ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the CENTRAL STATES WATER ENVIRONMENT ASSOCIATION ST. Charles, IL May 8-11,2006

TITLE OF PAPER: **Improved Wastewater Treatment in Portobelo, Panama**

AUTHOR(S): **Jennifer Kessler, Crystal Lee, Anne Mikelonis, Debra Weissman; Northwestern University/CSWEA Student Design Competition Winners**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Odor Control/Digestion**

SESSION NUMBER: **A** ***TIME:*** **11:15-11:45 AM**

Sustainable development is often understood as development "which meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission of Environment and Development). The Northwestern University chapter of Engineers for a Sustainable World (ESW-NU) is a nonprofit, interdisciplinary group of undergraduate and graduate students focused on the challenges of long-term, sustainable development. ESW-NU seeks lasting solutions to poverty reduction and works to improve environmental, social, and economic sustainability worldwide.

In the spring of 2005, members of ESW-NU appealed to the ESW national board for project partners in Latin America. Subsequently, ESW-NU received contact information for four non-governmental organizations (NGOs) in Panama. In December 2005, a four-member ESW-NU team embarked on a ten day scoping trip to Panama. The team met with the Panamanian NGOs and explored potential projects. The NGO Fundación de Apoyo al Desarrollo Social (FADE) agreed to collaborate with ESW-NU on engineering projects designed by Northwestern students. The design project undertaken in winter 2006 for IDEA 298/398 focuses on the problems identified by FADE in the town of Portobelo, Panama.

Portobelo is a town of 1200 located in the Colon province of Panama on the Atlantic side of the isthmus. The town sits on the southeastern corner of Portobelo Bay. Tourism is the source of Portobelo's income and economic livelihood. Every year close to 100,000 tourists flock to Portobelo to see the "Black Christ" statue in San Felipe Church. Fort San Jeronimo is Portobelo's other major tourist attraction. The fort was constructed in the sixteenth century by Spanish soldiers as part of a system of fortifications around the bay.

The raw sewage running through the town of Portobelo endangers public health, detracts from tourism, and endangers the preservation of Fort San Jeronimo. Currently there is no centralized wastewater treatment system in Portobelo. Five-sixths of the homes use septic tanks, but these tanks are neither well-designed nor well-maintained. Consequently, polluted water runs through several Portobelo creeks and into the bay. While pollution is a consistent problem in all the creeks, Guinea Creek is noteworthy, as it runs immediately along Fort San Jeronimo.

In conjunction with the FADE mission to foster human and economic development and preserve the community's natural and cultural heritage, FADE and ESW-NU hope to treat the wastewater discharging into upper Guinea Creek. At present, FADE and ESW-NU find it imperative to design a wastewater treatment system for the 21 homes along upper Guinea Creek. These homes are serviced by a community septic tank that is currently overflowing and discharging into the creek.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **An Economic Approach for Selecting Odor Control Technology**

AUTHOR(S): **Gayle Van Durme, Alicia Gilley, Patrick Laidlaw**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Odor Control/Digestion**
SESSION NUMBER: **A** ***TIME:*** **10:45 – 11:15 AM**

Action by concerned citizens' groups, as well as increased emphasis on air quality through stricter legislation, has induced many municipalities to focus attention on odor control at both existing and new wastewater treatment facilities. Odor control alternatives encompass numerous methods including liquid-phase chemical treatment; wet scrubbing; activated carbon absorption; and biological treatment. The selection of a specific odor control technology often incorporates not only the effective treatment capability, but also preferences for a specific technology or design, such as aversion to chemicals, operational requirements, multiple treatment technologies or other unique odor situations.

In recent years, many of the odor control options have rapidly advanced and the associated dollar values assigned to specific technologies have significantly changed. The intent of this paper is to present a detailed economic evaluation that will simplify the financial based selection process. A 20-year present value analysis (PVA) has been completed, based on design criteria with varying hydrogen sulfide (H_2S) concentrations between 1 and 100 ppm and airflow rates ranging from 100 to 50,000 cfm.

The technologies that were evaluated include single stage packed tower chemical wet scrubber, multi-stage packed tower chemical wet scrubber, in ground biofilter, modular bio-trickling filter, and activated carbon adsorption. The following economic criteria are incorporated into the evaluation: capital equipment, installation, water, media replacement, freeze protection, footprint, chemical costs, operation, maintenance, building requirements, and required accessory equipment. Data were obtained from vendors and operators from installations from the past few years.

An example of the 20-year present value analysis for a 16,900 cfm odor control unit indicates at low H_2S concentrations (below 2 ppm), a single stage packed tower chemical scrubber is more cost effective than a multi-stage packed tower chemical scrubber. At the same time, a high capacity activated carbon system is the most cost effective solution of any of these alternatives at levels as high as 25 ppm.

There are many design considerations and different technologies that can mitigate odor issues encountered at wastewater treatment facilities. This paper takes an economic look at the present value cost of different odor control technologies at varying design flows and loads. This information is vital to both practitioners and facility owners, as it provides insight into the economic variables associated with odor control. It also illustrates the importance of accurately determining hydrogen sulfide concentrations requiring treatment, as each odor control technologies are cost effective at different inlet hydrogen sulfide concentrations.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Odor Control at its Highest Level**

AUTHOR(S): **David Speth**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Odor Control/Digestion**
SESSION NUMBER: **A** ***TIME:*** **10:15 – 11:45 am**

Like many once-isolated plants located in growing communities, the Gurnee, Illinois, Sewage Treatment Plant faces rapidly encroaching development. In the 1990s, the land adjacent to the 24-mgd facility was developed into an upscale residential subdivision Odors from the two-stage activated sludge plant's solids handling facilities made their way into the subdivision, and the District began receiving complaints daily.

The composition and strength of odors from Gurnee's biosolids processes is more complex and intense than most wastewater treatment plants experience because significant amounts of reduced sulfur compounds are present. In 1999, an odor control system was brought online to treat foul air from the solids handling facilities. The system included three parallel liquid-scrubber trains, with each train containing two sodium hypochlorite mist scrubbers operated in series. This technology was the best available at the time; however, odor complaints continued. After extensive testing and optimization, the two-stage system achieved 90% removal of reduced-sulfur compounds and 99% removal of hydrogen sulfide. Even with these improvements, the neighborhood complaints continued.

Based on an analysis of scrubber operating data and observations of the scrubber plume, it was determined that to reduce off-site odors, the scrubber would have to remove an additional 90% to 99% of organic reduced-sulfur compounds — without adding any residual odor from the scrubbing solution chemicals.

After testing different chemical combinations in the scrubbing system and reviewing alternatives to improve performance, two innovative solutions were proposed: 1) adding a surfactant to the raw odorous air to remove non-water-soluble odors or allow them to be sorbed into the scrubber's chemical solution, and 2) adding high-performance packed-tower scrubbers as the third stage to treat the mist scrubber exhaust.

To confirm whether these modifications would improve odor removal at Gurnee, the District conducted a pilot test. Results showed consistently high removal of reduced sulfur compounds and a noticeable reduction in plume opacity and perceived odor concentration. After the successful pilot testing, several alternatives were analyzed to determine the optimum configuration for the full-scale packed tower system, and the new system was constructed.

Following startup in 2002, consistently high performance levels have been achieved. Most high-performance liquid scrubbing systems in the U.S. remove about 90% of methyl mercaptan and about 50% of dimethyl disulfide, but this system removes more than 99% and 90%, respectively. As a result of the improvements, total hydrogen sulfide removal at Gurnee has increased to

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99.7%, and total organic reduced sulfur compound removal has increased to 99.3%. The final odor concentrations exhausted into the atmosphere average 25 ppbv, a significant reduction from the 5000 ppbv average that originates in the sludge handling facilities. The system continues to perform above expectations for odor removal while producing a safe, non-toxic exhaust stream, making the North Shore Sanitary District a good neighbor to the residents of Gurnee.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Comprehensive Planning Provides Cost-Effective Multi-Modal Blending Facilities**

AUTHOR(S): **James Kleinschmidt, John Leonhard**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Wet Weather Treatment**
SESSION NUMBER: **C** ***TIME:*** **10:45 – 11:15 AM**

Planning for wastewater facilities where significantly expanded biological treatment and peak hourly flow hydraulic capacities will be required involves careful consideration for the reuse of existing facilities with remaining useful service life. Existing facilities for both primary and secondary treatment at the Fond du Lac Water Pollution Control Plant were not adequate sized to meet the enhanced level of biological treatment required for compliance with new ammonia limits. The peak hourly flow for the facility also needed to increase from approximately 32 mgd to 50 mgd.

The plan for new facilities implemented for the Fond du Lac Water Pollution Control Plant includes reuse of both existing primary and secondary treatment facilities. These reused facilities will provide up to 2 million gallons of wastewater storage prior to providing primary treatment for flows exceeding the 34 mgd capacity of the new biological treatment facilities. The facilities will be in compliance with the proposed EPA guidance on blending.

These facilities will also have the several alternative operating modes. The alternative modes include back-up forward flow clarifiers through the reuse of an existing pumping station, storage tanks for waste activated sludge or potentially toxic influent wastewater.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Site Constraints + Ammonia Limits + Peak Wet Weather Flow = High Rate Treatment & Biosolids Processing Technology For The Heart Of The Valley Metropolitan Sewerage District**

AUTHOR(S): **Thomas Vik**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Wet Weather Treatment**
SESSION NUMBER: **C** ***TIME:*** **10:15 – 10:45 AM**

Heart Of The Valley Metropolitan Sewerage District owns and operates an interceptor sewer, several metering stations and a 6.5 mgd pure oxygen activated sludge wastewater treatment facility at Kaukauna, Wisconsin. Wastewater treatment was originally provided at the site in the 1930's for the City of Kaukauna. The plant was modified in the late 1970's as a regional facility consisting of primary treatment, pure oxygen activated sludge, filtration and anaerobic digestion. The plant was again modified in the mid-1990's to process a peak flow of 30 mgd using primary effluent filtration during peak flow events.

Continued growth in the service area, persistent peak wet weather flows in excess of 50 mgd and the need to meet an ammonia nitrogen limit of 3.6 mg/l during the summer precipitated the need for plant modifications.

