Technical Memorandum February 19, 2017

To: W.A.T.E.R. & Gateway Neighborhood Association (GNA)

From: Timothy K. Parker, PG, CEG, CHG, Parker Groundwater

Subject: Technical Review of Crystal Geyser Bottling Plant Project Draft Environmental Impact Report (DEIR) for groundwater impacts and issues

I am a California Professional Geologist (License #5584), Certified Engineering Geologist (License # EG 1926), and Certified Hydrogeologist (License #HG 12), with over 25 years of geologic and hydrologic professional experience. My Resume and Project Experience are attached. I reviewed the groundwater portions of the subject DEIR and below are my comments.

DEIR CONCERNS AND DEFICIENCES

- Specific concerns and deficiencies regarding the DEIR and groundwater studies conducted include:
    - The studies were focused solely on the connection between the Crystal Geyser bottling plant production well (DEX-6) and Big Springs, and not on potential third-party impacts to adjacent domestic wells, and are therefore inadequate to determine a "no significant impact finding."
    - The hydrogeology is particularly complex leading to significant uncertainty and raising concern that neighboring domestic wells will be impacted, and there are no mitigations provided for if and when these impacts occur.
    - Testing of the interconnection between the lower aquifer system (fractured volcanic rock) from which the production wells pump, and the upper aquifer system (alluvial sand and clay) that dominantly supplies domestic wells was never evaluated. And only theoretical calculations have been used to predict the potential impact of renewed plant operations.

SUMMARY OF WORK PREVIOUSLY DONE

- Crystal Geyser and others have conducted groundwater studies for the proposed beverage production and bottling facility in the Mount Shasta area. The conclusions of those studies have been that increased pumping demand from plant operations will not cause significant or unreasonable impacts on groundwater levels in the plant area or on Big Springs. These studies were focused primarily on determining the connection of Crystal Geyer production well DEX-6 to Big Springs and the studies were in no way designed to specifically assess potential third-party impacts to domestic wells adjacent to the Crystal Geyser plant. Their conclusions are based on a number of factors including the amount of groundwater proposed to be pumped, compared to the amount of precipitation and rough estimation of groundwater availability.

- DEIR Appendix P, Hydrogeologic Evaluation Report summarizes the work and interpretations of a number of previous groundwater studies conducted for the bottling facility. The Appendix P report "preliminarily" concludes that pumping of the Crystal Geyser DEX-6 and Domestic Well is predicted theoretically to have minimal drawdown on the Big Springs and nearby domestic wells, and potential impacts to the water quality of Big Springs is anticipated to be minimal. There was no new data collection in the scope of the work completed under the Appendix P report; only field reconnaissance on observation of the plant and surrounding area. The report relied on work performed by previous studies on characterizing the hydrogeology, previous studies that were not designed to assess potential third-party impacts to domestic wells adjacent to DEX-6 well or the plant Domestic Well near the Crystal Geyser plant.

COMMENTS

- Recognizing the efforts to characterize the local hydrogeology by Crystal Geyser, the hydrogeology in the Mt Shasta area is extremely complex, consisting of volcanic deposits and reworked volcaniclastic sediments, overlain by alluvium, with an active tectonic overprint of fractures and faulting. Additionally, there is no water budget for the area, which is a local accounting of inflows and outflows to the system, a very basic hydrologic tool for tracking changes in the hydrologic system. This leads to considerable uncertainty in the findings and we believe justifies monitoring as a precautionary measure to assure no third party impacts from plant operations.

- The nearby community with private domestic wells needs protection from their wells impacted by groundwater quantity or quality issues due to the proposed operations Crystal Geyser. A number of adjacent domestic wells experienced water level and water quality issues during previous plant operations, which were not documented in previous reports, but can be verified by domestic well owners. These well issues disappeared once the previous plant operations ceased in November of 2010.

- There is no guarantee that domestic wells will not be impacted and domestic wells owners have a right to be concerned. The relationship and connectivity between the "shallow aquifer" and "lower aquifer" are not well characterized or reported. They are likely connected, at least to some degree, and in dynamic equilibrium, and it is not clear if some minor or potentially significant impacts may occur with long-term increased pumping of the plant operations in the future.

