



Goodland Water System Improvements Include a New Ion-Exchange Nitrate Removal Plant

Goodland, KS is located in the northwest corner of the state at the intersection of Interstate-70 and US Highway 27. From there, it's only seventeen miles west to the Colorado state line; it's forty-four north to Nebraska. Goodland, with a current population of 4,361, was incorporated in 1887 and is the county seat of Sherman County. The local economy is agricultural-based and includes sunflower farming. Goodland is only one of two marketing centers for sunflowers in the United States and Sherman County is the largest producer of commercial sunflowers on the High Plains.

Brochures showing off Goodland list several sites for visitors to enjoy but one unique site is the reproduction of a Van Gogh sunflower painting. A Canadian artist, Cameron Cross, hand-painted this 24-foot by 32-foot painting to serve as an appropriate landmark for the city. The painting rests on an 80-foot easel that weighs about 40,000 pounds. The painting is only one of seven planned in the world. Two others are located at Altona, Manitoba, Canada and Emerald, Queensland, Australia. The unique art project is a respite for travelers on I-70.

Goodland has utilized groundwater from the High Plains Aquifer, which includes the Ogallala Aquifer, as their source of water for many years. The High Plains Aquifer is the most important water source for much of western and central Kansas, supplying approximately seventy percent of the water used by Kansans each day. The High Plains Aquifer system lies beneath parts of eight states in the Great Plains, including about 30,500 square miles of western and central Kansas. In the year 2000, about twenty-one million acre-feet of ground water were removed from this aquifer across the eight-state region. The most important component of the High Plains Aquifer is the Ogallala Aquifer, which generally is the western half of the High Plains Aquifer in Kansas. According to *Public Information Circular 18* prepared by the Kansas Geological Survey, heavy pumping from this aquifer has caused declining water levels in the western part of the region.

Goodland water system Superintendent Rich Simon states that the water level in the city's wells has dropped about twenty feet in the last twenty years. The wells are about 300 feet in depth and the static water level is presently at about 190 feet. Even with the declining water level over the years, the overall water quality had continued to be acceptable; however, in recent years the nitrate level has increased to the point where some of the wells now exceed the maximum contaminant level (MCL) of 10 mg/L as (N).

This half-million gallon elevated storage tank shows the pride of Goodland, Kansas in their water supply system. The tank was constructed in 1996 and serves the commercial area near I-70 very well.



This photo shows two of the five ion exchange units supplied by Layne Christensen Company. The tanks contain nitrate selective resin for nitrate removal and are the main workhorse in the water treatment plant.

The city has a total of eleven wells in its system; some are located in town and some within one-half mile of the city. Six wells are currently in use. The other five wells have nitrate levels ranging from 10 to 15 mg/L. Production ranges from 250 to 600 gpm. Originally, one of the options considered for complying with the Nitrate MCL was to use a combination of high and low nitrate wells to blend down the nitrates. However, as the city was looking into this option, the nitrate level in the city's largest producing wells suddenly increased to 9.0 mg/L, making it impossible to blend down to below 10 mg/L. The only option that remained was to consider construction of a water treatment plant.

The engineering firm of Evans-Bierly-Hutchison (EBH) & Associates was employed to design a water treatment system. The choice was made to construct an ion-exchange plant for nitrate removal. In fact, the project consisted of three phases: Phase 1 was construction of the building, treatment plant components, ground level storage; Phase 2 consisted of water line installation; and, Phase 3 consisted of construction of the on-site lagoon system.

PHASE 1: This phase included the treatment components which consist of five ion-exchange tanks with a capacity of 1,600 gpm. These tanks contain an anion exchange resin to remove nitrate. Sodium chloride (brine salt) is used to regenerate the resin in the tanks. The tanks are designed for 1,600



This tank store sodium chloride (salt). Salt is used to re-generate the anion exchange resin in the five exchange tanks.



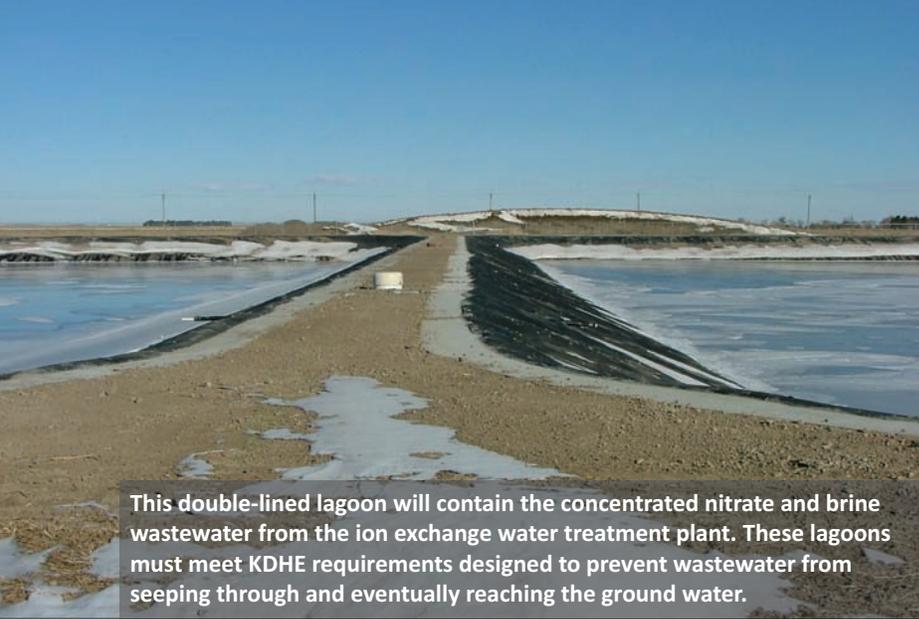
Rich Simon, Water Superintendent, points out the need and use of the pressure gauge at one of the three high service pumps. These pumps pick up treated water from the stainless steel tanks and deliver it to the distribution system. Note the piping is not yet connected in this photo taken in early January 2011. This project is not yet completed. The target completion date is March 1 and April 10 is the deadline for the plant to be operational.

