THE SOURCE GROUP, INC.

Memorandum

To: Janet Goldsmith, Esq.

From: Jon Philipp, P.G., C.Hg. and Paul Horton, P.G., C.Hg.

cc: Tom Berliner, Esq., Mark Blum, Esq., Stanley Powell, Esq.

Date: May 21, 2010

Re: Surface Water Drawdown at 5 cfs Pumping Rate

The maximum surface water drawdown resulting from irrigation well pumping was not specifically quantified in any of SGI's reports. Instead, SGI noted the lack of a significant surface water response in our River installed transducers when compared to the obvious groundwater responses. For the 2007 Study, the maximum groundwater drawdown measured at the River was 0.17-feet which occurred when both irrigation wells were pumping at a combined rate of 5.02 cfs.

In their Draft Environmental Impact Report (DEIR), PBS&J stated that our data showed the maximum SURFACE WATER drawdown was 0.17-feet, and based several significant impact conclusions on those results. That precipitated a more in-depth look at surface water drawdown in the River, focusing on the data collected during the 2007 Study when both wells in combination were pumping at ~ 5 cfs and the River flow was experiencing Critically Dry conditions. Below are three methods to measure or otherwise quantify surface water drawdown using data obtained during the 2007 Study.

Method #1 – Regression Analysis on Direct Measurement of Surface Water

The first quantification of pumping induced changes was the use of linear regression techniques on direct measurements of surface water elevation within the irrigation well pumping zone of influence (ZOI). Shallow piezometers were used to measure the surface water elevation of the River. For each shallow piezometer location (P2LS, P2RS, P3LS, and P3RS), a linear regression trend line was mathematically fit to both the pre-pumping data (September 23 at 11am through September 28 at 8am) and the pumping data (September 28 at 9am through October 4 at 8am) using Excel. The pre-pumping trend line was linearly extended so as to facilitate a direct comparison to the pumping data trend line.

If it is assumed that the onset of irrigation well pumping (occurring at 9am on September 28) was the only significant event (other examples could include rainfall or lagoon closure) that occurred throughout the timeline (September 23 at 11am through October 4 at 8am), then the magnitude of the deviation in trend lines between the pre-pumping data and the pumping data would primarily be directly related to irrigation well pumping. Exhibits 1 through 4 show the results of the analysis. For each shallow piezometer, the deviation between the pre-pumping and pumping trend lines was minimal. The maximum surface water drawdown resulting from irrigation well pumping at a rate of 5.02 cfs was approximately 0.01-feet (0.12 inches) as seen in the data from piezometer P3RS.

ESR--8

Though pumping does have a minor effect on surface water levels, the 0.17-foot surface water drawdown conclusion reached by PBS&J greatly overstates the effect.

Completing a similar trend analysis on the data from the deep piezometers (which measure ground water elevation as opposed to surface water elevation) at the P2 and P3 location provides yet another illustration that the PBS&J analysis overstates the amount of surface water drawdown attributable to irrigation well pumping. The SGI 2007 Study reported that during the period when both irrigation wells were pumping at 5.02 cfs, groundwater elevations along the Creamery Meadow bank of the River dropped a maximum of 0.17-feet (P2RD location) with no notable changes to surface water elevations (though the more detailed analyses presented here show that there is a small discernable effect on surface water elevations). Exhibits 5 through 8 show the results of the analysis of the four deep piezometer locations (P2LD, P2RD, P3LD, and P3RD). In the case of the deep piezometers, the deviation between the two trend lines (pre-pumping and pumping) would approximate the ground water drawdown resulting from pumping. In all cases, the deviation of the two trend lines was significant. The maximum ground water drawdown resulting from irrigation well pumping at a rate of 5.02 cfs was approximately 0.2-feet as seen in the data from piezometer P2RD. Comparing Exhibits 1 through 4 to Exhibits 5 through 8 shows a clear difference in the pumping trend lines relative to the non-pumping trend lines. If irrigation well pumping at 5.02 cfs had the effect of dropping River surface water elevations by 0.17-feet, the trend analysis of the shallow piezometers (monitoring surface water) would look similar to the trend analysis of the deep piezometers (monitoring ground water), and they don't.

Method #2 – Mass Balance Using Stage/Discharge Relationship

Figure 3-11 (included as Exhibit 9) of the 2007 Study shows the average daily flow at velocity transect stations 2 (VT2) and 3 (VT3). Data from VT2 showed that flow declined approximately 1.2 cfs from the start of the pumping period to the lowest flow recorded during the pumping period (the measured change in River flow seen on Figure 3-11 was from a rate of approximately 2.35 cfs before pumping to a rate of approximately 1.15 cfs after pumping, for a total decline of 1.2 cfs. . This coincides with the combined piezometer data from the 2007 Study that shows that for every 1 cfs pumped by the irrigation wells (i.e. when both wells are on simultaneously), groundwater inflow to the River is reduced by 0.24 cfs, which, in theory, would translate to a direct loss of flow at the VT2 location. Based on this relationship, the predicted total loss of flow while both wells pumped at 5.02 cfs would be approximately 1.2 cfs, which seems reasonable when compared with the VT2 data observed on Figure 3-11.

The decrease in flow can be converted to a decrease in river stage as follows: Figure 2-5 (included as Exhibit 10) of the 2007 Study shows the relationship between River surface water elevation and River flow rate at VT2 ($y = 15.8717x^2 - 11.7091x$ where 'y' is River Flow Volume and 'x' is River Elevation). This relationship was established by taking 13 direct measurements of River flow and comparing them to a contemporaneous measurement of surface water height from a nearby piezometer (P2RS in this case). Note that the coefficient of determination (i.e. the R-squared value) is 0.98 with regard to the fit of the data to the regression curve. Using the relationship, a reduction in flow from 2.35 cfs to 1.15 cfs will yield a corresponding drop in River surface water height of approximately 0.076-feet (0.91 inches). However, as can be seen in Exhibits 1 through 4 and Figure 3-11, the River surface water level was dropping both during the pumping period and the five days leading up to it. Thus, the reduction in flow from 2.35 cfs to 1.15 cfs and the corresponding surface water level drop of 0.076-feet cannot all be attributed to pumping.

