

Energy Efficiency in  
Municipal Water  
and Wastewater  
Treatment

**SAVING ENERGY  
EQUALS  
SAVING MONEY**

**Iowa  
Association of  
Municipal  
Utilities**

1735 NE 70<sup>th</sup> Ave.  
Ankeny, IA 50021

800-810-4268

fax 515-289-2499

[www.iamu.org](http://www.iamu.org)

## **Cedar Rapids Water Utility Energy Efficiency Management Program— Meeting the Demands of Industrial and Residential/Commercial Customers**

### **Cedar Rapids Water Department**

John North, Water Utility Director  
Population: 123,000

### **Water Treatment System Profile**

Cedar Rapids obtains its drinking water from shallow vertical and collector wells in sand and gravel deposits along the Cedar River. The supply of water is classified as groundwater under the direct influence of surface water. The well system consists of 4 well fields with a total of 4 collector wells and 45 vertical wells. Peak flow is 50 mgd with an average of 35 mgd. The system has a design capacity of 65 mgd.

Wells provide water to two treatment plants that are classified as conventional lime-softening facilities. Their treatment process consists of aeration, softening, recarbonation and chlorination, filtration, fluoridation and phosphate addition followed by distribution. Treated water is distributed to 16 water towers and/or booster combinations.

Community Population: The utility serves a population of 123,000 and has 44,000 customer accounts. Another 2,000 people are served through two wholesale water service agreements. Seventy five percent of water is used by 16 local industries with 25% use by residential, commercial and municipal customers.

### **Energy Efficiency Management Program**

Without monitoring and information, it's impossible to manage a water system. And for the Cedar Rapids Water Department (CRWD) and its Director John North, more information means more power to affect the efficiency of the water system.

**Energy Efficiency in  
Municipal Water  
and Wastewater  
Treatment**

**SAVING ENERGY  
EQUALS  
SAVING MONEY**

**Iowa  
Association of  
Municipal  
Utilities**

1735 NE 70<sup>th</sup> Ave.  
Ankeny, IA 50021

800-810-4268

fax 515-289-2499

[www.iamu.org](http://www.iamu.org)

As North points out, the two major budget areas in a water system that can be optimized are energy and treatment chemicals. Other areas, such as labor, are harder to control. But even energy costs are hard to control if the system managers don't understand how and where energy is used in the system.

To that end, the CRWD has implemented an extensive program to monitor, analyze, and evaluate energy consumption throughout its systems. The CRWD's goal is to have a "digital dashboard" that provides the data needed for informed management of the water system.

"We need to be careful about trying to benchmark and compare water systems to each other, because there are so many conditions unique to each system," said North. "But what we try to do is benchmark our own system to identify areas of inefficiency."

The Cedar Rapids Water Department Energy Efficiency Management Program consists of the following components:

- Keeping electrical usage records and development of analytical methods to review this data
- Monitoring and management of peak demand power and the power factor
- Power monitor equipment for real-time monitoring of power usage
- Variable speed/frequency drives for high service and booster pump stations
- Participation in Alliant Energy's interruptible program
- City-wide energy management system

The CRWD spends \$1.15 million annually on electric costs. They estimate that they are realizing annual savings of \$150,000 as a result of their energy efficiency management program. CRWD obtains its power from Alliant Energy, an investor owned utility, but is able to offset approximately 30% of its electrical costs by the sale of electricity produced at the city's hydroelectric power plant.

**Electrical Usage Record Keeping**

Extensive monitoring of electrical usage through the use of meters is conducted throughout the two water treatment plants and associated wells, booster stations, tanks and

## Energy Efficiency in Municipal Water and Wastewater Treatment

**SAVING ENERGY  
EQUALS  
SAVING MONEY**

## Iowa Association of Municipal Utilities

1735 NE 70<sup>th</sup> Ave.  
Ankeny, IA 50021

800-810-4268

fax 515-289-2499

[www.iamu.org](http://www.iamu.org)

other water department facilities. Three primary meters are used in the system with a total of 22 points monitored throughout the system. Both plants are hydraulically interconnected (or supply water to the same distribution systems) but operate separately.



