Reduce Energy Demand and Promote Renewable Energy Projects in Water Supplies

One of the major potential areas for significant national energy savings, renewable energy production and sustainability is within the over 50,000 small community water and wastewater utilities throughout the country. Over the past thirty years a nation wide on-site technical assistance network has been funded by the EPA and USDA to reach all water and wastewater supplies to improve public health and increase access to save drinking water. The program has exceeded expectations due to its unique structure. The structure provides a mechanism for communities to provide the assistance to their peers, which ensures the assistance focuses on small communities’ unique needs and is provided in a manner that they can understand. Having local community support for new and innovative energy plans is essential to its long-term success. This same on-site approach to assist small and rural water and waste water systems is often being used in this same program for energy conservation (see attached examples of energy assistance and concept/research paper). To adopt, support and expand these efforts would make a major impact on overall energy conservation in each state, and in the nation. Currently each state rural water association has a minimum of six in-the-field staff that are working together daily with the small communities in each state. The addition of an in-the-field energy conservation position would provide for an immediate on-site state wide small community water loss prevention and energy conservation program. The program would fully quantify energy and cost savings.

A New On-Site Initiative Could Result in Over 10,000/Year Assistance Contacts Like This One: Lowndes, AL – an on-site technician was dispatched to locate a leak that had evaded location. An emergency leak detection process was initiated using the throttled valve technique to determine the area of the leak. The pipe was excavated and repaired the next day. The leak detection process took three and three-quarter hours. The leak located accounted for approximately 150 gallons per minute which would cost approximately $7,776.00 per month to produce.

Example of a Water Supply Renewable Project: St. Mary’s County, MD – installing a new turbine electrical generator that will burn methane from the treatment plant's anaerobic digesters. The payback period is only 4 years. Waste heat from the generator will be used to heat the plant's control buildings and the digesters. This will not only save several hundred thousand dollars per year in electric bills, but will also reduce the plant's carbon footprint by reducing the amount of commercial power currently produced from fossil fuels. They plan to try to sell the carbon credits as a new revenue source.

U.S. Community Energy/Water Supply Demographics: 51,988 total U.S. community supplies: 92% (47,856) serve less than 10,000 populations. Nationally, small communities with water and wastewater supplies will spend between $600,000,000 and $1,000,000,000 for electricity each year. Out-of-pocket electrical cost for water is probably at least $0.50/1000 gallons.

National Rural Water Association
Duncan, Oklahoma
energywater@ruralwater.org      nrwa.ruralwater.org
**Alabama, Lowndes** - Mr. Franklin L. Buzbee, a Circuit Rider for The Alabama Rural Water Association, worked with Mr. Raymond Surles, full-time Certified Water Operator of Water Management Services, on November 25, 2007. The Lowndes County Water Authority is managed by Water Management Services and serves 1,100 customers in Lowndes County, Alabama. Mr. Surles can be reached by telephone at (334) 548-6235. The Lowndes County Water Authority produces all their metered water from ground sources. All customers are metered. All sources are disinfected at the source with chlorine gas.

Mr. Buzbee first met with Mr. Surles on Sunday, November 25, 2007 to locate a leak that had evaded location. Mr. Surles stated that the pump at the well that provides water for the South section of the system had been running since Saturday morning but the elevated storage tank was still empty. An emergency leak detection process was initiated upon arrival. Mr. Buzbee began the process by using the throttled valve technique to determine what area the leak was in. This was successful. A leak was located on Alabama Highway 21 just West of Blue Hill Road about 500 feet from the storage tank. The pipe was excavated and repaired the next day.

The leak detection process took three and three-quarter hours. The leak located accounted for approximately 150 gallons per minute. With the leak repaired, the Lowndes County Water Authority should save approximately $7,776.00 per month using a cost of production figure of $1.20 per 1,000 gallons. The free assistance provided by the Alabama Rural Water Association occurred during a holiday weekend, which could have resulted in higher rates by other private contractors.

**Alabama, West Blocton** - On February 1, 2007 Alabama RWA Circuit Rider #2, Andrew Crawford, was contacted by West Blocton Water Works Certified Water Operator Mr. Jerry Fondren (205-938-7622). Mr. Fondren requested assistance in locating a leak. The Town of West Blocton is a rural residential town located in Bibb County, Alabama. West Blocton Water Works serves 1,600-metered customers. West Blocton is also home to the extremely rare and beautiful Cahaba River Lilly, which lives in the Cahaba River. Started by the coal miners of West Alabama, it has long outlived the end of the mining era.

The Circuit Rider arrived on-site at the West Blocton Town Hall on February 1, 2007 at 5:30 PM to conduct a leak survey. After spending two days with a section of line valved off the Circuit Rider #2 found that a two-inch ninety-degree elbow pvc had blown off resulting in a 310 gallon per minute leak. This leak drained the Town of West Blocton’s water supply causing an emergency.

As a result of this contact, the savings to West Blocton Water Works is $15,400.00 per month, using a cost production factor of $1.15 per 1,000 gallons.

**Arkansas, Nail-Swaim** - Mr. Daniel T. Johnson, Circuit Rider from Arkansas Rural Water Association, was called by the Nail-Swaim Water Users Association, located in Newton County, to help find a large water loss on the water system, which was costing them over $2,000.00 a month.

Nail-Swaim has 280 connections with the users and water source, a well, both metered. The system provides full-time disinfection.
Mr. Johnson went to the location March 12-14, 2007 and with the help of the full-time, certified water operator, Lynn Spradley, looked day and night for the leak. They found a very small amount of water leaking; this amount was not close to the total loss amount. At that time Mr. Johnson said it appeared to be a "High Pressure" leak that was only leaking when pressure was applied to the system by the high service pump. He suggested that a hydraulic pressure test be done. This was done and several leaks were discovered. It appeared to have helped a great deal in the total water loss.

As for savings to the system it is no doubt a large amount but until another billing cycle is done it is not possible to calculate at this time, but should be in the range of $1,000.00 to $1,800.00. Total contact time was 21.25 hours.

