Lake County
Watershed Protection District

Big Valley
Alternative Groundwater Management Plan
Annual Report 2018

May 2019
Big Valley Groundwater Basin Summary

Location
The Big Valley Basin is the source of water supply for Kelseyville and is the largest agricultural area in Lake County. The Basin is located south of Clear Lake and includes the lowlands portion of Big Valley near Clear Lake, and the southern uplands portion near Adobe and Kelsey Creeks. (1)

The Big Valley Groundwater Basin is bordered by Clear Lake to the north, the Clear Lake Volcanic to the east and the Franciscan Formations border the basin to the west and south. Adobe and Kelsey Creeks flow through Big Valley and drain to the north into Clear Lake. (1)

Big Valley is roughly triangular shaped, and is at most six miles wide and approximately eight miles long. The ground surface in the northern portion of the basin gently slopes to the north towards Clear Lake. There are uplands on the west side of the valley, and separate uplands in the south central portion of the valley that have been uplifted approximately 400 feet by faulting. (2)(1)

Groundwater Aquifers
The Big Valley Basin is formed by four major aquifers that are separated by clay-rich lake deposits layers (see Figure 1).

“A1” Aquifer
Much of the northern portion of Big Valley is directly underlain by alluvial deposits ranging from 10 feet to 126 feet thick (2). The deposits are likely to be stream deposits, consisting of gravel, sand, and silt. The “A1” aquifer is generally unconfined except near and under Clear Lake, where it is confined by an overlying clay layer.

“A2” Aquifer
The “A2” aquifer is below the “A1” aquifer and a confining clay layer. The “A2” aquifer ranges from 14 to
140 feet in thickness, and is likely to be composed of stream deposits of gravel, sand, and silt clay. The “A2” aquifer is generally confined or semi-confined.

“A3” Aquifer
Much of the uplands in the southern portion of Big Valley are underlain by the “A3” aquifer, ranging from 5 to 160 feet in thickness. The deposits in the “A3” aquifer are similar to the deposits in the “A1” and “A2” aquifers, likely being comprised of stream deposits, gravel, sand, and silt. The “A3” aquifer is generally unconfined.

“Volcanic Ash” Aquifer
The “Volcanic Ash” aquifer is below the “A3” aquifer and a confining clay layer. The “Volcanic ash” aquifer is generally 2 to 5 feet thick, with thicknesses as high as 50 feet reported in two wells. The aquifer consists of volcanic tuff, and water flow throughout the aquifer is confined.

Aquifers A1 and A2 are generally located in the lower elevations of the Big Valley groundwater basin and consist of Kelseyville and Adobe-Manning Creek basins. There are 25 wells within these aquifers. Aquifer A3 consists of various upland aquifers. There are 13 wells within the A3 aquifer. No wells used for this report are located within the Volcanic Ash aquifer.

Water demand
In 2018 water year the water demand by the population is estimated as 1,408.42 acre-feet of water. The agricultural demand is estimated as 25,212.06 acre-feet of water. The total water demand for water year 2018 is determined as 26,620.48 acre-feet of water.

Recharge
The majority of recharge to groundwater in the “A1” and “A2” aquifers is from infiltration of surface flow from Kelsey and Adobe Creeks into the aquifer system. Additional recharge to the “A1” and “A2” aquifers occurs from percolation of rainfall, and underflow from the “A3” aquifer. The “A1” aquifer may also receive recharge from Clear Lake during the summer, when pumping has lowered the groundwater level below the level of Clear Lake. The “A3” aquifer is recharged by percolation of rainfall and by infiltration of water from Kelsey Creek. Recharge of groundwater in the “Volcanic ash” aquifer is poorly understood. It is probably recharged by underflow from uplands, and infiltration of streamflow at surface exposures of the volcanic ash. (1)

Flow direction
The direction of groundwater flow in Big Valley is generally northward towards Clear Lake. The groundwater gradient in the southern portion of the valley is approximately 70 feet per mile. The gradient in the northern portion of the valley is approximately 20 feet per mile.

References:
Big Valley Basin Hydrographs Summary

Submitted hydrographs show groundwater levels in the Big Valley Groundwater Basin behave differently in the northern portion than in the southern portion of the basin. Hydrographs in the northern portion, the alluvial system portion of Big Valley, are typically shallow in the spring and experience wide fluctuations over the irrigation season. Seasonal variation levels are typically 30 to 40 feet below spring levels, spring groundwater levels have remained generally constant over the last 40 years except in the drought periods. Seasonal variation levels in the northern portion of the A1 / A2 Aquifers averaged -11.5 between the 13 seasonal wells that ranged from -1.4 to -20.4. Seasonal variation levels in the southern portion of the A1 / A2 Aquifers averaged -9.4 between the 5 seasonal wells that ranged from -6.9 to -13.3.