The effects to River surface elevation attributable to both irrigation wells pumping at a combined rate of 5.02 cfs can be estimated by calculating the difference in flow between stations VT3 and VT2 during the pumping period and comparing it to the difference in flow between the two stations during the time immediately preceding the pumping period. The change should be directly attributable to irrigation well pumping. Using the average daily flows found on Figure 3-11 (SGI, 2008), the flow of the River at VT2 was a maximum of 0.42 cfs higher than the flow of the River at VT3 during the seven days leading up to the pumping period. During the pumping period, the flow of the River at VT2 was a maximum of 0.33 cfs lower than the flow of the River at VT3. This suggests that of the 1.2 cfs reduction in River flow that occurred during the pumping period, approximately 0.75 cfs of it was the result of irrigation well pumping. Again using the relationship between River flow and River surface water elevation established on Figure 2-5 (SGI, 2008), a 0.75 cfs reduction in River flow will yield a drop in surface water of approximately 0.04-feet (0.5 inches) when the irrigation wells are pumping at 5.02 cfs.

Method #3 – Use of Upstream Surface Water Trend to Modify Method #1 Regression Analysis

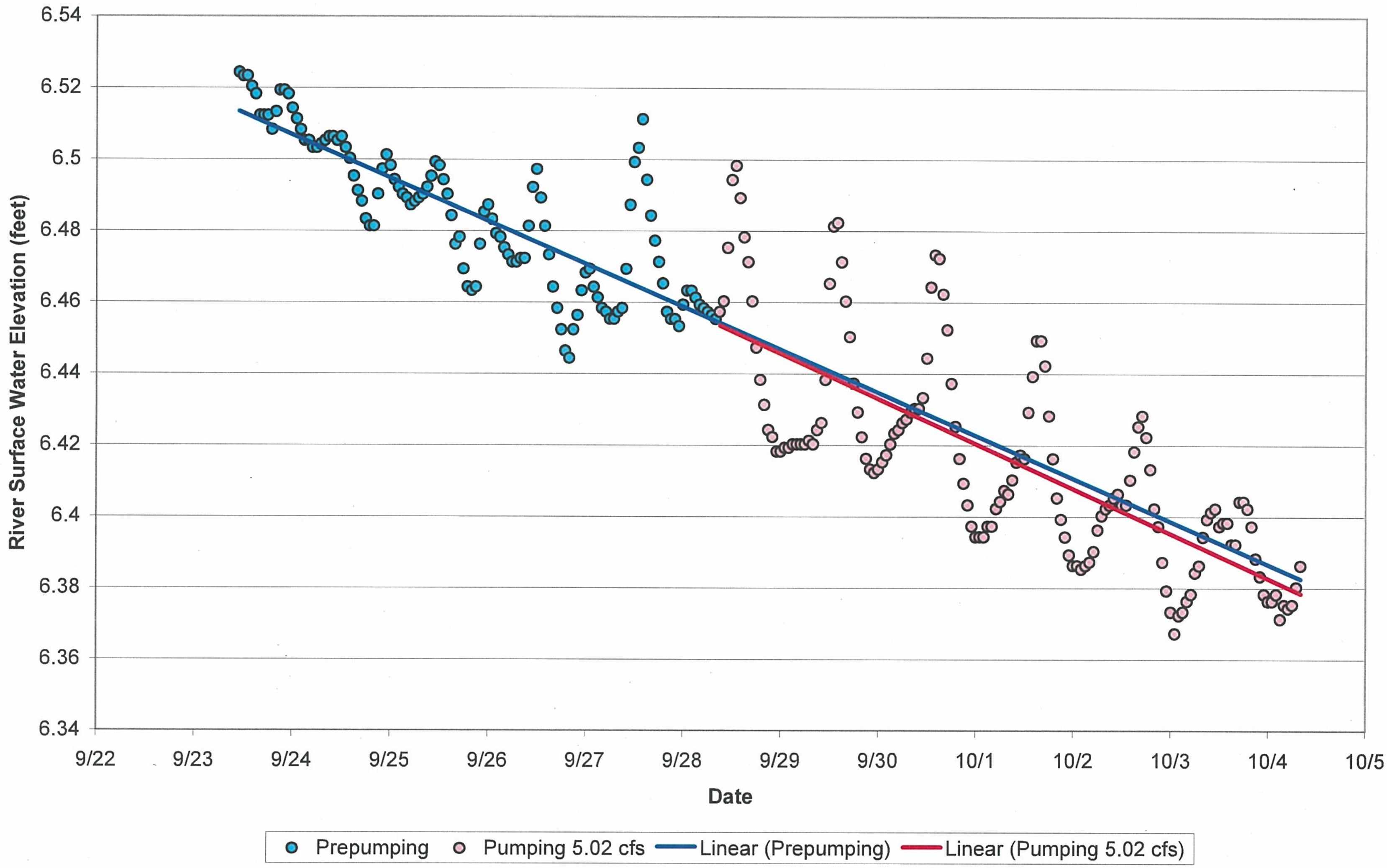
Based on the results of our recently more focused ZOI analysis, it became clear that a better understanding of surface water trends during the pumping period might be provided by using directly measured conditions at the edge of the ZOI, such as at the P4uLS location. The surface water trend at that location could be compared to surface water trend within the ZOI at P3RS during pumping. (see Exhibit 4, where the trend analysis indicated a surface drawdown effect of 0.01-feet). Though the surface water trends at P5 and P6, outside the ZOI, and thus unaffected by pumping, might have been used, they are in a completely different pool/run environment than the P2 through P4u locations. This difference adds a hydraulic variable (i.e. it is likely that the surface water levels would respond differently based on the geometry of the pool/run they are in) that cannot be accounted for, and thus could bias the results.

Exhibit 11 shoes the pumping and pre-pumping surface water trends for piezometer P4uLS. Exhibit 12 shows the pumping surface water trend from P4uLS superimposed on the P3RS linear regression analysis. Relative to the comparison with pre-pumping conditions which yielded a surface water effect of 0.01-feet, the comparison to the surface water trend at P4uLS during pumping revealed a surface water effect of approximately 0.03-feet. This is more in line with the results from the mass-balance method which showed a surface water drawdown effect of approximately 0.04-feet when both wells were pumping.

