# Appendix B1

## Hydrogeology Response Memorandum

***Water Resources Assoicates, Inc.***
***Consulting Hydrogeology***

# Memorandum

***To:*** **Luke Evans - ESA**

***From:*** Devon F. Ayres, P.G. / Christopher Johnson, P.G. – Water Resources Associates, Inc.

***Date:*** September 18, 2020

***Re:*** Under Canvas – Yosemite DEIR Comment Responses: UC Specific

---

The following are responses to a series of comments provided by third-party reviewers. At the end of each response, annotations indicate which specific comments the response addressed.

Wetter Year

Overall, 2019 had higher precipitation than the average for the previous nine (9) years. However, the five months leading into the start-up of the pumping tests, were either as dry, or drier than, than those nine preceding years.

Comment: General comment from several sources

Discharge Area

The straight-line distance from Well 1 to the discharge point is about 1,075 feet, and from Well 2 it is about 1, 042 feet. Revised Figure 5 shows the straight-line distances from each of the Under Canvas wells to the discharge point within the SWRCB-approved discharge area. The red line indicates the 140-foot long spreading pipe.
Upon receipt of the RWQCB discharge waiver, WRA directed the drilling contractor to facilitate discharging as far from the wells as feasible. Figure 5 shows where in the RWQCB-approved discharge area the pumped contents from wells 1 and 2 was distributed.
Using the 5,000-gallon tank next to Well 2 for temporary control and storage, water was pumped to the indicated discharge point. The red line signifies the 140-foot long PVC discharge spreader were water was diffused. Water pumped from Well 1 was discharged the same as Well 2 except Well 1 discharged water first was pumped to the 5,000-gallon storage tank at Well 2, then on to the discharge point. Therefore, discharge from both wells went to the same discharge linear feature.

***Water Resources Assoicates, Inc.***
***Consulting Hydrogeology***

Comments KS 1

Water Balance – Evapotranspiration

Evapotranspiration in the vicinity of the Under Canvas – Yosemite project is estimated to be about 18 inches per year, according to Goulden et al, 2012.

As discussed in our report, "the average annual precipitation at the project site is estimated to range between 35 to 40 inches", however the watershed has extensive areas above snowline, meaning that rainfall is not the only source of runoff from the watershed.

WRA adopted a very conservative approach to describing a water balance for the facility, based on the following assumptions and conditions, as outlined in our report:

- Assumed "only" about twelve (12) inches of precipitation of rainfall per year.
- Assumed only ten (10) percent recharge to the project site area.
- Ignored snowfall as a source of recharge, vis a vis snowmelt.
- The average daily demand (anticipated to be 7,775 gallons per day) was increased conservatively upwards by about 21% (rounded up to 10,000 gallons per day).

Subtracting the estimated 18 inches of evapotranspiration, from the range of annual rainfall, still leaves more precipitation than the twelve (12) inches used in our assumptions. Furthermore, the twelve (12) inches of precipitation assumed, also accounts for drier year conditions as well.

Comment KS 2

Fractured bedrock storage

No drawdown was observed in the wells observed onsite, when the other onsite well was pumped, therefore an assessment of storativity was not possible from the pumping test data.

The recovery rates for Wells 1 and 2, are suggestive of the fracture storage, and potential fracture system recovery from recharge. Well 2 recovered from ten (10) continuous days of pumping (which will not occur during routine operations at the project site) at twice the anticipated operational demand (estimated at 20 gallons per minute for 500 minutes per day, or 10,000 gallons) to within 95% of the original static water level in about two (2) days, which meets the current SWRCB criteria.

Based upon anticipated operational conditions, which would see a lower demand and pumping duration, we believe that fracture storage supporting Well 2 is adequate for the intended facility operations. Well 1 took longer to recover to 95% but was still able to do so in about five to six days. As such, while the recovery rate satisfies the SWRCB criteria, Well 1 will be the back-up to Well 2.

Comments KS 3

Type and Duration of Pumping Test

Pumping test duration was determined based on SWRCB criteria, the anticipated operational discharge rate and duration of pumping for normal facility operations, and with consideration towards conserving a valuable resource while still providing adequate data to assess the viability of the pumped wells.

Drilling operations revealed indications of aquifer pressurization, evidence of potentially higher than anticipated volumes of water during drilling, and during airlift pumping after drilling. These initial conditions influenced the decision to possibly conduct a constant discharge pumping test, rather than the more frequently used constant drawdown.

As Dr. Schmidt points out, the utility of the constant drawdown test is that it better addresses the typical declining discharge rate that occurs with time during fractured bedrock pumping tests. By holding the pumping water level constant, the flow rate is varied to accomplish this, which in turn identifies the sustainable flow rate over the course of the test.

As Dr. Schmidt has noted, the water levels in the Under Canvas wells behave as if the fracture system in which they are completed is under pressure or confined. WRA initially intended to conduct a constant drawdown test. However, using an initial starting discharge rate of forty (40) gallons per minute (twice the anticipated flow rate) it quickly became apparent that the pumping water level had stabilized, as had the discharge rate.

The discharge rate remained roughly stable at 40 GPM for the entire duration of the ten-day long pumping test. The pumping water level remained relatively stable for the same duration of time. It could be argued that a constant drawdown test was achieved, with a constant discharge of 40 GPM.

In either case, the data suggests wells in a pressurized fractured bedrock aquifer that should support planned operations at the site.

Comment KS 4

Sustainability during Drought Conditions

Including evapotranspiration into the conservative water balance assessment, was addressed in a previous comment. The conservative assessment of water balance provided by WRA, which sought to incorporate evapotranspiration by excluding snowmelt; and assuming only 12 annual inches of precipitation and only 10% recharge to the fractured bedrock aquifer system, supports the conclusion that the development does not appear to place a burden on the available groundwater supply in the project vicinity, even during period of extended drought".

The demand placed on the fractured bedrock aquifer during the pumping test produced about 32% of the annual demand in only the ten days of the pumping test. And yet recovery was relatively quick, well within the SWRCB criteria. Furthermore, the interpreted isolation between the Under Canvas wells and the Terra Vi wells, as evidenced by no impact on the Terra Vi wells during the Under Canvas pumping tests, along with the different water chemistries between these wells, further emphasizes the separation between these two demands.

Related to KS 2,3,4

Depth to water, transmissivity comments

Noted.
Comments KS 6, 7

Terra Vi Discharge Area

To the best of WRA's understanding, the Terra Vi discharge area is to the northwest of UC Well 1, by about 1,500 feet, and 2,000 feet from Well 2.
Comment KS 8

References

1. Goulden, Anderson, Bales, Kelly, Meadows, Winston, 2012, "Evapotranspiration along an elevation gradient in California's Sierra Nevada, Journal of Geophysical Research, v. 117, pg. 1-13. (https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2012JG002027)

Comments

1. General comment, Dan Courtney, July 21, 2020
2. Kenneth D. Schmidt, correspondence to Dan Courtney, July 30, 2020