DWR Update: Groundwater Conditions and Subsidence

Colusa County

September 10, 2015

Roy Hull, Engineering Geologist
CA Department of Water Resources

Groundwater and Geologic Investigations Section
Northern Region Office, Red Bluff
• Water Year

• Summer 2015 GW level report
  o Colusa County with select hydrographs
  o North Sacramento Valley

• Crash course in ground subsidence
Water Year Index 1971-2014

SACRAMENTO VALLEY WATER YEAR TYPE INDEX 1971-2014

1971 - 2014 AVERAGE = 8.01

Estimated Natural Runoff (millions of acre-feet)

Source: California Department of Water Resources

* Index based on flow in the million acre-feet
Sacramento Valley Precipitation

Northern Sierra Precipitation: 8-Station Index, May 8, 2015

- MSC - Mount Shasta City
- SHA - Shasta Dam
- MNR - Mineral
- QRD - Quincy
- BCM - Brush Creek
- SRR - Sierra Gold RS
- BYM - Blue Canyon
- PCF - Pacific House

Percent of Average for this Date: 74%

- 1982-1983 (wettest): 88.5
- 2010-2011: 72.7
- Average (1922-1998): 50.0
- 2012-2013: 44.3
- 2013-2014: 31.3
- 1923-1924 (driest): 17.1

Water Year (October 1 - September 30)
Sacramento Valley Precipitation

Northern Sierra Precipitation: 8-Station Index, September 8, 2015

- MSC - Mount Shasta City
- SHA - Shasta Dam
- MNR - Mineral
- QRD - Quincy
- DCM - Brush Creek
- SRR - Sierraville RS
- BYM - Blue Canyon
- PCF - Pacific House

Percent of Average for this Date: 75%

- 1982-1983 (wettest) 88.5
- 2010-2011 72.7
- Average (1922-1998) 50.0
- 2012-2013 44.3
- 2013-2014 36.8 - Current
- 1923-1924 (driest) 31.3
- 1923-1924 (driest) 17.1

Cumulative Daily/Monthly Precipitation (inches)

Total Water Year Precipitation

Water Year (October 1 - September 30)
Groundwater Change in Elevation Maps

hydrographs

Summer 2015
Groundwater Elevation Change Map
Colusa County

Summer 2013 to 2014
Summer 2014 to 2015

Average:
100 to 450 feet below ground surface

Colusa County - Sacramento Valley GW Basin

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Increase GWL(ft)</td>
<td>4.1</td>
</tr>
<tr>
<td>Maximum Decrease GWE (ft)</td>
<td>-21.0</td>
</tr>
<tr>
<td>Average Change GWE (ft)</td>
<td>-3.0</td>
</tr>
<tr>
<td>Average Well Depth (ft)</td>
<td>278</td>
</tr>
<tr>
<td>Number of Wells Monitored</td>
<td>39</td>
</tr>
</tbody>
</table>
Groundwater Elevation Change Map
Colusa County

Summer 2011 to 2015

Average: 100 to 450 feet below ground surface
Groundwater Elevation Change Map
Colusa County

Summer 2004 to 2015

Average:
100 to 450 feet below ground surface

Colusa County - Sacramento Valley GW Basin

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Increase GWL(ft)</td>
<td>2.6</td>
</tr>
<tr>
<td>Maximum Decrease GWE (ft)</td>
<td>-51.9</td>
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<tr>
<td>Average Change GWE (ft)</td>
<td>-19.4</td>
</tr>
<tr>
<td>Average Well Depth (ft)</td>
<td>253</td>
</tr>
<tr>
<td>Number of Wells Monitored</td>
<td>21</td>
</tr>
</tbody>
</table>
14N01E35P004

Shallow – 4’
14N01E35P003M
Period Of Record: 08/03/2010 to 08/03/2015

Inter-Shallow – 7’
14N01E35P002

Inter-Deep – 20’

Hydrograph Criteria
State Well Number contains ‘14N01’

Period Of Record: 08/03/2010 to 08/03/2015

State Well Number or CASSEM ID
Total Depth
Screen Intervals (ft-bgs)
Ground Surface Elevation (ft-nsl)
County
Well Use

Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements
14N01E35P001M
Period Of Record: 08/03/2010 to 08/03/2015

