

Review of Boise Front Geothermal Monitoring Data for Water Year 2009 (October 1, 2008 – September 30, 2009)

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1. EXECUTIVE SUMMARY

Monitoring results for Water Year 2009 (WY09) showed that the total gross withdrawal from the four downtown Boise geothermal district heating systems was 614.7 million gallons (mgal), which was 72.0 mgal less than in Water Year 2008 (WY08). The net withdrawal for WY09 was 207.6 mgal, which was 28.0 mgal less than the net withdrawal in WY08. Thus, the net withdrawal was 12% less in WY09 than in WY08. About 66% of the water withdrawn in WY09 was re-injected.

Water level¹ trends are most useful in the four non-pumping wells (BLM, Kanta, BGL #1, and BWSWD #3). Historically, the BLM well has been the primary monitoring well for the downtown Boise Geothermal system. In 2009, the maximum and minimum values increased 2.4 feet and 3.0 feet, respectively. Kanta's maximum and minimum water levels increased 2.6 feet and 3.0 feet, respectively from WY08 to WY09. The maximum water level for City of Boise's BGL#1 was the same in WY09 as it was in WY08; the minimum water level value was 2.3 feet higher in WY09. Although the maximum water level for BGL#1 did not increase, the length of time that the water level was more than 10 feet above the measuring point increased from 154 days in WY08 to 203 days in WY09. In 2009, the datalogger in BWSWD #3 quit working on July 31, 2009, and was out of operation for the remainder of the water year. Consequently, the maximum value in WY09 was not captured. The minimum water level was 0.6 ft higher in WY09 than in Water Year 2007 (WY07) (WY08's minimum value was unusually low compared to the historic values). The increasing water level trends in these wells coincide with the overall decrease in net withdrawals in WY09.

Because of the limited use of the Capitol Mall Production well in WY09 due to the construction on the State's Capitol building, there were no monthly supply temperatures that met the minimum requirement of being preceded by 8 hours of discharge rates over 300 gallons per minute. Water temperatures at BWSWD have fluctuated slightly over the last four years with the maximum temperatures in WY09 being a little higher than those in WY07 and WY08. The City of Boise's maximum supply water temperature was about the same in WY09 as in WY08, and the minimum value in WY09 was slightly higher than in WY08.

The total withdrawal of low temperature geothermal water in Ground Water District 63-S (GWD63-S) in WY09 was 175.7 mgal, which was 22.6 mgal less than in WY08 (which equates to a decrease of 11%). Interestingly, all of the GWD63-S wells that were in operation in FY09 had increases in withdrawals, except the Terteling Windsock well,

¹For flowing wells, pressure readings were converted to the equivalent feet below measuring points.

which had a large decrease of 40.3 mgal.

All of the wells in GWD63-S showed increasing trends in the maximum water levels in WY09. These trends are consistent with the overall decrease in total withdrawal. As it has been observed and documented in the past, the aquifer pressures/water levels in the GWD63-S wells respond quickly to changes in withdrawals from District wells.

2. DOWNTOWN BOISE/HARRIS RANCH

Withdrawals and Re-Injection

In WY09, gross and net withdrawals from the four downtown Boise district heating systems were 614.7 mgal and 207.6 mgal, respectively (Table 1 and Figure 1). The gross withdrawal was 72.0 mgal less in WY09 than in the previous water year. The net withdrawal was 28.0 mgal less, which was a decrease of 12% from the previous water year. About 66% of the fluids were re-injected.

All four heating systems had decreases in withdrawals in WY09. The Capitol Mall and Veterans Administration had large decreases: 31% and 18% respectively. Boise Warm Springs Water District and the City of Boise had small decreases in withdrawals: 3% and 2% respectively. The Capitol Mall used less water in WY09 because the system was not needed as much during the construction on the State's Capitol building.

Table 1. Withdrawals¹ from the four district geothermal heating systems in the downtown Boise area for Water Year 2009 (October 1, 2008 through September 30, 2009).

System	Gross Withdrawals ¹ for WY09 (million of gallons) and percent change from WY08 to WY09	Net Withdrawals ² for WY09 (million of gallons) and percent change from WY08 to WY09
Boise Warm Springs Water District	207.5 (-3%)	207.5 (-3%)
Capitol Mall	56.7 (-31%)	0 (NC ³)
City of Boise	191.2 (-2%)	0.03 (-99%)
Veterans Administration	159.3 (-18%)	0 (NC ³)
Total	614.7 (-12%)	207.6 (-12%)

¹These numbers contain some degree of uncertainty which is typically associated with measurement equipment and methods. Therefore, the amounts are being reported in millions with one decimal place.

²Net Withdrawals equal Gross Withdrawals minus Injection amounts.

³NC = No change.

Water Levels in the BLM, BWSWD, Kanta, City of Boise, and Harris Ranch Wells

Water level trends are most useful in the four non-pumping wells (BLM, BWSWD#3, Kanta, and BGL #1). Historically, the BLM well has been the primary monitoring well for the downtown Boise Geothermal system. In 2009, the maximum and minimum values increased 2.4 feet and 3.0 feet, respectively (Figure 2).

In 2009, the datalogger in BWSWD #3 quit working on July 31, 2009, and was out of operation for the remainder of the water year. Consequently, the maximum value in WY09 was not captured (Figures 3 and 4). The minimum water level was 0.6 ft high in WY09 than in WY07 (WY08's minimum value was unusually low compared to the historic values).

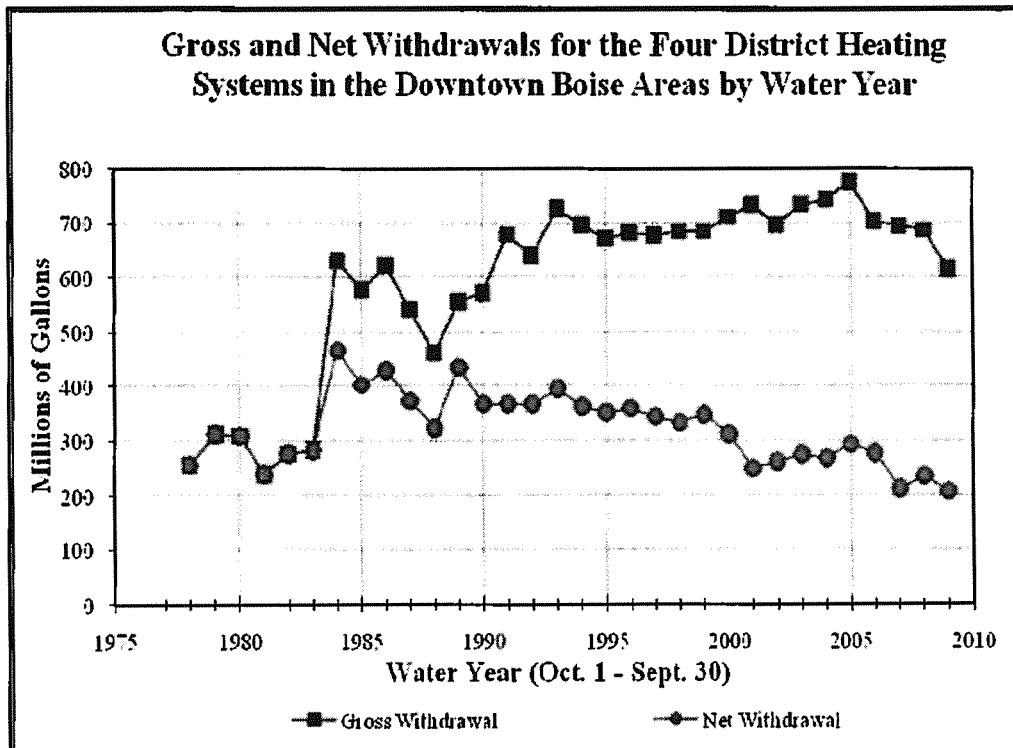


Figure 1. Gross and net withdrawals for the four district heating systems in the downtown Boise area for water years 1978 through 2009.

