By Pat McCool, KRWA Consultant

Good Water Quality Wells Gone Bad

Excessive iron in well water will likely lead to situations such as shown here on a pigging project. Ignoring treatment will only create significant problems for the system and customers as time goes by.

Kansas has many good water-quality wells serving cities and RWDs and others. These wells are a result of good water quality aquifers, adhering to good construction standards, and testing water quality before construction. These wells meet drinking water standards with only chlorination required by the Kansas Department of Health and Environment (KDHE).

However, over the years, the water quality of some wells has changed for the worse, resulting in the abandonment of a well or the construction of an expensive water treatment plant. This occurred because either nitrate, iron, manganese, arsenic, or selenium increased above drinking water standards. These wells were abandoned or a treatment plant was constructed without first determining the cause of the change in water quality and evaluating how to eliminate or mitigate the cause of the water quality change.

The following examples show how the matter of good water quality wells gone bad was handled differently by different public water supplies (PWS), their consultant, and the KDHE approval process.

Water Supply No. 1: Nitrate

This water system has six water supply wells. After many years of operation, three wells became high in nitrate. A water treatment plant was constructed, and residents now have much higher water bills. There was no curiosity and no evaluation of why three wells were high in nitrate and the three other wells were in compliance. A geohydrology evaluation of the wells, the aquifer, and the physical condition of the three wells could have determined that the wells could have been rehabbed or offset, resulting in low nitrate in the three high nitrate wells even at the same locations. There also was no evaluation if the six wells could be blended to reduce the nitrate of the six wells combined.

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Water Supply No. 2: Nitrate

This system has two water supply wells. After many years of operation, the nitrate levels increased in both wells. The system and its geohydrology consultant determined the causes of the nitrate increase and eliminated the main cause. The nitrate level then began to decrease. The city also constructed a new well that was low in nitrate to further reduce the nitrate level by blending the new well water with the two existing wells.

Water Supply No. 3: Manganese

This water system has a well that has declined in providing quality water over the years. This well had no manganese at all from 1960 to 1974. Manganese levels increased to 0.9 mg/l and higher – three times the KDHE guidance level. Thus, the city took the well off-line. Unfortunately, this well and the city water rights were such that the city wanted to keep using this well's location. Thus, it is known that the groundwater aquifer water quality at the well's location had been good in the past and most likely still is now. The problem is with the well and not the groundwater.

The water system and its geohydrology consultant evaluated the well and found several structural problems and extensive bacterial growth. Bacterial growth is the cause of the high manganese, and the structural problems caused or exacerbated the bacterial growth.

The city rehabbed the well, and now it produces good quality drinking water just as it did in the 1960s. The city did not have to construct a manganese removal treatment plant.

This photo shows iron deposits and bacterial growth inside the well pump discharge line.

Avoid water treatment for well water if possible. First, evaluate the well for changes in water quality. This photo shows a pressure sand filter to remove iron in a rural water district plant located in northeast Kansas.

Water Supply No. 4: Arsenic

The city has a well, and after many years of operation, the arsenic level in the well water increased until it did not meet drinking water standards. An expensive arsenic removal treatment plant was constructed and now the residents have much higher water bills. There was no effort or evaluation to determine the cause of the high arsenic and possible corrective actions.

There was no curiosity and no evaluation of why the arsenic level in the well water increased. A geohydrology evaluation of the wells, the aquifer, and the physical condition of the well could have determined that the well could have been rehabbed or a new well constructed, resulting in much lower arsenic.

Water System No. 5: Iron

In the late 1990s, the water system constructed two wells and an ion-exchange water treatment plant to soften the water. The plant was not designed to remove iron as the levels of iron in the groundwater are very low. After many years of operation, the wells became high in iron, causing operational problems at the treatment plant. The water district and its geohydrology consultant evaluated the wells and determined that the wells had developed severe bacterial growth.

Bacterial growth and electrolysis were the cause of the high iron. The bacterial growth is probably from incorrect well maintenance. The well was rehabbed, the iron level returned to lower levels, and treatment plant operational problems were greatly reduced. The only other alternative would be to add an expensive iron removal process.

Causes of good water quality wells "Gone Bad"

In general, there are two classes that most wells "gone bad" can be placed in. Each class is different because of how the contamination develops. The two classes are: 1) nitrate; and, 2) iron, manganese, arsenic, and selenium.

Nitrate contamination is from nitrate moving through the soil down to the water at the top of the aquifer. Water from well pumping is then contaminated with nitrate because of the higher nitrate water at the very top level getting down to the well screen by some conduit such as another well or boring, nearby monitoring wells, improper well construction, or by excessive drawdown.

Iron, manganese, arsenic, and selenium are usually a result of bacterial contamination of the well and/or deterioration of the well and/or improper construction of the well. Iron, manganese, arsenic, and selenium are in the aquifer sand and gravel minerals and have been there since the aquifer was formed. For these elements to get into the water being pumped, something changed. A geohydrology consultant can evaluate the well to determine and correct "that something".

Recommendations

Well casings and well screens can deteriorate over many years of use from corrosion and bacteria growth. If a well has been in service for 30 to 40 years, it is recommended that the well be inspected using a camera so its video is reviewed. After the well is videoed, then either the well is good and will be good for another 30 years, or corrective actions need to be taken to ensure the well is good for many more decades. Well problems caught early might be corrected for far less costs than waiting for a well production failure.

Annual Conference & Exhibition, March 28 – 30

Water quality and water well operations are the focus of a presentation to be given by Geohydrologist Ned Marks of Terrane Resources Company at the KRWA Annual Conference. The presentation on Wednesday afternoon, March 29, is entitled "Enhanced Maintenance for Public Water Supply Wells". Anyone who wants to know more about Good Water Quality Wells Gone Bad, and anyone who wants to know what to do to keep the water quality from going bad, is encouraged to attend.

Pat McCool has worked as a consultant to KRWA since January 2004. He previously worked for KDHE for 30 years. Pat has a bachelor's degree in Chemical Engineering and a master's degree in Environmental Engineering from the University of Kansas.


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