

Engineering Investigation of the Bunker Hill Basin 2015–2016

Figures



Figure 1: Project Area Engineering Investigation Report 2017

Coordinate System:
NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Source: SBVWCD, CASIL, SBVMWD
GIS Contact: K. Scholte
January 18, 2017

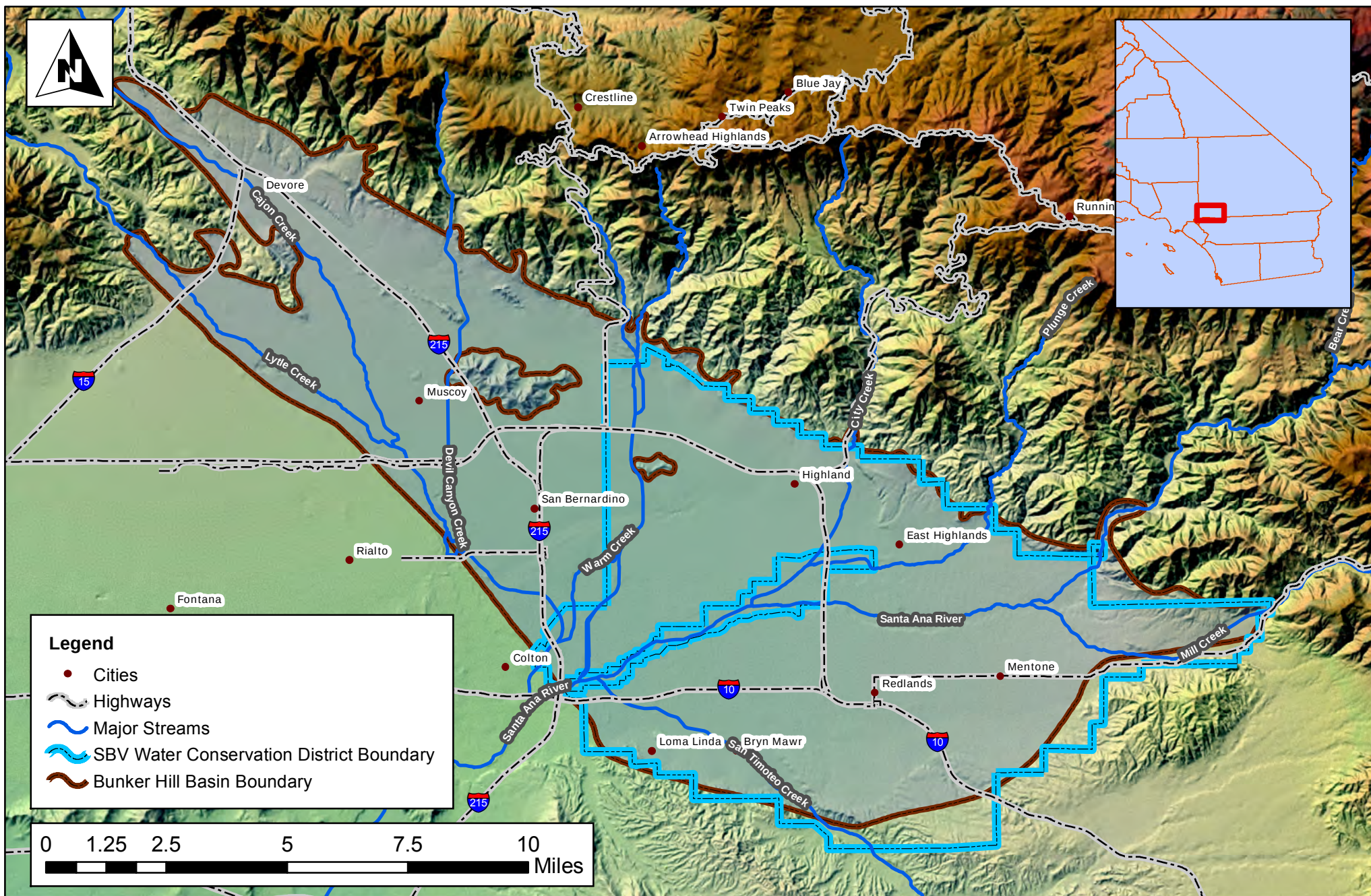


Figure 2: District and Water Agency Boundaries Engineering Investigation Report 2017

Coordinate System:
NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Source: SBVWCD, CASIL, SBVMWD
GIS Contact: K. Scholte
January 18, 2017

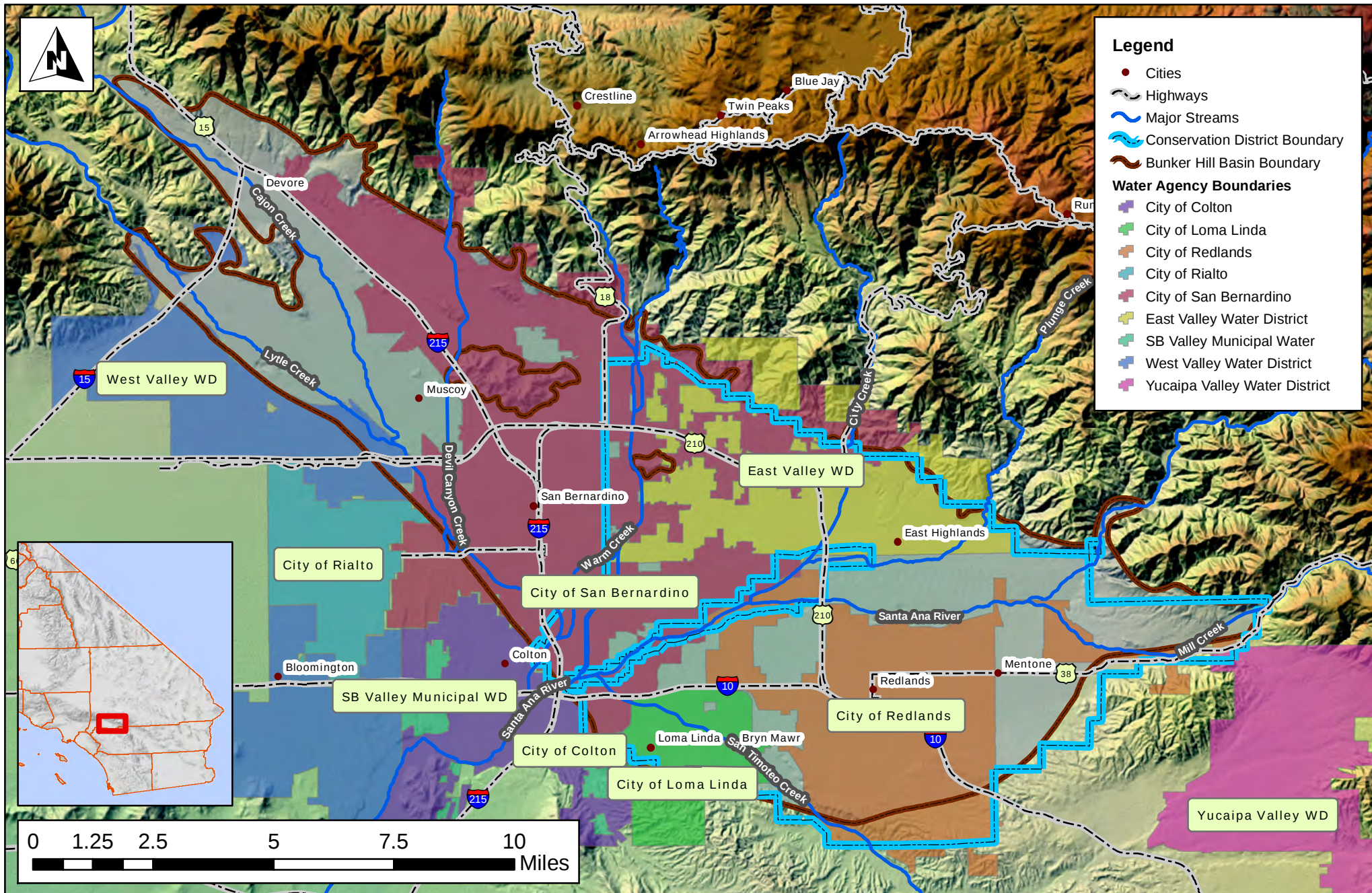


Figure 3: Bunker Hill Sub Basins Engineering Investigation Report 2017

Coordinate System:
NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Source: SBVWCD, CASIL, SBVMWD
GIS Contact: K. Scholte
January 18, 2017