Recommendation: In order to protect their domestic wells, the community requests assurances their wells are not going to be impacted and that a groundwater-monitoring program be implemented including a number of nearby domestic wells to create a baseline of information, followed by periodic monitoring to measure any changes in the system during the startup and implementation of plant operations. The neighborhood currently has a groundwater level monitoring program (The Big Springs Area Groundwater Elevation Study), which could be leveraged and/or integrated to assure groundwater resources are sustained in the area.

- The upper and lower aquifer systems appear to be connected, and are certainly interconnected through wells that screen both and may be conduits for impacts. The actual geometry of the hydrogeologic system in the vicinity of the plant is quite complex, because depositional systems in volcanic terrain are composed of great lateral and vertical variability, due to the different rock types typically involved, including but not limited to fractured volcanic rocks, lahars, ash fall tuffs, and ejecta. This is especially true on the slope of an active volcano like Mount Shasta which includes the possibility of fractures and faults that may be barrier or conduits to flow, volcanic tubes and other connections between producing zones which are impossible to predict, and can only be known when impacts occur. Further, the static water level depths in many Crystal Geyser wells appear to indicate that groundwater is likely governed by unconfined conditions in the fractured rock system. However, a few wells also appear to have groundwater contained in different depositional systems that are discontinuous from these fractured andesite aquifer system.

- Groundwater Flow Direction and Gradient - Appendix P: Appendix P is an Hydrogeologic Evaluation yet it does not include a ground water level contour map, which is the most basic of tools used by a groundwater professional. The groundwater gradient was calculated using a simple three-point problem and the result was a flow direction to the south, and not to the southwest towards Big Springs. When an additional well was added to define the groundwater gradient, the flow direction was to the northwest. A more southerly flow may also result in greater potential for impacts to residential wells to the south, as the production well would be intercepting groundwater destined for the domestic wells. **This analysis once again demonstrates the complexity of this particular hydrogeologic setting and system, the need for additional data, monitoring and an adaptive management and corrective actions if necessary to avoid third-party impacts, and taking a precautionary approach to the proposed project until more is known and documented about long-term pumping on the aquifer(s) system.**

- The suggestion that groundwater flows south or northwest, versus towards Big Springs, once again raises some questions about the validity of the connection of DEX-6 to the Big Springs, where direct tracer tests were never used or reported to connect the pumping well DEX-6 to Big Springs, but instead had to use a tracer test in a well very near to Big Springs, and then an aquifer pumping test of DEX-6 to demonstrate a groundwater level response in Dex-1, connecting DEX-6 to DEX-1 and DEX-1 to Big Springs. There was very little drawdown in Dex-1 from the pumping of DEX-6, which may suggest that while DEX-1 was within the zone of influence of DEX-6 pumping, it may not have been within the zone of capture of DEX-6 pumping. The zone of influence is basically the outline of the zone of depression that forms from groundwater pumping, but is larger and not the same as the zone of capture for a pumping well. Basically this would bring into question whether DEX-6 would actually be capturing the same groundwater as that emanating from Big Springs.

- Based on our understand of the aquifer pumping tests of DEX-6, no upper aquifer system wells were monitored, demonstrating that the focus of the studies has been solely to evaluate the production capability of the pumping wells and to try to demonstrate the hydrogeologic connection with Big Springs. Therefore, there has not been hydrogeologic evaluation of the interconnection between the upper and lower aquifer systems.

- Presentation of plots "accumulated departure" (correctly termed "cumulative departure") of precipitation and groundwater suggest correlation of the minor groundwater declines with "deficient precipitation" (correctly termed "cumulative precipitation deficit"). The period of record is short and data available is limited to draw this conclusion, as this may in fact also be correlated with greater pumping demand during drier years, and as is admittedly stated, associated with former plant operations.
  Recommendation: Collecting and assembling additional historical data from nearby wells and past climate to look at longer period of record would be

useful to further assess the potential correlation between hydrologic cycles, groundwater level trends and pumping demands.