The Kanta well's maximum and minimum water levels increased 2.6 feet and 3.0 feet, respectively, from WY08 to WY09 (Figure 5).

The maximum water level for the City of Boise's BGL#1 was the same in WY09 as it was in WY08; the minimum water level value was 2.3 feet higher in WY09 (Figure 6). Although the maximum water level did not increase, the length of time that the water level was more than 10 feet above the measuring point increased from 154 days in WY08 to 203 days in WY09.

The increasing water level trends in these four wells coincide with the overall decrease in net withdrawals in WY09.

Water levels in the Harris Ranch West and East wells showed overall increasing trends in WY09 (Figure 7), but these wells have distinctly different water level signatures than have the wells in the four downtown systems.

There were no water level measurements taken in the Old Penitentiary well in WY09.

Water Supply Temperatures for the Capitol Mall, BWSWD and City of Boise.

The Capitol Mall Production well was in limited use in WY09 because of construction on the State's Capitol building. Consequently, there were no monthly supply temperature readings that met the minimum requirement of being preceded by 8 hours of discharge rates over 300 gallons per minute (Figure 8).

Water temperatures were available for the BWSWD from May 2005 to September, 2009 (Figure 9). The maximum temperatures, which occur in the late summer each year, were in the range of 179.3 to 180 degrees Fahrenheit in WY05, WY06, and WY09. The maximum water temperatures were slightly lower in WY07 and WY08. Interestingly, the lower maximum water temperatures in WY07 coincide with the lowest annual withdrawal total for BWSWD since Water Year 1988.

The City of Boise's maximum supply water temperature was about the same in WY09 as in WY08 (Figure 10). The minimum value in WY09 was slightly higher than in WY08.

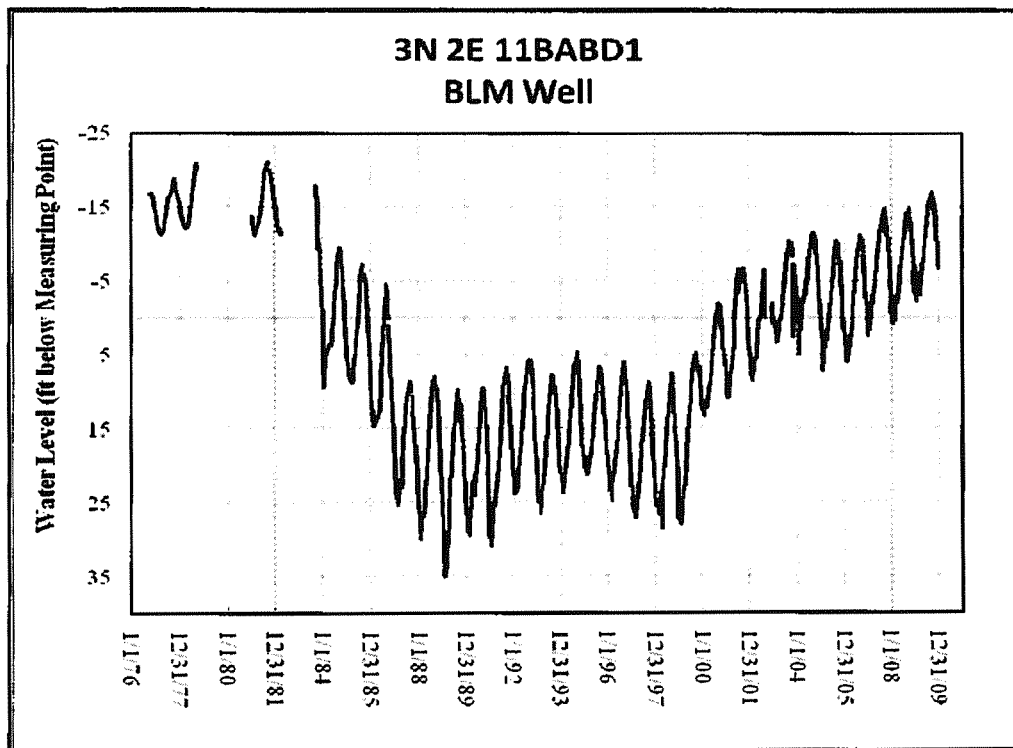


Figure 2. Water level hydrograph for the BLM well.

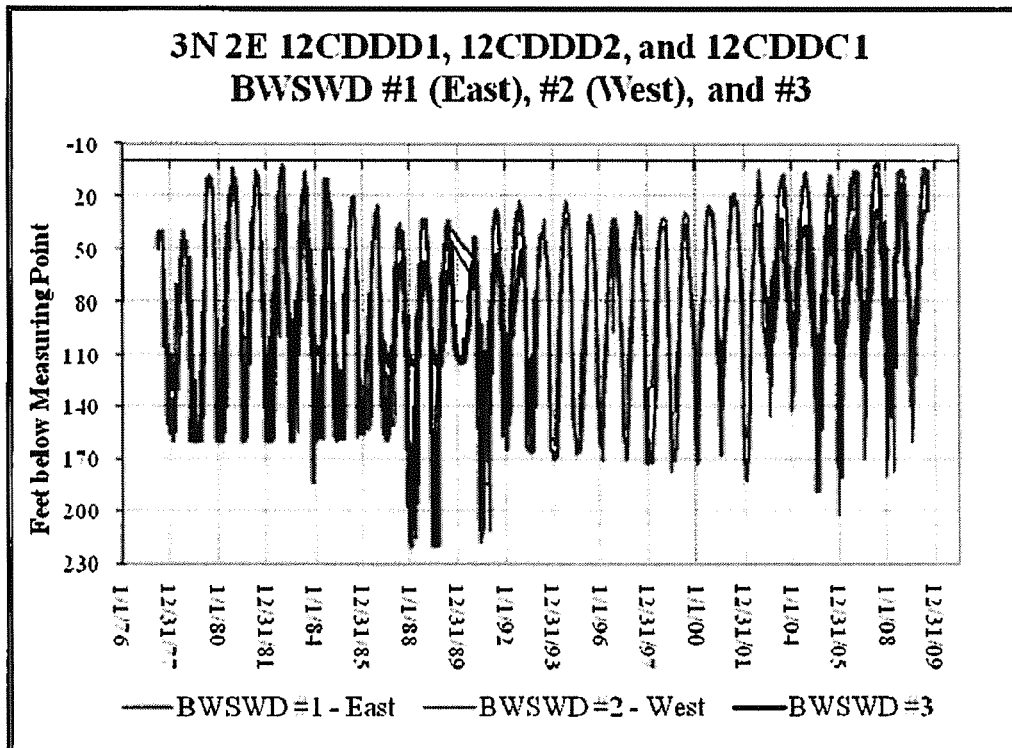


Figure 3. Water level hydrographs for the Boise Warm Springs Water District (BWSWD) wells.