### Indiana, Ramsey

The Ramsey Water Company (812-347-2551) is a large rural water system located in Harrison County, Indiana. They serve a population of 13,500 with 5,000-meter connections and sell water wholesale to other smaller water systems in the area. The water system has a Rural Development loan for water system improvements. Their source of water is ground water that is disinfected and metered at the treatment plant and pumped into the distribution system where it is metered at each customer service connection. The water system has approximately 400 miles of water main with over 500 flush and fire hydrants.

Mr. David Popp, General Manager and full-time certified operator for the Ramsey Water System contacted the Alliance of Indiana Rural Water’s Circuit Rider #2, Gordon Meyer. Mr. Popp requested assistance from the Alliance in conducting a water audit on the entire distribution system.

On July 9, 2007 Mr. Meyer traveled to Ramsey and met with Mr. Popp and Mr. Brandon Hawkins, a distribution system operator for the water system. Mr. Meyer explained the concept of conducting the water audit, which consisted of traveling throughout the water system and listening to the hydrants for the sound of water leaks by using the Alliance's sub-surface leak detector. Mr. Meyer and Mr. Hawkins then traveled throughout the distribution system during the next three working days listening to approximately 275 of the hydrants and over half of the distribution system. They were able to locate six areas of water leaks.

The Ramsey Water System is a very well maintained system with very little water loss. Due to a prior commitment, the water audit could not be completed. Mr. Meyer met with Mr. Popp and agreed to return at a later date to finish the water audit. The total time spent on-site during the first part of the audit was 23 hours. Ramsey Water saved approximately $15,000 from the assistance provided, which would have been needed to hire a private firm to conduct the audit. Lost revenue would also be saved from the unaccounted for water loss caused by the water leaks once they are repaired.

### Iowa, Le Grand

On November 8, 2007 Circuit Rider Jennifer Schwoob went to Le Grand, Iowa to visit with full-time certified operator Doug Beadle on his water loss. Le Grand is located in eastern Marshall County in central Iowa. Le Grand has a population of 883 residents with approximately 353 service connections. Doug can be reached at 641-750-7714. Le Grand buys 100 percent of their water from Central Iowa Rural Water Association (CIWA). Le Grand had two wells that had contaminants that were causing a constant problem, so they decided the best thing for them would be to hook up to CIWA.

Since they buy all of their water, Doug keeps a close eye on water loss. Doug has a loss of only about 8 percent in a normal month. In September Doug flushed fire hydrants and he started showing a significant increase in water loss after that. Doug typically pumps about 60,000 gallons per day and he went to 90,000 gallons per day after this. Jennifer and Doug had previously discussed several things he could do to try and find this leak. He was unsuccessful;
therefore, Jennifer arrived to help. After only about an hour Jennifer had found a leak at the local grain elevator. They had a 500-foot service line that was leaking into a drain tile that went under the railroad tracks and out of town. Jennifer saved the city about $2,500.00 in time and lost water that they are buying.

Sam Troyer
Harper RWD 5
1015 Central
Harper, KS 67058

Dear Sam,
It was a pleasure to assist you with the District’s operations while the tank was out of service to repair a leak and inspect the interior of the tank. You had checked the pressure at 4 am and it had fallen below 20 psi so you had no choice but to restart the pumps. The pumps ran and filled the tank to a level to provide 35 psi by 6 am. At that point we had 81 feet of water in the tank. The Idea is to shut the pumps down to allow the water to be used out of the tank just to the critical point, then shut the tank down and restart the pumps to keep the system in pressure. This ensures conservation and the least amount of wasted water.

From our previous work we knew that the tank could be isolated from the system and drained from the hydrant that was plumbed in between the tank and the valve. We opened the hydrant to drain the tank. We calculated the amount of water in the tank at just over 30,000 gallons. We installed a hose and a meter on the hydrant to determine just how much water we were going to lose. At 34,000 gallons on the meter we knew something was wrong. The valve to isolate the tank wasn’t holding and water from the system continued to enter the tank. We worked on the valve and got another half a turn on it. That stopped the flow and we completed the draining process. 36,000 gallons were drained.

After opening the tank and cleaning the bottom we discovered the cause of the leak was due to a pitted weld at the fill tube. The tank company did the welding repairs and painted the repaired area. The tank was disinfected and then the valve was opened to start the refilling process. While in the cleaning phase we found a couple of bird skeletons in the bottom of the tank. This was due to a screen missing on the vent tube allowing birds to enter the tank. The screen was replaced. This as I recall was a problem 10 years ago when I cleaned and inspected the tank then. The coating on the interior of the tank looked pretty good at the bottom. At the top there is some rusting starting to show. There was also a film on the interior of the tank. It is possible this could be from food grade oil used in oil lube vertical turbine pumps that is used by the city since you purchase your water from them. There are still a few of these types of pumps around but most have been replaced with water lube systems. The safety climb cable on the tank ladder was flapping in the wind and rubbing the paint off; it was tied off with nylon ties to prevent this.

We also changed out the master meter at the north pump station. By having a functioning meter here we can better determine how much water is going to this part of the district and keep a close eye on water loss problems.

Sincerely,
Jon Steele
Circuit Rider

Kansas, Crawford - Kansas Rural Water Circuit Rider #2 Bob Kirby provided assistance upon request to Ed Thompson, water operator for Crawford Chicopee Water Corp., 620-231-2115 on December 21, 2007. The assistance concerned high unaccounted for water. This system is located in Crawford County in southeastern Kansas. It serves 190 connections. The operator is part-time and is not certified. The system utilizes continuous disinfection. The water source is
Public Wholesale 11.
The total time to provide this assistance was one and one-half hours off-site and seven and threequarter hours on-site. The potential savings to the system because of this assistance is estimated to be $ 25,550. Kansas Rural Water Association provides follow-up documentation to many of the technical assistance visits. A letter was provided to the system summarizing this assistance; the letter was copied to appropriate state agencies as well as USDA Rural Development. The letter provided to the system read as follows:

December 23, 2007
Ed Thompson
Crawford Chicopee Corp.
212 South Pesavento Ave.
Plattsburg, KS 66762
Dear Ed,
This is in follow up to the recent visit by KRWA concerning the problems with unaccounted for water the system was experiencing. It was a pleasure to meet you and I would like to thank you for the opportunity to assist you with this issue.
On Friday December 21, 2007 we met and performed a water loss survey in and around Chicopee. After some valve work we were able to determine the general area where a significant leak was located. When the area was walked, we found a significant leak in front of the residence at 401 West Crestview Avenue. The leak was located in tall grass and was running under the vegetation into an irrigation pond for the golf course.
This leak was estimated to be running at almost 14 gallons per minute or around 20,000 gallons per day. The system purchases water from Public Wholesale District No. 11 at a cost of $3.50 per thousand gallons. With this repair the system should recognize a monthly savings of $2,100 and an annual cost savings of $25,550.
Please call Kansas Rural Water Association if we can be of further assistance. Also, visit the KRWA website www.krwa.net for news and information concerning water and wastewater utilities, upcoming training opportunities and other KRWA programs.
Sincerely,
Bob Kirby
Technical Assistant

Kentucky, Muhlenburg - The Muhlenburg County Water System is located in Muhlenburg County, Kentucky. Muhlenburg County Water System has 6,040-metered service connections. The community utilizes purchased water from the Centertown Water System. The raw water is metered and disinfected by the producer. Muhlenburg County has chlorination booster systems at the pump stations to improve disinfection controls. The system has a full-time, certified operator.
On July 27, 2007 Jeff Spurlin, certified operator for Muhlenburg County Water, contacted Kentucky RWA Circuit Rider #1, Tim Blanton, for assistance in leak detection. Within the Powderly distribution area, the operations crew and Circuit Rider 1 performed leak survey work. After locating and isolating valves it was determined that the leak was on an eight-inch PVC water line and was leaking at a rate of 56 gallons per minute. It was reported by a homeowner that this leak had appeared 18 months earlier.
The effects of a leak of this nature on a water system adds up to 80,000 gallons per day, and a loss in revenue of $96.00 per day, or $2,880.00 per month, and $34,560 per year. To more efficiently find and repair water leaks like this Circuit Rider 1 has assisted the system in designing an ongoing leak detection program. With ongoing efforts water losses of this severity...
can be identified and corrected in a timelier manner. Circuit Rider 1 spent five hours and fortyfive minutes on this leak discovery, saving the water system $34,560 per year.

Kentucky, New Haven - Jeff Lee, the #3 Kentucky RWA Circuit Rider, responded to a request from Tim Bartley, the certified full-time water distribution superintendent for the City of New Haven (502-549-1002). The request for assistance was help with leak detection. Jeff arrived on July 30, 2007 at the city's distribution water system. New Haven buys their water wholesale from the City of Bardstown. Bardstown has an Actiflo water treatment plant. The plant is metered at the raw water inlet line. The plant has gas chlorination as its full-time disinfection. New Haven's distribution system has 680 water connections that are metered. New Haven also has other full-time operators. The total on-site time was five hours at the Nelson County system. Jeff helped the system locate some service line leaks, which added up to 30 gallons per minute. A one-time savings up to $90 dollars a day was realized by the system. The total on-site savings were $2,700 a month.

Maryland, Greensboro - Maryland Circuit Rider #1, Charlie Bowman, was requested to provide technical assistance by Town Manager, Dave Kibbler for the Town of Greensboro, Maryland (Caroline County). The town was losing approximately a million gallons of unaccounted for water per quarter. Upon arrival on February 12, 2007, the Circuit Rider started a survey on the town’s distribution system using correlation equipment. Working with town employees with knowledge of the system, we were able to complete only 8,000 feet of water main finding over 30 leaks. This was enough to alert the town of major problems with failing water mains. At this point the Circuit Rider met again with Town Manager Kibbler to report his findings and to help with a course of action. Greensboro serves about 850-metered customers and has full-time treatment with disinfection and certified operations for their well system. Just identifying leaks will save the town about $3,000.00 but will also save much more in time and loss of water.

Missouri, Breckinridge - On May 22, 2007 Missouri Rural Water Association Circuit Rider, Joe Anstine, made a requested visit to the City of Breckinridge, Missouri. The City of Breckinridge is located in Caldwell County and has 201 system connections. This system has a surface water treatment plant that can produce 90 gallons per minute. The city utilizes chlorine as its full-time source of disinfection. The city may be contacted at (660) 644-5614. This number is to the water plant as the city does not employ a full-time person to open City Hall on a daily basis. Mrs. Linda Bills, a Missouri State Certified Operator, and employed full-time, made contact with Missouri Rural Water Association Circuit Rider Anstine about concerns of high water loss within the system. Mr. Anstine used Missouri Rural Water Association's X-Mic leak detection equipment to do a leak survey of the system. Mr. Anstine found three fire hydrants leaking and two service taps that were leaking. Mrs. Bills stated that the city would replace the fire hydrants and repair the service taps. On August 18, 2007 Mrs. Bills contacted Mr. Anstine about the City of Breckinridge being unable to produce enough water to consistently keep the pressure above 30 psi in the system and believed the city was experiencing a leak to cause this problem. Mr. Anstine asked Mrs. Bills if the district they serve water to had recently had any leaks causing the city to lose pressure. Mrs. Bills stated that she would check and get back with Mr. Anstine. On August 20th Mrs. Bills called and asked Mr. Anstine to come to the City of Breckinridge and
provide assistance with finding a leak. Mrs. Bills stated that the leak was getting so bad that all
pressure had been lost several times over the weekend and the system had been placed on a boil
order by the Missouri Department of Natural Resources.
On August 21st Mr. Anstine arrived on-site at the City of Breckinridge. Mr. Anstine assisted by
the city water treatment plant operator, Perry Addison, started listening to all fire hydrants and
meters in the system. Mr. Anstine found two fire hydrants and one service line leaking. The city
contracted with a local contractor to do the emergency repairs to the system. During the repairs
of the leaks, Mrs. Bills stated that the leaks that had been found and repaired in May of 2007 had
reduced the production of water by 17,500 gallons per day.
On August 22nd Mr. Anstine returned to finish listening to the system and to see if the repairs
from the previous day had helped in the loss of water and pressure in the system.
Mr. Anstine contacted Mrs. Bills on August 24th to see if the water usage had dropped off since
the repairs that had been made on the 21st. Mrs. Bills stated that the production rate at the plant
had returned to normal and the system had regained pressure and was in the process of doing
bacteriological samples so the system could be taken off the boil order list with the Missouri
Department of Natural Resources.
The savings to this system in May of 2007 was an average of the 17,500 gallons of water per day
at a cost of $3.50 per 1,000 gallons which saved the city approximately $1,837.50 per month in
production cost. The savings to the system on the August leaks will save the city an average of
28,800 gallons of water per day at the cost of $3.50 per 1,000 gallons, which will save the City
approximately $3,024.00 per month in production cost. Theses contacts lasted 18 hours in total.