McMahon Associates, Inc. was retained by Heart Of The Valley to develop a Facility Plan and design the upgrade to the plant. The design increases the organic capacity of the plant by 25% for future growth and is able to process a peak flow of 60 mgd all on the existing site using a unique combination of high rate treatment technologies including:

- Ballasted sedimentation for primary treatment and phosphorus removal for flows up to 60 mgd.
- Biological aerated filter for secondary treatment and nitrification.
- Auto-thermal thermophilic aerobic digestion of all waste biosolids to produce a Class A biosolids.

All existing structures and tanks except for two 1930 primary clarifiers and one circular secondary clarifier were integrated into the new plant for purposes other than their original intended use.

This paper presents pilot test results on Heart Of The Valley wastewater for the ballasted sedimentation and BAF process. The unique design features and flow sheet of the plant are described. The design uses one tenth of the area normally required for a conventional nitrifying activated sludge plant. Also unique to this plant is the sale of treated effluent to Calpine (power plant), which will also be discussed.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Strategies for Complying with Limits for Toxic Substances in NPDES Permits**

AUTHOR(S): **Gerald Bills**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Industrial Treatment/Regulatory**
SESSION NUMBER: **B** ***TIME:*** **11:15 - 11:45 AM**

The emphasis for controlling toxic water pollutants has changed from a technology based approach to a water quality based approach. In situations where technology based limitations are being met while the water quality standards are not, water quality based NPDES permit limits can be imposed on a discharger.

The U.S. Environmental Protection Agency has established national ambient water quality criteria for several metals and ammonia to protect freshwater and saltwater organisms from acute and chronic toxicity. The national criteria are used by the states to formulate enforceable water quality standards for receiving waters. A water quality standard is a law or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular water body, and an antidegradation statement. The standards are used to determine water quality based NPDES limits for discharges.

Several options are available to the discharger if an initial determination of NPDES permit limits suggests a need for water quality based limits for metals or ammonia. These include:

- Development of accurate site specific data for substances that can affect the toxicity of metals and ammonia (hardness, temperature, pH and alkalinity)
- Clean sampling of toxic metals in the effluent and background receiving water
- Development of site specific Chemical Translators
- Development of site specific criteria (Recalculation Procedure, Water Effect Ratio)
- Establishment of mixing zones
- Dynamic modeling (Monte Carlo or Probabalistic Modeling)

Each of these strategies should be examined and evaluated before accepting a limit for toxic metals and/or ammonia in a NPDES permit. The purpose of this paper and presentation is to provide an overview of these options as they relate to determining and complying with limits for metals and ammonia in NPDES permits.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the CENTRAL STATES WATER ENVIRONMENT ASSOCIATION St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Treatment and Disposal of High Strength Fruit and Vegetable Processing Wastewater**

AUTHOR(S): **Dennis Totzke**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Industrial Treatment/Regulatory**

SESSION NUMBER: **B** ***TIME:*** **10:45 - 11:15 AM**

Food processors are often confronted with the need to upgrade an existing wastewater treatment system. The driving force could be regulatory, related to unacceptable performance, caused by varying waste loads, or any combination thereof.

Van Drunen Farms, located in Momence, Illinois, is a producer of freeze-dried and dehydrated fruits and vegetables and infused fruits. In addition, they are the largest supplier of organically grown culinary herbs in the country. Expanding production and increased wastewater discharge costs from the City prompted Van Drunen to investigate process wastewater treatment alternatives, ranging from high load anaerobic treatment to low load aerated lagoon treatment.

Process wastewater is characterized by intermittent discharge, high organic strength (chemical oxygen demand levels of 5,000 to 15,000 mg/L) and low total suspended solids (less than 400 mg/L). The design basis for the wastewater was established at an average flow of 32,000 gpd, a chemical oxygen demand load of about 2,500 lbs/d, and a total suspended solids load of about 100 lbs/d. A preliminary engineering study was completed and recommended the use of flow and load equalization followed by aerated lagoon treatment and land disposal of biosolids and treated wastewater. High load anaerobic treatment, although ideally suited to handle high strength soluble process wastewater, was not economically competitive.

The treatment system was designed and submitted for permitting in late 2002. It was constructed from March 2003 through November 2003. Startup took place in early 2004 with minimal problems. Performance of the system has been exemplary. Chemical oxygen demand removal has averaged over 98%. Treated wastewater and biosolids are land applied as seasonal weather and crop-growing conditions allow. Operating costs are very low, with little operator attention required. The wastewater treatment system has met the goals established during design and has provided Van Drunen Farms with a reliable and cost effective treatment plant.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Treatment of Poultry and Dairy Waste and Subsequent Capacity Related Issues in a Small Community Wastewater Treatment Facility**

AUTHOR(S): **David Muenzner, Don Esping, Tim Block, Scott Gilbertson**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Industrial Treatment/Regulatory**
SESSION NUMBER: **B** ***TIME:*** **10:15 – 11:45 AM**

The City of Melrose, Minnesota is home to a large turkey processing facility and a dairy products facility, both of which discharge waste to the municipal wastewater treatment facility (WWTF). The City of Melrose WWTF receives nearly 70% of its influent flows and loads from these industries, with the remaining portion residential wastewater. The WWTF has historically been plagued by large fluctuations in influent flows and loads due to the operations at these industrial facilities, particularly over weekend periods when industry production slows. Industrial pretreatment processes were implemented to offload influent loading, which significantly reduced both the influent load spikes and nuisance items such as turkey feathers. However, process control issues remained.

Brown and Caldwell was selected to assess WWTF capacity and to develop a facility plan for the Melrose WWTF. The facility plan addressed the condition and capacity of the plant process trains and associated process equipment and defined solutions aimed at addressing replacement of deteriorated equipment, biosolids processing and storage capacity, and process-related odor issues.

As part of the planning process, a comprehensive wastewater characterization of the influent flows and loads was performed. The wastewater characterization and subsequent bench scale testing revealed poor settleability of TSS in the influent which resulted in poor TSS capture in primary clarification. The BioWin™ simulator was used with the characterization data to provide an updated capacity assessment for the WWTF. Brown and Caldwell concluded that the industrial pretreatment processes removed the most readily degradable and settleable materials in the wastewater, leaving the WWTF to process the difficult to degrade and poorly settling materials. The end result was an unexpected decrease in the secondary treatment capacity of the WWTF over previously assumed values.

An improved understanding of the treatment facility performance and associated capacity allowed Brown and Caldwell and the City of Melrose, with collaborative input from industry, to provide a design that improves process control, optimizes facility capacity, and reduces operation and maintenance problems while providing a facility that will meet the City's needs well into the future.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Regulatory, Technical, and Modeling Challenges to Developing a Frequency Based SSO Control Project in Wayne County, Michigan**

AUTHOR(S): **Robert Czachorski, Greg Kacvinsky**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Collection Systems: Computer-Aided Solutions**

SESSION NUMBER: **K** ***TIME:*** **3:30 – 4:00 PM**

Wayne County's North Huron Valley / Rouge Valley (NHVRV) interceptor system collects sewage from 15 communities located in Southeast Michigan and transports flows to the Detroit Water and Sewerage Department (DWSD) for disposal. The County is evaluating a regional approach to controlling sanitary sewer overflows (SSOs). A new methodology was used to perform the hydrologic modeling called the antecedent moisture (AM) model, which is a continuous model that produces a good match to observed flow data for several years. The accuracy of the model resulted in a high level of confidence in the frequency analysis for SSOs and in the recommended improvements to control SSOs. This paper will present the development of Wayne County's regional project and the modeling and analysis innovations used.

The State of Michigan has been very proactive with SSOs by establishing a formal SSO policy in December of 2002. This is one of the first SSO policies to be implemented in the Country and contains very aggressive standards for controlling SSOs. The policy calls for a 25-year, 24-hour design storm event during the growth season using average soil moisture conditions. The policy also allows for an alternative approach with a performance standard resulting in an SSO frequency of less than once in 10 years.

For the NHVRV system, previous event modeling led to the conclusion that a storage tunnel with an outlet to a CSO basin would likely be the SSO control project. Frequency of discharge to the CSO basin or "co-mingling" was explored by trying to use an event model, but the confidence in the results was low. For this reason, the County elected to use the continuous antecedent moisture model to establish a frequency basis for developing their SSO control strategy.

A continuous AM model was developed using a four-year period of record from the County's flow meters. A good match to measured flows was achieved, even with highly variable seasonal and rainfall conditions, because the model predicts the variations in capture coefficients. This allowed the County and MDEQ to feel confident that the existing hydrology was well understood, and eliminated the reliance on using a design event and "average conditions" to make decisions.

Continuous model simulations uncovered a potential hydraulic restriction in the system that had not been detected with previous modeling. This led to the conclusions that river inflow, system blockages and problems with downstream pump operations are likely contributors to the observed problems in addition to high flows during infrequent events. This led towards resolution of those problems, with the potential of reducing the required size of the previously sized tunnel.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
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St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Control of Infiltration and Inflow: I/I Limits at Thorn Creek Basin Sanitary District**

AUTHOR(S): **Derek Wold, James Daugherty, Jennifer Hindel**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Collection Systems: Computer-Aided Solutions**

SESSION NUMBER: **K** ***TIME:*** **3:00 – 3:30 PM**

Thorn Creek Basin Sanitary District (TCB) provides treatment of wastewater for six communities in the southern suburbs of Chicago. Each of the six communities owns and operates its own local sanitary sewer collection system. TCB's Wastewater Treatment Plant (WWTP) experiences increased flow rates during storm events as a result of inflow and infiltration (I/I) into the tributary sewers. I/I that enters the sewers can cause sewage backups in basements, sewer overflows, and the bypass of untreated wastewater to Thorn Creek. As a result of high I/I, TCB determined that it was necessary to establish flow limits to reduce I/I to an acceptable level.

Four methodologies were investigated for calculating the allowable I/I flow for a particular storm event. The previous I/I Limits in TCB utilized a predictive equation based on rainfall and flow regression. However, a review of the available data indicated that there is a weak correlation between rainfall and I/I. Based on a statistical analysis of historical data, the Probabilistic Method was selected for establishing the I/I Limits for TCB. This method utilizes historical data to develop an equation for calculating the return interval for a wet weather event based on the flow measured at the WWTP.

