GEOSCIENCE

June 22, 2015

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Delivered By E-mail

Subject: Monterey Peninsula Water Supply Project – Test Slant Well Long Term Pumping Test and Coastal Development Permit #A-3-MRA-14-0050

Dear Tom:

In compliance with Special Condition 11 of Coastal Development Permits (CDPs) A-3-MRA-14-0050 and 9-14-1735, CalAm has been monitoring daily water and TDS levels in a number of monitoring wells (MW) in the near and far vicinity of the Test Slant Well (TSW). At the compliance point for Special Condition 11 under the CDPs (MW-4), groundwater level and TDS monitoring began on 20-Feb-15 in the deepest monitoring well (MW-4D), and on 9-Mar-15 in the shallow (MW-4S) and middle (MW-4M) monitoring wells. The long-term Test Slant Well pumping test began at 15:20 pm on 22-Apr-15 at a discharge rate of approximately 2,000 gpm. On June 5th The water level trends were declining and approached 1 foot in MW-4. As a result, the test slant well was voluntarily turned off on June 5th to allow for review of further data.

On 10-June-15, the Hydrogeologic Working Group (HWG) sent a letter to your office discussing water level and TDS trends from the start of pumping to 21-May-15. The general consensus of the HWG based on examination of fluctuations and trends in water levels, was that the observed fluctuations and downward trends were not due to Test Slant Well pumping but rather the result of irrigation pumping cycles and/or regional seasonal fluctuations. In addition, the HWG found that, groundwater levels in MW-4M are higher at the coast then inland in the 180-FTE aquifer which suggest that the slight increase in electrical conductivity in MW-4M is not associated with test slant well pumping but rather from historical seawater intrusion from the inland gradient or seasonal fluctuations. After reviewing the Long Term Monitoring Report No. 7 encompassing the

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period 3-Jun-15 to 10-Jun-15, the HWG requested data through 17-Jun-15 for further review. The following summarizes our comments on the additional data review.

1.0 HWG ASSESSMENT OF MONITORING WELL DATA 10-APR-15 TO 17-JUN-15.

1.1 General

Groundwater elevations in all monitoring wells have been monitored daily using downhole transducers and/or hand measurements. Figures 1-1, 1-2 and 1-3 show groundwater elevations for monitoring Wells MW-3, MW-4 and MW-5 respectively for the time period before start of long term pumping to 12 days after pumping stopped. For scaling considerations, MW-5 water levels were split into two figures; 1-3a (MW-5S) and 1-3b MW-5 (M,D). Similarly, Figures 2-1, 2-2 and 2-3 show EC values for monitoring Wells MW-3, MW-4 and MW-5 respectively. General west to east profiles of groundwater levels for several time periods are shown in Figure 3 for periods of pumping and no pumping. As MW-4 is the point of compliance as identified in Special Condition 11 of the CDP, water levels and TDS variations are discussed in detail for this well. In addition, water levels and EC in the three monitoring wells within the MW-4 cluster (S,M,D) respond somewhat differently over time and the HWG felt it necessary to discuss these trends and fluctuations separately for each aquifer zone. Table 1a and 1b below summarize water level and EC values for the 68 day period 10-Apr-15 to 17-Jun-15 followed by a detailed discussion of each aquifer zone.

Monitoring Well	Pre-Pumping April 10	Start of Pumping April 22	End of Pumping June 5	June 17	Difference June 17 – April 10
MW-4S	4.3	4.2	3.3	3.3	-1.0
MW-4M	0.7	0.3	-1.3	-1.4	-2.1
MW-4D	-6.2	-7.2	-10.5	-10.5	-4.3

Table 1a. Summary of Water Level Elevations (ft NAVD88) for MW-4 (April-June 2015)

Monitoring Well	Pre-Pumping April 10	Start of Pumping April 22	End of Pumping June 5	June 17	Difference June 17 – April 10
MW-4S	10,500 (6,720)	10,000 (6,400)	9,000 (5,760)	9,000 (5,760)	-1,500 (-960)
MW-4M	29,500 (18,880)	30,000 (19,200)	31,000 (19,840)	31,400 (20,096)	1,900 (1,216)
MW-4D	41,200 (26,368)	41,500 (26,560)	41,400 (26,496)	41,500 (26,560)	300 (192)

Table 1b. Summary of EC Values, μs/cm (TDS, mg/L) for MW-4 (April-June 2015)

1.2 Groundwater Elevations and TDS for MW-4

In general, aquifer confinement is highest in the deepest zone, less in the middle zone and least confined in the upper zone. This is clearly seen in the fluctuations of water levels in Figure 1-2. MW-4S representing the Dune Sand aquifer has very muted water level responses reflecting a higher storativity value approaching the aquifer's effective porosity (i.e. specific yield). Daily tidal fluctuations are indistinguishable in this layer. The middle zone (MW-4M) representing the 180-FTE aquifer shows the pressure response to daily tidal fluctuations although somewhat less than the confined lower zone. In the deepest zone, 400 ft aquifer (MW-4D), the two daily tidal peaks are clearly visible reflecting a high degree of confinement.

1.2.1 Groundwater Levels – MW-4S

Examination of the water level response in the shallow aquifer shows that a straight line can be drawn between the first point (10-Apr-15) and the last point (17-Jun-15) with a declining slope of 0.015 ft/day. There are some slight oscillations of the water levels with a period of approximately one week which is assumed to correspond to water level recovery due to lack of irrigation pumping on the weekends (see the blue vertical bars in Figure 1-2 representing Sundays). The oscillations and declining trend are evident before test slant well pumping started, during pumping, and after pumping stops.