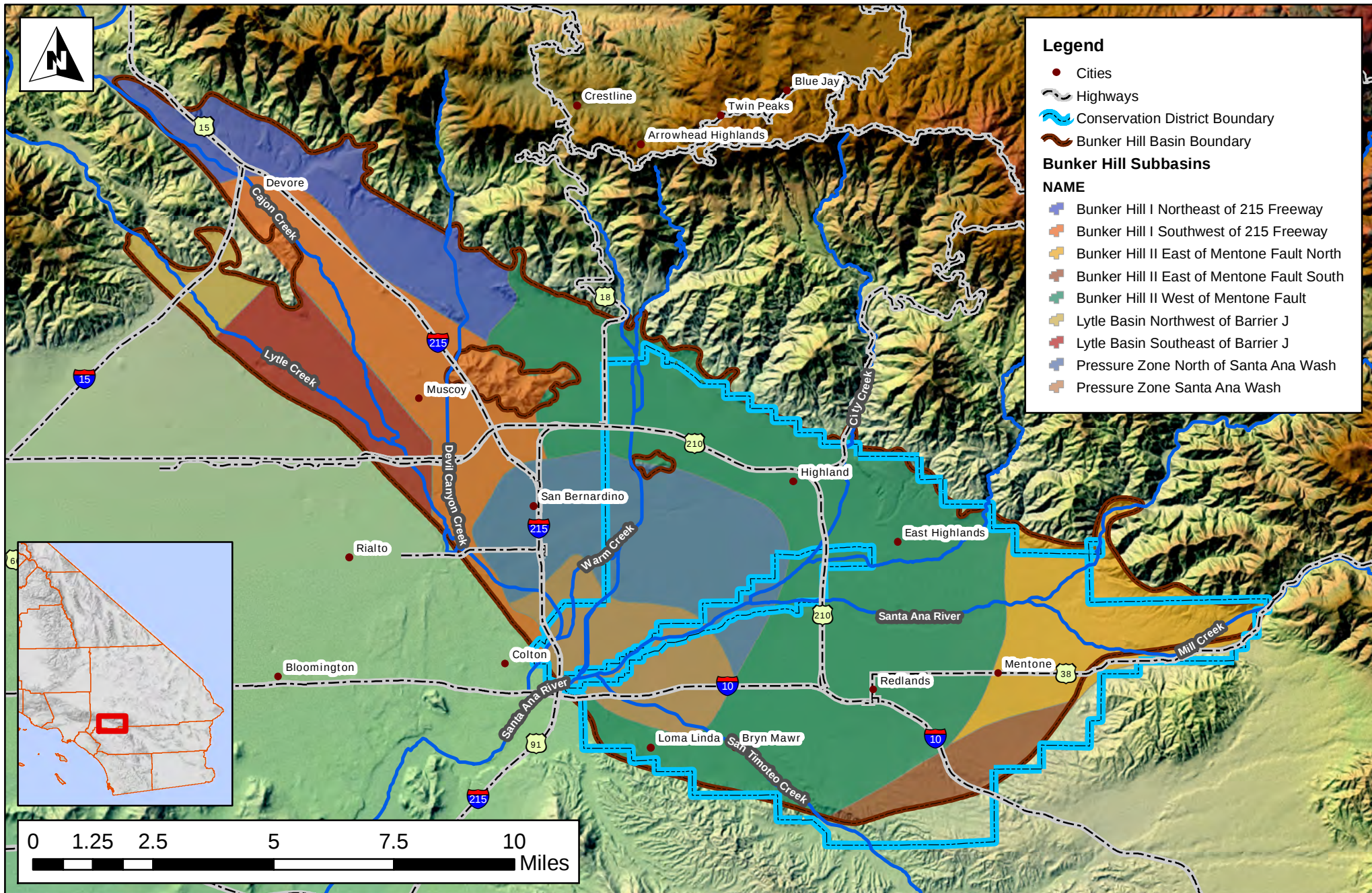


Figure 4: Precipitation Trends and Station Locations October 2015 - September 2016 Engineering Investigation Report 2017

Coordinate System:
NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Source: SBVWCD, CASIL, SBVMWD
GIS Contact: K. Scholte
January 18, 2017

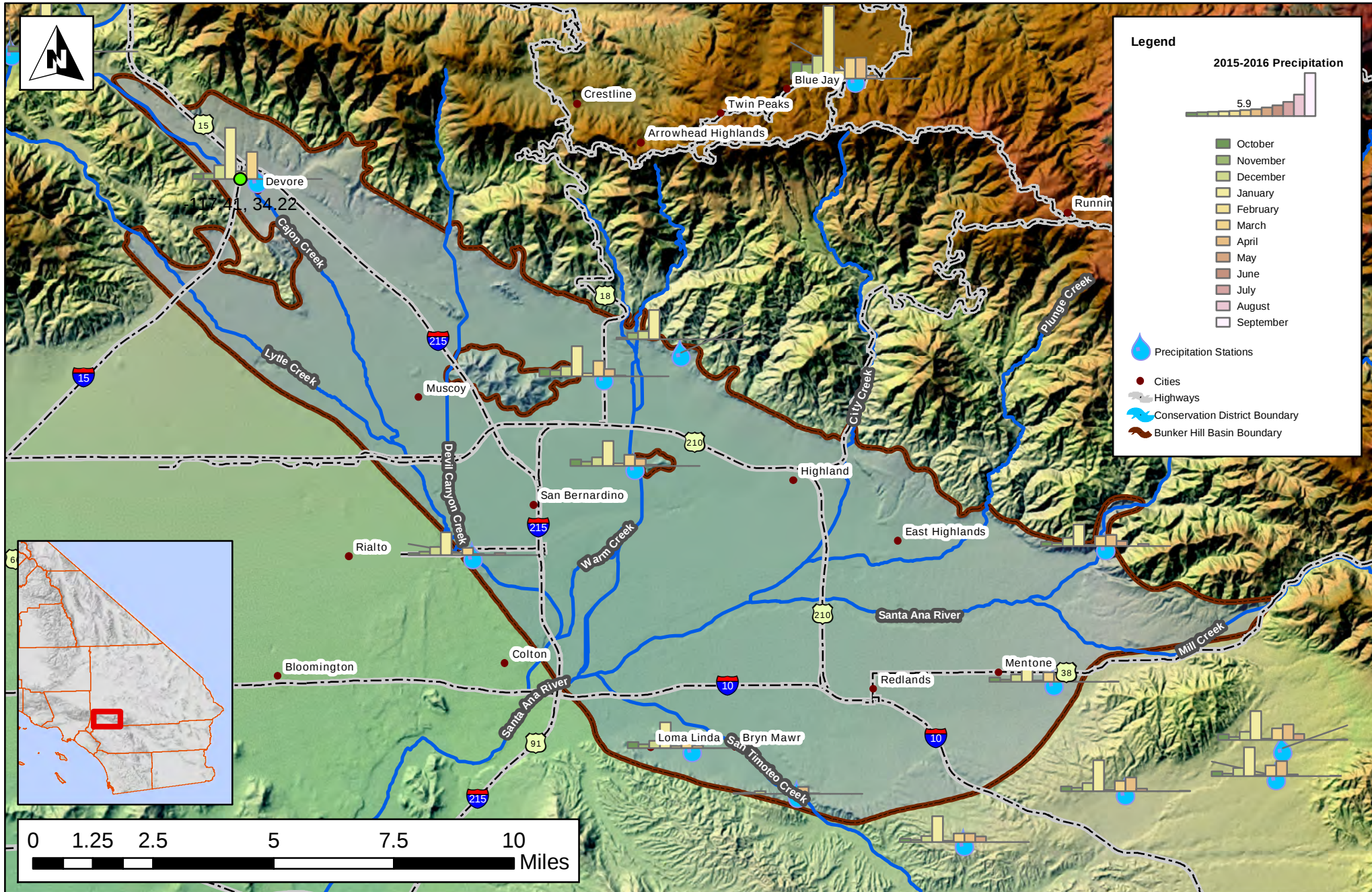


Figure 5: Water Elevation Contour Surface Fall 2015 Engineering Investigation Report 2017

Coordinate System:
NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Source: SBVWCD, CASIL, SBVMWD
GIS Contact: K. Scholte
January 25, 2017