To determine the allowable peak flow for a storm event of specific return interval, an equation was developed to calculate allowable flow based on residential and industrial populations and per capita flow values. The I/I limits were established so that the capacities of TCB's facilities are not exceeded by the 5-year event. The limits were also set so that TCB's facilities have sufficient capacity to serve its entire Facilities Planning Area (FPA) upon buildout.

Establishing I/I Limits also included the development of a flow monitoring network to meter flow rates during wet weather events. Flow meters were installed during 2004. Analysis of the data determined that five communities are currently out of compliance with the I/I Limits. The District is currently reviewing the proposed Compliance Schedules submitted by each community to meet the I/I Limits. The District is providing guidance to the communities on budgeting and affordability issues and is assisting

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communities in commissioning an engineering analysis and establishing a maintenance program to comply with CMOM guidance from IEPA.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Computer Hydrologic & Hydraulic Modeling of RDII**

AUTHOR(S): **Stephen Sticklen**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Collection Systems: Computer-Aided Solutions**

SESSION NUMBER: **K** ***TIME:*** **2:00 – 2:30 PM**

Peoria, Illinois' Kickapoo interceptor is a sanitary sewer with a watershed of approximately 45 mi2. During periods of heavy rain, there is a possibility that the conveyance capacity of this sewer may be exceeded. Taking a proactive approach, the Peoria Sanitary District has developed alternatives to minimize this risk. A key tool in evaluating the response of this critical sewer to wet weather events was a MOUSE hydrologic / hydraulic model.

Techniques such as unit hydrographs were quickly found to be inadequate for predicting the complex nature of the wet weather response of this sanitary sewer system. Seasonal fluctuations of rainfall dependent inflow and infiltration (RDII) necessitated a more capable hydrologic model. MOUSE's RDII module is an empirical model that can accurately simulate a watershed's entire hydrologic cycle and the subsequent system flows. However rather than calibrating the model to individual events lasting 1-2 days, it required 2-3 years of continuous flow and rainfall data in order to verify the ability of the model to simulate the long-term effects and seasonal fluctuations which typify separate sanitary sewer systems. Once this calibration was complete, MOUSE's long-term-simulation (LTS) module was used to quickly perform alternative evaluations utilizing a 50-year simulation. In doing so, modelers easily observed the frequency of system exceedances for a variety of system improvement alternatives including remote storage, increased conveyance and treatment capacity, etc. The demand for modeling of this nature will grow as regulatory agencies continue to focus on reducing SSOs.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **SCRAPS: An Expert System for Prioritizing Sewer Inspections**

AUTHOR(S): **Andy Lukas**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Collection Systems: Computer-Aided Solutions**

SESSION NUMBER: **K** ***TIME:*** **1:30 – 2:00 PM**

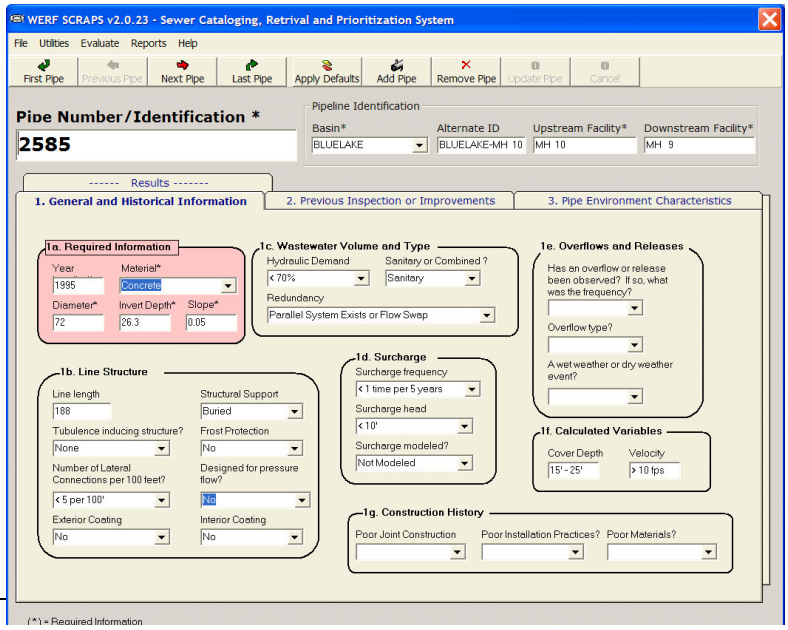
The condition of sewer infrastructure in the United States has recently received significant negative press, such as the D- grade given in the 2005 ASCE Infrastructure Report Card. Traditionally, age, size and material (brick and other pipe materials) have been the only factors used in prioritizing inspections and in predicting the timing of potential repair and replacement. This traditional approach does not take into account a deeper understanding of the mechanisms leading to structural or operational failure, or of the impact of failures on the community and the environment. All utilities face budget constraints that limit the ability to inspect and repair or replace sewer infrastructure.

SCRAPS Development

The Water Environment Research Foundation (WERF) determined that utilities needed a tool for storing information that would support assessing the criticality of their sewers. WERF subsequently contracted with Brown and Caldwell to develop this tool. The Sewer Cataloguing Retrieval And Prioritization System (SCRAPS) tool is based on an expert system developed with the University of Washington. The SCRAPS tool's knowledge base was assembled from a group of national experts. Input from these experts was used to develop the tool's logic that assesses the need to inspect specific pipes based on available information. In validation exercises using case studies supplied by the experts, the tool was shown to outperform a group of experts in quantifying the need to inspect. SCRAPS represents the cumulative work of several entities and a number of individuals.

SCRAPS Overview

A solid understanding of the variables leading to sewer failure allows agencies to strategically focus inspection programs. Each of these factors can be categorized into two broad areas: Consequence of Failure and Likelihood of Failure. The inspection prioritization process uses basic pipe information, inspection, rehabilitation and maintenance history as the basis for determining ratings for consequence and risk of sewer failure. SCRAPS uses these ratings to produce a combined ranking that rates the high consequence and risk sewers through low consequence/low risk sewers.
Prioritization using this approach allows municipalities to apply limited resources to the most critical sewer assets first. Figure 1 provides a screen capture of the SCRAPS tool interface for inputting and reviewing data. Because the



SCRAPS tool runs on an open-source database, it can be connected to typical GIS data for viewing on maps.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Membrane Bioreactor System Provides Reuse Solution for Illinois Golf Course**

AUTHOR(S): **Sanjay Patel, Enviroquip, Inc., Kevin Buoy**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Research/Water Reuse**
SESSION NUMBER: **J** ***TIME:*** **3:30 – 4:00 PM**

Construction has completed on Illinois's first membrane bioreactor (MBR) system for the treatment of wastewater. The plant is designed to treat high strength wastewater from the White Pines Golf Course located in DuPage County, IL. With commissioning in February 2006, DuPage County's MBR Package Plant is a fully integrated, automatic treatment process that combines flat-plate submerged membrane technology with UV disinfection, odor control, and a PLC-based control system to produce a reuse quality effluent that will serve the golf course, banquet hall, and restaurant facility. The project schedule called for design, construction, and commissioning to be completed within eight (8) months from notice-to-proceed. This accelerated schedule was possible because DuPage County elected to use a pre-engineered modular system that greatly reduced the time required for design and on-site installation. This paper will discuss the selection criteria and rationale for the MBR technology utilized, the plant design, and any plant performance data available following startup.

Designed specifically for wastewater applications, the Enviroquip MBR package plant was selected for its ease of operation, peaking capabilities, effluent quality, and small footprint. The plant is housed in a concrete structure designed for operation in extreme environmental conditions, including seismic zones and sub-zero temperatures. The White Pines WWTP is designed to treat an average daily flow of 10,000 gpd with influent values for $CBOD_5$/TSS/TKN of 300/300/45 mg/L at a minimum temperature of 10°C. Average effluent limits of 5/5/1 mg/L ($CBOD_5$/TSS/NH_3-N) are guaranteed at design operating conditions.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **All for One and One for All; A Water Reuse Partnership with Innovative Treatment and Permitting**

AUTHOR(S): **Derek Cambridge, Mary Fralish**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Research/Water Reuse**
SESSION NUMBER: **J** ***TIME:*** **3:00 – 3:30 PM**

Cooperation between the City of Mankato, MN, Calpine Corporation, and the Minnesota Pollution Control Agency (MPCA) has created benefits for all. An agreement was developed to treat and reuse the City's wastewater treatment plant effluent as cooling water for a proposed 640-megawatt power plant. Reuse was proposed by Calpine after understanding the complexities and costs associated with permitting and maintaining their own water supply and discharge. The agreement provided the power plant with a reliable source of up to 6 million gallons a day (mgd) of high quality treated effluent.

An innovative treatment strategy was developed along with the creative discharge compliance solutions. The water quality requirements for the reuse water were consistent with California's Title 22 Reuse Regulations. An Actiflo ballasted flocculation process was provided to coagulate secondary effluent and to precipitate phosphorus. Cloth media tertiary filters were provided after the Actiflo process to ensure the turbidity requirements of the Title 22 regulation could be maintained. A chlorine contact basin was constructed to provide advanced disinfection using sodium hypochlorite prior to pumping the reuse water to Calpine. Approximately 2 mgd of flow will be returned from Calpine back to the Mankato WWTP for discharge to the Minnesota River under the City's NPDES permit.

The presentation will discuss the development of this project from the conceptual stages through design and implementation, and elaborate on the collaborative effort between the City of Mankato, Calpine, and MPCA. The presentation will also discuss options evaluated for the tertiary treatment facilities and the reasons for final selection.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Characteristics of Autotrophic Organisms in Aerated Anoxic BNR processes**

AUTHOR(S): **Dennis J. Barnes**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Research/Water Reuse**
SESSION NUMBER: **J** ***TIME:*** **2:00 – 2:30 PM**

McCarty kinetic equations, using the typical values found in most wastewater textbooks, would predict low rates of nitrification in aerated-anoxic processes, particularly in cold weather. However, full-scale wastewater plants with aerated-anoxic reactors (such as the Orbal process), typically exhibit excellent nitrification performance in cold weather. Bench-scale tests conducted at the University of Wisconsin – Madison have suggested that unique autotrophic organisms, with a lower oxygen half-saturation coefficient than those found in aerobic biological processes, are prevalent in aerated-anoxic processes.