1.2.2 Groundwater Levels – MW-4M

The following observation is based on average trends in the transducer data shown on Figure 1-2. Tidal fluctuations are clearly seen in the plot for the entire record. Levels in MW-4M appear to have a more irregular series of trends than MW-4S. Based on trends between the start of data shown on the plot (10-Apr-15) to 10-May-15, there is a declining slope that is relatively constant at approximately 0.04 ft/day. From the 10^{th} to the 18^{th} of May, there is a flattening of slope followed by a downward trend of approximately 0.09 ft/day between May 18^{th} and 28^{th}. After May 28^{th} to the end of data, June 17^{th}, data is relatively flat.

1.2.3 Groundwater Levels – MW-4D

MW-4D is a confined aquifer with a thick clay layer separating this zone from upper aquifers (Shallow-Dune Sand and Middle 180-FTE). Data measurements do not show any influence in this zone from test slant well pumping even as close as MW-1. The daily tidal fluctuations are very pronounced as can be seen in Figure 1-2 and the weekly oscillation cycle is believed to be associated with inland irrigation pumping cycles. The overall general trend of the water levels is downward with periodic steepening and flattening as was seen in MW-4M but more pronounced.

1.3 TDS concentrations in MW-4

The level of electrical conductivity (EC) which is an indicator of total dissolved solids (TDS) in the MW-4 monitoring wells have been monitored daily through use of dedicated downhole transducers with electrical conductivity probes. Figure 2-2 shows EC values in MW-4 prior to the start of long term pumping and after cessation of pumping on 5-Jun-15 for all three MW-4 monitoring wells (S,M,D). The electrical conductivity in MW-4S continues to show a slightly decreasing trend, of approximately 1,800 us/cm (1,152 mg/L) in approximately 68 days (16.9 mg/L per day). The EC in MW-4M has increased approximately 2,000 us/cm (1,280 mg/L) in 68 days (18.8 mg/L per day). The electrical conductivity in MW-4D has essentially remained the same. The increase in salinity in MW-4M is most probably due historical inland gradients and historical seawater intrusion identified in the 180-FTE by others.

2.0 POTENTIAL FACTORS INFLUENCING WATER LEVELS AND TDS FLUCTUATIONS AND TRENDS

Figure 1-2 shows groundwater elevation plots in MW-4 from 10-Apr-15 to 17-Jun-15 for all three zones (S,M,D). Also, shown on the plot are precipitation amounts and the weekend (Sundays). As can be seen, slight recovery in water levels can generally be seen following weekends where no irrigation pumping is assumed. The precipitation events shown on Figure 1-2 do not directly correlate with water level fluctuations or trends most probably due to lag times associated between precipitation events and water level response.

2.1.1 Water Level Profiles

Figure 3 shows water level profiles from the test slant well area to MW-5 which is approximately 9,000 ft inland. The profiles show response of the 180-FTE aquifer before pumping during pumping, and after pumping stopped. Data show water levels are higher near the coast (+1 to +4 ft NAVD88) and decline moving inland (0 to -4 ft NAVD88). Also, when the test slant well is pumping, the water level in MW-3 is higher than at MW-4 but not as high as it is when the well is not operating. Even after stopping pumping, MW-4 continues to decline in response to regional pumping inland. Both MW-3M and MW-4M reflect how pressure responses move horizontally and vertically through the three-dimensional heterogeneous groundwater system due to the test pumping, regional pumping, and ocean tides. On the former, the different responses in wells MW-3M and MW-4M simply reflect different horizontal or vertical connectivity between the pumping well and the monitoring well.

2.1.2 Inland Pumping Can Have Far Reaching Impacts in Confined and Semi-Confined Aquifers (MW-4M, MW-4D, and MW-5).

The regional pumping signature in MW-4M and MW-4D could be the result of extractions miles inland in confined and semi-confined aquifer systems. In other words the pressure response in confined and semi-confined aquifer systems (e.g. 180 ft aquifer) may be transmitted from regional pumping wells located a significant distance from the coastal monitoring wells (even landward of the intrusion front). To examine whether recharge from precipitation could also be a contributing factor to water level responses in the MW-4 monitoring wells, precipitation from the Salinas station is shown on Figure 1-2.

It is also worthy to note that all three levels in MW-5 (S,M,D) located over 9,000 ft from the TSW show a steady declining trend due to regional pumping and/or seasonal fluctuations (see Figures 1-3a and 1-3b)

Additionally, regarding the potential "double-standard" of claiming impacts on CalAm's monitoring wells from inland pumping but lack of inland water level impacts from TSW pumping, the reason for this is that the TSW is located adjacent to the ocean and draws the vast majority of its water from the ocean (thus, minimal inland effects), whereas the inland regional pumping wells draw their water from the aquifers and not the ocean (thus, significant basin-wide water level drawdown effects).

3.0 HWG SUMMARY

Based on data collected before and after the Test Slant Well pumping between 10-Apr-15 to 17-Jun-15, the following is the consensus of the HWG:

- Based on the amplitude to daily water level responses to tidal fluctuations, the shallow aquifer is unconfined, the middle aquifer is semi-confined and the deep aquifer is confined.

- It appears that in MW-4M and MW-4D, the cycle of oscillations is approximately one week and corresponds to inland pumping cycles with no pumping on the weekends.

- Precipitation does not seem to directly impact MW-4 water level changes and a lag time may be involved in such changes.

- As the deeper aquifer zone (400 ft aquifer) does not seem affected by test slant well pumping even at close distances (e.g. MW-1), there is clear separation between this zone and aquifers providing water to the test slant well (Dune sand and 180-FTE) (see Test Slant Well Long Term Monitoring Report No. 7, dated 16-Jun-15).

- MW-4S shows a consistent declining trend of approximately 0.015 ft/day for the entire period of record April 10th to June 17th. Oscillations of the data appear to have an approximate seven day period with corresponds to the assumption of no weekend pumping (i.e. water levels appear to recover after Sunday).

- MW-4M appears to reflect outside influence not associated with the test slant well, which could include cyclic irrigation. The record shows various changes in slope which are not correlated with test slant well pumping and most likely are due to regional influences.