**Hydrograph Criteria**
State Well Number contains "14N01"

**Deep – 15’**

- **State Well Number or CASPER ID**: 14N01E35P001M
- **Total Depth (ft-bgs)**: 365 – 956
- **Ground Surface Elevation (ft-bgs)**: 46.74
- **County**: COLUSA
- **Well Use**: Observation

**Graph Details**
- **Ground Surface Elev**: Orange line
- **RP Elev**: Dashed line
- **Periodic Measurements**: Blue line
- **Questionable Measurements**: Red line

**Date Range**
- Aug-10 to Aug-15
Groundwater Elevation Change Map
Sacramento River Valley

Summer 2013 to 2014
Summer 2014 to 2015

Average:
100 to 450 feet below ground surface

Summary Results for Summer 2013 to Summer 2014 Change in Groundwater Elevation

<table>
<thead>
<tr>
<th>Measure</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Increase GWE (ft)</td>
<td>14.6</td>
</tr>
<tr>
<td>Maximum Decrease GWE (ft)</td>
<td>-39.0</td>
</tr>
<tr>
<td>Average Change GWE (ft)</td>
<td>-4.1</td>
</tr>
<tr>
<td>Average Well Depth (ft)</td>
<td>255</td>
</tr>
<tr>
<td>Number of Wells Monitored</td>
<td>209</td>
</tr>
</tbody>
</table>
Groundwater Elevation Change Map
Sacramento River Valley

Summer 2011 to 2015

Average:
100 to 450 feet below ground surface

Summary Results for Summer 2011 to Summer 2015
Change in Groundwater Elevation

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Increase GWE (ft)</td>
<td>11.8</td>
</tr>
<tr>
<td>Maximum Decrease GWE (ft)</td>
<td>-47.5</td>
</tr>
<tr>
<td>Average Change GWE (ft)</td>
<td>-12.5</td>
</tr>
<tr>
<td>Average Well Depth (ft)</td>
<td>253</td>
</tr>
<tr>
<td>Number of Wells Monitored</td>
<td>176</td>
</tr>
</tbody>
</table>
Groundwater Elevation Change Map
Sacramento River Valley

Summer 2004 to 2014
Summer 2004 to 2015

Average:
100 to 450 feet below ground surface

Summary Results for Summer 2004 to Summer 2014 Change in Groundwater Elevation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Increase GWE (ft)</td>
<td>13.8</td>
</tr>
<tr>
<td>Maximum Decrease GWE (ft)</td>
<td>-93.8</td>
</tr>
<tr>
<td>Average Change GWE (ft)</td>
<td>-13.8</td>
</tr>
<tr>
<td>Average Well Depth (ft)</td>
<td>242</td>
</tr>
<tr>
<td>Number of Wells Monitored</td>
<td>162</td>
</tr>
</tbody>
</table>
DWR Groundwater Information Center

Maps

http://water.ca.gov/groundwater/gwinfo
Small Break!
Questions?

http://water.ca.gov/groundwater/

Photo Credit: Sue Graue
Crash course in subsidence,
Upper Sacramento River Valley
Subsidence in Glenn Co
# Subsidence in Glenn Co

## Table 1: West side of Glenn County, south of Orland

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>ORLA</td>
<td>267.58</td>
<td>267.58</td>
<td>267.58</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>K852</td>
<td>230.71</td>
<td>230.74</td>
<td>230.55</td>
<td>0.36</td>
<td>0.09</td>
<td>-2.28</td>
<td>-0.33</td>
<td>-1.92</td>
<td>-0.18</td>
</tr>
<tr>
<td>AGUI</td>
<td>274.45</td>
<td>274.39</td>
<td>274.18</td>
<td>-0.72</td>
<td>-0.18</td>
<td>-2.52</td>
<td>-0.36</td>
<td>-3.24</td>
<td>-0.30</td>
</tr>
<tr>
<td>CHER</td>
<td>230.11</td>
<td>230.15</td>
<td>229.96</td>
<td>0.48</td>
<td>0.12</td>
<td>-2.28</td>
<td>-0.33</td>
<td>-1.80</td>
<td>-0.16</td>
</tr>
<tr>
<td>BIGW</td>
<td>457.72</td>
<td>457.77</td>
<td>457.71</td>
<td>0.6</td>
<td>0.15</td>
<td>-0.72</td>
<td>-0.10</td>
<td>-0.12</td>
<td>-0.01</td>
</tr>
<tr>
<td>Y380</td>
<td>462.79</td>
<td>462.79</td>
<td>462.79</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Notes:**