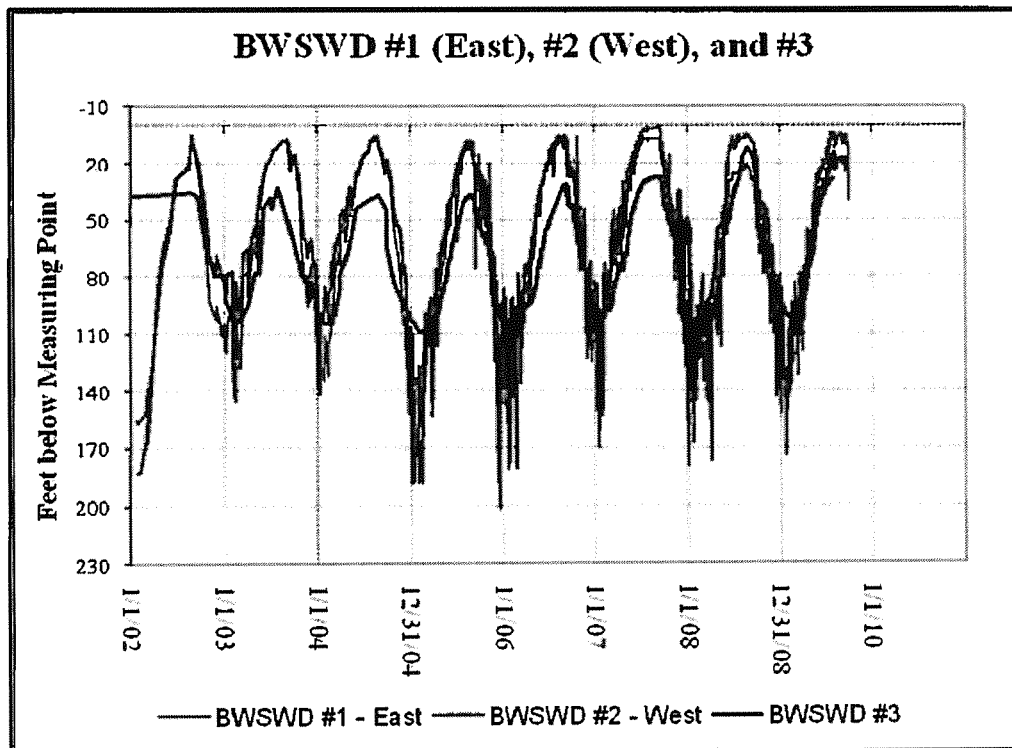


Figure 4. Water level hydrographs for the Boise Warm Springs Water District (BWSWD) wells, January 2002 to September 2009.

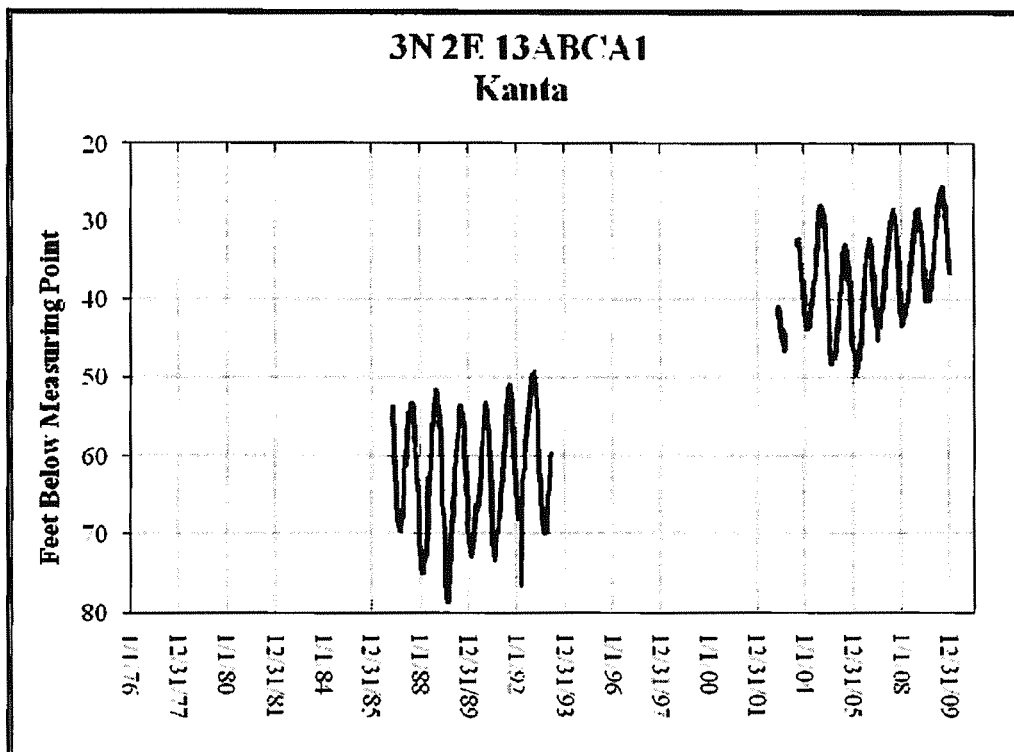


Figure 5. Water level hydrograph for the Kanta well.

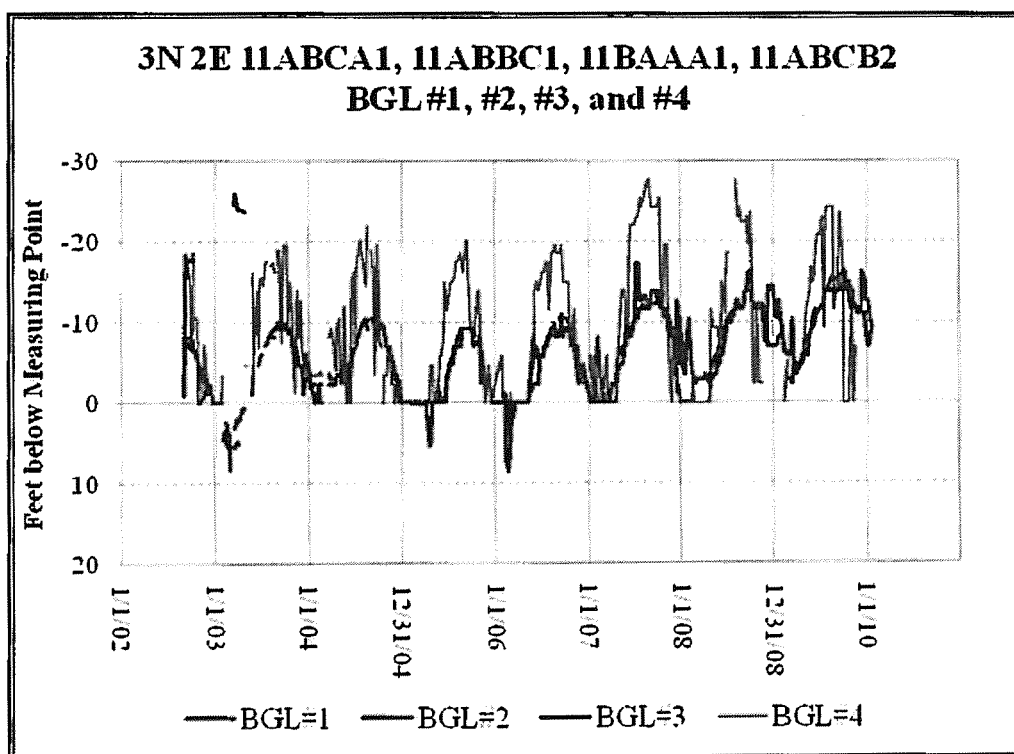


Figure 6. Water level hydrographs for the City of Boise's BGL #1, #2, #3, and #4 wells.