- Data show that the regional trends and fluctuation cycles in MW-4 are most likely due to inland pumping and/or seasonal fluctuations and are expected to continue.

- Groundwater levels in MW-4M are higher at the coast than inland (see Figure 3) validating the reported historical seawater intrusion identified in the 180-FTE by others. These conditions suggest that the slight increase in electrical conductivity in MW-4M is not associated with test slant well pumping. Further increases in TDS are anticipated as the result of regional inland groundwater production, which is not due to test slant well pumping.

- The Test Slant Well is physically located and likely producing primarily from the Dune Sand aquifer with a lesser amount from the 180-FTE aquifer, which is confirmed by the monitoring well data in the shallow and middle monitoring wells at MW-1 and MW-3.

- Even under a “worst case scenario” relating to factors/causes of the regional water level declines and slight changes in the downward trend of those declines (i.e. not caused by changes in inland pumping or outside influences), it seems clear from the data collected so far that if there is any drawdown at MW-4S and/or MW-4M – it is less than 0.5 feet and probably closer to 0.2 to 0.3 feet. Given an allowable drawdown of 1.5 feet, the water levels are well within the allowable limit.

Sincerely,

The Hydrogeologic Working Group (Dennis Williams, Tim Durbin, Martin Feeney, Peter Leffler)

