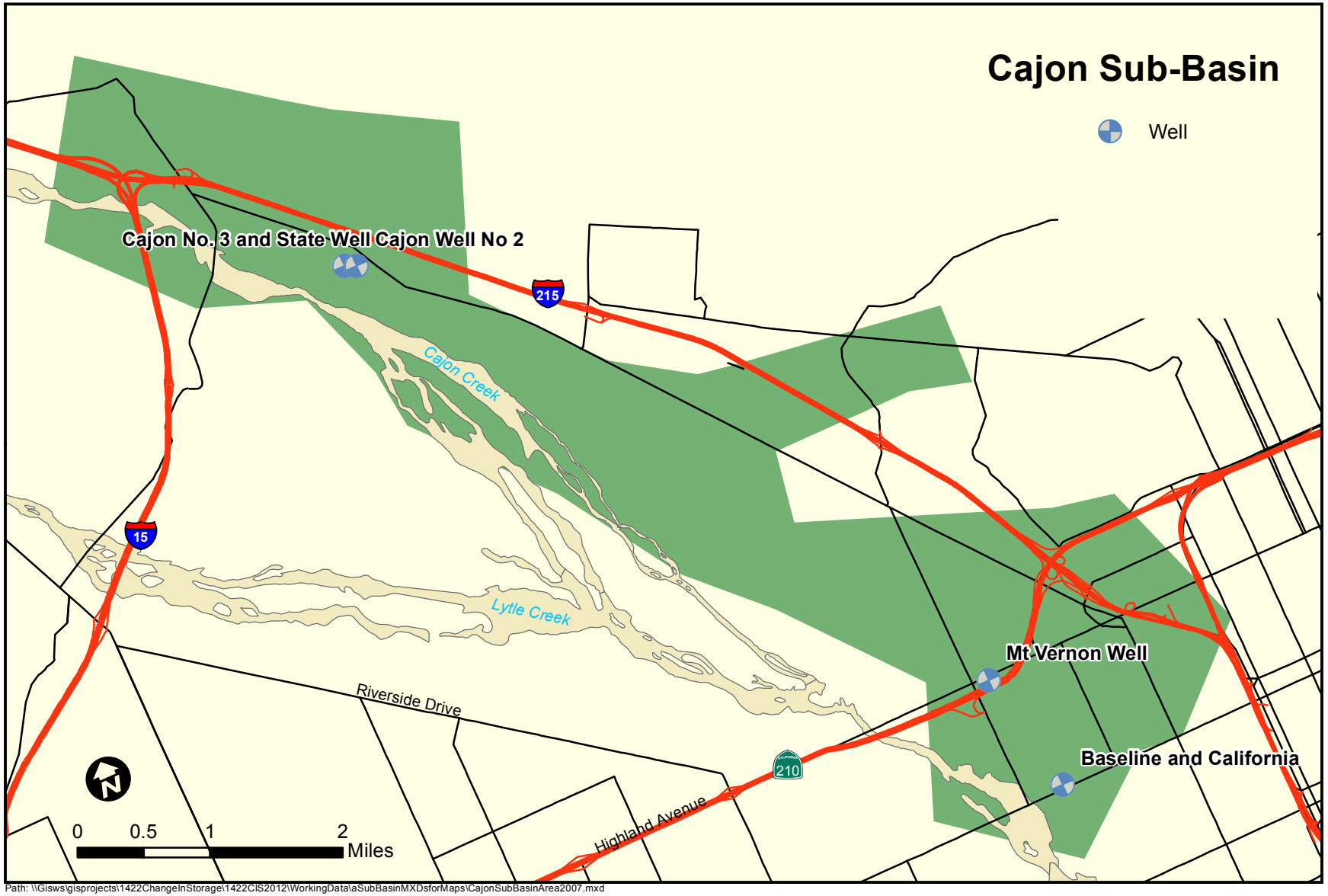
Change In Storage for the Cajon Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1934	0	n/a	0
1935	1	2,727	2,727
1936	-5	-5,653	-2,926
1937	10	15,215	12,289
1938	19	18,080	30,369
1939	6	-5,005	25,364
1940	8	2,091	27,455
1941	17	24,881	52,336
1942	-4	-14,541	37,795
1943	11	10,803	48,598
1944	12	11,376	59,974
1945	-3	-3,632	56,342
1946	-8	-10,790	45,552
1947	-9	-5,498	40,054
1948	-15	-15,133	24,921
1949	-14	-12,542	12,379
1950	-7	-2,595	9,784
1951	-13	-10,817	-1,033
1952	2	9,903	8,870
1953	-14	-13,833	-4,963
1954	-5	-4,860	-9,823
1955	-9	-10,534	-20,357
1956	-14	-16,316	-36,673
1957	3	9,655	-27,018
1958	9	17,153	-9,865
1959	-9	-8,349	-18,214
1960	-8	-9,204	-27,418
1961	-13	-16,502	-43,920
1962	-5	-4,666	-48,586
1963	-1	1,479	-47,107
1964	-9	-6,714	-53,821
1965	-8	-5,836	-59,657
1966	-9	-7,858	-67,515
1967	4	5,840	-61,675
1968	6	8,771	-52,904
1969	41	38,982	-13,922
1970	3	-5,336	-19,258
1971	4	-3,004	-22,262
1972	-9	-12,262	-34,524
1973	11	17,783	-16,741
1974	-3	-579	-17,320
1975	-9	-13,326	-30,646
1976	19	5,760	-24,886
1977	-32	-18,387	-43,273

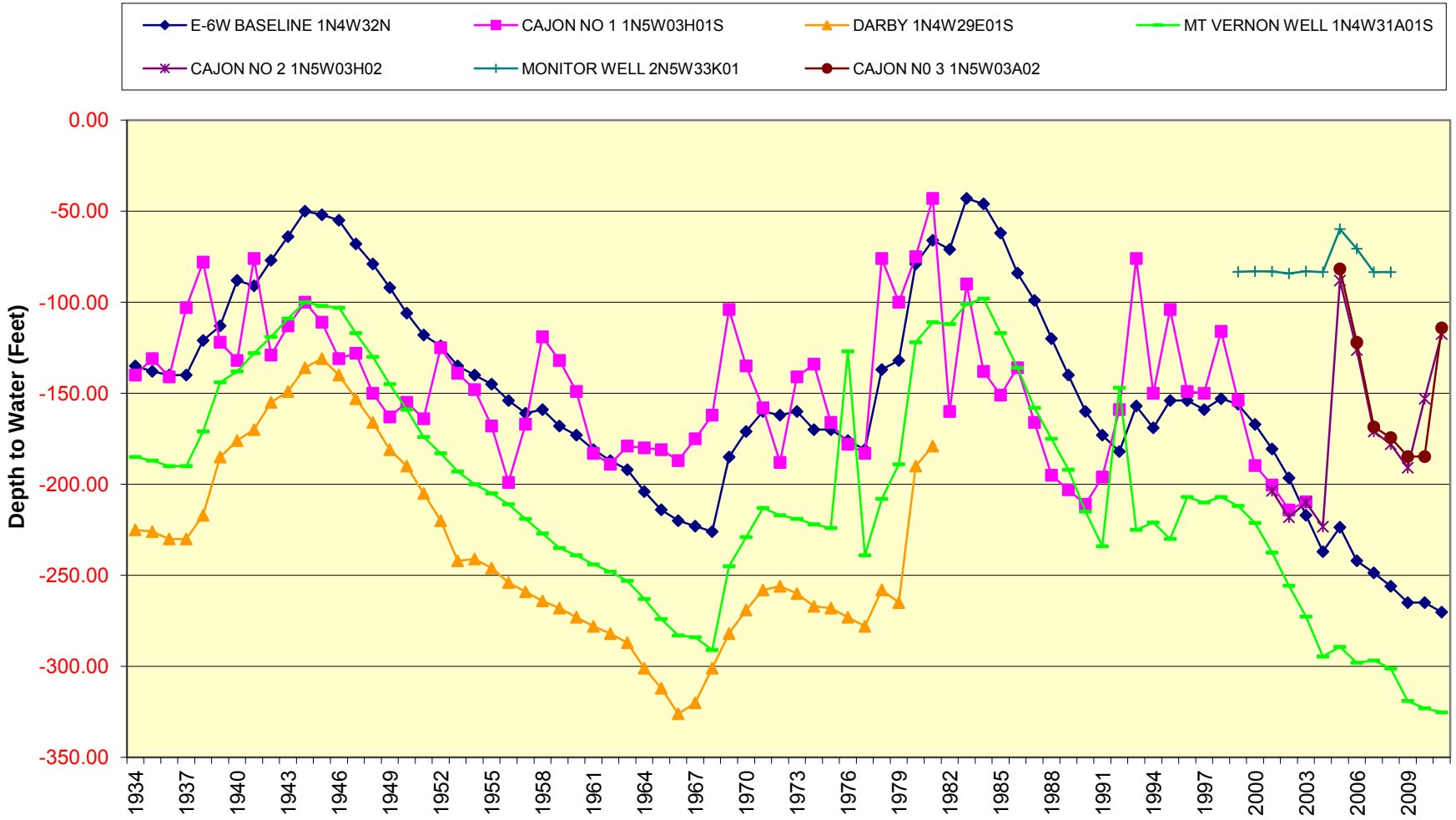
San Bernardino Valley Municipal Water District

Change In Storage for the Cajon Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1978	51	57,276	14,003
1979	-2	-8,324	5,679
1980	55	44,197	49,876
1981	17	18,611	68,487
1982	-41	-31,017	37,470
1983	36	36,661	74,131
1984	-16	-19,249	54,882
1985	-16	-14,328	40,554
1986	-9	-3,458	37,096
1987	-22	-22,350	14,746
1988	-22	-20,895	-6,149
1989	-15	-12,038	-18,187
1990	-17	-14,210	-32,397
1991	-6	-2,305	-34,702
1992	38	45,699	10,997
1993	10	9,487	20,484
1994	-27	-30,849	-10,365
1995	17	17,786	7,421
1996	-7	-26,213	-18,792
1997	-3	-1,497	-20,289
1998	14	31,321	11,032
1999	-15	-8,134	2,898
2000	-14	-15,417	-12,519
2001	-10	-11,244	-23,763
2002	-13	-12,902	-36,665
2003	-5	-6,578	-43,243
2004	-14	-14,377	-57,620
2005	44	45,908	-11,712
2006	-23	-18,090	-29,802
2007	-22	-14,901	-44,703
2008	-5	-4,780	-49,483
2009	-13	-25,204	-74,687
2010	8	14,969	-59,718
2011	10	12,439	-47,279


Cajon Sub-Basin
Well
Cajon No. 3 and State Well
Cajon Well No 2
215
Cajon Creek
15
Lytle Creek
Mt Vernon Well
Riverside Drive
210
Baseline and California
Highland Avenue
0 0.5 1 2
Miles
Path: \\Gisws\gisprojects\1422ChangeInStorage\1422CIS2012\WorkingData\aSubBasinMXDsforMaps\CajonSubBasinArea2007.mxd

Hydrographs for the Cajon Sub-Basin Wells



San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

CAJON SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	**E-6W BASELINE 1N4W32N** Source	**CAJON NO 1 1N5W03H01S** Source	**DARBY 1N4W29E01S** Source	**MT VERNON WELL 1N4W31A01S** Source	**CAJON NO 2 1N5W03H02** Substitute	**MONITOR WELL 2N5W33K01** Added Source	**CAJON N0 3 1N5W03A02** Substitute
1934	-135.00	-140.00	-225.00	-185.00			
1935	-138.00	-131.00	-226.00	-187.00			
1936	-140.00	-141.00	-230.00	-190.00			
1937	-140.00	-103.00	-230.00	-190.00			
1938	-121.00	-78.00	-217.00	-171.00			
1939	-113.00	-122.00	-185.00	-144.00			
1940	-88.00	-132.00	-176.00	-138.00			
1941	-91.00	-76.00	-170.00	-128.00			
1942	-77.00	-129.00	-155.00	-119.00			
1943	-64.00	-113.00	-149.00	-109.00			
1944	-50.00	-100.00	-136.00	-100.00			
1945	-52.00	-111.00	-131.00	-102.00			
1946	-55.00	-131.00	-140.00	-103.00			
1947	-68.00	-128.00	-153.00	-117.00			
1948	-79.00	-150.00	-166.00	-130.00			
1949	-92.00	-163.00	-181.00	-145.00			
1950	-106.00	-155.00	-190.00	-159.00			
1951	-118.00	-164.00	-205.00	-174.00			
1952	-124.00	-125.00	-220.00	-183.00			
1953	-135.00	-139.00	-242.00	-193.00			
1954	-140.00	-148.00	-241.00	-200.00			
1955	-145.00	-168.00	-246.00	-205.00			
1956	-154.00	-199.00	-254.00	-211.00			
1957	-161.00	-167.00	-259.00	-219.00			
1958	-159.00	-119.00	-264.00	-227.00			
1959	-168.00	-132.00	-268.00	-235.00			
1960	-173.00	-149.00	-273.00	-239.00			
1961	-181.00	-183.00	-278.00	-244.00			
1962	-187.00	-189.00	-282.00	-248.00			

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

CAJON SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	E-6W BASELINE 1N4W32N Source	CAJON NO 1 1N5W03H01S Source	DARBY 1N4W29E01S Source	MT VERNON WELL 1N4W31A01S Source	CAJON NO 2 1N5W03H02 Substitute	MONITOR WELL 2N5W33K01 Added Source	CAJON N0 3 1N5W03A02 Substitute
1963	-192.00	-179.00	-287.00	-253.00			
1964	-204.00	-180.00	-301.00	-263.00			
1965	-214.00	-181.00	-312.00	-274.00			
1966	-220.00	-187.00	-326.00	-283.00			
1967	-223.00	-175.00	-320.00	-284.00			
1968	-226.00	-162.00	-301.00	-291.00			
1969	-185.00	-104.00	-282.00	-245.00			
1970	-171.00	-135.00	-269.00	-229.00			
1971	-160.00	-158.00	-258.00	-213.00			
1972	-162.00	-188.00	-256.00	-217.00			
1973	-160.00	-141.00	-260.00	-219.00			
1974	-170.00	-134.00	-267.00	-222.00			
1975	-170.00	-166.00	-268.00	-224.00			
1976	-176.00	-178.00	-273.00	-127.00			
1977	-181.00	-183.00	-278.00	-239.00			
1978	-137.00	-76.00	-258.00	-208.00			
1979	-132.00	-100.00	-265.00	-189.00			
1980	-79.00	-75.00	-190.00	-122.00			
1981	-66.00	-43.00	-179.00	-111.00			
1982	-71.00	-160.00		-112.00			
1983	-43.00	-90.00		-101.00			
1984	-46.00	-138.00		-98.00			
1985	-62.00	-151.00		-117.00			
1986	-84.00	-136.00		-136.00			
1987	-99.00	-166.00		-158.00			
1988	-120.00	-195.00		-175.00			
1989	-140.00	-203.00		-192.00			
1990	-160.00	-211.00		-215.00			
1991	-173.00	-196.00		-234.00			

San Bernardino Valley Municipal Water District

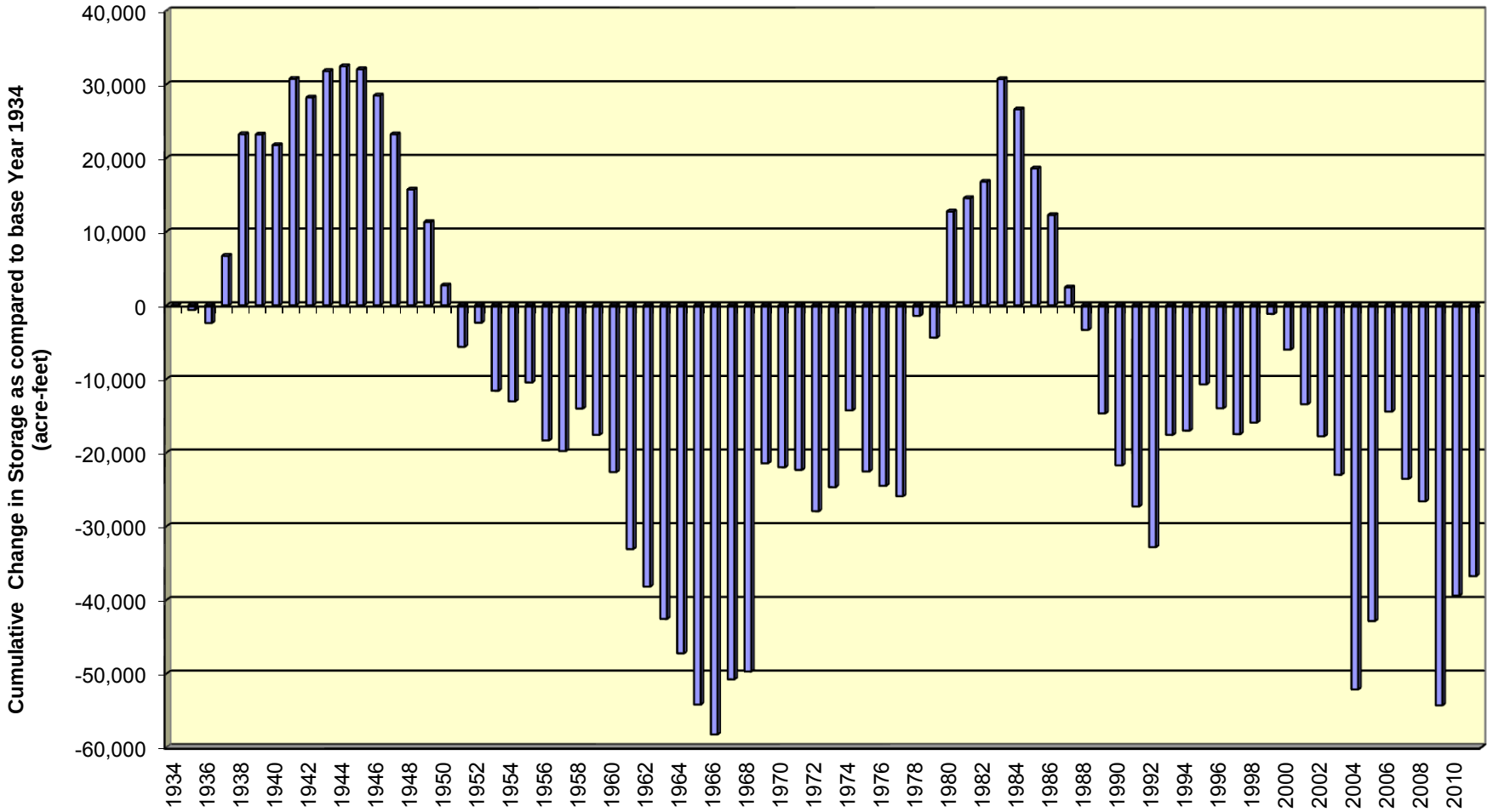
Change in Storage for the San Bernardino Basin Area 1934 - 2011

CAJON SUB-BASIN

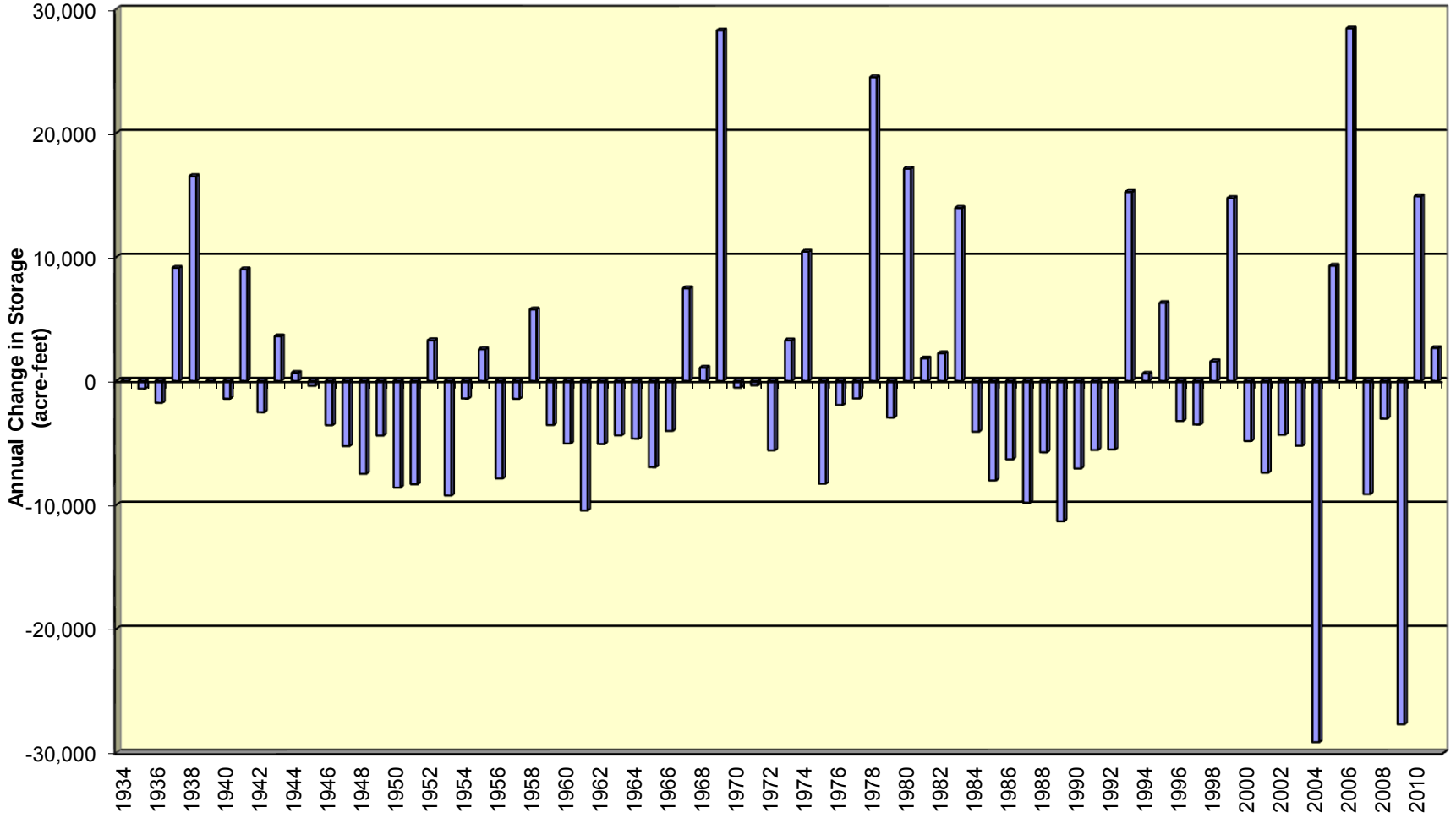
Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	**E-6W BASELINE 1N4W32N** Source	**CAJON NO 1 1N5W03H01S** Source	**DARBY 1N4W29E01S** Source	**MT VERNON WELL 1N4W31A01S** Source	**CAJON NO 2 1N5W03H02** Substitute	**MONITOR WELL 2N5W33K01** Added Source	**CAJON N0 3 1N5W03A02** Substitute
1992	-182.00	-159.00		-147.00			
1993	-157.00	-76.00		-225.00			
1994	-169.00	-150.00		-221.00			
1995	-154.00	-104.00		-230.00			
1996	-154.00	-149.00		-207.00			
1997	-159.00	-150.00		-210.00			
1998	-153.00	-116.00		-207.00			
1999	-156.00	-153.80		-211.90		-83.33	
2000	-167.10	-189.70		-221.20		-83.07	
2001	-180.60	-200.40		-237.50	-203.60	-83.12	
2002	-196.50	-214.10		-255.70	-218.10	-84.24	
2003	-217.00	-209.60		-272.70	-210.00	-83.00	
2004	-237.00			-294.60	-223.30	-83.45	
2005	-223.60			-289.30	-88.10	-59.84	-81.70
2006	-242.00			-298.00	-126.29	-70.63	-122.00
2007	-248.64			-296.78	-171.00	-83.48	-168.50
2008	-256.00			-301.16	-178.00	-83.48	-174.38
2009	-265.00			-319.00	-190.90		-184.80
2010	-265.00			-323.00	-153.00		-184.80
2011	-270.20			-325.20	-117.50		-114.10

Cumulative Change in Storage for the Devil Canyon Sub-Basin



Annual Change in Storage for the Devil Canyon Sub-Basin



San Bernardino Valley Municipal Water District

Change In Storage for the Devil Canyon Sub-basin 1934 - 2010

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1934	0	n/a	0
1935	0	-635	-635
1936	-3	-1,769	-2,404
1937	17	9,114	6,710
1938	31	16,514	23,224
1939	1	-45	23,179
1940	-8	-1,440	21,739
1941	12	8,997	30,736
1942	-2	-2,536	28,200
1943	5	3,596	31,796
1944	1	646	32,442
1945	-2	-399	32,043
1946	-6	-3,572	28,471
1947	-9	-5,269	23,202
1948	-13	-7,490	15,712
1949	-8	-4,409	11,303
1950	-15	-8,602	2,701
1951	-14	-8,346	-5,645
1952	9	3,277	-2,368
1953	-17	-9,239	-11,607
1954	-1	-1,422	-13,029
1955	-7	2,555	-10,474
1956	-14	-7,872	-18,346
1957	1	-1,442	-19,788
1958	13	5,764	-14,024
1959	-6	-3,562	-17,586
1960	-8	-5,048	-22,634
1961	-17	-10,460	-33,094
1962	-8	-5,093	-38,187
1963	-5	-4,393	-42,580
1964	-7	-4,666	-47,246
1965	-10	-6,959	-54,205
1966	-6	-4,037	-58,242
1967	16	7,468	-50,774
1968	3	1,062	-49,712
1969	47	28,267	-21,445
1970	-2	-542	-21,987
1971	-4	-364	-22,351
1972	-12	-5,604	-27,955
1973	7	3,270	-24,685
1974	12	10,425	-14,260
1975	-10	-8,298	-22,558
1976	-6	-1,945	-24,503
1977	-1	-1,418	-25,921

San Bernardino Valley Municipal Water District

Change In Storage for the Devil Canyon Sub-basin 1934 - 2011

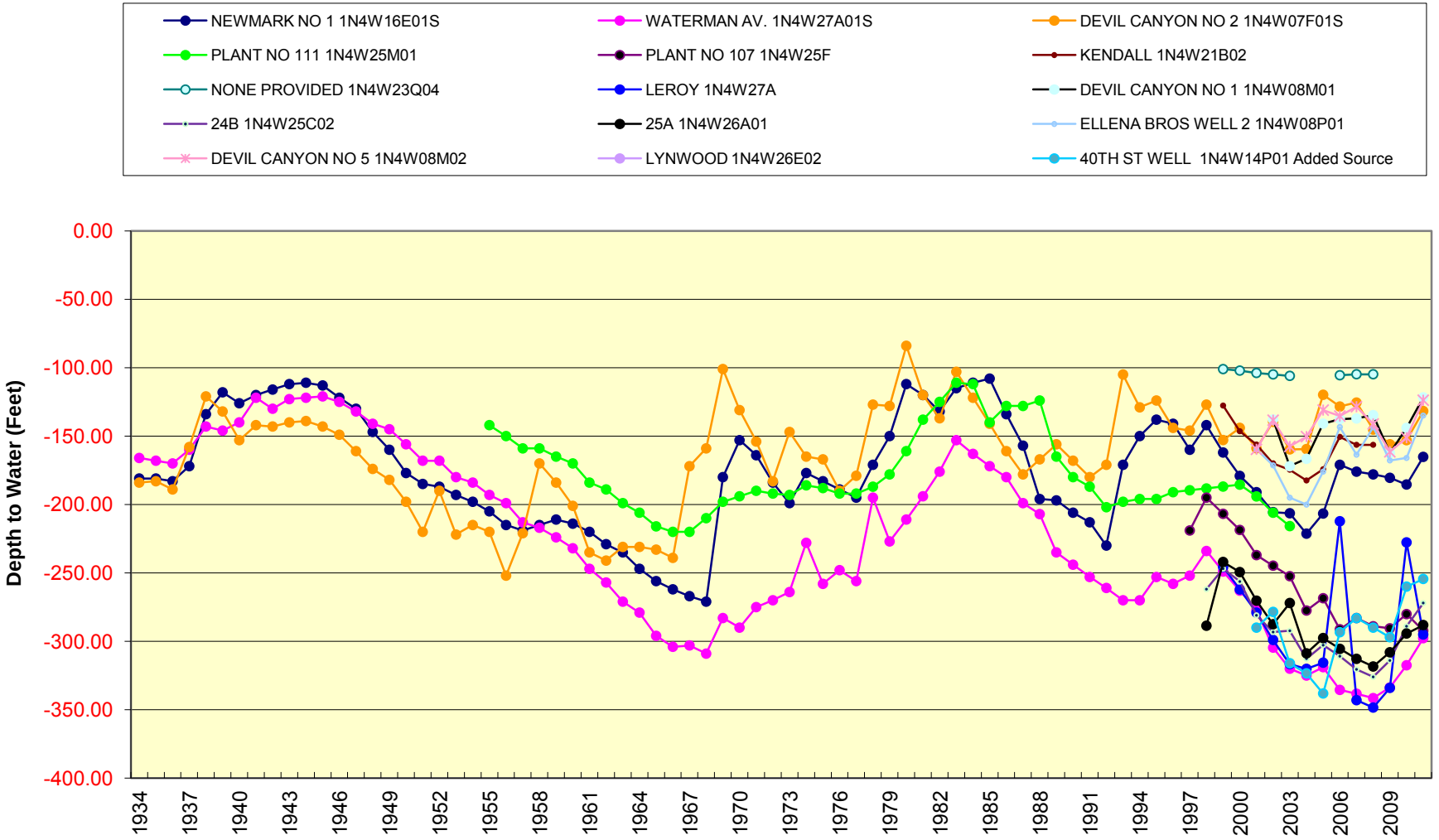
(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1934	0	n/a	0
1935	0	-635	-635
1936	-3	-1,769	-2,404
1937	17	9,114	6,710
1938	31	16,514	23,224
1939	1	-45	23,179
1940	-8	-1,440	21,739
1941	12	8,997	30,736
1942	-2	-2,536	28,200
1943	5	3,596	31,796
1944	1	646	32,442
1945	-2	-399	32,043
1946	-6	-3,572	28,471
1947	-9	-5,269	23,202
1948	-13	-7,490	15,712
1949	-8	-4,409	11,303
1950	-15	-8,602	2,701
1951	-14	-8,346	-5,645
1952	9	3,277	-2,368
1953	-17	-9,239	-11,607
1954	-1	-1,422	-13,029
1955	-7	2,555	-10,474
1956	-14	-7,872	-18,346
1957	1	-1,442	-19,788
1958	13	5,764	-14,024
1959	-6	-3,562	-17,586
1960	-8	-5,048	-22,634
1961	-17	-10,460	-33,094
1962	-8	-5,093	-38,187
1963	-5	-4,393	-42,580
1964	-7	-4,666	-47,246
1965	-10	-6,959	-54,205
1966	-6	-4,037	-58,242
1967	16	7,468	-50,774
1968	3	1,062	-49,712
1969	47	28,267	-21,445
1970	-2	-542	-21,987
1971	-4	-364	-22,351
1972	-12	-5,604	-27,955
1973	7	3,270	-24,685
1974	12	10,425	-14,260
1975	-10	-8,298	-22,558
1976	-6	-1,945	-24,503
1977	-1	-1,418	-25,921

