



FRWRD's 5 mgd West Water Reclamation Facility – facilities were laid out for capacity expansion to 25 mgd.

Fox River Water Reclamation District West WRF, Elgin, IL

Using BNR capability in advance of nutrient limits to reduce energy usage and gain operating experience before it is required

The Fox River Water Reclamation District (FRWRD), located in Elgin, IL owns and operates three water reclamation facilities (WRFs) with combined capacity of 38 mgd, 14 pump stations, and one CSO discharge location. FRWRD serves over 180,000 customers in Elgin, South Elgin, West Dundee, and portions of Sleepy Hollow, Streamwood, Hoffman Estates and unincorporated St. Charles Township. The District's West WRF was originally constructed in 1927 but was completely replaced and expanded in 2003. The plant was designed to treat flows from the west of the Fox River, including areas of significant near-term and projected long-term development. The plant has a current design capacity of 5.0 mgd with a modular design allowing

for expansion in 5 mgd increments to 25 mgd. The facility includes screening, grit removal, primary treatment, secondary treatment, and effluent disinfection. Sludge generated at the facility is pumped to FRWRD's Pagorski WRF for further treatment. The aeration tankage was designed as a conventional activated sludge process configured to allow switching to a five-stage Bardenpho BNR operating mode. The plant was operated as a conventional activated sludge facility until early 2012.

More than one driver led to implementing BNR now

Since 2001, FRWRD has participated in the Fox River Study Group (FRSG) — a compendium of local stakeholders in

the Fox River watershed that includes the Sierra Club, Friends of the Fox River, Fox River Ecosystem Partnership, Illinois Environmental Protection Agency (IEPA), Kane County, and most of the major wastewater dischargers on the 100 miles of the Fox River between the Stratton Dam on the north end and its confluence with the Illinois River. The FRSG has been collecting data and modeling the Fox River particularly related to impairments of low dissolved oxygen (DO) concentrations and high algae levels. The group is now developing a Fox River Implementation Plan (FRIP) which will focus on resolving DO and algae impairments by reducing phosphorus loadings from both point and non-point sources. As part of a



FRWRD's Superintendent Doug Haacker stands at the West plant aeration system, which is divided into five zones by concrete baffle walls.