Dennis Williams

Tim Durbin

Martin Feeney

Peter Leffler

Groundwater Elevation in MPWSP MW-3

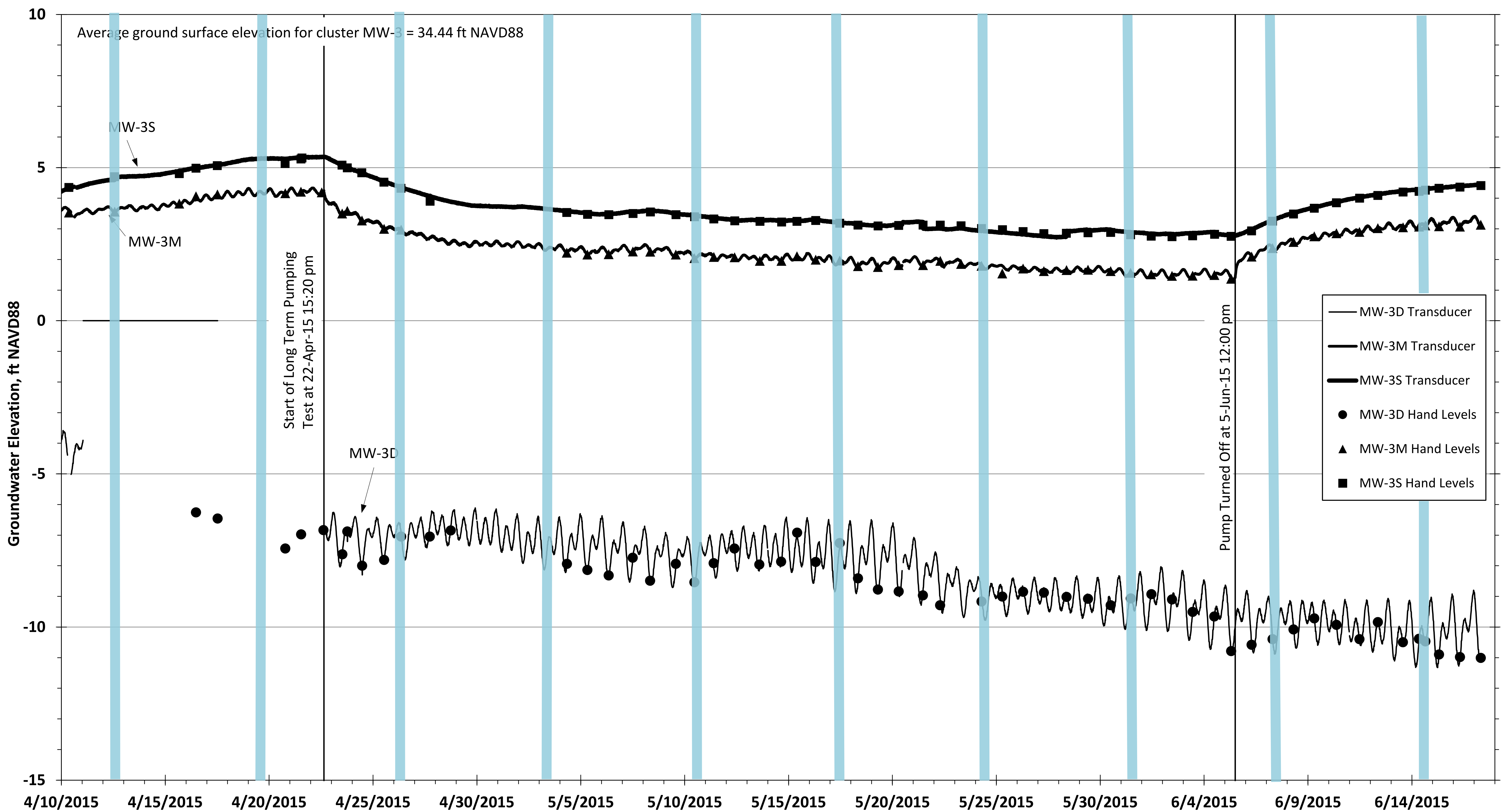

Figure 1-1

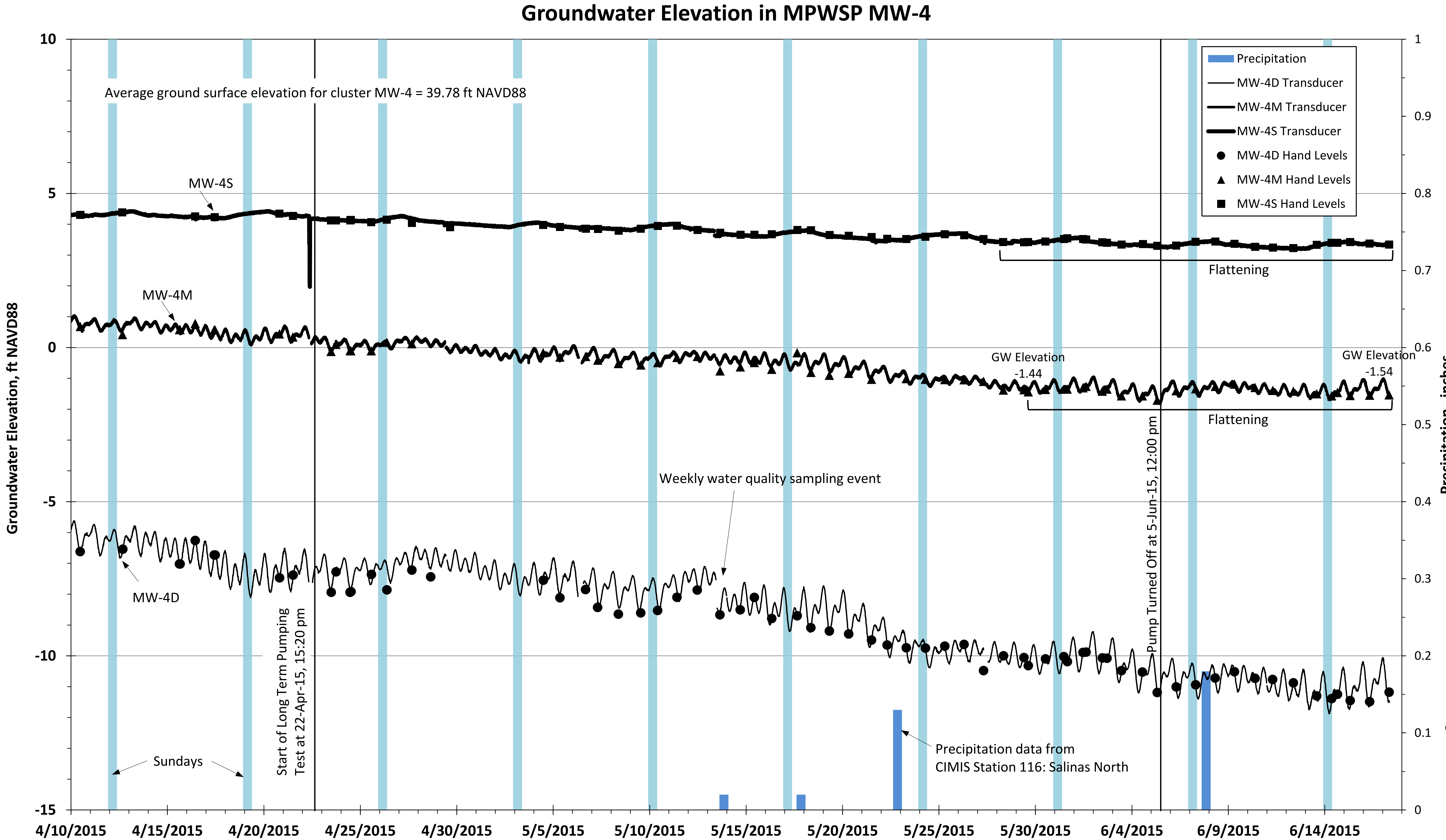
Groundwater Elevation in MPWSP MW-4
Average ground surface elevation for cluster MW-4 = 39.78 ft NAVD88
Precipitation
MW-4D Transducer
MW-4M Transducer
MW-4S Transducer
MW-4D Hand Levels
MW-4M Hand Levels
MW-4S Hand Levels
MW-4S
MW-4M
MW-4D
Flattening
Flattening
GW Elevation
-1.44
GW Elevation
-1.54
Weekly water quality sampling event
Start of Long Term Pumping
Test at 22-Apr-15, 15:20 pm
Pump Turned Off at 5-Jun-15, 12:00 pm
Sundays
Precipitation data from
CIMIS Station 116: Salinas North
Groundwater Elevation, ft NAVD88
Precipitation , inches
10
5
0
-5
-10
-15
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
4/10/2015
4/15/2015
4/20/2015
4/25/2015
4/30/2015
5/5/2015
5/10/2015
5/15/2015
5/20/2015
5/25/2015
5/30/2015
6/4/2015
6/9/2015
6/14/2015

