TREATMENT OF SURFACE AND GROUNDWATER: TOUR OF MOHAWK VIEW WATER TREATMENT PLANT

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INTRODUCTION

The Mohawk View Water Treatment Plant is unique in that it has three different raw water supplies: 1) a surface water reservoir in a suburban housing area with occasional algal blooms; 2) a ground water supply with high amounts of soluble iron and manganese; and, 3) a river supply with varying flows and water quality problems. The tour will show the wide variety of treatment methods used to deal with the water quality problems associated with these various raw water sources.

HISTORY OF THE LATHAM WATER DISTRICT

A public water supply was established in the Town of Colonie by the creation of the Latham Water District in the year 1929. When the District began operations, it served only a relatively small area around the present day Latham Circle. Over the years numerous extensions have been added until, at present, the Latham Water District serves most of the developed areas in the Town. When first created, the District relied on a few wells which pumped directly into the system.

As the service area expanded, the District began an almost constant search for new supplies in an effort to remain ahead of the increasing demands for water. A series of deep wells were developed throughout the Town, which also pumped directly into the system. Two of these original wells remain, useful only for emergency service. The 1950's saw the construction of the Stony Creek Reservoir Supply and the River Road Water Treatment Plant (RRWTP). In 1963, the site for the present day water supply complex was obtained and a 5.0 MGD well field was constructed adjacent to the river. This supply, completed in 1965, consisted of four wells, a 0.5 MG Clearwell, a 5 MGD High Lift Pumping Station, and a 30-inch transmission main to the distribution system. This supply was chlorinated and pumped directly into the Distribution System.

The Mohawk River flows along eight miles of the northerly boundary of the Town of Colonie. It is a great natural resource, draining an area of about 3,500 square miles. As the River is part of the Barge Canal system, the flow of water in the River is regulated by the New York State Department of Transportation. Average annual flow approximates two to three billion gallons of water per day. As early as 1963, the River was recognized as a future source of water for the Latham Water District. Various tests and studies of the River confirmed that it contained a water treatable by modern, conventional treatment processes.

In April 1966 the Town Board of Colonie, following the recommendation of O'Brien & Gere Consulting Engineers (1966), authorized what was called the Mohawk River Water Supply project, with an expenditure of $5,000,000 for construction of a 15 MGD water supply from the Mohawk River. This additional supply of water was

In Garver, J.I., and Smith, J.A. (editors), Field Trips for the 67th annual meeting of the New York State Geological Association. Union College, Schenectady NY, 1995, p. 377-382.

planned to meet an estimated 1980 maximum daily demand of 26 MGD and to augment the existing Stony Creek Reservoir and Mohawk View well supplies.

Application was made to the New York State Water Resources Commission for permission to take 15 MGD from the River. After a public hearing, the Commission granted the taking by a decision dated October 4, 1966. The section of the River from which the Latham Water District draws water was initially classified "B" (swimming). The Commission reclassified this section of the River as Class "A" (water supply after treatment), effective February 26, 1970. The new class "A" rating compelled upstream wastewater discharges to upgrade their treatment plants.

The Latham Water District intake is located approximately midway between Crescent Dam and Lock No. 7. The impoundment from which the water is drawn has an estimated surface area of approximately three square miles and a volume of about five billion gallons. The elevation of the impoundment is controlled by the New York Power Authority at its Crescent Hydroelectric Generating Station. The New York State Department of Environmental Conservation maintains a water quality monitoring station at the Route 32 Bridge in Cohoes.

Overview of Latham Water District Water Supply

The major components of the Latham Water District Water Supply include the Intake Channel, Raw Water Pump Station, Mohawk View Water Treatment Plant (MVWTP), Clearwell storage tanks, the Mohawk View & River Road High Lift Pump Stations, and Lagoons for settling basin and backwash wastes. The water treatment plant consists of the Aeration Basin, Flocculation and Coagulation Basins, Settling Basins, Rapid Sand Filters, and chemical feed facilities. The well supply, completed in 1965, now consists of 5 wells, with a permitted withdrawal of 7.5 MGD. The well supply receives full treatment at the WTP. Although the RRWTP was abandoned in 1985, the Stony Creek Reservoir today still supplies over 5.1 million gallons of raw water (on an almost daily basis) to the MVWTP.

