

2014-2015

Addendum to the Engineering Investigation of the Bunker Hill Basin



Prepared By:



July, 15, 2015

The San Bernardino Valley Water Conservation District (SBVWCD) is responsible for performing the Engineering Investigation of the Bunker Hill Basin as stated in Article 1, Section 75560 of the California Water Code, which requires that a Water Conservation District that proposes to levy a groundwater charge “... shall annually cause to be made an engineering investigation and report upon groundwater conditions of the District”. The 2014-2015 Engineering Investigation (EI) was performed in a similar manner to that of the 2013-2014 EI, with a few minor adjustments.

SBVWCD must make findings and determinations as they relate to the ground and surface water conditions of the Bunker Hill Basin and those areas within the District boundary. The following list indicates the amended values for the required findings:

Task 1. Annual change in storage for the Bunker Hill Basin for the preceding water year (July 1, 2013 to June 30, 2014 groundwater levels)

Change in storage between Fall 2013 and Fall 2014

-91,555 acre-ft (decrease)

The amount of water stored in the Basin decreased by 91,555 acre-ft between 2013 and 2014.

Task 2. Accumulated change in storage of the Bunker Hill Basin as of the last day of the preceding water year (2014)

Accumulated change in storage between July 1993 and June 2014.¹

- 535,877 acre-ft (decrease)

The amount in storage in the summer of 2014 is 535,877 acre-ft less than in the summer of 1993.

¹ In the District's Engineering Investigation (EI) prior to 1993-94, the accumulated change in storage was based on the basin storage in 1984 as considered full. A concern arose regarding high groundwater levels in the Pressure Zone of the Bunker Hill Basin. Therefore, in response to the City of San Bernardino's comments on accumulated change in storage, all EI's since that time are based on 1993 basin storage levels considered as full. The BTAC makes annual recharge recommendations to optimize recharge.

Task 3. Total groundwater production from the Bunker Hill Basin for the preceding water year (July 1, 2013 - June 30, 2014)

169,392 acre-ft

Task 4. Estimate of the annual change in the Bunker Hill Basin storage for the current water year (July 1, 2014 - June 30, 2015)

-94,727 acre-ft (decrease)

The amount of water in the Basin is estimated to decrease by 94,727 acre-ft during the current water year.

Task 5. Estimate of the annual change in the Bunker Hill Basin storage for the ensuing water year (July 1, 2015 - June 30, 2016)

1,351 acre-ft increase (100% average)

88,779 acre-ft decrease (50% average)*

91,480 acre-ft increase (150% average)**

The amount of water in the Basin is estimated to increase by 1,351 acre-ft during the ensuing water year presuming average precipitation.

*** The amount of water in the Basin is estimated to decrease by 88,779 acre-ft during the ensuing water year presuming 50% of average precipitation.**

**** The amount of water in the Basin is estimated to increase by 91,480 acre-ft during the ensuing water year presuming 150% of average precipitation.**

Task 6. Average annual change in Bunker Hill Basin storage for the immediate past 10 water years (2004-2014) shows a decrease.

-10,035 acre-ft (decrease)

Task 7. Estimated amount of agricultural water and other than agricultural water to be withdrawn from the groundwater supplies of the District for the ensuing water year (July 1, 2015 - June 30, 2016)

Estimated amount of agricultural water withdrawn from the groundwater supplies within the District boundary for the ensuing water year (July 1, 2015 - June 30, 2016)

20,248 acre-ft

Estimated amount of other than agricultural water withdrawn from the groundwater supplies of the District for the ensuing water year (July 1, 2015 - June 30, 2016)

85,456 acre-ft

Task 8. Estimated amount of water necessary for surface distribution for the ensuing water year for the Bunker Hill Basin and the District (July 1, 2015 - June 30, 2016)

Estimated amount of water necessary for surface distribution for the ensuing water year (July 1, 2015 - June 30, 2016) for the Bunker Hill Basin

68,904 acre-ft

Estimated amount of water necessary for surface distribution for the ensuing water year (July 1, 2015 - June 30, 2016) within the District boundary

56,001 acre-ft

Task 9. The amount of water which is necessary for the replenishment of the groundwater supplies of the Bunker Hill Basin and the District for the ensuing water year (July 1, 2015 - June 30, 2016)

The amount of water which is necessary for the replenishment of the groundwater supplies of the Bunker Hill Basin for the ensuing water year (July 1, 2015 - June 30, 2016)