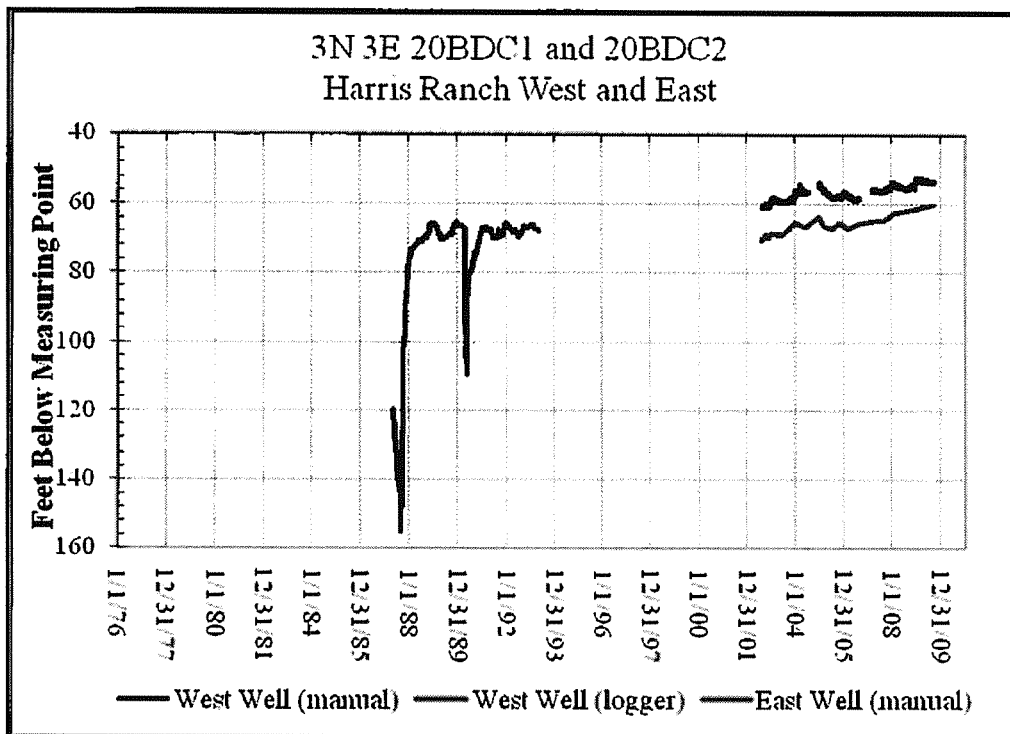


Figure 7. Water level hydrographs for the Harris Ranch wells.

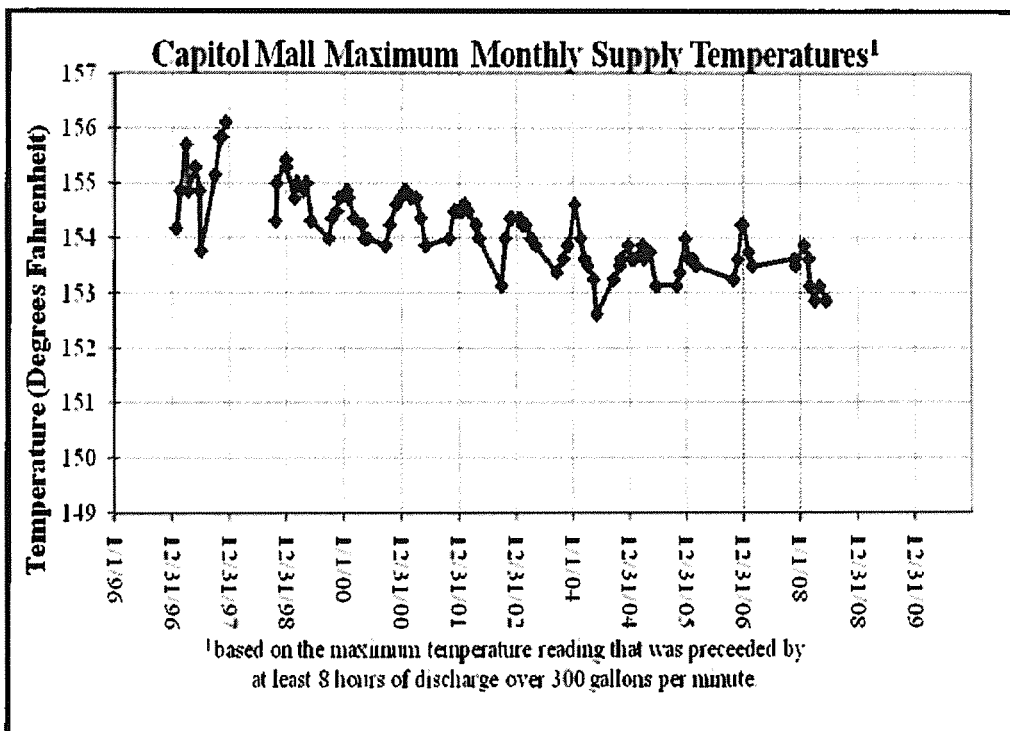


Figure 8. Maximum monthly water supply temperatures for the Capitol Mall geothermal system. There were no qualifying monthly supply temperatures in WY2009.