Intake Channel and Raw Water Pump Station

Water from the Mohawk River flows through a shore intake style Intake Channel. Water flows through a coarse bar rack and mechanized traveling water screen into the intake sump which makes up the lower level of the Raw Water Pumping Station. Suspended in this sump are four vertical turbine pumps which transmit raw water through 1900 feet of 30-inch pipe to the Aeration Basin. The four pumps are each nominally rated for five million gallons per day (MGD), thereby providing for 15 MGD capacity with any one unit out of service. A natural-gas-fired engine provides a 5.0 MGD emergency pumping capability. Chemical pre-treatment facilities were constructed in 1993 for metals oxidation and zebra mussel control.

Aeration Basin

The Aeration Basin is the point at which the River, Reservoir, and Well supplies enter the treatment process. The River and Reservoir supplies are combined in the yard piping upstream of the Aeration Basin. The Well Supply enters the Aeration Basin via an airbreak arrangement, preventing any back siphonage of raw water to the Wells.

The Aeration Basin functions primarily as a mix basin for the three possible raw water sources. Aeration and mixing are accomplished by eight floating electrically driven mechanical aerators, ensuring a high level of dissolved oxygen, providing oxidation of metals and taste-and-odor-producing compounds, and some air stripping of volatile compounds and other gases from the water. Under other operational modes employing powdered activated carbon, potassium permanganate, and/or chlorine dioxide, the Aeration Basin serves as a detention basin. Carbon is used to absorb organics, especially those causing taste, odor, and color. Chemical oxidants such as chlorine dioxide and/or potassium permanganate allow for oxidation of ferrous and manganous ions and some organics without the formation of trihalomethanes (THM). THM's are created with the interaction of chlorine with dissolved organics and forming Chloroform, etc.. The detention time in the basin at 15 MGD is 26 minutes.

Mohawk View Water Treatment Plant

The MVWTP includes facilities for rapid mixing, flocculation and coagulation, settling, and filtration of the water. The Plant has a nominal rated process capacity of 15 MGD and a hydraulic capacity of 40 MGD.

The first stage of treatment occurs before the water reaches MVWTP. Chemical pre-treatment for oxidation of iron and manganese along with taste and odor-producing compounds is practiced on all three raw water sources.

Contact times of up to 60 minutes occur before the water reaches the Aeration Basin. After the water flows through the Aeration Basin, various chemicals are introduced into the water in the Rapid Mix Chamber. Aluminum sulfate (or alum) and a polymer flocculant aid are fed to create a precipitate of aluminum hydroxide which coagulates and forms "floc" particles. These "floc" particles attract organic colloids, clay, algae, or any other particles which give the water some color or the appearance of being "dirty". The Rapid Mix Chamber is sized for 60 seconds detention time at 15 MGD.

Flow from the Rapid Mix Chamber is treated with chlorine dioxide for bacterial disinfection and oxidation as it is conducted into the Mix Basins. Gentle agitation from electrically driven vertical shaft flocculators help to form a denser, more settleable floc. Three 5 MGD dual compartmented basins provide two step flocculation. Total detention time in the flocculation basins at 15 MGD is 42 minutes.

Each Mix Basin discharges into a separate Settling Basin. Water enters the Settling Basin through orifices along the Dispersion Flume and leaves the basin through a similar arrangement in the Collection Flume. The basins are separated into two zones by a submerged half wall, and sludge is collected by two electrically driven mechanical rakes into hoppers in the bottom of the basins. The hoppers are hydraulically "vacuumed" off on regular intervals, and basins are drained and cleaned twice per year. Four hours detention time (at 15 MGD) is provided in the Settling Basins. This normally removes 90 to 99% of the particles in the water. The settled water is then delivered to the filters through the Settled Water Flume and Filter Influent piping.

Six dual media rapid sand filters perform the final step in clarification of the water. The filters are constructed of 22 inches of anthracite and 14 inches of sand on top of 10 inches of gravel. Filter bottoms are constructed with compound duplex vitrified tile blocks and each filter is provided with eight surface wash sweeps. Each filter has 595 square feet of surface area to process up to 2.5 MGD at a loading of 2.9 gallons per minute per square foot. The filters are backwashed when head loss exceeds 8 feet, when service run approaches 120 hours, or when effluent turbidity exceeds 0.35 NTU's. Filters are backwashed at a rate of 19 gallons per minute per square foot (16.5 MGD rate) until clean. Backwash water is a combination of water stored in a 0.8 MG backwash stand pipe (located to the rear of the WTP) and flow from the 30-inch finished water transmission main. A pressure regulating/altitude valve allows this tank to be refilled from a 12-inch connection to the transmission main before the water leaves the WTP site. For the first 30 minutes of a filter run after backwash, a polymer filter aid is added to condition the filter and enhance particle removal.