Figure 1-2

Groundwater Elevation in MPWSP MW-5S

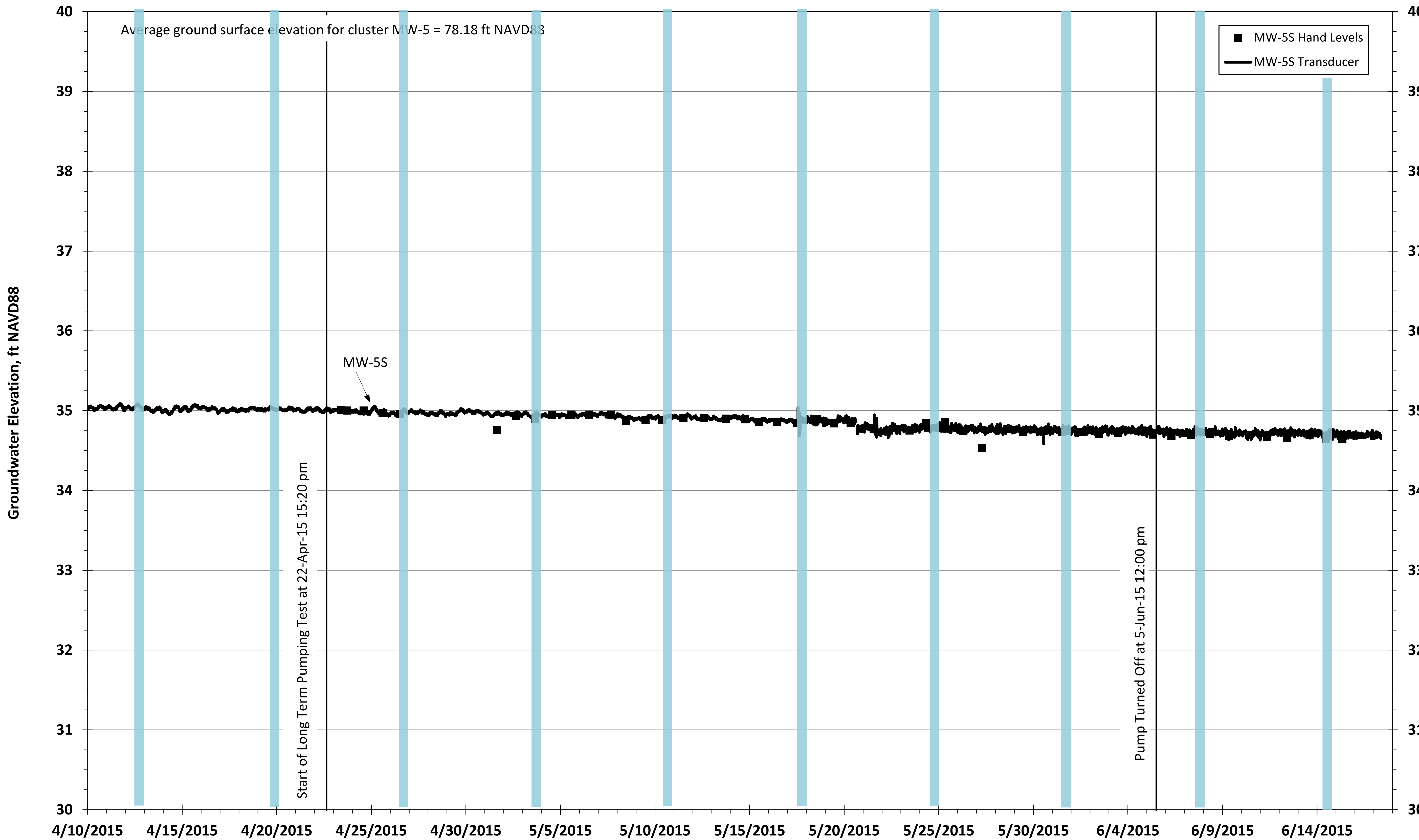

Figure 1-3a

Groundwater Elevation in MPWSP MW-5M and MW-5D

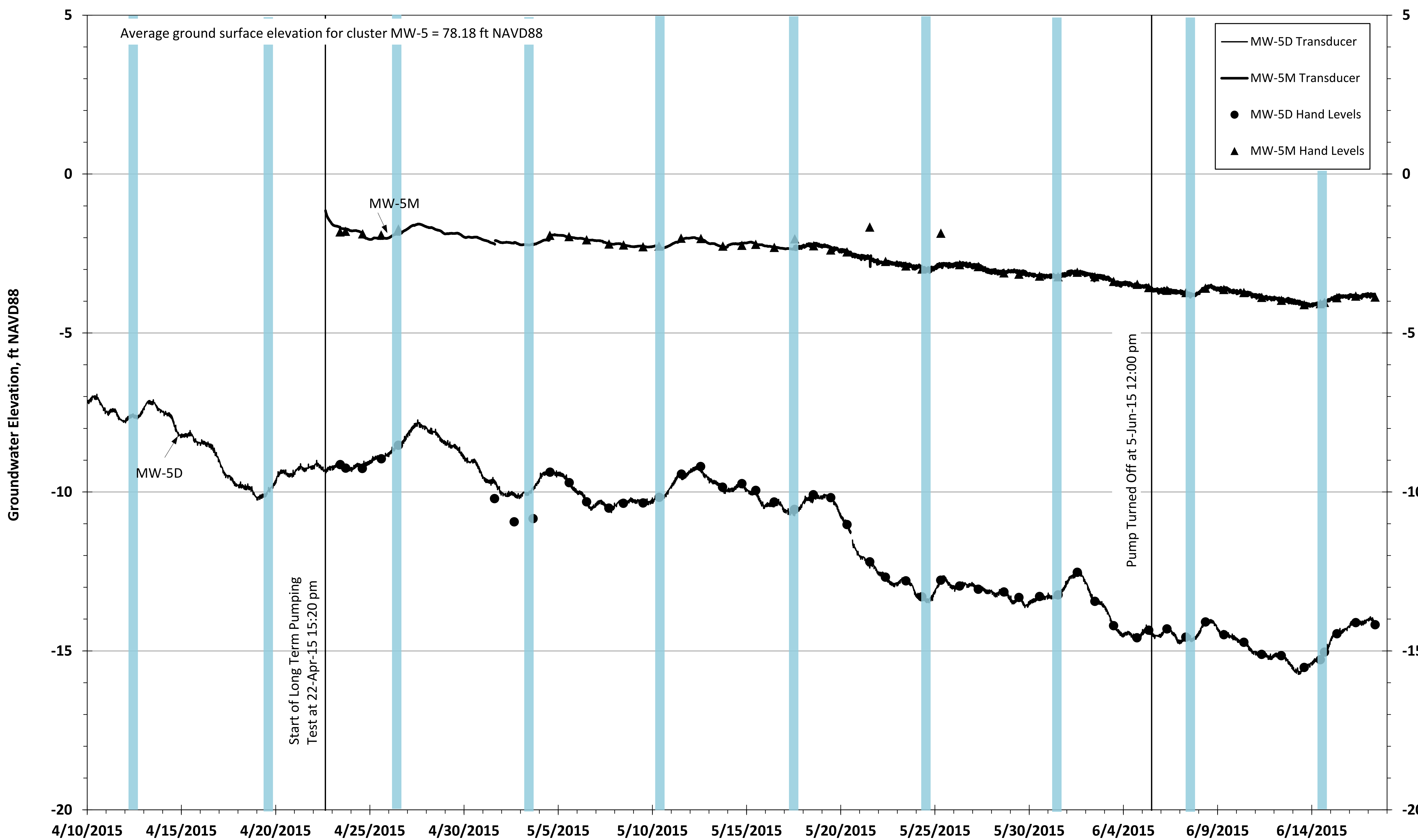

Figure 1-3b

Specific Conductivity in MPWSP MW-3

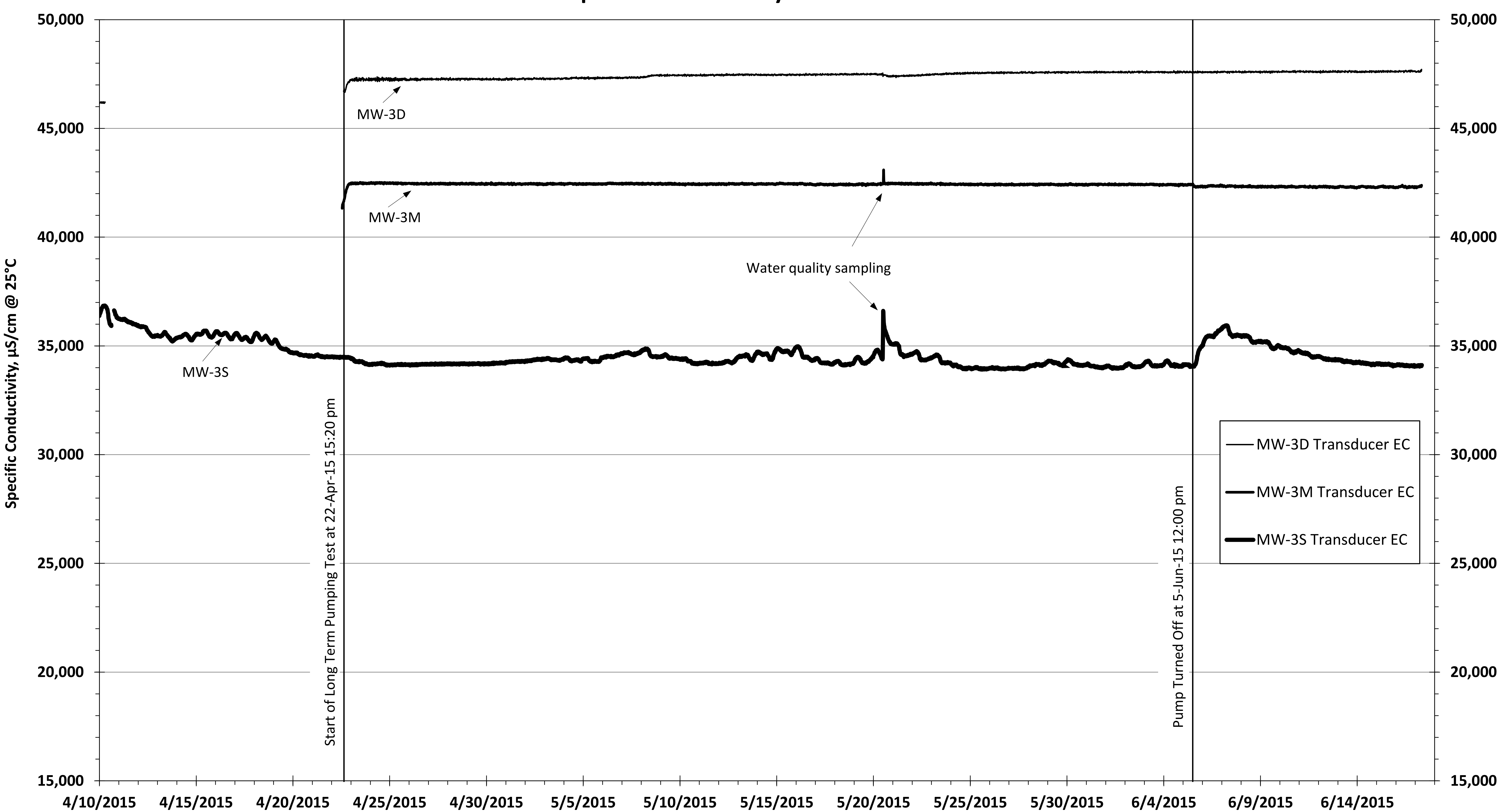

Figure 2-1

Specific Conductivity in MPWSP MW-4