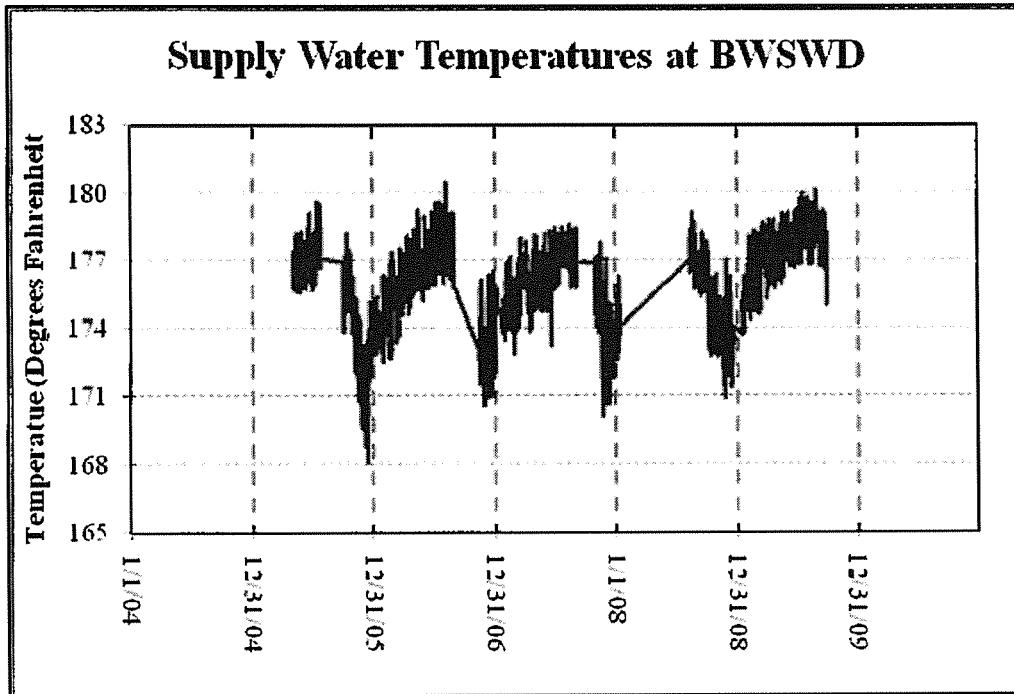


Figure 9. Water supply temperatures for the Boise Warm Springs Water District.

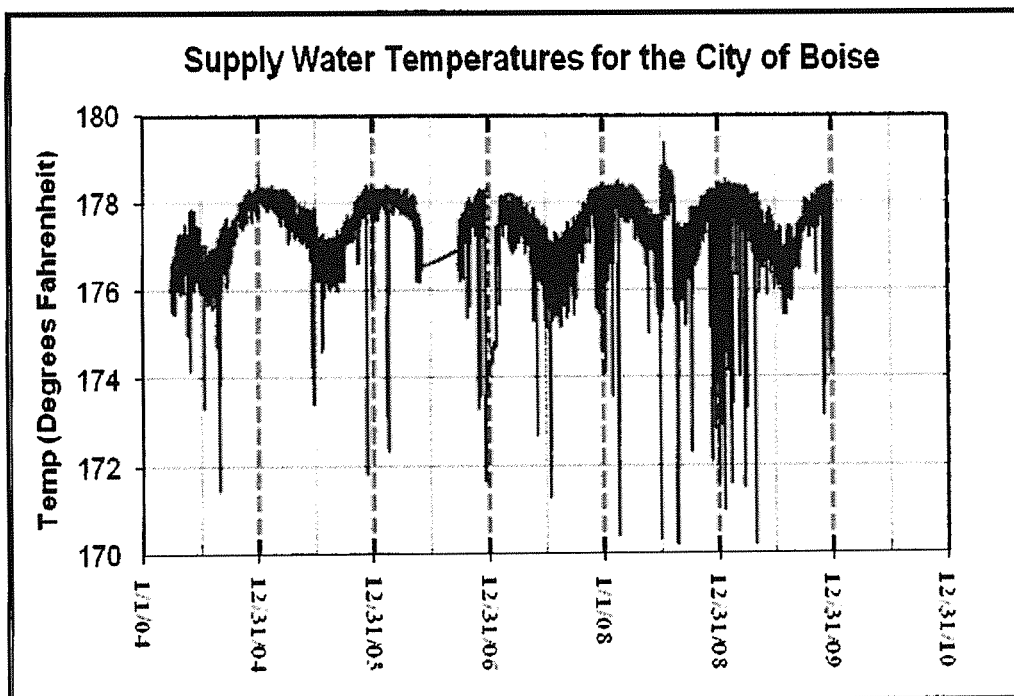


Figure 10. Water supply temperatures for the City of Boise's geothermal system. Readings less than 170 degrees Fahrenheit were removed from the dataset.

3. STEWART GULCH GROUND WATER DISTRICT 63-S

Withdrawals

The total withdrawal of low temperature geothermal water in GWD63-S in WY09 was 175.7 mgal (Figure 11). This amount was 22.6 mgal less than the withdrawal in WY08 (Table 2). This change was an 11% decrease from WY08 to WY09. Interestingly, all of the GWD63-S wells that were in operation in FY09 had increases in withdrawals, except the Terteling Windsock well, which had a large decrease of 40.3 mgal.

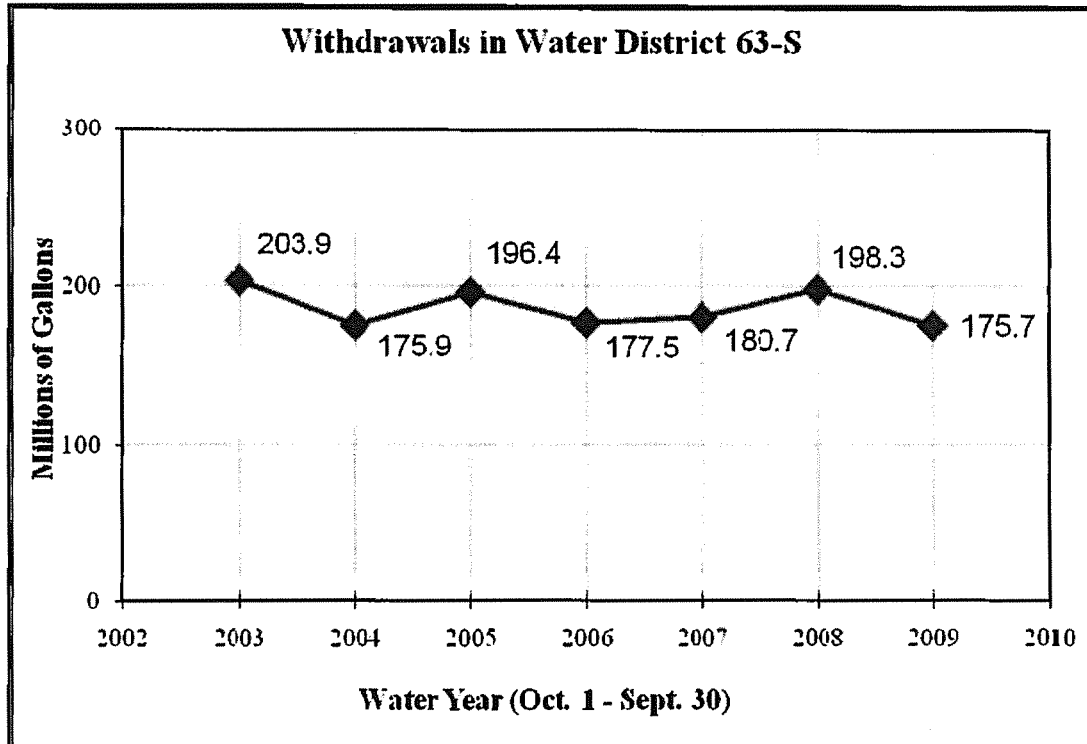


Figure 11. Geothermal withdrawals in Stewart Gulch Water District 63-S for Water Years 2003-2009.

Water Levels

All of the wells in GWD63-S showed overall upward trends in their maximum water levels in WY09 (Figures 12-19). These trends are consistent with the decrease in total withdrawal in the District in WY09. As it has been observed and documented in the past, the aquifer pressures/water levels in GWD63-S respond quickly to changes in withdrawal in District wells.

The Edwards well had an increase in the maximum water level of 3.5 feet from WY08 to WY09 (Figure 12). However the minimum water level actually decreased 0.9 feet in WY09.

