GE
Water & Process Technologies

Case Study

Big Canoe Water Treatment Plant

Application: Packaged plant water treatment system with enhanced coagulation for the filtration of surface water

Capacity: 1.0 MGD (3,785 m3/d)

Location: Big Canoe, Georgia, United States

Commissioned: January 2008

Challenge

Big Canoe is a mountain home development consisting of single family and multi-family housing complemented with a mixture of commercial, golf courses, tennis and fitness facilities. The community of approximately 8,000 acres (32 km2) has experienced a consistent and predictable growth since the early 1970's. As a result, there have been ongoing upgrades to the potable water system.

Big Canoe had previously utilized ground water wells for the potable water needs of the development, with a plan to switch to surface water treatment to serve the ultimate build-out capacity. As predicted, in the early 1990's, the demand for potable water increased to a point where a transition to a surface water treatment for Big Canoe's potable water needs was required.

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In 1992, a conventional sand filtration system was constructed to withdraw and treat an ultimate capacity of 1.0 million gallons per day (3,785 m3/d), the maximum permitted withdrawal capacity, from Lake Petit while still having a spare unit available for routine maintenance or failure of one of the other units.

Since its completion in 1996, the surface water plant has met the needs of Big Canoe's water consumption. However, with the increased growth, increasing water demand has lead to the need to upgrade the water treatment capacity of the system.

More recently, long-term drought has affected lake levels all over Georgia. With Lake Petit being both recreational as well as the primary raw water withdrawal source, the lake levels during the peak of the most recent drought have dropped to as much as 3 feet below normal. Concern over water supply during times of drought had prompted a thorough evaluation of the decision whether to continue to withdraw water from Lake Petit.

Solution

After evaluating several alternatives, engineering and design firm Cranston, Robertson & Whitehurst, P.C. recommended a plan to withdraw raw water from Blackwell Creek instead of Lake Petit to minimize the impacts of the water withdrawal on lake levels and provide a more reliable source of water. Water will be pumped to a new reservoir and then drawn into a new 1.0 million gallon per day (3,785 m3/d) water treatment plant for treatment. The existing water treatment plant at Lake Petit would remain in service as backup during drought conditions.

Membrane filtration technology was chosen as the best available technology for this upgrade for several reasons:

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Membranes provide a physical barrier to protect against disinfectant resistant pathogens such as *Giardia* and *Cryptosporidium*, which is a critical concern for surface water treatment plants;

The ability of submerged hollow fiber membranes, to deal with variations in raw water quality, such as increases in turbidity after rain events without operator intervention;

The ability of submerged membranes to operate in direct filtration mode without any chemical addition under most of the raw water conditions, thereby reducing the need to discharge a chemically modified waste to surface water and reducing the amount of sludge produced by the plant. Though not a major consideration now, future regulations will likely place restrictions on sludge handling and disposal that will greatly increase the cost of operating plants that rely on preliminary settling tanks for treatment.

After a successful three-month pilot study, Big Canoe selected a ZENON Membrane Solutions, part of GE Water & Process Technologies, Z-BOX* packaged water treatment system to treat surface water from Blackwell Creek. During the study, heavy rains caused by the hurricanes that hit the southern part of Georgia virtually turned Blackwell Creek into red mud. The membranes, however, demonstrated stable performance despite the sharp increase in turbidity and organics.

The key component of the Z-BOX system is filtration through the ZeeWeed* immersed ultrafiltration membranes. ZeeWeed hollow fiber membranes have microscopic pores on their surfaces. These pores allow clean water to pass through while rejecting particulate matter, including *Giardia* and *Cryptosporidium* that remain in the process tank until being discharged.

Process Overview

The Blackwell Creek Membrane Filtration Plant consists of two Z-BOX pre-engineered and factory-assembled package system treatment trains, with each train having one enhanced coagulation unit and one membrane unit. Each train has a capacity of 500,000 gpd (1,892 m3/d), for a total installed capacity of 1 MGD (3,785 m3/d) and a future capacity of 2 MGD (7,570 m3/d) will be possible by installing an additional membrane unit.

Each train is fully independent and can be operated individually if required. The use of multiple process trains enables the plant to be operated at the firm permeate production capacity of 0.5 mgd (1,892 m3/d) for periods of time with one membrane treatment train off-line for cleaning or maintenance.

Prior to membrane filtration, a coagulant is added to the raw water, as required seasonally, to reduce the color levels in the treated water. The pre-treated water then overflows to the membrane filtration units.

The membranes operate under a slight vacuum created within the hollow membrane fibers by a permeate pump. Treated water is drawn through the membranes, enters the hollow fibers and is pumped out to the treated water storage.

Air flow is introduced at the bottom of the membrane modules to create turbulence which scrubs and cleans the outside of the membrane fibers, allowing them to operate at a high flux. The aeration also oxidizes iron, manganese and organic compounds.