To support the findings at UW-Madison, operating data from several full-scale Orbal plants during cold weather was collected. Using the IAWQ Activated Sludge Model (ASM) and GPS-X modeling software, the performance of these plants was modeled, using lower lower oxygen half-saturation coefficients for autotrophs. The effluent quality predicted by the computer model was consistent with the actual performance at the full-scale plants.

In addition to discussing the results of this study, the construction and operating cost savings that can be realized by utilizing aerated anoxic processes will be presented.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **A Critical Design Parameter for Nitrification: Nitrifier Growth Rate**

AUTHOR(S): **Yu-Min Su, Dr. Krishna Pagilla**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Research/Water Reuse**
SESSION NUMBER: **J** ***TIME:*** **1:30 – 2:00 PM**

The nitrifier growth rate and aerobic volume requirements have been critical parameters in the design of treatment systems, particularly in achieving low N limits. In this study, our aim was to develop a rapid assay for determining the growth rate of nitrifiers, and to examine the extent of nitrification along the length of the aeration tank. A lab scale sequencing batch reactor (SBR) with four feeding stages in a cycle was operated to treat synthetic wastewater rich in ammonium N to stimulate the conditions required for the nitrification along the length of the aeration tank. Splitting of influent flow to multiple stages (step feed mode), instead of feeding at the beginning of each cycle results in a higher concentration gradient in the reactor which results in consistently higher nitrifier growth rate, a higher nitrite/nitrate conversion (~ 100%) and stable nitrogen removal performance at the end of the each cycle. The obtained growth rate and nitrite/nitrate conversion at the first stage is consistently higher than the other stages, and decreases as the number of stages increase because of the decrease in concentration gradient in the reactor.

In this study, the growth rate of nitrifiers is estimated by using “Low F/M tests” where the change in nitrifier mass during the test is small, and there is a linear response in the measured parameter (usually nitrate concentration) as recommended in WEF manual (1999). The range of nitrifier growth rate at 20°C, is between 0.78 and 0.63 day^{-1} as the number of stages increased from 1 to 4 with an average value of 0.69 day^{-1} when the initial nitrite/nitrate concentration in the reactor is zero as calculated in the WEF manual (1999). However, the initial nitrite/nitrate concentration is not zero in the fully nitrifying SBR, it usually ranges between 6.1 mg/L (first stage) to 7.3 mg/L (fourth stage). When these concentrations were used in the calculation, the nitrifier growth rate ranges between 2.89 and 2.48 day^{-1} as the number of stages increased from 1 to 4 with an average value of 2.64 day^{-1}. Higher values of nitrification rate as estimated in this research have a very significant impact on nitrification and nutrient removal system design and analysis. However, incorrect assessment of growth rate leads to level of magnitude error in aerobic reactor volume estimation.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Managing Wet Weather Flows One Residence at a Time**

AUTHOR(S): **Robert Hawes, William Gonwa**

DATE OF SESSION: **May, 10, 2006** ***SESSION TITLE:*** **Collection Syst/Wet Weather Flows**

SESSION NUMBER: **H** ***TIME:*** **11:30 – 12:00 PM**

Traditionally, municipalities have approached pollution control on a city-wide or a regional scale. Collection systems gather sewage from all sections of a city for treatment at a central wastewater treatment facility. Storm sewer systems gather runoff from a subdivision's streets and private properties for treatment in a regional detention pond. However, these approaches are not enough; municipalities must start managing wet weather flows in a decentralized fashion.

The City of Rock Island is in the midst of two separate programs to manage wet weather flows. One program deals with reducing combined sewer overflows (CSOs) and the other focuses on managing storm water. Both programs share the goals of enhancing the quality of the receiving waters and preventing damage to property. The CSO program uses a traditional approach where all combined sewage is conveyed to a centralized treatment facility. Rock Island's storm water management program takes the non-traditional approach of managing wet weather flows one residence at a time.

The City of Rock Island encourages its residents to retain storm water on their properties to reduce stress on the sewer system. The Rain Gardens for Rock Island Program offers technical assistance, provides free rain barrels, and pays property owners to install rain gardens. The public has shown substantial interest in the program. In the program's first summer (2005), the Department of Public works approved payment for 14 rain garden/rain barrel installations covering a total area of 12,816 square feet.

Total program benefits will depend upon citizen participation. Obviously, one or two rain gardens will not make a measurable difference in storm water runoff from a neighborhood. However, the impact of ten, twenty, or a hundred gardens will be noticed. The City of Rock Island hopes to invest $50,000 (12,500 square feet) a year in rain garden construction. At this rate, Rock Island will remove connected imperviousness equal to the area in 3 to 5 city blocks each year. Since Rock Island is in the business of storm water management for the long term, the impact over time will definitely be significant.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Clear Water Reduction in The Heart of The Valley**

AUTHOR(S): **Tammy Kuehlmann**

DATE OF SESSION: **May, 10, 2006** ***SESSION TITLE:*** **Collection Syst/Wet Weather Flows**
SESSION NUMBER: **H** ***TIME:*** **11:00 - 11:30 AM**

The Heart of the Valley Metropolitan Sewerage District (HOVMSD) provides five Fox Valley communities with wastewater conveyance and treatment services. The HOVMSD has been faced with meeting the challenges of growth coupled with aging infrastructure. In particular, the wastewater conveyance and treatment systems suffer from extreme wet weather related peak flow events, due to excessive clear water that enters the aging sewer systems throughout the service area.

The HOVMSD has set the goal of removing at least 30% of the wet weather induced inflow through improvements to the existing sewer system and eliminating illicit connections. Such a flow reduction is critical because limited land is available for expanding the existing WWTP, and the costs associated with constructing a second WWTP are prohibitive.

To accomplish the 30% inflow reduction, HOVMSD has embarked on a unique 10-year corroborative program with their service communities to identify and eliminate sources of rain dependent inflow. In the first two years of the program, each community will complete a Sewer System Evaluation Study (SSES). The SSES requires that each community fully map and detail the specifics of their entire sewer system, identify sources of rain dependent inflow, evaluate the necessary sewer rehabilitation, and develop a cost effective action plan. During the following eight years the communities will implement construction and non-construction projects to reduce the inflow.

Through a series of workshop meetings involving the HOVMSD project team, consisting of HOVMSD personnel and consultant team members, a detailed plan was developed that outlined a multifaceted approach to reducing infiltration and inflow. The plan was organized as a series of specific, measurable and achievable milestone steps including:

- Developing Fair and Equitable Goals for Individual Communities
- Developing an Atmosphere of Trust and Cooperation
- CMOM Review
- Developing a 10-year Schedule
- Compliance with Enforcement
- Revising User Charges

- Crossing the Public – Private Line
- Reviewing Construction Standards
- Continued Support

Through multi-jurisdictional cooperation and public and private efforts, the HOVMSD has set the stage for an aggressive regional reduction of inflow. Strategies developed in the first phases of the program will serve communities as they continue to eliminate sources of inflow and additionally, help them comply with pending CMOM legislation. Community technical and administrative staff and residents are equally informed and have a unified sense of goals. Continued technical assistance will guide communities through the process and help measure success.

This paper will present the approach being used at HOVMSD to meet the 30% inflow reduction goal.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **I/I Reduction Cost Effectiveness: The Results of Milwaukee MSD's Demonstration Projects**

AUTHOR(S): **Julie McMullin, Andy Lukas, Steve Heinz**

DATE OF SESSION: **May, 10, 2006** ***SESSION TITLE:*** **Collection Syst/Wet Weather Flows**

SESSION NUMBER: **H** ***TIME:*** **10:00 – 10:30 AM**

Facing the eventuality of sanitary sewer overflow (SSO) regulation from federal and state governments, many communities recognize the need to reduce wet weather flows in their systems. Unfortunately these same communities struggle with choosing the right path toward infiltration and inflow (I/I) reduction. In many cases, this trepidation is the result of not having enough local cost-effectiveness data to support choosing a specific approach for I/I reduction. As a result, communities have either a) selected a direction based on best technical judgment, or b) done nothing at all. The project presented in this paper represents a third option taken by the Milwaukee Metropolitan Sewerage District (MMSD). Starting in 1999, MMSD initiated an I/I reduction demonstration project. The purpose of the project was to implement I/I reduction projects that would provide conclusive data on effective practices and provide local construction costs. Brown and Caldwell was hired at the outset to consult MMSD on establishing project standards, selecting project locations, and performing an effectiveness evaluation of each implemented project.

After negotiating the ICAs, MMSD immediately installed flow and rainfall monitoring in these project areas. This data would serve as the basis for the eventual I/I reduction effectiveness evaluation. The selected projects then followed a course of conceptual approach, design, and construction. The following methods were ultimately used on the MMSD demonstration project:

- Cured-in-place pipe (CIPP) lining of building sewer laterals with minimal excavation
- CIPP lining with no excavation
- CIPP lining of storm sewers which crossed defective building sewer laterals
- Open cut and cover sewer lateral replacement
- Downspout disconnection in the combined sewer area
- Manhole rehabilitation

The information presented in this presentation will benefit other municipalities that desire to set up their own I/I reduction demonstration projects. The presentation will present the criteria used to evaluate potential project areas, what MMSD did to ensure the effectiveness could be estimated, how the projects were constructed, and conclusions on the cost-effectiveness of I/I reduction for each demonstrated reduction method.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Implementing a Major Conveyance Project to Meet Multiple Needs and Consider Various Competing Interests and Issues**

AUTHOR(S): **James Roth, David Raby**

DATE OF SESSION: **May, 10, 2006** ***SESSION TITLE:*** **Collection Syst/Wet Weather Flows**

SESSION NUMBER: **H** ***TIME:*** **9:30-10:00 AM**

The Metropolitan Council (Council) is a regional level governmental unit for the seven counties comprising the Twin Cities Metropolitan area in Minnesota. One of the Council's key functions is planning, constructing, and operating wastewater collection and treatment facilities within the region.

The southeastern portion of the Twin Cities Metropolitan area is currently served by two wastewater treatment plants (WWTPs); the Rosemount WWTP and the Empire WWTP. These plants currently have a combined treatment capacity of approximately 13 million gallons per day (MGD). In June 2000, the Council, through its Environmental Services Division (MCES), initiated a combined Master Planning and Facility Planning project for the Rosemount and Empire WWTP service areas. That, and related planning efforts, resulted in recommendations to implement a series of major conveyance projects designed to:

- Convey the effluent from the Empire WWTP more than 13 miles to discharge directly into the Mississippi River rather than continuing to discharge into the adjacent, recently re-classified Vermillion River that eventually flows into the Mississippi River.
- Phase out the Rosemount WWTP and convey the 4.5 MGD of wastewater projected to be generated in its service area to the Empire WWTP.

