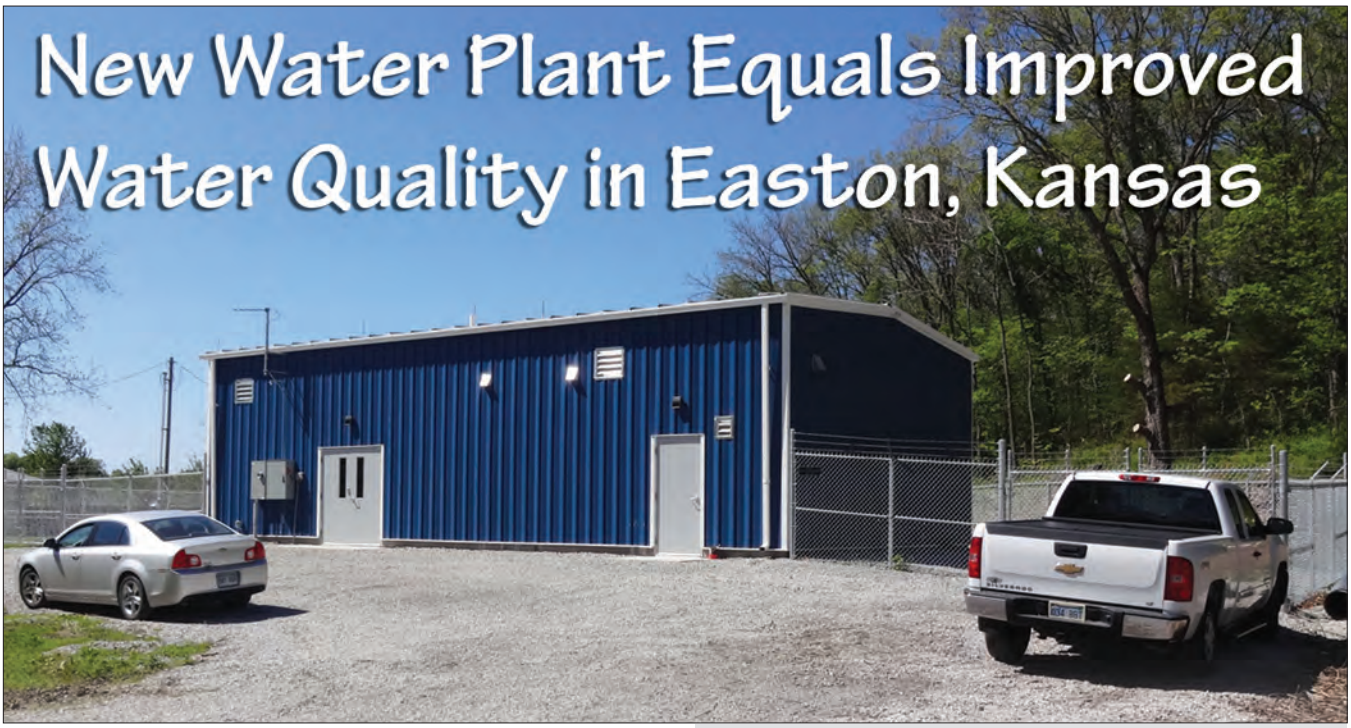
By Jeff Lamfers, Consultant, KRWA

New Water Plant Equals Improved Water Quality in Easton, Kansas



Easton's new iron and manganese removal plant and new well and distribution system improvements cost $2,056,000.

Easton, Kansas is a town of 257 residents located in the wooded hills of northern Leavenworth County. Directly east of town is Stranger Creek which unfortunately floods frequently and has caused significant property damage over the years. Easton is named after Easton, Pennsylvania the hometown of Andrew Reeder, the first governor of the Kansas Territory.

