# City of Kiel, Wisconsin

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## INTRODUCTION

The City of Kiel, Wisconsin, provides advanced wastewater treatment for residential and industrial wastewater generated within the City corporate limits, as well as high strength wastewater generated from outside sources. Treated effluent is discharged to the Sheboygan River.

Originally constructed in 1965, the facilities were upgraded in 1979 with two new final clarifiers. Since then, the Wastewater Treatment Facilities had smaller upgrades and revisions, including headworks revisions in 1996, aeration and solids handling upgrades in 1997, main pump house upgrades in 2001 and 2014, aeration in 2008, and biological phosphorus removal in 2011.

High strength wastewater is received from three local dairy facilities. Two of the facilities are planning significant increases in their flows and loadings. Due to the age of the existing facilities and the projected flows and loadings, the City of Kiel has retained the McMahon Group to undertake facilities planning.

## TREATMENT PROCESS

### General

The Wastewater Treatment Facilities flow scheme for liquid treatment includes raw sewage pumping, quarter-inch fine screening, aerated grit removal, primary clarification, fine bubble aeration with selector zones, final clarification, tertiary filtration, chlorine disinfection and post-aeration. The solids flow scheme includes co-settling of waste activated sludge (WAS) in the primary clarifiers, anaerobic digestion, belt press dewatering, Class A in-vessel pasteurization process, biosolids storage and land application.

### Influent Pump Station

The River Road Pump Station is the main influent Pump Station. The station has been upgraded over time, and currently has three 33-HP immersible pumps in a dry pit arrangement. With a firm capacity (one pump out of service) of 2.42 mgd, wastewater is transferred to the Wastewater Treatment Facilities' site via 8 and 12-inch parallel force mains.



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### Headworks
Flows from the River Road Pump Station are split between two spiral fine screens with quarter inch perforated openings. Each has a rated capacity of 4.3 mgd.

Grit removal consists of an aerated grit chamber, air lift pump and grit classifier.

### Primary Treatment
Following screening and grit removal, influent wastewater flows to two 28-foot diameter circular primary clarifiers. The concrete is original to 1965, while the mechanisms were upgraded in 1979. Settled solids are pumped to the anaerobic digestion system for stabilization.

### Secondary Treatment
Primary effluent flows by gravity to three secondary treatment trains, each consisting of an anaerobic selector zone and aeration zone. The anaerobic zones make up about 18% of the total treatment volume and promote Biological Phosphorus removal. The anaerobic zones are mixed using hyperbolic mixers. The aeration basins are mixed and aerated using ceramic fine bubble diffusers and air supplied by two 100-HP and two 150-HP positive displacement blowers.

The south basins consist of four tanks, where the anoxic/anaerobic zone takes a portion of Tank 1, and the remainder of Tank 1 and Tanks 2 and 3 are aerated. Tank 4 is used to receive hauled-in high strength waste.

The mixed liquor flow from the aeration basins flows to two 40-foot diameter circular secondary clarifiers.

Return activated sludge (RAS) is pumped to the anaerobic zones from a collection box using centrifugal pumps, and a small rotary lobe pump drawing from the RAS pump suction is used to divert the WAS stream to the primary clarifiers for co-thickening.

### Tertiary Treatment
Secondary effluent is pumped to four gravity filters with sand media. The filters provide total surface area of 576 square feet, and have a media depth of 2.5 feet. The three dry pit centrifugal filter feed pumps have a firm pumping capacity of about 3.74 mgd with one pump out of service. The filters have a rated flow capacity of 2,160 gpm or 3.1 mgd based on a loading rate of 5 gpm/square foot with one filter out of service. Filter backwash water is supplied by two vertical turbine pumps capable of backwashing at a rate of 20-feet/second. A positive displacement blower provides air scouring during the backwash cycle. Waste backwash water is handled using two dry pit centrifugal pumps.

### Disinfection
Filtered effluent is disinfected prior to discharge using gas chlorine. Chlorine gas is stored in 150 lb. cylinders and daily use averages about 25 ppd. Flow can be split between two plug flow chlorine contact basins. Sulfur dioxide is used for effluent dechlorination, and is also stored in 150 lb. cylinders.

### Solids Handling
The solids handling process at the Wastewater Treatment Facilities include the following major unit processes:

Anaerobic Digestion
Belt Press Dewatering
Class A Pasteurization System
Biosolids Storage

Primary sludge generated in the primary clarifiers is pumped to the anaerobic digestion complex. WAS is currently pumped with a small rotary lobe pump to the primary clarifiers for co-thickening and processing through the anaerobic digestion system. The anaerobic digestion system consists of two 45-foot diameter anaerobic digesters. The sludge is first sent to the primary digester, which is heated, mixed via a gas mixing system, and has a fixed cover. From the primary digester, the sludge is pumped to the secondary digester, which is not heated or mixed. The secondary digester has a floating cover for biogas storage. It basically provides storage and allows the digested sludge to become less active prior to being transferred to the dewatering facility.

Following digestion, the stabilized sludge is pumped to aerated holding tanks, and is dewatered with a 2.0-meter belt press. The dewatered solids or cake is conveyed to a pasteurization process to produce a Class A biosolid. The pasteurization process utilizes either lime or fly ash to produce the heat and dryness required in the process. The biosolids from the in-vessel system are transported by truck to the on-site 80-foot x 140-foot Biosolids Storage Building, pending land application.

### Combined Heat & Power (CHP)

The city is currently undertaking a Combined Heat & Power (CHP) project, parallel to the current Facilities Planning process. Major equipment items, including biogas conditioning for moisture, $H_2S$ and siloxane removal, and a 280 kW engine generator, are being procured directly by the City for installation by contractors. With an estimated project cost of $1.2-million, the City of Kiel was able to secure a $500,000 grant from Focus On Energy, reducing the capital outlay for the project and reducing the straight-line payback to less than three years.

The system is expected to produce two million kWH per year, and supply hot water for the anaerobic digestion process and building heat. CS





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