GEI Consultants
Bookman-Edmonston Division

Geotechnical
Environmental and
Water Resources
Engineering

December 12, 2011

Mr. Yitzhak Gilon
California American Water
4701 Beloit Drive
Sacramento, CA 95838-2434

Re: Canvasback Well Pump Modification
Yolo County, California

Dear Mr. Gilon:

GEI Consultants, Inc. (GEI) prepared this report to document the process and results of modifying the pump intake of the Canvasback well to reduce arsenic concentrations. The Canvasback well is located in and supplies water to the Wild Wings housing development. GEI evaluated the well in 2010 and provided five possible alternatives to reduce arsenic concentrations. The alternatives ranged from: 1) modification of the pump intake by simply lowering the pump intake; 2) modification of the pump intake by lowering the intake and including a packer to attempt to isolate off portions of the well screens; 3) modification of the well structure by placing liners over well screens to block off portions where higher arsenic concentrations are entering the well; 4) replacement of the well, and; 5) design and construction of a treatment plant. Based on community input, modification of the pump intake (without the packer) was selected as the most feasible alternative with the lowest cost to implement and the lowest cost for operations and maintenance. The approach was to extend the pump intake to near the bottom of the well, opposite the aquifer with the lowest concentrations of arsenic. This approach was projected to potentially lower arsenic concentrations to about 8 to 9 µg/L. The primary drinking water maximum contaminant level (MCL) for arsenic of 10 µg/L.

This report documents the results of time-sequential water quality sampling conducted prior to the pump intake modification to establish baseline conditions, pump intake modifications, and time-sequential water quality sampling conducted after the pump intake modification.

Pre-Pump Intake Modification Testing

The Canvasback well was pumped prior to the pump intake modification to confirm the pump operation and to collect time-sequential water quality samples prior to the extension of the pump intake. The static water level on September 28, 2011, was 126.6 feet below ground surface (bgs). The well was pumped at an average rate of 1,230 gpm

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for two hours, which resulted in 43 feet of drawdown in the well. Figure 1 shows the pumping rate during the test. Figure 2 shows the drawdown results. Water quality samples were collected 15, 30, 60, and 120 minutes after pumping started. The samples were analyzed for arsenic by California Laboratory Services (CLS) of Rancho Cordova, California. Table 1 summarizes the sample results. The laboratory results showed some variability during the pumping period with arsenic concentrations ranging from 10 µg/L to 12 µg/L, with all but one sample above the MCL for arsenic.

Pump Intake Modification

Kirby Pump & Mechanical of Rancho Cordova, California removed the pump from the well and added 190-feet of 10-inch diameter Certainteed CertaLok PVC pipe to the pump intake and re-installed the pump. The intake for the pump is now at 412 feet bgs and the well's total depth is 425 feet. Figure 3 shows the modified pump details.

During the work, grommets, which center the line-shaft that drives the pump and prevents wobble, were found to have excessive wear. The new rubber grommets come from the manufacturer with a tolerance of about 0.015-inch tolerance. The grommets were measured to have a 0.050-inch tolerance, about three times the tolerance of new grommets. The pump contractor recommended replacement of the grommets as he was concerned that they could fail in the near future, which would require having to remobilize and pull the pump. The grommets were replaced during pump installation.

Post-Pump Modifications Testing

The Canvasback well was pumped after the intake was lowered to confirm the pump was still operating similarly to pre-pump modification conditions and to assess any changes in water quality due to lowering the pump intake. The static water level on October 11, 2011, was 112.5 feet bgs, which is about 14 feet higher than during the pre-pump modification test conditions. This substantial change in groundwater levels suggests either groundwater levels in the well are being affected by pumping of another nearby well or there was a significant recharge event. The Canvasback well screens are between 365 and 415 feet bgs while the Pintail well screens are positioned between 935 and 1,061 feet bgs. The difference in the well screen positions suggests the Pintail well is not causing the change in water levels in the Canvasback well. Another well in the area may be creating the difference in the static water levels. A rain event reached the area on October 5 and 6, 2011, between the pre- and post-pump modification. Although there was a rain event, rises in groundwater levels typically take about 30 days or more before increases in groundwater levels are seen. Although possible, it is unlikely the rain caused the increase in groundwater levels.