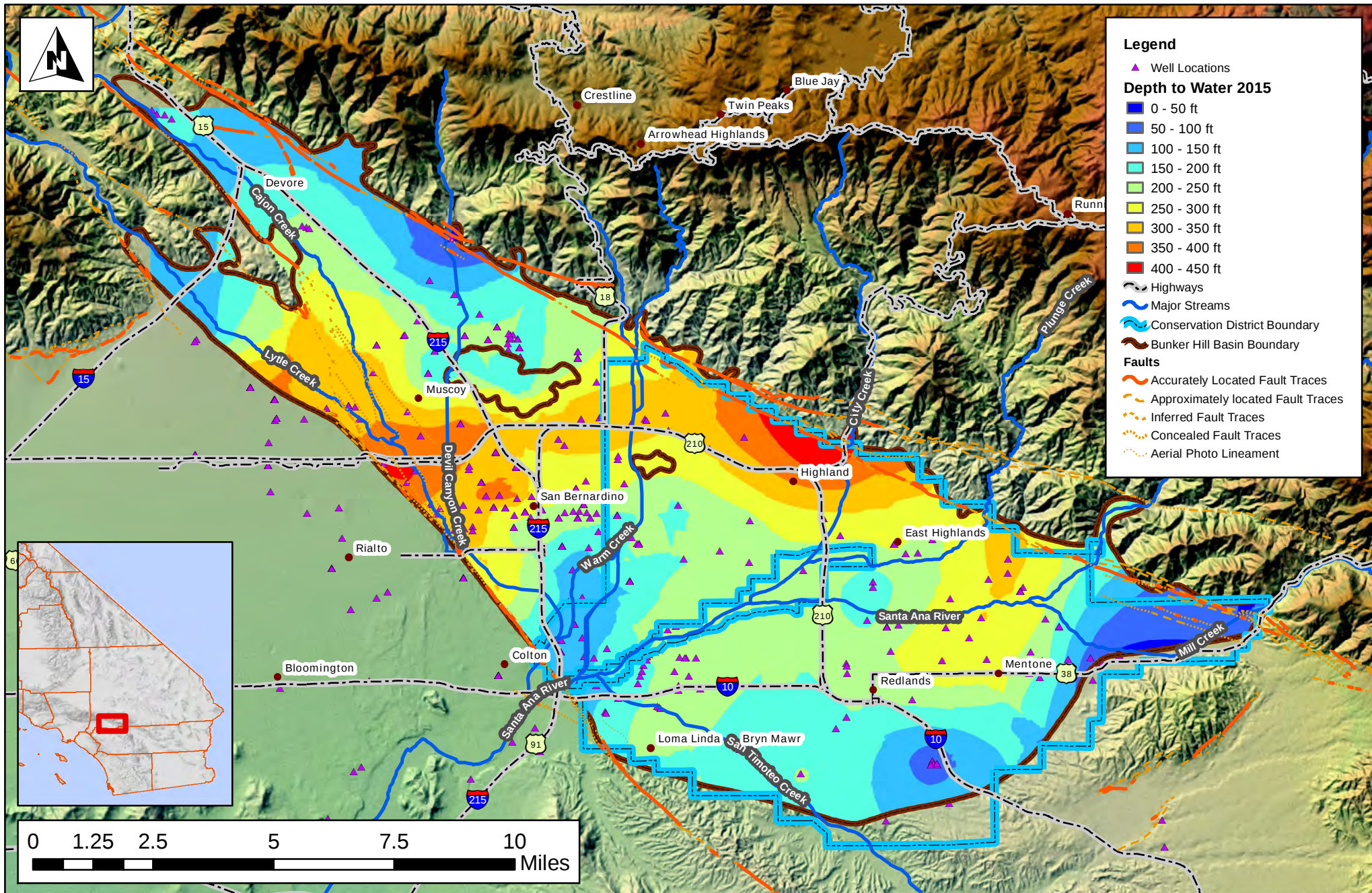


Figure 6: Water Elevation Contour Surface Fall 2016 Engineering Investigation Report 2017

Coordinate System:
NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Source: SBVWCD, CASIL, SBVMWD
GIS Contact: K. Scholte
March 6, 2017

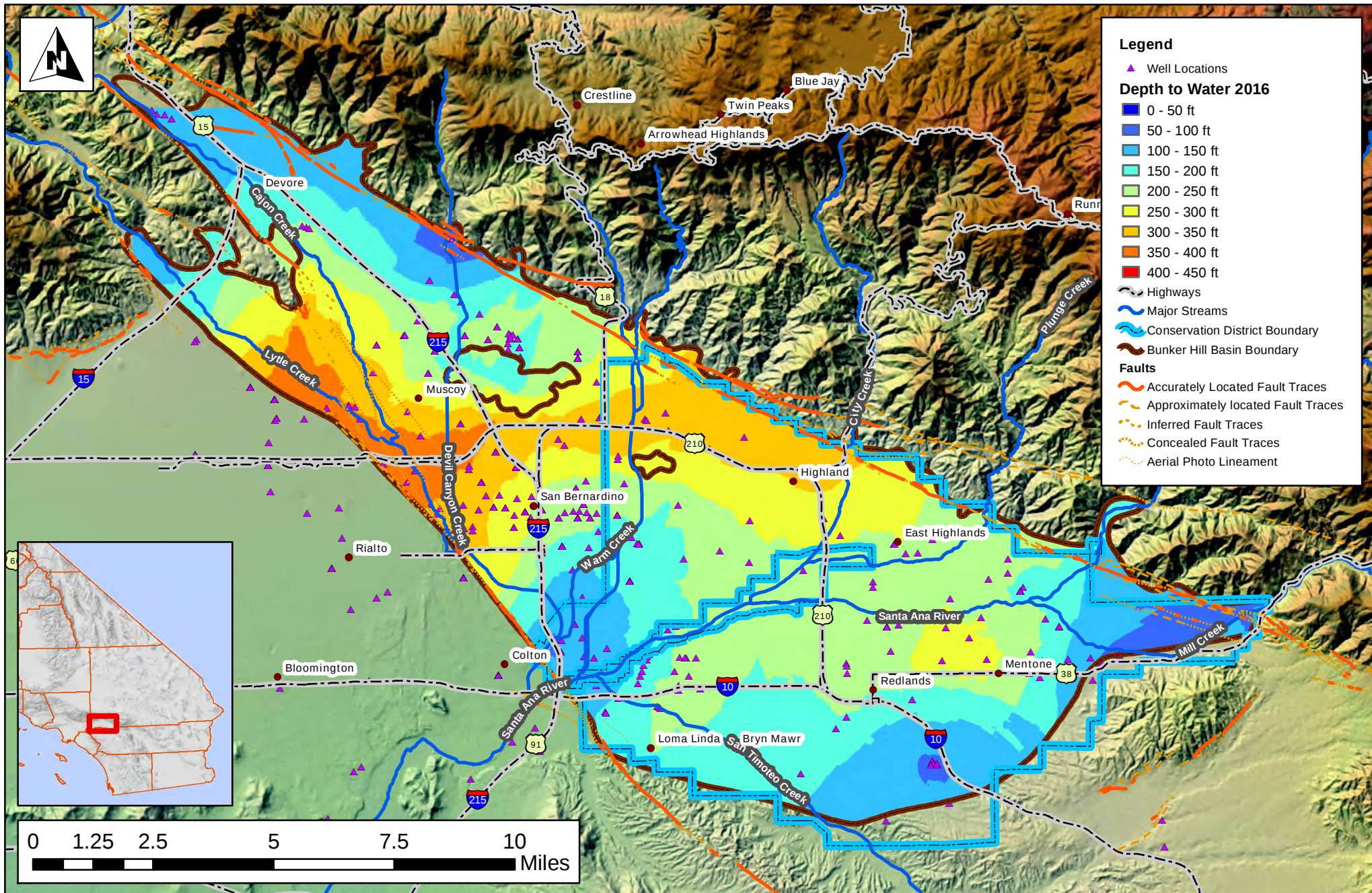


Figure 7: Key Wells (Appendix B Hydrographs) 2015-2016 Engineering Investigation Report 2017

Coordinate System:
NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Source: SBVWCD, CASIL, SBVMWD
GIS Contact: K. Scholte
January 26, 2017

