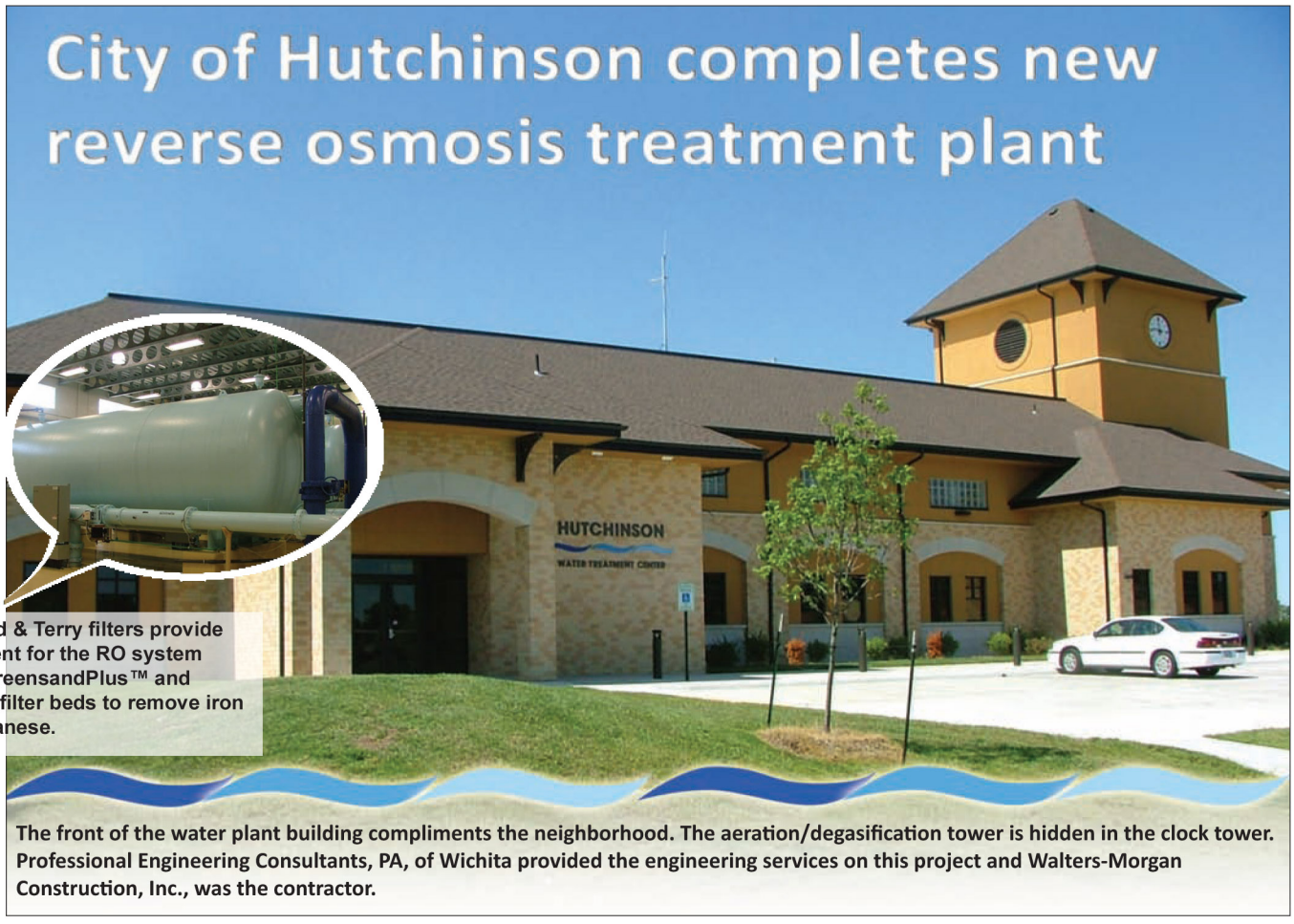
By Bert Zerr, KRWA Consultant

City of Hutchinson completes new reverse osmosis treatment plant



Hungerford & Terry filters provide pretreatment for the RO system utilizing GreensandPlus™ and anthracite filter beds to remove iron and manganese.