Final Treatment

After filtration, finished water is "post chlorinated" with chlorine for final disinfection. Corrosion control of the effluent flow is by pH adjustment with the addition of caustic soda (sodium hydroxide).

Clearwell Storage

Finished water from MVWTP flows into the Diversion Chamber. This concrete chamber splits the flow of water - approximately 70% flows downhill through a 36-inch pipeline to the MVHLPS Clearwells. The remaining 30% flows through a 12,000-foot-long 30 inch pipeline to the RRHLPS Clearwells. Two steel reservoirs are located behind the MVHLPS, a 0.5 MG tank constructed in 1965 and a 1.0 MG tank constructed as part of the Mohawk River Water Supply project. Three steel Clearwell tanks are located behind the RRHLPS, two 0.34 MG and one 0.5 MG reservoir.

High Lift Pumping Stations

Finished water is transmitted to the Distribution System by two high lift pump stations. The Mohawk View High Lift Pump Station (MVHLPS) has a rated capacity of 25 MGD. Five vertical turbine pumps are each powered by a 400 hp electric motor. Twin diesel generators provide emergency power.

The River Road High Lift Pump Station (RRHLPS) replaced the high lift pumping capabilities of the abandoned RRWTP, and has a rated capacity of 10 MGD. RRHLPS is equipped with two pumps rated for 2.5 MGD and one pump rated for 5.0 MGD. These vertical turbine pumps are each powered by a 400 hp electric motor. RRHLP #3 has an engine-driven right-angle drive to provide emergency pumping capabilities.

Chemical Application

Chemicals may be fed in at a number of points, thereby providing flexibility in operation. Chemical feed points and chemicals which can be fed in are as follows:

Reservoir	Potassium permanganate
Well Supply	Potassium permanganate, chlorine dioxide
Raw Water Pumping Station	Chlorine dioxide, powdered activated carbon (PAC), potassium permanganate
Rapid Mix Basin	Alum, caustic soda, weighting agents, chlorine, chlorine dioxide, PAC, polymer
Before Flocculation Basins	Chlorine dioxide
Before Filters	Polymer, chlorine
After Filters	Chlorine, caustic soda

Chemical Handling and Feeding

Chemicals normally used in the treatment process are chlorine, aluminum sulfate, sodium hydroxide, powdered activated carbon, potassium permanganate, polymers, sodium chlorite, and chlorine dioxide. Bulk handling and storage equipment is provided for all except chlorine dioxide. The chlorine dioxide is generated on site by reacting sodium chlorite and chlorine.

Chlorine is purchased, stored and utilized in "Ton" containers each weighing approximately 3700 pounds. Electric-powered lifting equipment for handling the chlorine has been provided. Chlorine application is accomplished by standard feeders with duplication of the largest to ensure 100 percent standby.

Alum and caustic soda are purchased, stored, and fed in as liquids. Purchase is by truckload lots with storage tanks sized accordingly. Liquid alum is fed from day tanks while caustic is fed directly from storage by proportioning pumps. Volumetric and gravimetric feeders are available to feed bagged equivalent dry chemicals in the event of breakdown in the basic alum or caustic systems.

Powered activated carbon is purchased in bulk truckload lots in powder form. As it is being unloaded, the carbon is wetted and is stored, handled, and fed in slurry form. Bagged activated carbon can be fed in dry powder form via volumetric feeder in the event of failure of the normal system.

Instrumentation and Control System

The instrumentation and control system provides the Operator with indicators and records of all major WTP and Distribution System operations. From the master control console, the Operator can start and stop well pumps, raw water pumps, aerators, rapid mixer, flocculators, sludge collectors, and high lift pumps. Control valves at the inlet to the flocculation basins and at the filter discharge rate controllers are also operable from the master control console. Filter control consoles, one for every two filters, permit easy operation by manipulation of switches on the filter console. Filter backwashes are Operator-attended, and are initiated when effluent quality degrades to 0.35 NTU, service run reaches 120 hours, or if loss of head reaches 8.0 feet.