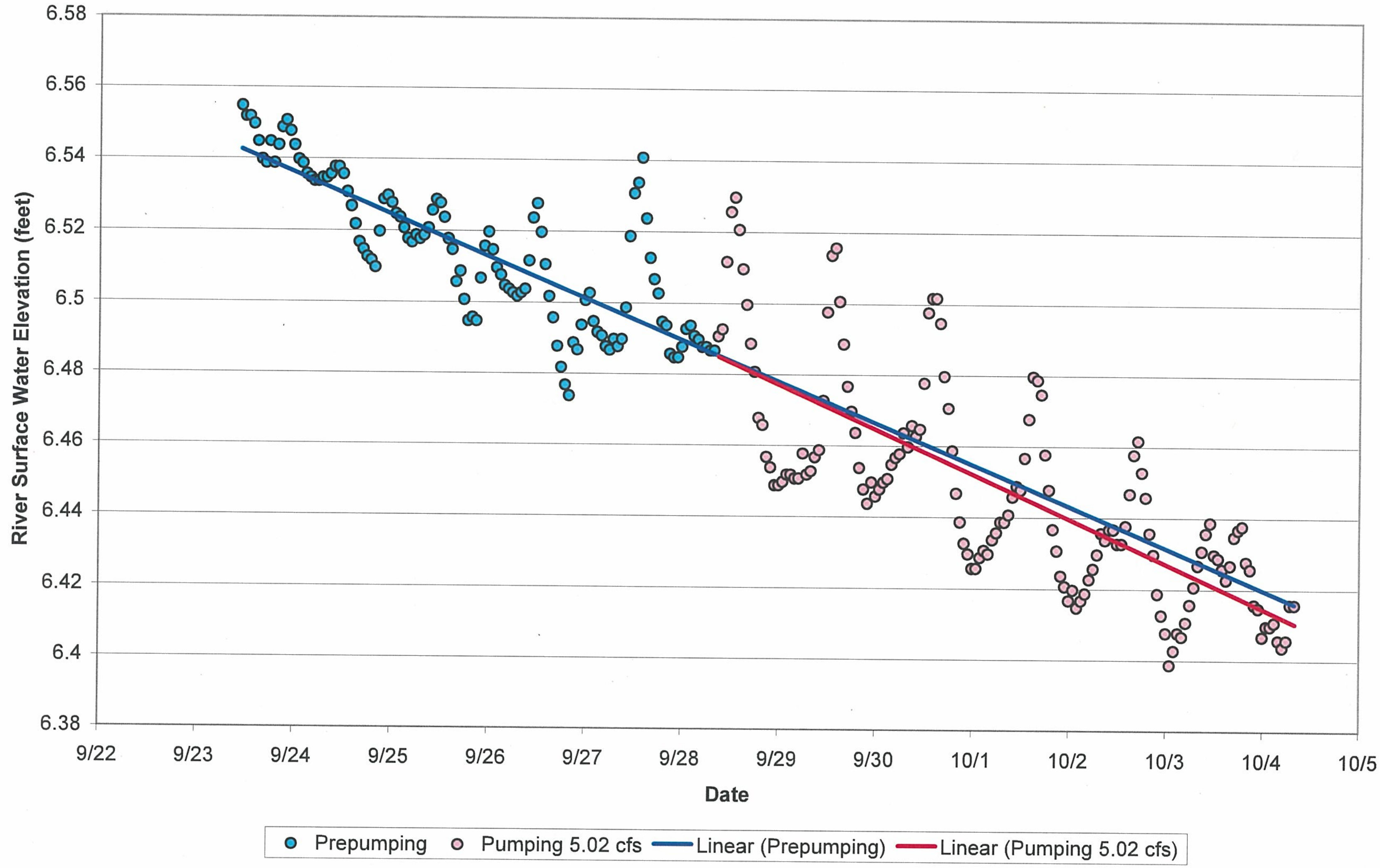
Conclusions

Based on the analysis described above, it is likely that the effect of pumping both irrigation wells at 5 cfs during Critically Dry summer flow conditions will lower surface water elevations approximately 0.01 to 0.04-feet (0.1 to 0.5 inches), though more likely closer to 0.03 to 0.04-feet (0.4 to 0.5 inches). Note that this occurs within the daily evapotranspiration (ET) fluctuation of up to 0.1-feet (1.2 inches). The reduction in surface water due to pumping is not constant throughout the ZOI; it is greatest at the lower end where cumulative surface water withdrawal is greatest, such as at the P2 location. Surface water drawdown effects would be progressively smaller moving upstream, approaching zero at the edge of the ZOI.

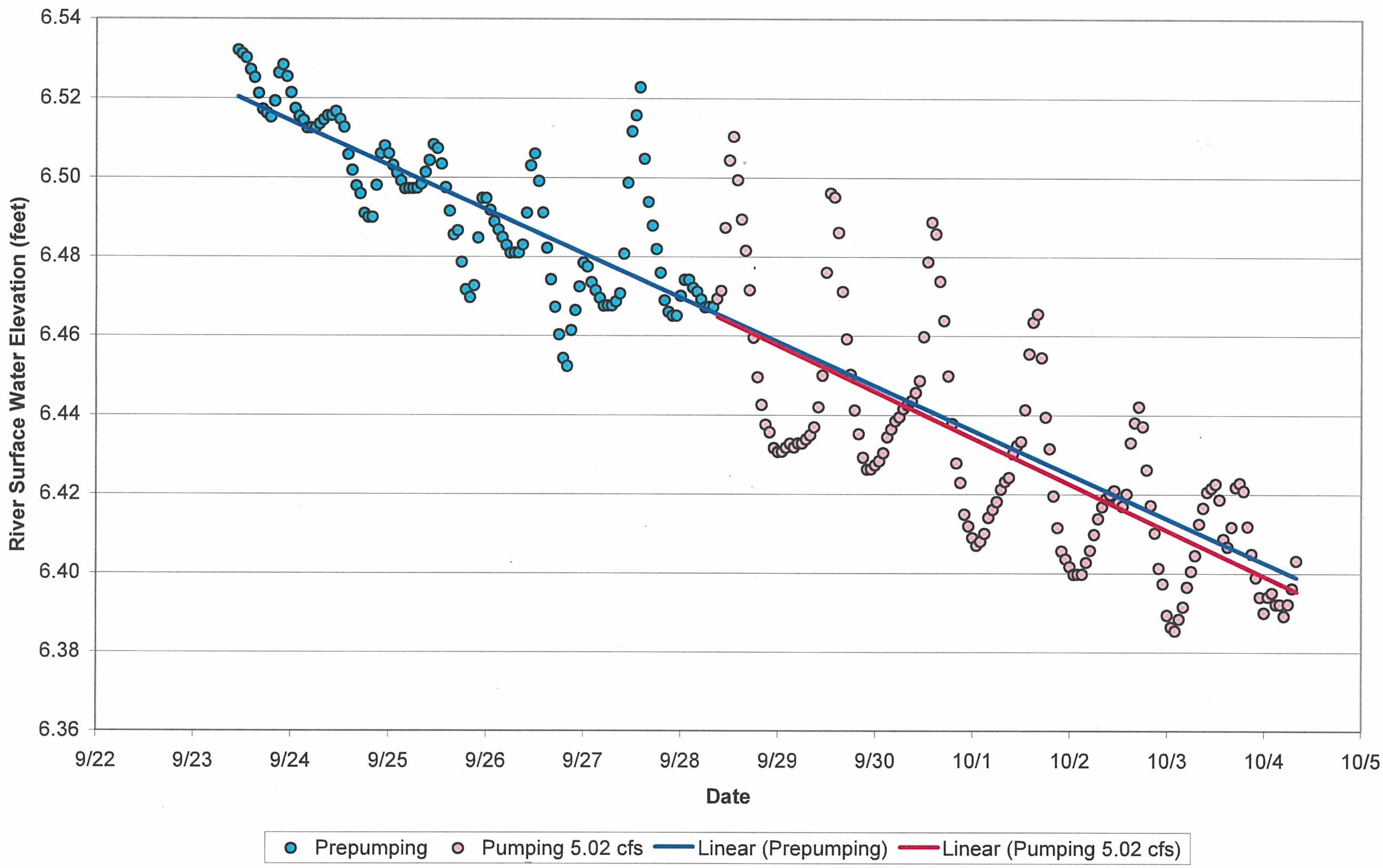
P2LS Surface Water Trend Analysis - Exhibit 1