San Bernardino Valley Municipal Water District

Change In Storage for the Devil Canyon Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1978	36	24,493	-1,428
1979	-1	-2,963	-4,391
1980	29	17,117	12,726
1981	-1	1,812	14,538
1982	1	2,224	16,762
1983	22	13,938	30,700
1984	-7	-4,102	26,598
1985	-13	-8,029	18,569
1986	-11	-6,328	12,241
1987	-15	-9,819	2,422
1988	-8	-5,764	-3,342
1989	-15	-11,326	-14,668
1990	-11	-7,063	-21,731
1991	-9	-5,576	-27,307
1992	-8	-5,528	-32,835
1993	30	15,236	-17,599
1994	0	579	-17,020
1995	9	6,283	-10,737
1996	-6	-3,236	-13,973
1997	-3	-3,519	-17,492
1998	16	1,572	-15,920
1999	-14	14,749	-1,171
2000	-9	-4,853	-6,024
2001	-14	-7,407	-13,431
2002	-7	-4,345	-17,776
2003	-13	-5,237	-23,013
2004	8	-29,138	-52,151
2005	13	9,289	-42,862
2006	13	28,432	-14,430
2007	-12	-9,131	-23,561
2008	-3	-3,047	-26,608
2009	-3	-27,693	-54,301
2010	21	14,894	-39,407
2011	10	2,648	-36,759

Hydrograph for the Devil Canyon Sub-Basin Wells



San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

DEVIL CANYON SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	**NEWMARK NO 1** **1N4W16E01S** Source	**WATERMAN AV.** **1N4W27A01S** Source	**DEVIL CANYON NO 2** **1N4W07F01S** Source	**PLANT NO 111** **1N4W25M01** Source	**PLANT NO 107** **1N4W25F** Substitute	**KENDALL** **1N4W21B02** Added Source	**NONE PROVIDED** **1N4W23Q04** Added Source
1934	-181.00	-166.00	-184.00				
1935	-181.00	-168.00	-183.00				
1936	-183.00	-170.00	-189.00				
1937	-172.00	-160.00	-158.00				
1938	-134.00	-143.00	-121.00				
1939	-118.00	-146.00	-132.00				
1940	-126.00	-140.00	-153.00				
1941	-120.00	-122.00	-142.00				
1942	-116.00	-130.00	-143.00				
1943	-112.00	-123.00	-140.00				
1944	-111.00	-122.00	-139.00				
1945	-113.00	-121.00	-143.00				
1946	-122.00	-125.00	-149.00				
1947	-130.00	-132.00	-161.00				
1948	-147.00	-141.00	-174.00				
1949	-160.00	-145.00	-182.00				
1950	-177.00	-156.00	-198.00				
1951	-185.00	-168.00	-220.00				
1952	-187.00	-168.00	-190.00				
1953	-193.00	-180.00	-222.00				
1954	-198.00	-184.00	-215.00				
1955	-205.00	-193.00	-220.00	-142.00			
1956	-215.00	-199.00	-252.00	-150.00			
1957	-219.00	-213.00	-221.00	-159.00			
1958	-215.00	-217.00	-170.00	-159.00			
1959	-211.00	-224.00	-184.00	-165.00			
1960	-214.00	-232.00	-201.00	-170.00			
1961	-220.00	-247.00	-235.00	-184.00			
1962	-229.00	-257.00	-241.00	-189.00			
1963	-235.00	-271.00	-231.00	-199.00			

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

DEVIL CANYON SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	NEWMARK NO 1 1N4W16E01S Source	WATERMAN AV. 1N4W27A01S Source	DEVIL CANYON NO 2 1N4W07F01S Source	PLANT NO 111 1N4W25M01 Source	PLANT NO 107 1N4W25F Substitute	KENDALL 1N4W21B02 Added Source	NONE PROVIDED 1N4W23Q04 Added Source
1964	-247.00	-279.00	-231.00	-206.00			
1965	-256.00	-296.00	-233.00	-216.00			
1966	-262.00	-304.00	-239.00	-220.00			
1967	-267.00	-303.00	-172.00	-220.00			
1968	-271.00	-309.00	-159.00	-210.00			
1969	-180.00	-283.00	-101.00	-198.00			
1970	-153.00	-290.00	-131.00	-194.00			
1971	-164.00	-275.00	-154.00	-190.00			
1972	-184.00	-270.00	-183.00	-192.00			
1973	-199.00	-264.00	-147.00	-193.00			
1974	-177.00	-228.00	-165.00	-186.00			
1975	-183.00	-258.00	-167.00	-188.00			
1976	-189.00	-248.00	-190.00	-192.00			
1977	-195.00	-256.00	-179.00	-192.00			
1978	-171.00	-195.00	-127.00	-187.00			
1979	-150.00	-227.00	-128.00	-178.00			
1980	-112.00	-211.00	-84.00	-161.00			
1981	-120.00	-194.00	-120.00	-138.00			
1982	-132.00	-176.00	-137.00	-125.00			
1983	-115.00	-153.00	-103.00	-111.00			
1984	-111.00	-163.00	-122.00	-112.00			
1985	-108.00	-172.00	-141.00	-140.00			
1986	-134.00	-180.00	-161.00	-128.00			
1987	-157.00	-199.00	-178.00	-128.00			
1988	-196.00	-207.00	-167.00	-124.00			
1989	-197.00	-235.00	-156.00	-165.00			
1990	-206.00	-244.00	-168.00	-180.00			
1991	-213.00	-253.00	-180.00	-187.00			
1992	-230.00	-261.00	-171.00	-202.00			
1993	-171.00	-270.00	-105.00	-198.00			

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

DEVIL CANYON SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	**NEWMARK NO 1** **1N4W16E01S** Source	**WATERMAN AV.** **1N4W27A01S** Source	**DEVIL CANYON NO 2** **1N4W07F01S** Source	**PLANT NO 111** **1N4W25M01** Source	**PLANT NO 107** **1N4W25F** Substitute	**KENDALL** **1N4W21B02** Added Source	**NONE PROVIDED** **1N4W23Q04** Added Source
1994	-150.00	-270.00	-129.00	-196.00			
1995	-138.00	-253.00	-124.00	-196.00			
1996	-141.00	-258.00	-144.00	-191.00			
1997	-160.00	-252.00	-146.00	-189.60	-219.00		
1998	-142.00	-234.00	-127.00	-188.30	-195.00		
1999	-162.00	-249.00	-152.90	-186.90	-206.80	-127.70	-101.04
2000	-179.10	-263.00	-144.00	-185.50	-218.60	-146.46	-102.14
2001	-191.00	-277.00	-158.90	-194.10	-237.00	-156.15	-103.87
2002	-205.60	-304.60	-139.60	-206.00	-244.70	-169.92	-104.92
2003	-206.40	-320.00	-159.70	-215.80	-252.40	-174.55	-105.98
2004	-221.30	-325.00	-159.50		-277.50	-182.43	
2005	-206.60	-318.90	-119.80		-268.50	-174.24	
2006	-171.00	-335.50	-128.41		-291.20	-150.57	-105.52
2007	-176.00	-338.30	-125.52		-283.00	-156.37	-104.80
2008	-178.00	-341.50	-145.27		-289.00	-156.37	-104.80
2009	-180.50	-333.80	-156.00		-290.50		
2010	-185.40	-317.50	-153.00		-280.10		
2011	-165.20	-297.70	-131.70		-292.30		

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

DEVIL CANYON SUB-BASIN

'Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft).

Year	LEROY 1N4W27A Substitute	DEVIL CANYON NO 1 1N4W08M01 Added Source	24B 1N4W25C02 Substitute	25A 1N4W26A01 Substitute	ELLENA BROS WELL 2 1N4W08P01 Added Source	DEVIL CANYON NO 5 1N4W08M02 Added Source	40TH ST WELL 1N4W14P01 Added Source
1934							
1935							
1936							
1937							
1938							
1939							
1940							
1941							
1942							
1943							
1944							
1945							
1946							
1947							
1948							
1949							
1950							
1951							
1952							
1953							
1954							
1955							
1956							
1957							
1958							
1959							
1960							
1961							
1962							
1963							

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

DEVIL CANYON SUB-BASIN

'Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft).

Year	LEROY 1N4W27A Substitute	DEVIL CANYON NO 1 1N4W08M01 Added Source	24B 1N4W25C02 Substitute	25A 1N4W26A01 Substitute	ELLENA BROS WELL 2 1N4W08P01 Added Source	DEVIL CANYON NO 5 1N4W08M02 Added Source	40TH ST WELL 1N4W14P01 Added Source
1964							
1965							
1966							
1967							
1968							
1969							
1970							
1971							
1972							
1973							
1974							
1975							
1976							
1977							
1978							
1979							
1980							
1981							
1982							
1983							
1984							
1985							
1986							
1987							
1988							
1989							
1990							
1991							
1992							
1993							

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

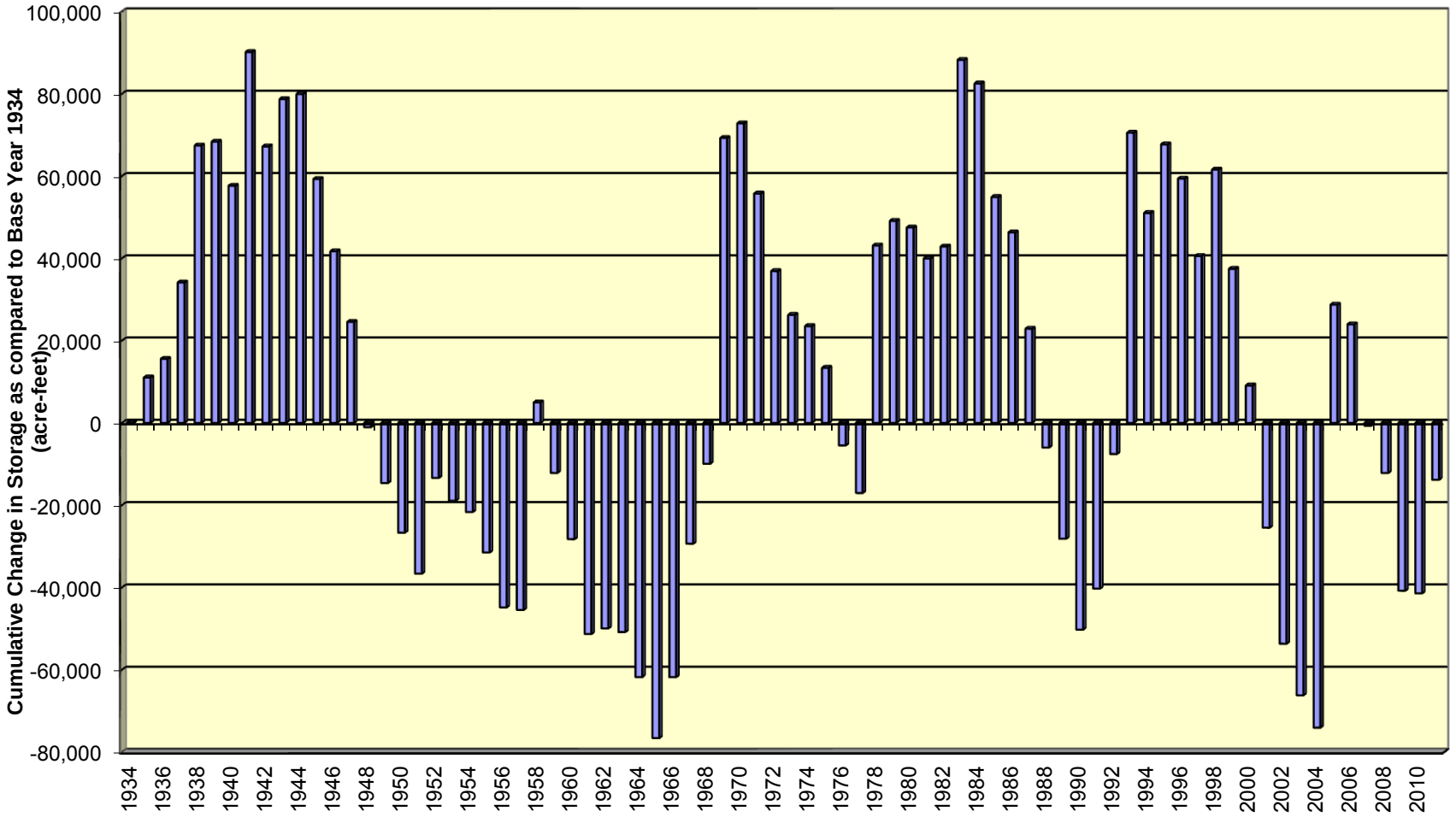
DEVIL CANYON SUB-BASIN

'Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

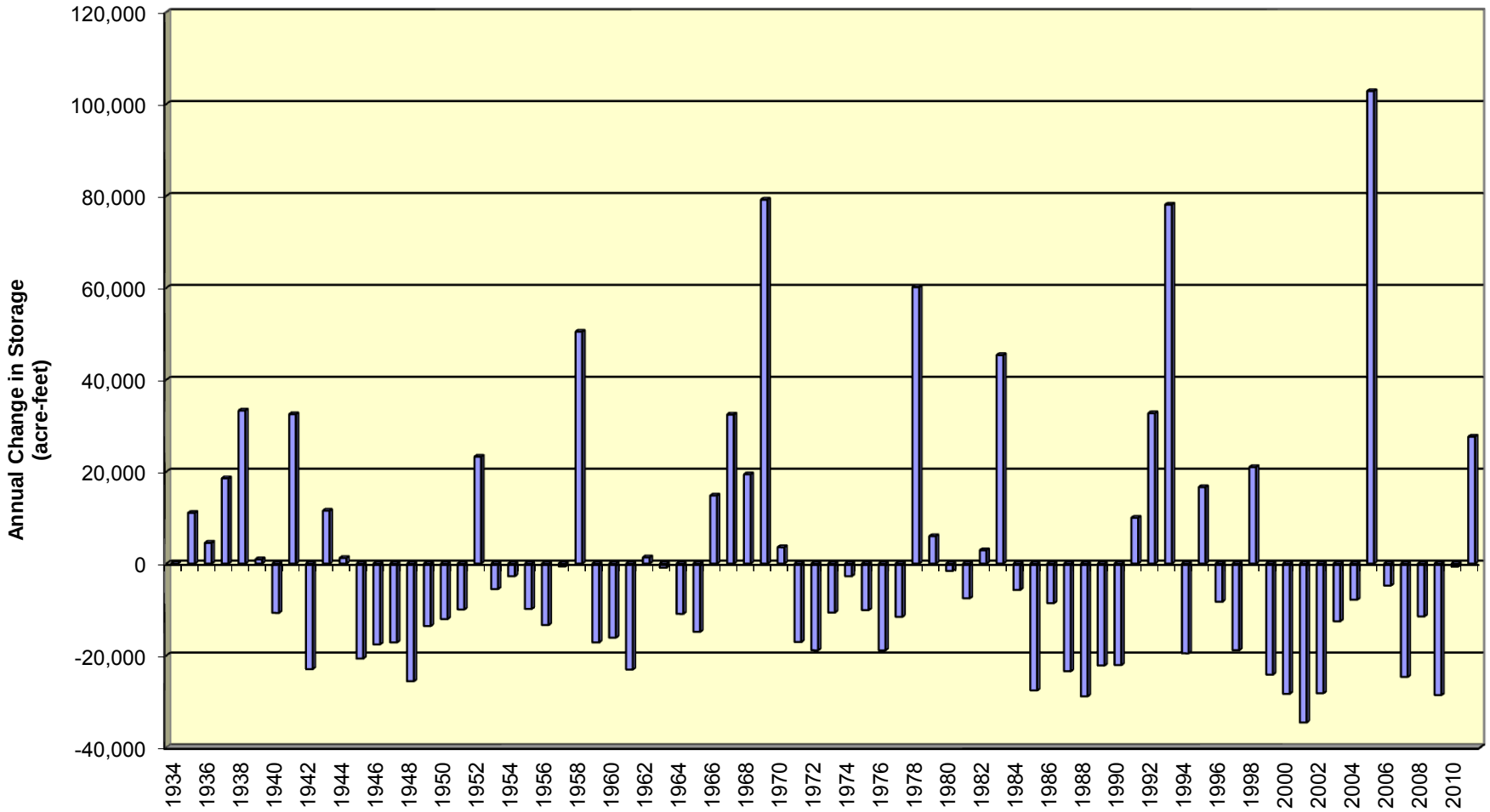
Depth to Water (ft).

Year	LEROY 1N4W27A Substitute	DEVIL CANYON NO 1 1N4W08M01 Added Source	24B 1N4W25C02 Substitute	25A 1N4W26A01 Substitute	ELLENA BROS WELL 2 1N4W08P01 Added Source	DEVIL CANYON NO 5 1N4W08M02 Added Source	40TH ST WELL 1N4W14P01 Added Source
1994							
1995							
1996							
1997							
1998			-261.90	-288.60			
1999	-245.70		-246.90	-242.00			
2000	-262.10		-256.30	-249.40			
2001	-279.00		-281.00	-270.30	-159.70	-159.70	-290.00
2002	-299.00	-137.90	-293.20	-287.50	-171.40	-138.40	-278.50
2003	-316.70	-172.00	-292.30	-272.00	-195.00	-157.60	-316.00
2004	-320.10	-166.60	-312.70	-308.80	-200.10	-150.40	-323.40
2005	-315.60	-140.90	-302.80	-297.60	-176.00	-131.00	-338.10
2006	-212.25	-137.55	-310.90	-305.50	-143.37	-135.35	-293.35
2007	-343.00	-137.15	-320.50	-312.80	-163.62	-128.54	-283.03
2008	-348.40	-134.70	-326.00	-318.40	-143.51	-141.16	-290.00
2009	-334.00	-162.50	-314.00	-308.00	-167.80	-161.50	-297.00
2010	-227.70	-144.00	-289.00	-294.30	-166.00	-151.20	-260.00
2011	-295.00	-121.70	-272.00	-288.10	-135.00	-123.80	-254.40

Cumulative Change in Storage for the Lytle Creek Sub-Basin



Annual Change in Storage for the Lytle Creek Sub-Basin



San Bernardino Valley Municipal Water District

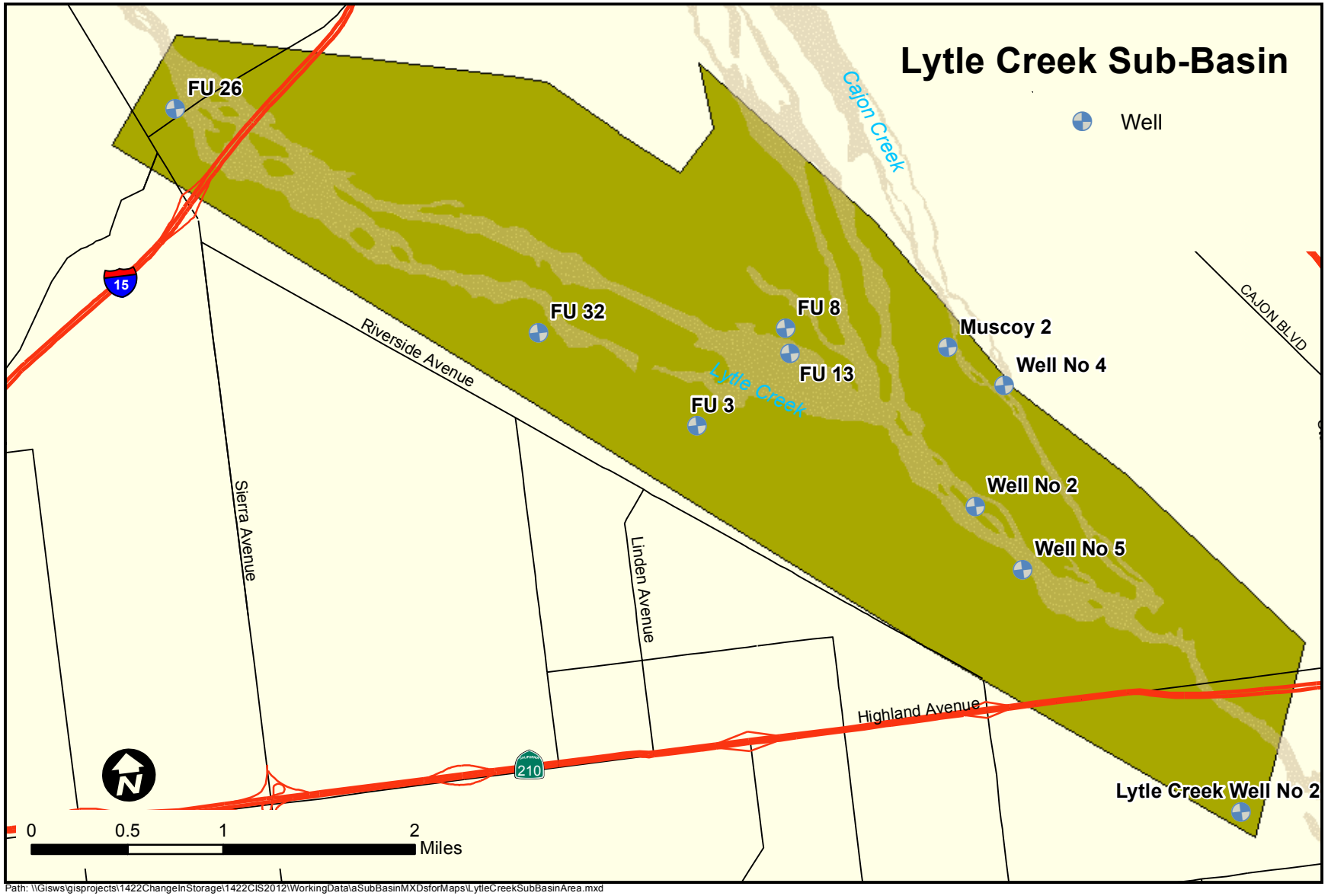
Change In Storage for the Lytle Creek Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1934	0	n/a	0
1935	16	11,039	11,039
1936	3	4,524	15,563
1937	30	18,561	34,124
1938	62	33,297	67,421
1939	9	926	68,347
1940	-18	-10,717	57,630
1941	50	32,509	90,139
1942	-32	-22,956	67,183
1943	15	11,515	78,698
1944	2	1,224	79,922
1945	-32	-20,656	59,266
1946	-27	-17,567	41,699
1947	-27	-17,153	24,546
1948	-39	-25,594	-1,048
1949	-19	-13,579	-14,627
1950	-22	-12,057	-26,684
1951	-17	-9,964	-36,648
1952	30	23,256	-13,392
1953	-3	-5,523	-18,915
1954	-4	-2,738	-21,653
1955	-14	-9,853	-31,506
1956	-18	-13,361	-44,867
1957	-3	-596	-45,463
1958	68	50,451	4,988
1959	-26	-17,150	-12,162
1960	-22	-16,108	-28,270
1961	-28	-23,046	-51,316
1962	0	1,366	-49,950
1963	1	-885	-50,835
1964	-21	-10,938	-61,773
1965	-25	-14,831	-76,604
1966	18	14,805	-61,799
1967	53	32,429	-29,370
1968	33	19,431	-9,939
1969	129	79,194	69,255
1970	9	3,552	72,807
1971	-21	-17,053	55,754
1972	-27	-18,851	36,903
1973	-17	-10,643	26,260
1974	-7	-2,741	23,519
1975	-13	-10,131	13,388
1976	-26	-18,859	-5,471
1977	-20	-11,573	-17,044

San Bernardino Valley Municipal Water District

Change In Storage for the Lytle Creek Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1978	103	60,162	43,118
1979	10	5,964	49,082
1980	6	-1,588	47,494
1981	-18	-7,544	39,950
1982	1	2,912	42,862
1983	56	45,372	88,234
1984	-13	-5,730	82,504
1985	-38	-27,599	54,905
1986	-13	-8,602	46,303
1987	-36	-23,422	22,881
1988	-47	-28,867	-5,986
1989	-35	-22,178	-28,164
1990	-41	-22,083	-50,247
1991	5	9,959	-40,288
1992	35	32,721	-7,567
1993	139	78,106	70,539
1994	-21	-19,516	51,023
1995	30	16,655	67,678
1996	-13	-8,288	59,390
1997	-29	-18,815	40,575
1998	27	21,005	61,580
1999	-31	-24,144	37,436
2000	-57	-28,334	9,102
2001	-27	-34,576	-25,474
2002	-42	-28,205	-53,679
2003	-33	-12,542	-66,221
2004	-18	-7,866	-74,087
2005	153	102,835	28,748
2006	-9	-4,791	23,957
2007	-31	-24,651	-694
2008	-18	-11,482	-12,176
2009	-35	-28,620	-40,796
2010	26	-640	-41,436
2011	45	27,617	-13,819



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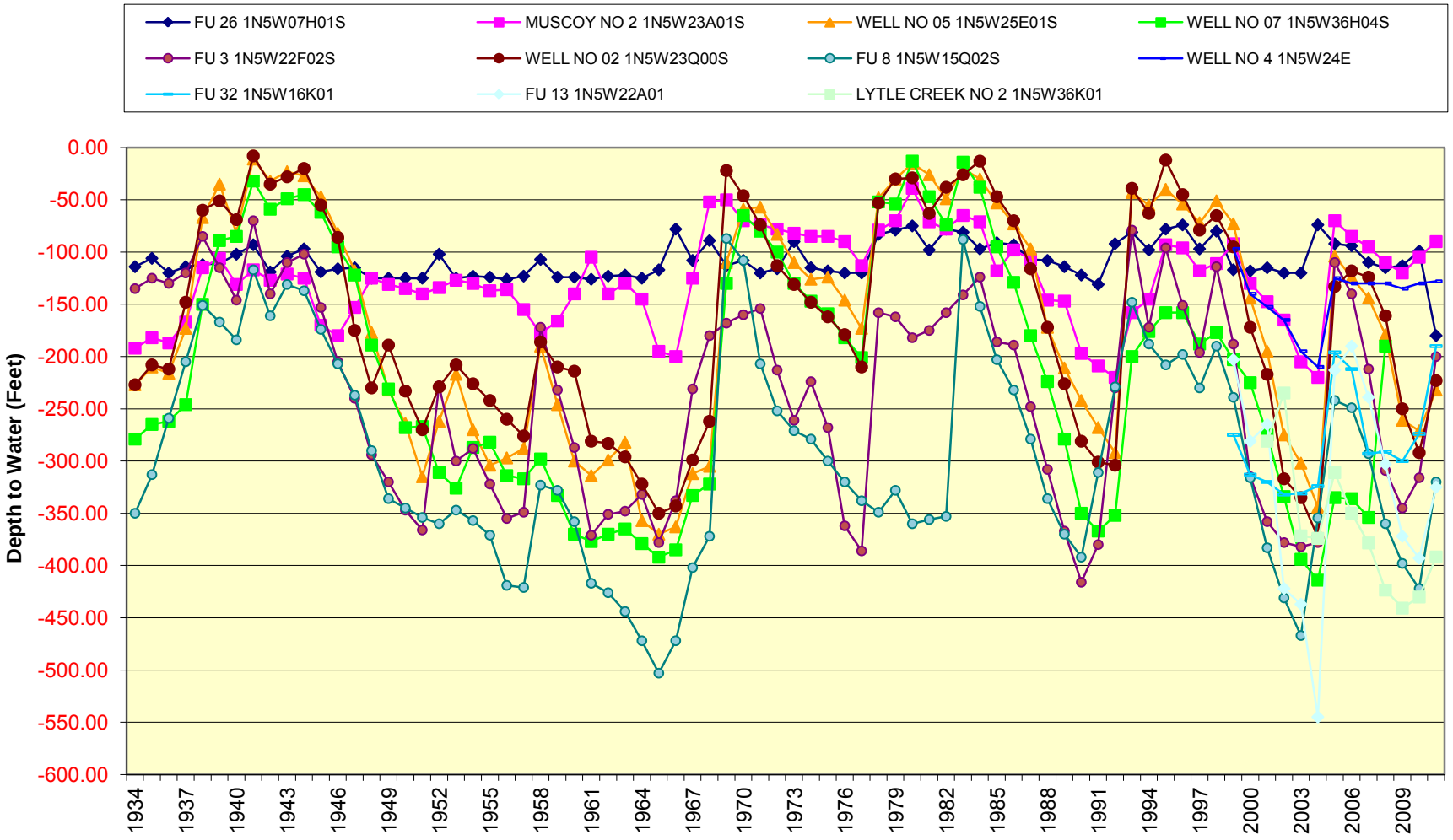
Hydrograph for the Lytle Creek Sub-Basin Wells



San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

LYTLE CREEK SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	FU 26 1N5W07H01S Source	MUSCOY NO 2 1N5W23A01S Source	WELL NO 05 1N5W25E01S Source	WELL NO 07 1N5W36H04S Source	FU 3 1N5W22F02S Source	WELL NO 02 1N5W23Q00S Source	FU 8 1N5W15Q02S Source
1934	-114.00	-192.00	-227.00	-279.00	-135.00	-227.00	-350.00
1935	-106.00	-182.00	-210.00	-265.00	-125.00	-208.00	-313.00
1936	-120.00	-187.00	-216.00	-262.00	-130.00	-212.00	-259.00
1937	-114.00	-167.00	-173.00	-246.00	-120.00	-148.00	-205.00
1938	-112.00	-115.00	-67.00	-150.00	-85.00	-60.00	-151.00
1939	-111.00	-106.00	-35.00	-89.00	-115.00	-51.00	-167.00
1940	-102.00	-131.00	-82.00	-85.00	-146.00	-69.00	-184.00
1941	-93.00	-117.00	-11.00	-32.00	-70.00	-8.00	-117.00
1942	-119.00	-127.00	-32.00	-59.00	-140.00	-35.00	-161.00
1943	-104.00	-121.00	-23.00	-49.00	-110.00	-28.00	-131.00
1944	-97.00	-125.00	-27.00	-45.00	-102.00	-20.00	-137.00
1945	-119.00	-170.00	-47.00	-62.00	-153.00	-55.00	-174.00
1946	-116.00	-180.00	-82.00	-95.00	-205.00	-86.00	-207.00
1947	-115.00	-153.00	-118.00	-122.00	-240.00	-175.00	-237.00
1948	-125.00	-125.00	-177.00	-189.00	-294.00	-230.00	-290.00
1949	-125.00	-131.00	-232.00	-231.00	-320.00	-189.00	-336.00
1950	-125.00	-135.00	-264.00	-268.00	-347.00	-233.00	-345.00
1951	-125.00	-140.00	-315.00	-267.00	-366.00	-270.00	-354.00
1952	-102.00	-134.00	-262.00	-311.00	-228.00	-229.00	-360.00
1953	-125.00	-127.00	-217.00	-326.00	-300.00	-208.00	-347.00
1954	-123.00	-130.00	-270.00	-287.00	-288.00	-226.00	-357.00
1955	-124.00	-137.00	-304.00	-282.00	-322.00	-242.00	-371.00
1956	-126.00	-136.00	-297.00	-314.00	-355.00	-260.00	-419.00
1957	-123.00	-155.00	-288.00	-317.00	-349.00	-276.00	-421.00
1958	-107.00	-178.00	-190.00	-298.00	-172.00	-186.00	-323.00
1959	-124.00	-166.00	-246.00	-333.00	-232.00	-210.00	-328.00
1960	-124.00	-140.00	-300.00	-370.00	-287.00	-214.00	-358.00
1961	-126.00	-105.00	-314.00	-377.00	-371.00	-281.00	-417.00
1962	-123.00	-140.00	-299.00	-370.00	-351.00	-283.00	-426.00
1963	-122.00	-130.00	-282.00	-365.00	-348.00	-296.00	-444.00