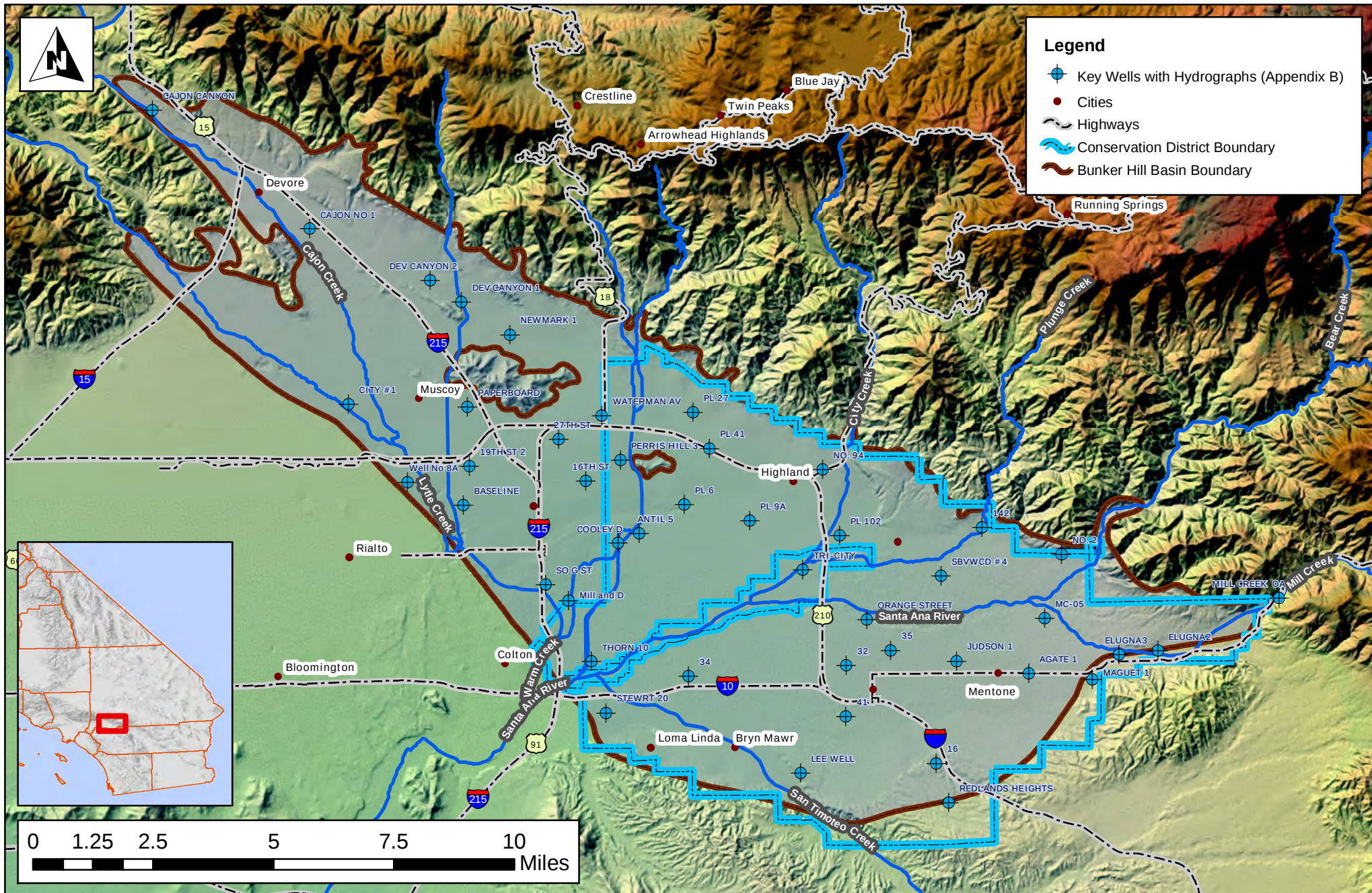
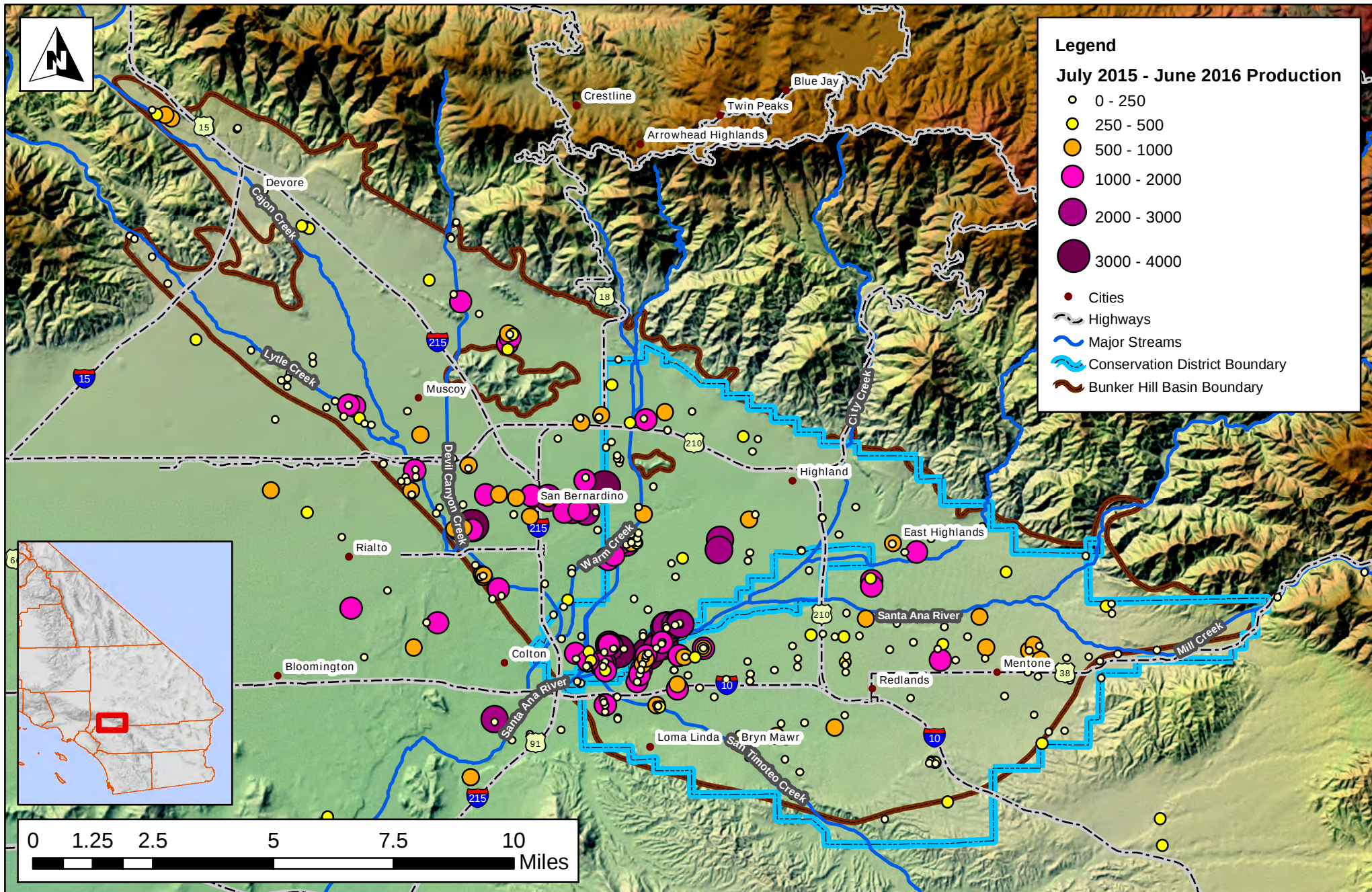
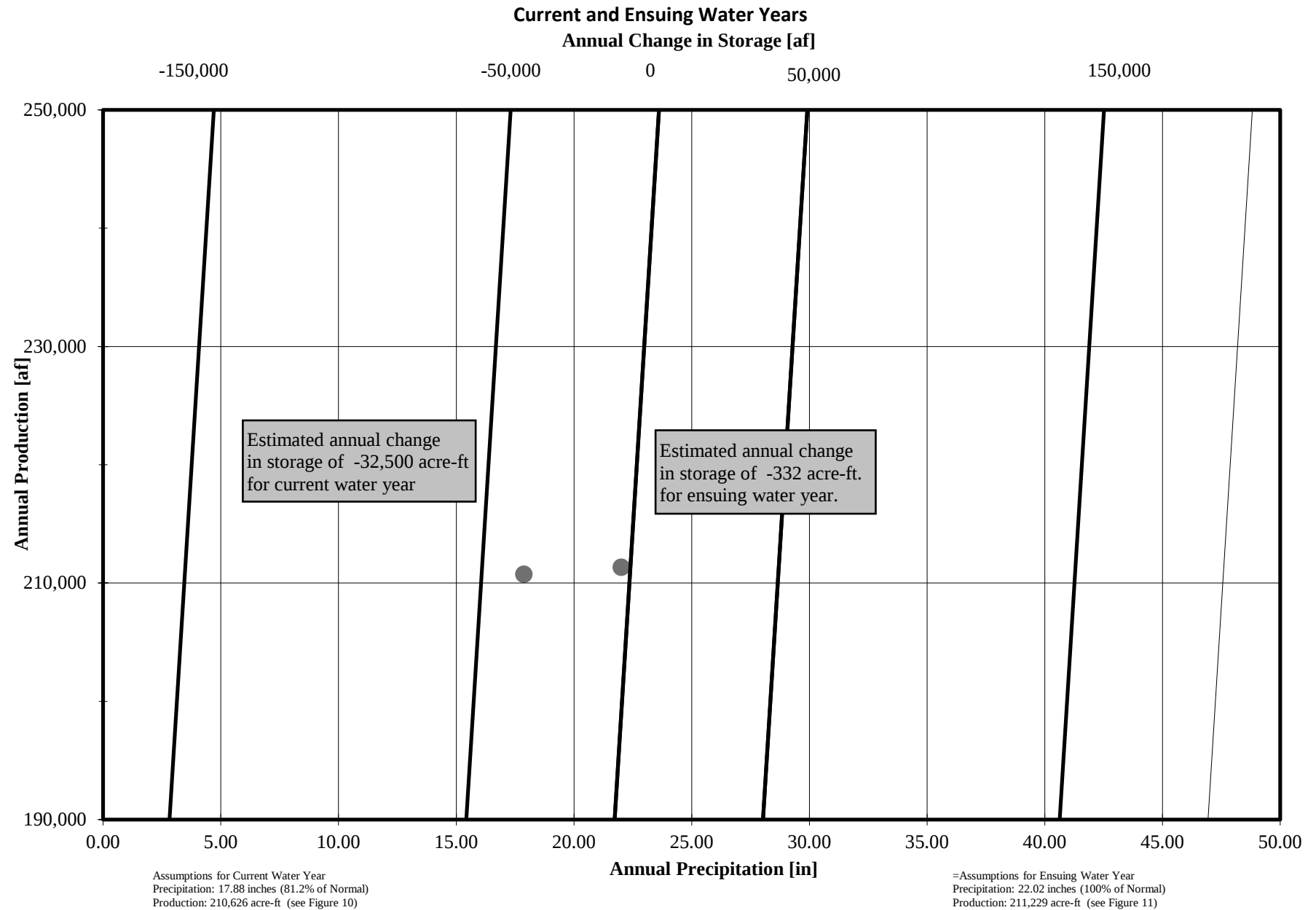


Figure 8: Groundwater Production Bunker Hill Basin
Total Well Production for July 2015 - June 2015
Engineering Investigation Report 2017

Coordinate System:
NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Source: SBVWCD, CASIL, SBVMWD
GIS Contact: K. Scholte
March 6, 2017