Easton has a long history of water quality problems. Unfortunately, groundwater in the vicinity is high in both iron and manganese. Iron and manganese are naturally occurring elements commonly found in groundwater. This is especially true for wells drilled in alluvial deposits along creeks and rivers. Unfortunately, if iron and manganese concentrations rise above certain levels, they can cause staining problems and discolored water complaints. Consequently, EPA has established non-enforceable, "Secondary Maximum Contaminant Levels" for both contaminants. The secondary limit for iron is 0.3 mg/L and for manganese is 0.05 mg/L. If greater than 0.3 mg/L, iron can cause an orange to red, rusty color or stain and a metallic taste. If greater than 0.05 mg/L, manganese can cause color/staining from light yellow to black, depending on the concentration. Manganese can also cause an oily sheen on the surface of water and impart a bitter metallic taste. These limits were established due to aesthetic considerations such as taste and color. As such, these contaminants do not present a risk to human health at the aforementioned limits.

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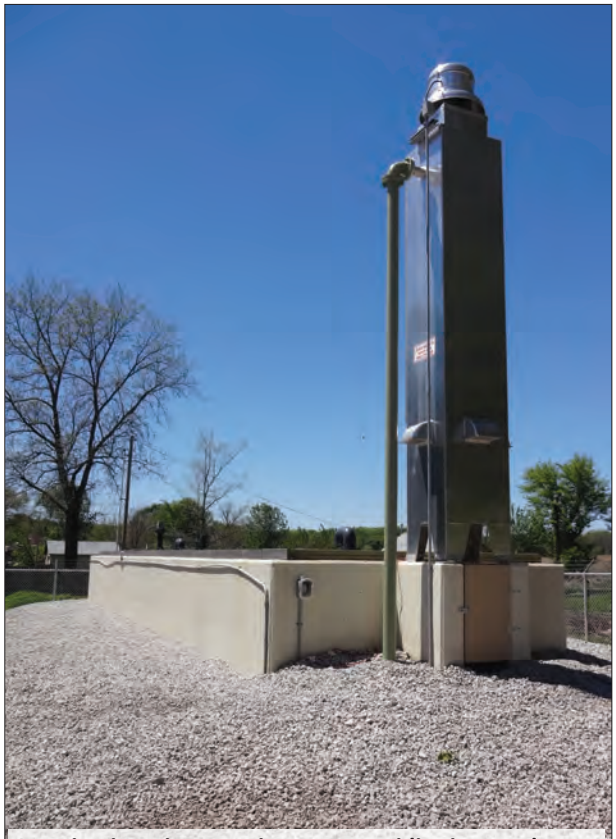
Red/brown water complaints

Having worked in the Lawrence District Office of KDHE for many years, I can confirm that Easton residents have complained in the past about discolored water problems. Such complaints were not uncommon. I have attended city council meetings where residents would bring in a sample of their tap water that looked like dark, concentrated reddish-brown tea. Likely causes were either a breakdown in the treatment process or recent flushing of mains which can actually make the situation worse by stirring up iron and manganese deposits in the lines. Large water main breaks can cause the same problem. For comparison purposes, the KDHE laboratory analyzed the most recent inorganic sample from the city's point of entry (POE) collected in March

2015. This water was treated by the old water plant. That sample had an iron concentration of 1.2 mg/L (4 times greater than the secondary limit) and a manganese concentration of 0.14 mg/L (almost 3 times greater than the secondary limit).

Since 1956, raw water from the city's wells has been treated at their water treatment plant designed to remove iron and manganese. Such plants typically consist of several treatment stages including aeration, adding oxidants (like chlorine and potassium permanganate) to bring the iron and manganese out of solution, settling and filtration. Such was the case with the city's plant until it was recently replaced with a new plant. In early February 2016, a new iron/manganese removal plant was placed in service to serve the residents of Easton. And the results have been very noticeable. In the past, it was not uncommon for residents to purchase bottled water for drinking and to complain that their tap water was not usable for any purpose. Today, residents are seeing clearer water that meets EPA's secondary limits for iron and manganese and can now be used for drinking, food preparation, washing clothes, etc. But it took the city many years to reach this point.

