L-R: Operators Bill Hutson and Larry Wollin, Superintendent Bob Scherr, Operator Ken Bosteder, Foreman Bill Kiessling, and GIS Intern Derek Furger.

City of Lake Mills
Wastewater Treatment Plant

By Kevin Hopkins, P.E., Strand Associates, Inc.

Superintendent Bob Scherr and his four operating staff at the City of Lake Mills, Wisconsin, wastewater treatment plant received the Central States Water Environment Association's Wisconsin Section Operation Award this year at the 84th Annual Meeting.

Plant background

The Lake Mills Wastewater Utility serves 8.2 square miles and approximately 5,200 residential, commercial, and industrial customers within the city limits and in the town of Lake Mills. The staff maintain 42 miles of sanitary sewer as well as 17 lift stations within the service boundary.

The treatment plant was upgraded from an RBC plant to an activated sludge oxidation ditch plant in 1991. In 2002 a new raw wastewater bar screen and wash press were installed along with chemical phosphorus removal and additional sludge storage. A 2009 upgrade included SCADA alarm, plant, and lift station monitoring.

Table 1:
Influent Flows and BOD5 Loadings

Year	Influent Flow mgd	Influent BOD_5 lbs/day
2007	1.05	1,433
2008	1.12	1,312
2009	0.94	1,415
2010	0.91	1,454

The treatment plant is designed for an average daily flow of 1.16 mgd and a maximum daily flow of 2.42 mgd. Design BOD_5, TSS, and TKN loadings are 1,856 lbs/day, 2,143 lbs/day, and 235 lbs/day, respectively. Average annual influent flows and BOD_5 loadings from 2007 through 2010 are summarized in Table 1.

Preliminary treatment and influent pumping

Raw wastewater enters the screening building where it is screened with a step screen with 1/4-inch spacing between bars. Screenings are washed and compressed and disposed of at a landfill. The original coarse mechanical screen is used as a backup screen. Flow is metered in a Parshall flume and discharges to a submersible pump station. Four submersible pumps, including one backup pump, have a firm pumping capacity of 2.9 mgd and pump the screened wastewater to the oxidation ditch splitter box.

Secondary treatment

Screened wastewater is mixed with RAS in the oxidation ditch splitter box before being split between two oxidation ditches. Each oxidation ditch has a volume of 808,000 gallons and one 50 hp variable speed aerator. Volumetric design loading to the oxidation ditches is 9 lbs BOD_5/1,000 cu ft/day for both BOD_5 removal and nitrification.

Mixed liquor flow is split at the end of the oxidation ditches where it flows to two final clarifiers. Because of the long detention time in the oxidation ditches (1.4 days at design average flow), the clarifiers are covered to minimize freezing. Each clarifier is 55 feet in diameter with a 16.5-foot side water depth. A suction header in each clarifier is piped to a telescopic valve that controls the rate of RAS withdrawal from the clarifier. RAS flow is metered before discharge to a RAS pumping station. Two dry-pit centrifugal pumps plus one backup pump RAS to the oxidation ditch splitter box.

Phosphorus removal

Total phosphorus (TP) is chemically removed by adding alum to the head or end of the oxidation ditches. Two 4,600-gallon tanks provide approximately two months of alum storage. Alum is pumped to the application point using flow-paced chemical metering pumps.

Table 2: WPDES Permit Limits

BOD5 mg/L	TSS mg/L	NH3-N mg/L	TP mg/L
10 (May - Oct)	10 (May - Oct)	1.6 - 12 (varies by month)	1
14 (Nov - Apr)	14 (Nov - Apr)		

Table 3: Effluent Quality

Year	BOD_5 mg/L	TSS mg/L	NH_3-N mg/L	TP mg/L
2007	2	2	< 0.1	0.7
2008	2	3	< 0.1	0.7
2009	3	4	< 0.1	0.7
2010	2	3	< 0.1	0.7

Disinfection and post-aeration

Secondary effluent is metered and then disinfected using gaseous chlorine. A chlorine contact tank provides sufficient detention time to meet the fecal coliform limit of 400-count/100 ml from May 1 through September 30. Gaseous sulfur dioxide is used to remove remaining chlorine residual prior to discharge. Diffused aeration and a cascading step aerator are used to provide dissolved oxygen to meet the effluent limit of 7 mg/L. Treated effluent is discharged to Rock Creek, which is a tributary to the Crawfish River.

Biosolids management

Excess biosolids generated by the treatment processes are periodically removed. The biosolids are pumped with polymer to a gravity belt thickener. The thickener provides a quiescent settling zone to separate water from the solids. The biosolids are thickened to approximately four percent total solids. Filtrate from the thickener is returned to the influent pumping station for treatment. Thickened biosolids are pumped to one of five storage tanks on site. This provides a minimum of 180 days storage. Submersible mixers in each tank mix the contents prior to removal. The city contract hauls the biosolids to local farmland for beneficial reuse. The biosolids are injected into the soil and consistently meet state and federal Class B requirements. Contract hauling occurs in the spring and fall.

Laboratory, storage, and maintenance

The plant has a fully equipped laboratory to run daily tests for monitoring influent, effluent, and process parameters. Annual metals analysis for biosolids monitoring is contracted out to a commercial laboratory. Storage buildings and parking garages on site provide facilities to maintain equipment and store utility vehicles.

Plant performance

The plant's WPDES permit limits for key effluent parameters are summarized in Table 2.

Average annual effluent parameters from 2007 through 2010 are summarized in Table 3.

The plant has consistently met WPDES permit limits for BOD_5, TSS, NH_3-N, and TP. Effluent NH_3-N concentrations are often nondetectable. Fecal coliform, chlorine residual, and dissolved oxygen concentrations are also consistently within limits. CS

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