

Air-stripping provides a cost-effective solution for VOC removal.

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# GROWING PAINS THREE NEW PLANTS ADDRESS CAPACITY, QUALITY ISSUES

**B**LAINÉ, MINN., A NORTHERN suburb of Minneapolis, established its public water system more than 40 years ago. Since that time, Blaine has seen tremendous growth and is now one of the state's fastest-growing cities, with a population over 50,000.

Blaine relies on wells to provide potable water to its population. As the population has grown, so has the number of wells to meet the increasing demand. The city now has 17 wells with a combined pumping capacity of approximately 16,200 gpm.

Water had been treated at individual wells with the addition of chlorine, fluoride, and a polyphosphate to sequester iron and manganese. However, some customers still had water quality problems, such as red and black water that

caused staining of plumbing fixtures.

In addition, the discovery of the volatile organic chemical (VOC) 1,2-dichloroethane (DCA) in two wells at concentrations higher than the 5 µg/L maximum contaminant level (MCL) caused the two wells to be taken off line. Well No. 3 contained 20 µg/L of DCA, and Well No. 4 had 7.9 µg/L of DCA.

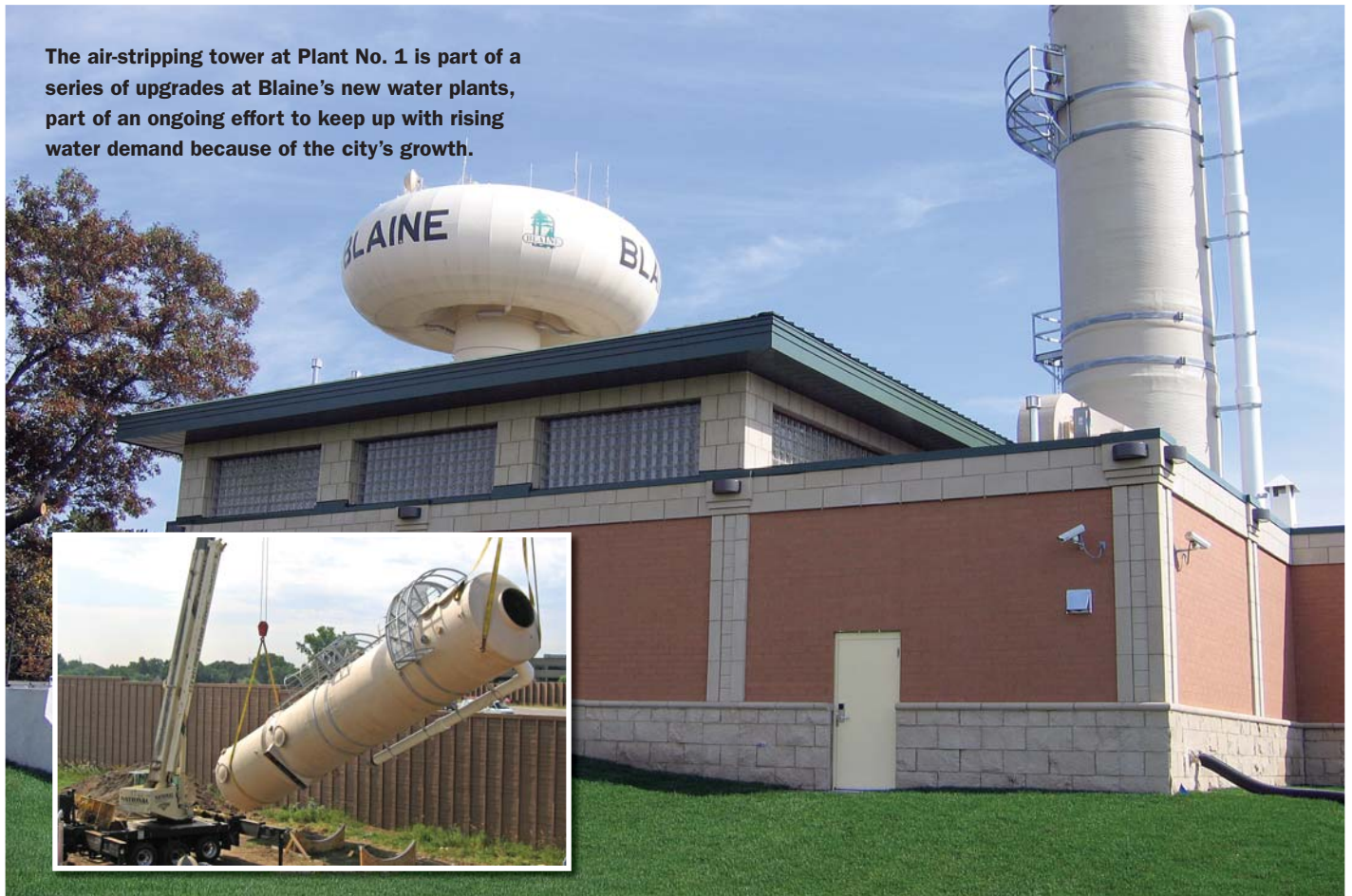
In 2002, the city completed a water supply master plan, which projected construction of several water treatment plants to improve water quality. A rate study was completed to show the rate increases needed to fund the construction of the plants. After a series of public informational meetings, the Blaine city council approved a rate increase from \$0.75 to \$1.10/1,000 gal for the first 24,000 gal and \$1.35/1,000 gal for the next 24,000 gal.



A 60-ft-tall air-stripping tower was lowered into place at Blaine's Treatment Plant No. 1 on July 27, 2006. The tower allowed the city to put two wells back into service after more than 10 years of being off line because of VOCs.

## Water Treatment

The air-stripping tower at Plant No. 1 is part of a series of upgrades at Blaine's new water plants, part of an ongoing effort to keep up with rising water demand because of the city's growth.



