

ARSENIC IN DRINKING WATER COMPLIANCE SUCCESS STORIES

McCook, NE: Addressing Multiple Contaminants Through Treatment and Blending

Case Study Contact Information

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Many of the production wells for McCook, Nebraska, have elevated levels of arsenic, uranium and/or nitrate. The selected compliance approach allows the City to meet federal Maximum Contaminant Levels for all three contaminants.

Lessons Learned

The City of McCook, NE evaluated several mitigation approaches before deciding on ion exchange treatment and blending to address the terms of a consent decree and their long-standing source water contamination problem with arsenic, uranium, and nitrate.

System Description

The [City of McCook](#) EXIT Disclaimer is located in the southwestern portion of Nebraska in Red Willow County, approximately 14 miles from the Kansas border. The City provides drinking water service to 7,994 people with an average daily demand of 2.38 MGD. The drinking water supply is provided by 9 wells located in an alluvial aquifer adjacent to the Republican River. A tenth well was recently abandoned due to high levels of nitrate and uranium. The wells have an average depth of 70 feet and range in production capacity from 177 gpm to 1,400 gpm. The largest well is not used often due to high nitrate levels (14 mg/L).

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Source Water Contamination

Under the terms of a consent decree, the City of McCook agreed to make improvements to its drinking water system to ensure compliance with maximum contaminant levels for [nitrate, uranium, and arsenic](#) EXIT Disclaimer. The consent decree was spurred by violations of the Clean Water Act over a 5-year period in addition to Safe Drinking Water Act violations for nitrate and uranium.

Many of the City's production wells have elevated levels of nitrate, uranium, and/or arsenic. Arsenic has been detected in City wells at levels of 10-15 ppb. Results of water sampling conducted in 2003 show that arsenate (As(V)) comprises 70 to 90 percent of the arsenic in two City wells. The City has been dealing with high nitrate levels for 17 years. Nitrate levels at the point-of-entry to the distribution system were greater than 10 mg/L in two of four samples collected in 2005. Based on water sampling results from 2005, the average uranium level in the distribution system is 32 ppb.

Nitrate levels drive the selection and combination of production wells used on a particular day. City personnel carefully plan the combination of wells in service at any one time to assure that the treatment system can remove nitrate, uranium, and arsenic to safe levels.

Water Treatment Selection

The City selected an ion exchange treatment system to remove arsenic, nitrate, and uranium from the drinking water supplies. The treatment process includes a cation exchange reaction for water softening, and an anion exchange reaction to remove the contaminants. The treatment plant, rated at a 6.8 MGD production capacity, was built in about 14 months and put into service February 7, 2006. Depending on which sources of supply are being used, the treatment system is set up to treat 50 to 55 percent of the water, and the remaining water bypasses the treatment process and is blended with the treated water. The finished water contains nitrate levels less than 8 mg/L, arsenic levels less than 8 ppb, and uranium levels of 25 ppb. ([McCook Community Profile](#) EXIT Disclaimer)

Maximum Contaminant Levels (MCLs) Allowed by Drinking Water Regulations	
Arsenic	10 ppb
Nitrate	10 ppm
Uranium	30 ppb

Water Treatment Options

The ion exchange resin is periodically regenerated on-site, producing a liquid waste stream that includes backwash water, brine solution, and rinse water. The brine solution may contain high levels of arsenic, nitrate, and uranium. As an interim measure, the City is currently discharging this waste stream to the wastewater treatment plant, located two

miles from the water treatment plant. For the February to June 2006 period, an average of 2.6 percent of the water produced was wasted in the treatment process.

The City has identified a deep earth injection well as the only viable long-term solution for waste stream disposal. The City considered discharging the waste stream directly to the Republican River but the Nebraska Department of Environmental Quality (DEQ) would not allow this discharge because of the waste stream's salinity level. The City considered landfill disposal but was unable to obtain approval prior to building the water treatment plant. The approval for landfill disposal is based on several factors including the estimated waste volume and the results of a Toxicity Characteristic Leaching Procedure test on a waste sample to confirm that the waste is not hazardous. Other alternatives considered included mixing the brine with the water discharged from the City's wastewater treatment plant, and discharge to a large storage pond.

The deep earth injection well will cost an estimated \$1 million to construct and cost about \$50,000 a year to maintain. The cost per user will be around 14 cents per 1,000 gallons. The City has drilled a test well and conducted necessary tests and expects to receive the final decision and permit in early Spring 2007.

Alternatives Considered

Before deciding on the ion exchange treatment option, the City also considered reverse osmosis (RO) treatment and development of a new well field in another aquifer. The City rejected the RO treatment alternative because 25 percent of the water would be wasted, requiring disposal either to a water body or to a wastewater treatment plant. In comparison, the ion exchange process only wastes 1.5 percent of treated water. The City engineers discussed the possibility of obtaining an NPDES permit to discharge the RO waste stream to the Republican River but learned from the DEQ that the permit most likely would not be allowed due to the waste stream's expected arsenic level and lower than normal river levels due to the current regional drought. The RO process also requires a high energy cost because of the high pressure required to move the water through the filters.

Over a 13-year period, the City evaluated the possibility of abandoning the existing wells and developing a new well field in the Ogallala (High Plains) aquifer, one of the world's largest aquifers. The City purchased land that provided access to this aquifer and drilled test wells to evaluate water quality and production capability. Preliminary test results showed that water quality was acceptable. However, because this land was located adjacent to a former U.S. Air Force Base, many water system customers were concerned about possible contamination of the new drinking water supply. For this reason, the City withdrew plans for this new well field.



McCook's new water treatment facility including a new 4 MG water storage tank.

Funding Process

Capital spending amounted to \$12.3 million for the new treatment facilities including the ion exchange treatment system, a waste disposal system for the water treatment waste stream, and a 4-million gallon water storage tank. The project was funded by water system revenues. A rate increase was originally anticipated but was not needed because of higher than expected water consumption that generated additional revenues.

Conclusions

The City of McCook, Nebraska rejected reverse osmosis technology for arsenic removal due to the expected waste volume and the inability to obtain a discharge permit. Developing a new well field was also considered and then rejected due to public concern about the proposed wellfield's proximity to a military base. The City found that waste disposal was a critical issue for the selected treatment option, ion exchange. Blending is also used to minimize costs and maximize treatment plant performance.

Arsenic is a Regional Problem

Three communities located 20 miles east of McCook have taken a different approach to arsenic compliance. The towns of Bartley, Indianola, and Cambridge have detected arsenic levels of about 11 ppb in their groundwater supplies. These communities decided to form a regional water system, and to drill 3 new wells. The Bartley, Indianola, Cambridge Water Agency applied for a Nebraska Department of Natural Resources water transfer permit to allow water to be transferred from the well sites north of Bartley to the three communities. About half the communities' existing wells are being abandoned, except one well that will be maintained in each community for fire protection. The Agency received \$393,000 in [Community Development Block Grant](#) EXIT Disclaimer funding for the well field. The towns of Bartley and Indianola received [USDA Rural Development Grants](#) EXIT Disclaimer in the amount of \$231,000 and \$2.1 million, respectively, to complete the regional water system project. This funding was critical to the successful completion of the project since 30% of the local population is on a fixed income.