Prediction Chart for Annual Change in Storage

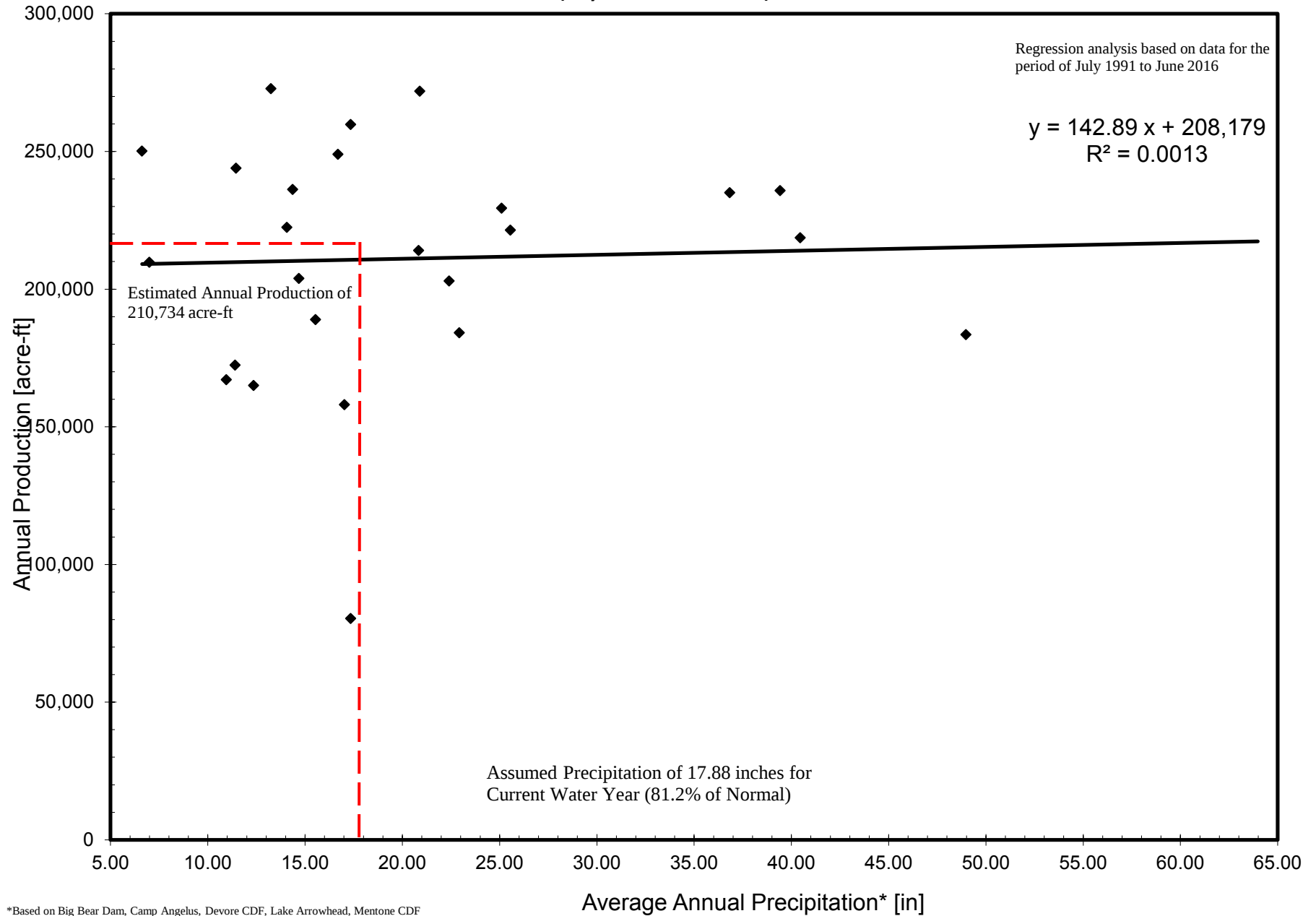


* Based on Big Bear Dam, Camp Angelus, Devore CDF, Lake Arrowhead, Mentone CDF
Redlands Country Club, San Bernardino County Hospital, Santa Ana Powerhouse #3, and Yucaipa CDF.

$$\text{Change in Storage} = -103,946 + 7,817 * \text{Precipitation} + -0.32 * \text{Production} \quad (R^2 = 0.79)$$

Estimate of Production for Current Water Year

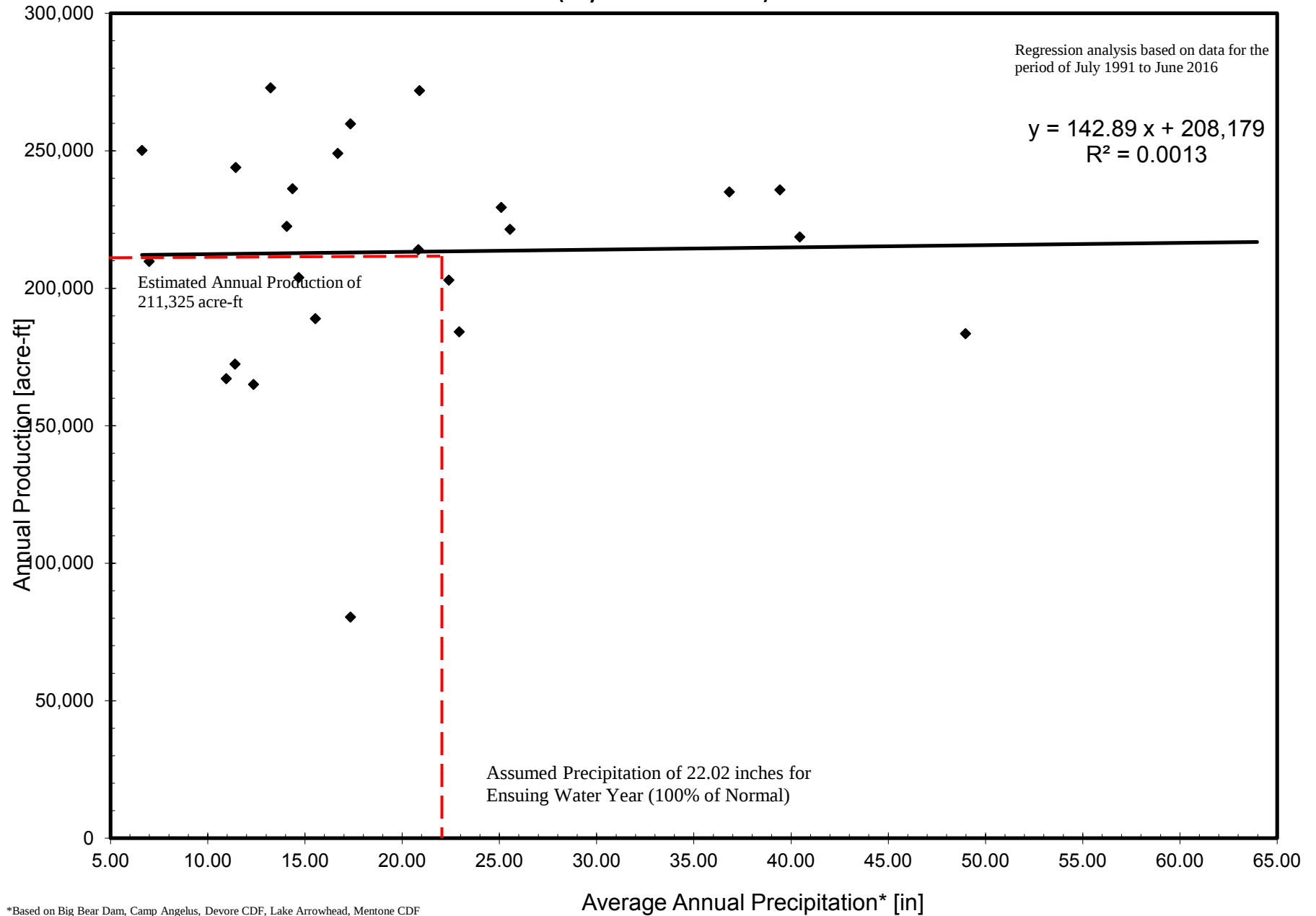
(July 2016 to June 2017)



*Based on Big Bear Dam, Camp Angelus, Devore CDF, Lake Arrowhead, Mentone CDF, Redlands Country Club, San Bernardino County Hospital, Santa Ana Powerhouse #3, and Yucaipa CDF.

Estimate of Production for Ensuing Water Year

(July 2017 to June 2018)



*Based on Big Bear Dam, Camp Angelus, Devore CDF, Lake Arrowhead, Mentone CDF, Redlands Country Club, San Bernardino County Hospital, Santa Ana Powerhouse #3, and Yucaipa CDF.

Engineering Investigation of the Bunker Hill Basin 2015–2016

Tables



Summary of Percentage of Normal Precipitation

1986 to 2016 (Water Year - Oct. to Sept.)