Design of the system began in early 2003 and construction on the first of several design packages began in late 2004. Design of the final package will be complete in late 2005 and construction of all packages is scheduled to be complete in late 2007. Overall capital costs associated with all phases of the project are expected to be approximately $90 Million. This paper will describe the overall design process used to consider the following competing interests/issues:

- Implementation of conveyance systems geared toward minimizing the use/length of force mains considering MCES' history of increased maintenance for those facilities.
- Installation of significant tunneled pipeline components by qualified tunneling contractors.
- Dissipating and/or utilizing energy associated with conveying wastewater effluent down a bluff and into the Mississippi River.
- Installation of a pipeline across active barge channels without impacting barge deliveries.
- Providing opportunities for future use of treated wastewater effluent for irrigation purposes.
- Partnering with a municipality to provide an opportunity to convey storm water and treated wastewater effluent in a common pipeline rather than construct two separate pipelines.
- Capitalizing on an opportunity to combine a treated wastewater effluent pipeline and sanitary sewer interceptors/force mains into a single, common trench.
- Partnering with a governmental entity to plan for future wastewater connections and upgrading a local roadway system.
- Matching design/construction packages to likely bonding capacities for local/regional construction contractors.

ABSTRACT

The following is an abstract of a paper given at the 79thAnnual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Sidestreams: Treatment Options at Biological Nutrient Removal Facilities**

AUTHOR(S): **Heather M. Phillips, Mark Steichen, Ed Kobylinksi**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Biological Nutrient Removal**
SESSION NUMBER: **G** ***TIME:*** **11:30 – 12:00 PM**

Dewatering sidestreams can be very problematic for biological nutrient removal (BNR) facilities. In biological phosphorus removal facilities, phosphorus is concentrated in the biosolids, and as much as 60 percent can be released in the anaerobic digester and recycled back to the BNR facility. Similarly, as much as 40 percent of the total Kjeldahl nitrogen (TKN) tied up in the solids is released as ammonia and recycled in the sidestreams. Because dewatering schedules are typically based on the convenience of solids disposal (Monday through Friday, 8 am through 5 pm), the BNR facility will experience nutrient slug loads if sidestreams are not equalized. Sudden increases in the ammonia load in a nitrifying system will cause sharp increases in the oxygen uptake rate, putting additional demands on the blowers. If aerobic digestion is used, intermittent recycling of nitrate can make it more difficult to comply with stringent total nitrogen (TN) limits. Slug loads of nutrients can also complicate chemical feed operations. All of these problems are worsened at facilities that process biosolids from multiple sources, since the "imported" biosolids bring additional nutrients with them. This presentation will summarize findings from several projects, focusing on two strategies: 1) managing untreated sidestreams at the BNR facility, and 2) implementing sidestream treatment.

The BNR facility can best handle sidestream loads if the flow is equalized in an equalization basin, or with a continuous dewatering schedule. Recycling additional ammonia in sidestreams results in hidden capital costs associated with the blower size and number of diffusers, due to higher airflow requirements. Recycling additional phosphorus may cause biological phosphorus removal plants to require facilities such as fermenters or chemical feed systems to provide additional readily biodegradable carbon, as one study will show. Another option is to treat sidestreams separately with conventional processes or with one of the many proprietary technologies, such as the SHARON®, In-Nitri®, BABE®, or ANAMMOX® processes, all of which will be discussed. A cost comparison will also show that proprietary processes such as SHARON® can be cost-competitive with conventional sidestream treatment for large facilities.

There are many options for managing sidestreams on both the biosolids processing and liquid processing sides, but there needs to be a thorough understanding of the system

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mass balance and a true accounting of costs. As the presentation will show, every facility is different and identifying and quantifying the hidden capital and operational costs is critical to selecting the best-valued management strategy.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Biological Nutrients Removal Using Advanced MBR Technology**

AUTHOR(S): **Harold Mao, Dan Higgins, Jessica Malpica De La Torre**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Biological Nutrient Removal**
SESSION NUMBER: **G** ***TIME:*** **11:00 – 11:30 AM**

Currently, the application of integrated Membrane Bioreactor (MBR) with Biological Nutrient Removal (BNR) systems are growing rapidly in wastewater treatment as, compared to conventional systems, it is a high rate system that has a much smaller footprint and lower HRT, minimize the chemical consumptions and sludge production. And more importantly, MBR BNR system can reliably produce high effluent quality meeting the most stringent requirements for discharge and/or reuse including TN and TP.

This presentation will first discuss the fundamentals of MBR technology and recent developments, specifically MBR systems for biological nutrients removal using the immersed hollow fibre (HF) membranes. Initially, in the early 1990's, many MBR plants were small-sized package plants, using long HRT and SRT, and incorporating high MLSS concentrations, low filtration fluxes, ex-situ membrane cleaning and only designed for removal of BOD/TSS. Later in the 1990's, larger municipal system designs were used (< 2 MGD), with greater attention to pretreatment, shorter HRT and SRT, lower MLSS, moderate membrane filtration fluxes, and using both in-situ and ex-situ membrane cleaning. Currently, MBR systems ranging in size from medium to very large (> 10 MGD) are integrating the biological nutrients removal processes for higher levels of TN and TP removal with reduced chemical usage and sludge production.

The main objectives of this study are to compare the pilot results with the full scale MBR performance under the field operation conditions, to address the design and optimization of MBR BNR system using ZW membrane system, and to discuss the impacts of the key design and operation factors on the performance of a MBR BNR system. The key process parameters for designing MBR BNR systems are significantly different from a conventional BNR system. Understanding the difference between the two systems is essential for design engineers and BNR system operators to develop/operate a reliable integrated MBR BNR system.

Several case studies will be presented to highlight the effectiveness of MBR technology and reliability, performance and benefits of MBR BNR systems for wastewater treatment and biological nutrients removal.

This presentation will provide essential technical information for wastewater managers, consulting engineers, regulators and operators to better understand MBR and MBR BNRs and to properly select and effectively operate MBR systems.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Optimizing BNR at The Sheboygan WWTP: A Case Study**

AUTHOR(S): **Dale Doerr, Bill Marten**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Biological Nutrient Removal**
SESSION NUMBER: **G** ***TIME:*** **10:00 – 10:30 AM**

The Sheboygan Regional wastewater treatment plant (WWTP) treats an average flow of approximately 10 mgd from the City of Sheboygan and neighboring communities. Liquid treatment includes fine screening, grit removal, primary sedimentation, activated sludge and disinfection, with effluent discharged to Lake Michigan. Primary sludge and waste activated sludge (WAS) are anaerobically digested. The digested sludge biosolids are thickened and stored onsite prior to beneficial reuse on agricultural land.

Because of its Lake Michigan discharge, the plant has been required to remove phosphorus for decades, with an effluent total phosphorus limit of 1 mg/L, and historically achieved this through chemical precipitation. More recently, the plant was informed that it would have effluent ammonia limits included in its next WPDES permit. A provision in the permit allowed the plant a 2 year testing period to investigate options to achieve compliance with the effluent ammonia limits.

The plant's activated sludge system was modified during the 1990s to incorporate unaerated, mixed selector zones upstream of aeration basins, along with replacing turbine aerators with fine bubble discs. The selector zone (termed "BNR Reactors") retrofit, which involved modifying one-third of the existing aeration basins, was implemented with the goal of achieving biological phosphorus removal (Bio-P). The aeration modifications were implemented for energy savings and to ensure adequate oxygen transfer capacity after a third of the aeration basins had been converted to BNR Reactors.

Since these modifications, plant performance has been variable, both in terms of biological phosphorus and ammonia removal. The inconsistent biological nutrient removal (BNR) performance has been influenced by a wide range of factors that include facility/equipment limitations, operational practices, and management issues. This presentation will discuss a case study of a project aimed at optimizing the plant's BNR performance through a combination of field studies, data analysis, and staff training. This will be a joint presentation by the plant's consultant and superintendent that will include both the technical and management challenges that at times hinder, and which must be overcome to achieve optimal BNR performance.

ABSTRACT

The following is an abstract of a paper given at the 79thAnnual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Threshold Limits for Nutrient Removal Technologies**

AUTHOR(S): **Dr. Krishna Pagilla, Dr. Meltem Urgun-Demirtas, Dr. Heng Zhang**

DATE OF SESSION: **May 10, 2006** ***SESSION TITLE:*** **Biological Nutrient Removal**
SESSION NUMBER: **G** ***TIME:*** **9:30 – 10:00 AM**

In 2001, USEPA proposed water quality nutrient criteria that will have a significant impact on water pollution control industry and require development of new technologies and/or significant improvement of existing technologies due to stringent future effluent N and P limits. This paper presents findings from a current WERF project (02-CTS-1) on best available technologies being implemented to achieve low N and P levels at the WWTPs, technology and cost assessment to evaluate the feasibility of implementing them at other plants, and key technology gaps and research needs to achieve very low N and P effluents.

Plants consistently achieving <5mg TN/L and <0.5mg TP/L were identified from worldwide literature search and plant data collection. There were many plants achieving either very low TN levels (<3.0 mg/L) or TP (<0.1 mg/L) in their effluents, but not both. Survey of WWTPs implementing nutrient removal to achieve low N and P in the effluents also showed that considerable chemical costs are incurred to achieve low N and P effluents. Biological N removal with supplemental carbon and enhanced chemical P removal using alum or ferric salts are the most common methods implemented at the existing low N and P effluent plants. Technology assessment could be used to establish treatment alternatives for different thresholds of effluent nutrient levels, but cost assessment is site-specific and treatment plant specific.