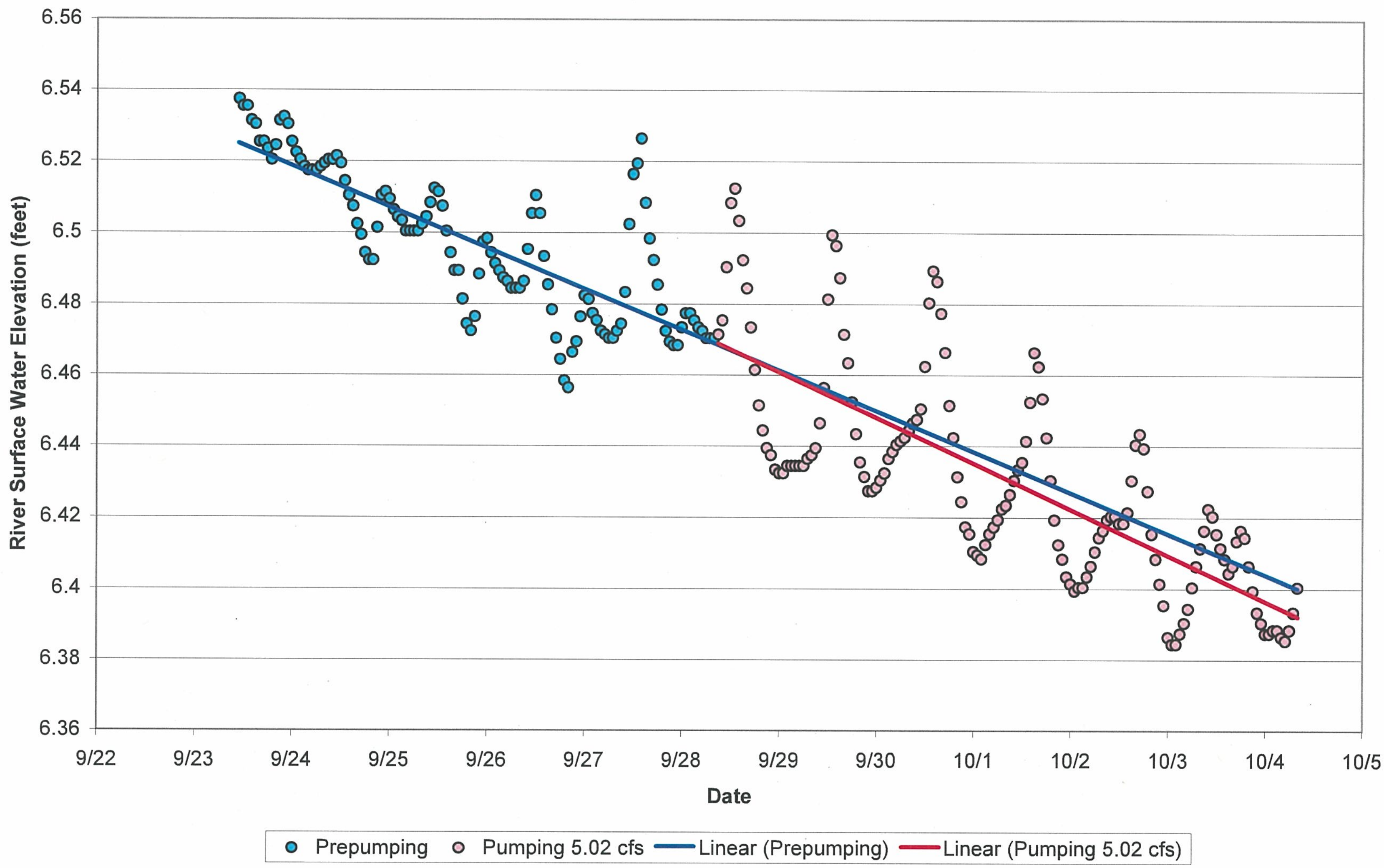
P2RS Surface Water Trend Analysis - Exhibit 2