John North and Bruce Jacobs view electrical monitoring system.

Electrical usage data is stored in spreadsheets and frequently reviewed to identify unexplained changes in power usage. When an unexplained increase in power usage is observed action is taken to identify the cause and corrective measures are taken immediately. Some of

the itemized values include: kilowatt hour (kWh) usage, kWh per million gallons pumped, total kWh, average cost per kWh and total charge for peak hour usage and charges, off hour usage and charges, base demand calculations, power factor credits and energy cost adjustments.

Leak detection equipment is used by CRWD to control leaks within the system and complements the energy usage monitoring. This program has resulted in the utility being able to account for 94% of the water pumped to the distribution system.

### **Monitoring and Management of Peak Demand Power and the Power Factor**

Another energy management tool used by the CRWD is to manage peak demand power. Time of day management has some limitations for this city due to water storage issues. Plant operators are trained to turn on generators or direct drives, or a combination of both, during peak demand periods. Operators are provided operational guidelines and monitor the SCADA system to ensure that KW demand does not exceed a set peak level. When the demand approaches this value, they must either run the generator or reduce the demand level by shutting off non-essential electrical equipment or treat less water.

**Energy Efficiency in  
Municipal Water  
and Wastewater  
Treatment**

**SAVING ENERGY  
EQUALS  
SAVING MONEY**

**Iowa  
Association of  
Municipal  
Utilities**

1735 NE 70<sup>th</sup> Ave.  
Ankeny, IA 50021

800-810-4268

fax 515-289-2499

[www.iamu.org](http://www.iamu.org)

Plans are currently underway to expand the on-site generation of electricity capabilities of both water treatment plants. This will expand the current peak demand program. CRWD is working with Alliant on transmission capacity and development of a maintenance service agreement to enhance reliability of the CRWD's internal electrical distribution system.

Credits are given to the CRWD from Alliant Energy for power factor management. The water utility is able to take advantage of credits given to them if they maintain their power factor above an established value. The credit is based on the power factor recorded in the 15-minute period of highest electrical demand during each billing period.

**Power Monitoring Equipment for Real-Time Power Usage Monitoring**

Allen Bradley power monitors are used in-line with Alliant's electric meters to measure power consumption at the same point. John notes, "This information has been proven especially valuable in those instances when Alliant Energy had to estimate power usage due to problems with its meter." When analyzing power consumption, it is important to ensure that pumping and other operational records are adjusted to coincide with the actual dates of the metered electrical usage. In the future, the CRWD hopes to have real time pricing with Alliant Energy, which can help to minimize energy costs.



Bruce Jacobs points out features of energy monitoring equipment.

**Energy Efficiency in  
Municipal Water  
and Wastewater  
Treatment**

**SAVING ENERGY  
EQUALS  
SAVING MONEY**

**Iowa  
Association of  
Municipal  
Utilities**

1735 NE 70<sup>th</sup> Ave.  
Ankeny, IA 50021

800-810-4268

fax 515-289-2499

[www.iamu.org](http://www.iamu.org)

**Use of Variable Speed/Frequency Drives**

When John first started working at CRWD, all pumps were fixed speed. They have replaced many fixed speed pumps with variable speed/frequency drives and plan to continue the conversion where they can best optimize their application. An additional benefit to replacing with variable speed drives is the rebate that is provided from Alliant Energy. Alliant Energy offers incentives and support for any process improvement that improves energy efficiency.

**Interruptible Electric Rates**

CRWD's standby power capabilities have allowed it to take advantage of the interruptible program and rate offered by Alliant Energy. Interruptible customers enjoy lower rates by promising to curtail their power demand to a prescribed level whenever requested. The standby power is needed to ensure continuous operations so the reduced electrical costs are a welcomed secondary benefit.