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

LYTLE CREEK SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
	FU 26 1N5W07H01S	**MUSCOY NO 2 1N5W23A01S**	**WELL NO 05 1N5W25E01S**	**WELL NO 07 1N5W36H04S**	**FU 3 1N5W22F02S**	**WELL NO 02 1N5W23Q00S**	**FU 8 1N5W15Q02S**
Year	Source	Source	Source	Source	Source	Source	Source
1964	-125.00	-145.00	-357.00	-379.00	-332.00	-322.00	-472.00
1965	-117.00	-195.00	-370.00	-392.00	-378.00	-350.00	-503.00
1966	-78.00	-200.00	-363.00	-385.00	-338.00	-343.00	-472.00
1967	-108.00	-125.00	-312.00	-333.00	-231.00	-299.00	-402.00
1968	-89.00	-52.00	-305.00	-322.00	-180.00	-262.00	-372.00
1969	-113.00	-50.00	-110.00	-130.00	-168.00	-22.00	-87.00
1970	-108.00	-70.00	-59.00	-65.00	-160.00	-46.00	-108.00
1971	-120.00	-74.00	-57.00	-80.00	-154.00	-74.00	-207.00
1972	-116.00	-78.00	-83.00	-100.00	-213.00	-113.00	-252.00
1973	-90.00	-82.00	-110.00	-130.00	-261.00	-131.00	-271.00
1974	-115.00	-85.00	-126.00	-147.00	-224.00	-148.00	-279.00
1975	-118.00	-85.00	-124.00	-159.00	-268.00	-162.00	-300.00
1976	-120.00	-90.00	-146.00	-182.00	-362.00	-179.00	-320.00
1977	-120.00	-113.00	-173.00	-201.00	-386.00	-210.00	-338.00
1978	-83.00	-79.00	-48.00	-52.00	-158.00	-53.00	-349.00
1979	-79.00	-70.00	-30.00	-54.00	-162.00	-30.00	-328.00
1980	-75.00	-39.00	-15.00	-13.00	-182.00	-29.00	-360.00
1981	-98.00	-71.00	-26.00	-47.00	-175.00	-63.00	-356.00
1982	-78.00	-78.00	-49.00	-74.00	-158.00	-38.00	-353.00
1983	-81.00	-65.00	-20.00	-14.00	-141.00	-26.00	-88.00
1984	-97.00	-71.00	-30.00	-38.00	-124.00	-13.00	-152.00
1985	-91.00	-118.00	-53.00	-95.00	-186.00	-47.00	-203.00
1986	-93.00	-98.00	-73.00	-129.00	-189.00	-70.00	-232.00
1987	-107.00	-107.00	-97.00	-180.00	-248.00	-116.00	-279.00
1988	-108.00	-146.00	-172.00	-224.00	-308.00	-172.00	-336.00
1989	-114.00	-147.00	-211.00	-279.00	-367.00	-226.00	-370.00
1990	-122.00	-197.00	-242.00	-350.00	-416.00	-281.00	-392.00
1991	-131.00	-209.00	-268.00	-367.00	-380.00	-301.00	-311.00
1992	-92.00	-220.00	-292.00	-352.00	-230.00	-304.00	-229.00
1993	-81.00	-158.00	-43.00	-200.00	-79.00	-39.00	-148.00

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

LYTLE CREEK SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	**FU 26 1N5W07H01S** Source	**MUSCOY NO 2 1N5W23A01S** Source	**WELL NO 05 1N5W25E01S** Source	**WELL NO 07 1N5W36H04S** Source	**FU 3 1N5W22F02S** Source	**WELL NO 02 1N5W23Q00S** Source	**FU 8 1N5W15Q02S** Source
1994	-98.00	-145.00	-55.00	-176.00	-172.00	-63.00	-188.00
1995	-78.00	-93.00	-40.00	-158.00	-96.00	-12.00	-208.00
1996	-74.00	-96.00	-54.00	-158.00	-151.00	-45.00	-198.00
1997	-97.00	-118.00	-72.00	-188.00	-196.00	-79.00	-230.00
1998	-80.00	-111.00	-51.00	-177.00	-114.00	-65.00	-190.00
1999	-117.00	-92.00	-73.00	-203.00	-188.00	-95.00	-239.00
2000	-118.00	-130.00	-144.00	-225.00	-315.00	-172.00	-316.00
2001	-115.00	-147.50	-195.00	-275.00	-358.00	-217.00	-383.00
2002	-120.00	-165.00	-275.00	-334.00	-378.00	-317.00	-431.00
2003	-120.00	-205.00	-302.00	-394.00	-382.00	-335.00	-467.00
2004	-74.00	-220.00	-344.00	-414.00	-378.00	-373.00	-354.50
2005	-92.00	-70.00	-104.00	-335.00	-110.00	-133.00	-242.00
2006	-94.00	-85.00	-124.00	-336.00	-140.00	-118.00	-249.00
2007	-110.00	-95.00	-144.00	-354.00	-212.00	-124.00	-293.00
2008	-115.00	-110.00	-179.00	-190.00	-309.00	-161.00	-360.00
2009	-113.00	-120.00	-261.00		-345.00	-250.00	-398.00
2010	-99.00	-105.00	-271.00		-316.00	-292.00	-422.00
2011	-180.00	-90.00	-232.00		-200.00	-223.00	-320.00

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

LYTLE CREEK SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft)						
Year	**WELL NO 4 1N5W24E** Added Source	**FU 32 1N5W16K01** Substitute	**FU 13 1N5W22A01** Substitute	**LYTLE CREEK NO 2 1N5W36K01** Added Source			
1934							
1935							
1936							
1937							
1938							
1939							
1940							
1941							
1942							
1943							
1944							
1945							
1946							
1947							
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1954							
1955							
1956							
1957							
1958							
1959							
1960							
1961							
1962							
1963							

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

LYTLE CREEK SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft)						
Year	**WELL NO 4 1N5W24E** Added Source	**FU 32 1N5W16K01** Substitute	**FU 13 1N5W22A01** Substitute	**LYTLE CREEK NO 2 1N5W36K01** Added Source			
1964							
1965							
1966							
1967							
1968							
1969							
1970							
1971							
1972							
1973							
1974							
1975							
1976							
1977							
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1984							
1985							
1986							
1987							
1988							
1989							
1990							
1991							
1992							
1993							

San Bernardino Valley Municipal Water District

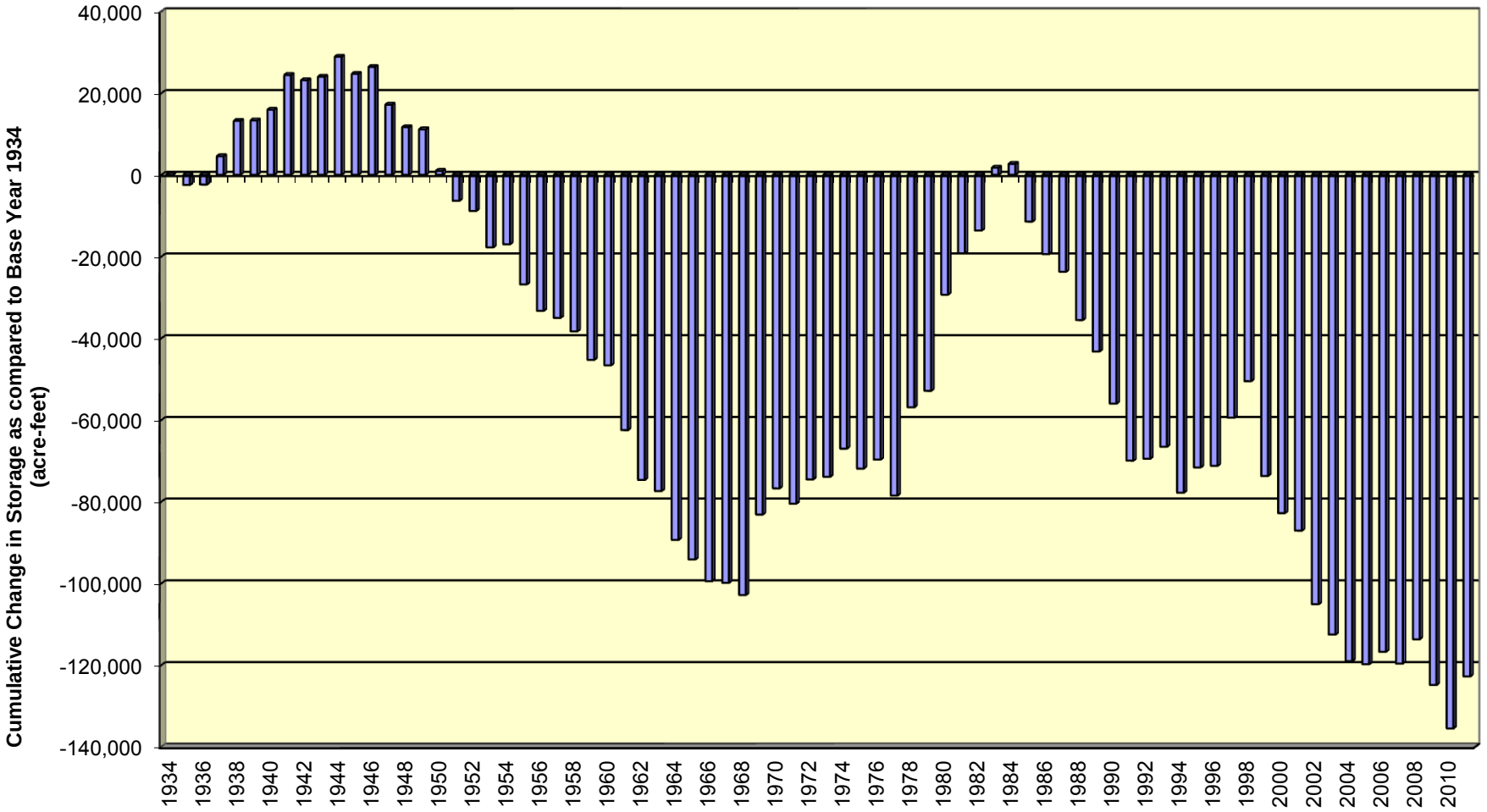
Change in Storage for the San Bernardino Basin Area 1934 - 2011

LYTLE CREEK SUB-BASIN

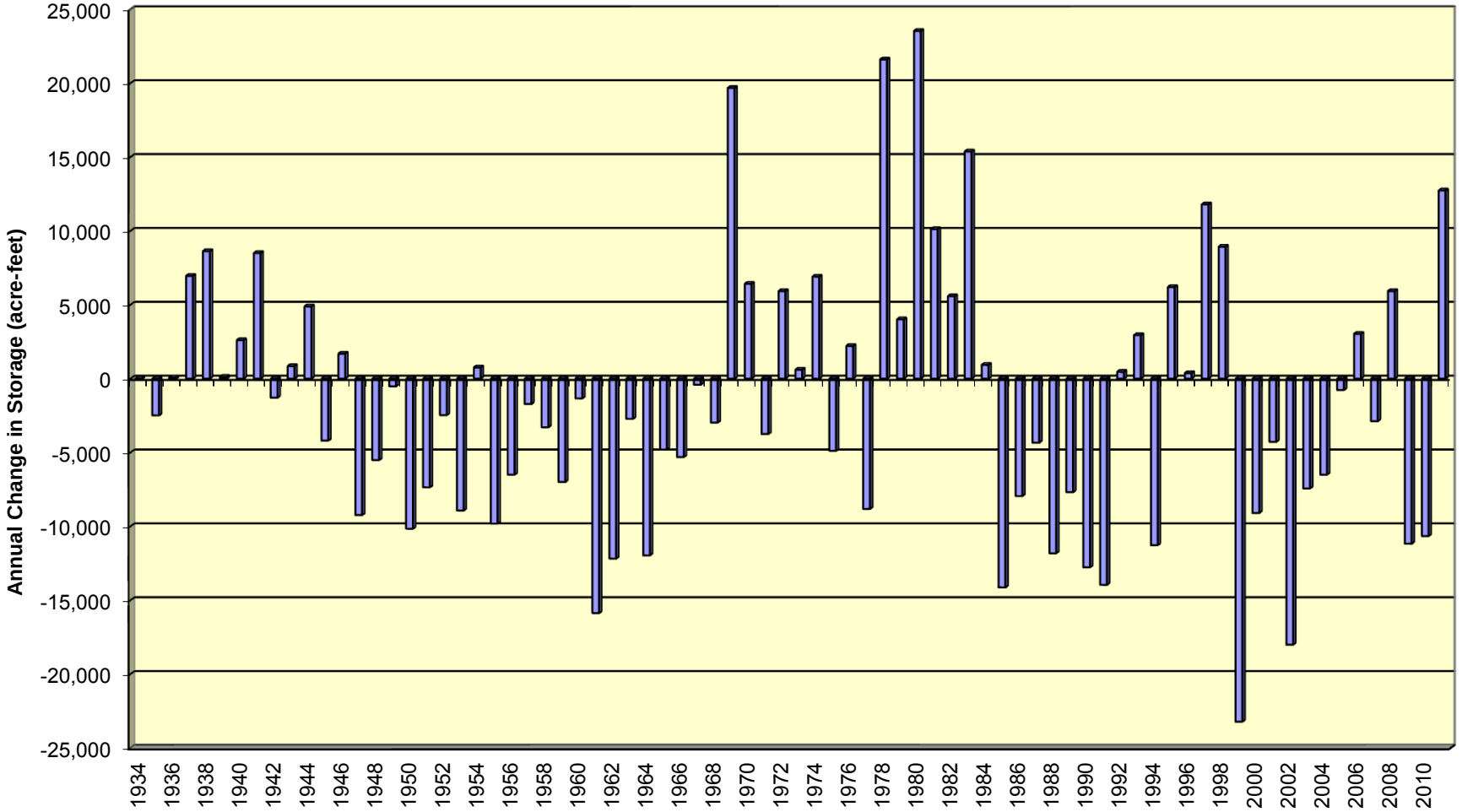
Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft)						
Year	**WELL NO 4 1N5W24E** Added Source	**FU 32 1N5W16K01** Substitute	**FU 13 1N5W22A01** Substitute	**LYTLE CREEK NO 2 1N5W36K01** Added Source			
1994							
1995							
1996							
1997							
1998							
1999	-97.00	-275.00	-203.00				
2000	-140.00	-313.00	-281.00				
2001	-152.50	-320.00	-265.00	-281.00			
2002	-165.00	-332.00	-422.00	-234.90			
2003	-195.00	-331.00	-437.00	-371.60			
2004	-210.00	-324.00	-545.00	-374.00			
2005	-125.00	-196.00	-213.00	-311.00			
2006	-130.00	-212.00	-190.00	-349.90			
2007	-130.00	-293.00	-239.00	-378.39			
2008	-130.00	-291.00	-303.00	-423.50			
2009	-135.00	-300.00	-372.00	-440.80			
2010	-130.00	-274.00	-393.00	-430.10			
2011	-128.00	-190.00	-325.00	-391.80			

Cumulative Change in Storage for the Pressure Zone Sub-Basin



Annual Change in Storage for the Pressure Zone Sub-Basin



San Bernardino Valley Municipal Water District

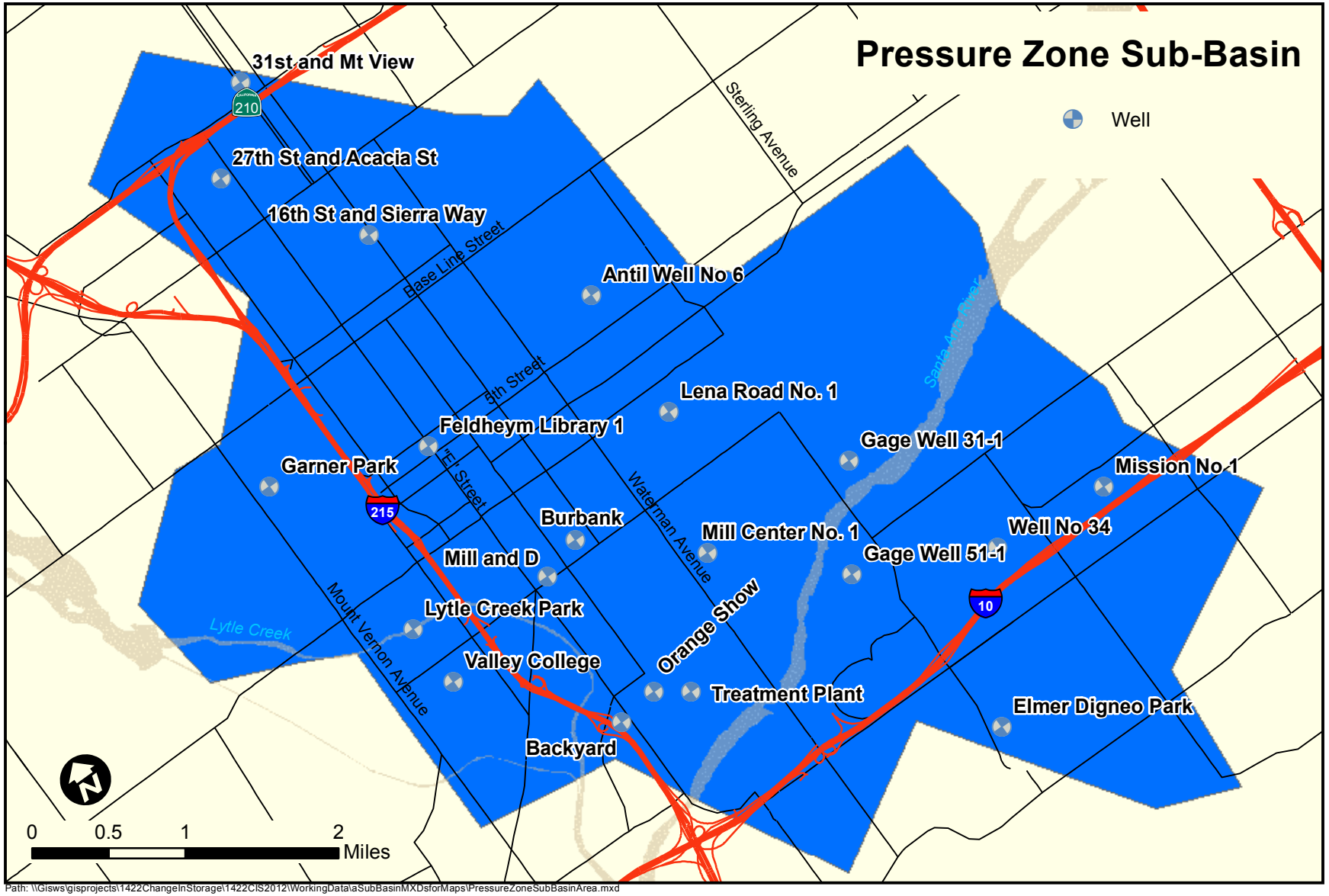
Change In Storage for the Pressure Zone Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1934	0	n/a	0
1935	-3	-2,484	-2,484
1936	1	89	-2,395
1937	8	6,961	4,566
1938	9	8,638	13,204
1939	1	121	13,325
1940	2	2,610	15,935
1941	7	8,507	24,442
1942	-3	-1,289	23,153
1943	1	853	24,006
1944	6	4,893	28,899
1945	-6	-4,190	24,709
1946	3	1,694	26,403
1947	-11	-9,229	17,174
1948	-6	-5,514	11,660
1949	0	-519	11,141
1950	-11	-10,156	985
1951	-7	-7,354	-6,369
1952	-4	-2,467	-8,836
1953	-9	-8,921	-17,757
1954	2	763	-16,994
1955	-9	-9,810	-26,804
1956	-12	-6,500	-33,304
1957	1	-1,713	-35,017
1958	-5	-3,289	-38,306
1959	-9	-6,988	-45,294
1960	1	-1,334	-46,628
1961	-19	-15,866	-62,494
1962	-11	-12,182	-74,676
1963	-3	-2,718	-77,394
1964	-12	-11,963	-89,357
1965	-6	-4,795	-94,152
1966	-8	-5,307	-99,459
1967	-3	-412	-99,871
1968	-4	-2,972	-102,843
1969	20	19,683	-83,160
1970	6	6,418	-76,742
1971	1	-3,741	-80,483
1972	5	5,932	-74,551
1973	2	612	-73,939
1974	7	6,910	-67,029
1975	-2	-4,883	-71,912
1976	3	2,218	-69,694
1977	-9	-8,818	-78,512

San Bernardino Valley Municipal Water District

Change In Storage for the Pressure Zone Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1978	22	21,610	-56,902
1979	5	4,020	-52,882
1980	25	23,540	-29,342
1981	15	10,127	-19,215
1982	6	5,581	-13,634
1983	14	15,379	1,745
1984	1	930	2,675
1985	-15	-14,130	-11,455
1986	-13	-7,945	-19,400
1987	-3	-4,335	-23,735
1988	-8	-11,820	-35,555
1989	-9	-7,680	-43,235
1990	-13	-12,770	-56,005
1991	-13	-13,955	-69,960
1992	-1	463	-69,497
1993	0	2,947	-66,550
1994	-7	-11,268	-77,818
1995	5	6,202	-71,616
1996	9	376	-71,240
1997	3	11,802	-59,438
1998	6	8,938	-50,500
1999	-8	-23,219	-73,719
2000	-10	-9,093	-82,812
2001	-5	-4,280	-87,092
2002	-19	-18,009	-105,101
2003	-8	-7,427	-112,528
2004	-9	-6,495	-119,023
2005	-1	-762	-119,785
2006	5	3,037	-116,748
2007	-6	-2,876	-119,624
2008	2	5,932	-113,692
2009	-7	-11,169	-124,861
2010	-4	-10,655	-135,516
2011	4	12,742	-122,774



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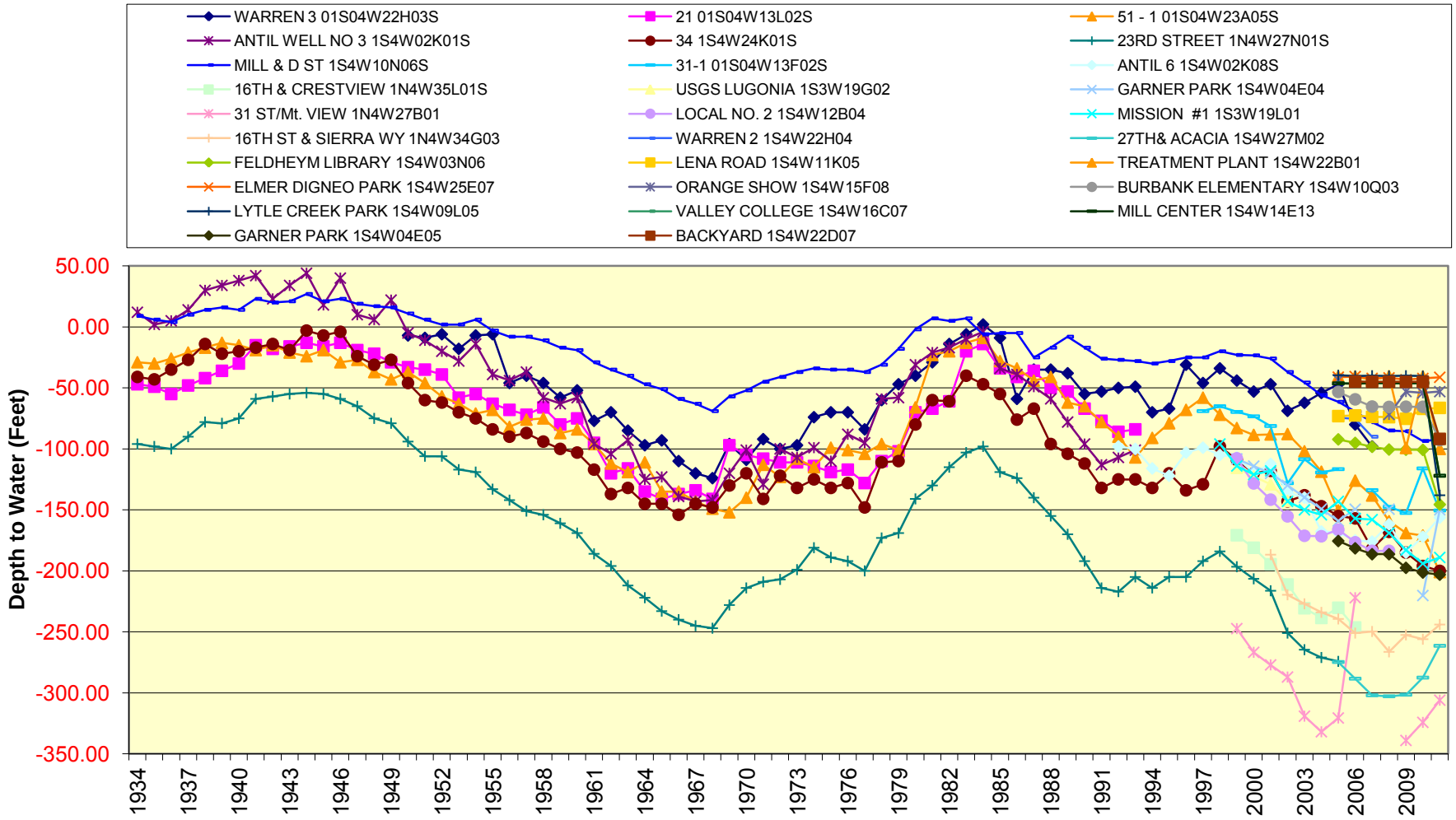
Hydrographs for the Pressure Zone Sub-Basin



San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
PRESSURE ZONE SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft.)								
Year	WARREN 3 01S04W22H03S Source	21 01S04W13L02S Source	51 - 1 01S04W23A05S Source	ANTIL WELL NO 3 1S4W02K01S Source	34 1S4W24K01S Source	23RD STREET 1N4W27N01S Source	MILL & D ST 1S4W10N06S Source	31-1 01S04W13F02S Source
1934		-47.00	-29.00	12.00	-41.00	-96.00	9.00	
1935		-49.00	-30.00	2.00	-43.00	-98.00	6.00	
1936		-55.00	-26.00	5.00	-35.00	-100.00	4.00	
1937		-48.00	-21.00	14.00	-27.00	-90.00	10.00	
1938		-42.00	-17.00	30.00	-14.00	-78.00	14.00	
1939		-36.00	-13.00	34.00	-22.00	-79.00	16.00	
1940		-30.00	-15.00	38.00	-20.00	-75.00	14.00	
1941		-15.00	-19.00	42.00	-17.00	-59.00	23.00	
1942		-18.00	-15.00	23.00	-14.00	-57.00	20.00	
1943		-16.00	-21.00	34.00	-19.00	-55.00	21.00	
1944		-13.00	-24.00	44.00	-3.00	-54.00	27.00	
1945		-16.00	-19.00	18.00	-7.00	-55.00	21.00	
1946		-13.00	-29.00	40.00	-4.00	-59.00	23.00	
1947		-19.00	-27.00	10.00	-24.00	-65.00	19.00	
1948		-22.00	-37.00	6.00	-31.00	-75.00	17.00	
1949		-29.00	-43.00	22.00	-27.00	-79.00	16.00	
1950	-7.00	-33.00	-37.00	-5.00	-46.00	-94.00	11.00	
1951	-9.00	-35.00	-46.00	-11.00	-60.00	-106.00	6.00	
1952	-6.00	-39.00	-57.00	-20.00	-62.00	-106.00	2.00	
1953	-18.00	-58.00	-63.00	-28.00	-70.00	-117.00	2.00	
1954	-7.00	-55.00	-71.00	-14.00	-75.00	-119.00	6.00	
1955	-6.00	-63.00	-68.00	-39.00	-84.00	-133.00	-3.00	
1956	-46.00	-68.00	-82.00	-44.00	-90.00	-142.00	-8.00	
1957	-40.00	-72.00	-76.00	-37.00	-87.00	-151.00	-8.00	
1958	-46.00	-66.00	-75.00	-58.00	-94.00	-154.00	-11.00	
1959	-58.00	-80.00	-87.00	-63.00	-100.00	-161.00	-17.00	
1960	-52.00	-75.00	-84.00	-58.00	-103.00	-169.00	-19.00	
1961	-77.00	-95.00	-96.00	-96.00	-117.00	-186.00	-29.00	
1962	-70.00	-120.00	-112.00	-104.00	-137.00	-196.00	-35.00	
1963	-85.00	-116.00	-119.00	-93.00	-132.00	-212.00	-40.00	
1964	-97.00	-135.00	-111.00	-125.00	-145.00	-222.00	-47.00	
1965	-93.00	-141.00	-135.00	-123.00	-145.00	-233.00	-51.00	
1966	-110.00	-137.00	-135.00	-139.00	-154.00	-240.00	-59.00	
1967	-120.00	-134.00	-143.00	-143.00	-145.00	-245.00	-63.00	
1968	-124.00	-141.00	-149.00	-142.00	-148.00	-247.00	-69.00	
1969	-96.00	-97.00	-152.00	-120.00	-130.00	-228.00	-57.00	
1970	-109.00	-105.00	-140.00	-101.00	-120.00	-214.00	-52.00	
1971	-92.00	-108.00	-113.00	-129.00	-141.00	-209.00	-45.00	
1972	-100.00	-111.00	-123.00	-100.00	-122.00	-207.00	-41.00	

San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
PRESSURE ZONE SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft.)								
Year	WARREN 3 01S04W22H03S Source	21 01S04W13L02S Source	51 - 1 01S04W23A05S Source	ANTIL WELL NO 3 1S4W02K01S Source	34 1S4W24K01S Source	23RD STREET 1N4W27N01S Source	MILL & D ST 1S4W10N06S Source	31-1 01S04W13F02S Source
1973	-97.00	-111.00	-108.00	-107.00	-132.00	-199.00	-37.00	
1974	-74.00	-114.00	-115.00	-99.00	-125.00	-181.00	-34.00	
1975	-70.00	-119.00	-99.00	-110.00	-132.00	-189.00	-35.00	
1976	-70.00	-117.00	-101.00	-88.00	-128.00	-192.00	-35.00	
1977	-84.00	-128.00	-104.00	-95.00	-148.00	-200.00	-37.00	
1978	-60.00	-110.00	-96.00	-59.00	-111.00	-173.00	-31.00	
1979	-47.00	-102.00	-101.00	-58.00	-110.00	-169.00	-18.00	
1980	-40.00	-70.00	-66.00	-31.00	-80.00	-141.00	-2.00	
1981	-29.00	-67.00	-23.00	-21.00	-60.00	-130.00	7.00	
1982	-14.00	-61.00	-20.00	-17.00	-61.00	-115.00	5.00	
1983	-6.00	-20.00	-13.00	-10.00	-40.00	-103.00	7.00	
1984	2.00	-14.00	-9.00	-4.00	-47.00	-98.00	-6.00	
1985	-9.00	-34.00	-28.00	-34.00	-55.00	-119.00	-5.00	
1986	-59.00	-41.00	-34.00	-39.00	-76.00	-124.00	-5.00	
1987	-35.00	-36.00	-44.00	-49.00	-67.00	-140.00	-25.00	
1988	-35.00	-50.00	-41.00	-59.00	-96.00	-155.00	-17.00	
1989	-38.00	-53.00	-62.00	-78.00	-104.00	-170.00	-8.00	
1990	-55.00	-67.00	-65.00	-96.00	-112.00	-192.00	-17.00	
1991	-53.00	-77.00	-78.00	-113.00	-132.00	-214.00	-26.00	
1992	-50.00	-86.00	-90.00	-107.00	-125.00	-217.00	-27.00	
1993	-49.00	-84.00	-107.00	-101.00	-125.00	-205.00	-28.00	
1994	-70.00		-91.00		-132.00	-214.00	-30.00	
1995	-67.00		-79.00		-120.00	-205.00	-28.00	
1996	-31.00		-68.00		-134.00	-205.00	-25.00	
1997	-46.00		-58.00		-129.00	-192.00	-25.00	-69.00
1998	-34.00		-72.00		-98.00	-184.00	-20.00	-65.00
1999	-44.00		-82.90		-109.00	-196.60	-23.00	-69.70
2000	-53.00		-88.50		-120.00	-206.50	-23.30	-73.30
2001	-47.00		-88.15		-118.00	-216.30	-25.90	-81.20
2002	-68.80		-87.80		-143.00	-251.00	-37.00	-128.10
2003	-62.20		-102.00		-138.00	-264.60	-45.60	-108.50
2004	-54.10		-118.70		-147.00	-271.00	-55.90	-119.30
2005	-47.10		-150.50		-155.00	-274.20	-61.40	-116.60
2006	-80.00		-126.00		-157.00		-69.44	
2007	-98.00		-138.20		-182.00		-78.12	-133.80
2008			-159.30		-168.00		-84.90	-147.50
2009			-169.00		-185.00		-85.50	-152.50
2010			-171.00		-196.00		-93.50	-116.00
2011			-201.00		-200.00		-92.20	-150.50