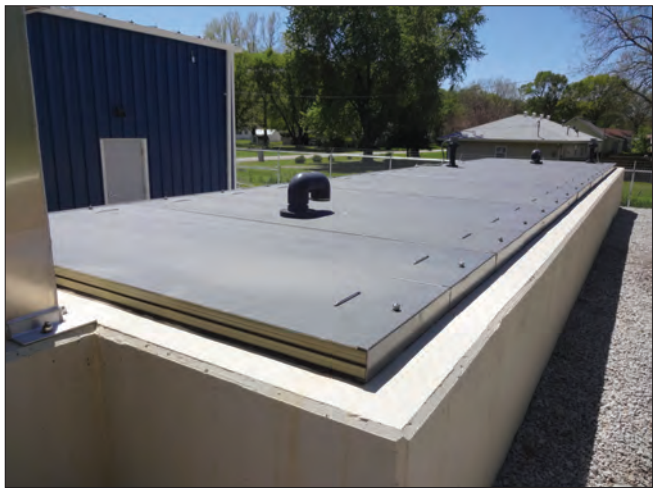
Over the years, the city has looked at several options to improve the quality of the water delivered to its residents. These include upgrading the old water treatment plant, drilling test wells to hopefully find water with lower iron and manganese levels, and purchasing water from other nearby public water supplies. Test well drilling did not result in any wells with significantly lower iron and manganese levels. And for a short period, the city looked into purchasing water from either Jefferson RWD 12 or Leavenworth RWD 5. Ultimately the city decided to retain an engineer to explore the option of building a new treatment plant to replace the old plant which had now been in service 60 years and was ineffective at removing iron and manganese.



Aeration is an inexpensive way to oxidize iron and manganese compared to chemical oxidation; this photo shows the new forced-draft aerator.

Easton retained Kramer Consulting, LLC of Topeka, Kan. Jack Kramer, PE is the firm principal. Ultimately, Kramer Consulting designed a new plant based on many of the same treatment principals used in the old plant. The city continues to use their two existing wells (Wells 2 and 3) with plans of adding a new well. They also upgraded their distribution system with construction of 8,600 feet of new Schedule 40 PVC pipe with tracer wire. The distribution system is now almost all PVC pipe. New fire hydrants and customer meters were also installed.

The centerpiece of the new treatment plant is three vertical pressure filters manufactured by Wigen Water Technologies, Chaska, Minn. Raw well water is pumped from Wells 2 and 3 to the plant where chlorine (pre-chlorination) is added. Chlorine solution is added to both disinfect and oxidize the iron and manganese. Liquid sodium hypochlorite (12.5 percent) solution is added using a ProSeries-M peristaltic pump. Water is

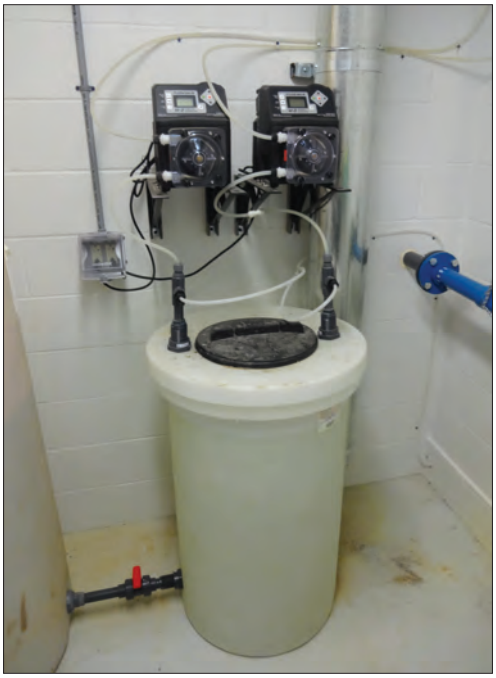


This photo shows the new covered sedimentation basin with hopper-bottom. Water is then pumped from the far end of this basin to the pressure filters.

