

# Nitrogen Makes Things Green in Greensburg: Just Keep It Out of the Water Please!



**F**ertilizer (primarily nitrogen) is a great resource. It gives lawns that beautiful deep green color everyone likes to see; it increases crop yield and quality. But one place it doesn't work out is when it contaminates public water supplies.

EPA has set the maximum contaminant level (MCL) for nitrate at 10 parts per million (mg/L). This standard became effective in July 1989. Prior to then the standard under the Safe Drinking Water Act as enacted in 1974 was 20 mg/L. I recall hearing Ground Water Geologist/Hydrologist Robert Vincent at a presentation at KRWA training session back in the 1980s. Robert stated that nitrate was the number one problem with groundwater that water systems would face. He was absolutely correct. We are now seeing new source water being developed and some nitrate removal treatment plants being constructed. Nitrate in excess of 10 mg/L continues to be troublesome for some public water systems in Kansas.

The extensive use of agricultural fertilizer applied to boost crop production is a major contributor to this problem. Some of that fertilizer simply runs off during heavy rain and some leaches to the water level. That is especially true with shallow aquifers where sandy or light topsoil is present.

If the crop does not use all of the applied nitrogen during its lifecycle, that means there's more available to leach down. Spraying herbicide to keep fields clean is also today's practice compared to allowing weeds and grasses to grow after a harvest that might also have used up excess nitrate.

## Case study: Greensburg, KS

As most Kansans can recall, Greensburg was struck with a devastating tornado that leveled 90 percent of the town on May 4, 2007. The town presently has about half of the population that it had prior to the tornado. Since that time there has been a tremendous rebuilding effort underway and although things have slowed down now much of the town

has been rebuilt with state of the art structures utilizing the latest "green", geothermal, solar, and wind technologies including new homes, a hospital, business incubator, a high school, city hall, library, city shop, a 100,000-gallon water storage tank – and a nitrate removal plant.

Greensburg now faces still another dilemma. The Kansas Department of Transportation has proposed the widening of Highway 54 to four-lane; the highway is Main Street in Greensburg. Property has already been purchased all the way through town just north of the existing highway. Since homes were destroyed by the tornado, property owners were eager to sell. The dilemma facing the city is that the new proposed highway route runs right



The owner of this lot has yet to rebuild on this foundation after the 2007 tornado.



Greensburg, KS is home to the largest hand-dug well in the world. The new enclosure was constructed after the 2007 tornado. The well measures 109 feet deep and 32 feet in diameter. It was completed in 1888 when both the Santa Fe and Rock Island Railroads were laying tracks across the plains of Kansas and needed a reliable water source.

through the existing 11-acre city park including a large pool, ball diamonds, tennis courts, trees and a lot of childhood memories. On one hand the city does not want to give up the property but on the other does not want to jeopardize KDOT using another route outside of town, thereby losing the commerce the traffic brings. So then it boils down to how much the city is willing to sell the property for. The city definitely wants to replace the park. However to replace what they currently have would probably cost more than KDOT wants to pay to acquire the property; negotiations are underway.

**The dilemma facing the city is that the new proposed highway route runs right through the existing 11-acre city park including a large pool, ball diamonds, tennis courts, trees and a lot of childhood memories.**

From 1995 to 2001, the city's Well No. 8 exceeded the 10 mg/L MCL for nitrate with levels as high as 18 mg/L. The city stopped using the well for the public water supply system. Well No. 6 has also exceeded the MCL for nitrate. There was a fertilizer facility nearby



The new Kiowa County Commons houses the Kiowa County Library and Historical Museum, Kansas State Extension Service, and the library.

## A prior cross connection

Several years before the tornado, one Saturday morning in May, I received a call from the city superintendent. In that phone call he explained to me that he had just been in the local coffee shop and a friend was giving him a hard time and made a joking comment about the water tasting bad. Of course he took it well, smiling and chuckling about it and thought it was all in fun. He proceeded over to self-serve counter to get a cup of coffee and a glass of water. Tasting the water, he spit it back into the glass. One of his pals laughingly made another genius comment, "Kind of tastes like 10-32-0 (a liquid fertilizer blend) doesn't it?"

Running more water from the sink he noticed a blue cast to the water. He knew this was not good. After checking the chlorine residual at zero in the northwest quarter of town he called me. Being involved with agriculture and gardening all my life I have mixed plenty of fertilizer and that was my first thought when he said "blue green" water. I knew that the fertilizer facility was near by and that somehow fertilizer may have entered the public water supply system. My advice was to collect a sample that I could deliver to the lab on the following Monday, flush the system out until clear and adequate chlorine residuals could be obtained and maintained and notify KDHE. Sure enough lab analysis revealed it was indeed fertilizer with nitrate levels of 9,000 mg/L and 12,000 mg/L phosphate!

In short what had happened was a backflow device at the liquid blending station was removed due to a leak and concentrated liquid fertilizer was pumped directly into the water system through a blending manifold by improper manual valve positioning. The chemical pumps overcame the pressure in the city mains.