Station	Historic Annual Avg. [in]	1986 -1987 [in]	1987 -1988 [in]	1988 -1989 [in]	1989 -1990 [in]	1990 -1991 [in]	1991 -1992 [in]	1992 -1993 [in]	1993 -1994 [in]	1994 -1995 [in]	1995 -1996 [in]	1996 -1997 [in]	1997 -1998 [in]	1998 -1999 [in]	1999 -2000 [in]	2000 -2001 [in]	2001 -2002 [in]	2002 -2003 [in]	2003 -2004 [in]	2004 -2005 [in]	2005 -2006 [in]	2006 -2007 [in]	2007 - 2008 [in]	2008 - 2009 [in]	2009 - 2010 [in]	2010 - 2011 [in]	2011 - 2012 [in]	2012 - 2013 [in]	2013 - 2014 [in]	2014 - 2015 [in]	2015 - 2016 [in]	Each Station 29- Yr. Avg. [in.]
Big Bear City	12.21	10.18	10.59	9.37	10.23	17.81	13.96	22.92	11.53	18.59	11.17	12.06	16.83	6.53	4.75	20.14	3.33	12.62	7.55	23.25	14.36	3.67	8.53	3.51	16.24	24.55	16.27	10.46	9.2	9.28	11.18	12.36
Big Bear Dam	31.78	19.17	28.89	20.84	17.60	34.79	38.90	81.92	28.67	52.65	24.40	29.97	51.70	14.20	20.60	21.40	9.20	38.10	19.60	59.10	26.40	10.30	23.00	19.70	26.00	20.24	11.83	18.73	13.34	25.74	18.381	27.51
Camp Angelus	27.64	20.50	4.95	17.20	17.90	26.44	28.16	61.14	17.20	46.70	26.00	29.00	49.52	16.10	21.10	21.50	7.70	35.40	13.20	35.20	41.90	0.00	2.70	18.00	18.80	1.60	17.49	13.89	9.93	19.69	11.22	21.67
Crafton Hills	13.70	9.00	12.11	10.00	6.30	12.27	10.69	22.99	5.45	27.10	7.84	16.67	25.55	7.29	6.40	10.49	2.46	17.57	9.47	31.39	11.45	3.34	13.34	8.82	17.80	24.52	9.57	9.16	6.55	13.76	10.56	12.66
Del Rosa Ranger Station	17.33	9.48	18.92	13.16	12.85	8.79	24.24	41.39	12.30	27.69	14.21	17.31	37.26	8.30	12.73	16.60	6.09	19.69	13.02	38.55	17.40	8.77	17.77	13.57	22.01	30.84	13.57	2.22	4.54	6.75	6.32	16.54
Devore CDF	26.38	12.39	17.90	10.75	15.00	20.41	31.32	63.98	15.40	45.44	20.58	33.10	45.13	13.61	8.04	15.52	10.90	35.35	16.44	60.36	24.80	8.86	25.21	16.51	34.12	43.20	17.47	14.04	13.81	18.14	15.29	24.10
Fallsvale	30.64	23.00	20.30	3.50	51.00	22.50	36.00	71.90	52.00	54.90	22.10	33.80	53.00	16.30	21.20	15.30	6.50	37.50	25.20	61.40	26.90	11.10	29.30	24.70	2.85	29.52	22.9	14.1	26.3	25.57	22.314	28.77
Lake Arrowhead	36.48	23.74	40.39	28.51	26.62	23.68	45.24	85.00	28.20	74.51	30.84	36.50	72.80	18.10	25.80	28.60	10.70	36.50	22.70	69.70	46.20	18.50	41.91	30.28	26.00	37.76	25.1	32.6	26.7	13.27	24.3	35.03
Loma Linda FD	10.51	7.41	10.45	8.84	7.69	7.16	13.44	25.56	10.99	19.02	7.15	9.78	22.74	5.12	7.74	6.38	2.45	14.48	8.06	22.59	11.06	3.51	9.63	8.95	13.10	18.24	6.79	7.32	9.06	9.5	7.86	10.74
Lytle Creek at Foothill	13.05	7.00	12.96	3.90	8.50	15.51	14.91	31.61	9.16	25.51	12.23	13.83	25.84	6.25	9.81	12.12	4.00	13.60	7.16	27.23	11.22	3.84	11.89	9.03	13.03	0.23	6.9	4.51	8.34	10.18	7.04	11.58
Lytle Creek Fire Station	22.66	11.20	22.40	12.83	17.90	32.07	49.09	87.71	20.50	47.57	24.49	23.10	52.18	11.81	20.40	18.34	4.47	16.96	12.09	44.11	18.92	4.22	21.89	3.32	0.00	28.46	8.18	7.32	8.03	23.79	13.56	22.23
Mentone CDF	14.41	9.23	8.85	8.64	6.13	12.55	15.93	23.85	8.35	17.10	9.42	15.73	27.09	4.28	9.08	10.16	4.06	15.00	10.38	24.94	11.01	5.41	10.75	9.38	14.96	17.77	7.9	7.33	3.11	1.51	8.57	11.28
Oak Glen	25.68	19.29	21.46	17.82	17.71	26.92	30.78	57.96	18.76	57.92	20.04	30.39	49.46	11.32	17.12	12.28	6.72	14.28	18.39	34.14	22.58	9.71	27.60	19.92	29.72	36.82	15.13	15.65	14.07	22.07	18.78	23.83
Redlands - Roth	11.29	7.79	11.18	8.08	7.21	13.34	14.96	25.57	10.06	20.49	8.08	10.77	22.29	6.46	7.41	10.38	3.35	12.18	9.16	24.43	9.52	3.31	9.46	8.82	15.12	17.38	4.34	1.54	2.08	2.72	1.7	10.31
Redlands Country Club	12.25	8.80	14.18	10.68	8.58	14.48	16.11	29.44	12.55	19.76	8.52	9.03	17.22	6.30	5.68	9.96	3.97	16.45	11.58	29.37	10.30	4.13	11.93	11.35	17.25	22.33	7.74	8.71	6.92	10.88	8.61	12.43
San Bernardino CDF	16.60	9.27	18.26	12.85	10.55	15.49	21.89	37.35	4.46	20.29	15.77	16.17	34.32	9.30	13.62	16.61	5.29	13.14	11.52	37.28	16.39	6.33	18.91	9.85	20.45	27.94	10.63	7.69	11.3	11.19	10.91	15.83
San Bernardino Co. Hospital	15.78	8.08	13.53	12.63	8.12	15.48	16.54	30.78	11.65	24.10	11.92	17.80	32.67	8.02	11.09	2.33	3.60	17.06	10.49	29.89	13.20	4.68	12.81	10.05	17.03	21.76	9.58	9.31	10.97	10.85	8.96	13.83
Santa Ana Pumphouse #3	16.33	12.28	14.67	9.38	10.32	15.84	18.38	22.98	15.92	24.85	11.05	16.60	27.95	7.01	6.78	8.63	3.23	18.24	9.40	27.65	11.78	6.13	10.73	9.73	14.58	20.18	8.62	9.05	7.42	9.97	9.29	13.29
Yucaipa CDF	15.35	11.02	11.33	9.74	7.25	11.16	17.85	34.20	11.40	30.24	10.52	15.62	24.70	7.63	11.10	9.92	5.66	19.47	11.84	32.70	13.14	6.56	14.67	12.11	18.79	25.09	11.8	11.1	6.87	13.28	11.11	14.60
Yucaipa Valley Water District	15.31	10.55	14.36	10.55	10.84	16.98	18.68	18.08	12.51	25.20	10.88	16.93	28.60	9.87	9.63	9.65	5.27	19.50	11.10	32.73	12.52	5.53	14.79	12.11	17.68	22.74	10.8	9.37	7.58	13.07	10.31	14.28

Percent of Normal	100%	65%	85%	62%	72%	94%	124%	227%	82%	176%	80%	105%	186%	50%	65%	72%	28%	110%	67%	194%	96%	33%	87%	67%	92%	122%	63%	56%	53%	70%	61%	92%
----------------------	------	-----	-----	-----	-----	-----	------	------	-----	------	-----	------	------	-----	-----	-----	-----	------	-----	------	-----	-----	-----	-----	-----	------	-----	-----	-----	-----	-----	-----