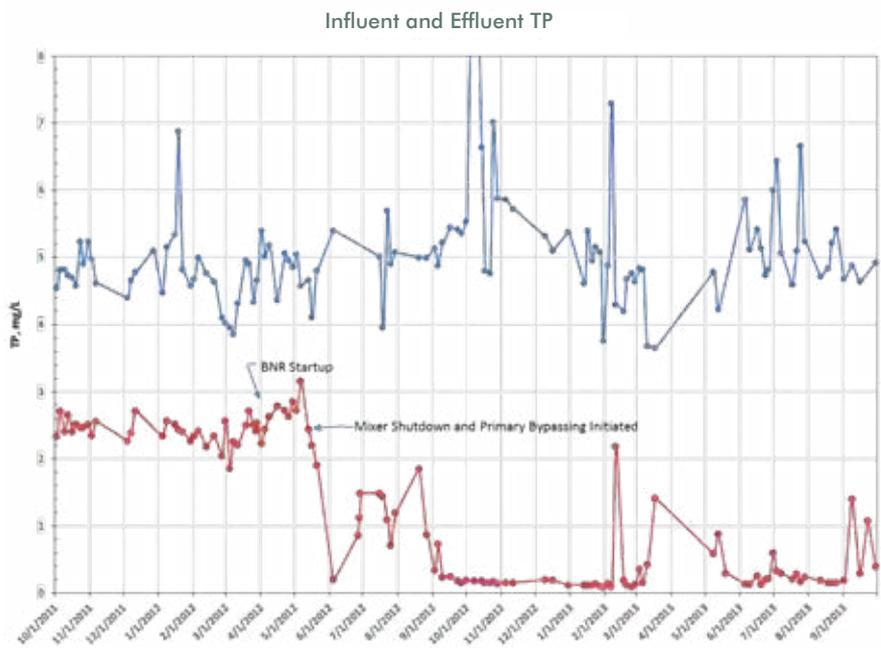
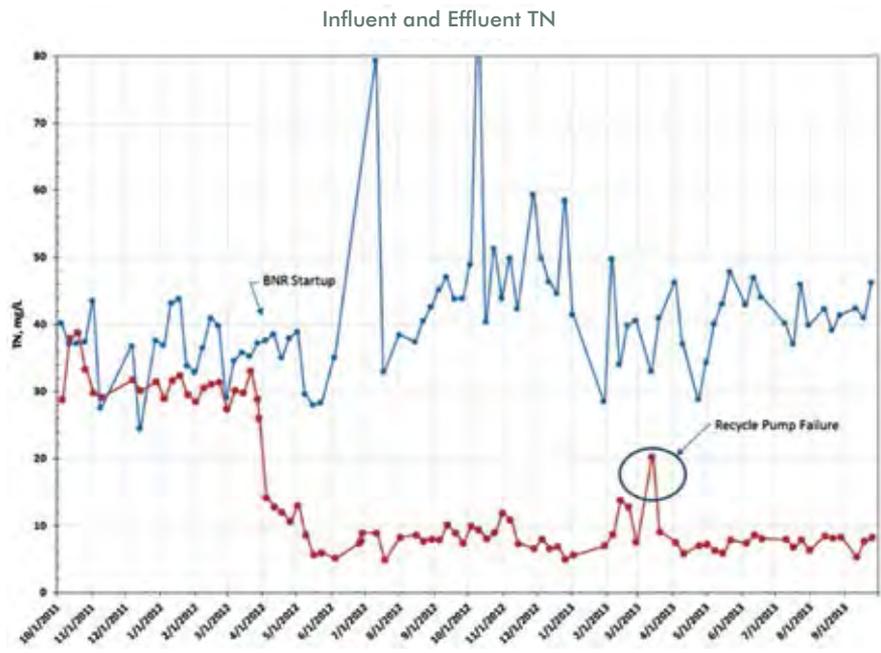
special NPDES permit condition, FRWRD will have to reduce total phosphorus (TP) in the effluent of all three of its WRFs to 1.0 mg/L in the permits that are about to be issued. Future limits could be more stringent depending on the results of the Fox River Implementation Plan.

In 2011, with efficient high speed blowers available, the startup of energy grant programs, and knowing that the existing blowers could not be turned down low enough to match current diurnal air demands, FRWRD initiated a project to add a high speed blower to the plant. In developing the project, it was determined that switching to the BNR mode would save more energy (and allow for additional grant funding) for the low additional capital cost of some additional mixers (the internal recycle pump had been previously purchased). As a result, mixers and one new high-speed blower have been installed at the plant.

System performance and energy savings

Given the impending 1.0 mg/L TP limit and the energy savings available, the West WRF was switched into BNR operating mode in April 2012. Following a pretty significant startup period, phosphorus levels have been reduced frequently down to 0.2 mg/L and total nitrogen has been reduced from 30 to 8 mg/L. Having the necessary tankage arrangements in place from the original design made the change very cost effective.

“Based on actual power data from October 2012, the estimated power reduction for the aeration system was over 380,000 kW-hrs per year, or a 35% reduction in power drawn.”



FRWRD was awarded two separate grants for a total of approximately \$90,000 based on energy savings. By going to BNR, the air demand was reduced by approximately 16 percent in addition to the energy savings of the more efficient blower.

Because the plant was designed for BNR, the capital cost for putting the Bardenpho process in place was only \$218,000, which includes the new 150 horsepower blower and three additional tank mixers. With the grant funding obtained, the net cost to the district was approximately \$128,000.