Missouri, Stewartsville - Sam Clary, Certified Water Operator and Water Superintendent with
the City of Stewartsville, contacted Missouri Rural Water Association Circuit Rider, Jim Balmer,
requesting assistance with a Hydrant Flushing Plan. The Circuit Rider contacted Sam at City
Hall, 816-669-3278, and scheduled a meeting.
The Circuit Rider was on-site May 17, 2007 at 2:00 p.m. to meet with Sam Clary and to review
the city's distribution map. The Circuit Rider gave an overview of the flushing plan noting that
gallons per minute and distribution line pressure could be recorded using equipment provided by
Missouri Rural Water Association. Discussion was had regarding needed personnel and
scheduling was accomplished. The Circuit Rider was off-site at 3:15 p.m. for a total of one and
one-quarter hours.
Stewartville, located in DeKalb County, Missouri, purchases its water from a metered,
disinfection, surface water supply and has 350-metered connections.
Circuit Rider Jim Balmer was on-site at 8:30 a.m., June 20, 2007 meeting with Sam Clary and
his assistants. The Circuit Rider reviewed with the personnel that day pressure and flow
measurements along with the hydrant condition that would be documented. Two of the thirty
hydrants tested could not be opened; the location was recorded and servicing by the city was
planned. With a hydrant flushing and maintenance program in place along with pressure checks
on distribution lines, water quality and integrity of the city's water will be accomplished.
The Circuit Rider was off-site at 5:15 p.m. for a total of eight and one-quarter hours. The value
of this service provided by the Missouri Rural Water Association to the City of Stewartsville is
$820.00 with the possibility as high as $1,070.00.

Montana, Manhattan - The Town of Manhattan, Montana (406-284-3235) is located in Gallatin
County and serves 475 connections that are not metered. The town's water system has a ground
water supply with three wells that are not metered or chlorinated at this time. The town has three
full-time certified water operators. The town clerk, Vicky Ellison, called the Montana Rural
Water Circuit Rider, Harry Whalen, and requested assistance in establishing a new-metered

water rate for their water system. The Circuit Rider traveled to the Town of Manhattan on April 5, 2007 and met with the town's Mayor, Tony Haag; Clerk, Vicky Ellison; and the town's Public Works Director, Stewart Cooper, for three hours to discuss the installation of water meters in the town and setting a new metered water rate.

The meeting was continued until April 19, 2007 at which time the Circuit Rider met for over six hours with the Mayor, Clerk, Public Works Director and continued into the evening with the Town Council. During the evening part of the meeting the Circuit Rider was asked to assist the town with the public hearing on the new water rates, which will be held in late May of 2007. The cost savings to the town is approximately $5,000, had outside engineer services been used.

**Nevada, Stagecoach** - On October 16, 2007 Circuit Rider 2, John Allred of the Nevada Rural Water Association, made a follow-up visit at Stagecoach General Improvement District regarding a request for assistance to develop and write a water conservation plan for the district. This request came on October 10, 2007 from Mr. Marlon Cook. Mr. Cook is the system's manager and may be reached at (775) 721-4709. Using a template developed by Nevada Rural Water and adapting it to the Stagecoach GID, Mr. Allred assisted Mr. Cook in the completion of a draft, which will be presented to the Stagecoach GID Board for approval.

Stagecoach is located in Lyon County on Highway 50. The GID has 412 connections, which are metered. The water system has two ground water wells, which are also metered. Both wells use sodium hypochlorite for full-time disinfection. Marlon Cook is a certified operator. Joe Seng is a new operator for the GID who is also a certified operator. The phone number for Stagecoach General Improvement District is: (775) 629-0849. On-site time spent on this visit was four and one-half hours. Savings to the GID in terms of consultation and engineering fees would be about $400.

**Hew Hampshire, Rollingsford** - On September 18, 2007 Granite State Rural Water Circuit Rider Jay Matuszewski responded to a request for assistance from Jack Hladick the full-time Certified Operator for the Rollingsford Water Department. Rollingsford is located in Strafford County and serves 450-metered connections with a metered ground water supply that has fulltime disinfection. Rollingsford is having some issues with its current supply in that near the end of the pump runs the water turns milky white; this could be caused by numerous different things. The operator also mentioned that the water chemistry also changes at the end of the pump runs. After reviewing the water analysis and other recorded data the Circuit Rider decided to conduct well draw down tests with the operator. The Circuit Rider spent five and one-quarter hours with this system conducting the tests and reviewing data. After the conclusion of the drawdown test it appears that the wells are being over pumped if they run five hours or more at a constant rate. The Circuit Rider recommended to the Operator that he change the timing of the pump runs to two hours on and two hours off. By doing this simple change the wells would have time to recover in between pump runs and not be at risk of pulling in air causing the milky water. It could also eliminate the problem of the water chemistry change by keeping a stable pumping level. The initial savings to the system is about $5,000.00 in consulting fees; if the recommendations work there is potential savings of over $300,000 in the cost of a new source. The Circuit Rider will do a follow-up visit with the Operator to check on the results of these suggestions. The Operator can be reached at 1-603-742-8124.

**New Jersey, Brooklawn** - On Monday, April 30, 2007 Dave Barclow, Head of Public Works for
Brooklawn, New Jersey, contacted Eric Denslow, Circuit Rider #1 for New Jersey Water Association, about getting some help with leak detection. He had recently found a leak in the water system that was flowing into a nearby storm drain but could not figure out exactly where the leak was coming from.