The city also increased connection charges to fund construction costs of new treatment plants to serve future customers.

### TREATMENT PLANT NO. 1

During routine water quality testing, the Minnesota Department of Health discovered the high VOC chemicals at Wells No. 3 and 4, which led to a Superfund designation by the Minnesota Pollution Control Agency. This meant some federal money was available to design a plant to treat the affected wells. Blaine considered two methods to remove the DCA: granulated activated carbon (GAC) and air-stripping.

The city conducted a pilot plant study, completed in May 2003, using air-stripping to determine how efficiently that

process removed DCA. The process was followed with filtration to remove iron and manganese from water pumped from Wells No. 3 and 4. The study showed that air-stripping removes about 90 percent of VOCs, leaving an effluent with DCA levels far below the 5 µg/L standard. Air-stripping was also a more cost-effective choice than GAC.

Water Treatment Plant No. 1 was completed at a cost of \$3.43 million in October 2006. The plant is equipped with a 60-ft-high air-stripping tower to remove VOCs and two pressure filters to remove iron and manganese. The pressure filters, designed at a rate of 10 gpm/ft<sup>2</sup>, were selected because of their small footprint; a gravity filter system would have required a larger building on a confined site. The plant allowed the two problem

wells, with a combined capacity of 2,000 gpm, to go back on line. The initial water quality results are in Table 1.

### TREATMENT PLANT NO. 2

The quest to improve water quality and to eliminate customer complaints of water discoloration caused by iron and manganese throughout the water system led Blaine to plan the construction of other plants.

Construction of a \$4.38 million, 8-mgd water treatment plant to serve Wells No. 12, 13, and 17 started January 2005, and the plant went on line February 2006. Wells No. 12 and 13, which are located inside the plant, produce about 3,500 gpm. Well No. 17, located about 2,000 ft east of the water plant, is connected to the plant by a 12-in. main and

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equipped with a submersible pump to draw water from the drift aquifer, producing 2,000 gpm.

Plant No. 2 is designed to remove iron and manganese through a chemical oxidation and filtration process. The plant is sized to easily add an aerator at minimal cost to remove radon from Well No. 13, because the well has a radon level of 697 pCi/L and will be out of compliance if the proposed MCL for radon of 300 pCi/L becomes a regulation (see Editor's Note, bottom right). The pilot study verified that an aerator would remove radon to meet the proposed radon standard.

Plants No. 1 and 2 are designed to remove iron and manganese by pumping raw water into a chlorine contactor designed for a 1-min detention time. High doses of chlorine are added to attain breakpoint chlorination to oxidize the iron and manganese. The water then enters a sulphur dioxide contact chamber, which also provides a 1-min detention time. Sulphur dioxide neutralizes any tastes and odors before the water goes to the filters and is also added after filtration to maintain a 1-mg/L chlorine residual in the distribution system.

Plant No. 2 has four pressure filters, each designed to filter 1,500 gpm at a rate of 10 gpm/ft<sup>2</sup> to remove iron and manganese. Fluoride is added to the plant effluent as the water enters the distribution system. Water quality results from treatment plant No. 2 are shown in Table 2.

The filters are backwashed by reversing the flow to remove particulate matter lodged in the filter media. Backwash water is directed to a reclaim basin and then recycled to the head of the plant. Sludge from the recycle basin is periodically pumped to a sanitary sewer.

An emergency chlorine scrubber system, designed to neutralize accidental release of chlorine, is part of the chlorine room, which was built to accommodate seven one-ton cylinders and a crane to handle them.

**Table 1: Treatment Plant No. 1**

After the plant went on line, water quality improved at Wells No. 3 and 4.

	IRON mg/L	MANGANESE mg/L	1,2-DICHLOROETHANE µg/L
Well No. 3	0.51	0.448	11.0
Well No. 4	0.50	0.397	5.1
Plant Effluent	0	0	1.3

**Table 2: Treatment Plant No. 2**

After the plant went on line, water quality improved at Wells No. 12, 13, and 17.

	CAPACITY gpm	IRON mg/L	MANGANESE mg/L
Well No. 12	1,000	0.036	0.42
Well No. 13	2,200	0.83	0.022
Well No. 17	2,000	0.54	0.47
Treated Water	5,200	0.00	0.00

### TREATMENT PLANT NO. 3


Water Treatment Plant No. 3, which will remove iron and manganese from Wells No. 6 and 11, was designed and bid in fall 2006. A \$2.81 million contract was awarded to the low bidder. The project is under construction and expected to be completed by the end of 2007. Like the first two treatment plants, plant No. 3 is designed to remove iron and manganese by chemical oxidation followed by filtration.

With the construction of the three water plants, Blaine will have a total treatment capacity of about 14 mgd. With peak day demands approaching 25 mgd, the city still has 10 wells that continue to receive treatment only through chemical addition at the wellhead. However, these wells are used only when water demand outstrips the treatment plant capacity.

### LOOKING AHEAD

Blaine continues to work toward increased treatment plant capacity. A

hydrogeological study was recently completed to determine the best location for new wells, and the city subsequently purchased 10 acres in the northeastern part of town. In the next five to seven years the city plans to tap several new wells and build a 12-mgd treatment plant on the new 10-acre site.

A regular flushing program to clean up the iron and manganese in the distribution system will complement the water quality improvements from the new treatment plants. The efforts are paying off: the iron and manganese problems now register in the nondetect range, the VOC levels are under control, and the city has seen a dramatic reduction in water quality complaints. 

*Editor's Note: The Radon Rule, proposed in 1999, is currently on hold in the regulatory process. The US Environmental Protection Agency's current timetable for final action on the proposal is May 2009.*