There are some key challenges in achieving lower levels of N and P in the efluents. The limits of treatment in achieving very low N effluents (total N ~ 1-2 mg/L) include carbon sources for denitrification, residual dissolved organic N (DON) and colloidal organic N in the effluent. DON content ranges from about 0.5 to 2 mg N/L with an average of about 1 mg N/L at low N removal plants in the US and could be as high as 60% of effluent TN. The source(s), fate and bioavailability of DON are not known and are key technology gaps for achieving very low TN effluents. Technical and economic challenges to achieve very low TP effluents include alkalinity deficiency, high chemical usage, high sludge production and lack of sufficient influent BOD for biological P uptake.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the CENTRAL STATES WATER ENVIRONMENT ASSOCIATION St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Two Stage Activated Sludge with High Purity Oxygen – Analyzing a Dinosaur**

AUTHOR(S): **James Liubicich, Randall Wirtz, Troy Stinson**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Secondary Clarifiers/Activated Sludge**

SESSION NUMBER: **F** ***TIME:*** **3:30 – 4:00 PM**

The 1999 Facility Plan and Capital Plan for the Glenbard Wastewater Authority (GWA) recommended replacing the current Two-Stage High Purity Oxygen Activated Sludge system (HPOAS) with Single Stage Air Activated Sludge (SSAAS) at the 16 million gallon per day (MGD) average flow and 47 MGD peak flow Glenbard Wastewater Treatment Plant. The High Purity Oxygen Process was considered innovative treatment when developed in the 1960s and 1970s. However, recent trends in the industry are moving away from high purity oxygen processes and towards air activated sludge. The Glenbard Plant is the only facility like it in Illinois.

Process changes instituted in 2004 at the plant, along with a thorough review of background information, have yielded a new direction whereby maintaining the existing design is being assessed with other alternatives in a 20 year planning study. This paper will detail a historical review of the Two Stage Activated Sludge High Purity Oxygen Process and will present a technical comparison of HPOAS and SSAAS. The paper will present a present worth cost analysis of alternatives based on actually operating data.

STATUS of INVESTIGATION: The six (6) month planning process was initiated in September 2005 and is scheduled to be finalized by mid March of 2006. Previous activated sludge assessments are believed to misrepresent certain operational considerations, especially power requirements. The Glenbard Plant historically has budgeted approximately $400,000 for electrical energy and has a very attractive cost of power at 3.6 cents per kilowatt. As deregulation takes place, a large cost increase for power is anticipated in the near future, making low energy alternatives more attractive.

DESCRIPTION of STUDY: The Facility Plan will provide an assessment of the facility in its entirety including flows and loads, preliminary, primary, secondary and tertiary treatment processes being employed at the plant. Presentation of the Two Stage HPOAS process will be compared to other alternatives on a present worth basis over a 20 year planning period. A historical review of HPOAS design will be given along with actual operating data from the plants history to support all conclusions.

CONCLUSIONS TO DATE: Recent process changes at the plant have proven beneficial in controlling solids inventories and reducing proliferation of filamentous bacteria and the problems commonly associated with filaments, including bulking sludge, floating sludge and foaming anaerobic digesters. These changes, along with a thorough evaluation of the capital costs required to convert the process, and the O&M costs to operate the system, are trending toward the conclusion that maintaining what appears to be an old fashioned process in service is the most cost effective long term solution.

WHAT FINDINGS MEAN TO THE WATER QUALITY COMMUNITY: This study will contribute to the understanding of the HPOAS process for the industry, as HPOAS finds itself being regulated to the history books in lieu of the more common air activated sludge alternatives. Often times HPOAS is assessed as the most cost effective treatment alternative but is eliminated from consideration due to the concern of high O&M requirements of oxygen generation and usage. Actual operating data will be used from the GWA facility that was first commissioned in 1982 and was thought to have only a 20 year life, but can now be potentially better assessed as a 40 to 50 year life. The historical aspect of air vs. oxygen will also be presented in terms of overall rates of biological treatment and required tank capacities to aid the design community.

Information will also be presented regarding biosolids production, biological phosphorus removal, and peak flow capacity with an HPOAS system compared to SSAAS.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the

CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Remove Filaments and Increase Capacity Without Adding Tankage: A Case Study At The Village Of Grafton Wastewater Facility**

AUTHOR(S): **Thomas Krueger, Kenneth Sedmak**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Secondary Clarifiers/Activated Sludge**
SESSION NUMBER: **F** ***TIME:*** **3:00 – 3:30 PM**

This presentation presents a case study on the conversion of a two-stage activated sludge plant to single stage incorporating "Selector Technology," and the effect this conversion had on overall plant performance and capacity.

The Village of Grafton operates a 1.7 mgd plant that is planned to combine with Cedarburg in a regional plant in the next 20 +/- years. Originally, the Village was planning to construct this regional plant in the late 1990s; however, a study completed in 1997 provided Grafton a roadmap of plant changes to increase the existing plant capacity to 2.5 mgd without adding new tankage. The first step in this plan recommended elimination of co-thickening waste activated sludge (WAS) in primary clarifiers through addition of a gravity belt thickener for WAS thickening. This improvement, implemented in 2003, dramatically increased the hydraulic detention time plant's anaerobic digesters, thereby improving sludge stabilization.

The next improvement recommended by the plan involved conversion of the two-stage activated sludge process to single stage. The plant's activated sludge process has two parallel treatment trains, each originally consisting of a compact plant for first and second stage aeration and first stage clarification, plus a separate second stage clarifier.

Historically, significant amounts of septage and other hauled-in waste have been taken at the plant, much of which can be high in soluble BOD and sulfides. The septage had contributed to continuous outbreaks of filamentous bacteria, predominantly identified as 021N and Sphaerotilus natans. The new single stage activated sludge process design incorporated a four-stage aerobic "selector" to provide a gradient F/M ratio for absorption of soluble BOD to control the filaments. The single stage design also provided increased hydraulic capacity by combining the mixed liquor flow to the four secondary clarifiers and improving return sludge pumping operations by replacing air lift

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pumps with mechanical pumps in the original first stage clarifiers. Since the single stage improvements became operational in 2004, the plant has achieved excellent performance and effluent quality, with no filament bulking incidents.

This paper will present operating data of the single stage activated sludge plant, showing improved activated sludge settling, selector F/M operation and selector removal of soluble BOD. The presentation by the Utility Manager and design consultant will discuss the benefits and challenges of this facility's conversion to single stage activated sludge for improved operation and capacity without the addition of tankage.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Clarifier Optimization at the Del-Hart Water Pollution Control Commission Facility**

AUTHOR(S): **Phil Korth**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Secondary Clarifiers/Activated Sludge**

SESSION NUMBER: **F** ***TIME:*** **2:00 – 2:30 PM**

The Delafield-Hartland Water Pollution Control Commission upgraded their wastewater treatment facility to a modern activated sludge facility. Modifications to the primary and final clarifiers along with new clarifiers were made as part of the construction project.

The existing rectangular primary clarifiers were re-designed to be more efficient. A mid tank baffle was installed to reduce density currents. The effluent troughs were lengthened and rotated to be parallel to the flow.

The existing secondary clarifiers were re-designed for activated sludge but due to their depth, were rated for a lower overflow rate. A new secondary clarifier was installed to add capacity. All clarifiers were installed with peripheral baffles, spiral scraper arms, energy dissipating feed well, and full length scum removal. Chlorine is added through a distribution pipe beneath the effluent weirs. This aids in disinfection but also keeps the weirs and troughs free of algae.

The clarifier design used optimization techniques that reduce density currents and improve overall performance. Performance data from Del-Hart shows that BOD and TSS removal improved in the primary clarifiers and the final clarifier showed excellent performance.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **CFD/Modeling Evaluation of Four Alternatives for Secondary Clarifiers**

AUTHOR(S): **W.H. Boyle, B.N. Davis**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Secondary Clarifiers/Activated Sludge**
SESSION NUMBER: **F** ***TIME:*** **1:30 – 2:00 PM**

For many years, a significant amount of field testing work has been conducted in order to evaluate and select the product alternatives, which can be applied to design a secondary clarifier with a substantially higher performance and capacity. There is debate among various design engineers and clarifier manufacturers on the performance (or efficiency) of several alternatives developed for the circular siphon feed secondary clarifiers. Field data provides the control of clarifier performance understanding in general as well as obtaining physical results. However, conclusions cannot be drawn only based on field tests and observation.

This CFD modeling was able to provide a complete and objective picture describing both performance and application conditions for four (4) evaluated alternatives in a direct side-by-side comparison under identical conditions. The alternatives were: 1) Spiral Scraper with typical EDI Influent well; 2) Hydraulic Header with typical EDI w/ flat floor; 3) Hydraulic Header with typical EDI w/ sloped floor; 4) Hydrualic Header with FEDWA baffle system with flat floor.

The state of the art fully Mass Conservative Clarifier Model used for this paper combines computational fluid dynamics with solids flux theory to provide a full and accurate picture of the hydraulic and solids regimes (under strong density impact) within the clarifier while maintaining full mass conservation during the entire simulation period. All aspects of clarification where taken onto account. This paper illustrates modeling results of the systematical clarifier stress tests, which not only include the clarifier performance (such as effluent SS, RAS compression/draw-off efficiency and control of sludge inventory, etc.) but also show the flow regimes under different loading conditions.

Using detailed clarifier modeling results, the clarifier can be analyzed by looking at the following aspects, in addition to effluent quality: 1) Relationship between the sludge blanket level and the effluent solds concentration. 2) Effect fo the clarifier hydraulic and solids loading on the effluent concentration, RAS concentration, the sludge blanket level and sludge inventory. 3) Variations of flow patters withn respec to the sludge blanket. 4) Solids distribution within the tank.

The conclusions of the CFD Modeling study are as follows:

Alternative 1 (spiral scraper with conventional EDI) has its sludge withdrawal efficiency proportional to the sludge inventory of the clarifiers. It only provides sufficient withdrawal efficiency when clarifier operations hold enough amount of sludge inventory. It shows a relatively weak ability to control solids inventory rising up during transient flow increase period. The jet of clarifier influent flow through a few influent slots on a cylindrical flat bottom tub type EDI is still very strong due to the very small cross sectional area of the slots. However, if the cross sectional area of the inlet slots is simply enlarged, flow short-circuiting (or uneven distributed flow) may occur among the slots. The strong influent jet causes significant sludge dispersion and strong turbulence in the clarifiers equipped with a cylindrical flat bottom tub type EDI. The poor hydraulic behavior due primarily to the improperly designed inlet can also be directly observed in the model predicted 3D flow fields.