- Two dye tracer tests were completed in June 1998 in DEX-1 by a Danone International Brands, Inc. contractor on well DEX-1. Four sampling stations located along the natural orifice of the spring and one station within the creek below the confluence of all spring flow emergences were used to collect discrete samples. In addition, real time field fluorometer sampling was performed at one station. The first test involved introduction of 500 gallons of fluorescein at a concentration of 100 parts per billion, with a result of no detections at the sampling stations. Since the first test was negative, a second test was conducted with the same volume and procedure with an increase of approximately 500 times the initial fluorescein concentration to 50 parts per million, and fluorescein was reported at two of the Big Springs stations and the creek monitoring stations.

  Discussion: Review of the state approved plan for the tracer test that the test was required to be conducted using an initial fluorescein dye concentration 100 ppb and if no detections, then the dye concentration would be increased by 100 times to 10 parts per million, however, the dye was actually increased to 57.8 PPM, or more than 5 times the agreed upon concentration. The approved plan also indicated that three of the Big Springs monitoring stations needed to have a positive response for fluorescein, however only two of the actual Big Springs stations had a positive measurement – the third one reported was actually in the creek, not a Big Springs station. That only two of the Big Springs monitoring stations had results and those were quite low suggests a fairly weak hydraulic connection considering the high concentration of the tracer dye and suggests a much stronger southerly component of groundwater flow from DEX-1 to Big Springs than the studies and reports indicate. Again, a more southerly flow may result in greater potential for impacts to residential wells to the south, as the production well would be intercepting groundwater destined for the domestic wells.

  Recommendation: The ambiguity in the procedures, results from the approved plan leads this once again to the conclusion of very complex and heterogeneous hydrogeology in the area of the Crystal Geyser plant, and the need for additional evaluation and monitoring to protect local residents' domestic wells and water supplies.

- Two water-supply wells are to be used at the plant: DEX-6 for production of bottled beverages, and the plant Domestic Well, for the plant's internal domestic use, the fire suppression tank, and other operational uses.

Formerly, the plant reportedly used approximately 160 gallons per minute (gpm) on a monthly average basis, which is approximately 230,400 gallons per day (gpd), 0.71 acre-feet per day (afd), and equivalent to 259 acre-feet per year (afy). The new Crystal Geyser plant is proposed to have two separate production lines which will be started up in phases, with Phase 1 having one production line starting up in 2017, and Phase 2 with the addition of the second production line at a later date. Production line one is anticipated to use an average of approximately 80 gpm on a monthly basis, approximately 115,000 gpd on an average annualized basis,or 129 afy. In the future, with two production lines operating, the plant would use an average of approximately 151 gpm on a monthly basis, annualized average of 217,000 gpd, or 243 afy. Considering the complexity of the volcanic terrain hydrogeology, the lack of data and analyses on the interconnectivity between the lower aquifer groundwater production zone of the plant and upper aquifer supply zone of the adjacent residential domestic wells, there may be an affect on the upper zone wells when the lower zone production is at peak pumping. A correlation may be determined if peak and aggregated daily, monthly and annual production rates are measured, recorded, and reported. **Recommendation:** The peak as well as daily, monthly and annual aggregated averages should be made measured, recorded and reported. If there appears to be an affect of Phase 1 production, then Phase 2 should be delayed until additional evaluations are conducted and mitigation is completed.

- Proposed Industrial Wastewater Discharge on Project Site – Several options are proposed for industrial wastewater disposal on the project site, none of which should be implemented considering the proximity of domestic wells pumping the shallow groundwater that will be impacted by this proposed waste disposal. All of these options will degrade the groundwater quality to some degree, which is ignored in the DEIR, as the options are compared to drinking water maximum contaminants levels.
  Recommendation: Further analysis should be conducted including fate and transport of wastes proposed to be disposed into the groundwater, and an antidegradation analysis should be conducted considering the assimilative capacity of the aquifer, which should be provided to the Regional Water Quality Control Board.

