WASTEWATER TREATMENT FACILITY

Big Lake, Minnesota

CITY OF Big Lake

BOLTON & MENK Engineers & Surveyors

Background

The City of Big Lake provides wastewater treatment for its residents. The original wastewater treatment facility was constructed in 1981 and was updated in 1996 and 1999.

The existing treatment facility was operating very well and meeting all permit limits. However, the treatment facility does not have capacity to handle the future growth for the City. There were specific portions of the treatment facility that really needed attention and those were the main lift station and screening, and the biosolids treatment process. The biosolids treatment process was at capacity because of the growth experienced and the biosolids system was on the verge of not meeting MPCA requirements. The original plan for upgrading the treatment facility included upgrading all facets of the treatment system; however, the economic crisis and subsequent slowdown in growth prompted the City to address the most critical areas of the treatment facility which were: the main lift station; pretreatment; the biosolids process; and completing SCADA improvements.

Bolton & Menk, Inc. was retained to plan, design and provide construction management of the new improvements to the treatment facility.

The project was constructed by Rice Lake Construction Group, Inc. for $13,151,000. Funding was provided by a combination of grants and loans from the Public Facilities Authority.

Description & Process

Mechanical wastewater treatment facilities include two separate processes that are combined to form an integrated treatment system. The processes are commonly referred to the “liquid stream” and the “solids stream”. The liquid stream combines various treatment components to convert the wastewater into natural byproducts of biological stabilization and the effectiveness of the liquid stream is what determines the quality of the effluent produced by the facility. The solids stream combines treatment components to stabilize, thicken and store the solids byproducts produced by the liquid stream for eventual incorporation into the soil.

The wastewater is collected by a system of gravity collection pipes throughout the City. The sanitary sewer collection system has 59.5 miles of pipe.

Within the collection system, fourteen lift stations with over 7.5 miles of forcemain piping help to move wastewater toward the wastewater treatment facility. All of the wastewater from these lift stations is eventually pumped and flows to the main lift station

The WWTP consists of a variety of different treatment processes, and the processes involved in the improvements project are described below.

Main Lift Station

The main lift station pumps all of the wastewater to the wastewater treatment facility. The main lift station is located along Ormsbee Street.

This new lift station has four submersible pumps. Two of the pumps are 20 horsepower each and can each pump 470 gallons per minute and the other two pumps are 43 horsepower pumps and they each have a pumping capacity 1,500 gallons per minute. The lift station pumps into dual forcemains, one is 8-inch diameter and the other is 12-inch diameter. This lift station is constructed with the future in mind to handle future capacity increases. In order to handle additional capacity the existing 8-inch forcemain will be replaced with a 16-inch forcemain. In addition, the 20 horsepower pumps will be replaced with 30 horsepower pumps that will each have a pumping capacity of 1,640 gallons per minute.

Preliminary Treatment

The wastewater from the Main Lift Station is pumped to the new pretreatment facility located at the wastewater treatment facility site. The pretreat-





ment facility is the first step in the treatment process and is often referred to as “Preliminary” treatment. Preliminary treatment is accomplished utilizing screening and grit removal processes. The wastewater that is pumped from the lift station is screened through a one-quarter inch drum screener, which removes the larger inorganic material while allowing the smaller material and organic material to continue through the treatment process. The screened material is removed from the waste stream using an auger system which also washes and dewaters the material prior to discharging the screened material into a waste dumpster. Screened inorganic waste material is then hauled to a sanitary landfill site.

Grit (sand and soil particles) removal is accomplished using a vortex grit removal system. Influent wastewater is channeled into a mechanically induced vortex chamber. The vortex spiral flow pattern tends to lift lighter organic material while settling heavy grit to the center bottom of the chamber. Grit is removed from the chamber using a grit pump, and is then washed and dewatered using a grit cyclone. The dewatered grit is then discharged to a waste dumpster and taken to a landfill.

The wastewater exits the pretreatment building and flows by gravity to the remainder of the wastewater treatment system for further treatment before discharging to the Mississippi River. The City of Big Lake utilizes an activated sludge process with final clarifiers and ultraviolet disinfection to treat the liquid portion of the wastewater. Biosolids are the solids that are a by-product of the treatment of wastewater. Treatment of biosolids is the final stage of the treatment process.

Biosolids Treatment

Biosolids are a combination of material removed from the wastewater stream as it enters the facility, and the biological growth generated by the secondary (biological) process. Biosolids contain nutrients—nitrogen and phosphorous—which can be beneficially recycled into reusable organic materials.

