By Pat McCool, Consultant, KRWA

Water Quality Changes Due to Well Condition

Hydrogeologist Ned Marks of Terrane Resources, Stafford, Kansas, evaluates subsurface geology from a test hole for well water quality and water production purposes.

There are many water wells in Kansas that for many decades have provided good, reliable water production and excellent water quality for public water supplies. However, sometimes the water quality changes for the worse such as from compliance with drinking water standards to non-compliance. It may be the case with primary drinking water standards such as nitrate, selenium and arsenic, and with secondary drinking water standards such as iron and manganese.

In the cases of primary drinking water standards, the Kansas Department of Health and Environment (KDHE) requires that the public water supply take action to notify the public and to bring the water back into compliance with the primary standards. Frequently, an expensive water treatment plant is constructed to remove or reduce the level of the "offending" element or compound.

Other possible solutions include constructing a new well, blending with better water from another source, or eliminating or mitigating the cause of the change in water quality. Sometimes a well is abandoned or, when the non-compliance is not corrected, placed on standby status for emergency use only.

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Changes in water quality

The causes for well water quality changes can be placed into either of two mechanisms. First, water can change from contaminants on the ground or just below the ground surface, dissolving in rainwater and then the rainwater percolating down though the soil and permeable rock to the aquifer. Second, surface water could be flowing directly down to the aquifer through conduits such as abandoned wells or other wells.

An example of this physical transport of the contamination is how nitrate enters the upper levels of an aquifer. This was discussed in an earlier *Lifeline* article and can be found at: https://krwa.net/portals/krwa/lifeline/1907/WaterWellProblems.pdf.

The second mechanism is the change in the water quality due to changing conditions in the subsurface, in and around the well. One condition is small, undissolved particles of silt and clay, containing the undissolved contaminants, entering the water due to physical change or damage in the casing, screen, or gravel pack. This can occur due to corrosion damage to the casing or screen, overpumping and other damage to the well.

A second condition is the lowering of pH of the groundwater in and near the well due to bacterial growths. By lowering the pH, elements and compounds in the geological formations can be solubilized into the water and also can be accumulated with the bacterial growths. Such can be the case for iron, manganese, arsenic and selenium.

For example, an increasing concentration of arsenic in well water can be from undissolved particles containing arsenic, entering the water, or from bacterial growths solubilizing arsenic into the water, or from bacterial growths accumulating arsenic and entering the water, or any combination of these.

Water well investigation

When well water quality changes for the worse, an investigation to determine the cause of the change should be initiated. This is especially important when the resultant quality is not in compliance with drinking water standards. If the cause can be determined, then corrective action might be possible and economical to bring the water quality back into compliance. Such a solution might preclude the construction of an expensive water treatment plant.

An example is the arsenic level in well water. The first requirement on the level of arsenic in drinking occurred when the Environmental Protection Agency first promulgated an enforceable maximum contaminant level (MCL) for arsenic in January 2001. The requirement was to take effect in January 2006.

Hydrogeologist Ned Marks collects numerous water samples as part of a well water quality investigation.

The MCL was established at 0.010 milligrams per liter (mg/l) after much controversy. The 0.010 mg/l is also sometimes stated as 10 micrograms per liter (ug/l) which is 10 parts of arsenic per one (1) billion parts of water.

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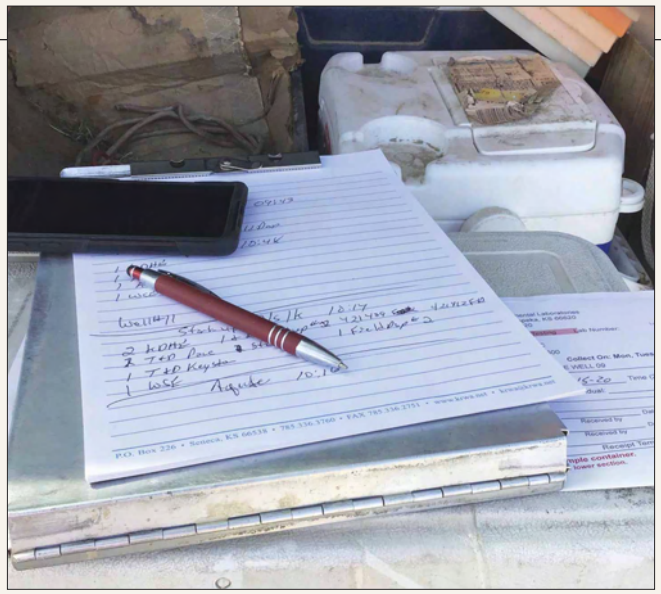
Most likely the cause of an increase of arsenic in well water quality is arsenic-containing, undissolved particles entering the water, or arsenic minerals in the clay, silt, sand, or gravel being solubilized into the water as a result of extensive bacterial growth. In Kansas the possibility of a pollution source contributing arsenic is extremely rare.

There are situations where a well has had low arsenic levels for many years or decades and then the arsenic levels increase to unacceptable levels. What has changed and can it be corrected? Those are the obvious

It requires numerous containers for water samples for the various parameters for just one water sample at one location and one time.



Notes logged on-site help ensure correct sampling location, sampling time, and each parameter.

questions that need to be investigated and answered.

When water suppliers sample water for arsenic for compliance purposes, the analyses is for the total amount of all types of arsenic in the water. However, for investigating the increase in arsenic levels in well water, more extensive analyses must be undertaken.

Investigation analyses should include both the undissolved and dissolved arsenic concentrations. Both of these analyses should be for samples collected at the beginning of the well pumping cycle, and at different times during the pumping cycles.

Investigation analyses might also include determining the presence or amounts of the different types of bacteria that are present in the well. As mentioned, these bacteria can cause solubilization of arsenic compounds into the water from the subsurface formations.

Depending on the results of the above analyses, on the subsurface geology, and on the construction of the well, the construction of a monitoring well nearby might be warranted and might provide valuable information on the cause and the reduction of arsenic in the well from information obtained and evaluated. The investigation might determine that the well condition or conditions are causing the increase in arsenic. If that is the case, then it is quite possible to "rehabilitate" and/or repair the well to reduce the arsenic to an acceptable level in the well water. Also, the investigation might determine whether an "offset" well with low levels of arsenic could be constructed nearby.

Your well water quality

Well water quality changes or problems usually are first realized from either consumer complaints (e.g., iron and manganese) or routine, regulatory-required monitoring of the water quality (e.g., nitrate and trihalomethanes). When either a change or problem is suspected or first known, a water supplier should seek advice on how to proceed.

However, it should be remembered that sometimes the analytical data may be incorrect, or misleading, or transient, or unrepresentative. KRWA has seen many cases of such analytical

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data when caution is advised in making conclusions on the basis of one sample.

If the well water quality is trending in the wrong direction or is out of compliance, then a geohydrology, water quality investigation might be warranted. Such an investigation should be undertaken by a hydrogeologist with considerable experience in water well construction, geohydrology, and water quality investigations.

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Water quality changes for the worse have resulted in required public notice and possible system upgrades. These include: construction of an expensive, complex water treatment plant; construction of new water wells; or, purchasing water from another water supplier. Before funds are spent on expensive construction or purchasing water, an investment should be made to determine the causes and possible correction of the water quality which may be less expensive and more acceptable.

When anyone receives water quality complaints or water quality data that may indicate something has changed for the worse, feel free to contact KRWA to assist in determining the significance and implications of the data. Contact the KRWA office at 785/336-3760 or email me at pat@krwa.net or call me at 785/215-9427. Understanding the data is the first step in determining what needs to be done, if anything.

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