Total Station Average	19.27
--------------------------	-------

Source: San Bernardino County Department of Transportation/Flood Control

Change in Groundwater Levels in Key Wells

Fall 2015 to Fall 2016

WCDCode	Recordation Number	State Well Number	Well Name	Owner Or Measuring Agency	2015 Depth To Water (ft)	2016 Depth To Water (ft)	Difference Fall 2015 to Fall 2016
1865	3601675	1N4W25A01S	27	East Valley Water District			
1984	3602113	1N3W30N01S	41	East Valley Water District	313.5	308.1	5.4
1364	3600026	1S3W04J01S	102	East Valley Water District	252.0	245.0	7.0
1401	3600220	1S3W01H01S	142 Mt. Harrison	East Valley Water District	313.0	297.0	16.0
1660	3601184	1N3W33F01S	94 Corwin	East Valley Water District	399.8	385.1	14.7
1851	3601660	1S3W06H04S	9A	East Valley Water District	232.0	242.0	-10.0
1010	9900021	1S3W09E02S	Tri-City Concrete	East Valley Water District	241.7	229.7	12.0
2271	3602855	1S4W25D07S	Anderson III	Loma Linda University	231	226	5.0
1727	3601308	1S2W19K01S	Agate #1	Redlands, City of	186.0	183.0	3.0
1708	3601283	1S2W22C02S	E. Lugonia #2	Redlands, City of			
1712	3601287	1S2W21B02S	E. Lugonia #3	Redlands, City of	27.0	26.0	1.0
1714	3601290	1S2W21D01S	E. Lugonia #6	Redlands, City of	66.0	60.0	6.0
1970	3602065	1S3W32J02S	Lee Well	Redlands, City of	229.0	229.0	0.0
1706	3601281	1S2W36F01S	Maguet #1	Redlands, City of	27.0	27.0	0.0
1709	3601284	1S2W21E01S	Maguet #2	Redlands, City of	66.0	52.0	14.0
1707	3601282	1S1W08H01S	Mill Creek #1	Redlands, City of			
1819	3601586	1S3W15F01S	Orange Street	Redlands, City of	176.0	189.0	-13.0
1591	3600918	2S3W01E01S	Redlands Heights	Redlands, City of	174.0	172.0	2.0
1718	3601294	1S3W35G09S	Well #13	Redlands, City of	67.0	65.0	2.0
1720	3601296	1S3W35H03S	Well #16	Redlands, City of	49.0	37.0	12.0
1722	3601298	1S3W21H01S	Well #32	Redlands, City of	221.0	230.0	-9.0
1723	3601299	1S4W24K01S	Well #34	Redlands, City of	217.0	225.0	-8.0
1964	3602032	1S3W22A02S	Well #35	Redlands, City of	259.0	259.0	0.0
1725	3601301	1S3W28H01S	Well #41	Redlands, City of	188.0	188.0	0.0
1702	3601263	1N5W23Q01S	City 1	Rialto, City of	260.0		
1668	3601225	1S4W02P02S	Cooley D	Riverside, City of	190.8	201.0	-10.2
1662	3601218	1S4W14P02S	Raub 1	Riverside, City of			
1677	3601234	1S4W27A19S	Stewart 19	Riverside, City of	182.0	183.7	-1.7
1744	3601431	1S4W27H01S	Stewart 20	Riverside, City of	168.4	157.1	11.3
1767	3601478	1S4W22B03S	Thorn 10	Riverside, City of	118.3		
1683	3601240	1S4W22H04S	Warren 1	Riverside, City of	165.7		
1554	3600787	1S4W23A02S	26-1	Riverside, City Of-Gage Canal	170.0	174.0	-4.0
2291	229101	1S2W07B01S	SBVWCD #1	San Bernardino Valley Water Cons. Dist.			
2290	229001	1S2W07K01S	SBVWCD #2	San Bernardino Valley Water Cons. Dist.	218.9	153.3	65.6
2286	228601	1S3W12J01S	SBVWCD #3	San Bernardino Valley Water Cons. Dist.	288.2	123.4	164.8
2288	228801	1S3W11H01S	SBVWCD #4	San Bernardino Valley Water Cons. Dist.			
1525	3600725	1N4W34G01S	17th & Sierra Way #2	San Bernardino, City of			
1517		1N4W32D03S	19th Street No. 1	San Bernardino, City of	338.6	352.5	-13.9
1520	3600720	1N4W27M02S	27th Street Well	San Bernardino, City of	303.4	304.8	-1.4
1519	3600719	1N4W27G01S	30th & Mtn. View	San Bernardino, City of	339.7	331.2	8.5
1979	3602081	1N4W27B01S	31st & Mtn. View	San Bernardino, City of	346.6	346.1	0.5
2066	3602422	1S4W02K08S	Antil Well #6	San Bernardino, City of	185.0	193.0	-8.0
2062	3602400	1N4W32N01S	Baseline Well	San Bernardino, City of	334.0	348.8	-14.8
1510	3600710	2N5W19K02S	Cajon Canyon Well	San Bernardino, City of	91.9	100.3	-8.5
1910	3601844	1N5W03H02S	Cajon Well #2	San Bernardino, City of	234.0	256.0	-22.0
2115	3602821	1N5W03A02S	Cajon Well #3	San Bernardino, City of		336.0	
2008	3602206	1N4W06H02S	Devil Canyon #3	San Bernardino, City of	27.8	30.2	-2.4
2007	3602205	1N4W06H01S	Devil Canyon #4	San Bernardino, City of	39.0	41.9	-2.9
3139	G363790	1N04W32PS	EPA EXTRAC WELL 112	San Bernardino, City of	487.6	497.4	-9.8
1537	3600737	1S4W10N06S	Mill & D	San Bernardino, City of	162.5	168.4	-5.9
1514	3600714	1N4W16E01S	Newmark #1	San Bernardino, City of	203.0	211.0	-8.0
1516	3600716	1N4W16E03S	Newmark #3	San Bernardino, City of	206.9	216.6	-9.7
1647	3601115	1N4W26P03S	Perris Hill #5	San Bernardino, City of	287.7	289.5	-1.8
2448	9900045	1S4W23H	Brier/Gould/Tippecanoe	San Bernardino, City of / shallow wells			
		1S04W22C	Wastewater N MW #1	San Bernardino, City of / shallow wells			
1936	3601944	1N5W23Q01S	2/Lower 7	West Valley Water District	364.0	363.0	1.0

Annual Change in Storage for Bunker Hill Basin

Fall 2015 to Fall 2016

Sub-area	[1] Annual Change in Water Level 2016 [ft]	[2] Area [acres]	[3] Storativity (S)	[4] Annual Change in Storage** [acre-ft]
Bunker Hill I - Northeast of 215 Freeway	-3.7	7,795	0.11	-3,199
Bunker Hill I - Southwest of 215 Freeway	-10.1	11,714	0.09	-10,661
Bunker Hill II - West of Mentone Fault	1.1	35,206	0.06	2,345
Bunker Hill II - East of Mentone Fault, North	25.0	8,584	0.13	27,859
Bunker Hill II - East of Mentone Fault, South	4.4	2,507	0.13	1,444
Lytle Basin - Northwest of Barrier J	1.7	1,924	0.13	417
Lytle Basin - Southeast of Barrier J	-2.5	5,237	0.07	-898
Pressure Zone - North of Santa Ana Wash	-1.8	11,920	0.02	-431
Pressure Zone - Santa Ana Wash	-0.4	6,686	0.02	-55

Total = 16,820

[1] Based on average changes in water level within each Sub-area

[2] Estimated using GIS

[3] Based on data from Hardt and Hutchinson (1980).

S, storativity: The amount of water stored or released per unit area of aquifer given unit head change.

[4] = [1] x [2] x [3]

*A positive sign denotes an increase in water level and a negative sign represents a decline in water level.

Accumulated Change in Storage for Bunker Hill Basin

1989 to 2016 (Based on "Zero Year" of 1993)

Year	Accumulated Storage [acre-ft]
1989	-58,000
1990	-170,700
1991	-196,000
1992	-191,000
1993	0
1994	-50,000
1995	41,100
1996	-43,100
1997	-75,500
1998	40,400
1999	-85,700
2000	-131,100
2001	-212,200
2002	-301,500
2003	-338,800
2004	-406,900
2005	-183,100
2006	-245,500
2007	-359,400
2008	-362,000
2009	-397,600
2010	-340,623
2011	-224,603
2012	-314,377
2013	-444,322
2014	-535,877
2015	-583,447
2016	-566,555

Note: A negative sign indicates a decline in storage and a positive sign represents an increase in storage.

Production for Sub-basins of Bunker Hill Basin

Preceding Water Year (July 2015 to June 2016)

Sub-area	Production July 2015 to June 2016 [acre-ft] ²
Bunker Hill I - Northeast of Interstate 215	3,816
Bunker Hill I - Southwest of Interstate 215	13,894
Bunker Hill II - West of Mentone Fault	22,984
Bunker Hill II - East of Mentone Fault, North	3,729
Bunker Hill II - East of Mentone Fault, South	1,510
Lytle Basin - Northwest of Barrier J	391
Lytle Basin - Southeast of Barrier J	5,104
Pressure Zone - North of Santa Ana Wash	40,412
Pressure Zone - Santa Ana Wash	66,189
Total	158,028

Notes: 209 Wells Used in these Calculations

1 - Refer to Appendix C for Well Values Compiled for Estimate.

2 - Estimated for Water Year July 2015-June 2016 production.