Brooklawn, New Jersey is located in Camden County. Brooklawn was incorporated as a borough on March 11, 1924 from portions of the now-defunct Centre Township, based on the results of a referendum held on April 5, 1924. The borough was reincorporated on March 23, 1926. As of the United States 2000 Census, the borough population was 2,354, with 900 water connections. It is a ground water system that is fully metered with a part-time certified operator. On Tuesday May 1, 2007 Eric met with Dave to assist in finding the location of the leak. Using the Ground Penetrating Radar, to locate the water main, and the LD-10 Subsurface Leak Detector Eric was able to find the leak so Dave and his crew could dig it up and repair it.

In conclusion Dave was very appreciative of the services provided by Eric Denslow and the New Jersey Water Association. By utilizing this free service Brooklawn was able to save roughly $1,500 in the cost of the leak and the cost of paying an outside contractor to come in and assist in finding the leak. Dave Barclow can be contacted at 856-456-0750.

New Mexico, Lumberton - The small community of Lumberton is located in Rio Arriba County in northern New Mexico. Lumberton Mutual Domestic Water Association has 54 connections and is all metered. They have full-time disinfection. The water for Lumberton comes from a river and the plant is metered. Mike Vantage is the certified water operator.

On May 29, 2007 the President of the water association called Lupe Aragon, Circuit Rider for New Mexico Rural Water Association, as Lumberton was out of water. Lupe arrived at the association on the same day and started working with Joey Valdez, one of the board members. The men worked up to 8:00 p.m. that night trying to get water in the tank.

On May 30th when there was 10 feet of water in the tank the men started doing leak detection but could not find the leak. On the 31st of May the men pressurized the system and found the leak. They worked on the leak and had it repaired about 7:00 p.m. The next day the Association's customers all had water.

On this contact the Community saved approximately $10,000.00. The contact phone number is 505-220-5429.

Ohio, Wakeman - On February 6, 2007, Trisha Summers contacted H. Jay Koralewski, Circuit Rider 1 (CR1) with Ohio Rural Water Association (ORWA), seeking assistance in locating a large water leak in their water system. Ms. Summers is the billing clerk for the Village of Wakeman, which is located in Huron County in northern Ohio. The population of Wakeman is approximately 950 people with 375 water service connections. The phone number for the village is 440-839-2622. The source of water for the Village of Wakeman is purchased surface water from a neighboring water system. The supplying water system utilizes continuous disinfection with chlorine and the Village of Wakeman does not add any additional chlorine in its system. The purchased water is metered through a master meter and all of the village's consumers are also metered.

When the master meter was recently read, it was noted that the usage for the village had increased by approximately 45 - 50%, from an average usage of 80,000 gallons per day up to about 150,000 gallons per day. After trying to locate a water leak over several days, the village decided to contact ORWA for assistance.

On February 8, 2007, the CR1 visited with Mr. John Fowler of the Village of Wakeman. Mr. Fowler is the full-time operator of the water distribution system and is not currently certified. A technical consultant is utilized as the person in responsible charge of the water system. Mr.
Fowler is the only full-time employee in the village's utility department. The CR1 and Mr. Fowler inspected some areas where it was likely that a leak may be and had discovered a storm sewer line running at a greater than anticipated flow rate. The water tested and appeared to be treated water, so the area was inspected in greater detail. Using ORWA's leak locating device, it was determined that the leak was in the street at an intersection. A contractor was called in and began digging, but due to deteriorating weather conditions and it being late in the day, the contractor came back the following morning and fixed the leak.

The CR1 spent approximately six and one-half hours on-site with Mr. Fowler in locating the leak and assisting with the initial leak repairs. By discovering this leak, the Village of Wakeman was able to realize a savings of approximately $165.00 per day or $5,000.00 per month for each day or month that the leak was not located and repaired. Mr. Fowler and the Village of Wakeman were grateful for the assistance of Ohio Rural Water Association in performing the leak detection services.

Ohio, New Vienna - This contact took place in the State of Ohio, in the County of Clinton for the Village of New Vienna on Wednesday, September 5, 2007 with a follow-up visit on September 6th to check everything out. The contact lasted a total of 10.5 hours for the two days. New Vienna has 550-metered connections. Their water sources are wells that are metered, but they can only produce half the water the town needs. They have another metered connection to Highland County Water who supplies the rest. They have a part-time contracted worker who is working to get certified and several of the board members help with the system. New Vienna does have full-time disinfection. Steve Valentine, several board members, and the Representative Congressman contact Ohio Rural Water about a very large water loss that the town was having. Aaron Reinhart, Ohio RWA CR2, and Jay Koralewski, Ohio RWA CR1, went to the town to provide assistance to the system. The system was using approximately 300,000 gallons a day, when the average usage was around 130,000 gallons a day. The weekend before Aaron and Jay showed up they had found three leaks on their own and had gotten them fixed. New Vienna had gotten their water usage back down to 150,000 gallons a day. Aaron and Jay decided that they would just check a few of the problem areas around town. They ended up finding three more leaks. One very small one, a larger one, and finally a very big one that they estimated was losing around 50,000 gallons a day. New Vienna fixed the very large one and was working on getting the other two fixed last time Aaron talked to them. The system’s water usage had dropped to an all time low and the system pressure was at an all time high. Aaron and Jay plan on going back to New Vienna in October and finish looking for leaks on the rest of the system. Total cost savings to the system for the leak detection would be around $1,500.00 and cost savings for the lost water would range around $650.00 a day not including electric and wear and tear on the equipment; therefore, the total cost savings for the month would be approximately $21,000.

Oklahoma, Minco - Richard DeShazo, Circuit Rider #1 for the Oklahoma Rural Water Association, responded to a request from the Mayor of Minco, Oklahoma on July 19, 2007, Mrs. Kelly Rupp, for technical assistance. The membranes in the R.O. treatment plant had scaled over shutting the treatment plant down. The town was forced to replace the membranes at a cost of $58,000.00. Mayor Rupp wanted Mr. DeShazo to work with the plant operator, Tim Anderson, to help determine the possible cause of the plant failure.