San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
PRESSURE ZONE SUB-BASIN (Continued)

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)							
Year	ANTIL 6 1S4W02K08S Source	16TH & CRESTVIEW 1N4W35L01S Substitute	USGS LUGONIA 1S3W19G02 Added Source	GARNER PARK 1S4W04E04 Added Source	31 ST/Mt. VIEW 1N4W27B01 Added Source	LOCAL NO. 2 1S4W12B04 Added Source	MISSION #1 1S3W19L01 Substitute	16TH ST & SIERRA WY 1N4W34G03 Substitute
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San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
PRESSURE ZONE SUB-BASIN (Continued)

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)							
Year	ANTIL 6 1S4W02K08S Source	16TH & CRESTVIEW 1N4W35L01S Substitute	USGS LUGONIA 1S3W19G02 Added Source	GARNER PARK 1S4W04E04 Added Source	31 ST/Mt. VIEW 1N4W27B01 Added Source	LOCAL NO. 2 1S4W12B04 Added Source	MISSION #1 1S3W19L01 Substitute	16TH ST & SIERRA WY 1N4W34G03 Substitute
1973								
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1992	-98.00							
1993	-100.00							
1994	-116.00							
1995	-122.00							
1996	-103.00							
1997	-99.00							
1998	-105.00						-96.00	
1999	-107.00	-170.78	-115.50	-108.22	-247.33	-107.72	-114.00	
2000	-119.80	-181.04	-122.42	-114.13	-266.75	-128.30	-121.00	
2001	-112.30	-194.60	-128.95	-119.97	-277.08	-141.60	-118.00	-186.70
2002	-135.60	-211.16	-142.54	-129.91	-287.00	-155.31	-143.00	-219.60
2003	-140.00	-230.62		-139.79	-319.11	-171.23	-150.00	-227.00
2004	-167.70	-238.57		-149.29	-331.90	-171.63	-154.00	-234.00
2005	-168.80	-230.24		-159.10	-320.60	-166.22	-143.00	-239.40
2006	-175.03	-246.38		-149.44	-222.00	-176.58	-157.00	-250.97
2007	-176.00					-183.58	-158.00	-249.68
2008	-161.80			-149.40		-183.58	-169.00	-266.40
2009	-185.00				-339.00		-183.00	-252.50
2010	-172.00			-220.20	-324.20		-194.00	-256.00
2011	-156.30			-149.90	-306.00		-189.00	-244.00

San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
PRESSURE ZONE SUB-BASIN (Continued)

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)							
Year	WARREN 2 1S4W22H04 Substitute	27TH& ACACIA 1S4W27M02 Substitute	FELDHEYM LIBRARY 1S4W03N06 Added Source	LENA ROAD 1S4W11K05 Added Source	TREATMENT PLANT 1S4W22B01 Added Source	ELMER DIGNEO PARK 1S4W25E07 Added Source	ORANGE SHOW 1S4W15F08 Added Source	BURBANK ELEMENTARY 1S4W10Q03 Added Source
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San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
PRESSURE ZONE SUB-BASIN (Continued)

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)							
Year	WARREN 2 1S4W22H04 Substitute	27TH& ACACIA 1S4W27M02 Substitute	FELDHEYM LIBRARY 1S4W03N06 Added Source	LENA ROAD 1S4W11K05 Added Source	TREATMENT PLANT 1S4W22B01 Added Source	ELMER DIGNEO PARK 1S4W25E07 Added Source	ORANGE SHOW 1S4W15F08 Added Source	BURBANK ELEMENTARY 1S4W10Q03 Added Source
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2005	-74.40	-274.70	-92.20	-73.12	-40.47	-41.20	-43.35	-53.29
2006	-75.50	-288.34	-95.08	-72.58	-40.63	-40.71		-59.39
2007	-90.00	-302.00	-98.30	-73.78	-43.39	-42.20		-65.30
2008		-302.80	-100.53	-73.98	-40.44	-41.82	-71.76	-65.61
2009		-301.50	-100.67	-75.29	-99.23	-43.32	-53.00	-65.43
2010		-287.50	-100.80	-67.15	-40.60	-42.27	-54.13	-65.50
2011		-261.40	-145.59	-66.40	-100.00	-41.30	-53.06	-92.80

San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
PRESSURE ZONE SUB-BASIN (Continued)

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	LYTLE CREEK PARK 1S4W09L05 Added Source	VALLEY COLLEGE 1S4W16C07 Added Source	MILL CENTER 1S4W14E13 Added Source	GARNER PARK 1S4W04E05 Added Source	BACKYARD 1S4W22D07 Added Source		
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San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
PRESSURE ZONE SUB-BASIN (Continued)

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	LYTLE CREEK PARK 1S4W09L05 Added Source	VALLEY COLLEGE 1S4W16C07 Added Source	MILL CENTER 1S4W14E13 Added Source	GARNER PARK 1S4W04E05 Added Source	BACKYARD 1S4W22D07 Added Source		
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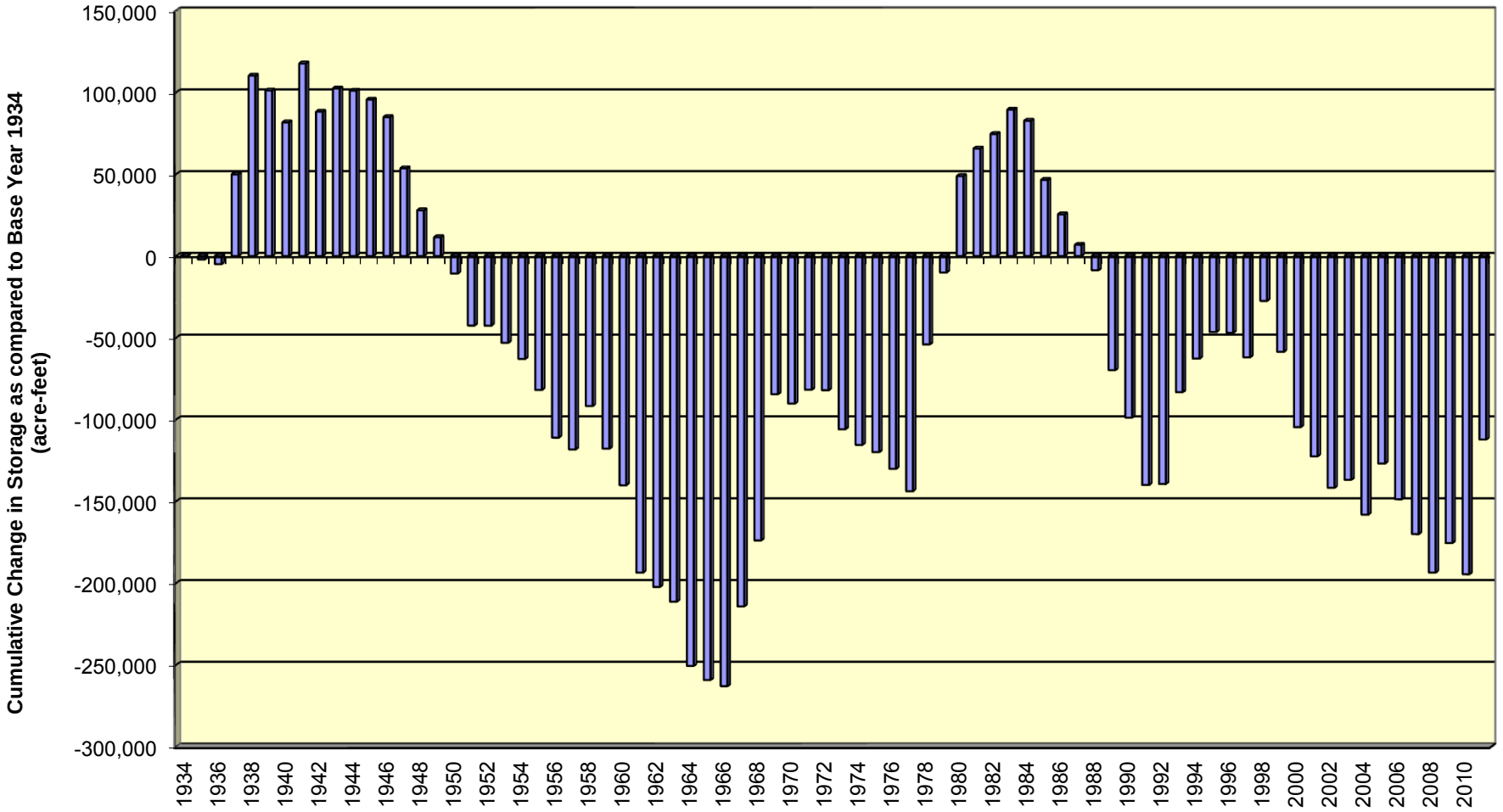
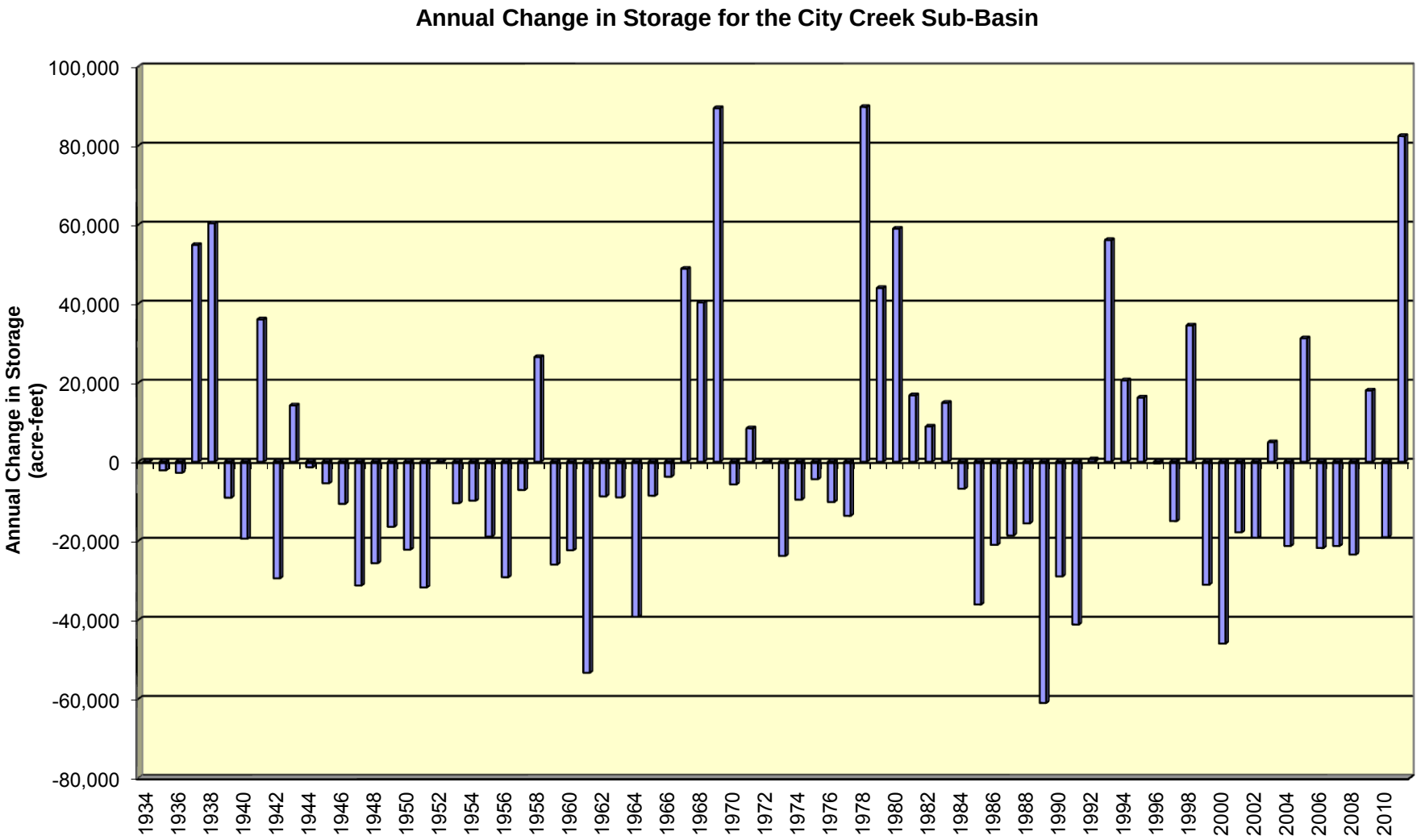
2005	-39.63	-70.26	-46.23	-175.52			
2006	-40.23	-70.27	-46.56	-181.53	-44.83		
2007	-40.00	-70.52	-45.99	-186.32	-44.98		
2008	-40.15	-70.43	-46.14	-186.32	-44.98		
2009	-40.00	-70.49	-46.33	-197.50	-45.02		
2010	-40.30	-70.30	-46.00	-201.38	-45.05		
2011	-138.00	-143.50	-122.00	-203.10	-91.80		

Cumulative Change in Storage for the City Creek Sub-Basin




Annual Change in Storage for the City Creek Sub-Basin
Annual Change in Storage (acre-feet)
100,000
80,000
60,000
40,000
20,000
0
-20,000
-40,000
-60,000
-80,000
1934
1936
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San Bernardino Valley Municipal Water District

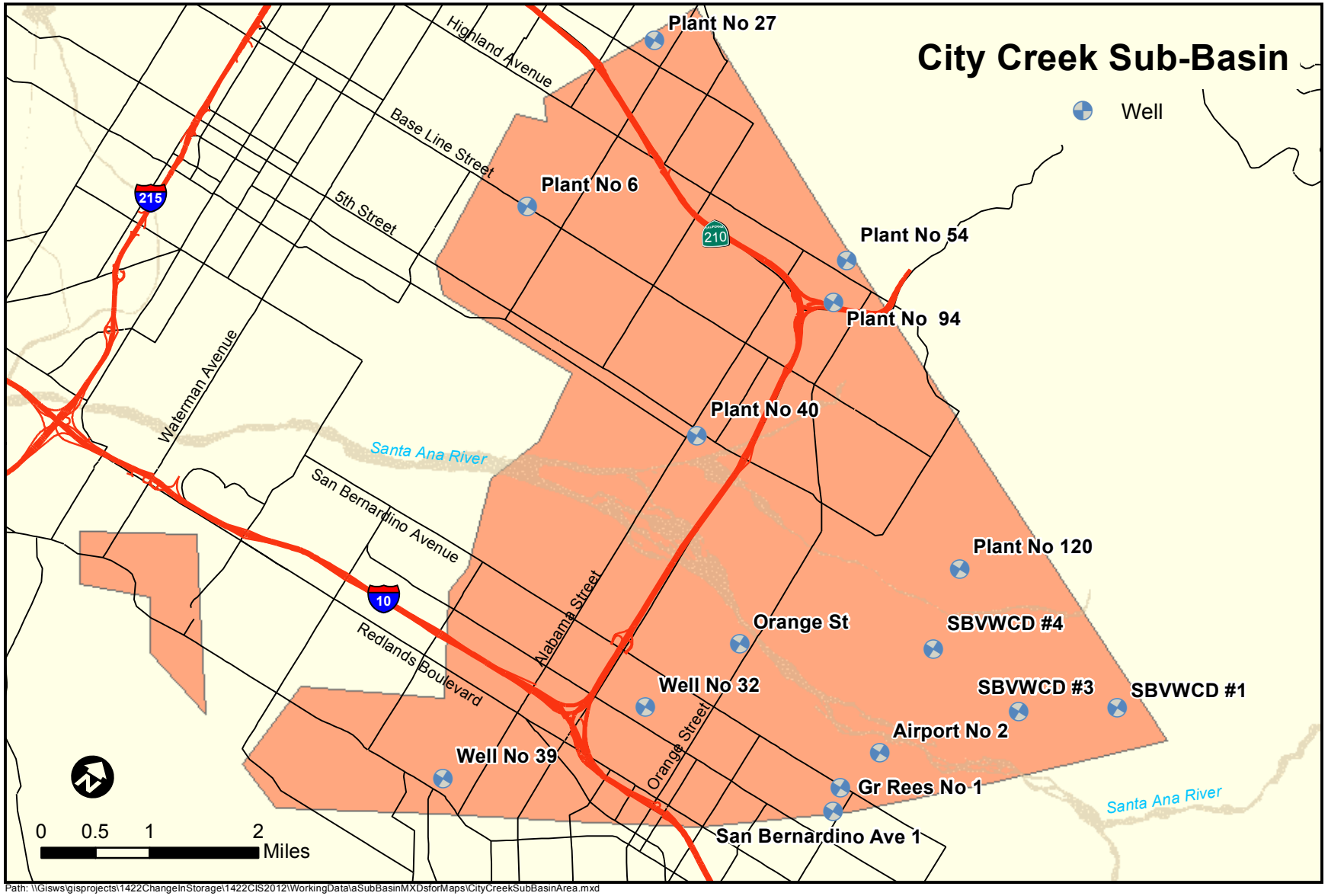
Change In Storage for the City Creek Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1934	0	n/a	0
1935	-1	-2,179	-2,179
1936	-1	-2,802	-4,981
1937	24	54,853	49,872
1938	26	60,340	110,212
1939	-3	-9,101	101,111
1940	-8	-19,467	81,644
1941	15	36,016	117,660
1942	-13	-29,496	88,164
1943	7	14,244	102,408
1944	-1	-1,406	101,002
1945	-2	-5,458	95,544
1946	-6	-10,667	84,877
1947	-12	-31,299	53,578
1948	-10	-25,663	27,915
1949	-7	-16,455	11,460
1950	-16	-22,241	-10,781
1951	-13	-31,812	-42,593
1952	-1	-21	-42,614
1953	-4	-10,500	-53,114
1954	-4	-9,873	-62,987
1955	-8	-18,914	-81,901
1956	-12	-29,231	-111,132
1957	-2	-7,142	-118,274
1958	9	26,490	-91,784
1959	-11	-26,023	-117,807
1960	-9	-22,382	-140,189
1961	-21	-53,413	-193,602
1962	-4	-8,760	-202,362
1963	-5	-9,015	-211,377
1964	-17	-39,262	-250,639
1965	-4	-8,605	-259,244
1966	-1	-3,808	-263,052
1967	20	48,813	-214,239
1968	17	40,290	-173,949
1969	40	89,460	-84,489
1970	-1	-5,746	-90,235
1971	2	8,443	-81,792
1972	-1	-318	-82,110
1973	-8	-23,831	-105,941
1974	-3	-9,592	-115,533
1975	-2	-4,410	-119,943
1976	-5	-10,186	-130,129
1977	-7	-13,696	-143,825

San Bernardino Valley Municipal Water District

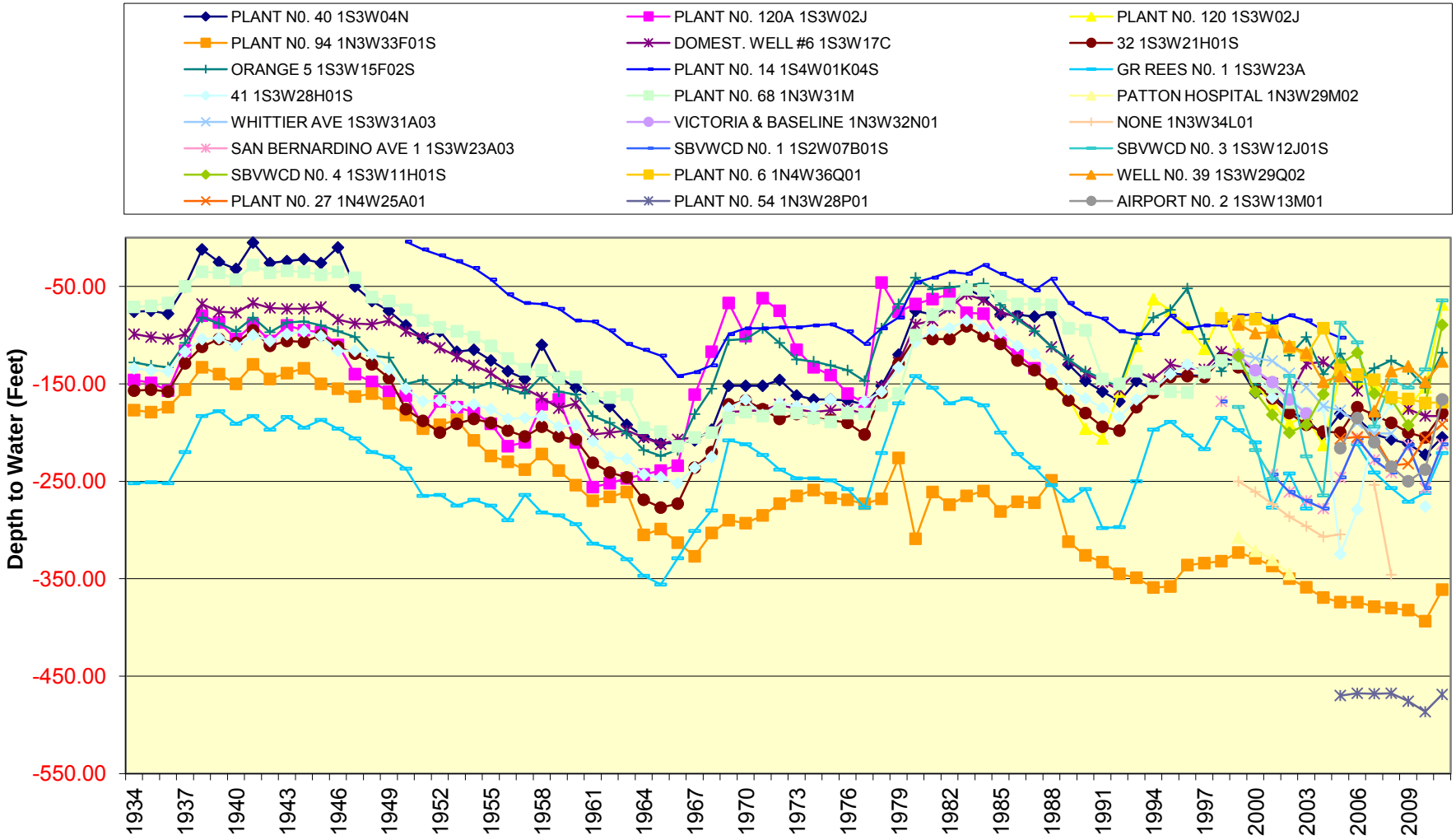
Change In Storage for the City Creek Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1978	36	89,758	-54,067
1979	22	43,951	-10,116
1980	21	58,966	48,850
1981	7	16,804	65,654
1982	2	8,897	74,551
1983	6	14,890	89,441
1984	-3	-6,823	82,618
1985	-16	-36,130	46,488
1986	-9	-21,038	25,450
1987	-8	-18,659	6,791
1988	-5	-15,578	-8,787
1989	-26	-61,028	-69,815
1990	-11	-29,017	-98,832
1991	-16	-41,190	-140,022
1992	-2	616	-139,406
1993	23	56,087	-83,319
1994	10	20,573	-62,746
1995	8	16,221	-46,525
1996	0	-453	-46,978
1997	-7	-15,021	-61,999
1998	12	34,478	-27,521
1999	-4	-31,118	-58,639
2000	-20	-46,018	-104,657
2001	-12	-17,857	-122,514
2002	1	-19,242	-141,756
2003	-14	4,923	-136,833
2004	-15	-21,327	-158,160
2005	18	31,225	-126,935
2006	16	-21,828	-148,763
2007	-25	-21,308	-170,071
2008	0	-23,474	-193,545
2009	-2	18,017	-175,528
2010	-17	-19,089	-194,617
2011	43	82,409	-112,208



Path: \\Gisws\gisprojects\1422ChangeInStorage\1422CIS2012\WorkingData\aSubBasinMXDsforMaps\CityCreekSubBasinArea.mxd

Hydrograph for City Creek Sub-Basin Wells



San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

CITY CREEK SUB-BASIN

'Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	PLANT N0. 40 1S3W04N Source	PLANT N0. 120A 1S3W02J Source	PLANT N0. 120 1S3W02J Substitute	PLANT N0. 94 1N3W33F01S Source	DOMEST. WELL #6 1S3W17C Source	32 1S3W21H01S Source	ORANGE 5 1S3W15F02S Source
1934	-76.00	-146.00		-177.00	-99.00	-157.00	-128.00
1935	-75.00	-149.00		-179.00	-102.00	-156.00	-131.00
1936	-78.00	-157.00		-174.00	-104.00	-158.00	-133.00
1937	-50.00	-116.00		-156.00	-99.00	-129.00	-108.00
1938	-12.00	-80.00		-133.00	-68.00	-112.00	-82.00
1939	-25.00	-87.00		-140.00	-76.00	-104.00	-88.00
1940	-32.00	-104.00		-150.00	-77.00	-108.00	-96.00
1941	-5.00	-89.00		-130.00	-67.00	-95.00	-82.00
1942	-26.00	-106.00		-145.00	-72.00	-111.00	-97.00
1943	-24.00	-90.00		-139.00	-73.00	-106.00	-87.00
1944	-22.00	-95.00		-134.00	-73.00	-107.00	-86.00
1945	-26.00	-97.00		-150.00	-71.00	-100.00	-90.00
1946	-10.00	-110.00		-155.00	-84.00	-112.00	-96.00
1947	-50.00	-140.00		-163.00	-88.00	-119.00	-102.00
1948	-65.00	-148.00		-160.00	-89.00	-130.00	-121.00
1949	-75.00	-158.00		-170.00	-85.00	-144.00	-123.00
1950	-90.00	-162.00		-182.00	-96.00	-176.00	-150.00
1951	-103.00	-193.00		-196.00	-103.00	-188.00	-146.00
1952	-96.00	-168.00		-192.00	-113.00	-200.00	-160.00
1953	-117.00	-174.00		-187.00	-122.00	-191.00	-146.00
1954	-115.00	-179.00		-208.00	-131.00	-186.00	-154.00
1955	-126.00	-191.00		-224.00	-139.00	-190.00	-149.00
1956	-137.00	-214.00		-230.00	-151.00	-198.00	-155.00
1957	-145.00	-210.00		-238.00	-155.00	-204.00	-160.00
1958	-110.00	-171.00		-222.00	-164.00	-194.00	-142.00
1959	-143.00	-166.00		-239.00	-175.00	-204.00	-158.00
1960	-154.00	-210.00		-254.00	-170.00	-207.00	-161.00
1961	-164.00	-256.00		-270.00	-202.00	-231.00	-183.00
1962	-173.00	-252.00		-266.00	-200.00	-241.00	-190.00
1963	-192.00	-247.00		-261.00	-198.00	-246.00	-201.00

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

CITY CREEK SUB-BASIN

'Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	PLANT N0. 40 1S3W04N Source	PLANT N0. 120A 1S3W02J Source	PLANT N0. 120 1S3W02J Substitute	PLANT N0. 94 1N3W33F01S Source	DOMEST. WELL #6 1S3W17C Source	32 1S3W21H01S Source	ORANGE 5 1S3W15F02S Source
1964	-204.00	-243.00		-305.00	-205.00	-269.00	-218.00
1965	-211.00	-239.00		-299.00	-212.00	-277.00	-224.00
1966	-211.00	-234.00		-313.00	-207.00	-273.00	-218.00
1967	-208.00	-161.00		-327.00	-205.00	-236.00	-181.00
1968	-197.00	-117.00		-303.00	-200.00	-220.00	-155.00
1969	-152.00	-67.00		-290.00	-179.00	-171.00	-105.00
1970	-152.00	-101.00		-293.00	-178.00	-167.00	-104.00
1971	-152.00	-62.00		-285.00	-177.00	-176.00	-93.00
1972	-146.00	-75.00		-273.00	-171.00	-186.00	-108.00
1973	-162.00	-115.00		-265.00	-176.00	-181.00	-125.00
1974	-166.00	-133.00		-259.00	-179.00	-185.00	-127.00
1975	-166.00	-141.00		-267.00	-177.00	-187.00	-131.00
1976	-167.00	-160.00		-269.00	-176.00	-190.00	-136.00
1977	-171.00	-170.00		-273.00	-181.00	-202.00	-147.00
1978	-152.00	-46.00		-268.00	-153.00	-159.00	-93.00
1979	-120.00	-76.00		-226.00	-128.00	-129.00	-68.00
1980	-75.00	-68.00		-309.00	-89.00	-102.00	-41.00
1981	-79.00	-63.00		-261.00	-85.00	-104.00	-53.00
1982	-70.00	-58.00		-274.00	-72.00	-104.00	-51.00
1983	-52.00	-77.00		-265.00	-58.00	-91.00	-49.00
1984	-61.00	-78.00		-260.00	-64.00	-101.00	-47.00
1985	-79.00	-106.00		-281.00	-76.00	-109.00	-69.00
1986	-79.00	-120.00		-271.00	-82.00	-126.00	-84.00
1987	-81.00	-134.00		-272.00	-95.00	-136.00	-96.00
1988	-77.00		-150.00	-249.00	-112.00	-150.00	-112.00
1989	-130.00		-165.00	-312.00	-126.00	-167.00	-125.00
1990	-147.00		-196.00	-326.00	-139.00	-180.00	-137.00
1991	-158.00		-206.00	-333.00	-148.00	-194.00	-145.00
1992	-168.00		-158.00	-345.00	-156.00	-198.00	-153.00
1993	-147.00		-111.00	-349.00	-137.00	-174.00	-104.00

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

CITY CREEK SUB-BASIN

'Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)						
Year	PLANT N0. 40 1S3W04N Source	PLANT N0. 120A 1S3W02J Source	PLANT N0. 120 1S3W02J Substitute	PLANT N0. 94 1N3W33F01S Source	DOMEST. WELL #6 1S3W17C Source	32 1S3W21H01S Source	ORANGE 5 1S3W15F02S Source
1994	-156.00		-63.00	-359.00	-145.00	-159.00	-82.00
1995	-139.00		-75.00	-358.00	-130.00	-143.00	-74.00
1996	-141.00		-92.00	-336.00	-134.00	-142.00	-52.00
1997	-142.00		-114.00	-334.00	-135.00	-143.00	-104.00
1998	-121.00		-77.00	-332.00	-117.00	-125.00	-137.00
1999	-130.60		-113.85	-323.10	-122.60	-133.00	-119.00
2000	-159.00		-150.70	-329.10	-137.70	-149.00	-151.00
2001	-161.00		-170.30	-336.90	-149.60	-165.00	-84.00
2002	-178.50		-190.60	-349.90	-162.00	-180.00	-121.00
2003	-186.20		-183.00	-358.80	-129.50	-192.00	-102.00
2004	-203.00		-212.80	-369.30	-127.40	-199.00	-140.00
2005	-180.70		-138.70	-374.00	-138.60	-200.00	-119.00
2006	-185.30		-148.30	-374.10	-157.30	-174.00	-148.00
2007	-201.80		-151.80	-378.70		-182.00	-134.00
2008	-207.00		-164.20	-380.10		-190.00	-126.00
2009	-211.50		-173.20	-382.20	-176.00	-200.00	-135.00
2010	-222.70		-153.50	-393.60	-183.00	-205.00	-154.00
2011	-204.90		-68.60	-361.20	-183.00	-180.00	-118.00