Table 2. Withdrawals¹ from Stewart Gulch Ground Water District 63-S geothermal wells for Water Year 2009 (October 1, 2008 through September 30, 2009).

Well	Withdrawals in WY09 (millions of gallons)	Change from WY09 (millions of gallons)	Percent Change from WY09
TTCI Tiegs (Triangle)	0	0	0
TTCI Silkey (Shed)	5.8	+0.8	+16%
TTCI House (Office)	0.8	+0.2	+33%
Edwards Greenhouse	63.7	+3.7	+6%
Terteling Ranch Windsock	65.4	-40.3	-38%
Terteling Ranch Pool	15.8	+2.7	+21%
Quail Hollow (Tee Ltd) Upper	19.4	+9.6	+98%
Quail Hollow (Nibbler) Lower	<0.1	+<0.1	+27%
Whitehead	4.8	+0.7	+17%
Total	175.7	-22.6	-11%

¹These numbers contain some degree of uncertainty which is typically associated with measurement equipment and methods. Therefore, the amounts are being reported in millions with one decimal place.

The TTCI Tiegs (Triangle) well showed similar patterns with the maximum water level increasing 4.2 feet from WY08 to WY09 (Figure 13). The TTCI House (Office), and Silkey (Shed) also had similar water level trends (Figures 14 and 15).

The Quail Hollow wells showed increases in the maximum water levels (Figures 16 and 17). The minimum water levels for the Quail Hollow wells declined a small amount in WY09.

Both the maximum and minimum water levels in the Terteling Ranch Windsock and Pool wells increased in WY09 (Figures 18 and 19).

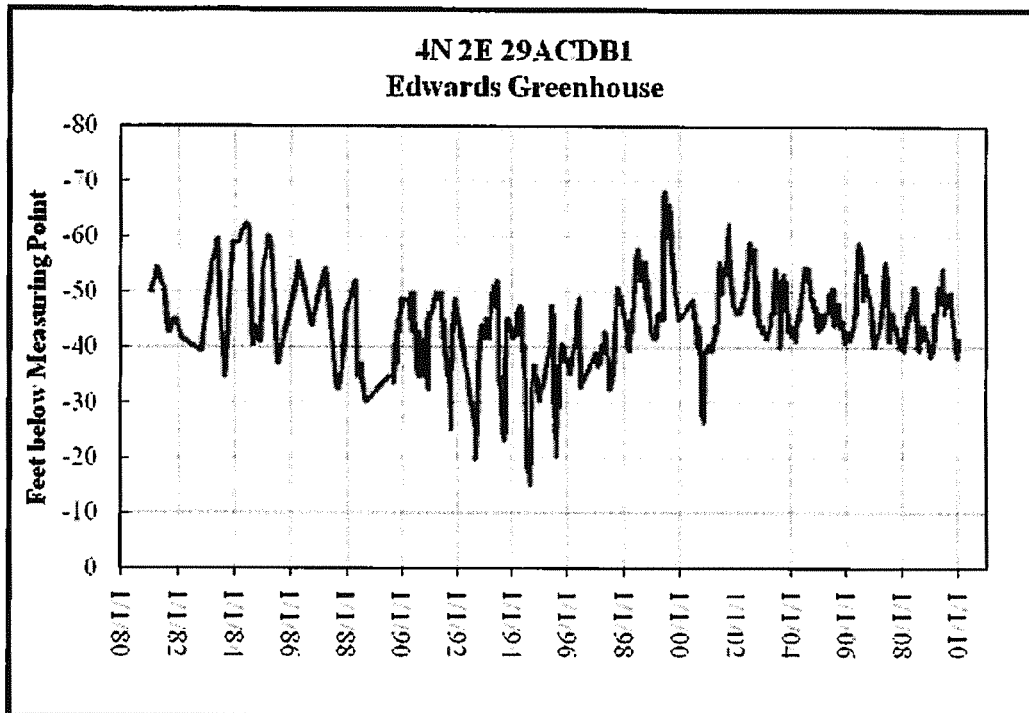


Figure 12. Water level hydrograph for the Edwards Greenhouse well.

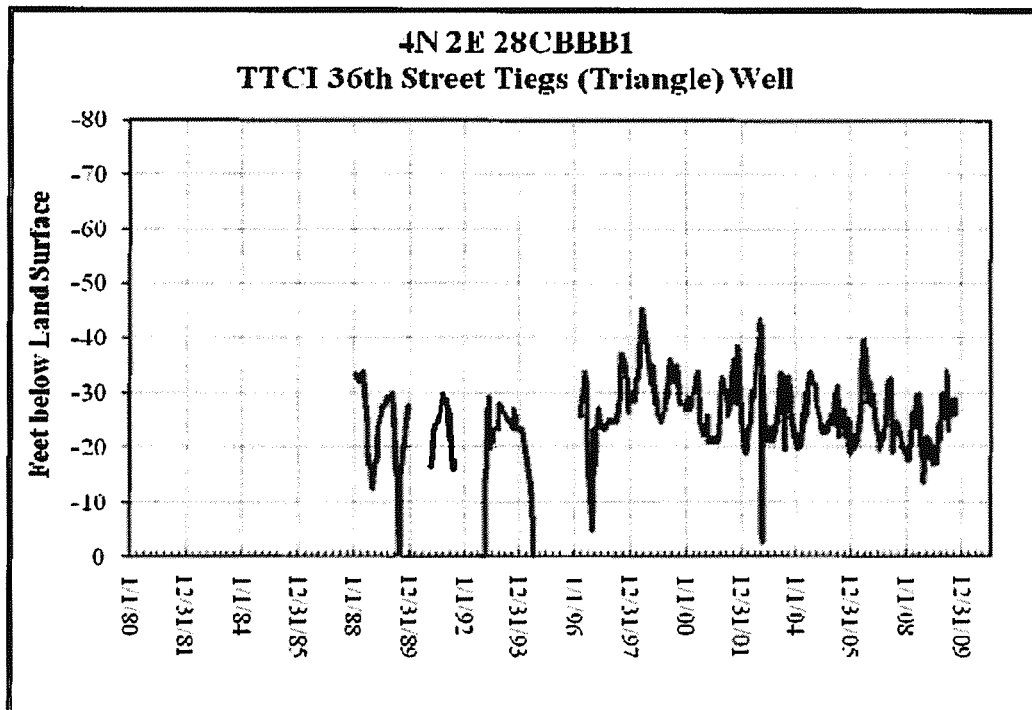


Figure 13. Water level hydrograph for the TTCI 36th Street Tiegs (Triangle) well.