On July 24th, Mr. DeShazo and Mr. Anderson, along with Jon Blickenstaff from Sequoyah Engineering, checked the KDF filters and found them to be in good condition. The clear well was the next point of inspection; a considerable amount of sediment was detected in the clear well. Mr. DeShazo and Mr. Anderson drained the clear well and found around eight-inches of
sediment in the sump. This sediment was being picked up by the pumps and pumped into the pre-filters on the R.O. unit fouling the pre-filters every 24 hours at a cost of $240.00 a day. All parties involved felt that the excessive sediment would have caused the scaling of the membranes.

Minco is in Grady County and has 659 meters. Their water source is well water and they use chlorine gas for disinfection. Savings to the system was $240.00 per day and potentially $58,000.00 for another set of membrane filters. Contact phone number is (405) 352-4274.

**Pennsylvania, Claysville** - Glenn Cowles, Circuit Rider 1 from Pennsylvania Rural Water, was contacted by Jay Hickman, the Water Superintendent and certified, full-time water operator, from the Claysville Donegal Joint Municipal Authority in Claysville, Pennsylvania located in Washington County (724-663-7770), (Public Water System ID #5630040) because of a high unaccounted for water loss that they were unable to locate. The water system was producing the maximum amount of water the filtration plant was capable of and not able to keep their storage tank full. Claysville Donegal has 594 water connections, serving a population of 1,600 people, where both the source and users are metered with full-time disinfection. Their water system is classified as a surface water source obtaining it from the School Street Reservoir in the borough and providing filtration at their School Street Water Plant.

Glenn spent a total of 14 hours on-site on May 15, 16, and 17, 2007 helping Jay locate a leak using a meter at the water filtration plant, a listening device and correlator. This leak was found on a three-inch cast iron line serving a Pennsylvania Highway Welcome Center on Interstate 70. It was leaking an estimated 86,400 gallons per day. Total savings to the system was estimated to be $126,144.00 annually based on a $4.00 per thousand-gallon purchase price.

**Pennsylvania, Tunkhannock** - Tunkhannock Boro Municipal Authority is located in Wyoming County, Pennsylvania along the Susquehanna River and Route 6. Tunkhannock has a metered ground water source with full-time disinfection as well as 976-metered customers.

On January 30, 2007 Rural Water Association Circuit Rider, Chris Shutt, met with the general manager and certified operator, Rodger Hadzel, and his full-time certified operators. This meeting was for the purpose of leak detection assistance. It was found that the system was losing 100,000 gallons of treated water a day, above and beyond the normal usage of the system.

Rodger and his crew were able to isolate the leak area by shutting down different main line valves in the system. They had it confined to a four-block area but couldn't pinpoint the leak. Chris was asked to assist and using Pennsylvania Rural Water Association equipment the leak was found and pinpointed so it could be repaired.

The length of this visit was four hours. The savings to the system was approximately $109,500.00 in lost revenue, treatment, and contractor's fees along with possible upgrade to the plant and storage facilities to accommodate the extra production. This is a cost of $3.00 per thousand gallons per year. Rodger Hadzel can be reached at 570-836-3493.

**Rhode Island, Pascoag** - On Wednesday, November 29, 2006, Atlantic States Rural Water Circuit Rider, Mike Romano, was contacted by Mike Lima, Superintendent of the Pascoag Fire District (401-255-7714) for technical assistance. The fire district is located in Pascoag, Rhode Island, a village in the Town of Burrillville that is located in the northwest corner of the state.

Mr. Lima requested the assistance of Atlantic States Rural Water in conducting a leak survey of the fire district’s distribution system.

Due to a major MTBE contamination of the fire district's water supply five years ago, the district now purchases water from the neighboring Town of Harrisville. Purchasing water has led to a greater desire to conserve water and reduce unaccounted for water loss. Also, the Rhode Island
Department of Health encourages systems to conduct yearly leak surveys.

Circuit Rider Romano worked with the Pascoag Fire District a total of 74.75 hours over a threemonth period. In that time Mr. Lima and Circuit Rider Romano were able to complete a leak survey of the fire district's entire distribution system, which identified three leaks. They then pinpointed and repaired the leaks. Surveying and pinpointing were conducted using specialized equipment provided by Atlantic States Rural Water consisting of a Z-Corr Digital Leak Correlator, a Metrotech HL-400 Amplifying Ground Mic, 16 Flow Metrix Uni-Loggers and a Metrotech 810 Line Locator. Using the Atlantic States Rural Water equipment a savings to the Pascoag Fire District was estimated at $6,000.00 on services and labor costs.

**Texas, Natalia** - At approximately 8:45 a.m. on July 30, 2007 Mr. Delbert Hoover, Circuit Rider (CR) with the Texas Rural Water Association, made a requested contact visit to the City of Natalia and met with the Water Superintendent, Joe Arrellano. City of Natalia is located in Medina County, Texas, (830-663-9929) and is a metered and full-time disinfected ground water treatment system that serves 586-metered customers.

On the date of the contact visit, the City employed a Certified Operator, which is their full-time operator. Mr. Arrellano advised Mr. Hoover of his concern with the high water loss totals at month's end. Mr. Hoover discussed various reasons for the loss, which may not have been included in or accounted for in the totals, such as flushing, Fire Department usage, and water leaks. Mr. Arrellano was unaware that the water loss during leaks should be estimated to the best of his ability.

Following a tour of the system, Mr. Arrellano advised Mr. Hoover that flushing of water lines was also not included in the water loss totals. Upon inspection of a check valve at the wellhead, Mr. Hoover discovered that it was leaking back into the well, which would account for additional water loss. Mr. Hoover explained to Mr. Arrellano that while the well is pumping water, the water is being metered, but when the well is off the metered water is leaking back into the well. Mr. Hoover further explained the importance of a meter change-out program and suggested that the master meter be calibrated.

Mr. Hoover left City of Natalia at approximately 12:15 p.m. after educating Mr. Arrellano on various reasons for monthly water loss totals. This three hour and thirty minute contact visit potentially saved the city thousands of dollars in consultant fees.