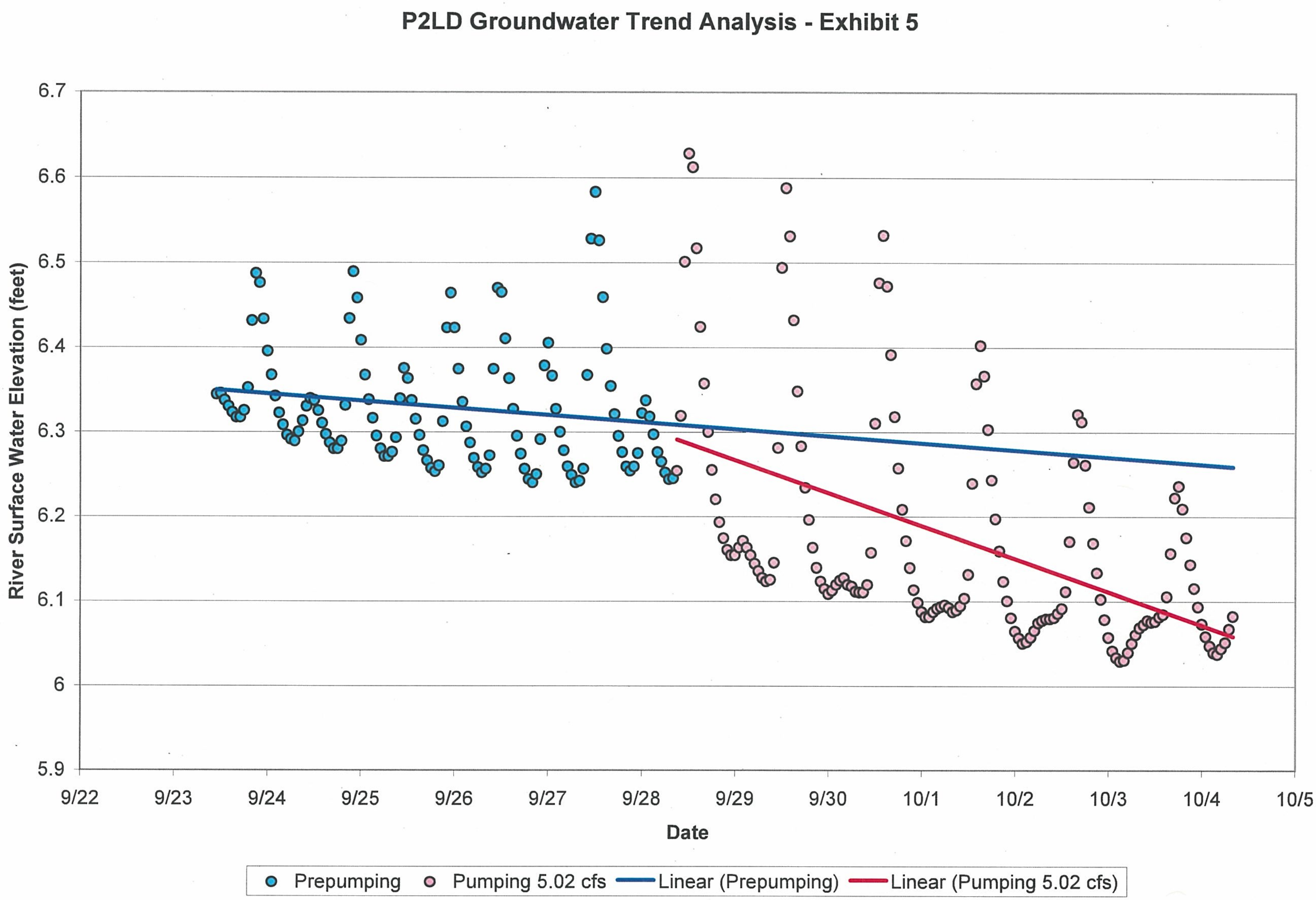


P3LS Surface Water Trend Analysis - Exhibit 3

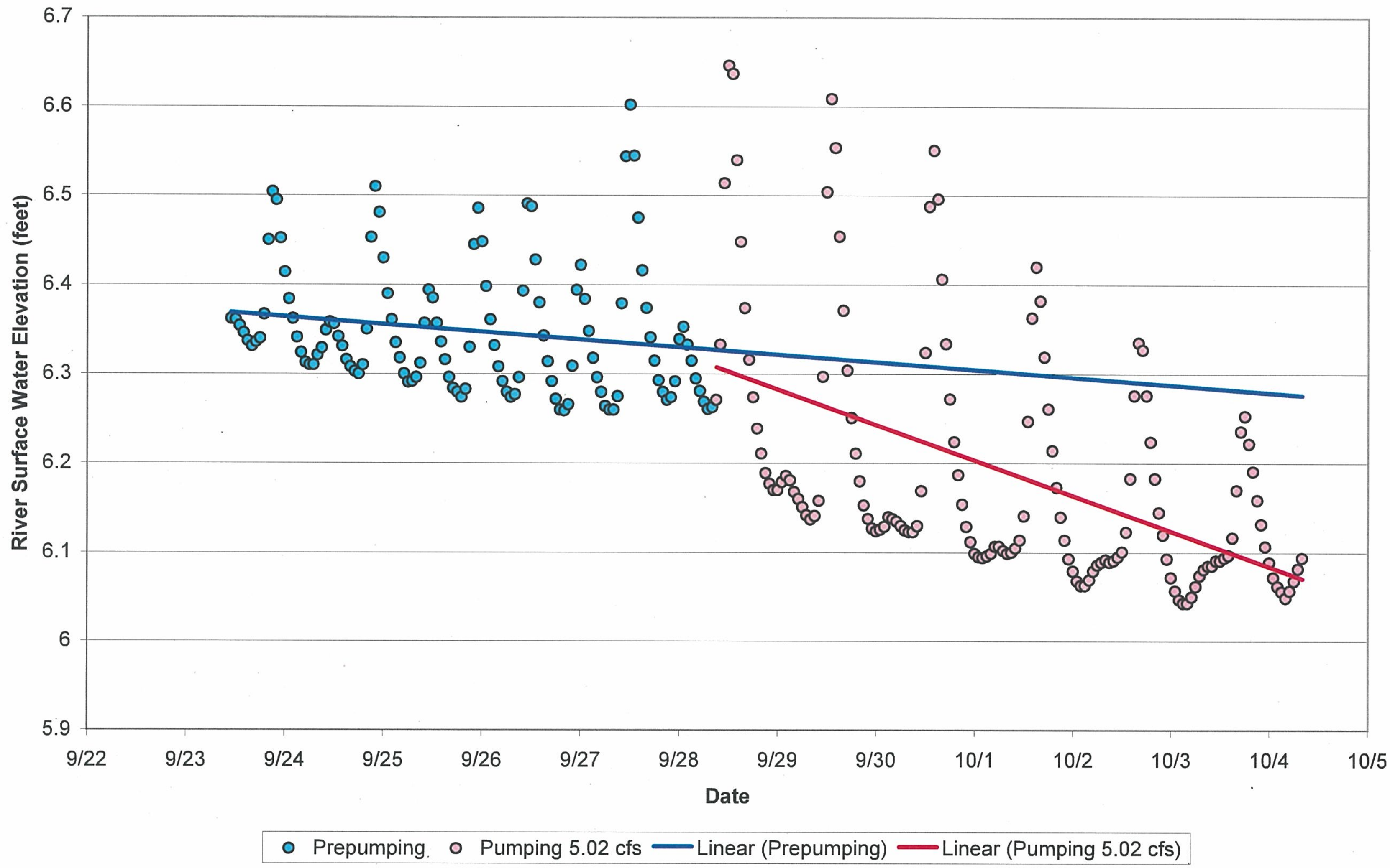


P3RS Surface Water Trend Analysis - Exhibit 4

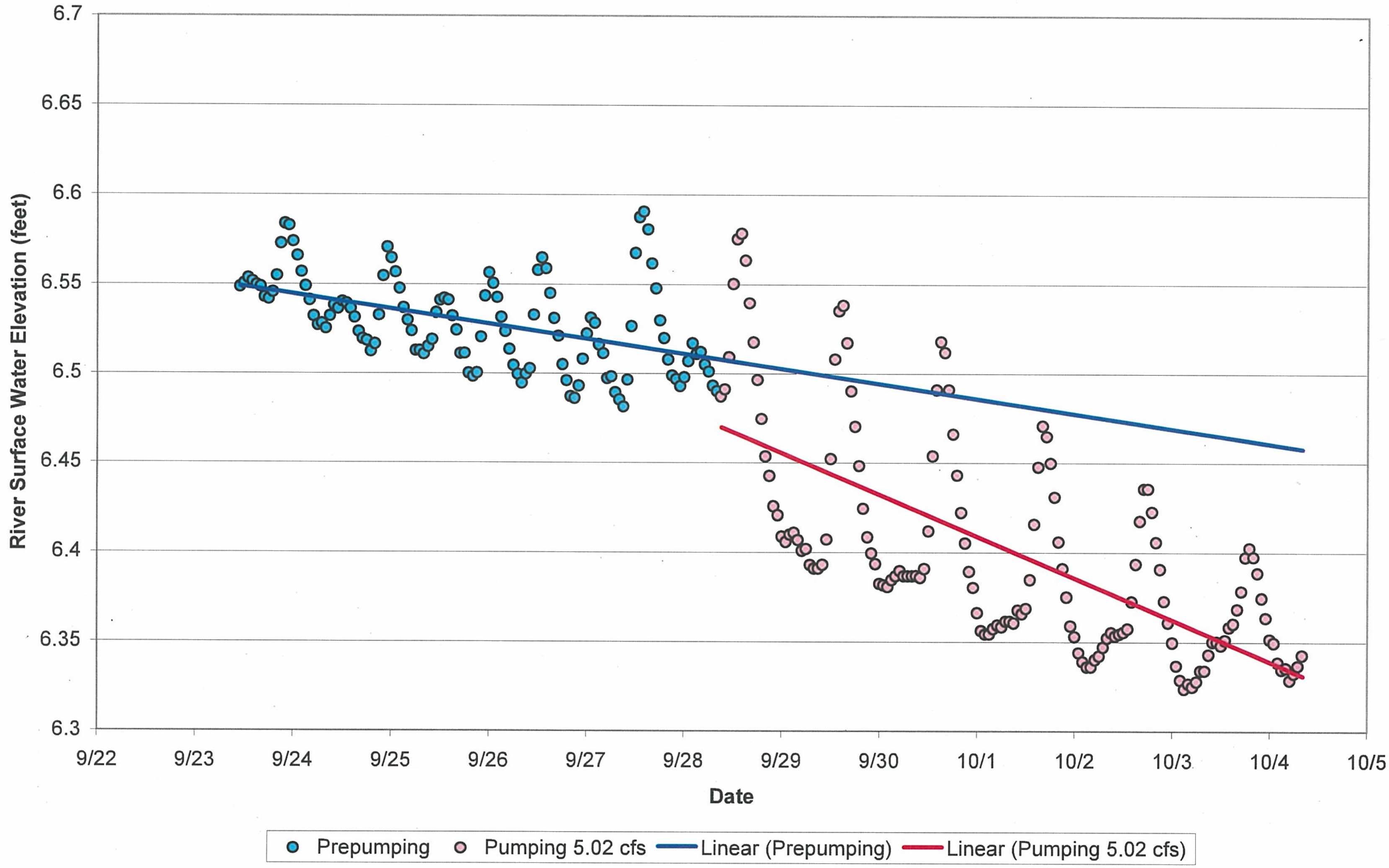



P2LD Groundwater Trend Analysis - Exhibit 5
River Surface Water Elevation (feet)
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
Date
Prepumping
Pumping 5.02 cfs
Linear (Prepumping)
Linear (Pumping 5.02 cfs)