In the 2018 water year the Lake County had monitored the groundwater levels from 38 wells in the Big Valley Basin.
Big Valley
13N-09W-02C2

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)
Big Valley
13N-09W-02H1

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)

\[ y = 1E-04x + 1325.8 \]
\[ R^2 = 0.0163 \]

\[ y = -2E-06x + 1319.9 \]
\[ R^2 = 5E-06 \]
Big Valley
13N-09W-03P1

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)

y = -0.0007x + 1361.7
R² = 0.1095

y = -0.0002x + 1318.2
R² = 0.0038
Big Valley
13N-09W-03R1

\[ y = -0.0003x + 1353.2 \]
\[ R^2 = 0.1793 \]

\[ y = 0.0006x + 1299.4 \]
\[ R^2 = 0.1954 \]
Big Valley
13N-09W-03R2

𝑦 = -0.0003𝑥 + 1355.1
𝑅² = 0.2437

𝑦 = 0.0004𝑥 + 1306.6
𝑅² = 0.0872

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)
Big Valley
13N-09W-04G1

y = -0.0003x + 1345.3
R² = 0.0457

y = 0.0012x + 1264.2
R² = 0.1727

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)
y = 0.0002x + 1345.8
R² = 0.0361

y = 0.0003x + 1330.9
R² = 0.1214
Big Valley
13N-09W-09D5

Spring Water Levels

Fall Water Levels

Reference Point Elevation

Linear (Spring Water Levels)

Linear (Fall Water Levels)
Big Valley
13N-09W-09L1

Spring Water Levels

Fall Water Levels

Reference Point Elevation

Linear (Spring Water Levels)

Linear (Fall Water Levels)

\[ y = 0.0003x + 1343.8 \]
\[ R^2 = 0.0693 \]

\[ y = 0.0009x + 1311.9 \]
\[ R^2 = 0.5728 \]
Big Valley
13N-09W-10E1

y = 0.0005x + 1324.8
R² = 0.1502

y = 0.0017x + 1260.1
R² = 0.3037


Spring Water Levels  Fall Water Levels  Reference Point Elevation

Linear (Spring Water Levels)  Linear (Fall Water Levels)
Big Valley
13N-09W-12M2

y = 0.0007x + 1309.5
R² = 0.2376

y = 0.0003x + 1315.5
R² = 0.0334
Big Valley
13N-09W-15B2

$y = -1E-04x + 1359.8$
$R^2 = 0.0216$

$y = 0.0014x + 1291.4$
$R^2 = 0.1943$

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)
Big Valley
13N-09W-15D1

Spring Water Levels

Fall Water Levels

Reference Point Elevation

Linear (Spring Water Levels)

Linear (Fall Water Levels)
Big Valley
13N-09W-15J1

$y = 0.0003x + 1391$
$R^2 = 0.0326$

$y = -5E-05x + 1398.8$
$R^2 = 0.0017$

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)
Big Valley
13N-09W-15M1

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)

\[ y = -0.0005x + 1411.4 \]
\[ R^2 = 0.0957 \]

\[ y = -0.0006x + 1410 \]
\[ R^2 = 0.1556 \]

Big Valley
13N-09W-16E2

y = -0.0007x + 1332.9
R² = 0.3873

y = -0.0008x + 1373.3
R² = 0.0085

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)
Big Valley
13N-09W-18J1

\[ y = 0.0012x + 1344.9 \]
\[ R^2 = 0.333 \]

\[ y = 0.0015x + 1322.7 \]
\[ R^2 = 0.2601 \]
Spring Water Levels  
Fall Water Levels  
Reference Point Elevation  
Linear (Spring Water Levels)  
Linear (Fall Water Levels)
Big Valley
13N-09W-22M1

\[
y = 0.0015x + 1332.5
\]
\[R^2 = 0.121\]

\[
y = 0.0024x + 1263.1
\]
\[R^2 = 0.229\]
Big Valley
13N-09W-27D1

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)
Big Valley
13N-09W-27Q1

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)
Big Valley
13N-09W-28N3

Spring Water Levels

Fall Water Levels

Reference Point Elevation

Linear (Spring Water Levels)

Linear (Fall Water Levels)
Big Valley
13N-09W-29R1

\[ y = -0.0011x + 1491 \]
\[ R^2 = 0.0843 \]

\[ y = -0.0026x + 1523.6 \]
\[ R^2 = 0.2425 \]

Spring Water Levels
Fall Water Levels
Reference Point Elevation
Linear (Spring Water Levels)
Linear (Fall Water Levels)
Big Valley
14N-09W-32G2

Spring Water Levels

Fall Water Levels

Reference Point Elevation

Linear (Spring Water Levels)