gpm flow with four of the five tanks in-use (one tank sitting idle). Treated water flows to two stainless steel tanks, each with a capacity of 100,000 gallons. Water from the steel tanks is pumped into the system by three high service pumps, each with a capacity of 1,650 gpm. The design pumping rate was determined using the city's maximum flow per day of 3,300 gpm and using only two of the three pumps at any one time. The proposed plant operating procedure is to blend raw well water with treated water so that finished water will have nitrate at a level no higher than 7.0 mg/L. Plant operation will be computer controlled and

adjustments to the rate of blend water to treated water will be automatically controlled based on online monitoring equipment. The steel building housing the treatment equipment was over-sized to allow for additional treatment skids for the future if needed. Miller Construction Services, LLC of Goodland is the contractor on this phase.

PHASE 2: This phase consisted of the installation of PVC gathering lines from the eleven wells to the plant and lines back out from the plant to the distribution system. The project included: 3,150 feet of 20-inch line; 8,100 feet of 16-inch line; 10,000 feet of 10-inch line; and, 11,700 feet of 6-inch line. Van Kirk Bros. Contracting, Sutton, NE was the contractor on this phase.

PHASE 3: This phase consisted of construction of a lagoon system for use in containing the nitrate concentrated wastewater as the ion-



This double-lined lagoon will contain the concentrated nitrate and brine wastewater from the ion exchange water treatment plant. These lagoons must meet KDHE requirements designed to prevent wastewater from seeping through and eventually reaching the ground water.



This metal building houses the treatment plant; the two stainless steel tanks are used to store treated water. Each tank has a capacity of 100,000 gallons.

exchange units are backwashed and recharged. Because the Kansas Department of Health and Environment (KDHE) considers this type of waste as industrial waste, the lagoons must be double lined to prevent leakage from percolating through the soil and reaching ground water. Both liners must be at least 30 mils (0.030 inch) thick and must have some material between the liners to serve as a conduit

directing any leakage to an observation sump or manhole. Additional information pertaining to double lined lagoons can be viewed on the KDHE Web site. Sporer Land Development, Inc., Oakley, KS was the contractor on this phase.

This \$6 million dollar project was funded by the Kansas Public Water Supply Loan Fund (KPWSLF) utilizing funds as directed by the American Recovery and Reinvestment Act (ARRA). The impact on users was only a change in the basic rate which increased from \$7.60 for 300 cubic feet (2,244 gallons) to \$15.60 per month. The charge for additional water remained the same at \$1.07 for 100 cubic feet (748 gallons). There is also a monthly charge for meter sizes; the charges are \$2 for a 1-inch meter; \$7 for a 1.5-inch meter; \$15 for a 2-inch meter; \$30 for a 3-inch meter; and \$50.00 for a 4-inch meter. When asked the city's opinion of the project, City Clerk Mary Volt says the city was very happy with the overall project including the financing arrangement.

For additional information on the High Plains Aquifer, check out the Kansas Geological Survey Web site at www.kgs.ku.edu/.

I also encourage readers to attend the 2011 KRWA annual conference at Century II Convention Center in Wichita on March 29, 30, and 31. Numerous sessions will address issues important to both management and operational personnel. Also, anyone interested in gaining more information should attend the session on Nitrate removal for water systems at 1:30 p.m. on Wednesday, 3/30 and also visit with vendors who provide services and equipment to address water quality problems.



"The Big Easel Project", a hand-painted reproduction of one of Vincent Van Gogh's sunflower paintings, a public domain painting, rests on an easel more than eighty feet tall. The 24-foot by 32-foot painting can be seen by travelers on I-70, especially those headed west. Goodland is only one of two marketing centers for sunflowers in the United States and Sherman County is the largest producer of commercial sunflowers on the High Plains.

Bert Zerr is currently a consultant with KRWA. He has been with KRWA for the last four years. Bert was a District Engineer with the KDHE in the Salina District Office for thirty-two years.