The well was pumped at an average rate of about 1,260 gpm for two hours. The slightly higher pumping rate is likely due to the static water level being at a shallower depth (less head to pump against). The pumping rate after the intake was installed was similar to the pumping rate prior to the extension of the intake, which indicates the pump contractor returned the well to a similar operating condition. Figure 1 shows the pumping rates.

The pumping rate for the pre-pump intake modifications was lower than the post-pump intake modifications test. Because of the higher pumping rate during the post-pump intake modifications test, the drawdown was about four feet lower. Lowering the pump intake did not affect the pumping capacity. Figure 2 shows the differences between the pre- and post-pump intake modification drawdowns.

While the well was being pumped to confirm the post-pump intake modifications operation, water quality samples were collected from the well. Water quality samples were collected at 15, 30, 60 and 120 minutes after starting the pump. The pump was then turned off for two hours before restarting the pump at 500 gpm. The lower pumping rate was selected as this would meet the demand of the Wild Wings development and there was a potential that pumping the well at this rate could result in lower arsenic concentrations. The well was pumped for two additional hours. Water quality samples were again collected at 15, 30, 60 and 120 minutes.

The water quality samples were analyzed by CLS. All of the water quality samples had the same result for arsenic, 11 µg/L, for both the 1,260 gpm pumping rate and the 500 gpm pumping rate. The results still exceed the 10 µg/L MCL for arsenic.

Conclusions

Based on the results from the water quality sampling performed post-pump intake modification, the lowering of the pump intake did not have the intended effect of lowering the total arsenic concentrations below the MCL. This initial step had to be taken as it was a simple solution that would have resulted in a low cost fix that would not have increased maintenance or operations costs if it were successful. Because the arsenic concentrations were not reduced below the MCL, the Canvasback well will need to remain as a standby source and cannot be changed to an active status. Even though the arsenic concentrations are above the MCL, the Department of Public Health will allow the water from the Canvasback well to be served to the public for up to 15 days per year. In the event that the Pintail well needs to be repaired, the Canvasback well could be used in the interim. This still does not provide the Wildwings development with two unimpaired redundant water supply sources.

Five alternatives were initially developed that could potentially reduce the arsenic concentrations. Three of the alternatives, including the one attempted, were based on modifying the pump or well structure to reduce the arsenic concentrations. Based on the outcome of the work completed, it does not appear that further attempts to modify the pump intake or well structure will be successful to reduce arsenic concentrations. Therefore, treatment or well replacement appears to be the only feasible options to mitigate arsenic levels in the Canvasback well. It appears that low to moderate concentrations of arsenic are present in the aquifers beneath the development; therefore, drilling a new well in an effort to avoid treatment altogether is a risky endeavor. Treatment of the water from the well has the highest certainty of reducing the arsenic concentrations to below the MCL but treatment has the highest capital and operating costs. We recommend that Yolo County Department of Planning and Public Works pursue grant funding for pilot testing, design and construction of a treatment plant.

If you have any questions pertaining to these procedures and findings, please feel free to call Richard Shatz at (916) 631-4566.