- Thresholds of Significance – The Thresholds of Significance Analysis considers the possibility of third party impacts to local domestic wells and their owners adjacent to the plant by proposed bottling facilities operation using a simplistic model, which does not consider the complexity of the local hydrogeology. The concern here relates once again to the technical analysis that has been conducted which has focused on the "lower aquifer" and potential impacts to Big Springs, with very little attention or technical analysis of the "upper aquifer" and potential third party impacts to domestic wells mostly drawing water from the upper aquifer. The "upper aquifer" and lower aquifer" are likely connected; there is no technical evidence to demonstrate otherwise, and analysis to demonstrate a less than significant impact to adjacent domestic wells is theoretical.

Recommendations: additional data collection, monitoring and data evaluation by qualified groundwater professionals is necessary as is recommended in **Appendix P Hydrogeologic Evaluation Report**, consultants to Crystal Geyser. This should include, but not be limited to (modified from Appendix P):

1. Plot the production volumes from each well, along with precipitation, static water levels and pumping water levels, in order to assess the correlation and potential impact of pumping on groundwater levels in all monitored sites. The periodicity of data collection should be scaled to capture the short- and long-term potential impacts of pumping and aquifer response. For the Crystal Geyser plant, this should include DEX-6, DEX-3A, DEX-3B, DEX-1, and the facility plant Domestic Well; additionally, a subset of the domestic wells in the "Big Springs Area Groundwater Elevation Study" Area monitoring program would be useful to include.

2. Perform detailed hydrogeologic evaluation to determine the water budget and sustainable yield of the aquifer systems in the area. This is typically comprehensive in determining the water balance of the area and involves the following general elements:
   - Collection of hydrometeorological data to differentiate between plant operations and climate variations and determination of a Baseline Period based on precipitation data.
   - Recharge to the aquifer systems by precipitation and/or surface water.
   - Irrigation returns.
   - Input via septic/leachfield systems.
   - Average household usage of water.
   - Outflow from springs.
   - Extraction by all pumping wells.
   - Groundwater underflow into and from the aquifer systems.

3. Conduct a longer-term aquifer test on the Domestic Well, in order to determine aquifer properties of the "shallow" aquifer system, further assess shallow aquifer heterogeneity and interconnection with the lower aquifer, and to adequately assess the potential impact on adjacent domestic wells. This may be able to be performed by packing off the "deeper" fractured rock aquifer system and pumping from only the shallower alluvial sediments.

(These alluvial sediments may not be able to yield significant quantities of water to a well, based on their fine-grained nature, although some sand and gravel layers could produce greater amounts, comparatively. Such testing could provide a final determination of this).

4. Changes in spring flow over time should be plotted against total pumping of the plant wells and changes in precipitation over time.

5. Plot temporal changes in key water quality constituents in groundwater samples from the wells. Typical key water quality constituents would be TDS, EC and selected cations and anions, such as Ca, Mg, Na and HCO3, SO4 and Cl. Tracking changes in these constituents would provide indication of any possible gross changes in the water quality that may by introduced by pumping of the well.

6. Monitoring results should be reported annually and results should be reviewed and assessed for potential local impacts prior to start up of Phase 2. Monitoring should be designed and implemented to be capable of assessing short- and long-term effects and potential impacts on groundwater levels and groundwater quality of the average and peak production pumping on the local area, including adjacent domestic wells and Big Springs. In order to be transparent and to show no impacts, groundwater level monitoring results should be made available and accessible on a website.

7. The recommended additional testing and monitoring should be implemented in advance of plant startup to establish baselines and ensure equipment is working effectively.

8. If monitoring reveals groundwater level declines affecting the operation of residential domestic wells adjacent to the plant, mitigation measures to be considered should include changing the plant groundwater production schedule and ramping down plant pumping to reduce or eliminate impacts to domestic wells.

9. If residential domestic wells are demonstrably impacted by plant groundwater production, Crystal should be held responsible for well repairs and or well replacement.