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

CITY CREEK SUB-BASIN (Continued)

'Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)					
Year	PLANT N0. 14 1S4W01K04S Source	GR REES N0. 1 1S3W23A Source	41 1S3W28H01S Source	PLANT N0. 68 1N3W31M Source	PATTON HOSPITAL 1N3W29M02 Added Source	WHITTIER AVE 1S3W31A03 Added Source
1934		-252.00	-134.00	-71.00		
1935		-251.00	-136.00	-70.00		
1936		-252.00	-137.00	-67.00		
1937		-220.00	-117.00	-50.00		
1938		-183.00	-104.00	-35.00		
1939		-178.00	-103.00	-36.00		
1940		-191.00	-111.00	-43.00		
1941		-183.00	-100.00	-28.00		
1942		-197.00	-106.00	-36.00		
1943		-184.00	-99.00	-34.00		
1944		-195.00	-96.00	-35.00		
1945		-187.00	-101.00	-38.00		
1946		-196.00	-116.00	-35.00		
1947		-206.00	-116.00	-41.00		
1948		-220.00	-119.00	-61.00		
1949		-225.00	-135.00	-65.00		
1950	-4.00	-237.00	-155.00	-74.00		
1951	-12.00	-265.00	-168.00	-85.00		
1952	-18.00	-264.00	-167.00	-92.00		
1953	-24.00	-275.00	-174.00	-96.00		
1954	-31.00	-269.00	-171.00	-102.00		
1955	-43.00	-275.00	-176.00	-111.00		
1956	-58.00	-290.00	-186.00	-124.00		
1957	-67.00	-264.00	-185.00	-135.00		
1958	-68.00	-282.00	-183.00	-136.00		
1959	-73.00	-285.00	-194.00	-144.00		
1960	-85.00	-294.00	-192.00	-143.00		
1961	-86.00	-314.00	-209.00	-165.00		
1962	-95.00	-318.00	-225.00	-164.00		
1963	-109.00	-330.00	-227.00	-161.00		

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

CITY CREEK SUB-BASIN (Continued)

'Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)					
Year	PLANT N0. 14 1S4W01K04S Source	GR REES N0. 1 1S3W23A Source	41 1S3W28H01S Source	PLANT N0. 68 1N3W31M Source	PATTON HOSPITAL 1N3W29M02 Added Source	WHITTIER AVE 1S3W31A03 Added Source
1964	-115.00	-347.00	-243.00	-195.00		
1965	-121.00	-356.00	-246.00	-199.00		
1966	-142.00	-329.00	-252.00	-214.00		
1967	-138.00	-301.00	-236.00	-205.00		
1968	-131.00	-280.00	-225.00	-200.00		
1969	-99.00	-208.00	-175.00	-185.00		
1970	-93.00	-212.00	-166.00	-179.00		
1971	-93.00	-223.00	-182.00	-183.00		
1972	-92.00	-238.00	-170.00	-176.00		
1973	-92.00	-247.00	-173.00	-180.00		
1974	-90.00	-247.00	-174.00	-185.00		
1975	-89.00	-249.00	-166.00	-189.00		
1976	-96.00	-258.00	-178.00	-180.00		
1977	-109.00	-277.00	-168.00	-181.00		
1978	-93.00	-221.00	-158.00	-172.00		
1979	-82.00	-170.00	-133.00	-160.00		
1980	-46.00	-142.00	-107.00	-100.00		
1981	-41.00	-154.00	-95.00	-79.00		
1982	-35.00	-170.00	-93.00	-68.00		
1983	-37.00	-165.00	-85.00	-53.00		
1984	-28.00	-172.00	-93.00	-54.00		
1985	-37.00	-200.00	-97.00	-60.00		
1986	-44.00	-222.00	-111.00	-68.00		
1987	-54.00	-236.00	-119.00	-68.00		
1988	-42.00	-254.00	-135.00	-69.00		
1989	-67.00	-270.00	-156.00	-93.00		
1990	-78.00	-258.00	-165.00	-95.00		
1991	-83.00	-298.00	-175.00	-145.00		
1992	-96.00	-297.00	-184.00	-150.00		
1993	-99.00	-250.00	-166.00	-137.00		

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

CITY CREEK SUB-BASIN (Continued)

'Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)					
Year	**PLANT N0. 14** **1S4W01K04S** Source	**GR REES N0. 1** **1S3W23A** Source	**41** **1S3W28H01S** Source	**PLANT N0. 68** **1N3W31M** Source	**PATTON HOSPITAL** **1N3W29M02** Added Source	**WHITTIER AVE** **1S3W31A03** Added Source
1994	-99.00	-197.00	-155.00	-155.00		
1995	-80.00	-189.00	-140.00	-158.00		
1996	-93.00	-203.00	-130.00	-159.00		
1997	-90.00	-217.00	-139.00	-138.00		
1998	-90.00	-185.00	-127.00	-126.00		
1999	-79.70	-197.50	-128.00	-129.00	-307.74	-119.06
2000	-78.70	-210.00	-140.00	-142.60	-321.36	-123.43
2001	-86.90	-277.00	-164.00	-153.10	-330.50	-126.43
2002	-79.60	-242.00	-159.00	-169.20	-345.02	-139.17
2003	-84.80	-278.00	-182.00	-180.00		-153.66
2004	-95.10		-174.00			-172.77
2005	-102.60		-324.80			-177.27
2006		-212.00	-279.00			-190.27
2007		-241.00	-197.00			-200.88
2008		-257.00	-170.00			-200.80
2009		-271.00				
2010		-262.00	-276.00			
2011		-221.00				

San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
CITY CREEK SUB-BASIN (Continued)

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (Feet)				
Year	**VICTORIA & BASELINE** **1N3W32N01** Added Source	**NONE** **1N3W34L01** Added Source	**SAN BERNARDINO AVE 1** **1S3W23A03** Substitute	**SBVWCD N0. 1** **1S2W07B01S** Added Source	**SBVWCD N0. 3** **1S3W12J01S** Added Source
1934					
1935					
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1944					
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1948					
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1963					

San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
CITY CREEK SUB-BASIN (Continued)

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (Feet)				
Year	**VICTORIA & BASELINE** **1N3W32N01** Added Source	**NONE** **1N3W34L01** Added Source	**SAN BERNARDINO AVE 1** **1S3W23A03** Substitute	**SBVWCD N0. 1** **1S2W07B01S** Added Source	**SBVWCD N0. 3** **1S3W12J01S** Added Source
1964					
1965					
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1972					
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1974					
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1991					
1992					
1993					

San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
CITY CREEK SUB-BASIN (Continued)

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (Feet)				
Year	**VICTORIA & BASELINE** **1N3W32N01** Added Source	**NONE** **1N3W34L01** Added Source	**SAN BERNARDINO AVE 1** **1S3W23A03** Substitute	**SBVWCD N0. 1** **1S2W07B01S** Added Source	**SBVWCD N0. 3** **1S3W12J01S** Added Source
1994					
1995					
1996					
1997					
1998			-168.00		
1999	-120.50	-250.08		-193.75	-173.65
2000	-136.00	-260.87		-276.13	-218.00
2001	-148.18	-273.33	-243.00	-299.19	-247.60
2002	-166.07	-286.28	-261.00	-179.75	-141.82
2003	-180.49	-296.24	-270.00	-257.45	-224.37
2004		-306.88	-278.00	-297.00	-264.56
2005		-304.52	-246.00	-134.06	-87.28
2006			-206.00	-159.69	-107.43
2007		-253.72	-228.00	-241.11	-193.84
2008		-345.90	-241.00	-227.00	-146.45
2009			-213.00	-225.50	-153.90
2010			-257.00	-207.10	-135.20
2011			-212.00	-116.20	-64.31

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

CITY CREEK SUB-BASIN (Continued)

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (Feet)					
Year	**SBVWCD N0. 4** **1S3W11H01S** Added Source	**PLANT N0. 6** **1N4W36Q01** Substitute	**WELL N0. 39** **1S3W29Q02** Added Source	**PLANT N0. 27** **1N4W25A01** Substitute	**PLANT N0. 54** **1N3W28P01** Substitute	**AIRPORT N0. 2** **1S3W13M01** Substitute
1934						
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1963						

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

CITY CREEK SUB-BASIN (Continued)

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (Feet)					
Year	**SBVWCD N0. 4** **1S3W11H01S** Added Source	**PLANT N0. 6** **1N4W36Q01** Substitute	**WELL N0. 39** **1S3W29Q02** Added Source	**PLANT N0. 27** **1N4W25A01** Substitute	**PLANT N0. 54** **1N3W28P01** Substitute	**AIRPORT N0. 2** **1S3W13M01** Substitute
1964						
1965						
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1974						
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1977						
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1979						
1980						
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1988						
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1990						
1991						
1992						
1993						

San Bernardino Valley Municipal Water District

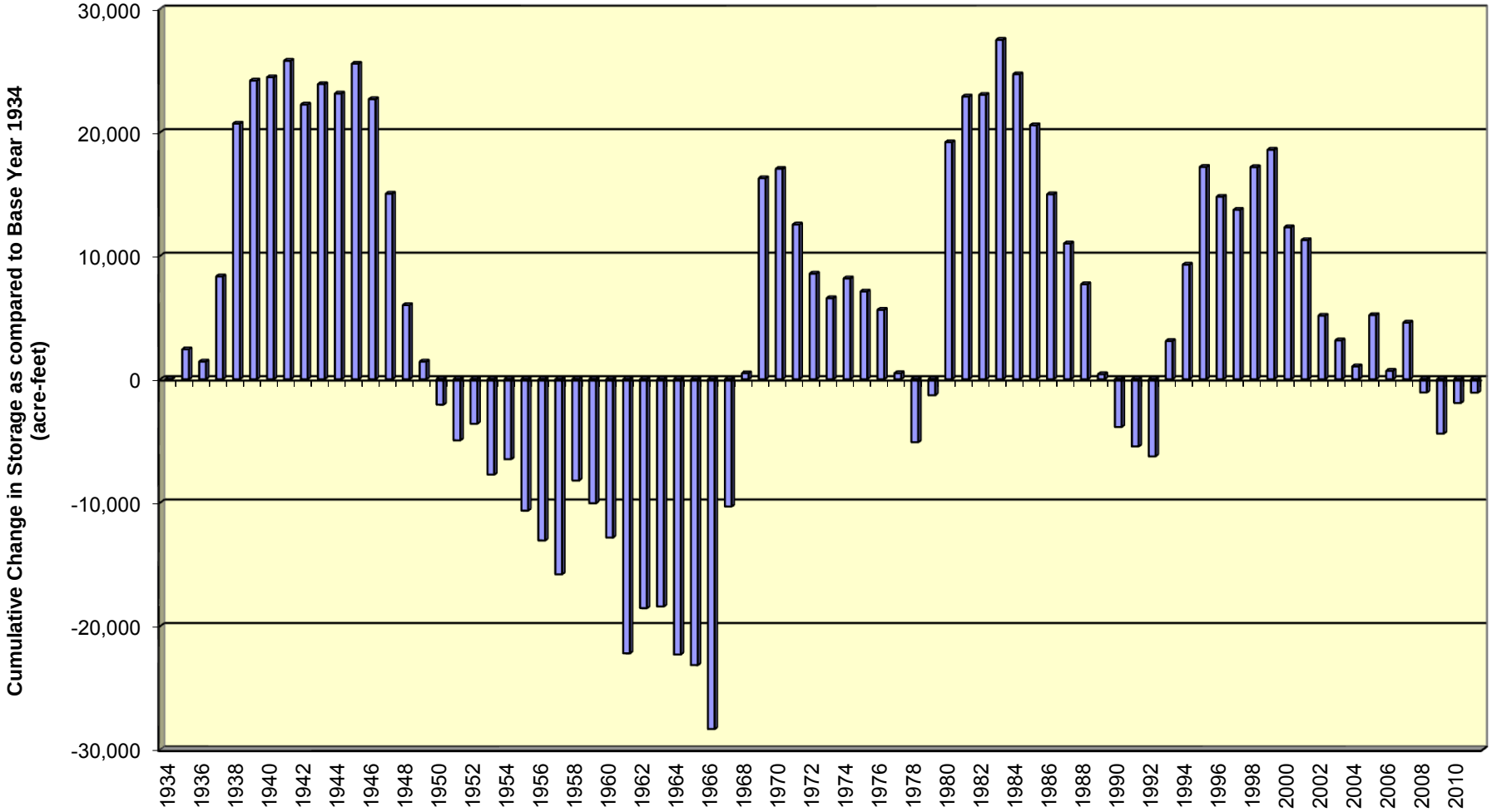
Change in Storage for the San Bernardino Basin Area 1934 - 2011

CITY CREEK SUB-BASIN (Continued)

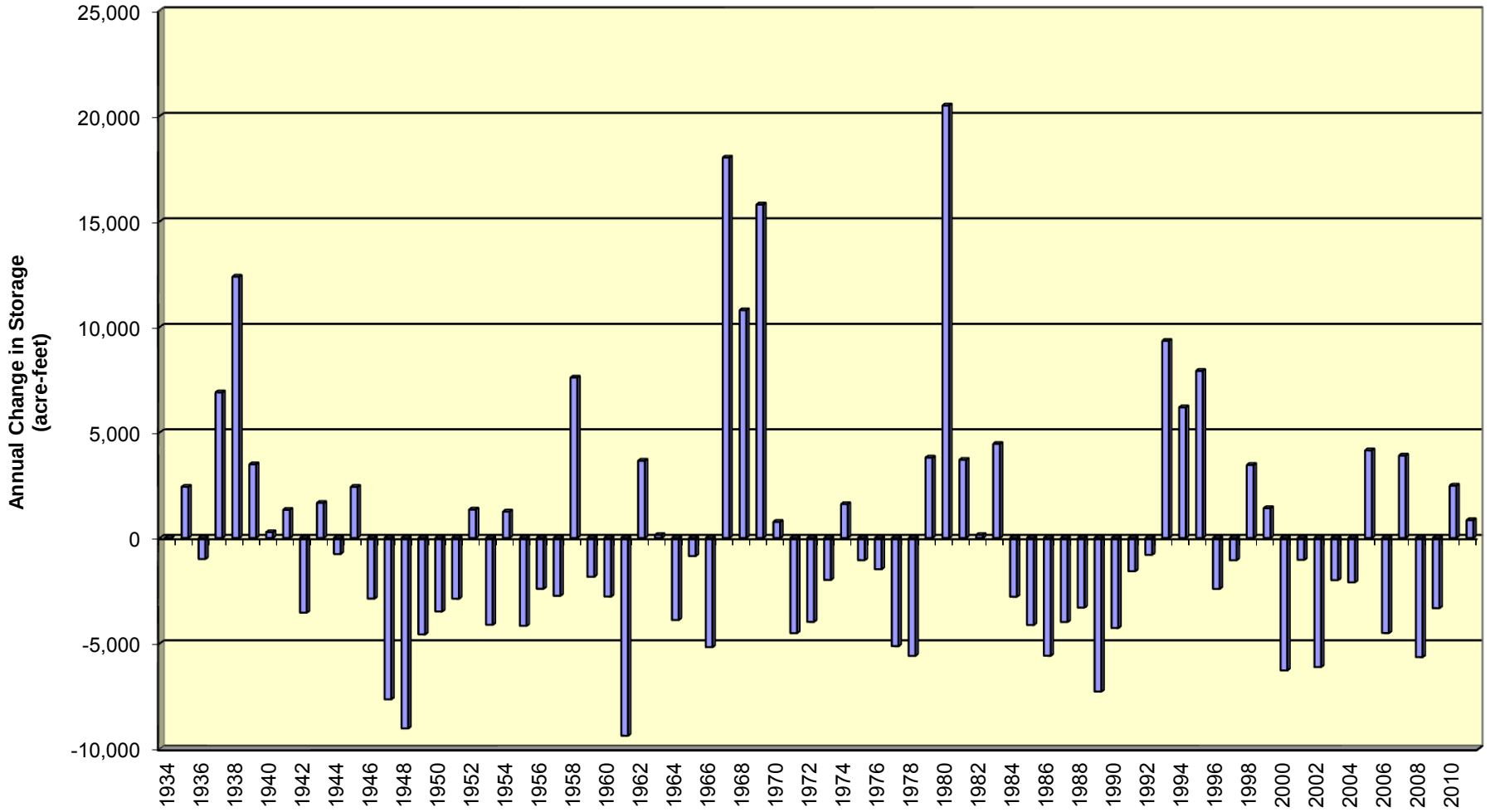
Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (Feet)					
Year	**SBVWCD N0. 4** **1S3W11H01S** Added Source	**PLANT N0. 6** **1N4W36Q01** Substitute	**WELL N0. 39** **1S3W29Q02** Added Source	**PLANT N0. 27** **1N4W25A01** Substitute	**PLANT N0. 54** **1N3W28P01** Substitute	**AIRPORT N0. 2** **1S3W13M01** Substitute
1994						
1995						
1996						
1997						
1998		-82.80				
1999	-121.60	-85.80	-89.00			
2000	-158.25	-83.60	-98.00			
2001	-181.70	-95.70	-97.00			
2002	-200.11	-112.50	-111.00			
2003	-191.97	-120.60	-118.00			
2004	-160.68	-92.90	-148.00			
2005	-129.40	-135.80	-142.00	-206.30	-469.90	-216.00
2006	-118.06	-140.50		-204.50	-467.60	-185.00
2007	-160.03	-145.80	-178.00	-205.00	-468.00	-210.00
2008	-165.69	-163.90	-137.00	-234.00	-467.60	-235.00
2009	-192.50	-165.50	-132.00	-232.00	-475.80	-250.00
2010	-171.00	-169.60	-148.00	-206.00	-486.50	-238.00
2011	-89.45	-168.90	-127.00	-191.50	-468.80	-166.00

Cumulative Change in Storage for the Redlands Sub-Basin



Annual Change in Storage for the Redlands Sub-Basin



San Bernardino Valley Municipal Water District

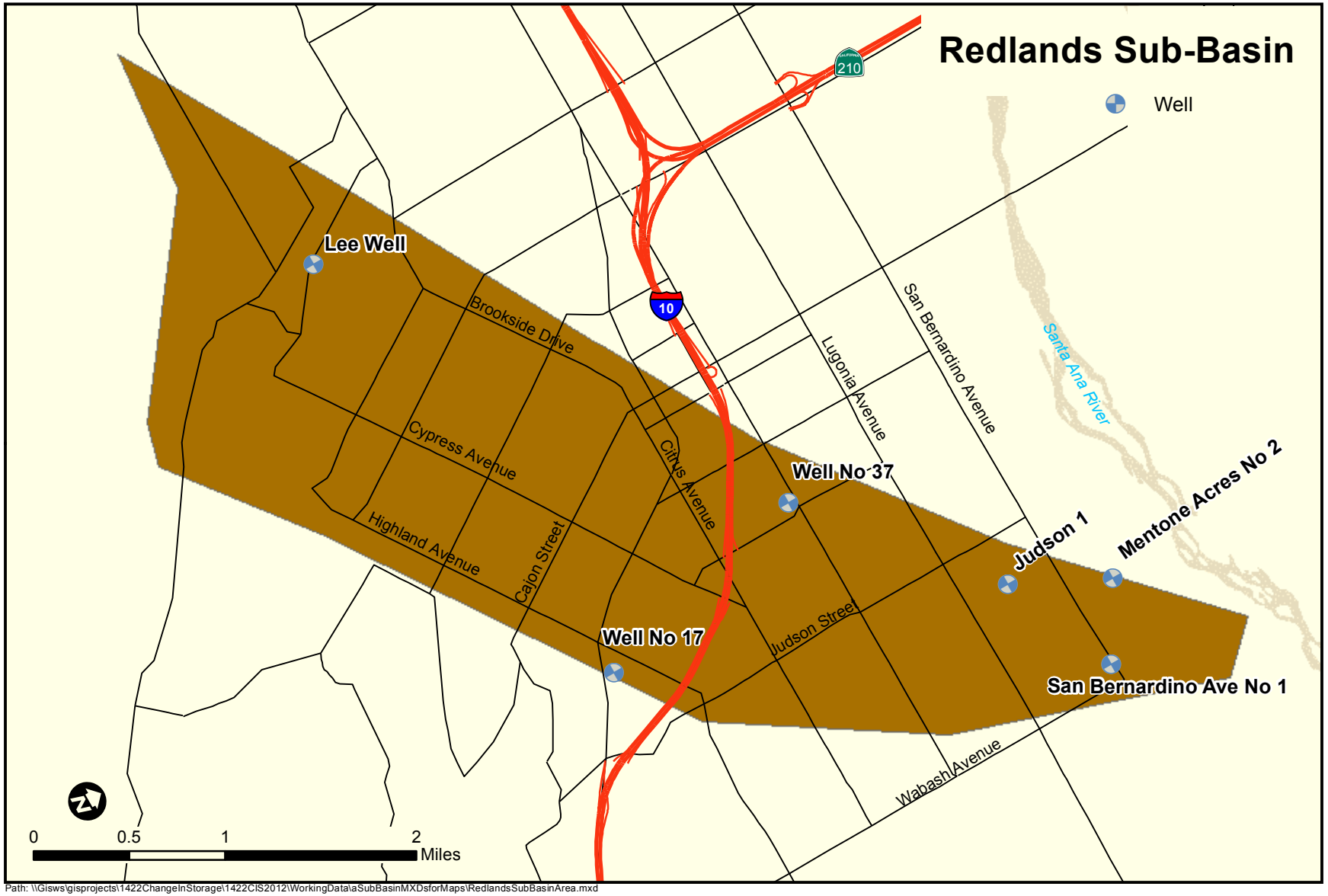
Change In Storage for the Redlands Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1934	0	n/a	0
1935	5	2,422	2,422
1936	-2	-1,000	1,422
1937	16	6,898	8,320
1938	28	12,380	20,700
1939	8	3,484	24,184
1940	-1	272	24,456
1941	3	1,330	25,786
1942	-8	-3,543	22,243
1943	4	1,658	23,901
1944	-2	-764	23,137
1945	5	2,417	25,554
1946	-7	-2,877	22,677
1947	-17	-7,651	15,026
1948	-20	-9,030	5,996
1949	-10	-4,575	1,421
1950	-8	-3,489	-2,068
1951	-6	-2,885	-4,953
1952	3	1,342	-3,611
1953	-9	-4,118	-7,729
1954	3	1,246	-6,483
1955	-9	-4,166	-10,649
1956	-5	-2,414	-13,063
1957	-6	-2,745	-15,808
1958	15	7,599	-8,209
1959	-2	-1,842	-10,051
1960	-7	-2,781	-12,832
1961	-20	-9,375	-22,207
1962	7	3,658	-18,549
1963	0	140	-18,409
1964	-9	-3,892	-22,301
1965	-2	-860	-23,161
1966	13	-5,177	-28,338
1967	39	18,026	-10,312
1968	23	10,790	478
1969	34	15,801	16,279
1970	3	759	17,038
1971	-10	-4,512	12,526
1972	-8	-3,981	8,545
1973	-3	-1,990	6,555
1974	4	1,601	8,156
1975	-3	-1,055	7,101
1976	-4	-1,485	5,616
1977	-12	-5,133	483

San Bernardino Valley Municipal Water District

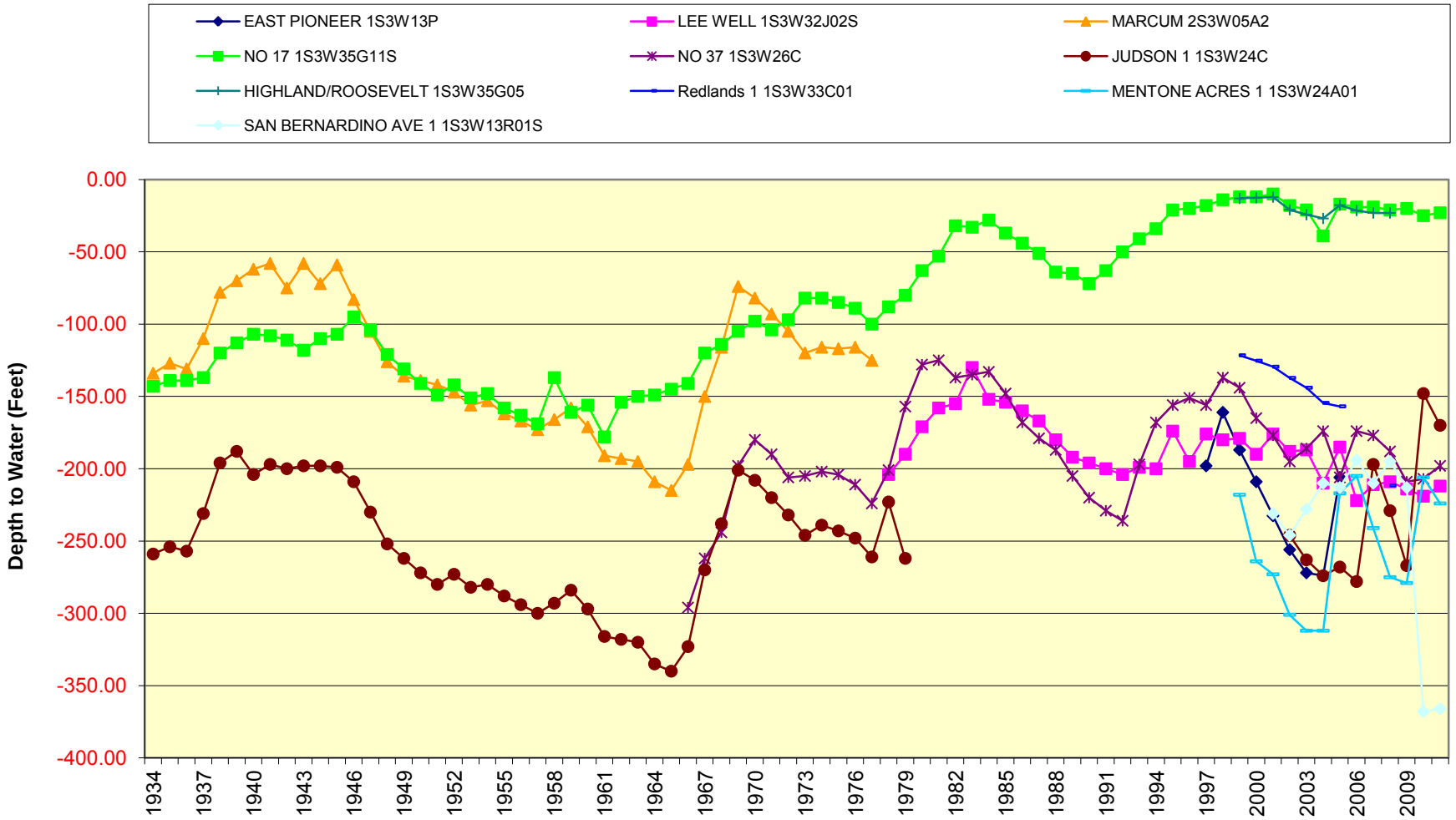
Change In Storage for the Redlands Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1978	24	-5,591	-5,108
1979	7	3,805	-1,303
1980	22	20,494	19,191
1981	9	3,700	22,891
1982	4	140	23,031
1983	9	4,455	27,486
1984	-5	-2,791	24,695
1985	-9	-4,131	20,564
1986	-11	-5,586	14,978
1987	-8	-3,988	10,990
1988	-11	-3,303	7,687
1989	-10	-7,285	402
1990	-9	-4,273	-3,871
1991	-1	-1,576	-5,447
1992	1	-802	-6,249
1993	18	9,337	3,088
1994	12	6,189	9,277
1995	17	7,913	17,190
1996	-5	-2,416	14,774
1997	5	-1,057	13,717
1998	14	3,457	17,174
1999	-8	1,407	18,581
2000	-15	-6,279	12,302
2001	-5	-1,040	11,262
2002	-15	-6,120	5,142
2003	-6	-2,001	3,141
2004	-7	-2,104	1,037
2005	21	4,150	5,187
2006	1	-4,510	677
2007	5	3,900	4,577
2008	-9	-5,652	-1,075
2009	-14	-3,331	-4,406
2010	5	2,475	-1,931
2011	-3	840	-1,091



Path: \\Gisws\gisprojects\1422ChangeInStorage\1422CIS2012\WorkingData\aSubBasinMXDsforMaps\RedlandsSubBasinArea.mxd

Hydrograph for the Redlands Sub-Basin



San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2010

REDLANDS SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (Feet)							
	EAST PIONEER	**LEE WELL**	**MARCUM**	**NO 17**	**NO 37**	**JUDSON 1**	**HIGHLAND/ROOSEVELT**	**Redlands 1**
	1S3W13P	**1S3W32J02S**	**2S3W05A2**	**1S3W35G11S**	**1S3W26C**	**1S3W24C**	**1S3W35G05**	**1S3W33C01**
Year	Source	Source	Source	Source	Source	Source	Added Source	Added Source
1934			-134.00	-143.00		-259.00		
1935			-127.00	-139.00		-254.00		
1936			-131.00	-139.00		-257.00		
1937			-110.00	-137.00		-231.00		
1938			-78.00	-120.00		-196.00		
1939			-70.00	-113.00		-188.00		
1940			-62.00	-107.00		-204.00		
1941			-58.00	-108.00		-197.00		
1942			-75.00	-111.00		-200.00		
1943			-58.00	-118.00		-198.00		
1944			-72.00	-110.00		-198.00		
1945			-59.00	-107.00		-199.00		
1946			-83.00	-95.00		-209.00		
1947			-105.00	-104.00		-230.00		
1948			-126.00	-121.00		-252.00		
1949			-136.00	-131.00		-262.00		
1950			-139.00	-141.00		-272.00		
1951			-142.00	-149.00		-280.00		
1952			-147.00	-142.00		-273.00		
1953			-156.00	-151.00		-282.00		
1954			-153.00	-148.00		-280.00		
1955			-162.00	-158.00		-288.00		
1956			-167.00	-163.00		-294.00		
1957			-173.00	-169.00		-300.00		
1958			-166.00	-137.00		-293.00		
1959			-158.00	-161.00		-284.00		
1960			-171.00	-156.00		-297.00		
1961			-191.00	-178.00		-316.00		
1962			-193.00	-154.00		-318.00		
1963			-195.00	-150.00		-320.00		
1964			-209.00	-149.00		-335.00		
1965			-215.00	-145.00		-340.00		
1966			-197.00	-141.00	-296.00	-323.00		
1967			-150.00	-120.00	-262.00	-270.00		
1968			-116.00	-114.00	-244.00	-238.00		
1969			-74.00	-105.00	-198.00	-201.00		
1970			-82.00	-98.00	-180.00	-208.00		
1971			-93.00	-104.00	-190.00	-220.00		
1972			-105.00	-97.00	-206.00	-232.00		
1973			-120.00	-82.00	-205.00	-246.00		
1974			-116.00	-82.00	-202.00	-239.00		
1975			-117.00	-85.00	-204.00	-243.00		
1976			-116.00	-89.00	-211.00	-248.00		

