Municipal Water Treatment Facility

BIG LAKE, MINNESOTA

CITY OF
Big Lake

BACKGROUND

The City of Big Lake retained Bolton & Menk Inc. to design and construct a water supply and water treatment system to meet the current and future demands of the City. The existing treatment of masking iron and manganese was becoming an issue to customers and needed to be addressed.

The raw water in the City of Big Lake contains radionuclides above the maximum contaminant level as set forth by the Minnesota Department of Health and the U.S. Environmental Protection Agency and required treatment to meet these regulations. In addition, the raw water supply has higher concentrations of iron and manganese. It was determined that an iron and manganese removal plant should be constructed and the radionuclides would be filtered out with the oxidized manganese, thereby meeting the necessary teratment standards.

The purpose of this handout is to provide information about the water treatment facility. A process flow diagram for the water treatment facility can be found on the back page.

DESCRIPTION & PROCESS

The Big Lake Water Treatment Facility has an average design capacity of 4.8 million gallons per day and a maximum capacity of 5.7 million gallons per day. The first step in the water treatment process is aeration. The purpose of aeration is to begin the oxidation of iron and manganese to an insoluble form so they can be filtered from the water. The water is pumped from the municipal wells to the top of the aerator. The aerator is comprised of numerous slotted trays through which the water flows. A forced draft fan blows air through the aerator to further aid in the oxidation process.

From the aerator, the water flows by gravity into a 150,000-gallon detention tank which holds the water for approximately 33 minutes. The detention tank allows for further oxidation of the iron and manganese. The chemical potassium permanganate is added after the detention tank to assist in the oxidation of manganese.

After the detention tank, the water flows by gravity into four 20'x20' filter basins. Each filter basin has a Leopold-type underdrain system, reverse-graded gravel and dual-filter media. The underdrain system is constructed of a series of blocks approximately 11" wide by 12" high by 48" long made of high density polyethylene (HDPE). The blocks are arranged end to end and mechanically joined to form continuous underdrain laterals for the full length of the filter. The reverse-graded gravel is a series of layers of progressively smaller gravel placed on top of the underdrain blocks designed to retain filter media. The filter media itself is composed of 15 inches of anthracite and 15 inches of specially graded and crushed silica sand. The anthracite and

Chlorine Feed System

Filters

Filter Pipe Gallery

Aerator

Filter Room
Detention Tank and Filters

SCADA Computer Screen

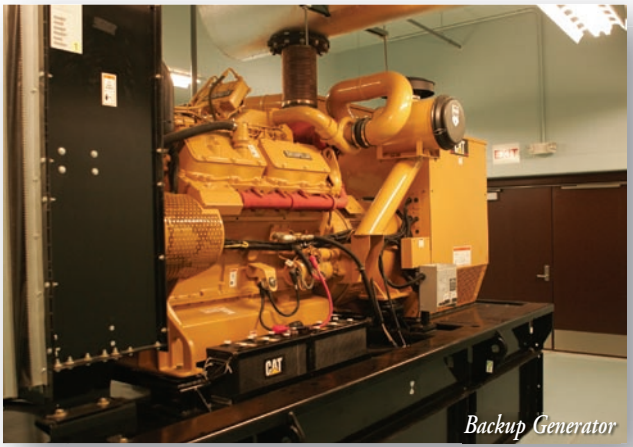
High Service Pumps

silica sand filter out the iron and manganese which were oxidized to an insoluble form in the previous stages. The radionuclides are filtered out with the oxidized manganese.

The material that is trapped by the filter beds is removed from the filters by a process called backwashing. Backwashing is accomplished by means of reversing the flow of water through the filter. This process is further enhanced by blowing compressed air up through the underdrain blocks. The filter design allows for simultaneous air and water backwashing. This maximizes the cleaning of the filter bed media prior to returning it to service. The backwash water flows to the reclaim tank. The backwash reclaim tank is located underground, just east of the treatment plant, and has a capacity of 105,000 gallons. The backwash water is held in the tank to allow particles to settle out. The clear water is returned to the beginning of the process, and the accumulated solids are pumped to the sanitary sewer system for treatment at the wastewater treatment facility.