GS: Ground Surface

1 – Monument held fixed

2 – North American Vertical Datum of 1988 (NAVD88)

3 – Per year rates rounded to hundredths
**GPS Grid**

- Last Measurement – 2008
- Subset of Glenn Co – 2015
- Complete resurvey 2016 (?)
Lithology example: Powerhouse Rd

- Lithology - Fines
  - Clay
  - Silt
- Pumping
  - Causes drying and flattening of fines

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>LITHOLOGIC DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>SILT: dark yellowish orange (10YR 6/6); soft, non-plastic; CLAY from 12 - 22 feet bgs.</td>
</tr>
<tr>
<td>50</td>
<td>SAND WITH GRAVEL: dark yellowish brown (10YR 4/2); 70% sand, 30% gravel.</td>
</tr>
<tr>
<td>75</td>
<td>SILT: moderate yellowish brown (10YR 5/4); soft, non-plastic; CLAY from 60 - 68 feet bgs.</td>
</tr>
<tr>
<td>100</td>
<td>GRAVEL WITH SAND: dark yellowish brown (10YR 4/2); 50% gravel, 50% sand.</td>
</tr>
<tr>
<td>125</td>
<td>CLAY: moderate yellowish brown (10YR 6/6); soft, low plasticity; SILT from 115 - 132 feet bgs, trace poorly graded, fine grained GRAVEL from 81 - 93 feet bgs.</td>
</tr>
<tr>
<td>150</td>
<td>SILTY GRAVEL WITH SAND: moderate yellowish brown (10YR 5/4); 60% gravel, 20% sand, 20% silt.</td>
</tr>
<tr>
<td>175</td>
<td>SILT: moderate yellowish brown (10YR 5/4); soft, non-plastic; CLAY from 180 - 185 feet bgs; 10% SAND and GRAVEL from 144 - 172 feet bgs.</td>
</tr>
<tr>
<td>200</td>
<td>SILT and CLAY: dark greenish gray (5G 4/1); interbedded soft, non-plastic silts and clays.</td>
</tr>
<tr>
<td>225</td>
<td>SAND: dark greenish gray (5G 4/1); 100% sand.</td>
</tr>
<tr>
<td>250</td>
<td>SILT: light olive gray (5Y 6/1); soft, sticky, trace fine grained sand.</td>
</tr>
<tr>
<td>275</td>
<td>ML</td>
</tr>
<tr>
<td>300</td>
<td>ML</td>
</tr>
<tr>
<td>325</td>
<td>ML</td>
</tr>
<tr>
<td>350</td>
<td>ML</td>
</tr>
<tr>
<td>375</td>
<td>GP</td>
</tr>
<tr>
<td>400</td>
<td>GRAVEL: greenish black (5G Y 2/1); 100% gravel.</td>
</tr>
<tr>
<td>425</td>
<td>ML</td>
</tr>
<tr>
<td>450</td>
<td>ML</td>
</tr>
<tr>
<td>475</td>
<td>ML</td>
</tr>
<tr>
<td>500</td>
<td>SP</td>
</tr>
<tr>
<td>525</td>
<td>ML</td>
</tr>
<tr>
<td>550</td>
<td>ML</td>
</tr>
<tr>
<td>575</td>
<td>ML</td>
</tr>
<tr>
<td>600</td>
<td>ML</td>
</tr>
<tr>
<td>620</td>
<td>Total depth of borehole was 620 feet below ground surface.</td>
</tr>
</tbody>
</table>

SILT: greenish gray (5G 6/1); 100% soft, non-plastic; 30% sand from 532 - 540 feet bgs.
SILT: medium bluish gray (5B 5/1); soft, non-plastic; 5% sand.
SILT: greenish gray (5G 6/1); soft, non-plastic, trace fine grained sand.
What does NASA say?

- The small area of intense subsidence evident near Arbuckle in 2014 shows an uneven subsidence with time in Figure 3, totaling about 5” for the last half of 2014, but no subsidence in 2006 - 2010.
Figure 3
2006-2010

...but no subsidence in 2006 - 2010
...totaling about 5” for the last half of 2014
Thank-you!
Questions?

http://water.ca.gov/groundwater/

Photo Credit: Sue Graue