The instrumentation system utilizes pulse duration and 4-20 milliamp signals. Master control of the filter effluent rate of flow is based on the elevation of water in the plant. The Master Control matches the flow through the filters with the incoming flow of raw water (influent). Chemical feed rates are automatically varied in accordance with variations in influent flow rate.

Laboratory Facility

The MVWTP laboratory includes equipment for making physical, chemical, bacteriological and microscopic tests on the water. Pumped sampling lines deliver continuous samples to the laboratory from various stages of the treatment process. Frequent testing of the raw and finished water plus testing at different stages of treatment ensure that proper treatment is being accomplished to provide a safe and palatable water for the Latham Water District customers.

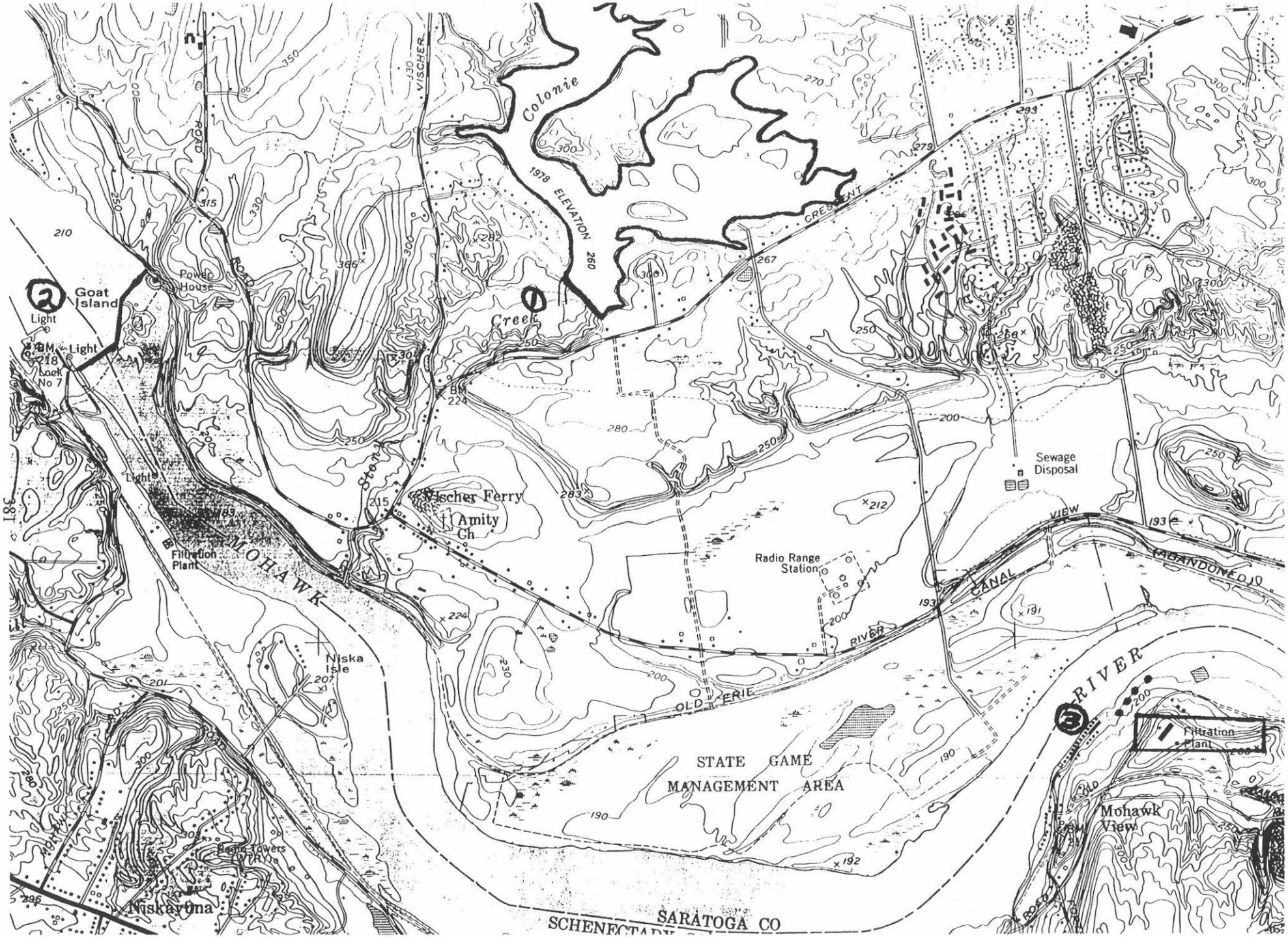

Figure 1. Location map showing: 1) the surface reservoir; 2) the Mohawk River; and, 3) the well field and Water Treatment Plant.

Waste Lagoons

Two lagoons provide gravity settling and thickening of process waste (filter backwash water, mix and settling basin waste flow, etc.) before the clarified supernatant water is discharged back into the Mohawk River. Discharge of this wastewater flow is governed by a New York State Department of Environmental Conservation (NYSDEC) State Pollution Discharge Elimination System (SPDES) permit. Original design provided for between 1 and 4 years of sludge storage before cleaning is required. The current cleaning interval is 1 year and is accomplished by conventional excavation equipment. Ramped access for vehicular traffic makes cleaning operations as easy as possible.

Future Expansion

Future expansion has been considered in design to permit the eventual doubling of the capacity of the MVWTP. Groundwater supplies adjacent to the river and in the glacial Colonie Channel have been explored. The Raw Water Pumping Station can be doubled in capacity by replacing present pumps and motors with larger units and duplicating the raw water transmission pipeline. Room is available for duplicating the Aeration Basin. Provision is made at the Rapid Mix Basin in the WTP to duplicate the piping to and from the mix basin. The number of flocculation basins, settling basins, and filters can be increased by addition of a single bay at the eastern end of the Filter Gallery or by construction of a completely new