Alternative 2 (hydraulic header with conventinal EDI w/ flat floor) provides up to 30% higher sludge withdrawal efficiency than that of Alternative 1. The MLSS in bioreactors is often diluted during peak flow period due to the significant solids inventory shifting from the bioreactors into the clarifiers. Together with an optimized RAS flow rate the higher sludge collection/withdrawal efficiency of the Tow-Bro header provides a stable process operation through more effectively returning solids inventory back into the bioreactors. The same influent hydrualic concerns were noted at high flows as with Alternative 1 using the conventional EDI design.

Alternative 3 (hydraulic header with conventional EDI w/ sloped floor): provided same advantages as Alternate 2 with some increased solids storage capacity.

The optimized Alternative 4 (Tow-Bro + FEDWA) is able to provide significantly higher capacity (up to 40%) than that of the clarifiers used in Alternative 1. The application of the FEDWA ensures a major enhancement in controlling dispersed sludge layers through effectively damping the turbulence into the clarifiers. When the baffled FEDWA design is used, the velocities behind the outer baffle were found to be many times smaller than those in the clarifiers with a cylindrical flat bottom tub type EDI at the same location due to the continuous, repeated impingement of the influent jet on the staggered baffles.

KEYWORDS: CFD Modeling, FEDWA, EDI wells, Clarifier, hydraulic header, header, upgrade, retrofit, Tow-Bro, TSS, RAS concentration, overflow rate, performance, state point analysis, activated sludge secondary clarifier, SLR, solids loading rate, mass loading, ML, flow pattern/solids distribution, plant capacity evaluation.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Deregulation: Friend or Foe?**

AUTHOR(S): **Nicholas Menninga, Dan Dragan**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Management**
SESSION NUMBER: **E** ***TIME:*** **3:30 – 4:00 PM**

In United States 500,000 customers lose power every day for an average of about two hours. In fact 76% of Americans have had at least one electrical service interruption of their electrical service in the last year and 23% have had at least four interruptions. Even with the significant increase in the natural gas, electric and gasoline prices, energy issues are not top-of-mind for most Americans. When people are asked about most important energy related issues that face our country, electrical reliability or power utility infrastructure issues fall behind issues such as high gasoline prices, natural gas prices, dependency on foreign oil and alternate energy sources.

Under this background of indifference to energy related issues, one of the most significant changes in power distribution is taking place: **deregulation.** The year 2007 will be a critical year in the deregulation process in Illinois.

This paper will look at the ongoing changes that deregulation will have on the billing rates of Commonwealth Edison in its Northern Illinois service area. Rate structures are shifting, since ComEd is becoming a pure 'wires only' company, rather than a complete electrical supply and distribution utility. These new rate structures will impact the pricing of electricity, as well as the operating behavior of significant electrical users. Many wastewater utilities will find that the cost effectiveness of their cogeneration or standby facilities will change, requiring a re-examination of their electrical infrastructure, as well as their operational protocols.

This presentation will help raise awareness of deregulation and the impacts it could have on the wastewater industry.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Asset Management Implementation Using TEAMS**

AUTHOR(S): **David Rein, Patrick Rein and Clif Allen**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Management**
SESSION NUMBER: **E** ***TIME:*** **3:00 – 3:30 PM**

Implementation of advance asset management techniques has been found to reduce the overall operating costs for water and wastewater treatment plants by nearly 20%. Thus, implementation is being encouraged at many levels of government

Early in 2005, the City of Fergus Falls, MN made the decision to implement an "Advanced Asset Management Program." The objective of the first phase of the program was stated as:

- "Operation and maintenance of the Wastewater Treatment Plant and Collection System assets in a sustainable and cost-effective manner (least cost) while providing the required level of services for both present and future customers."

Rein & Associates was selected to be the overall Project Manager. The "Total Electronic Asset Management System, TEAMS" software developed by the Maryland Center for Environmental Training under funding by the USEPA was selected as the data base software for implementation.

The TEAMS software brings together the many elements of "Advanced Asset Management", (inventory, condition, criticality, valuation, maintenance management, renewal/replacement planning, and financial planning) into one cohesive data base management program. The TEAMS open software design using "Access" allows the user to easily tailor the program to their particular needs.

Nearly 60% of the City of Fergus Falls WWTP assets have been inventoried and entered into the data base. Asset criticality and condition have been assigned. Work orders are being generated, completed and entered into the data base. Reports such as Work Order by Date, Tasks Completed, Supervisor's Task Report, Projected Replacement Costs, Lifetime Asset Cost Report, Cost Effective Capital Investment Decision, and Asset Remaining Life are being generated. A Five Year CIP Plan with defendable criteria has been produced. Both the required maintenance and the R/R programs are prioritized according to both criticality and condition.

Implementation has not been easy or fast. Internal resistance has been encountered at more than one level. However, progress has been made to the point where benefits are becoming apparent to all.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **My SCADA System is Secure and Other Security Myths**

AUTHOR(S): **Eric Durdov**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Management**
SESSION NUMBER: **E** ***TIME:*** **2:00 – 2:30 PM**

This paper will present and disprove some of the most commonly held myths with regard to SCADA/Cyber-Security. Some of the myths covered include:

- Utilities and SCADA Systems can't be hacked!
- I Have a Firewall – I'm Secure!
- Hacking is Hard!
- My SCADA System is NOT connected to the Internet!
- I don't have a SCADA System – I don't need to worry!
- I only have to worry about Outsiders…
- I would know if I were being hacked!
- Security is a Project – When will it be done?
- IT Security and SCADA Security are the same!
- My SCADA System is Secure!
- I can't stop the Hackers!

Real world incidents of hacking in the water and wastewater industry will be presented. Stories will be told of how the hackers did it, what the effects on the utility were, and how the attack could have been prevented. Some of the techniques commonly used are not really high-tech, these include emotional intelligence (EQ) which will also be discussed.

A list of questions that utilities can use to assess SCADA/Cyber-Security readiness will be presented. After answering these questions as a utility, one would be able to gauge their preparedness and risk of a SCADA/Cyber-Security attack.

An approach for how utilities can actively take precautions to reduce the risks of an attack will be described. The model that will be presented is the SCADA/Cyber Security Lifecycle of Assessment, Penetration Testinmg, Design Upgrades, and Administration/Maintenance.

The goal is to raise awareness of SCADA/Cyber-Security and present to the utilities that there may be real threats and vulnerabilities in their systems and what can be done to mitigate risks.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

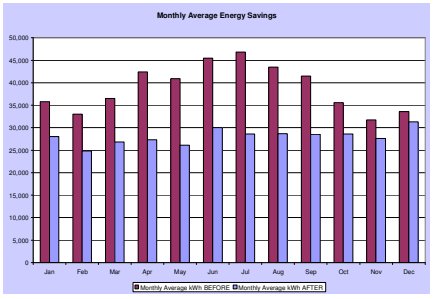
TITLE OF PAPER: **Energy Use – what gets written down gets managed!**

AUTHOR(S): **Joe Cantwell and Don Voigt**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Management**
SESSION NUMBER: **E** ***TIME:*** **1:30 – 2:00 PM**

The Problem
Energy consumption awareness is more than an awareness of your home or office thermostat settings. Discovering where the utility energy bill is being sent and beginning to track energy consumption/costs at your utility – and have it analyzed for potential reduction – is a new paradigm for our industry. www.watergy.org offers insight in it's statement… "simply monitoring energy consumption (i.e. 'seeing the bill') has shown that such monitoring reduces consumption by 10%" - just by monitoring it! Thus, we begin this new world of energy consumption management. This paper will help you understand what your power bill is telling you and what would be considered "best practice" for energy consumption for your utility.

Goals and Objectives
Wherever management seeks to improve, there needs to be a benchmark to identify the present conditions to compare to. Benchmarking the level of power consumption in the water and wastewater industry – until recently – has been difficult at best. This is attributable to the USA model of "cheap energy" - endless supply and limited or no monitoring of consumption. European practices have long been based on their extensive use of benchmarking and associated energy consumption modeling. Wisconsin Focus on Energy – in the interest of setting "standards" for best practices in water/wastewater – funded a pioneering benchmarking study. The purpose of the study was to identify the base energy consumption level of various size facilities and various unit treatment processes. To obtain this information it was found that metering and monitoring each unit process had to done to obtain the data required to define the proposed benchmark values. The analyzed data was then compared to similar data that had been assembled, by others, from European treatment facilities. It was generally found that the benchmarked facilities were consuming more energy than European counterparts.

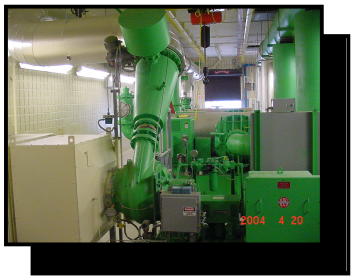


Actual Energy Savings Through Energy Efficiency Modifications at a Wisconsin Municipal Wastewater Utility

Subsequent to the benchmarking study, a number of Wisconsin utilities reviewed their energy consumption practices and implemented selected opportunities to reduce consumption of energy. Subsequent to their changes, these utilities have found that their energy saving modifications have put their facility's energy consumption at similar levels to the European consumption values. This information can be utilized to present that there would be definite value in managing energy at all levels regulators, designers, operators and management.

Results
Case studies will be presented to provide specific examples on how Wisconsin Utilities identified and implemented energy reductions at their facilities..

Actions
The paper will also present actions site personnel can take to perform preliminary self reviews to identify potential energy savings available at their facilities.



A single blower installed at Janesville, WI Utility replaces 3 older blowers and saves over $30,000 per year on their

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Achieving High Quality Effluent Voluntarily at the Greater Bayfield WWTP**

AUTHOR(S): **Jane Carlson, Margaret Guell**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Operations/Constr/Small Syst**
SESSION NUMBER: **D** ***TIME:*** **3:30 – 4:00 PM**

There is growing interest among communities in the Central States to provide wastewater treatment above-and-beyond typical regulatory requirements. Reasons may include antidegradation or anti-backsliding requirements, total maximum daily load (TMDL) or other waste load allocations, preparation for future anticipated effluent limits, or interest in environmental stewardship.