Operating data has shown that energy use has been reduced as anticipated. Since operating the Bardenpho system, the aeration tanks require about 16% less air for treatment than previous operation and the air is provided by the very efficient high-speed blower that can operate at much lower outputs than the existing centrifugal blowers. Based on actual power data from October 2012, the estimated power reduction for the aeration system was over 380,000 kW-hrs per year, or a 35% reduction in power drawn. Even considering the estimated energy to run the mixers and internal recycle pump, the power savings are over 15%.

“By going to the high-speed blower, it gave us a better range to work with, and we’re able to better target the actual air demand that we have, versus the conventional blower,” FRWRD Executive Director Bob Trueblood explains. “We could have made the BNR work without it, but it works so much better with the high-speed blower.” This is especially true because of the need to keep the DO out of the anaerobic and anoxic zones. In the past, DO values over 5 mg/L occurred often in the aeration tanks because the blower output just couldn’t be reduced any further. Return sludge flows containing high DO concentrations would have reduced the available anaerobic volume of that zone.

Early lessons learned

Getting the process up and running took longer than staff expected. A couple of additional operational

modifications were made before biological phosphorus removal really took off. The first was bypassing some influent flow around the primary tanks, taking it directly to the aeration system. The second change was based on advice from another municipality that has been operating bio-P longer – Algonquin, IL. They found that reducing the run time of the mixer in the anaerobic zone improved

their phosphorus removal. FRWRD staff implemented the same strategy, automating a reduced mixer run time schedule of 30 minutes on followed by 90 minutes off. With these changes implemented, plant effluent TP dropped dramatically.

The other lessons learned were the same as many other facilities have reported: bio-P performance drops off during rainy periods and there seems



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New laboratory in the Administration Building – 95% of normally occupied spaces have views to the outside. (Photograph Courtesy of A. Romanovsky of DLA Architects, Ltd.)

to be an annual bio-P “reset” in late summer to early fall. The reason for the performance upset is unknown, but seems consistent with what others are reporting.

In March of 2013, the mixed liquor recycle pump malfunctioned, sending effluent nitrogen levels back up to 18 mg/L until the pump was repaired. This situation served as a valuable lesson for staff in preparing for upcoming nutrient regulations. It also provided an opportunity to have a refresher with operations staff and others on how the process works and why TP values could still be maintained.

New district headquarters

As previously noted, FRWRD has three WRFs. The Pagorski WRF is currently the largest at 25 mgd and was the home of the District’s administration building. During the assessment on renovating or replacing the aging Administration Building, it became clear that a new building would allow for upgrading the laboratory facilities and creating a better work environment.

Locating the new Administration building next to the West WRF had

“During the assessment on renovating or replacing the aging Administration Building, it became clear that a new building would allow for upgrading the laboratory facilities and creating a better work environment.”

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The building was designed to respect the natural prairie and river view setting. (Photograph Courtesy of A. Romanovsky of DLA Architects, Ltd.)

advantages in construction sequencing, staging the relocation of staff and equipment, and freeing up space for future process facilities at the land-locked Pagorski WRF. The site chosen – along the Fox River and across the street from the West WRF – allowed FRWRD to incorporate Green Building concepts beyond those typically provided. The facility includes traditional green elements such as using recycled materials, low flow fixtures, energy efficient building envelope design, permeable pavers, bioswale stormwater management, reflective roofing, and construction waste recycling as part of submission for LEED Silver Certification. An innovative design element is the engineered solar louvers on the south façade that are angled to minimize heat gain in the hot summer months while maximizing sunlight penetration in winter months. Finally, in a true tie-in to FRWRD’s core business, all heating and cooling (including the hot water in the sinks) is provided by the plant’s effluent water loop. During winter months, the heat exchanger extracts heat from the effluent water to run the water-to-water heat pump and in the summer, heat is rejected to the plant effluent loop. The system also recovers energy from the laboratory exhaust air since those airflows are not recycled within the building. Having these elements incorporated into the building adds another way FRWRD can demonstrate to the public our commitment to sustainability. **CS**

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