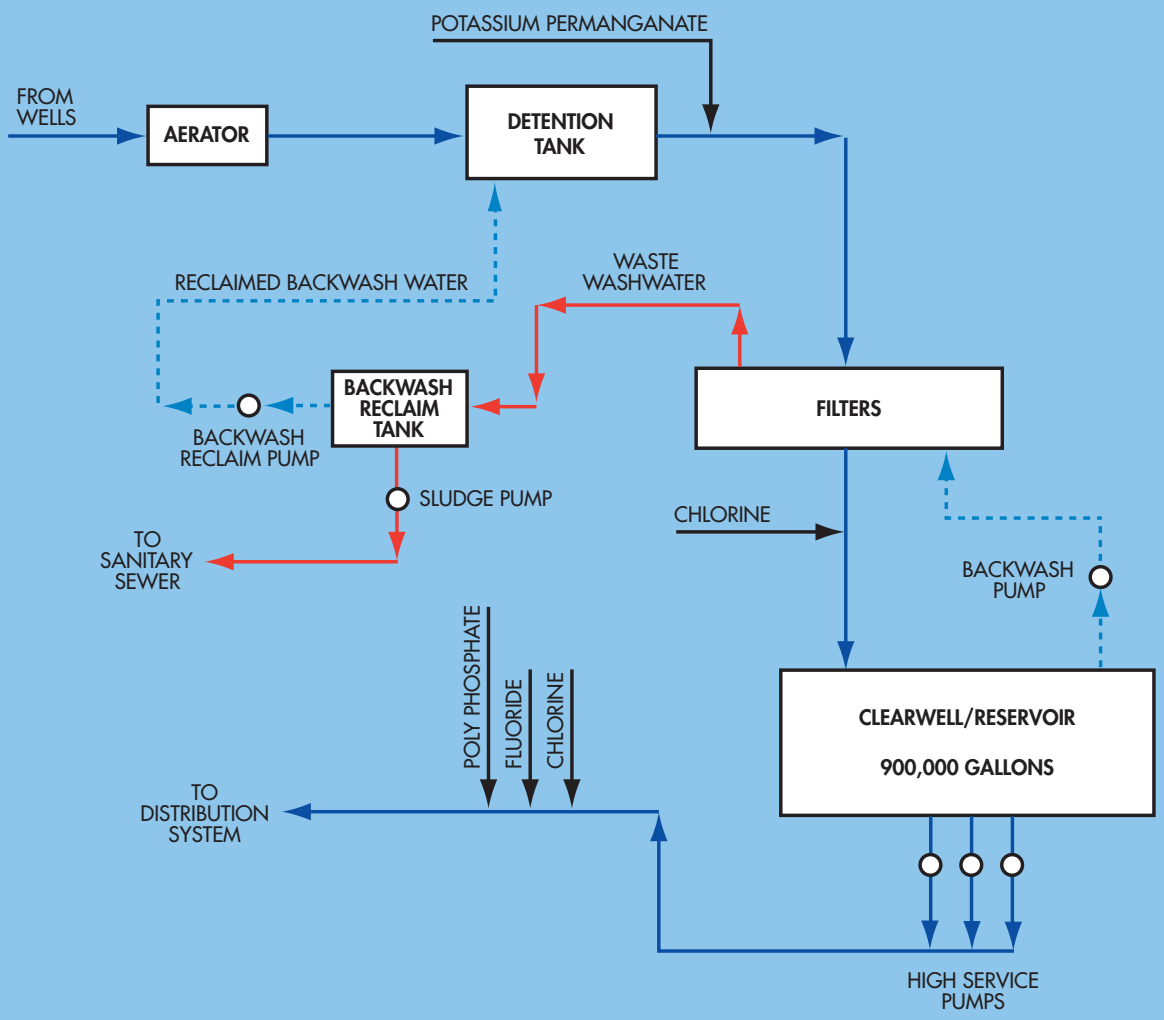
The filtered water flows by gravity to a new 150,000-gallon clearwell and 750,000-gallon reservoir, which are located under the floor of the backwash pump room. One 125-horsepower vertical turbine pump is mounted on top of the clearwell to provide backwash water. Once the clearwell is full, the filtered water is chlorinated to provide a disinfecting residual and fluoridated to enhance public dental health. To comply with lead and copper regulations, polyphosphate is added to the finished water, which creates a very thin coating on piping systems thereby preventing leaching of lead and copper into the water. The water is then pumped to the distribution system by three 125-horsepower, vertical-turbine pumps.

The operation of the wells, the treatment plant, and the high-service pumps is automatically controlled by Allen Bradley Programmable Logic Controllers (PLC's). The PC compatible SCADA system software enables the operators to run the treatment plant directly from the control room. All alarm conditions are printed out in the control room, and all critical alarms are sent out to the duty operator by an automatic telephone dialer.



Backup Generator

PROCESS FLOW DIAGRAM



DESIGN SUMMARY

NEW PLANT CAPACITY
4.8 million gallons average per day
5.7 million gallons maximum per day

CONSTRUCTION COST
$8 million

CONSULTING CITY ENGINEER
Bolton & Menk, Inc.

WATER TREATMENT FACILITY CONTRACTOR
Gridor Construction