AQUIFER STORAGE AND RECOVERY (ASR) WELL SYSTEM: AN ARIZONA EXPERIENCE WITH RECLAIMED WATER

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The storage and re-use of reclaimed water is a large part of the overall water solution for many Arizona communities. The higher demands placed on utilities during the summer and lower demands during the winter results in a reclaimed water system that needs to be flexible. To provide that flexibility, some communities, such as the City of Chandler, utilize aquifer storage and recovery (ASR) wells to store excess reclaimed water in the shallow aquifer during periods of low demand and pump the stored water into a reclaimed water system during periods of high demand. The technology and systems to allow ASR wells to operate efficiently and reliably with reclaimed water are varied, but this article will describe the City of Chandler's experience with ASR well systems utilizing reclaimed water.

Overall Need

For some Arizona communities, including the City of Chandler, there are no viable means to discharge reclaimed water to an existing wash or river system. In addition, when discharging reclaimed water to these waters a community does not fully benefit from this water resource. This could result in a community purchasing additional water resources to make up the difference in their overall water portfolio.

Aquifer storage and recovery provides an alternate means to seasonally store the excess water when demand is low for landscaping or other reclaimed water needs. Also, this method of recharge is particularly effective during periods of high rainfall such as during the annual monsoon season or other extreme events. When a community has no other means to discharge reclaimed water, ASR wells can act as an additional discharge point but without the additional testing to meet NPDES requirements that would be required for discharging to a wash or river system.

Recharge Technology

The act of recharging water into the shallow aquifer requires a means to regulate the amount of reclaimed water flow based upon the surrounding hydrogeologic conditions. One piece of technology is utilizing an in-hole stainless steel flow control valve which regulates the open/closed position of an internal bladder with compressed air or nitrogen gas. A higher pressure setting results in a partially closed or fully closed position. A lower pressure setting results in a full open or partially open setting. Figure 1 and Figure 2 indicate the flow control valve prior to installation.


Figure 1

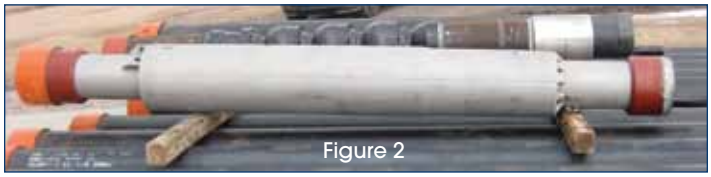
Figure 2

Figure 3 and Figure 4 detail the compressed air system which also incorporates a high pressure nitrogen gas as a back-up source. The infinitely variable flow control valve can be regulated by maintaining a water level within the ASR well or an operator selectable set point.


Figure 3


Figure 4

When recharging water through a well pump, some additional equipment is required. A key piece of equipment is a check valve located beneath the pump bowl assembly. The check valve will not allow the recharge water to escape from the bottom of the bowl

assembly, but through the above mentioned flow control valve. The check valve will need to be constructed of material to resist corrosion and repel the high pressure conditions. Another feature to include in the well pump is within the motor. The motor needs to include non-reverse ratchets (NRR) to ensure the well pump does not spin backwards during the recharge mode of operation.

Recharging reclaimed water into the shallow aquifer will diminish in capacity over a period of time. This is due to a number of factors. Some may include any remaining suspended solids in Class A+ effluent and possible biological growth. To counter act this effect, the well pump ceases to recharge and is commanded to turn on to the purge mode of operation.

Purge Water Management

Purging an ASR well is necessary to maintain its peak performance over the long term. The act of purging includes running the well pump for a pre-determined time period to allow the material built-up during the recharge mode of operation to exit the surrounding filter pack and well casing louvers. For comparison between modes of operation, the City of Chandler utilizes the purge mode of operation for twenty minutes for every eight hours in the recharge mode of operation. The purge mode of operation is variable, based upon the specific community, and would be modified based upon underlying hydrogeologic conditions.

The amount of water generated during a purge mode of operation, depending upon the capacity of the recharge well, can be significant. For example, each ASR well within the City of Chandler purges at a flow rate of 1,000 to 1,500 gallons per minute. Simply putting the purge water into the sewer system is one available option, but may require additional hydraulic capacity at the water reclamation facility to accommodate the flow. One possible option the City of Chandler is considering is to treat purge water by mechanically removing the solids and pumping the remaining flow into the reclaimed water system. Utilizing electrically actuated valves will control where the flow goes, whether the well is in the recharge mode of operation or the purge mode of operation. Refer to Figure 5 and Figure 6 for reference.

Well Pump for Recovery

Similar to purging an ASR well to maintain its recharge capacity, the well pump can be utilized to recover recharge water and place it within the reclaimed water system. The well pump would then operate very similar to any other well placed on a distribution system. The major difference is ensuring the flow control valve is closed during operation and the proper electrically actuated valve configuration is completed.

Figure 5

Figure 6

For many Arizona communities, including the City of Chandler, utilizing aquifer storage and recovery wells as part of their reclaimed water systems will ensure reclaimed water disposal is efficient, reliable, and provides another component to an overall water portfolio.