The front of the water plant building compliments the neighborhood. The aeration/degasification tower is hidden in the clock tower. Professional Engineering Consultants, PA, of Wichita provided the engineering services on this project and Walters-Morgan Construction, Inc., was the contractor.

Hutchinson, Kansas, with a population of more than 40,000, is located on the Arkansas River in south-central Kansas; it is the county seat of Reno County. Most Kansans are probably aware that Hutchinson is the home of the Kansas State Fair held in September. Hutchinson is also known for having the Kansas Cosmosphere and Space Center, which is advertised to contain one of the most significant collections of space artifacts in the world, and the largest collection of Russian artifacts outside of Moscow. The Underground Salt Museum is another unusual attraction located in Hutchinson. Salt was discovered in Reno County in 1887 and as a result, several salt processing plants have been operating in the area since that time giving Hutchinson its nickname "The Salt City." One of the mines, while still a working salt mine, has a museum open to the public that is located 650 feet below ground. Excavated portions of the mine are now used for archival storage of movie and television masters, data tapes, and permanent business records. Underground Vaults and Storage (UVS) currently houses the masters for "The Wizard of Oz," "Gone with the Wind", and "Star Wars," and many others. While perhaps not a tourist attraction, the city of Hutchinson recently completed construction of extensive water supply improvements that include a reverse osmosis (RO) water treatment plant.

Like several other cities in the state, Hutchinson was faced with a contamination issue that needed to be solved.

Why build a water treatment plant – and why now?

Like several other cities in Kansas, Hutchinson was faced with a contamination issue that needed to be solved. In the early 1980s, testing at wells in the southeast part of town revealed contamination of groundwater with volatile organic chemicals (VOCs). The city eventually agreed to a consent order with the Kansas Department of Health and Environment (KDHE), accepting responsibility for remediation of the site. Actually a negotiated agreement was reached between city officials, the KDHE, and the industries responsible for the contamination whereby the city would take the lead in the cleanup efforts. The city's willingness to proceed with this project was a positive move because it allowed this site to avoid becoming an EPA Superfund site.

Project scope and processes

The project consisted of remediation extraction wells being constructed at the contaminated site southeast of town. Water from these wells, with water from wells located northwest of town, is pumped to a new water treatment plant. The water from the northwest wells contains high levels of chloride and hardness. A total of 16 wells supply water to the city. These wells pump water to the new water treatment plant that utilizes reverse osmosis (RO) as the primary treatment process. Untreated water from the wells enters a wetwell basin where four low service vertical turbine pumps on variable frequency drives (VFD) are used to pump to pressure filters. The purpose of the pressure filters is to remove chemically oxidized iron and manganese prior to reaching the RO membranes. There are three horizontal vessels, each containing two filters that contain anthracite and greensand pressure filter media. The next treatment unit consists of six cartridge filters that provide further protection of the RO membranes from large particulates such as iron precipitates and sand. Sodium metabisulfite is added at this stage to neutralize any chlorine remaining in the water from the pressure filters, again to protect the RO membranes, as chlorine is not compatible with RO membranes.

These wells pump water to the new water treatment plant that utilizes reverse osmosis (RO) as the primary treatment process.

This tank and pump arrangement is the clean-in-place system which uses RO treated water for cleaning the membranes.

The workhorse of the water treatment facility

The RO membranes are the workhorses of the treatment system. The membranes remove nearly all of the dissolved and particulate materials from the water. The membranes remove hardness, chlorides, and possibly some of the VOCs. Booster pumps are used to force water through the RO membranes. Four booster pumps, one for each train, are used to increase the pressure from 10 psi to between 150 and 200 psi. The system is fully automated by a computer

The Hydranautics RO membrane system consists of four skids. Each skid contains 36 tubes with 252 individual membranes. The four skids therefore, have a total of 1,008 eight-inch diameter membranes. The membranes are two stage units.