**Texas, Nigton-Wakefield** - At 9:00 a.m., on Friday, April 13, 2007 Mr. William White a Circuit Rider with the Texas Rural Water Association made a USDA RD requested contact with Mr. Kenneth Spencer. Mr. Kenneth Spencer is the Vice President of Nigton-Wakefield Water Supply Corporation (WSC) located in Trinity County, Texas, phone number (936) 674-7546. Nigton-Wakefield WSC employs a part-time licensed operator. Nigton-Wakefield WSC has a 178-connection ground water system, which is completely metered and provides continuous disinfection.

Prior to meeting with Nigton-Wakefield WSC, Mr. White met with Mr. Ronnie Lawrence with the USDA RD office in Huntsville, Texas on Wednesday, April 11, 2007 at 3:00 P.M. Mr. Lawrence informed Mr. White that Nigton-Wakefield WSC was a new system, which began operation in 2006 and was already delinquent on their debt payments to USDA RD and needed help on calculating rates and fees. Mr. Lawrence advised Nigton-Wakefield WSC also needed help in board responsibilities and board operation.

Mr. Spencer the Vice President of Nigton-Wakefield WSC informed Mr. White during the two hour and forty-five minute contact that Nigton-Wakefield WSC needed assistance with calculating rates, policies and procedures and anything else Mr. White thought they might need. Mr. White explained the Circuit Rider Program to Mr. Spencer. Mr. White provided Mr.
Spencer with a handout on properly calculating rates. Mr. White also instructed Mr. Spencer on calculating rates and fees. Mr. White discovered the system engineer calculated the original rates for Nigton-Wakefield WSC with 2,000 gallons included in the base rate. With no previous usage data the engineer had based the rates on a median usage per connection of 4,000 to 6,000 gallons per month. In March 2007 Nigton-Wakefield WSC had only one connection use more than 2,000 gallons of water. Mr. White explained that Nigton-Wakefield WSC would either have to double the usage of their customers, which would not happen, or calculate their rates using the current usage data in order to be solvent.

Mr. White explained the Open Meetings Act and Public Information Act requirements and advised how Nigton-Wakefield WSC could obtain copies of manuals and videos from the Attorney General's office to be in compliance with state law. Mr. White provided a copy of the TRWA sample Annual Meetings Procedures and explained the process of conducting an annual meeting. He also explained the functions of by-laws and the system tariff. Mr. Spencer's questions were answered and he was offered any further assistance that might be needed in the future.

Mr. White secured from Nigton-Wakefield WSC at 11:45 a.m., April 13th having given Nigton-Wakefield WSC the ability to become financially solvent and conduct business in compliance with state laws. Mr. White possibly saved Nigton-Wakefield WSC thousands of dollars in legal fees and fines.

**Vermont, Jeffersonville** - On December 6, 2007 Vermont Rural Water Circuit Rider Brent Desranleau answered a call for assistance from Rich MacKay, who is the full-time certified operator for the Village of Jeffersonville, Vermont. The water system is located in Lamoille County and services 185 residential and some light commercial accounts. Jeffersonville's source is from several springs that feed two storage tanks. The system has full-time disinfection and a master meter. Jeffersonville had lost over 150,000 gallons of water over two days, and was unable to locate the problem.

When Desranleau arrived, he and the operator reviewed all of the system mapping and hydraulic information to try and determine the elevation of the possible leak in the system. Once this was completed a site visit to the altitude valve pit and other PRV vaults were then checked as well; this concluded the work on the 6th of December.

On the 10th of December, Desranleau returned to resume looking for the leak, and over the course of the weekend, water was hauled in to keep the high zone under pressure. Leaks on the delivery side of storage were located in a remote location of the system, which appeared to have been leaking for some time. As the search proceeded, Desranleau located a large leak on a fourinch cast iron line that was running down into a wooded area of the system, which was not visible from the road. This leak was repaired the next day, and the storage tank resumed filling. Desranleau spent a total of 13.75 hours on-site with the system, and as a result of his site visit, the Jeffersonville Water Department had a one-time savings of $7,000.00 that would have been spent in water hauling cost, chemical treatment and subcontracting time to excavate for leaks.

**Virginia, Goshen** - On June 15, 2007, Virginia Rural Water Association Circuit Rider 1, Kenny Reynolds, traveled to the Town of Goshen for leak detection in their distribution system. The Town of Goshen is located in the Shenandoah Valley in the foothills of the Alleghany Mountains. The Town of Goshen is located approximately 15 miles northwest of historic Lexington in Rockbridge County. The Town of Goshen, incorporated in 1883/84, has a land area of 1.7 square miles and a population of 400 residents. Circuit Rider Kenny Reynolds received a call on June 14, 2007 from William White that the Town of Goshen had a water leak that they had not been able to locate and it was draining their water storage tanks. Hours later
the Circuit Rider was notified that they had located the leak, but would like for him to come up on the 15th to check over their system.

On June 15, 2007, Circuit Rider Kenny Reynolds met with William White and Jake Worley, (540-997-5545), part-time water and distribution employees for the Town of Goshen. Mr. William White, a Virginia Water Works Operator Class IV, stated that after repairing the water leak on their six-inch main they have been unable to fill their storage tanks and most of their citizens are out of water. The spring water supply is metered and continuous disinfection with bleach is provided at the well house. The 250 residential and commercial customers are not metered.

Circuit Rider Kenny Reynolds and Town of Goshen staff began leak detection in their distribution system. The Circuit Rider used sensitive listening devices and correlating equipment to locate possible water leaks. The Circuit Rider experienced difficulty in listening for possible water leaks due to lack of water or water pressure in the distribution system piping. The Circuit Rider over the next several days began shutting off all water connections and isolating areas of the distribution system for individual leak detection. Due to water being shut off arrangements were made for bottled drinking water and tankers of water for flushing and bathing for the Town’s citizens to be brought in. The State of Virginia Health Department/Office of Drinking Water Programs placed the Town of Goshen on a boil water advisory.