Biosolids also contain pathogens, which need to be controlled for public health reasons. In order to control pathogens, and prepare the biosolids for future use, the biosolids are heat dried using indirect heat utilizing thermal oil. The high heat and extremely dry product creates an end product that has value as a fertilizer.

Biosolids are first pumped in liquid form, as 1 to 2% solids, from the clarifiers to the existing biosolids tanks. The existing tanks have more than 700,000 gallons of

capacity. The biosolids from these tanks are pumped to new storage tanks located in the new biosolids processing building. These new storage tanks have a capacity of 150,000 gallons. The total amount of storage allows for scheduling of the biosolids treatment on a batch type basis for efficiency. The first step in drying the biosolids is to create a cake material and to do this the biosolids are pumped to centrifuges. The centrifuges spin at a very fast speed, up to 1,800 revolutions per minute, and the water is separated from the solids, producing a biosolids "cake" that is 16 to 20% solid material. This biosolid cake drops from the centrifuges onto a conveyor, which transports the cake to storage bunker. The purpose of the bunker is to temporarily store the dewatered biosolids to allow continuous operation of the dryer once the dryer starts up. The storage bunker has a volume of 50 cubic yards.

The dewatered biosolids from the storage bunker are conveyed into the dryer. The biosolids are dried in this process using a heat exchanger process. The dryer will heat the biosolids to over 300 degrees F. and the biosolids are maintained in the dryer until the biosolids are dried to meet the Class A requirements for pathogens and vector attraction. Once the solids exit the drying system the solids will be 90 plus percent solids. The dryer unit is heated using thermal oil that is heated with a natural gas boiler.

The dried biosolids are transferred by conveyors and eventually blowers into a storage silo. The storage silo has a capacity of 6,000 cubic feet. In addition to the dried biosolids storage silo, the City retains their existing aerobic digester and storage tank for liquid biosolids, allowing the City flexibility in processing the biosolids.

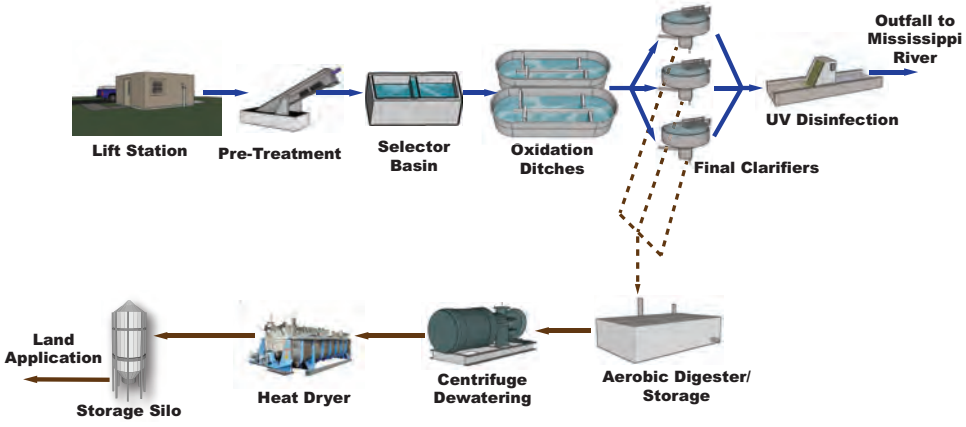
The dried biosolids are disposed of by applying to agricultural lands as well as other approved properties.

Controls and Support Facilities

The entire facility was upgraded with a new automatic control system, including Programmable Logic Controllers and Wonderware software. The automatic control system includes graphic displays, alarm conditions and logs, as well as historical data trending and displays. The data collected is used to provide operation and maintenance reports.

Permanent generators were provided at the main lift station and also for the biosolids and pretreatment facilities. In addition, a utility equipment storage and maintenance area provides the facilities necessary to maintain the wastewater utility equipment. This area houses equipment used to maintain the City collection system and lift stations, without exposure to outdoor elements.

Process Flow Diagram



Design Summary

- Dryer Capacity .....7,846 Lbs/Hour
- Final Biosolids Product .....90+ % Solids
  Class A, Exceptional Quality
- Cost Of Project $15,470,120
- Engineer .....Bolton & Menk, Inc.
- General Contractor .....Rice Lake Construction Group