144,679 acre-ft

The amount of water which is necessary for the replenishment of the groundwater supplies within the District boundary for the ensuing water year (July 1, 2015- June 30, 2016)

104,354 acre-ft

Summary of Changes

Table 1 below summarizes the minor differences from the March report and the addendum:

Table 1: Summary of Addendum Differences

Tasks	Description	Mach 2015	Addendum
Task 1	Annual Change in Storage	-85,368	-91,555
Task 2	Accumulated Change in Storage	-529,690	-535,877
Task 3	Basin Production	165,799	169,392
Task 4	Estimated Annual Change in Storage (Current Water Year)	-94,727	-94,727
Task 5	Estimated Annual Change in Storage (Ensuing Water Year)	1,351	1,351
Task 6	10 Year Average Change in Storage	-9,141	-10,035
Task 7	Estimated Production District Boundary (Agricultural)	16,925	20,248
	Estimated Production District Boundary (Non-Agricultural)	85,358	85,456
Task 8	Estimated Surface Distribution (District)	69,424	68,904
	Estimated Surface Distribution (Basin)	56,419	56,001
Task 9	Estimated Replenishment Required for Constant Storage (Basin)	144,158	144,679
	Estimated Replenishment Required for Constant Storage (District)	100,933	104,354
	Replenishment to Reach "Full" Level	768,576	775,284

Methodology

To make the findings and determinations listed above, District staff researched available hydrogeologic, precipitation, and engineering data for the Bunker Hill Basin and surrounding areas. These data were compiled and analyzed and a predictive relationship between precipitation, production, and change in basin storage was adapted from similar relationships developed by Geoscience Support Services in the preparation of previous Engineering Investigations. This relationship was based on empirical data enables the prediction of change in storage, given certain annual production and precipitation levels. In addition, annual and accumulated change in storage was calculated based on historic water level changes throughout the Bunker Hill Basin.

The San Bernardino Valley Municipal Water District (SBVMWD) also performs calculations for the Bunker Hill Basin using their own data sets and calculation methods. In past years the annual change in storage value obtained by both agencies has been very agreeable, but in the 2014-2015 EI the difference required a second assessment.

SBVWCD calculates the annual change in storage for the Bunker Hill Basin using the average groundwater elevation change, the area of the sub-basins, and the storativity coefficients for the nine hydrologic sub-areas:

- Bunker Hill I - Southwest of Interstate 215
- Bunker Hill I - Northeast of Interstate 215
- Bunker Hill II - West of Mentone Fault
- Bunker Hill II - East of Mentone Fault
- Lytle Basin - Southeast of Barrier J
- Lytle Basin - Northwest of Barrier J
- Pressure Zone - North of Santa Ana Wash
- Pressure Zone - Santa Ana Wash

The average groundwater elevation change is calculated using the requested static well depth data from the well owners within the Bunker Hill Basin. The sub-basins area of extent was estimated using digitized polygons in GIS and the average storativity for each sub-basin was determined based on data from Hardt and Hutchinson, 1980. The combination of these three values for each sub-basin is then summed to get the annual change in storage.

Using the Export_WaLevels.xls provided by SBVMWD, a comparison calculation for the Engineering Investigation was performed. In general, SBVWCD always strives to use the last available value that is obtained from the different providers and will not use a value further back than October. This is done so that an annual change in storage value can be obtained, and is as close to a year in time as possible. The use of static well readings is always preferred, but when not available, comparing two pumping values for the same well is occasionally accepted based on proximity to other pumping wells and the how reasonable the obtained difference value is.

Using the 78 wells in the provided spreadsheet SBVWCD calculation method was performed using both the SBVMWD and the SBVWCD values. After removing the zero values for 2013 for EVWD's Plant No. 142 and WVWD's Well 8A, and the -9999 value for 2014 for EVWD's Plant No. 27 in SBVMWD data, the calculation brought about much more comparable values. SBVMWD data provided -106,952 acre-ft and SBVWCD data provided -102,704 acre-ft which are within an acceptable range of each other (<5%). However, when SBVWCD full data set is used there is still a large difference in the obtained change in storage values. These values can be seen in the table below:

SBVMWD				
	Average	Area	Storativity	Change in Storage
Bunker Hill I Southwest of 215 Freeway	-14.68	11,714	0.09	-15471
Bunker Hill I Northeast of 215 Freeway	-27.73	7,795	0.11	-23773
Bunker Hill II West of Mentone Fault	-18.26	35206	0.06	-38568
Lytle Basin Southeast of Barrier J	-41.67	5237	0.07	-15275
Lytle Basin Northwest of Barrier J	0.00	1924	0.13	0
Pressure Zone North of Santa Ana Wash	-3.62	11920	0.02	-863
Pressure Zone Santa Ana Wash	-9.88	6686	0.02	-1321
Bunker Hill II East of Mentone Fault North	-10.22	8584	0.13	-11402
Bunker Hill II East of Mentone Fault South	-0.86	2507.4	0.13	-279
				-106952
SBVWCD				
	Average	Area	Storativity	Change in Storage
Bunker Hill I Southwest of 215 Freeway	-9.50	11,714	0.09	-10015
Bunker Hill I Northeast of 215 Freeway	-24.00	7,795	0.11	-20579
Bunker Hill II West of Mentone Fault	-19.06	35206	0.06	-40262
Lytle Basin Southeast of Barrier J	-36.50	5237	0.07	-13381
Lytle Basin Northwest of Barrier J	0.00	1924	0.13	0
Pressure Zone North of Santa Ana Wash	-11.44	11920	0.02	-2726
Pressure Zone Santa Ana Wash	-16.00	6686	0.02	-2140
Bunker Hill II East of Mentone Fault North	-11.75	8584	0.13	-13113
Bunker Hill II East of Mentone Fault South	-1.50	2507.4	0.13	-489
				-102704

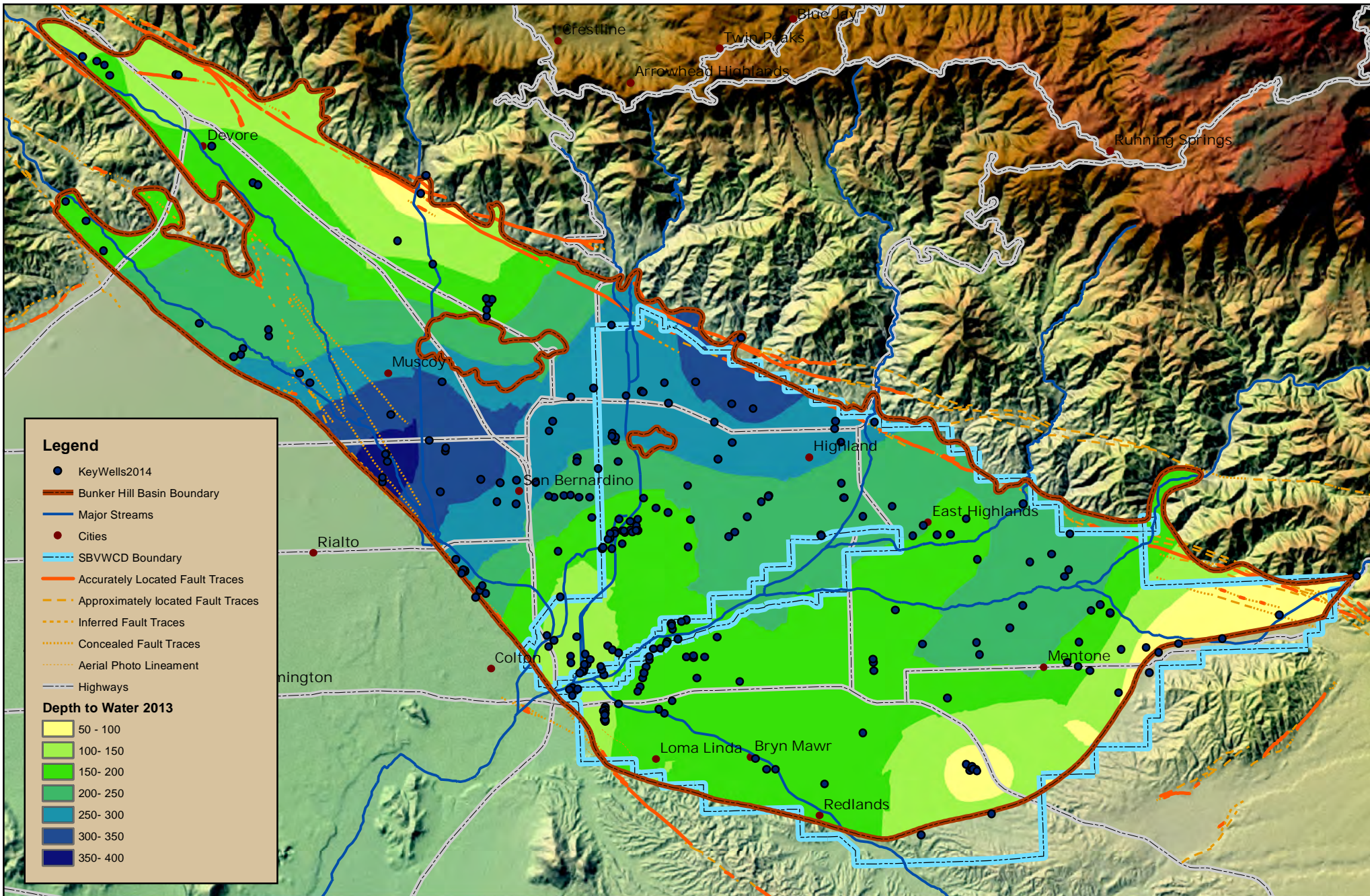
There are many potentially contributing factors that would cause the differences in the change of storage value. SBVMWD’s chosen wells do not cover the entirety of the Bunker Hill Basin, leaving the Lytle Basin Northwest of Barrier J area with no value. This may be due to a data availability issue as many of the wells in that sub-basin are operated by the Fontana Water Company who decline to provide data for the EI. SBVWCD chose data for 223 wells for the 2014-2015 EI from 15 different agencies. The large discrepancy caused a greater look into the location of wells in comparison to pumping wells, spreading basins, and other wells, as well as the usage of pumping depth values, the last available value for the year, or the largest change in depth. Using the last available value for each year and removing values that are from wells that appear to either have an error in the reading or are near an actively pumping well, made the overall value more acceptable, but still considerably off from the 78 well value.