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2010

REDLANDS SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (Feet)							
Year	EAST PIONEER 1S3W13P Source	LEE WELL 1S3W32J02S Source	MARCUM 2S3W05A2 Source	NO 17 1S3W35G11S Source	NO 37 1S3W26C Source	JUDSON 1 1S3W24C Source	HIGHLAND/ROOSEVELT 1S3W35G05 Added Source	Redlands 1 1S3W33C01 Added Source
1977			-125.00	-100.00	-224.00	-261.00		
1978		-204.00		-88.00	-201.00	-223.00		
1979		-190.00		-80.00	-157.00	-262.00		
1980		-171.00		-63.00	-128.00			
1981		-158.00		-53.00	-125.00			
1982		-155.00		-32.00	-137.00			
1983		-130.00		-33.00	-135.00			
1984		-152.00		-28.00	-133.00			
1985		-154.00		-37.00	-148.00			
1986		-160.00		-44.00	-168.00			
1987		-167.00		-51.00	-179.00			
1988		-180.00		-64.00	-187.00			
1989		-192.00		-65.00	-205.00			
1990		-195.00		-72.00	-220.00			
1991		-200.00		-63.00	-229.00			
1992		-204.00		-50.00	-236.00			
1993		-199.00		-41.00	-197.00			
1994		-200.00		-34.00	-168.00			
1995		-174.00		-21.00	-156.00			
1996		-195.00		-20.00	-151.00			
1997	-198.00	-176.00		-18.00	-156.00			
1998	-161.00	-180.00		-14.00	-137.00			
1999	-187.00	-179.00		-12.00	-144.00		-13.06	-121.55
2000	-209.00	-190.00		-12.00	-165.00		-12.64	-125.32
2001	-232.50	-176.00		-10.00	-177.00		-12.15	-129.44
2002	-256.00	-188.00		-18.00	-195.00	-246.00	-20.88	-137.20
2003	-272.00	-187.00		-21.00	-186.00	-263.00	-24.30	-143.96
2004	-274.00	-210.00		-39.00	-174.00	-274.00	-26.92	-154.45
2005	-206.00	-185.00		-17.00	-206.00	-268.00	-17.70	-156.85
2006		-222.00		-19.00	-174.00	-278.00	-21.42	
2007		-211.00		-19.00	-177.00	-197.00	-23.13	
2008		-209.00		-21.00	-188.00	-229.00	-23.13	-211.49
2009		-214.00		-20.00	-209.00	-267.00		
2010		-219.00		-25.00	-207.00	-148.00		
2011		-212.00		-23.00	-198.00	-170.00		

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2010

REDLANDS SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (Feet)

Year	MENTONE ACRES 1 1S3W24A01 Substitute	SAN BERNARDINO AVE 1 1S3W13R01S Added Source	
1934			
1935			
1936			
1937			
1938			
1939			
1940			
1941			
1942			
1943			
1944			
1945			
1946			
1947			
1948			
1949			
1950			
1951			
1952			
1953			
1954			
1955			
1956			
1957			
1958			
1959			
1960			
1961			
1962			
1963			
1964			
1965			
1966			
1967			
1968			
1969			
1970			
1971			
1972			
1973			
1974			
1975			
1976			

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2010

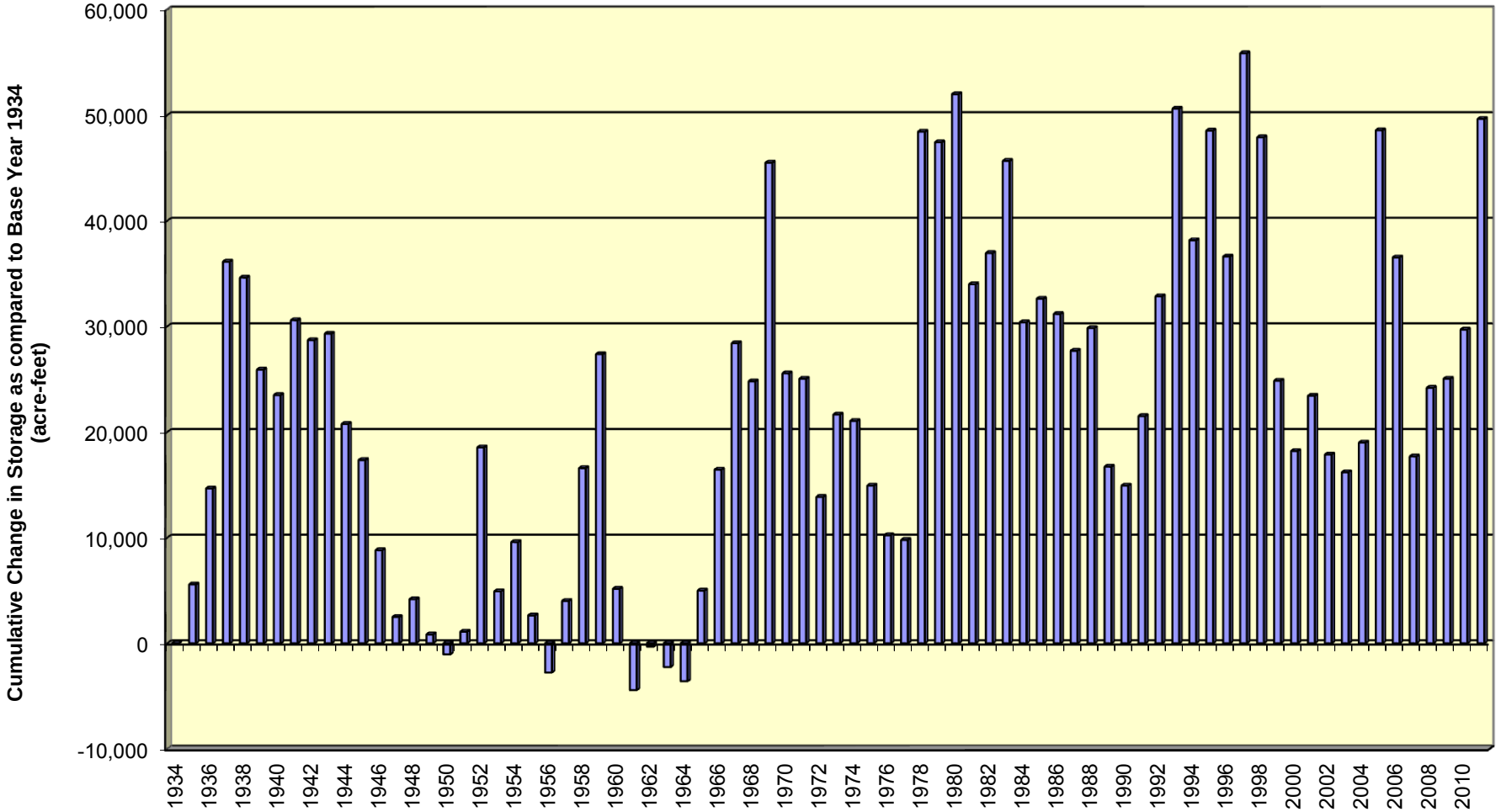
REDLANDS SUB-BASIN

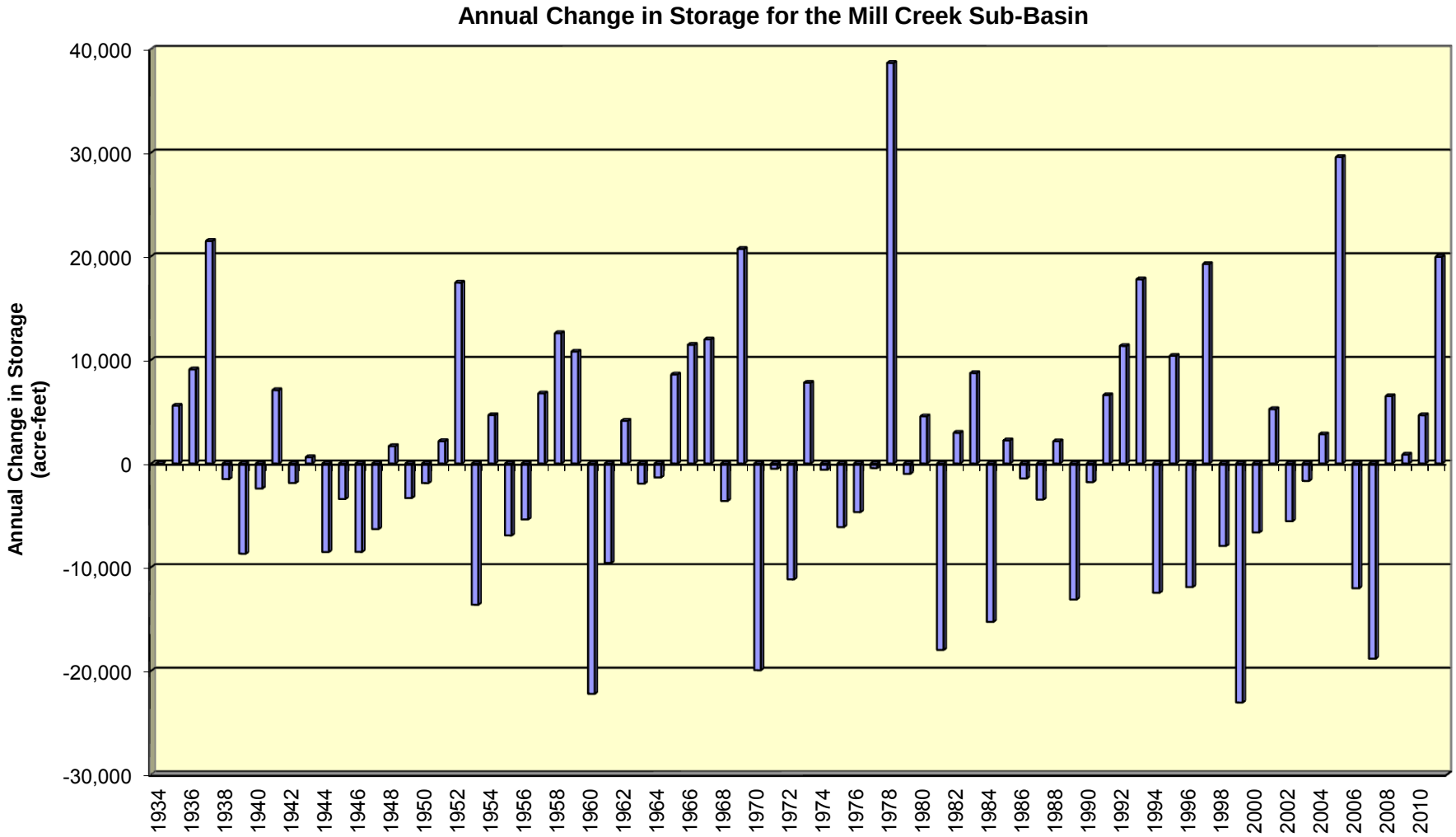
Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (Feet)

Year	MENTONE ACRES 1 1S3W24A01 Substitute	SAN BERNARDINO AVE 1 1S3W13R01S Added Source	
1977			
1978			
1979			
1980			
1981			
1982			
1983			
1984			
1985			
1986			
1987			
1988			
1989			
1990			
1991			
1992			
1993			
1994			
1995			
1996			
1997			
1998			
1999	-218.00		
2000	-264.00		
2001	-273.00	-231.00	
2002	-301.00	-246.00	
2003	-312.00	-228.00	
2004	-312.00	-210.00	
2005	-217.00	-213.00	
2006	-205.00	-194.00	
2007	-241.00	-210.00	
2008	-275.00	-195.00	
2009	-279.00	-213.00	
2010	-206.00	-368.00	
2011	-224.00	-366.00	

Cumulative Change in Storage for the Mill Creek Sub-Basin




Annual Change in Storage for the Mill Creek Sub-Basin
Annual Change in Storage (acre-feet)
40,000
30,000
20,000
10,000
0
-10,000
-20,000
-30,000
1934
1936
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010

San Bernardino Valley Municipal Water District

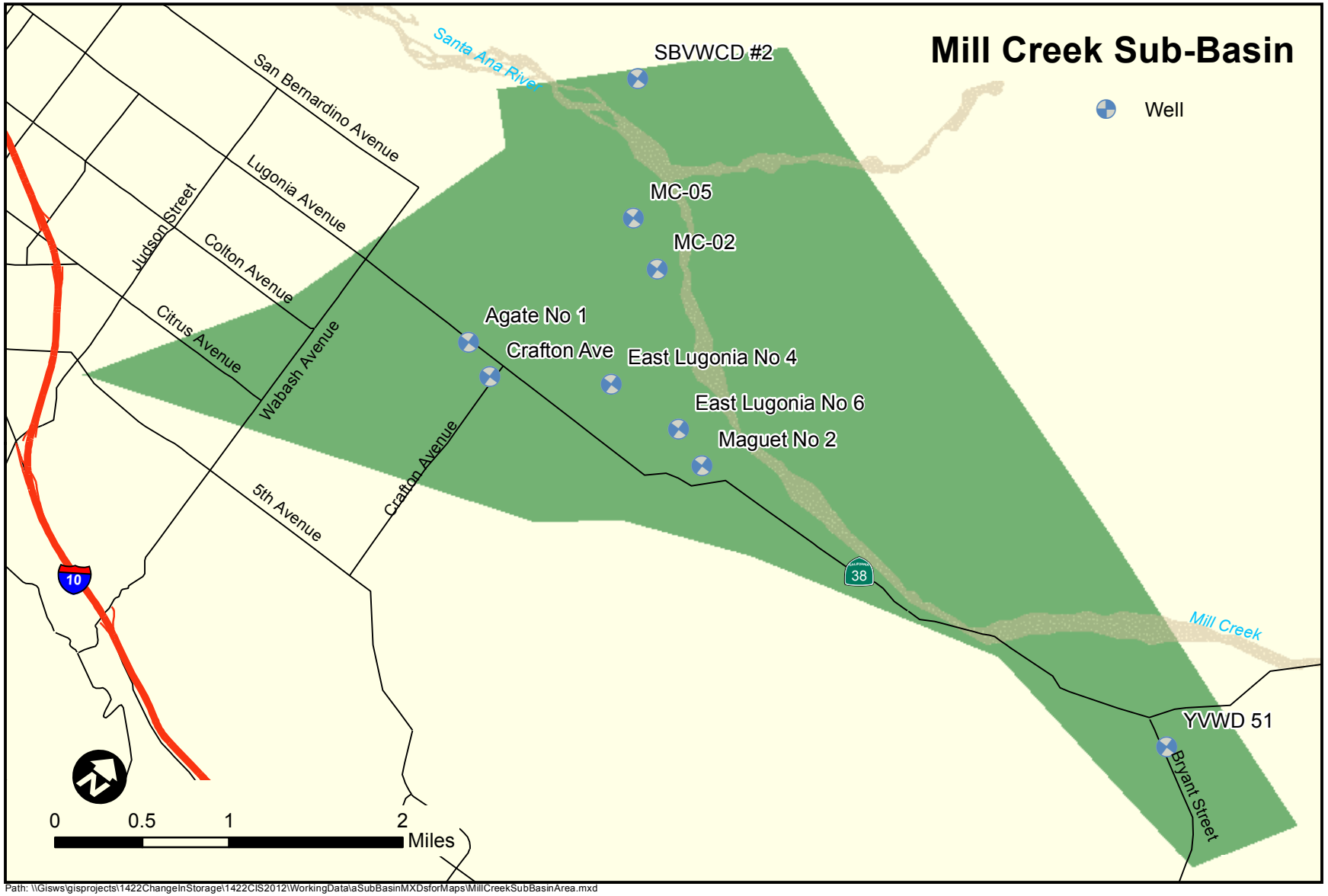
Change In Storage for the Mill Creek Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1934	0	n/a	0
1935	11	5,575	5,575
1936	20	9,081	14,656
1937	30	21,472	36,128
1938	-4	-1,506	34,622
1939	-16	-8,705	25,917
1940	-3	-2,412	23,505
1941	15	7,081	30,586
1942	-8	-1,883	28,703
1943	3	608	29,311
1944	-14	-8,542	20,769
1945	-3	-3,421	17,348
1946	-13	-8,531	8,817
1947	-13	-6,322	2,495
1948	4	1,677	4,172
1949	-5	-3,332	840
1950	-5	-1,890	-1,050
1951	3	2,151	1,101
1952	29	17,447	18,548
1953	-22	-13,629	4,919
1954	8	4,664	9,583
1955	-13	-6,947	2,636
1956	-11	-5,394	-2,758
1957	14	6,767	4,009
1958	25	12,574	16,583
1959	10	10,797	27,380
1960	-32	-22,220	5,160
1961	-17	-9,592	-4,432
1962	8	4,121	-311
1963	-3	-1,939	-2,250
1964	-3	-1,344	-3,594
1965	17	8,585	4,991
1966	18	11,449	16,440
1967	17	11,973	28,413
1968	-6	-3,615	24,798
1969	31	20,705	45,503
1970	-29	-19,947	25,556
1971	-3	-507	25,049
1972	-15	-11,184	13,865
1973	12	7,794	21,659
1974	-1	-605	21,054
1975	-11	-6,130	14,924
1976	-7	-4,694	10,230
1977	4	-440	9,790

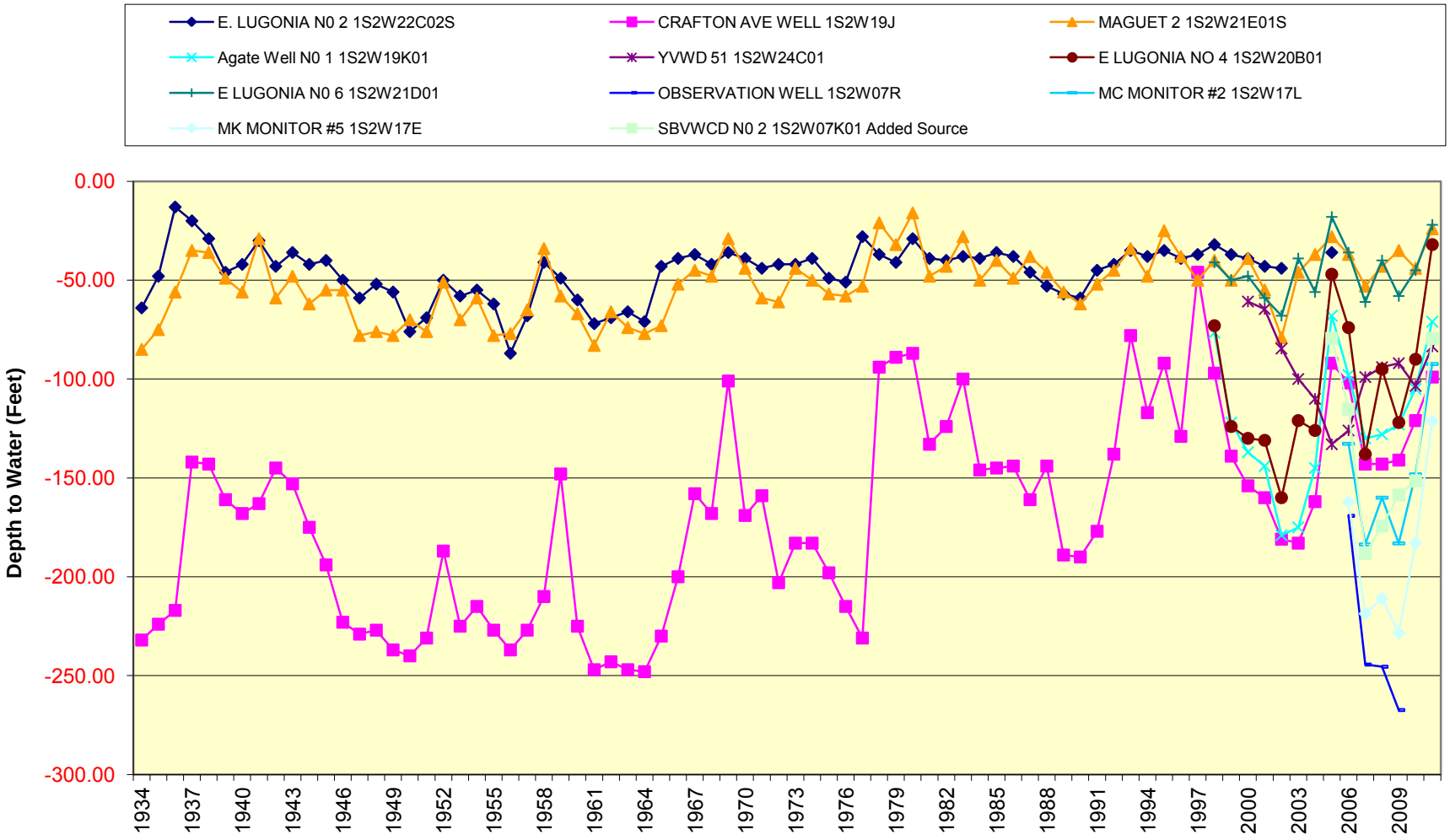
San Bernardino Valley Municipal Water District

Change In Storage for the Mill Creek Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1978	53	38,652	48,442
1979	-3	-1,001	47,441
1980	10	4,546	51,987
1981	-29	-17,993	33,994
1982	4	2,958	36,952
1983	14	8,723	45,675
1984	-23	-15,284	30,391
1985	5	2,232	32,623
1986	-3	-1,445	31,178
1987	-5	-3,482	27,696
1988	1	2,148	29,844
1989	-20	-13,125	16,719
1990	-3	-1,796	14,923
1991	12	6,593	21,516
1992	16	11,338	32,854
1993	26	17,767	50,621
1994	-19	-12,468	38,153
1995	17	10,390	48,543
1996	-18	-11,923	36,620
1997	24	19,248	55,868
1998	-30	-7,957	47,911
1999	-27	-23,059	24,852
2000	-12	-6,656	18,196
2001	-7	5,243	23,439
2002	-20	-5,565	17,874
2003	19	-1,681	16,193
2004	4	2,811	19,004
2005	41	29,567	48,571
2006	-18	-12,042	36,529
2007	-41	-18,835	17,694
2008	13	6,498	24,192
2009	-7	856	25,048
2010	17	4,657	29,705
2011	41	19,938	49,643


Mill Creek Sub-Basin
Well
SBVWCD #2
Santa Ana River
MC-05
MC-02
Agate No 1
Crafton Ave
East Lugonia No 4
East Lugonia No 6
Maguet No 2
YVWD 51
Mill Creek
Bryant Street
San Bernardino Avenue
Lugonia Avenue
Judson Street
Colton Avenue
Citrus Avenue
Wabash Avenue
Crafton Avenue
5th Avenue
10
38
0
0.5
1
2
Miles
Path: \\Gisws\gisprojects\1422ChangeInStorage\1422CIS2012\WorkingData\aSubBasinMXDsforMaps\MillCreekSubBasinArea.mxd

Hydrograph for the Mill Creek Sub-Basin Wells



San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

MILL CREEK SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft.)					
Year	E LUGONIA N0 6 1S2W21D01 Added Source	SBVWCD N0 2 1S2W07K01 Added Source	MC MONITOR #2 1S2W17L Added Source	MK MONITOR #5 1S2W17E Added Source	OBSERVATION WELL 1S2W07R Added Source
1934					
1935					
1936					
1937					
1938					
1939					
1940					
1941					
1942					
1943					
1944					
1945					
1946					
1947					
1948					
1949					
1950					
1951					
1952					
1953					
1954					
1955					
1956					
1957					
1958					
1959					
1960					
1961					
1962					
1963					

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

MILL CREEK SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

	Depth to Water (ft.)				
	E LUGONIA N0 6	**SBVWCD N0 2**	**MC MONITOR #2**	**MK MONITOR #5**	**OBSERVATION WELL**
	1S2W21D01	**1S2W07K01**	**1S2W17L**	**1S2W17E**	**1S2W07R**
Year	Added Source	Added Source	Added Source	Added Source	Added Source
1964					
1965					
1966					
1967					
1968					
1969					
1970					
1971					
1972					
1973					
1974					
1975					
1976					
1977					
1978					
1979					
1980					
1981					
1982					
1983					
1984					
1985					
1986					
1987					
1988					
1989					
1990					
1991					
1992					
1993					

San Bernardino Valley Municipal Water District

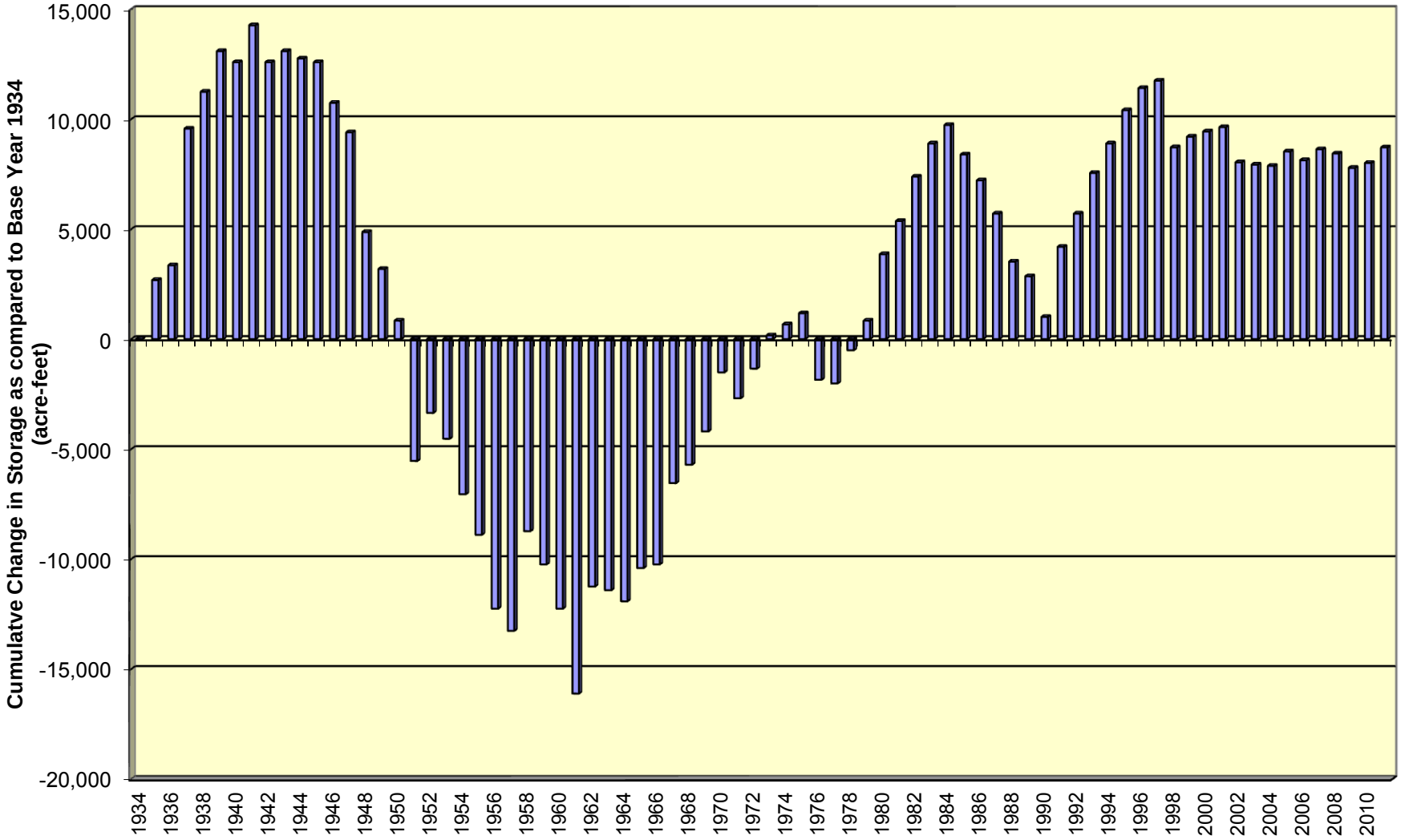
Change in Storage for the San Bernardino Basin Area 1934 - 2011

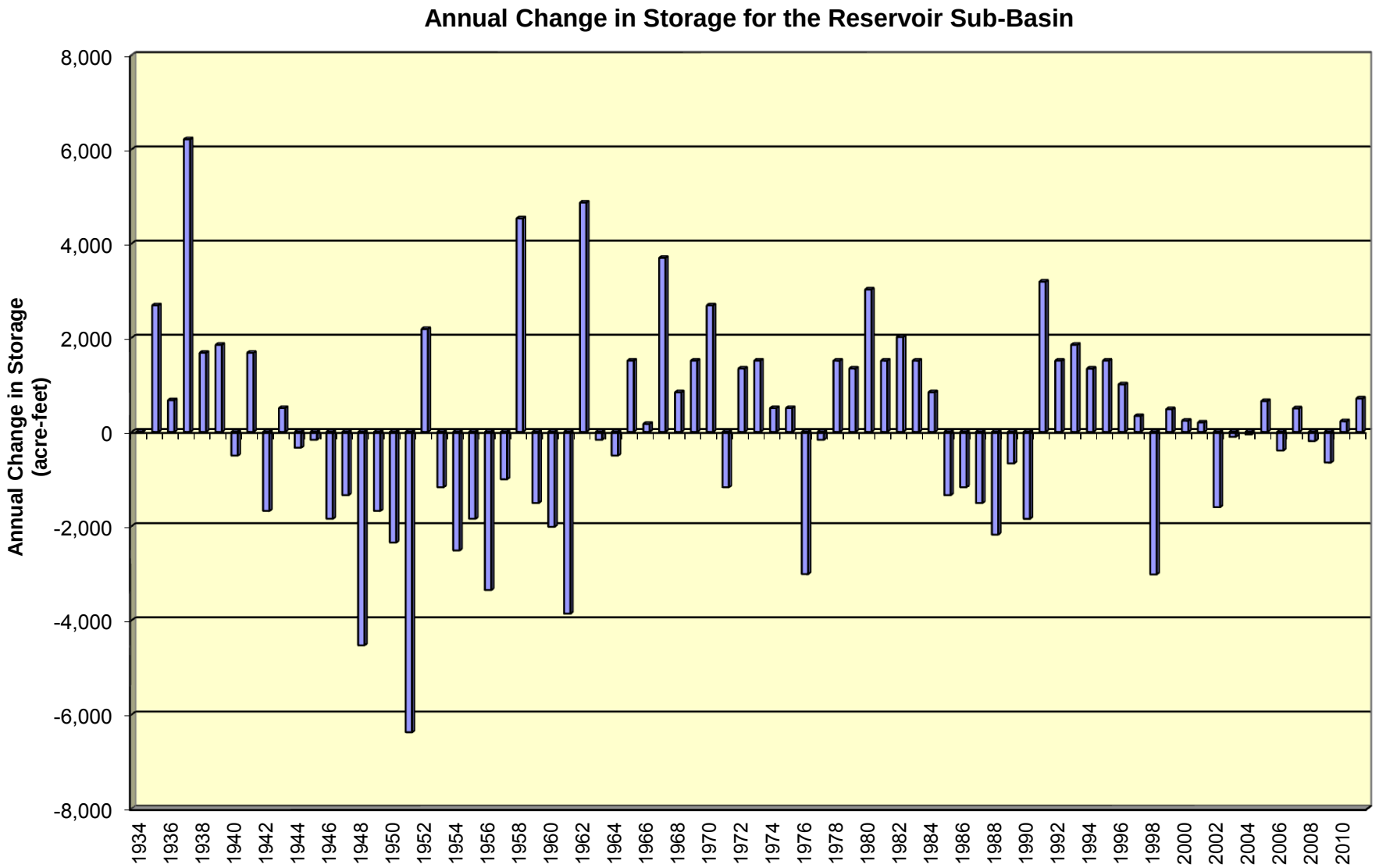
MILL CREEK SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft.)					
Year	**E LUGONIA N0 6 1S2W21D01** Added Source	**SBVWCD N0 2 1S2W07K01** Added Source	**MC MONITOR #2 1S2W17L** Added Source	**MK MONITOR #5 1S2W17E** Added Source	**OBSERVATION WELL 1S2W07R** Added Source
1994					
1995					
1996					
1997					
1998	-41.00				
1999	-50.00				
2000	-48.00				
2001	-59.00				
2002	-68.00				
2003	-39.00				
2004	-56.00				
2005	-18.00	-79.40			
2006	-36.00	-115.23	-132.75	-162.14	-169.20
2007	-61.00	-188.20	-183.64	-218.66	-244.40
2008	-40.00	-174.40	-160.00	-211.00	-245.50
2009	-58.00	-158.60	-183.10	-228.50	-267.40
2010	-45.00	-151.60	-148.20	-182.90	
2011	-22.00	-79.49	-92.40	-121.27	