Hungerford & Terry, Inc., Clayton, NJ - pretreatment units shown above consist of three GreensandPlus™ pressure filters. Anthracite and GreensandPlus media are used to remove iron and manganese in order to protect the RO membranes.

This photo shows two sets of pumps; the nearest pumps with tan piping transfer concentrated reject water to disposal wells. The pumps in the background are the four raw water pumps on variable frequency drives (VFDs).

This is a shot of the pump and piping gallery with waste and raw pumps on the left and finished water and pressure filter backwash pumps on the right.

control system and continuous data including flow rates, pressures and water quality are collected and evaluated. Water exiting the RO membranes is pumped to a forced air aeration/degasification tower to remove carbon dioxide and any remaining VOCs. From the aeration tower, RO water is blended with raw water from the northwest well field. This blending process stabilizes the water by adding back minerals and adjusting the pH. The blending occurs in a series of turbulent piping and includes additional chemical treatment. Following the blending process, water is disinfected before entering the 0.750-million gallons (MG) clearwell. The chlorine system is fully monitored and includes chlorine scrubber and fire protection equipment in the event of an emergency.

Plant capacity

The plant was designed to produce 10 million gallons per day (MGD). Six MG of this volume is RO treated water and 4.0 MG is raw well water. Finished water quality is very good at this blending rate with Hardness averaging about 130 mg/l; Chlorides averaging about 60 mg/l; and Alkalinity

Six of the eight pumps shown here pump treated water to the distribution system. The two pumps in the center of the row are pressure filter backwash pumps.

This photo shows the scrubber treatment equipment used to handle the accidental release of chlorine gas. This equipment is usually designed to neutralize and absorb the entire contents of a one-ton cylinder. Please check out the article "Containment systems help ensure chlorine capture" by Gary Armentrout in the July 2004 issue of *The Kansas Lifeline* magazine for more information on this subject.

Bob Fisher, operator, cleans an area in the water plant. City operators keep the water plant building and related systems polished.

averaging about 105 mg/l. Current usage is about 7.0 MGD. At a production rate of 10 MGD, the four skids produce about 2.0 MGD of concentrated reject water. Disposal of this reject water is via two deep disposal wells located in southeast Hutchinson. The reject water contains chlorides at a concentration of about 1,200 mg/l. About five miles of pipeline were needed to transport the reject water to the two disposal wells that were drilled to a depth of 4,800 feet into the Arbuckle Formation.

Cost of project and funding sources

The overall cost of this project was just under $35 million. The RO treatment plant cost was just under $18 million; about $4 million was spent to construct the two deep disposal wells. The pipelines and remediation facilities cost approximately $13 million. Funding sources for this project include more than $13 million from settlement funds and contributions from companies responsible for the groundwater contamination, $3.4 million in federal grants, and the remainder ($1.15 million) from the city capital improvement program. A loan of $16.65 million was acquired from the Kansas Public Water Supply Loan Fund administered by KDHE.

Rate increase to residents

Brent Lundmark, Water Treatment Systems Coordinator, reports that water rates have basically doubled as a result of this project. However, Brent also says that about 400 local residents attended the recent open house and he did not hear any serious complaints about the new water rates, possibly due in part because the city has been raising rates gradually over the past few years.

Present water rates in Hutchinson, KS

Per 100 cu. ft. (748.1 gal.)

	Monthly Minimum	0 to 500 cu. ft. (3,740.5 gal.)	501 to 5,000 cu. ft. (37,405 gal.)	> 5,000 cu. ft. (>37,405 gal.)
Inside City	$ 8.38	$2.18	$1.96	$1.78
Outside City	$16.76	$3.27	$2.94	$2.67

I would like to acknowledge the assistance of Brent Lundmark for providing information for this article. Also, it is important that Hutchinson city officials be recognized for taking on a project that not only will clean up a contaminated site but will also supply city residents with a much improved water quality.

Bert Zerr is currently a consultant with KRWA. He has been with KRWA for the last four years. Bert held the position as District Engineer with the KDHE in the Salina District Office for 32 years prior to that.