Several years ago, a group of communities in the Bayfield, Wisconsin area came together to investigate the potential for a regional wastewater management scheme that would have minimal impact on Lake Superior, in the spirit of "zero discharge." Alternatives for a groundwater or nearby stream discharge were identified as too costly and did not offer environmental benefits over a high quality Lake Superior discharge. Based on cost, environmental benefit, flexibility for future growth, and availability of funding, the communities decided to serve the area with a high technology mechanical wastewater treatment plant (WWTP) designed to achieve a high quality effluent for discharge to Lake Superior.

The City and Town of Bayfield and Pikes Bay Sanitary District proceeded to establish effluent goals and evaluate technologies for the proposed Greater Bayfield WWTP. Wastewater treatment technologies evaluated included chemical and biological nutrient removal, various activated sludge modifications, effluent polishing through a wetland system, innovative filtration, membrane filtration, and membrane bioreactors (MBR). Total suspended solids (TSS) concentration was used as a surrogate indicator of effluent quality. Conservative values of effluent TSS were identified for each alternative and compared with the capital and present worth costs. Plotting cost versus TSS revealed that below about 5 mg/L TSS concentration (the "knee of the curve") costs increased exponentially as the TSS concentration approached 0 mg/L. For the local communities, the "knee of the curve" represented the highest quality effluent that could reasonably be achieved. The unit processes that were thus selected included fine screening, an oxidation ditch system with biological phosphorus and nitrogen removal, chemical phosphorus removal polishing, final clarification, cloth disk filtration, and UV disinfection. Biosolids management includes aerobic digestion and sludge reed bed dewatering/storage. A hauled waste receiving station was also included.

The WWTP design incorporates several energy-saving features and a unique mix of grant and loan funding that will be summarized during the presentation. The WWTP is under construction with startup in January 2006 and final completion scheduled for June 2006.

This presentation will be valuable to any community faced with stringent discharge permit limits, whether voluntary or mandated.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the CENTRAL STATES WATER ENVIRONMENT ASSOCIATION St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Experiences with Subsurface Flow Wetlands in Wisconsin-A Case Study**

AUTHOR(S): **David Flowers**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Operations/Constr/Small Syst**
SESSION NUMBER: **D** ***TIME:*** **3:00 – 3:30 PM**

What started as a one time public education project in 1995 grew to building and operating several subsurface flow wetlands treating domestic wastewater in Wisconsin for: single residences, multiple (clustered) residences, and for commercial/ institutional concerns. This paper shares experiences gathered during five plus years of constructing and operating six wetland systems in central and southeastern Wisconsin.

Public education inspired building the first subsurface flow wetland at a nature center that averages three (3) busloads of school children per day and with seasonal peak usage as well. The children have an extensive curriculum of activities, some feature:

- Sustainable development
- The value of wetlands in cleaning water, and
- The water cycle (counteracting the out-of-sight, out-of-mind situation after flushing the toilet)

Subsurface flow wetlands show excellent removal qualities for nitrogen when compared to other passive treatment technologies. Five case studies are included in the paper, encompassing six wetland complexes. All include: varying methods of wastewater collection from small diameter to large diameter collectors, septic tanks from clustered to individual residential, and lined subsurface flow wetland cells followed by dispersal wetland cells (unlined).

All five of these wetland case studies have been built under a State of Wisconsin, Department of Commerce (COMM 83) statute that allows experimentation with on-site systems. One requirement is quarterly testing of wastewater characteristics by a certified laboratory. These and other results are displayed in the paper.

A number of challenges were overcome, including freezing of some components during harsh winter months. These experiences will be shared along with suggestions on where future improvements are likely.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Let's take our four largest wastewater lift stations out of service this Summer and not lose any sleep at night: A Case Study**

AUTHOR(S): **Joseph Pisula**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Operations/Constr/Small Syst**
SESSION NUMBER: **D** ***TIME:*** **2:00 – 2:30 PM**

The City of Marquette, Michigan (population 20,500) owns and operates four major lift stations that transport wastewater to the City's 6.2 million-gallon-per-day (MGD) treatment plant. Station capacities range from 0.69 MGD to 6.61 MGD. The oldest station was constructed in the 1940's, the newest in 1978. In 2003, the City reviewed the lift station conditions and determined that the pumps, piping, controls, and electrical equipment needed an upgrade.

While the below-grade structures were in good condition, other problems existed. The Pine Street lift station pumps had been inappropriately selected for their head conditions, causing the pumps to cavitate. At the largest lift station, Lake Street, the City wished to eliminate persistent hydrogen sulfide odors. This station was a source of numerous odor complaints, due to its close proximity to nearby residences, a marina, and a tourist attraction (Maritime Museum).

In 2004, the City authorized Donohue to lead the project's planning and design effort. The project required significant demolition work, which included tasks such as increasing pump suction pipe sizes, adding a corrosion barrier to the Lake Street station wetwell, and replacement of major electrical and control subsystems in each station. These replacements required that each station be taken completely off-line while the station was being rehabilitated. The Lake Street Station was off-line for nearly two months, with no loss of wastewater service to any customers. This $3.47 million project utilized a well-conceived bypass pumping arrangement for each station, which utilized multiple redundancies and back-up alarm and telemetry features to assure City personnel that service was being reliably maintained.

A unique project aspect was the effect that a major flood had on the City's outlook on wastewater system reliability and vulnerability. In the past, each station's electrical power was fed from two substations. However, during the design phase, an earthen dam upstream of the City failed, causing flooding in the north end of the City and knocking out power from both substations that served one of the stations. As a result, the City added a standby generator to each station.

This presentation will present various elements of the project and the measures taken to ensure that collection system capacity or efficiency was not compromised.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the
CENTRAL STATES WATER ENVIRONMENT ASSOCIATION
St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Operation of Fine Screens at the Madison Metropolitan Sewerage District**

AUTHOR(S): **Mathias Allen, Barney Fullington, Paul Nehm**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Operations/Constr/Small Syst**
SESSION NUMBER: **D** ***TIME:*** **1:30 – 2:00 PM**

During planning for a recent upgrade to the Nine Springs Wastewater Treatment Plant, the Madison Metropolitan Sewerage District (MMSD) recognized its need for improving digestion and headworks capacity, and the desire for an alternative method for recycling biosolids from the current liquid land application program. During design selection, MMSD established a desire to produce some type of Class A biosolids product for local, commercial distribution. This decision, in effect, drove other decisions related to digestion and headworks design.

The Nine Springs Plant had existing, aerated grit tanks that required upgrading and were nearing capacity. Although the plant had no influent screening, primary sludge was screened and degritted, however, waste activated sludge was not screened prior to introduction into the digesters. Because of this lack of screening, certain inorganic solids (rags and plastics) were identifiable in the biosolids end product. MMSD realized that this would be unacceptable in any final end-product for commercial distribution.

A combination of perforated plate fine screening followed by vortex grit removal was chosen for the headworks improvements. At the time of selection, perforated plate fine screening technology was in its infancy in the U.S. wastewater industry and the 180 mgd peak flow facility was to be the largest operating facility of its kind in the U.S. The facility was placed into service at the Nine Springs Wastewater Treatment Plant during late summer and fall of 2005. MMSD staff was heavily involved in the selection, design, installation, and startup of these processes and has gained valuable experience with this screening technology through all phases of the project. Since the start of operation, MMSD has been closely monitoring the operation of the screens, modifying operational strategies, and making some design improvements. This paper will provide information on the quantity of screenings removed, describe maintenance requirements of the system, and provide suggestions for improvement of future fine screening system designs.

ABSTRACT

The following is an abstract of a paper given at the 79th Annual Meeting of the CENTRAL STATES WATER ENVIRONMENT ASSOCIATION St. Charles, IL May 8-11, 2006

TITLE OF PAPER: **Experience Operating Chemically Enhanced Clarification to Treat Wet-Weather Flows**

AUTHOR(S): **Richard Onderko, Thomas Sigmund, John Siczka, Todd Elliott**

DATE OF SESSION: **May 9, 2006** ***SESSION TITLE:*** **Wet-Weather Treatment**
SESSION NUMBER: **C** ***TIME:*** **11:15 – 11:45 AM**

The Milwaukee Metropolitan Sewerage District (District) conducted demonstration tests in 2005 to evaluate chemically enhanced clarification (CEC) of wet-weather flows at the District's two wastewater treatment plants (WWTPs). CEC offers the potential to treat intermittent high wet-weather flows, produce high-quality effluent, and fit into the limited space at the Jones Island and South Shore WWTPs. Two CEC processes were tested at the South Shore WWTP: DensaDeg®, manufactured by Infilco Degremont, and ACTIFLO®, manufactured by Krüger. Primary clarifier influent was the wastewater source for the two CEC processes. Testing was conducted during both dry-weather and wet-weather conditions.

The CEC demonstration testing program included the following specific objectives: evaluate the performance of the selected CEC technologies, evaluate the feasibility of UV disinfection for CEC effluent, compare CEC treatment to existing secondary treatment, and determine key design criteria for full-scale application of CEC for wet-weather flows.

Bench-scale tests indicated that aluminum sulfate (alum) and ferric chloride offered the best performance. Demonstration testing evaluated the coagulants at various doses to achieve the desired biochemical oxygen demand (BOD_5) and total suspended solids (TSS) removal from the CEC processes (50 percent for BOD_5 and 85 percent for TSS) and to maximize UV transmittance (UVT).

Specific wastewater characteristics and wastewater treatment process chemicals were unexpectedly found to interfere with CEC and to render UV disinfection impractical. At the Jones Island WWTP wastewater contributions from a yeast plant significantly reduced the CEC performance and UVT below levels generally acceptable for UV disinfection. At the South Shore WWTP, pickle liquor (a source of ferrous iron) added to the plant influent for phosphorus control adversely affected TSS removal and caused instability in the CEC units. Ferrous iron also caused rapid fouling of the UV quartz sleeves. Without pickle liquor addition to the influent both the ACTIFLO and DensaDeg units performed well.

The CEC units typically achieved about 2- log removal of *E. coli* and fecal coliform and greater than 2-log removal of male-specific coliphage. This compared favorably to the existing primary and secondary treatment at the South Shore WWTP.

The CEC processes provided high levels of treatment at very high overflow rates, minimizing their footprint for inclusion at either the Jones Island or South Shore WWTPs. The CEC process may be susceptible to reduced performance by specific industrial wastewater components and wastewater treatment process chemicals, and this must be included in design of CEC facilities. When these factors are accounted for, CEC performance improves and can achieve UVT levels acceptable for application of UV disinfection.