P2RD Groundwater Trend Analysis - Exhibit 6



P3LD Groundwater Trend Analysis - Exhibit 7



P3RD Groundwater Trend Analysis - Exhibit 8

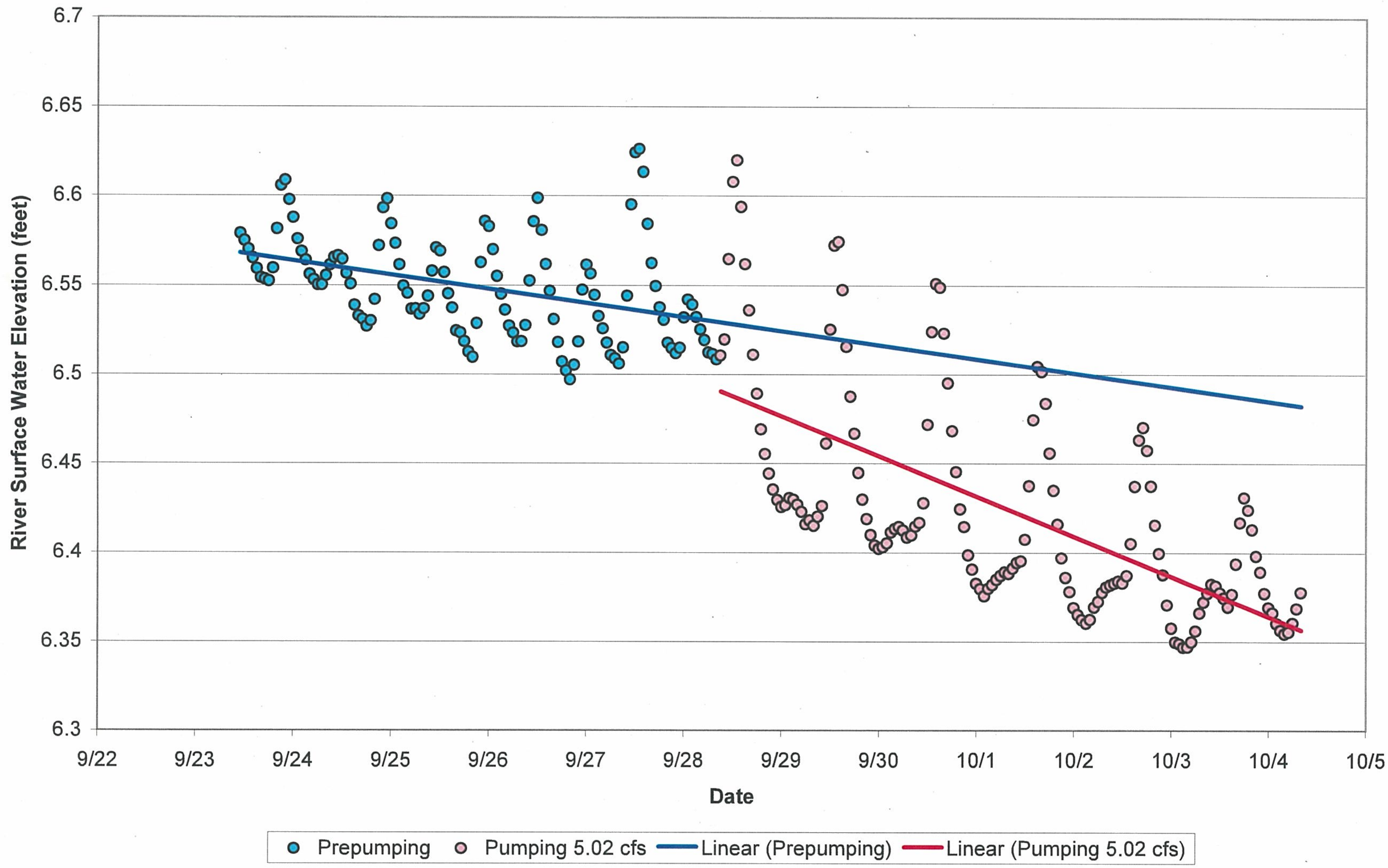
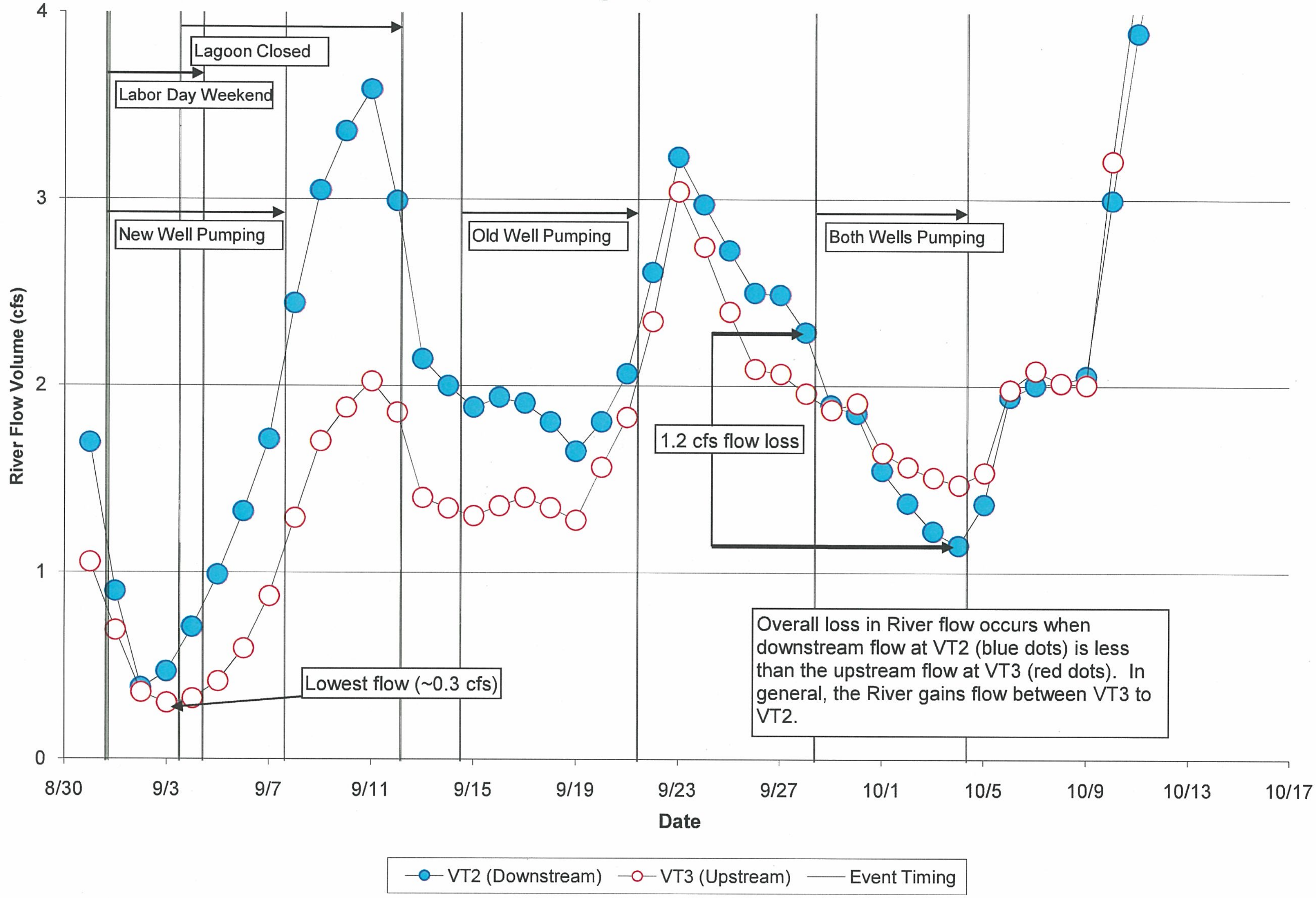


Exhibit 9/Figure 3-11
Average Daily Flow Volume at VT2 and VT3
El Sur Ranch
Big Sur, California