wing on the Western side of the WTP. There is ample space for constructing additional Clearwell Storage and improvements to the MVHLPS. Additional power supply and a second finished water transmission main to the Distribution System, required when total water demand from the site exceeds 25 MGD, were considered when laying out the present plant, pumping, and storage facilities.

ADDITIONAL SOURCES OF INFORMATION (NOT REFERRED TO IN TEXT)

Arnow, Theodore. 1949. The Ground Water Resources of Albany County, New York, US Geological Survey and New York Water Power and Control Commission, Albany, NY, Bulletin GW-20.

O'Brien & Gere. March 1966. Investigation of Water Supply - town of Colonie, Latham Water District.

Simpson, E.S. 1949. Buried Preglacial Ground Water Channels in the Albany-Schenectady Area in New York. US Geological Survey and New York Water Power and Control Commission, Albany, NY, Bulletin GW-20A.

O'Brien & Gere Engineers, Inc. April 1991. Well Field Assessment, Mohawk View Site, Town of Colonie, 34 p.

Dineen, Robert, et.al. 1983. "Bedrock Topography and Glacial Deposits of the Colonie Channel Between Saratoga Lake and Coeymans, New York" with Waller, Roger "Ground-water Potential of Capital District Buried-Valley Deposits". New York State Museum Map and Chart Series #37, Albany, NY.

TRIP GUIDE

Leave Civil Engineering/Geology Building (Butterfield Hall) at Union College, exiting the Campus via Nott Street/VanVranken Street (northeast). Turn right at light onto Nott Street. At the second light, bear left onto Rosa Road (Ellis Hospital on right). Proceed for 1 mile until stop light on RT#146 (Balltown Road). Go straight (toward GE R&D Center) on River Road. Proceed 2.5 miles east, past GE R&D Center, on River Road, turning left at stop sign on to Rosendale Road. Follow Rosendale Road for 2 miles. Ignore turn to right at arrow onto Vly Road, and proceed straight on Old River Road. Proceed on Old River Road 2 miles until intersection of Forts Ferry Road. Proceed straight across intersection (River Road changes to Onderdonk Road after intersection). The treatment plant is on the right side immediately after the bicycle path crossing. Take access road into the parking lot (#3 on map).

Information as to access and possible tours of the plant can be answered by calling Robert Maswick (518-783-2774) at the Mohawk View Water Treatment Plant. A schematic of the plant will be made available at the Treatment Plant.