Regards,

Ryan Alward
Project Geologist

Richard W. Shatz, C.HG. 84
Principal Hydrogeologist

Enclosure
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Figures

FIGURE 1
PUMPING RATE VS. TIME
PRE- AND POST- PUMP MODIFICATION

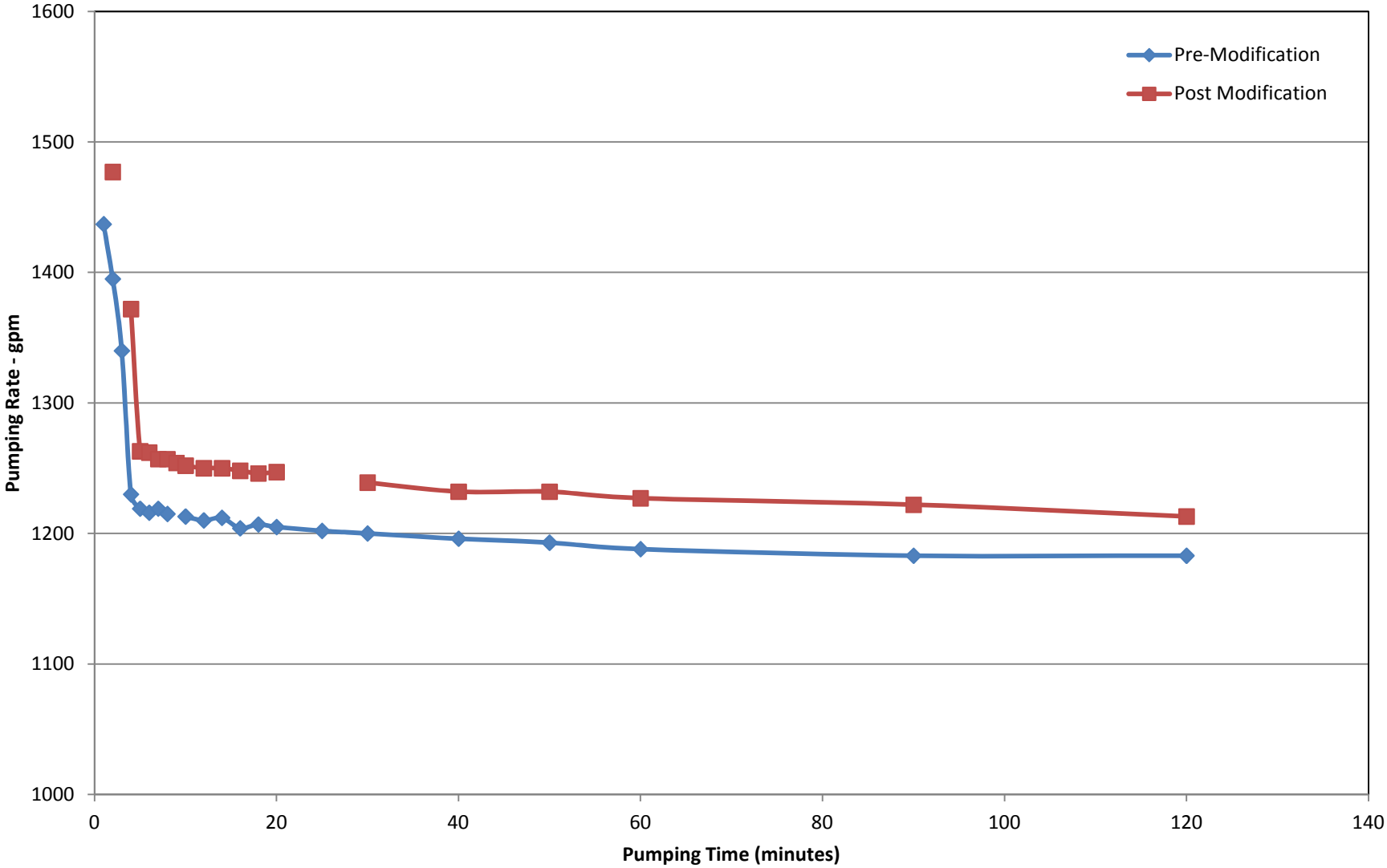
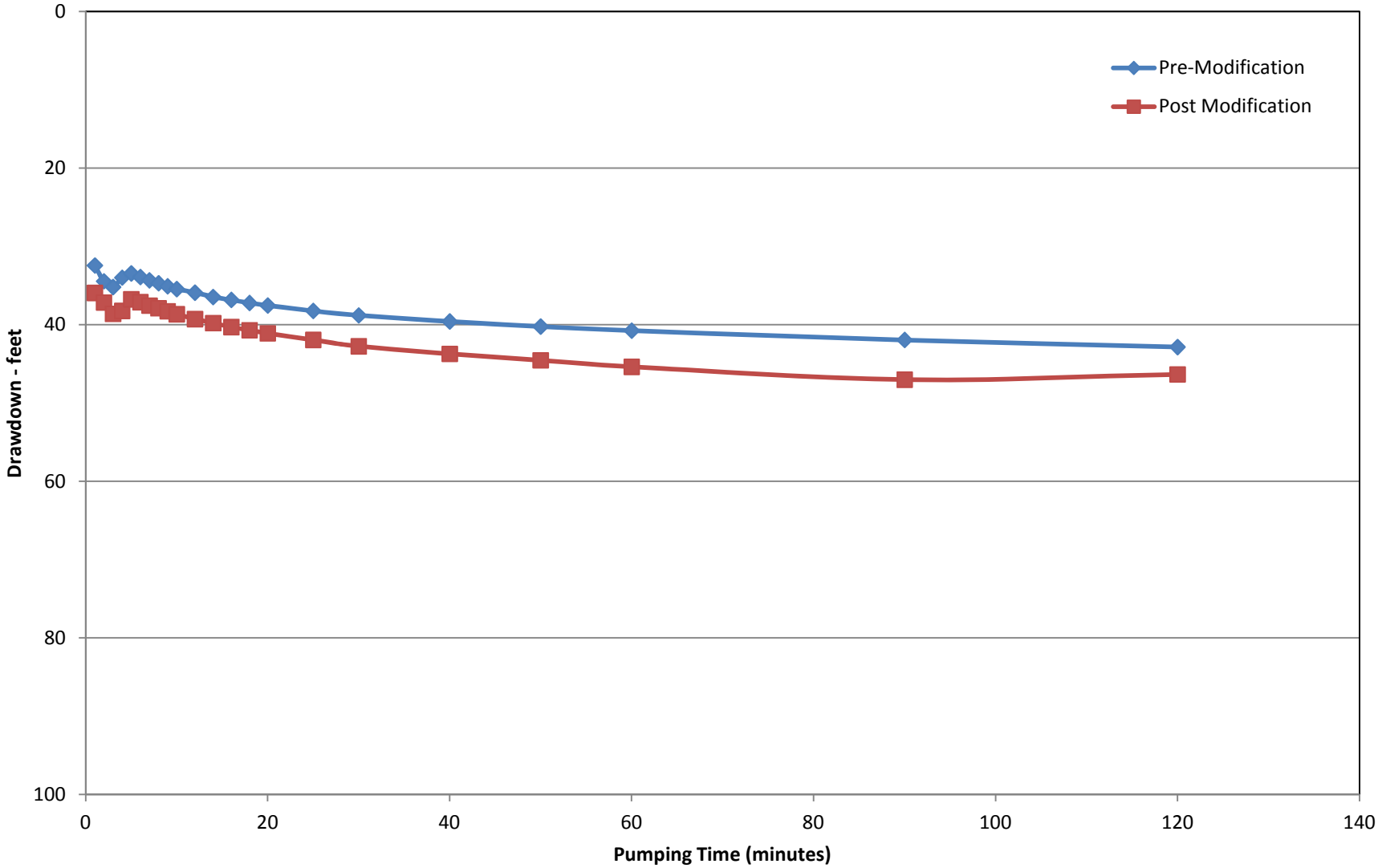
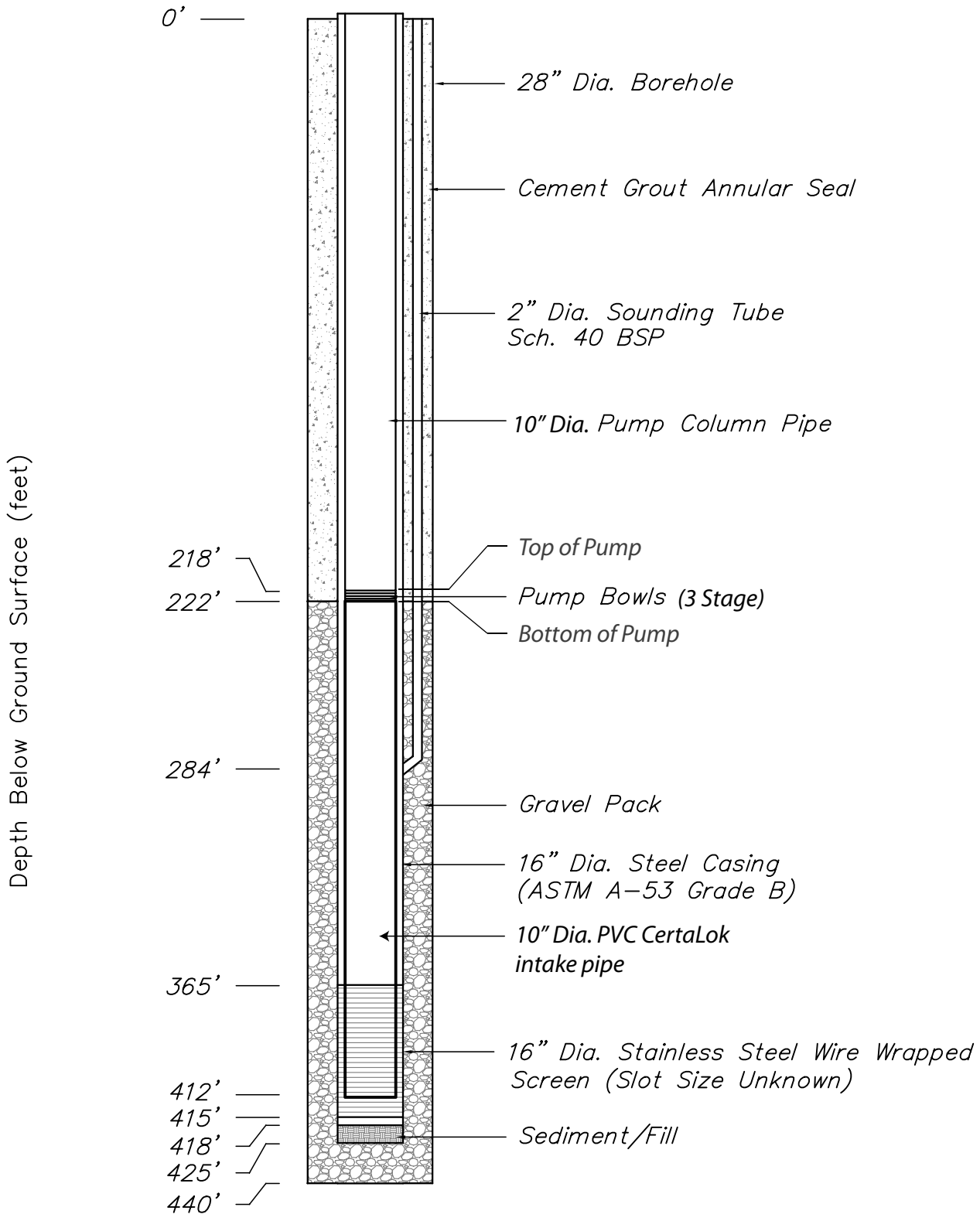


FIGURE 2
DRAWDOWN VS. TIME
PRE- AND POST- PUMP MODIFICATION



Canvasback Well



Note:
Well Construction Details Based on Driller's Well Log and 6/8/2010 Video Survey. And 2011 Modifications

California American Water Canvasback Well Pump Modifications	GEI Consultants Bookman-Edmonston Division	As-Built Well Construction Details December 2011 | Figure 3

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Table

TABLE 1
CANVASBACK WELL
TIME SEQUENTIAL SAMPLING RESULTS

Date	Pumping Rate (gpm)	Pumping Time (Minutes)	Arsenic (µg/L)
9/28/2011	1200	15	11
9/28/2011	1200	30	12
9/28/2011	1200	60	10
9/28/2011	1200	120	11
10/11/2010	1200	15	11
10/11/2010	1200	30	11
10/11/2010	1200	60	11
10/11/2010	1200	120	11
10/11/2010	500	15	11
10/11/2010	500	30	11
10/11/2010	500	60	11
10/11/2010	500	120	11