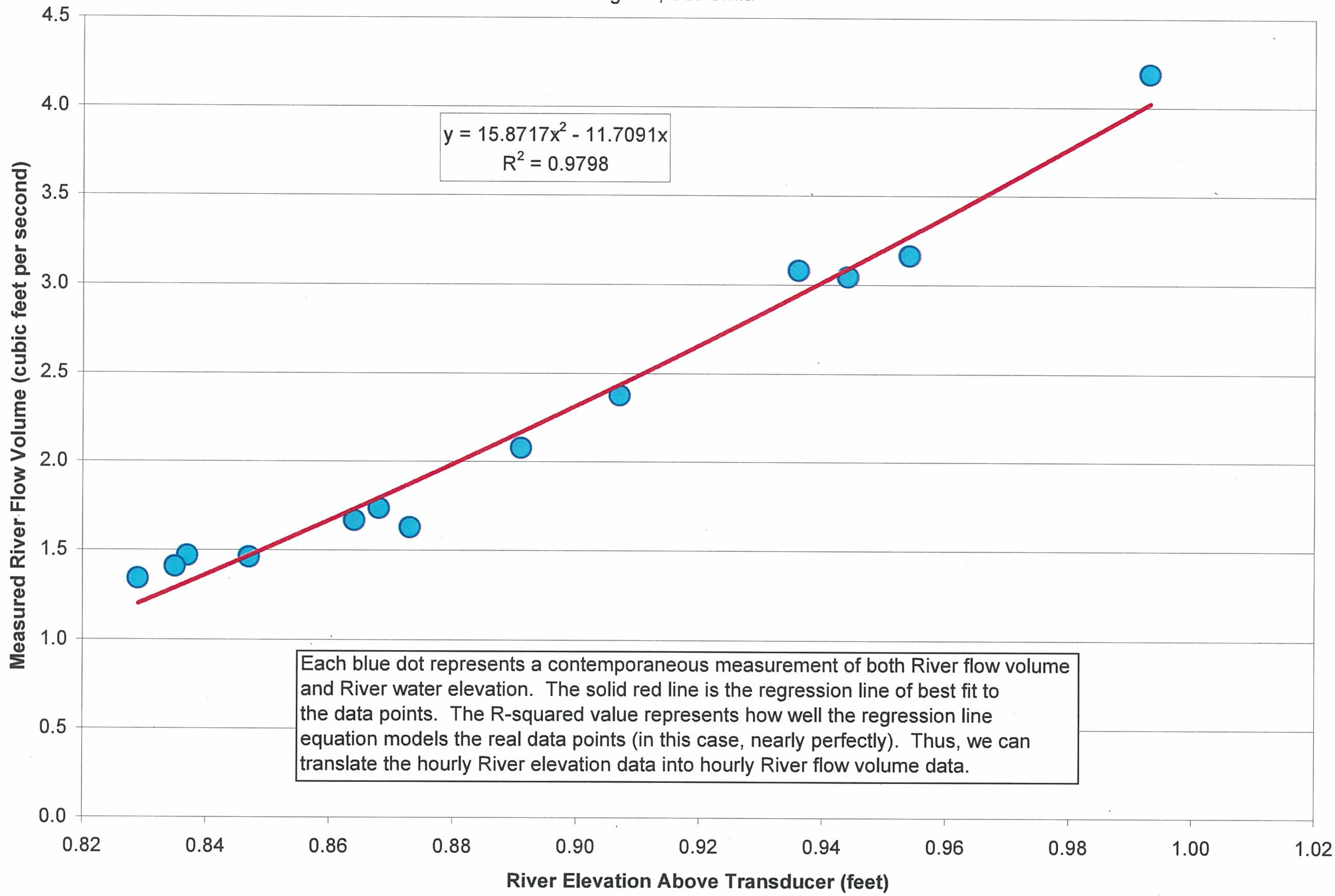
THE SOURCE GROUP, INC.

Exhibit 10/Figure 2-5

Regression Line Fit to VT2 River Flow Data and River Elevation at P2RS

El Sur Ranch

Big Sur, California



SGI environmental THE SOURCE GROUP, INC.

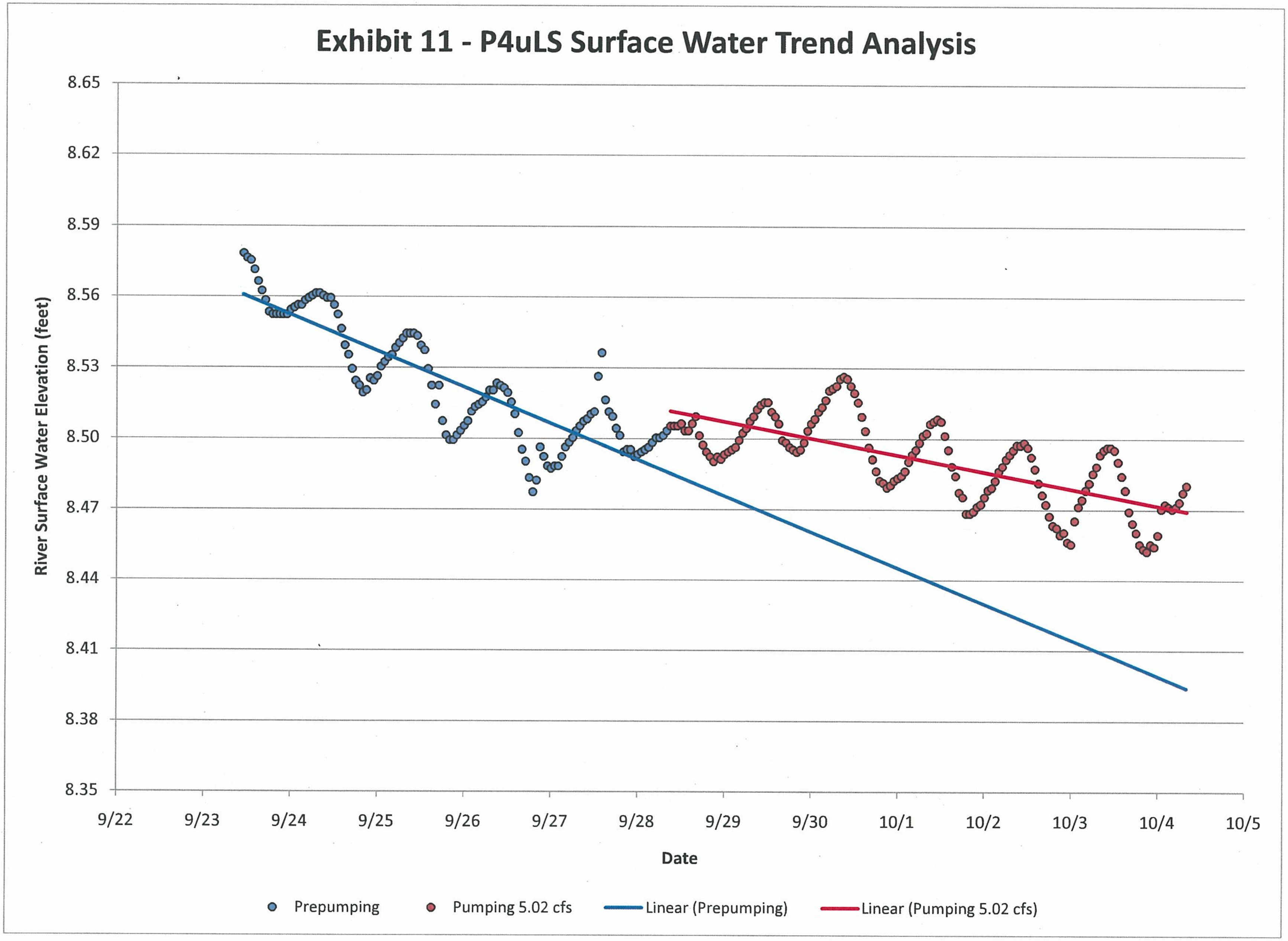


Exhibit 11 - P4uLS Surface Water Trend Analysis
River Surface Water Elevation (feet)
8.65
8.62
8.59
8.56
8.53
8.50
8.47
8.44
8.41
8.38
8.35
9/22
9/23
9/24
9/25
9/26
9/27
9/28
9/29
9/30
10/1
10/2
10/3
10/4
10/5
Date
Prepumping
Pumping 5.02 cfs
Linear (Prepumping)
Linear (Pumping 5.02 cfs)

P3RS Surface Water Trend Analysis - Exhibit 12