Advice and recommendations were also made to the facility personnel of how to protect the city water supply. The fertilizer had been effectively flushed from the system; chlorine residuals were back to normal. So you would think the problem is solved. Well not so fast. Several weeks pass and I receive another call from the city superintendent asking me to come to the city. He had something he wanted me to look at. When I arrived he took me over to the city pool that was being prepped and cleaned for the traditional Memorial Day weekend opening. But there was a white material coming off of the \$86,000 liner that had just been replaced a year before. It was almost like window glazing compound. I learned during my visit that the pool had been filled at during the time of the cross connection at the fertilizer plant. The swimming pool had been filled with the blue green fertilizer water.

After some further investigation, I learned the liner was basically a type of PVC material and that it was possible that the phosphoric acid in the fertilizer could have reacted with the liner. It might be assumed that PVC would be impervious to chemicals like fertilizer. A quick call to the manufacturer of the liner describing the situation, but not revealing anything about the high content fertilizer being in the pool, quickly provided the answer. Once the conditions were described to the manufacturer their first statement was that they have only seen such erosion of the lining material in two other instances and on both cases, there had been a contamination of water with liquid nitrate at time when the pools were filled.

both wells. In 2002 KDHE did a site inspection and found soil and runoff water that showed high levels of nitrate. After much sampling of groundwater and soil in the area, a remediation plan was developed. The plan included removal and replacement of more than 3,000 cubic yards of contaminated soil and the installation and construction of an extraction well at the site of the greatest contamination. Water from that well was to be used by the plant for its agricultural spray mixing water instead of using city water. That would hopefully capture and pump out some of the highly contaminated water (up to 138 mg/L) and help to keep the zone of contamination contained while providing the agricultural water needs of the facility. It was determined latter through an aquifer test that the sporadic pumping of the extraction well was not going to effectively capture the nitrate plume. To make matters worse the tornado of 2007 destroyed the fertilizer facility causing the release of still more stored fertilizer, further contaminating the soil and groundwater around the site. The facility has since been upgraded with prevention measures in place to prevent future problems.



**This photo shows the new nitrate removal plant constructed in Greensburg, KS. The building is a reinforced pre-cast concrete structure that looks as if it could survive almost anything nature can send its way.**

**New removal plant**

Greensburg’s new nitrate removal treatment system is a fully automated, Layne Christensen ION Exchange system with state of art monitoring. The building is a reinforced pre-cast concrete structure that looks as if it could survive any storm nature can send its way. The nitrate skid can treat up to 280 gpm; there are three high

service pumps rated at 340 gpm to provide a blend of treated and untreated water into the distribution system. The finished treated water is stored and pumped from two 25,000-gallon tanks inside the building. The plant can be operated in a “nitrate target mode” or a “flow mode” based on the level of incoming nitrate. When the nitrate levels begin to exceed the

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**Greensburg Public Works Superintendent Mick Kendall points out the "nitrate sensing unit" in Greensburg's new nitrate removal plant.**



**This photo shows finished water storage and high service pumps inside the city of Greensburg's water treatment plant.**

set point, the operator is alerted that the filters will need to be regenerated. Any wastewater produced from the plant goes into the city's sewer system. The plant is backed up with a fully automated 100 KW electrical generator.

Greensburg's water rates were not increased but are scheduled for a minor increase this summer. The present rates are \$12.50 minimum, then \$2 per thousand for the first 7,000 gallons and then \$2.25 per thousand for all water in excess of 7,000 gallons. The city plans to increase the rates slightly, adding \$2 to the monthly minimum and \$0.25 to the charge per thousand.

The total cost of the project was \$3.96 million. Funding was provided through a USDA Rural Development loan of \$2,665,118 and a grant of \$1,530,000. The balance of the funding was contributed by the city. The project engineer was Professional Engineering Consultants, Wichita; the contractor was APAC-Kansas, Shears Division, Hutchinson, KS.

As I mentioned, some other public water systems are still troubled with exceeding the 10 mg/L standard for nitrate in drinking water. Treatment plants are expensive. Cities and RWDs should exhaust all other options first. It may be possible to draw water from different levels of the aquifer, in effect pulling less contaminated water from the lower levels. Perhaps there's a

failure of sealing around the well casing. Wellhead and groundwater protection programs should be evaluated. If corn has to be grown near wellsites, does the water system allow high amounts of fertilizer to be applied in close proximity to the well? Those are low-cost options compared to constructing and operating a nitrate removal plant.

If your city or RWD has any concerns about water quality issues, I encourage you to contact KRWA. The

Association has staff who are very qualified to discuss water quality and treatment. KRWA staff are familiar with the operation of many water treatment plants across the state.

*Jon Steele has been employed by KRWA as a Circuit Rider since 1995. Jon is certified as a water and wastewater operator. He has more than twenty-five years experience in public works, construction and industrial arts.*



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