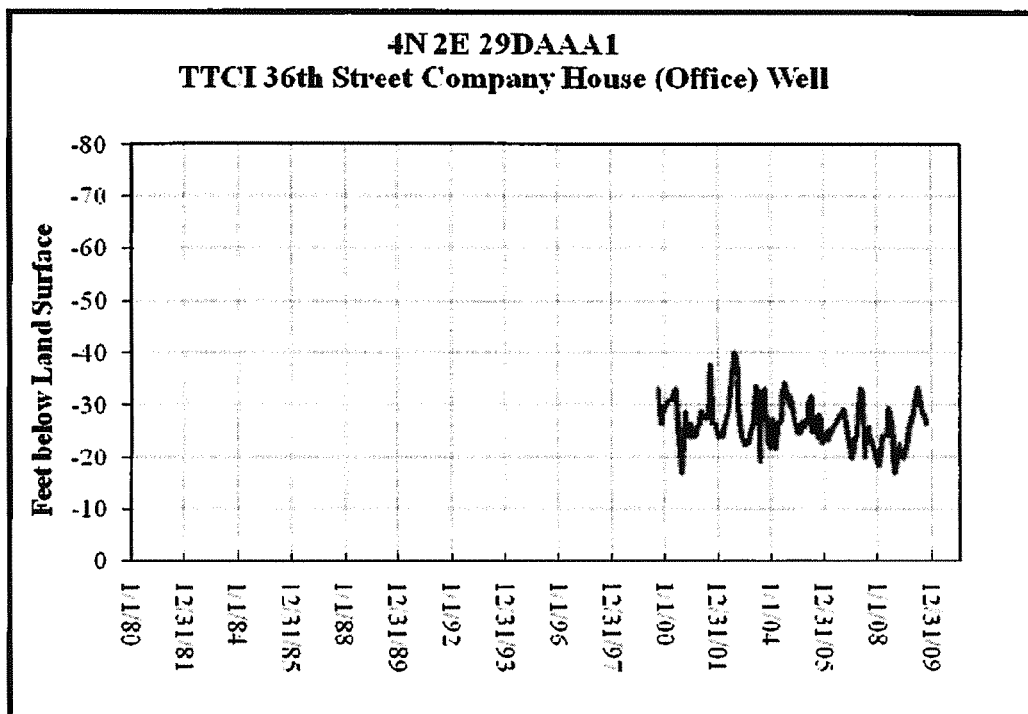


Figure 14. Water level hydrograph for the TTCI 36th Street House (Office) well.

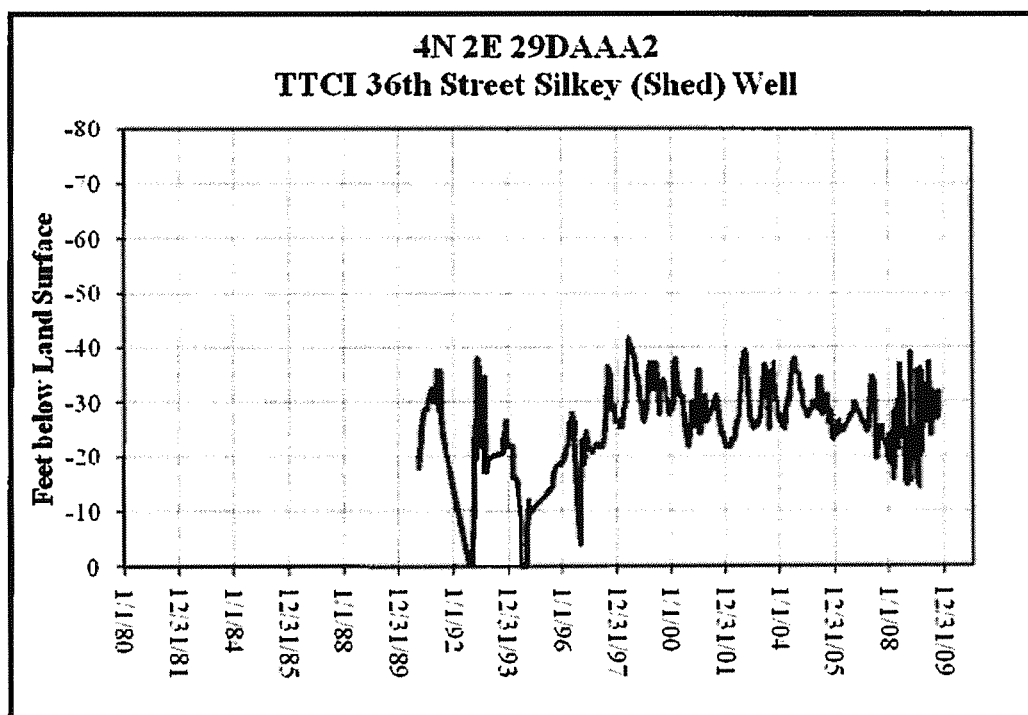


Figure 15. Water level hydrograph for the TTCI 36th Street Silkey (Shed) well.

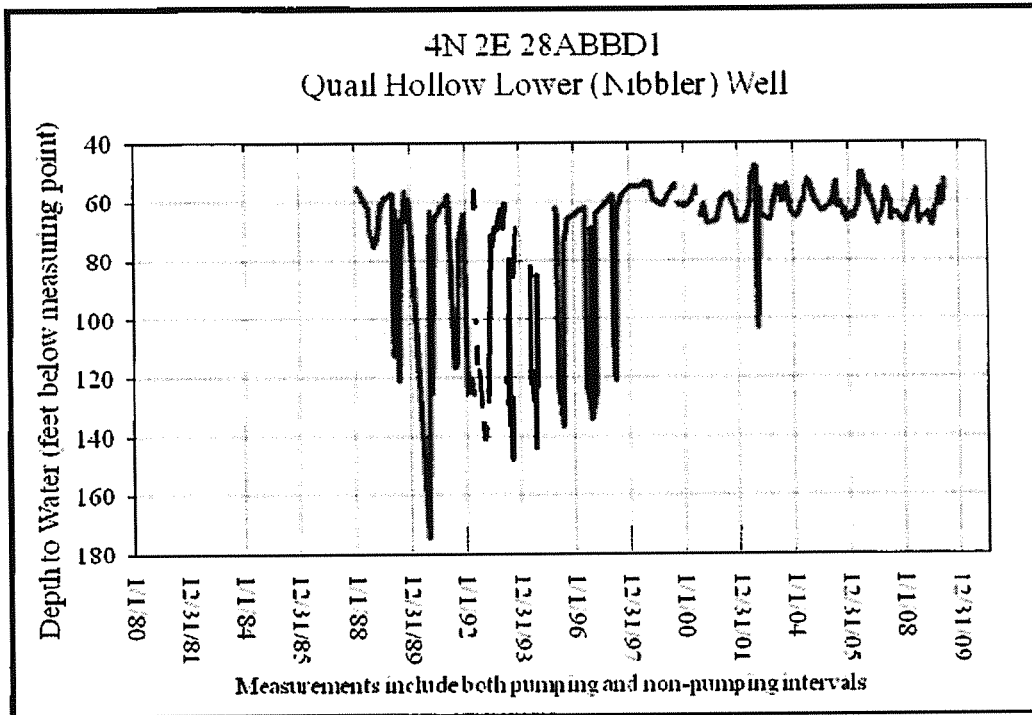


Figure 16. Water level hydrograph for the Quail Hollow Lower well.