Cumulative Change in Storage for the Reservoir Sub-Basin




Annual Change in Storage for the Reservoir Sub-Basin
Annual Change in Storage (acre-feet)
8,000
6,000
4,000
2,000
0
-2,000
-4,000
-6,000
-8,000
1934
1936
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010

San Bernardino Valley Municipal Water District

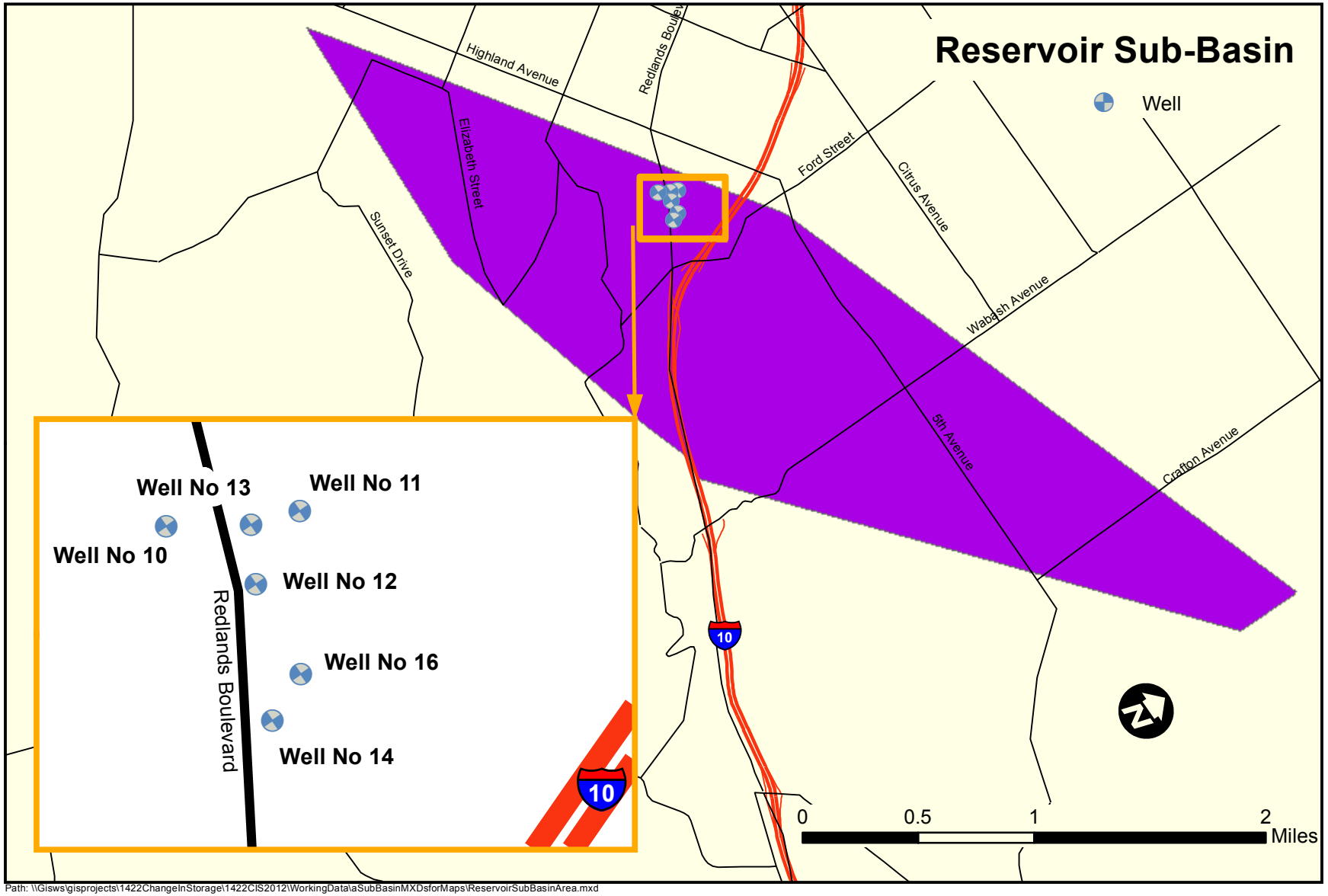
Change In Storage for the Reservoir Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1934	0	n/a	0
1935	16	2,686	2,686
1936	4	671	3,357
1937	37	6,211	9,568
1938	10	1,678	11,246
1939	11	1,847	13,093
1940	-3	-504	12,589
1941	10	1,679	14,268
1942	-10	-1,679	12,589
1943	3	504	13,093
1944	-2	-336	12,757
1945	-1	-168	12,589
1946	-11	-1,846	10,743
1947	-8	-1,343	9,400
1948	-27	-4,532	4,868
1949	-10	-1,679	3,189
1950	-14	-2,350	839
1951	-38	-6,378	-5,539
1952	13	2,182	-3,357
1953	-7	-1,175	-4,532
1954	-15	-2,518	-7,050
1955	-11	-1,846	-8,896
1956	-20	-3,358	-12,254
1957	-6	-1,007	-13,261
1958	27	4,532	-8,729
1959	-9	-1,510	-10,239
1960	-12	-2,015	-12,254
1961	-23	-3,860	-16,114
1962	29	4,868	-11,246
1963	-1	-168	-11,414
1964	-3	-504	-11,918
1965	9	1,511	-10,407
1966	1	168	-10,239
1967	22	3,693	-6,546
1968	5	839	-5,707
1969	9	1,511	-4,196
1970	16	2,685	-1,511
1971	-7	-1,175	-2,686
1972	8	1,343	-1,343
1973	9	1,511	168
1974	3	503	671
1975	3	504	1,175
1976	-18	-3,021	-1,846
1977	-1	-168	-2,014

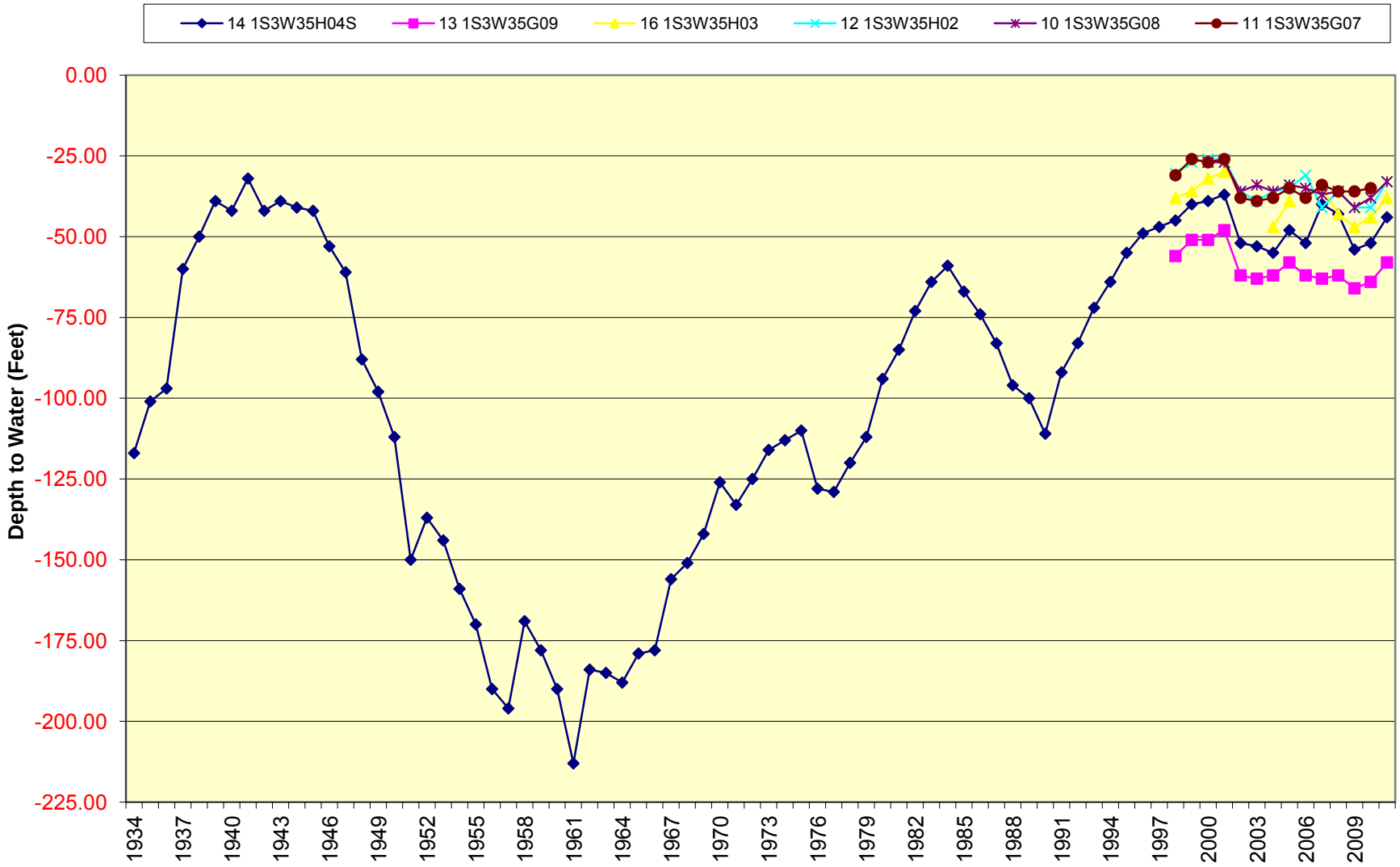
San Bernardino Valley Municipal Water District

Change In Storage for the Reservoir Sub-basin 1934 - 2011

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1978	9	1,510	-504
1979	8	1,343	839
1980	18	3,022	3,861
1981	9	1,510	5,371
1982	12	2,015	7,386
1983	9	1,510	8,896
1984	5	840	9,736
1985	-8	-1,343	8,393
1986	-7	-1,175	7,218
1987	-9	-1,511	5,707
1988	-13	-2,182	3,525
1989	-4	-671	2,854
1990	-11	-1,847	1,007
1991	19	3,189	4,196
1992	9	1,511	5,707
1993	11	1,847	7,554
1994	8	1,342	8,896
1995	9	1,511	10,407
1996	6	1,007	11,414
1997	2	336	11,750
1998	-31	-3,027	8,723
1999	4	481	9,204
2000	-4	236	9,440
2001	1	197	9,637
2002	-5	-1,598	8,039
2003	-1	-106	7,933
2004	-8	-54	7,879
2005	4	652	8,531
2006	-2	-396	8,135
2007	1	497	8,632
2008	-1	-195	8,437
2009	-5	-652	7,785
2010	2	224	8,009
2011	6	708	8,717


Reservoir Sub-Basin
Well
Highland Avenue
Redlands Boulevard
Elizabeth Street
Ford Street
Citrus Avenue
Sunset Drive
Wabash Avenue
5th Avenue
Crafton Avenue
Well No 13
Well No 11
Well No 10
Well No 12
Well No 16
Well No 14
Redlands Boulevard
10
10
0
0.5
1
2
Miles
Path: \\Gisws\gisprojects\1422ChangeInStorage\1422CIS2012\WorkingData\aSubBasinMXDsforMaps\ReservoirSubBasinArea.mxd

Hydrograph for the Reservoir Sub-Basin Wells



San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

RESERVOIR SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft.)

Year	14 1S3W35H04S Source	13 1S3W35G09 Added Source	16 1S3W35H03 Added Source	12 1S3W35H02 Added Source	10 1S3W35G08 Added Source	11 1S3W35G07 Added Source
1934	-117.00					
1935	-101.00					
1936	-97.00					
1937	-60.00					
1938	-50.00					
1939	-39.00					
1940	-42.00					
1941	-32.00					
1942	-42.00					
1943	-39.00					
1944	-41.00					
1945	-42.00					
1946	-53.00					
1947	-61.00					
1948	-88.00					
1949	-98.00					
1950	-112.00					
1951	-150.00					
1952	-137.00					
1953	-144.00					
1954	-159.00					
1955	-170.00					
1956	-190.00					
1957	-196.00					
1958	-169.00					
1959	-178.00					
1960	-190.00					
1961	-213.00					
1962	-184.00					
1963	-185.00					
1964	-188.00					

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

RESERVOIR SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft.)

Year	14 1S3W35H04S Source	13 1S3W35G09 Added Source	16 1S3W35H03 Added Source	12 1S3W35H02 Added Source	10 1S3W35G08 Added Source	11 1S3W35G07 Added Source
1965	-179.00					
1966	-178.00					
1967	-156.00					
1968	-151.00					
1969	-142.00					
1970	-126.00					
1971	-133.00					
1972	-125.00					
1973	-116.00					
1974	-113.00					
1975	-110.00					
1976	-128.00					
1977	-129.00					
1978	-120.00					
1979	-112.00					
1980	-94.00					
1981	-85.00					
1982	-73.00					
1983	-64.00					
1984	-59.00					
1985	-67.00					
1986	-74.00					
1987	-83.00					
1988	-96.00					
1989	-100.00					
1990	-111.00					
1991	-92.00					
1992	-83.00					
1993	-72.00					
1994	-64.00					
1995	-55.00					

San Bernardino Valley Municipal Water District

Change in Storage for the San Bernardino Basin Area 1934 - 2011

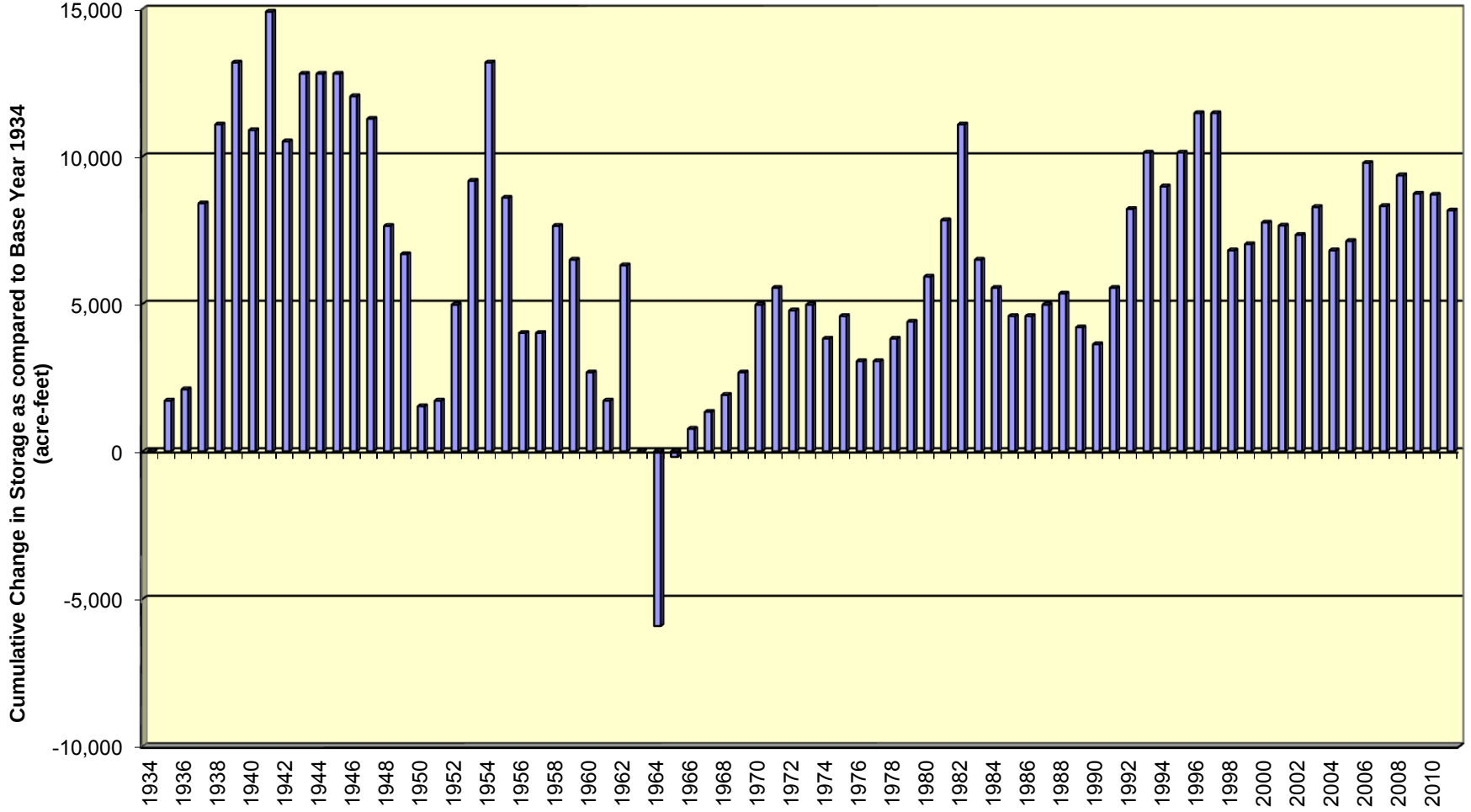
RESERVOIR SUB-BASIN

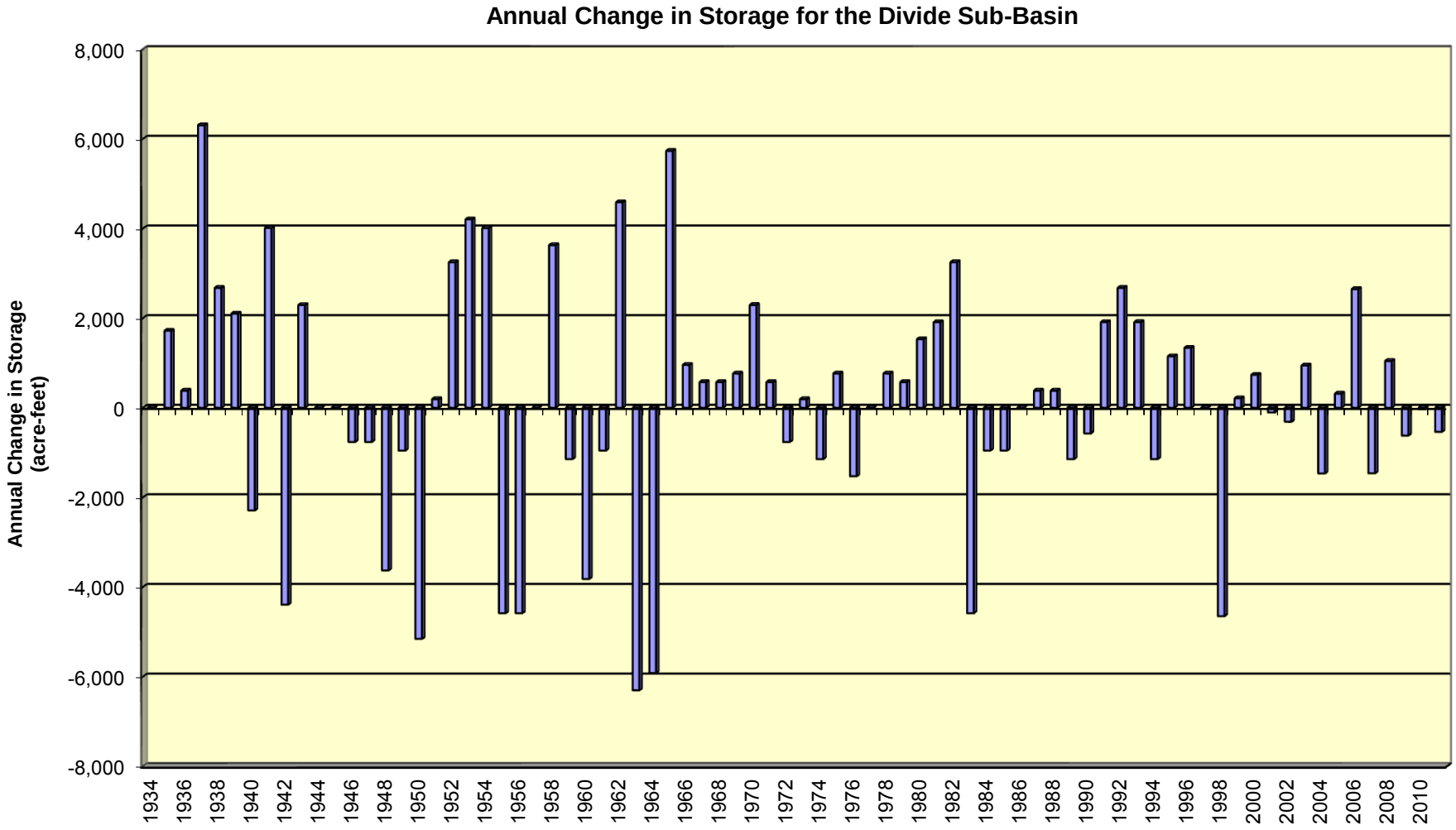
Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft.)

Year	14 1S3W35H04S Source	13 1S3W35G09 Added Source	16 1S3W35H03 Added Source	12 1S3W35H02 Added Source	10 1S3W35G08 Added Source	11 1S3W35G07 Added Source
1996	-49.00					
1997	-47.00					
1998	-45.00	-56.00	-38.00	-30.50		-31.00
1999	-40.00	-51.00	-36.00	-27.00		-26.00
2000	-39.00	-51.00	-32.00	-26.00	-27.00	-27.00
2001	-37.00	-48.00	-30.00	-26.00	-27.00	-26.00
2002	-52.00	-62.00		-36.00	-36.00	-38.00
2003	-53.00	-63.00		-39.00	-34.00	-39.00
2004	-55.00	-62.00	-47.00	-36.00	-36.00	-38.00
2005	-48.00	-58.00	-39.00	-35.00	-34.00	-35.00
2006	-52.00	-62.00		-31.00	-35.00	-38.00
2007	-40.00	-63.00	-35.00	-41.00	-37.00	-34.00
2008	-43.00	-62.00	-43.00	-36.00	-36.00	-36.00
2009	-54.00	-66.00	-47.00	-41.00	-41.00	-36.00
2010	-52.00	-64.00	-44.00	-41.00	-38.00	-35.00
2011	-44.00	-58.00	-38.00	-33.00	-33.00	-32.00

Cumulative Change in Storage for the Divide Sub-Basin




Annual Change in Storage for the Divide Sub-Basin
Annual Change in Storage (acre-feet)
8,000
6,000
4,000
2,000
0
-2,000
-4,000
-6,000
-8,000
1934
1936
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010

San Bernardino Valley Municipal Water District

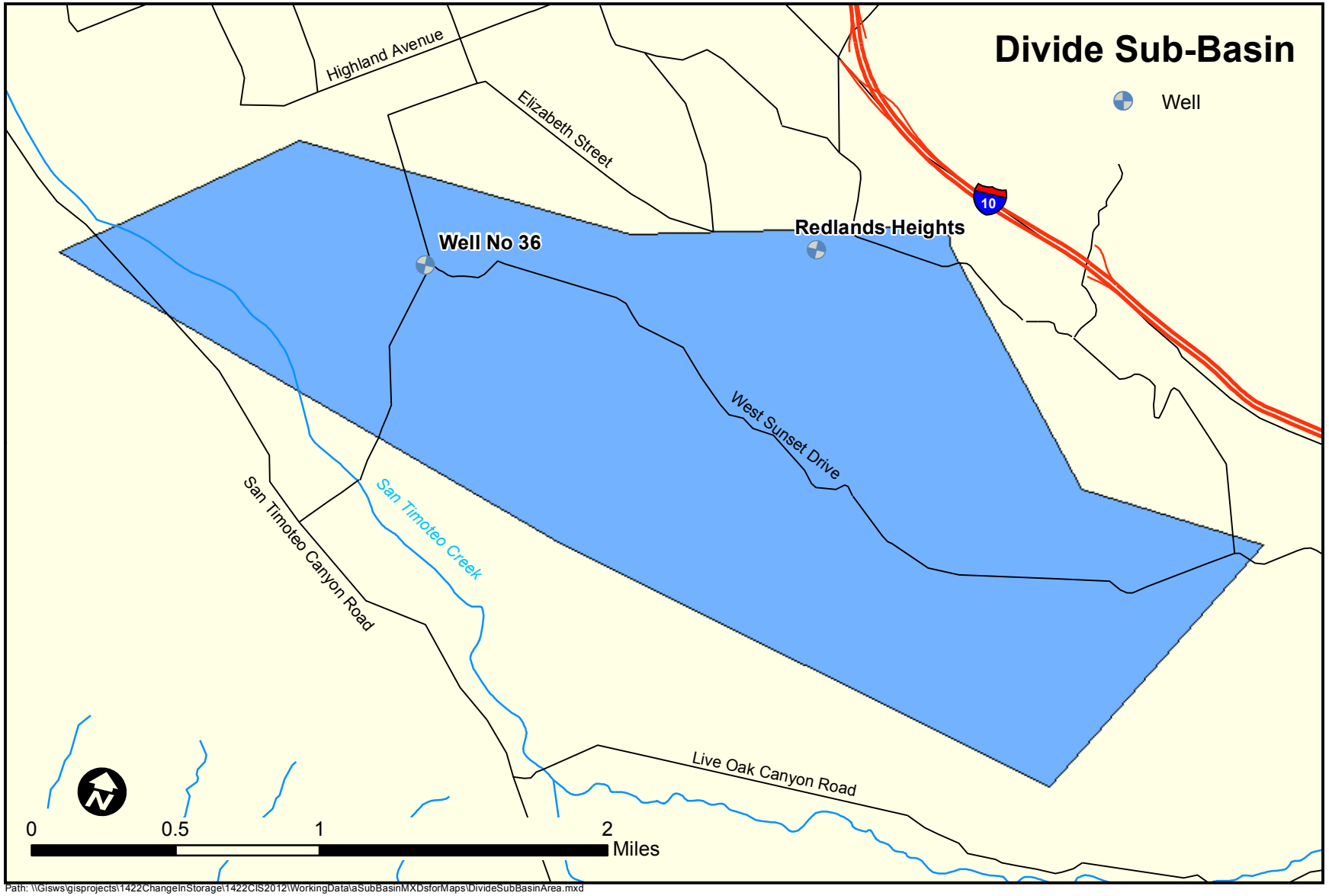
Change In Storage for the Divide Sub-basin 1934 - 2010

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1934	0	n/a	0
1935	9	1,719	1,719
1936	2	382	2,101
1937	33	6,304	8,405
1938	14	2,675	11,080
1939	11	2,101	13,181
1940	-12	-2,292	10,889
1941	21	4,012	14,901
1942	-23	-4,394	10,507
1943	12	2,292	12,799
1944	0	0	12,799
1945	0	0	12,799
1946	-4	-764	12,035
1947	-4	-764	11,271
1948	-19	-3,630	7,641
1949	-5	-955	6,686
1950	-27	-5,158	1,528
1951	1	191	1,719
1952	17	3,248	4,967
1953	22	4,203	9,170
1954	21	4,011	13,181
1955	-24	-4,585	8,596
1956	-24	-4,584	4,012
1957	0	0	4,012
1958	19	3,629	7,641
1959	-6	-1,146	6,495
1960	-20	-3,821	2,674
1961	-5	-955	1,719
1962	24	4,585	6,304
1963	-33	-6,304	0
1964	-31	-5,922	-5,922
1965	30	5,731	-191
1966	5	955	764
1967	3	573	1,337
1968	3	573	1,910
1969	4	764	2,674
1970	12	2,293	4,967
1971	3	573	5,540
1972	-4	-764	4,776
1973	1	191	4,967
1974	-6	-1,146	3,821
1975	4	764	4,585
1976	-8	-1,528	3,057
1977	0	0	3,057

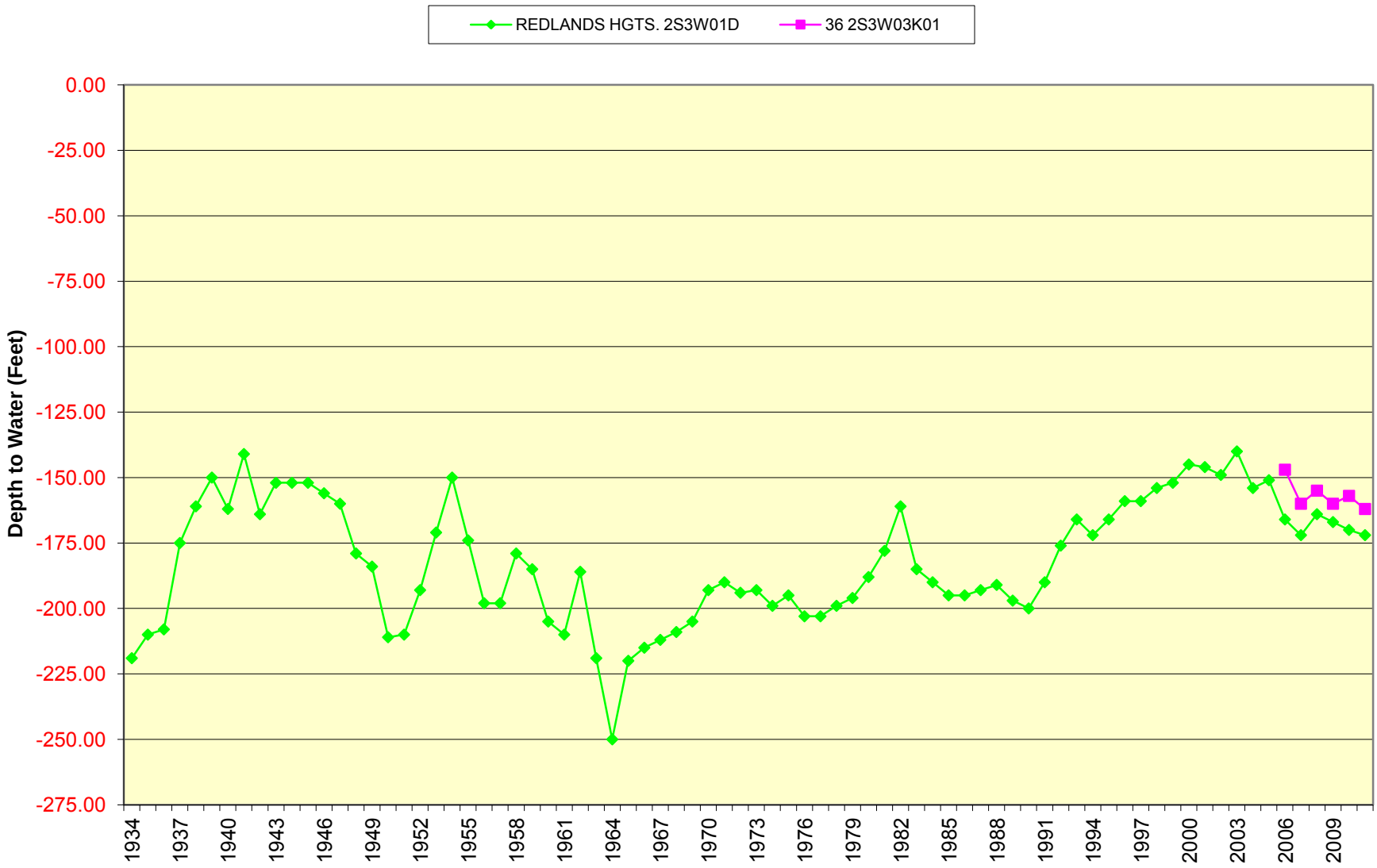
San Bernardino Valley Municipal Water District

Change In Storage for the Divide Sub-basin 1934 - 2010

(1) Year	(2) Basin Index (ft.)	(3) Annual Change in Groundwater Storage (acre-feet)	(4) Cummulative Change in Groundwater Storage (acre-feet)
1978	4	764	3,821
1979	3	573	4,394
1980	8	1,528	5,922
1981	10	1,910	7,832
1982	17	3,248	11,080
1983	-24	-4,585	6,495
1984	-5	-955	5,540
1985	-5	-955	4,585
1986	0	0	4,585
1987	2	382	4,967
1988	2	382	5,349
1989	-6	-1,146	4,203
1990	-3	-573	3,630
1991	10	1,910	5,540
1992	14	2,674	8,214
1993	10	1,911	10,125
1994	-6	-1,146	8,979
1995	6	1,146	10,125
1996	7	1,337	11,462
1997	0	0	11,462
1998	5	-4,651	6,811
1999	2	210	7,021
2000	7	734	7,755
2001	-1	-105	7,650
2002	-3	-314	7,336
2003	9	943	8,279
2004	-14	-1,467	6,812
2005	3	314	7,126
2006	-15	2,649	9,775
2007	-10	-1,462	8,313
2008	7	1,042	9,355
2009	-4	-621	8,734
2010	0	-32	8,702
2011	-4	-537	8,165


Divide Sub-Basin
Well
Highland Avenue
Elizabeth Street
10
Redlands Heights
Well No 36
West Sunset Drive
San Timoteo Creek
San Timoteo Canyon Road
Live Oak Canyon Road
0
0.5
1
2
Miles
Path: \\Gisws\gisprojects\1422ChangeInStorage\1422CIS2012\WorkingData\aSubBasinMXDsforMaps\DivideSubBasinArea.mxd

Hydrograph for the Divide Sub-Basin Wells



San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
DIVIDE SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft.)