This photo shows the three Wigen pressure filters. This is the final treatment stage for removing any remaining iron and manganese from the water.

then routed to a forced-draft aerator for further oxidation of iron and manganese. Potassium permanganate is then added after the aerator and before the rectangular sedimentation basin. This basin has two compartments with the first one having a hoppered bottom to allow for removing settled iron and manganese. Sediment on the bottom of this basin is periodically pumped to the city's sanitary sewer. The basin is also covered to keep out debris and minimize chlorine loss. Water is then pumped to the three pressure filters which operate in parallel. The flow rate through each filter is 20 to 22 gpm. The filter media is specific for removing iron and manganese. Some arsenic is also removed. Filtered water then flows into a new 36,000-gallon clearwell. This line from the filter to the clearwell has a tap for adding chlorine (post-chlorination) in order to maintain adequate residuals in the system. Two 77-gpm high service pumps pump treated water into the distribution system. In addition to the clearwell, the city has a 60,000 ground level, concrete storage tank on a hill southwest of town.

The plant also has a 9,600-gallon decant tank to hold water from backwashing the filters. Sediment is allowed to settle and then the somewhat clear water is pumped from this tank, run through an in-line bag filter and returned to the influent line to the pressure filters. Such a setup results in reusing backwash water and helps minimize

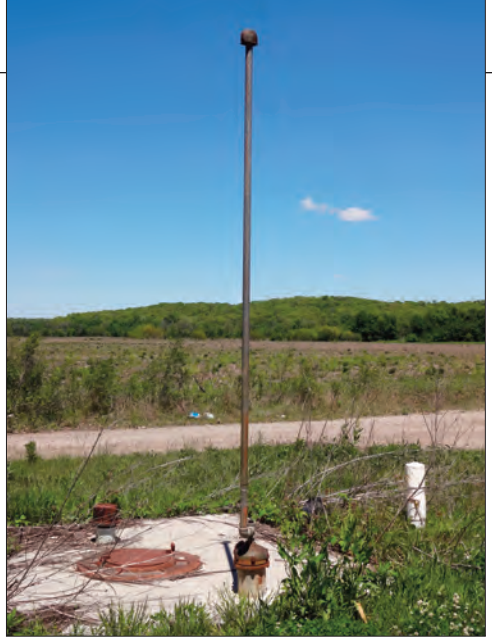


ProSeries-M peristaltic pumps are used for both pre and post-chlorination.

the amount of water used at the plant to produce water. The plant production is rated at 60 gpm.

Cost for the new well, distribution system improvements and new treatment plant was $2,056,000. USDA Rural Development and the Kansas Department of Commerce funded the project. Rural Development provided a grant of $912,000 and loan of $644,000. The rate on the loan is 2.5 percent for 40 years. Department of Commerce provided a grant of $500,000. The contractor was Smi-Co Construction, Inc. of Odessa, Mo.

As of May 15, 2016, the plant is performing very well. City staff receives many positive comments from residents about the improvement in the quality of water they receive. On-site testing confirms this fact. As part of the project, the city now has a Hach DR 900 Multiparameter Handheld Colorimeter. The colorimeter can be used to test finished water for iron, manganese and arsenic. Recent results show the following: iron at 0.03 mg/L, manganese at 0.04 mg/L and arsenic at 0.0 mg/L. Operator Jimmy Herken also reports that he is producing less water than at the old plant. Most likely reasons include replacing older, lower reading customer meters with new, accurate meters, reduced water loss due to the 8,600 feet of new waterline that was installed and the recycling/reuse of backwash water. Since the new plant was placed in service on February 2, 2016, the plant is producing an average of 23,430 gallons per day. This equals a per capita water production of approximately 91 gallons/person/day.



This photo shows Well No. 3 with extended well vent. KDHE requires the elevation of the well vent be not less than two feet above the 100-year flood level.

If your water system happens to be experiencing the same problem as Easton had with discolored water, many customer complaints and high levels of iron and/or manganese, please contact me or other KRWA staff. We can help, not only with the technical issues but also with explaining financing options. KRWA staff have more than 400 years of experience working with and helping systems and many of those with well water high in iron and manganese. If I can be of assistance, I can be reached at 913-850-8822 or email me at jeff@krwa.net.

Jeff Lamfers began work for KRWA in November 2008. Jeff has more than thirty years of regulatory experience in the oversight and operation of water and wastewater systems with the Kansas Department of Health and Environment. He is a graduate of the University of Kansas with a degree in Environmental Studies with an emphasis in aquatic biology.