*Data Sources: 15 Primary Water Purveyors (excluding Fontana Union),
as well as San Bernardino Watermaster, and SBVMWD.*

Estimates of Percentage of Normal Precipitation for Previous Water Year

July 2015 to June 2016

	[0]		[1]	[2]	[3]	[4]	[5]	[6]	[7]
	July to June		Season - July to December			Season - January to June			Jul. 2015- Jun. 2016
Station	Historic Average Annual	2015-2016	Historic Average	Sum Jul 2015 to Dec 2015	% of Normal	Historic Average	Sum Jan 2016 to Jun 2016	% of Normal	Water Year % of Normal
	[inches]	[inches]	[inches]	[inches]	[%]	[inches]	[inches]	[%]	[%]
Big Bear Dam	35.40	22.05	11.61	10.49	90%	23.40	11.56	49%	63%
Devore CDF	26.57	17.79	8.54	5.94	70%	18.03	11.85	66%	67%
Camp Angelus	27.31	22.86	9.46	14.32	151%	17.97	8.54	48%	83%
Lake Arrowhead	36.58	32.09	11.82	15.03	127%	23.73	17.06	72%	90%
Mentone CDF	12.47	9.38	3.85	2.82	73%	8.62	6.56	76%	75%
Redlands Country Club	12.49	11.86	3.97	4.90	123%	6.81	6.96	102%	110%
San Bernardino County Hospital	15.63	11.75	4.96	5.40	109%	10.35	6.35	61%	77%
Santa Ana Pumphouse #3	16.30	11.71	5.41	4.94	91%	10.17	6.77	67%	75%
Yucaipa CDF	15.47	13.74	4.94	5.08	103%	10.39	8.67	83%	90%

Avg (in) = 22.02 17.03

Average = 104.2%

Average = 69.4%

2015-16 Average = 81.2%

[1], [4]: Based on data provided by San Bernardino County Department of Transportation/Flood Control

[3] = ([2] / [1]) x 100

[5] = [0] - [2]

[6] = ([5] / [4]) x 100

[7] = (([2] + [5]) / ([1] + [4])) x 100

Average Annual Change in Storage for Bunker Hill Basin

Fall 2006 to Fall 2016

(The Immediate Past 10 Water Years)

Sub-area	[1] Average Change in 10 Years in Water Level* [ft]	[2] Area [acres]	[3] Storativity (S)	[4] Average Annual Change in Storage** [acre-ft]
Bunker Hill I - Southwest of 215 Freeway	-6.80	11,714	0.09	-7,011
Bunker Hill I - Northeast of 215 Freeway	-7.29	7,795	0.11	-6,247
Bunker Hill II - West of Mentone Fault	-5.79	35,206	0.06	-12,017
Bunker Hill II - East of Mentone Fault	-6.49	11,091	0.13	-9,350
Lytle Basin - Southeast of Barrier J	12.64	5,237	0.07	4,632
Lytle Basin - Northwest of Barrier J	-3.24	1,924	0.13	-810
Pressure Zone - North of Santa Ana Wash	14.40	11,920	0.02	3,434
Pressure Zone - Santa Ana Wash	-6.91	6,686	0.02	-924

Total = -28,293

[1] Based on average annual changes in water level within each Sub-area over last 10 years.

[2] Estimated using GIS.

[3] Based on data from Hardt and Hutchinson (1980).

S storativity: The amount of water stored or released per unit area of aquifer given unit head change.

[4] = [1] x [2] x [3]

*A positive sign denotes an increase in water level and a negative sign represents a decline in water level.

Summary of Surface Distribution Water for Bunker Hill Basin

1988 to 2016

Streamflow Diversions	1988 [acre-ft]	1989 [acre-ft]	1990 [acre-ft]	1991 [acre-ft]	1992 [acre-ft]	1993 [acre-ft]	1994 [acre-ft]	1995 [acre-ft]	1996 [acre-ft]	1997 [acre-ft]	1998 [acre-ft]	1999 [acre-ft]	2000 [acre-ft]	2001 [acre-ft]	2002 [acre-ft]
Lytle Creek															
Fontana Union WC	2,991	2,245	204	1,633	12,980	7,343	12,601	9,893	10,730	7,266	8,626	9,695	4,131	5,829	2,906
Mount Vernon WC	724	724	724	724	724	1,143	102	0	0	0	0	312	786	778	975
Rialto, City of	1,111	1,005	792	1,014	743	193	843	44	1,070	393	896	1,461	NA	1,305	1,143
San Bernardino, City of	1,448	1,448	1,448	1,448	1,448	520	2,400	2,400	0	0	0	0	0	0	0
West Valley Water District	3,696	3,696	2,554	3,701	3,696	3,696	3,697	3,696	3,686	4,079	3,696	3,408	3,047	3,175	2,573
Subtotal	9,970	9,118	5,722	8,520	19,591	12,895	17,243	16,033	17,886	11,738	13,218	14,876	7,964	11,087	7,597
Mill Creek															
Redlands, City of	7,731	8,285	6,794	11,109	14,559	19,086	14,505	9,786	12,250	10,250	11,224	11,951	8,852	9,496	5,867
SBVWCD Mill Creek Spreading					8,638	21,359	8,522	16,347	3,791	5,576	17,227	2,025	3,868	3,337	352
SBVWCD-MC-DWR															
Subtotal	7,731	8,285	6,794	11,109	14,559	19,086	14,505	9,786	12,250	10,250	11,224	13,976	12,720	12,833	6,219
Bunker Hill Creeks															
Arrowhead Water & Power West Twin Crk															
Arrowhead Water & Power East Twin Crk	1,439	1,348	1,606	7,417	2,178	16,821	2,225	9,277	3,273	4,451	9,734	2,276	1,420	1,339	616
Devore Water Company Kimbark Lower Cajon															
Subtotal	0	0	0	0	0	0	0	0	0	0	0	2,276	1,420	1,339	616
Santa Ana River															
Bear Valley Mutual WC	14,170	14,785	11,244	20,651	26,014	42,079	23,812	30,794	38,252	31,479	36,632	30,245	29,498	26,301	23,458
Redlands Water Co	963	890	577							760					
SBVWCD SAR Spreading				7,268	12,767	41,950	11,427	20,040	13,331	10,361	40,346	6,167	5,085	3,315	1,371
SBVWCD-DWR-SAR															
Subtotal	15,133	15,675	11,821	20,651	26,014	42,079	23,812	30,794	38,252	32,239	36,632	36,412	34,583	29,616	24,829

Streamflow Diversions	2003 [acre-ft]	2004 [acre-ft]	2005 [acre-ft]	2006 [acre-ft]	2007 [acre-ft]	2008 [acre-ft]	2009 [acre-ft]	2010 [acre-ft]	2011 [acre-ft]	2012 [acre-ft]	2013 [acre-ft]	2014 [acre-ft]	2015 [acre-ft]	2016 [acre-ft]	Avg. [acre-ft]
Lytle Creek															
Fontana Union WC	3,029	3,774	4,439	12,203	6,516	6,727	5,776	10,052	18,037	7,656	3,775	3,586	3,407	3,236	6,596
Mount Vernon WC	1,442	754	70	250	437	927	1,132	167	685	578	520	468	421	379	550
Rialto, City of	726	1,707	1,209	1,448	1,160	1,165	1,135	1,000	1,148	1,319	996	1,020	871	1,041	998
San Bernardino, City of	0	580	5	254	483	498	450	450	0	0	0	0	0	0	546
West Valley Water District	2,380	4,710	2,079	3,081	NA	3,369	2,435	3,322	3,382	2,954	2,369	3,810	3,389	1,737	3,254
Subtotal	7,577	11,525	7,802	17,236	8,596	12,686	10,928	14,991	23,252	12,507	7,660	8,884	8,088	6,393	11,944
Mill Creek															
Redlands, City of	12,541	10,168	12,574	15,409	9,607	12,332	7,785	10,076	13,492	6,085	7,041	4,657	3,912	4,400	10,063
SBVWCD MC	4,489	3,089	29,138	9,510	1,531	3,810	4,450	8,891	16,185	4,666	1,734	888	1,080	1,058	7,262
SBVWCD-MC-DWR			0	0	0	431	555	831	1,434	0	515	0	0	18	315
Subtotal	17,030	13,257	41,712	24,919	11,138	16,573	12,790	19,798	31,111	10,751	9,290	5,545	4,992	5,475	17,641
Bunker Hill Creeks															
Arrowhead Water & Power West Twin Crk		50	50	50	50	40	40	40	46	46	41	46	46	46	45
Arrowhead Water & Power East Twin Crk		2,500	1,750	1,700	1,725	3	0	0	1,097	987	987	889	800	720	2,810
Devore Water Company Kimbark		29	97	80	62	68	51	56	78	37	33	59	59	59	59
Subtotal	0	2,579	1,897	1,830	1,837	111	91	96	1,221	1,180	1,062	994	905	825	2,915
Santa Ana River															
Bear Valley Mutual WC	12,633	11,227	12,516	17,689	11,560	13,519	7,303	7,000	15,445	17,218	5,923	5,271	4,823	5,411	18,860
Redlands Water Co		588	981	1,044	884	625	654	629	739	4,917	2,036	5,201	5,629	6,957	2,004
SBVWCD SAR Spreading	12,330	5,669	27,841	14,476	4,002	17,550	8,456	21,662	36,801	9,073	5,519	1,537	2,982	2,792	13,235
SBVWCD-DWR-SAR			0	5,855	1,993	0	981	1,115	1,511	441	169	0	81	15	1,013
Subtotal	24,963	17,484	41,338	39,064	18,439	31,694	17,394	30,406	54,496	31,649	13,647	12,009	13,515	15,174	35,113

Assumed as average and are provisional data.

Total =		67,613
16 Total =	27,867	

Surface Diversions, comments:

The amount of water for surface distribution for the ensuing water year (October 1, 2017 to September 30, 2018) was estimated based on the average surface for the Santa Ana River, Bunker Hill Creeks, Mill Creek, and Lytle Creek for the period of 1988 to 2016. As shown in Table 8 above, the average surface diversion for the Santa Ana River, Bunker Hill Creek, Mill Creek , and Lytle Creek, including Department of Water Resources purchased water, between 1988 to 2016 was 35,113; 2,915; 17,641; 11,944 acre-feet respectively.