Year	REDLANDS HGTS. 2S3W01D Source	36 2S3W03K01 Added Source
1934	-219.00	
1935	-210.00	
1936	-208.00	
1937	-175.00	
1938	-161.00	
1939	-150.00	
1940	-162.00	
1941	-141.00	
1942	-164.00	
1943	-152.00	
1944	-152.00	
1945	-152.00	
1946	-156.00	
1947	-160.00	
1948	-179.00	
1949	-184.00	
1950	-211.00	
1951	-210.00	
1952	-193.00	
1953	-171.00	
1954	-150.00	
1955	-174.00	
1956	-198.00	
1957	-198.00	
1958	-179.00	
1959	-185.00	
1960	-205.00	
1961	-210.00	
1962	-186.00	

San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
DIVIDE SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft.)

Year	REDLANDS HGTS. 2S3W01D Source	36 2S3W03K01 Added Source
1963	-219.00	
1964	-250.00	
1965	-220.00	
1966	-215.00	
1967	-212.00	
1968	-209.00	
1969	-205.00	
1970	-193.00	
1971	-190.00	
1972	-194.00	
1973	-193.00	
1974	-199.00	
1975	-195.00	
1976	-203.00	
1977	-203.00	
1978	-199.00	
1979	-196.00	
1980	-188.00	
1981	-178.00	
1982	-161.00	
1983	-185.00	
1984	-190.00	
1985	-195.00	
1986	-195.00	
1987	-193.00	
1988	-191.00	
1989	-197.00	
1990	-200.00	
1991	-190.00	

San Bernardino Valley Municipal Water District
Change in Storage for the San Bernardino Basin Area 1934 - 2011
DIVIDE SUB-BASIN

Shaded cells with no values represent no depth available; shaded cells with values represent interpolated depths

Depth to Water (ft.)

Year	REDLANDS HGTS. 2S3W01D Source	36 2S3W03K01 Added Source
1992	-176.00	
1993	-166.00	
1994	-172.00	
1995	-166.00	
1996	-159.00	
1997	-159.00	
1998	-154.00	
1999	-152.00	
2000	-145.00	
2001	-146.00	
2002	-149.00	
2003	-140.00	
2004	-154.00	
2005	-151.00	
2006	-166.00	-147.00
2007	-172.00	-160.00
2008	-164.00	-155.00
2009	-167.00	-160.00
2010	-170.00	-157.00
2011	-172.00	-162.00

APPENDIX: SBVMWD CHANGE IN STORAGE MODEL

List of Figures

List of Tables

A. INTRODUCTION

The San Bernardino Valley Municipal Water District was incorporated on February 17, 1954. The District is one of 29 contractors of the California State Water Project (SWP) and has the fifth largest annual entitlement to SWP water at 102,600 acre-feet. The District takes delivery of SWP water through the Devil Canyon Powerhouse on the East Branch of the California State Aqueduct.

The District serves a population of about 600,000 people within a 328 square mile area in the east San Bernardino Valley. Currently, there are over 33 miles of 12-inch to 78-inch diameter pipelines in the District's delivery system. The system includes 28 service connections to deliver both native and SWP water for direct delivery or groundwater recharge within the District's boundary. Groundwater recharge is conducted to lessen the impact of increasing well production from the various groundwater basins within the District's boundary and to help the District meet certain legal obligations.

One of the legal obligations imposed on the District is the responsibility for maintaining the "safe yield" of the San Bernardino Basin Area. The safe yield is a theoretical maximum amount of water that may be removed from the basin on an annual basis without degrading the usable water supply. For the San Bernardino Basin Area, this amount has been set by the Western-San Bernardino Watermaster at 232,100 acre-feet/yr (Watermaster, pg. 24).

One method of accounting for groundwater that enters or leaves the San Bernardino Basin Area is to estimate the change in groundwater volume, or storage, using a network of observation wells. The change in groundwater elevation for these observation wells along with the given soil characteristics can be used to approximate the change in groundwater storage.

B. THE SBVMWD CHANGE IN STORAGE MODEL

B.1 Background

The San Bernardino Valley Municipal Water District (SBVMWD) has been calculating the change in groundwater storage for the San Bernardino Basin area since 1970. The first calculation was completed for the years 1934 – 1960 by the State of California Department of Water Resources (DWR) and the results were summarized in Bulletin 104-5, Meeting Water Demands in the Bunker Hill-San Timoteo Area, Geology, Hydrology, and Operation-Economics Studies, Text and Plates (Olson, pp. 90 – 92). The DWR change in storage values were calculated using the Specific Yield Method (Olson, pp. 85 – 98) and a mathematical model developed by TRW, Incorporated, Redondo Beach, California (TRW). In 1980, SBVMWD updated the change in storage calculation to include the years 1961 – 1980 (Van Gelder). In the early 1990's, SBVMWD created a new change in storage model using GRID software developed by Environmental Systems Research Institute (ESRI), Redlands, California. GRID was selected because it allowed a finer model resolution and because it was able to interpolate surfaces or create contour maps from a spatial distribution of data points. The differences between the two models are summarized in Table B.1.1.

Table B.1.1. Differences between DWR model and SBVMWD Model.

Item	DWR Model	SBVMWD Model
Method of Analysis	Specific Yield Method	Specific Yield Method
Sub-basin boundaries	DWR Bulletin No. 104-5	DWR Bulletin No. 104-5
Wells (quantity)	75	See main report
Water Levels	Constant across "nodes"	Interpolated from given data
Specific Yield	DWR Bulletin No. 45	DWR Bulletin No. 45
Computer Software	FORTRAN IV	ESRI GRID® Software
Model resolution (cell size)	75 "nodes" (cells): Smallest cell= 589 acres Largest cell = 1,778 acres	335,758 cells: Uniform cell size: 100 ft. square (.23 acre)

Although the two models use different computer programs and a different quantity of wells (many of the wells used in the original study have since been abandoned) to calculate the

change in groundwater storage, the results obtained from the two models are similar (see Figure B.1.1). The difference in the results can be mostly attributed to the improved capabilities of the SBVMWD model.

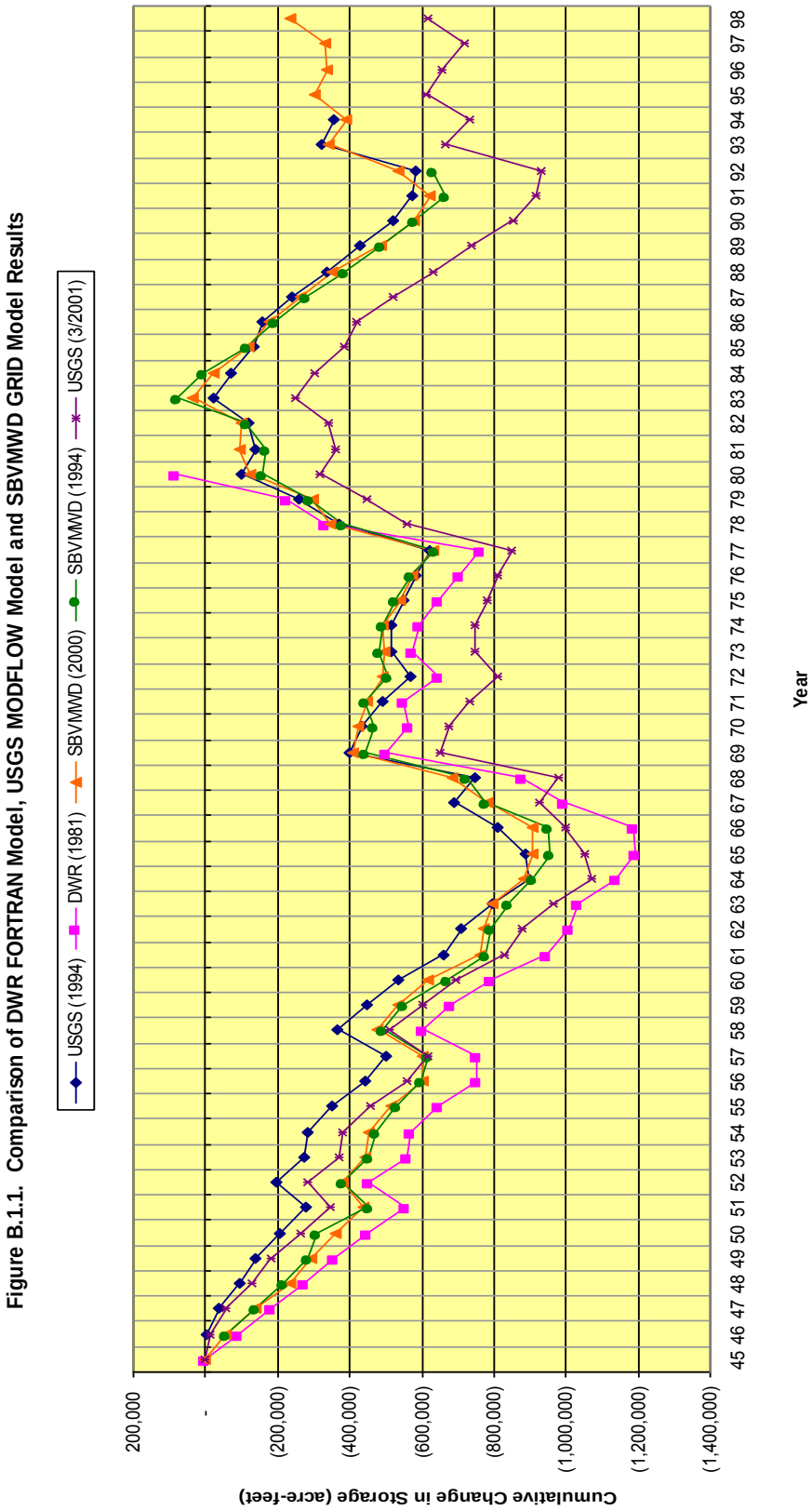


Figure B.1.1. Comparison of DWR FORTRAN Model, USGS MODFLOW Model and SBVMWD GRID Model Results

Geologists divided the DWR model for the San Bernardino Basin Area into 75 polygons (see Table B.1.2), or "nodes", using the Theissen method of polygon construction. The nodes were drawn to surround an area where the soil characteristics, specific yield, and groundwater surface could be assumed constant. The change in storage was computed for each individual node using the Specific Yield Method. The sum of the change in storage for all of the nodes was the change in storage for the San Bernardino Basin area.

Table B.1.2. Quantity of Theissen Polygons ("Nodes") for the Department of Water Resources Bulletin 104-5.

Area No.	Designation	No. of Nodes
1	Cajon	8
2	Devil Canyon	4
3	Lytle Creek	10
4	Pressure Zone	16
5	City Creek	19
6	Redlands	5
7	Mill Creek	8
8	Reservoir	3
9	Divide	2
	TOTALS	**75**

The surface area of the smallest node was 589 acres and the surface area of the largest node was 1,778 acres. The large node, or model cell size, provides one of the largest differences between the SBVMWD model and the DWR model. The SBVMWD model has been divided into a uniform, square cell size of 100 feet per side (0.23 acre). This smaller cell size of the SBVMWD model allows values to be more accurately assigned to each model cell based upon the given contour maps instead of assuming constant values across large areas like the DWR model. For example, each model uses storage coefficients from DWR's Bulletin No. 45 (Eckis). The specific yield data from Bulletin No. 45 is presented on a contour map (Eckis, Plate E). The SBVMWD model is able to convert this contour map into a grid which contains a unique specific yield value for each

of its 335,758 model cells. In contrast, the DWR model must assume a single, constant specific yield across each of its 75 larger nodes. The larger number of model cells in the SBVMWD model allows it to use a more accurate representation of the specific yield contour map in the change in groundwater storage calculation.

In addition to providing a more accurate representation of the specific yield contour map, the SBVMWD model also provides a more accurate representation of the water levels within each sub-basin. The DWR model assumes a constant water level across each of its 75 nodes. This constant groundwater surface across each node causes the DWR model to produce a groundwater surface with a "stair step" appearance. The finer resolution and ability of the SBVMWD model to interpolate a groundwater surface within each sub-basin from the given well data. This produces a water level surface that is more representative of the true surface than the "stair step" surface generated by the DWR model.

In conclusion, the DWR model and SBVMWD model produce similar results. The difference between the two models is most likely due to the finer model resolution and the interpolation capabilities of the newer SBVMWD model.

B.2 Method of Analysis

The San Bernardino Valley Municipal Water District (SBVMWD) Change in Storage (CIS) model calculates the cumulative change in storage (CCIS) using a spatial distribution of available wells and the Specific Yield Method, as put forth in the Department of Water Resources' Bulletin 104-5 (Olson, pg. 85). This method calculates the change in storage based upon an adaptation of the simple mathematical equation for calculating volume, (length * width * height).

$$\mathbf{CCIS = (h_{present\ year} - h_{base\ year})SA} \qquad \textbf{(Equation B.2.1)}$$

where,

CCIS = Cumulative change in storage, acre-feet

$(h_{present\ year} - h_{base\ year})$ = Change in saturated thickness, ft.

$h_{present\ year}$ = Depth to groundwater, present year

$h_{base\ year}$ = Depth to groundwater, base year (1934)

S = Specific Yield, dimensionless

A = Area, acres

In Equation B.2.1, “length * width” is given by the surface area, A, of the basin and “height” is given by, ($h_{present\ year}$ - $h_{base\ year}$), the change in saturated thickness. The specific yield simply adjusts the volume calculation to account for the fact that only the pore space in the soil is available for water storage. Figure B.2.1 illustrates the Specific Yield Method.

Given the cumulative change in storage values for a series of years, these cumulative values can be used to calculate the annual change in groundwater storage. The annual change in groundwater storage is simply the difference between a year’s cumulative change in storage and the previous year’s cumulative change in storage (Equation B.2.2).

$$\mathbf{ACIS_{present\ year} = CCIS_{present\ year} - CCIS_{previous\ year}} \qquad \textbf{(Equation B.2.2)}$$

where,

ACIS = Annual Change in Storage for the present year, acre-feet

$CCIS_{present\ year}$ = Cumulative Change in Storage for the present year, acre-feet

$CCIS_{previous\ year}$ = Cumulative Change in Storage for the previous year, acre-feet

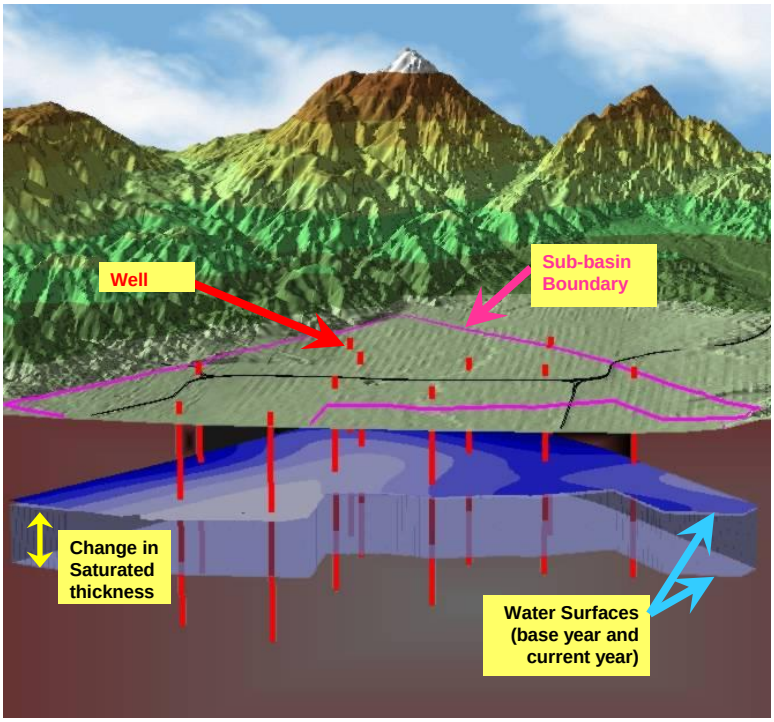


Figure B.2.1. Illustration of the Specific Yield Method for calculating the change in groundwater storage (Equation B.2.1).

B.3 Technical Approach

Each of the variables in the cumulative change in storage calculation (Equation B.2.1) varies depending upon the geographic position within the San Bernardino Basin Area and can be spatially represented by a contour map. The SBVMWD Change in Storage model was written in Environmental Systems Research Institute's (ESRI) GRID software because it allows contour maps to be converted into "grids" and used directly in the simple mathematical equation for the cumulative change in storage.

When a contour map is converted into a grid, the software essentially breaks the contour map down into smaller, user-defined pieces called cells. The GRID software stores a unique value within each grid cell depending upon its geographic location. For example, each cell in the depth to groundwater grid contains a unique value for the depth to groundwater based upon its geographic position in the grid. Figure B.3.1 illustrates the conversion of a contour map into a grid**.** The user has the flexibility to control the cell size. The smaller the cell size, the more representative of the actual contour map. However, there is a trade-off between cell size and processing speed. Since the software performs calculations on each individual grid cell, a finer grid requires more calculations and, therefore, takes longer to process. Thus, the challenge is to select the largest cell size possible without significantly impacting the results. The cell size for the SBVMWD CIS model is 100 feet square.

Once the contour maps have been converted to grids, these grids are used in Equation B.2.1. When the GRID software uses grids in any algebraic equation, the results are stored in a new grid. For example, when two grids are multiplied, the software essentially lays the two grids on top of one another and multiplies the values in each individual grid cell on a cell-by-cell basis. The results are stored in a new grid and are located in the same geographic cell location as the two values used in the calculation. The same logic applies to the cumulative change in storage calculation. The software generates the change in saturated thickness grid by subtracting one water level grid from the other. The change in saturated thickness grid (height) is then multiplied by the specific yield grid (unit less) and then multiplied by the cell size (area) which results in a grid containing the cumulative change in storage in each cell (see Figure B.3.2). The cumulative change in storage for the entire area is simply the summation of the individual cell values.

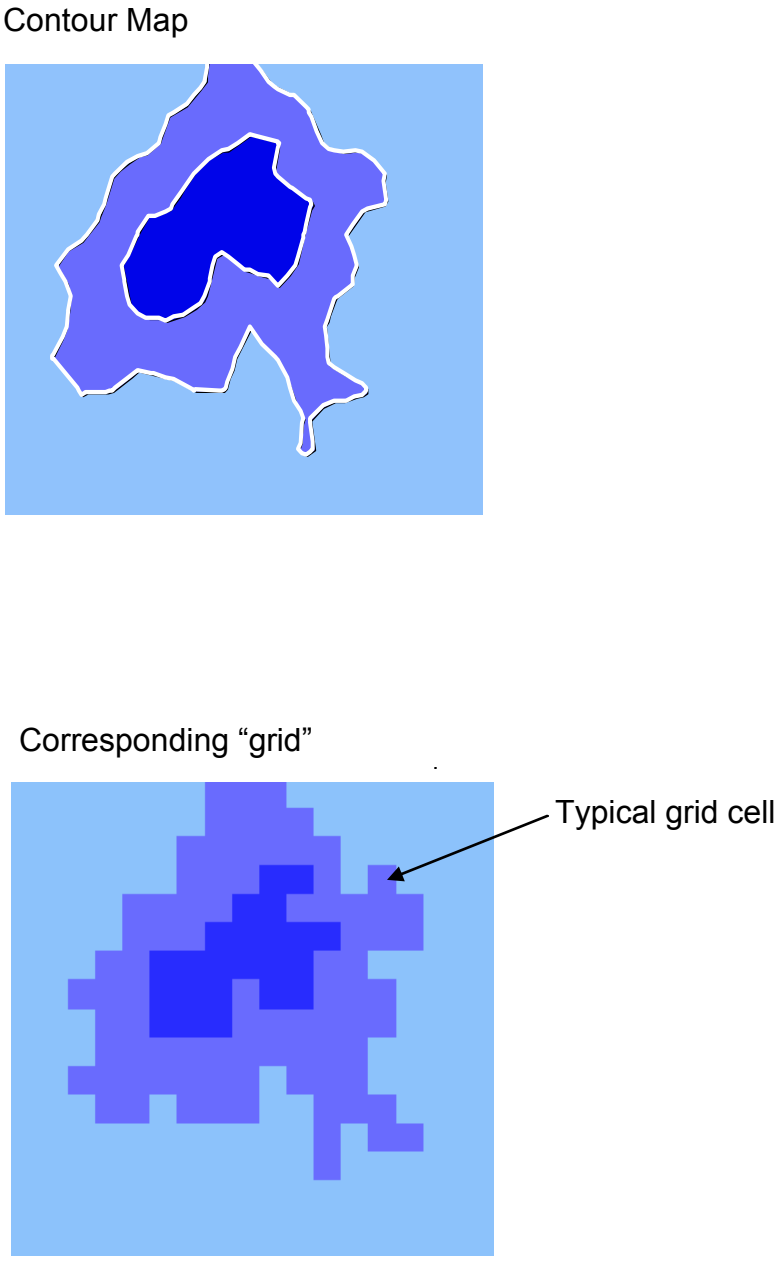


Figure B.3.1. Grid representation of a contour map.

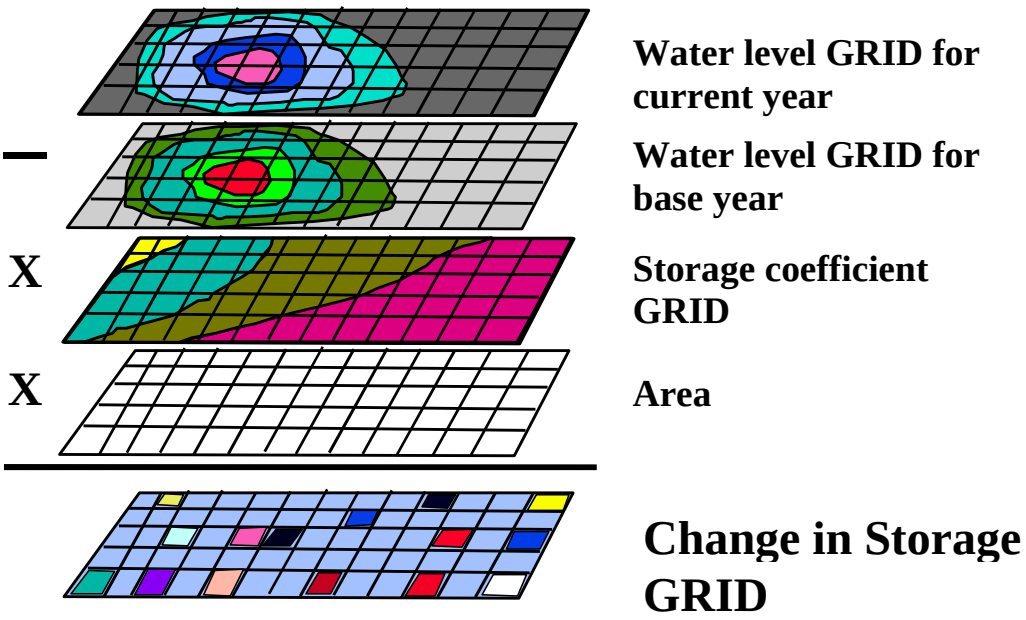


Figure B.3.2. Grid representation of Equation B.2.1.

The SBVMWD model uses the calendar year instead of the water year (October through September). Calendar years were chosen so that the SBVMWD model results would be coincident with the United States Geological Survey groundwater model results which are dependent upon local pumping records kept by calendar year.

B.4 Data

Sub-basin boundaries. The SBVMWD Change in Storage model used the same sub-basins identified in the Department of Water Resources (DWR) Bulletin 104-5 (DWR, Plate 14) (Basin Groundwater Storage Data). DWR Geologists divided the San Bernardino Basin area into nine sub-basins based upon the known hydrologic barriers (faults) in the valley.

Well Locations. Wherever possible, the change in storage model used the same wells used in Bulletin 104-5. However, many of the original wells have since been abandoned and are no longer available for measurement. Whenever one of the original wells was unavailable, an attempt was made to find a “replacement well” in the same vicinity. If a replacement well was not available in the same vicinity, an effort was made to find an additional well within the sub-basin that would improve the spatial distribution of

data points. In addition to geographic location, replacement wells were selected based upon the following criteria:

1. *Public ownership*. Because public water agencies tend to be more diligent at data collection, SBVMWD limited its selection of replacement wells to those owned by public water agencies.

2. *Similar hydrograph.* A hydrograph is a plot of the static water level over time. The hydrograph for each replacement well was compared to the hydrograph of the well it was replacing to ensure that the replacement well was measuring water levels from the same aquifer as the original well.

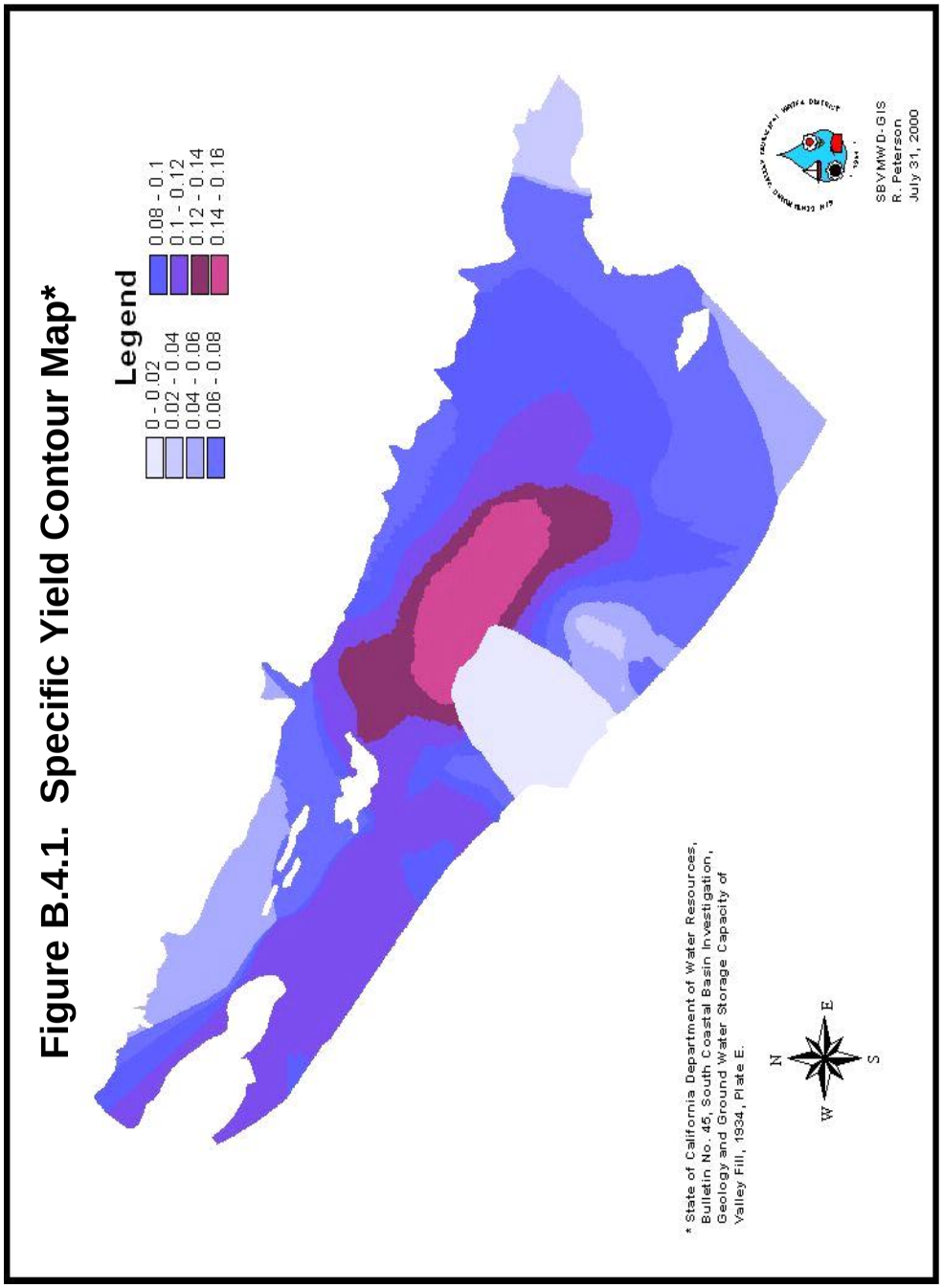
Static depth to water. Like the DWR model, the SBVMWD Change in Storage model uses the highest, annual fall (September - December) static (pump OFF) depth-to-water measurement for each well. The fall season was selected because it follows the summer months during which basin water levels are drawn down to their lowest levels due to the high demands. Fall is also chosen because the cooler fall weather causes pumping rates to dramatically decline and allows the water surface to recover to a level that is more representative of the static water surface.

Static water level data was obtained directly from the well owners and was verified to be static by reviewing the well's hydrograph. Large downward "spikes" in the data were investigated by comparing the depth of the spike to the estimated cone of depression. If the depth of the spike was similar to the cone of depression, that data point was assumed to be dynamic (pump ON) and the data point was eliminated from the analysis. When points were eliminated, or missing from the data, a straight-line interpolation was performed between the known points. Although there is some error associated with assigning points by straight-line interpolation, it was felt that omitting points from the overall interpolation of the water surface would cause a larger error in the analysis.

Before the depth to water data could be used in the Change in Storage model, it had to first be converted into a grid surface. The annual depth to water grids for each sub-basin were interpolated using the highest fall measurements and the Inverse Distance Weighted method of interpolation. Interpolation was intentionally performed separately

within each sub-basin to eliminate the potential problem of interpolating across sub-basin boundaries, which are groundwater barriers.

Specific Yields. The specific yield is "the ratio of the volume of water that will drain under the influence of gravity to the volume of saturated rock" (Heath, pp. 28-29). The specific yield values used for the study area were obtained from the Department of Water Resources report entitled South Coastal Basin Investigation Geology and Ground Water Storage Capacity of Valley Fill, Bulletin No. 45 (Eckis, Plate E) (see Figure B.4.1).



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