Linear (Fall Water Levels)

y = -5E-05x + 1328
R² = 0.0042

y = 0.0006x + 1291.1
R² = 0.3188
y = 0.0001x + 1323
R² = 0.0466

y = -3E-05x + 1323.3
R² = 0.0024
y = 0.0003x + 1313.1
R² = 0.1301

y = 0.0008x + 1287.6
R² = 0.3437
Big Valley Basin Agricultural Water Demand

Big Valley Land Use, Acres

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<tr>
<th>Type of Crop</th>
<th>Area, Acres</th>
<th>Water Demand, Inches</th>
<th>Efficiency</th>
<th>Water Intake, Acre-Feet</th>
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<td>P - Pasture</td>
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Partial sums:

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<td>25,212.06</td>
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the consumption rates estimates: https://naldc.nal.usda.gov/naldc/download.xhtml?id=CAT87201264&content=PDF
grapes water demand: http://cemendocino.ucanr.edu/files/17223.pdf
Big Valley Basin Population Water Demand

The estimates for population - Census 2010, Track 10
(http://www.usboundary.com/Areas/Census%20Tract/California/Lake%20County/Census%20Tract%202010/439965)

The estimates for Water Use, gpcd - USGS

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Groundwater Elevations (ft)

- 1,329 - 1,346
- 1,347 - 1,367
- 1,368 - 1,387
- 1,388 - 1,405
- 1,406 - 1,427
- 1,428 - 1,459
- 1,460 - 1,485
- 1,486 - 1,506
- 1,507 - 1,529

Additional Notes:
* Groundwater elevations ranged from 1328 to 1495 ft
* Contour Interval -- 10 ft
* Elevations are Mean Sea Level North American Vertical Datum of 1988 (NAVD 88)
* 26 wells available for analysis
Groundwater Elevations (ft)
- 1,317 - 1,327
- 1,328 - 1,338
- 1,339 - 1,348
- 1,349 - 1,357
- 1,358 - 1,367
- 1,368 - 1,380
- 1,381 - 1,391
- 1,392 - 1,402
- 1,403 - 1,419

Big Valley Basin
Groundwater Elevations
Fall 2018

Additional Notes:
* Groundwater elevations ranged from 1317 to 1521 ft
* Contour Interval -- 10 ft
* Elevations are Mean Sea Level North American Vertical Datum of 1988 (NAVD 88)
* 37 wells available for analysis
## Seasonal Changes in Groundwater for Water Year 2018 -- Big Valley

<table>
<thead>
<tr>
<th>STATE NO</th>
<th>Spring</th>
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<th>Seasonal Change</th>
<th>Baseline Seasonal Change</th>
<th>Long-Term Seasonal Change</th>
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<td>Fall</td>
<td>Seasonal Change</td>
<td>Baseline Seasonal Change</td>
<td>Long-Term Seasonal Change</td>
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Big Valley Basin
Change in Groundwater Elevations
Spring 2018 to Fall 2018

Additional Notes:
* Groundwater change elevations ranged from -1.4 to -32.9 ft
* Contour Interval = 5 ft
* Elevations are Mean Sea Level North American Vertical Datum of 1988 (NAVD 88)
* 25 wells available for analysis
**Additional Notes:**
* Groundwater change elevations ranged from -9.9 to 14.0 ft
* Contour Interval – 5 ft
* Elevations are Mean Sea Level North American Vertical Datum of 1988 (NAVD 88)
* 25 wells available for analysis

**Big Valley Basin**
Departure from Average
Spring/Fall 2018 to Long-Term Seasonal Change

County of Lake
Water Resources Department

**Departure from Average (ft)**
-10.0 to -5.3
-5.2 to -2.5
-2.4 to -0.6
-0.5 to 1.3
1.4 to 3.1
3.2 to 5.4
5.5 to 8.2
8.3 to 10.9
11 to 15.0
### Changes in Groundwater Storage for 2018 -- Big Valley

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Monday, April 29, 2019
Big Valley Basin
Change in Groundwater Storage
Spring 2018 to Long-Term Spring Average

Groundwater Basin Boundary
County Boundary

Departure from Average (ft)
-3 - -1
0 - 0.09
0.1 - 1
2 - 2
3 - 4
5 - 6
7 - 7
8 - 8
9 - 10

Additional Notes:
* Changes in groundwater ranged from -3.6 to 17.6 ft
* Contour Interval -- 5 ft
* Elevations are Mean Sea Level North American Vertical Datum of 1988 (NAVD 88)
* 26 wells available for analysis
Big Valley Basin
Change in Groundwater Storage
Fall 2018 to Long-Term Fall Average

Additional Notes:
* Changes in groundwater ranged from -5.0 to 12.7 ft
* Contour Interval – 5 ft
* Elevations are Mean Sea Level North American Vertical Datum of 1988 (NAVD 88)
* 37 wells available for analysis