**Industrial Monitoring of Water Use**

CRWD has taken its internal practices to monitor water and energy and applied them to helping its customers. One of the services CRWD offers to its largest, industrial customers is to provide them with a method to monitor their own water consumption.

A TeleData interface module installed on the City's water meter provides a continuous, real-time read to the industry's SCADA system and a daily history is also transmitted via telephone lines to the Water Department. The CRWD provides and installs the equipment at no cost to the industry and only asks the industry to provide access to a telephone line to enable the daily transmission of the water usage information to the Water Department.

Having up-to-the minute data on their water consumption allows customers to optimize their usage and pinpoint and fix problems quickly. While it may not seem to be in the best interest of a water utility to encourage conservation, according to North, this service is in everyone's best interest. "We still want to sell water, but we want to help our customers ensure that water goes for its intended use. Helping our industries maximize their efficiency helps

**Energy Efficiency in  
Municipal Water  
and Wastewater  
Treatment**

**SAVING ENERGY  
EQUALS  
SAVING MONEY**

**Iowa  
Association of  
Municipal  
Utilities**

1735 NE 70<sup>th</sup> Ave.  
Ankeny, IA 50021

800-810-4268

fax 515-289-2499

[www.iamu.org](http://www.iamu.org)

ensure their continued viability, which means continued water purchases,” said North.

Service to customers is just one of the benefits of this type of remote metering arrangement. It also allows the CRWD to take meter readings without entering the companies’ facilities and provides daily monitoring versus weekly or monthly. If a meter fails, the data is lost for a day, not for longer periods.

The technologies used by CRWD to monitor and manage water and energy are state-of-the-art, but they’re not enough, according to North. “Our challenge is to use the technology and have our staff make a personal commitment to carry out our goals. We need constant re-education about the importance of energy efficiency and water management,” he said.

**Water Conservation**

CRWD does not have a formal water conservation program but does assist residential customers in researching unusually high water usage (typically found to be leaking toilets). This service is provided at no cost to the customer. They also screen meter reads each day to identify apparent abnormally high usage and will contact the customer ASAP to advise them of a possible problem.

**Citywide Energy Management System**

Internally, within the CRWD, a data acquisition software system is used for tracking and control of energy consumption within the entire treatment system. This system provides real-time energy readings and energy usage history. Information is taken from the energy monitoring equipment and stored in a data management system that can be used to evaluate energy consumption on a site-by-site basis and is used to maintain demand within certain limits and alert operators to use on-site generation for peak shaving. The city of Cedar Rapids is installing a citywide energy management system similar to the system used at CRWD to track energy consumption and develop the ability to consolidate loads/meters in the future.

**Energy Efficiency in  
Municipal Water  
and Wastewater  
Treatment**

**SAVING ENERGY  
EQUALS  
SAVING MONEY**

**Iowa  
Association of  
Municipal  
Utilities**

1735 NE 70<sup>th</sup> Ave.  
Ankeny, IA 50021

800-810-4268

fax 515-289-2499

[www.iamu.org](http://www.iamu.org)

**Suggestions for Smaller and Similar Size Water  
Treatment Systems**

John North has the following suggestions for those water treatment systems that have always wanted to develop an energy efficiency program for their treatment systems but are just not sure where to start.

“Start your program by contacting your local electric supplier. They can be a valuable resource. Take advantage of their expertise and the programs that they may have to offer. The next step that is really the key to a successful energy efficiency program is the collection, compilation, and on-going analysis of operating and energy usage. One other important step in the development of a program is the need and benefits of investing in electric metering and other energy management technologies as well as training for staff.”

**Acknowledgements**

We are grateful to John North and other staff members at the Cedar Rapids Water Department including Greg Morningstar, Roy Hesemann, Bruce Jacobs, and Darrell Cannon for providing us with the information needed for this case study.