SBVWCD Full Data Set				
	Average	Area	Storativity	Change in Storage
Bunker Hill I Southwest of 215 Freeway	-4.52	11,714	0.09	-4760
Bunker Hill I Northeast of 215 Freeway	-11.91	7,795	0.11	-10210
Bunker Hill II West of Mentone Fault	-21.72	35206	0.06	-45872
Lytle Basin Southeast of Barrier J	-21.88	5237	0.07	-8022
Lytle Basin Northwest of Barrier J	-11.43	1924	0.13	-2860
Pressure Zone North of Santa Ana Wash	-5.19	11920	0.02	-1238
Pressure Zone Santa Ana Wash	-7.24	6686	0.02	-969
Bunker Hill II East of Mentone Fault North	-14.46	8584	0.13	-16140
Bunker Hill II East of Mentone Fault South	-4.56	2507.4	0.13	-1485
				-91555

Lytle Basin Northwest of Barrier J’s average value was originally calculated as zero due to the lack of availability of data from The Fontana Water Company. The value shown is the average of all of the sub-basins. Because the obtained values for the smaller subsets were comparable between agencies, The District’s calculation method is still acceptable. In order to ensure this, Valley’s model would need to be performed using the same large data set that the District uses for its calculation.

Updated Graphics

These elevations were plotted for 136 wells using a Geographic Information System (GIS) and are plotted in **Figures 1 & 2** for Fall 2013 and Fall 2014. The water elevation values were used to derive an interpolated surface for the extent of the Bunker Hill Basin. For purposes of comparison, Fall 2013 and Fall 2014 static groundwater elevation surface contours are provided in **Figures 1 & 2** respectively.



State Plane NAD 83, Zone V, feet
 10M DEM DWR
 SBVWCD Water Elevation
 2011 - 340 Wells
 IDW Interpolation Method
 Watermaster Services,
 All City Water Agencies
 and SBVMWD