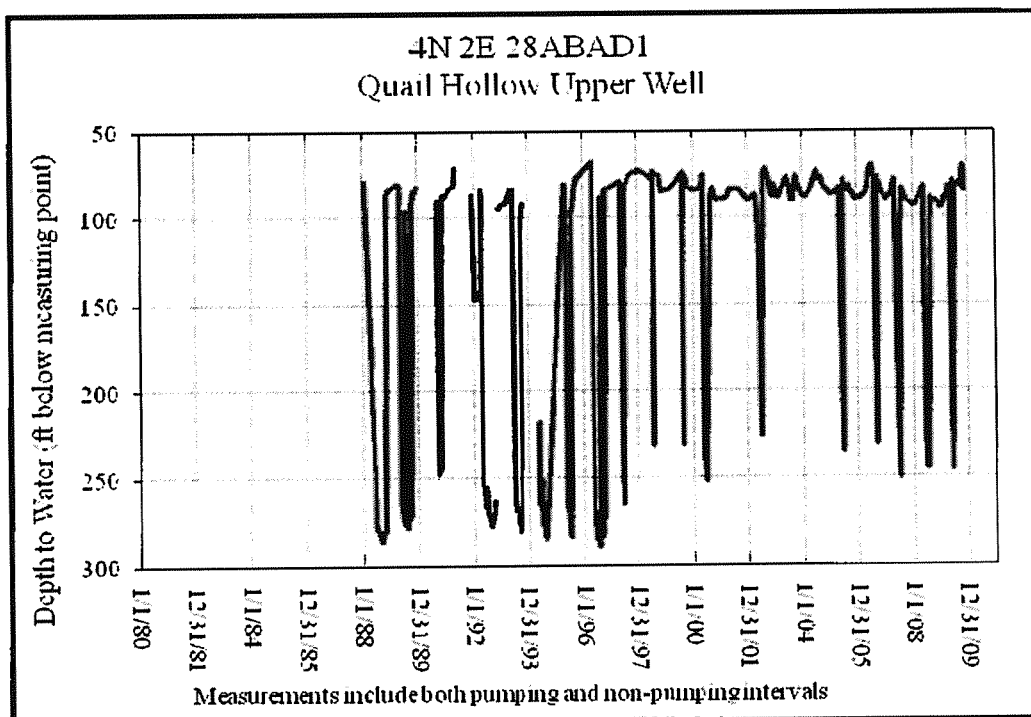


Figure 17. Water level hydrograph for the Quail Hollow Upper well.

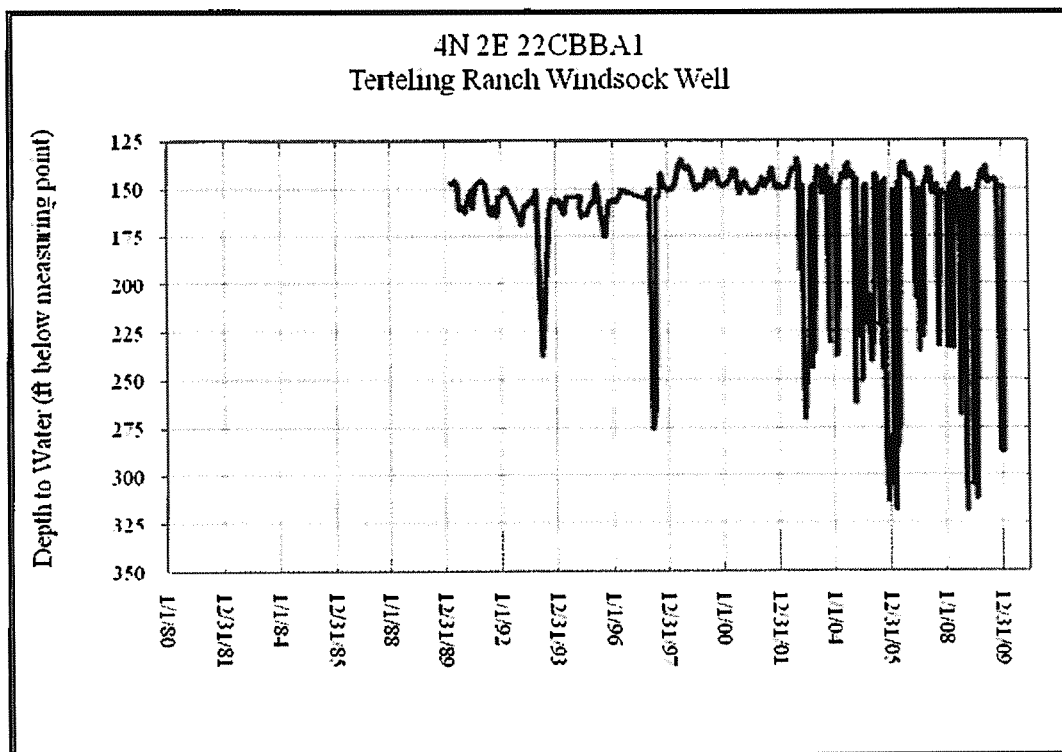


Figure 18. Water level hydrograph for the Terteling Ranch Windsock well.

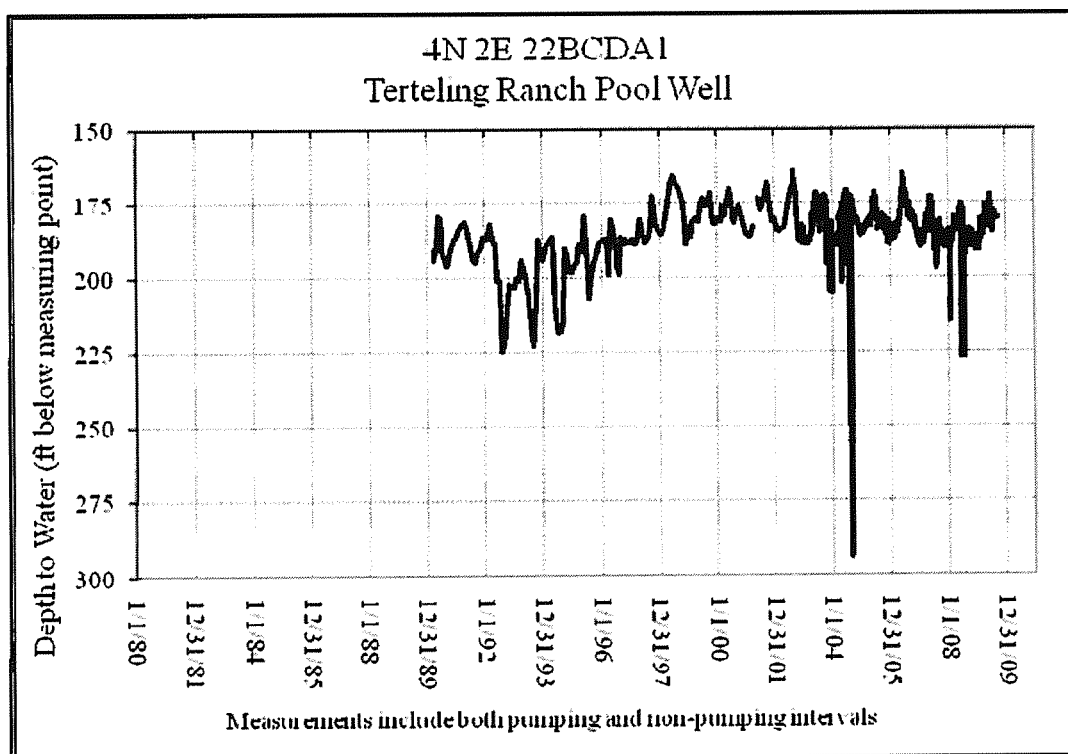


Figure 19. Water level hydrograph for the Terteling Ranch Pool well.