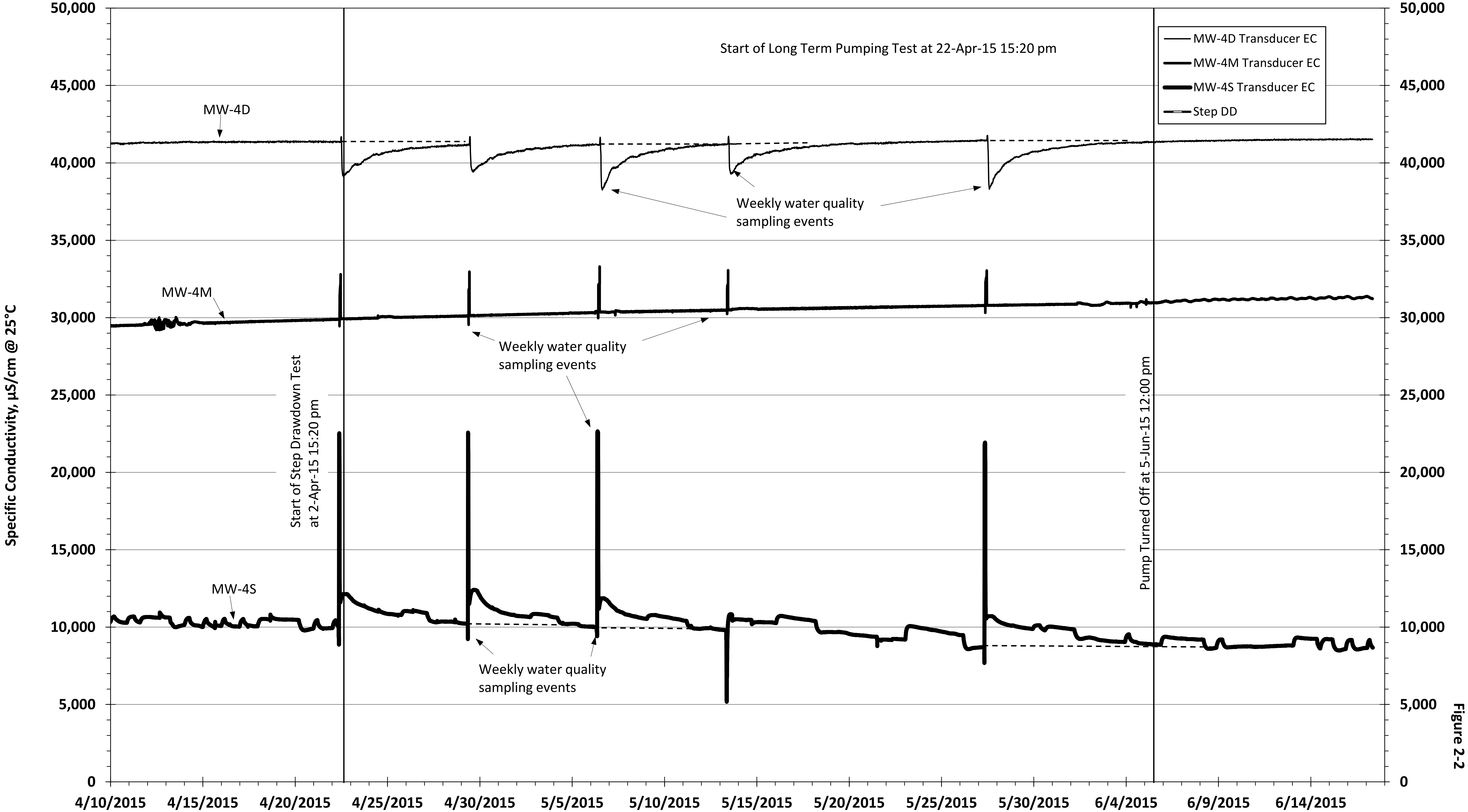

Figure 2-2

Specific Conductivity in MPWSP MW-5

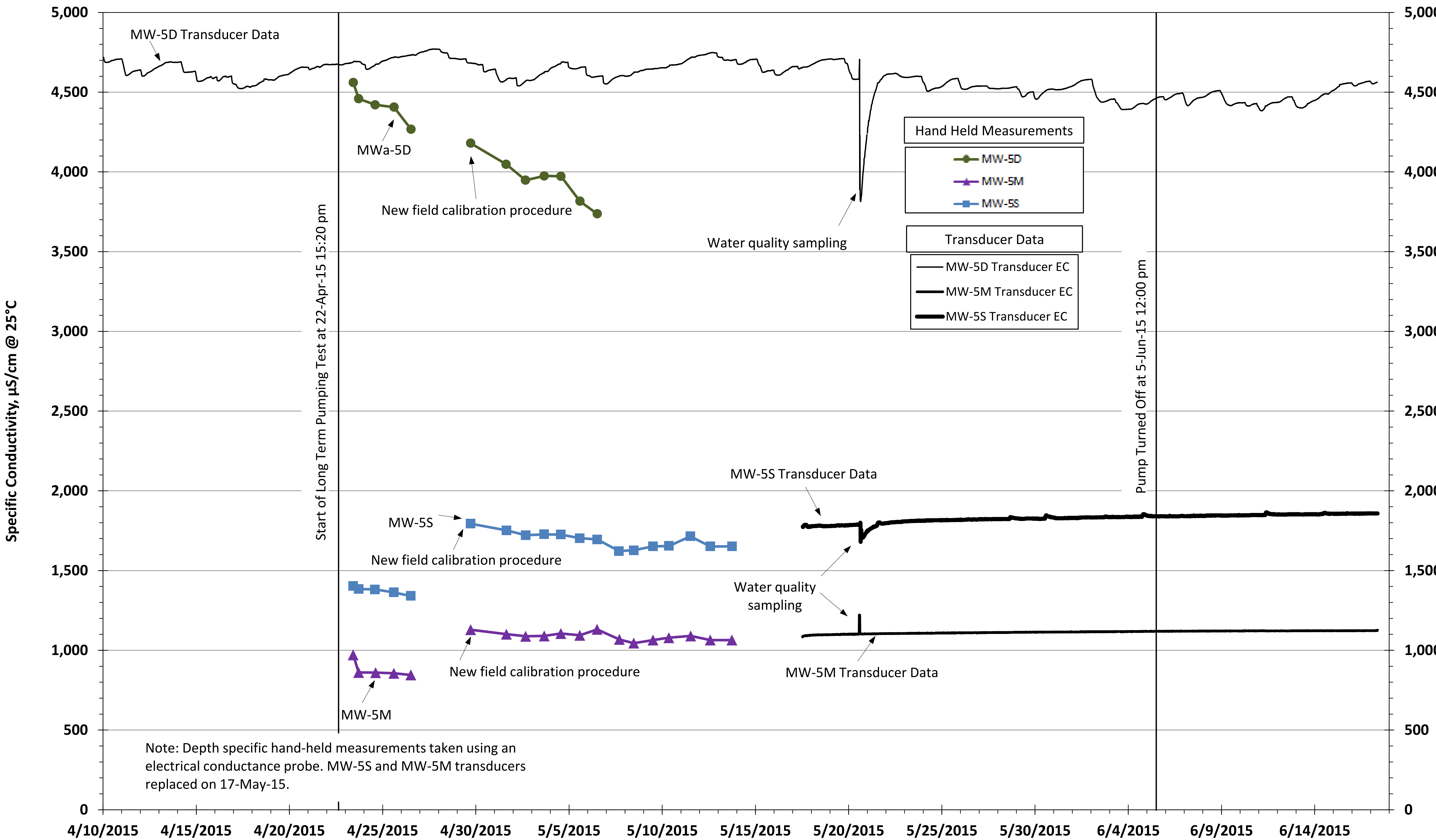

Figure 2-3

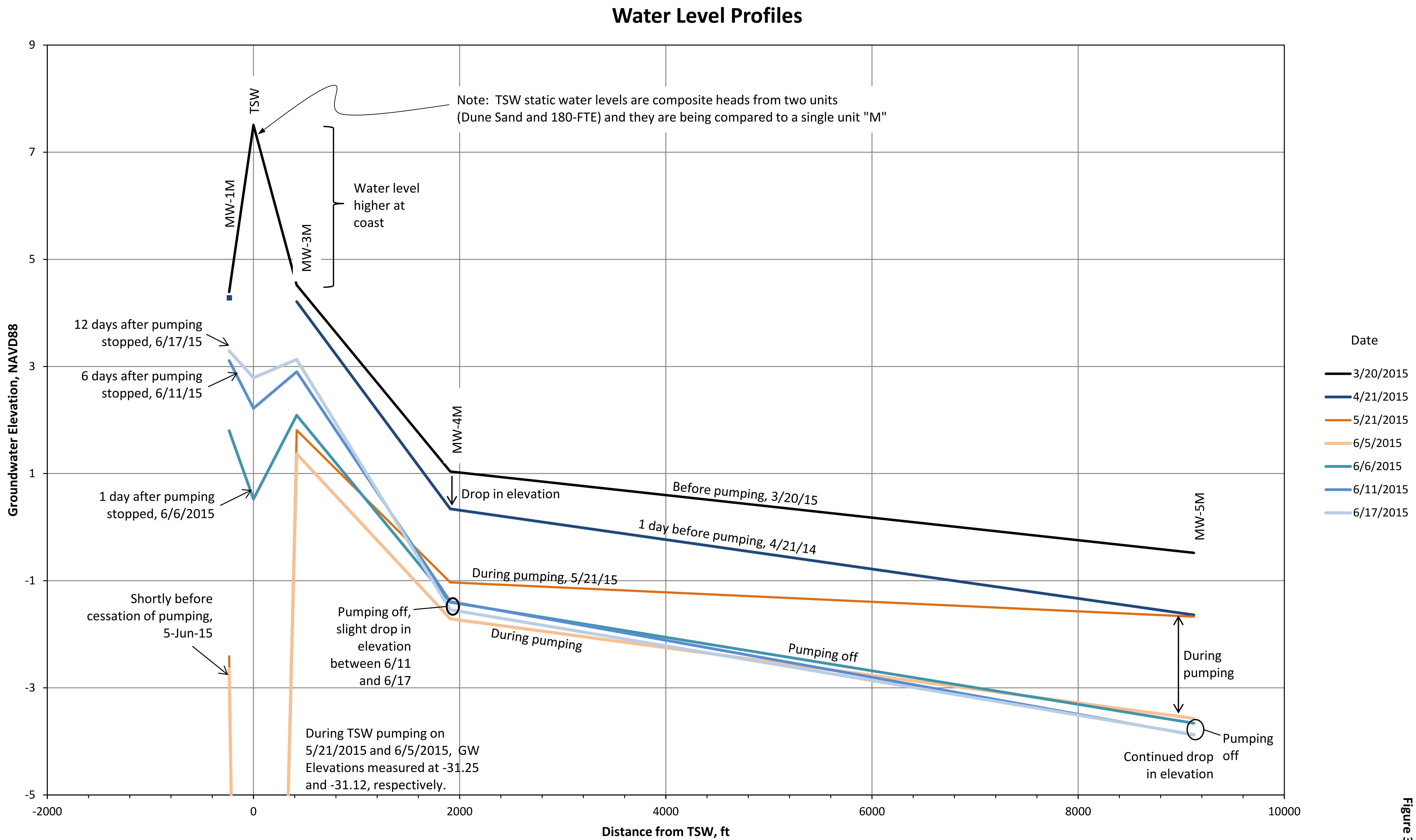
Water Level Profiles
Groundwater Elevation, NAVD88
Distance from TSW, ft
9
7
5
3
1
-1
-3
-5
-2000
0
2000
4000
6000
8000
10000
TSW
MW-1M
MW-3M
MW-4M
MW-5M
Note: TSW static water levels are composite heads from two units
(Dune Sand and 180-FTE) and they are being compared to a single unit "M"
Water level higher at coast
12 days after pumping stopped, 6/17/15
6 days after pumping stopped, 6/11/15
1 day after pumping stopped, 6/6/2015
Shortly before cessation of pumping, 5-Jun-15
Drop in elevation
Before pumping, 3/20/15
1 day before pumping, 4/21/14
During pumping, 5/21/15
During pumping
Pumping off
Pumping off, slight drop in elevation between 6/11 and 6/17
During TSW pumping on 5/21/2015 and 6/5/2015, GW Elevations measured at -31.25 and -31.12, respectively.
During pumping
Pumping off
Continued drop in elevation
Date
3/20/2015
4/21/2015
5/21/2015
6/5/2015
6/6/2015
6/11/2015
6/17/2015

Figure 3