0.45 0.9 1.8 2.7
 Miles

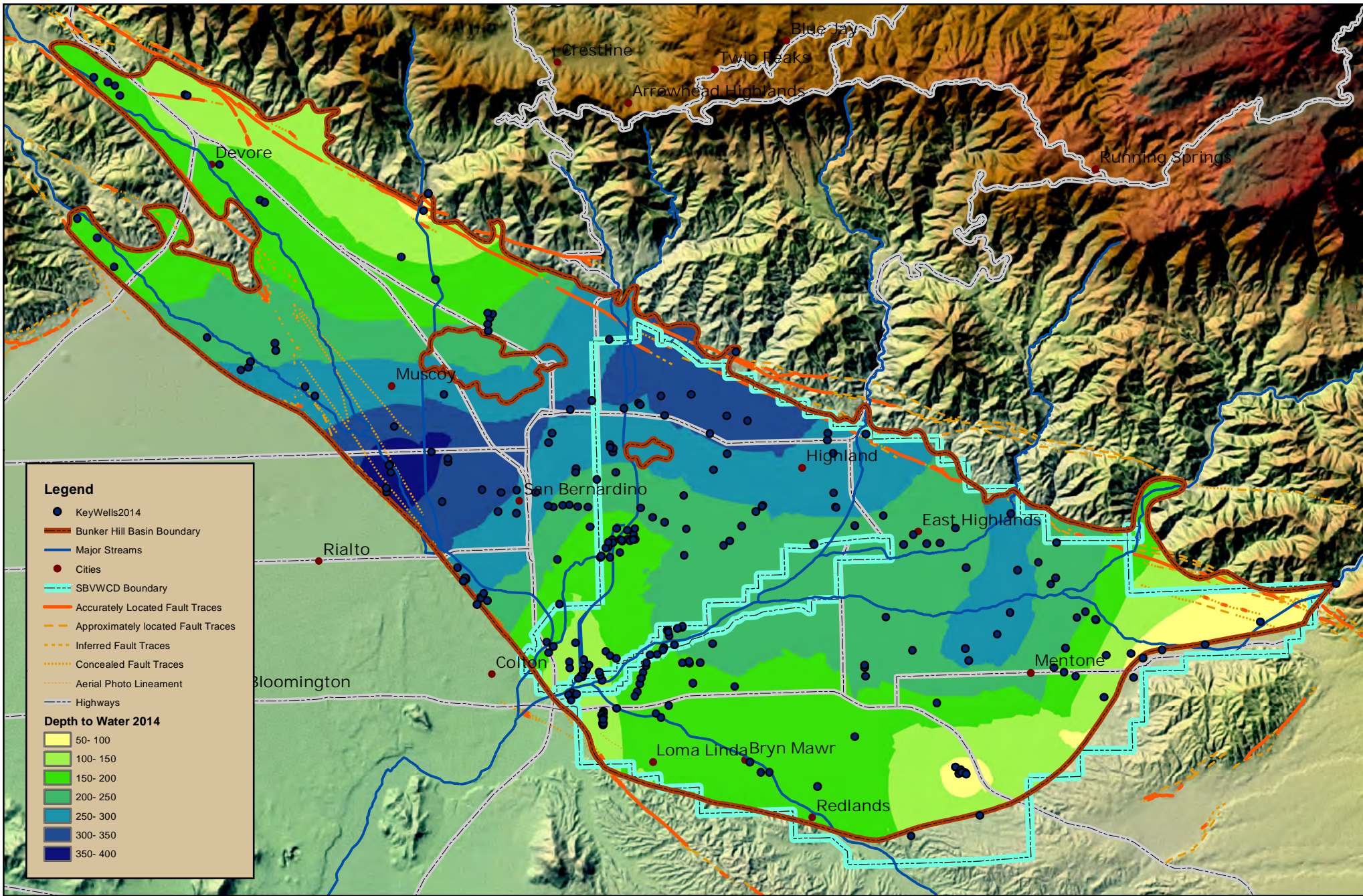
Water Elevation Contour Surface Fall 2013 Engineering Investigation Report Addendum 2015

Engineering Investigation Addendum
 July 2015

Source: SBVWCD GIS
 E. Mancilla, E. Berger,
 & K. Scholte



Figure 1



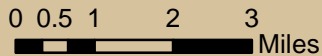
Legend

- KeyWells2014
- Bunker Hill Basin Boundary
- Major Streams
- Cities
- SBVWCD Boundary
- Accurately Located Fault Traces
- Approximately located Fault Traces
- Inferred Fault Traces
- Concealed Fault Traces
- Aerial Photo Lineament
- Highways

Depth to Water 2014

- 50- 100
- 100- 150
- 150- 200
- 200- 250
- 250- 300
- 300- 350
- 350- 400

State Plane NAD 83, Zone V, feet
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 SBVWCD Water Elevation
 2011 - 340 Wells
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 All City Water Agencies
 and SBVMWD



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Figure 2