On June 18, 2007, Virginia Rural Water Association Circuit Rider 2, Mark Norris, arrived on scene to assist with leak detection. Over the next several days numerous water leaks were located and repaired by work crews from neighboring communities. On June 20, 2007, State of Virginia Governor Tim Kaine designated a State of Emergency for the Town of Goshen. This makes resources and personnel from the state and other sources more readily available. These resources included Rockbridge County and State of Virginia Office of Emergency Management personnel and equipment, the American Red Cross, and personnel and equipment from the Virginia National Guard.

On June 24, 2007 water was restored to all residents of the Town of Goshen. The various funding agencies are working with the Town of Goshen’s local government officials for possible loans or grants available for a much-needed distribution pipe system upgrade.

Circuit Rider 1 was on-site for a total of 166 hours performing leak detection, water line location, or assisting town crews with valve operation, and technical assistance. Circuit Rider 2 was onsite for numerous hours also performing leak detection, and as a coordinator working at the Office of Emergency Management’s Command Post, locating needed supplies and equipment. It is estimated leak detection costs run approximately $800.00 to $1,500.00 per day, and line location is approximately $1,000.00 per day for a private contractor. The Town of Goshen incurred no charges for the services of the VRWA Circuit Riders. Conservatively, The Town of Goshen saved $20,000.00 in leak detection and line location, and technical assistance fees from Circuit Rider 1 alone. During the ten days that Circuit Rider 1 was on-site, a total of 14 major leaks were located and repaired. Also, numerous small service leaks were located and are continuing to be repaired. Presently, the Town of Goshen is pumping approximately 150,000 gallons of water at the spring pump house, which is down from their normal use of 300,000 gallons per day. Additional savings will come in the form of water production costs: such as electrical for extra hours pumping, wear and tear on the pumps, and extra water treatment chemical expenses. Most importantly, the Citizens of the Town of Goshen have their water supply back up and running, the boil water advisory has been lifted by the Virginia Department of Health, and life in Goshen is back closer to normal.
member of the Coronet Bay Heights Water Association Inc., contacted Bob Kreb, Evergreen RWOW Circuit Rider #3, for assistance in locating a distribution line and a leak in the system. This is a private non-profit system of 46 connections located on the north end of Whidbey Island near the City of Oak Harbor in Island County, Washington. After a short conversation, it was apparent that Mr. Jorgensen would need field assistance so an appointment was made for Bob to visit the system.

Upon arrival at Coronet Bay Heights Water Association, Bob met with Mr. Jorgenson and the system operator. Bob was informed that the system was using about 2,000 gallons of water per day more than usual. The system is metered at the source and at 60% of the service connections. Mr. Jorgensen and Bob began a systemic search for the leaking line. Using the service connections that could be located in the system they began to walk one of the main distribution lines using a leak detector along the way. As they walked one section of distribution line, it became evident there was a leak. A leak was estimated to be on a two-inch distribution line running under the street. The line was dug up and a leak was found five feet off the center of the street. Bob discussed the different ways to look for possible leaks. The Coronet Bay Heights Water Association is not using disinfection at this time. They are currently metered at the source and are working on meter installation to residents.

Bob was at the system a bit more than three hours on two separate occasions discussing the system, the possible repairs, and recommending improvements such as installing meters at service connections. The timely response and leak detection efforts of Evergreen Rural Water Association resulted in an estimated savings to the system of potentially $1,500 per day, the typical cost of a professional leak detection company to respond. The efforts of Evergreen Rural Water of Washington saved this system an estimated $25,000 in intangible costs (electrical, equipment wear and tear, and equipment costs) this money can better be used to accomplish the needed repairs to Coronet Bay Heights Water Association.

West Virginia, Kingwood - On Thursday, April 26, 2007 West Virginia RWA Circuit Rider 1, Rick Dennison, received a request for assistance from Eric Degler the distribution operator from Kingwood Waterworks, 304-329-1241. Rick was not busy that afternoon so arrangements were made to meet and investigate the problem. Kingwood is the county seat of Preston County, West Virginia in north central West Virginia bordering on both Maryland and Pennsylvania. It is a small town of about 3,000 people with average unemployment and middle income. The water treatment plant is a conventional surface water plant using pre and post chlorination, rapid sand filtration and both raw and finished water meters. Robert McVickers is the chief operator and they have a total of two Class III operators and one Class II operator on staff. They have approximately 1,300-metered customers and they also wholesale water to one Public Service District with close to 900 customers.

Rick met with Eric around 1:00 p.m. that day. The leak was unusual in that the water was getting into some electrical conduit and flowing to a major panel box where it exited the box to disappear underground again. They investigated without being able to make any conclusions due to noise interference and having a car wash and a laundry mat on the two-inch line that was suspected of causing problems with turning the line on and off to listen. Since Rick was staying in Kingwood they agreed to meet that night so they would be able to shut off the line without interfering with the customers and avoid the noise problem. Within 30 minutes they were able to get a location on the leak and then checked a different location while they were working that night. The leak was estimated at close to 30 GPM and was causing great concern since it was flowing from the electrical panel box. The estimated cost of the leak was over $2,500.00 per month and Rick was on-site for a total of four hours.

West Virginia, Adrian - On Thursday, May 17, 2007 West Virginia RWA Circuit Rider #2, Jack McIntosh, received a request from Nina Monroe, Office Manager of Adrian PSD (304-924-6107), to provide technical assistance involving leak detection which had just occurred earlier that day.

Jack arrived within the hour to meet with the maintenance men to determine the location of the leak. He reviewed technical data from tanks and the booster station to determine the area of the leak. Following this review Jack provided the necessary technical assistance to pinpoint the 400-gallon per minute leak for repair.

The Adrian PSD is located in the central portion of West Virginia in Upshur County, home of the Sago Mine disaster. It is made up of 1,100-metered customers, full-time disinfection, and one certified operator. They purchase their water for resale from the City of Buckhannon. Upshur County has an unemployment rate of 4.4% and has had a population change of 1.2% last year. A mean travel time for people traveling to work is 26.4 minutes and the median household income is $34,624.00.

During this on-site visit of two and one-half hours, Jack saved Adrian PSD $18,489.00 per month in lost water with the leak of 17.28 million gallons per month.

West Virginia, Logan County - On April 16, 2007, Circuit Rider William Miller from West Virginia Rural Water received a request for technical assistance involving leak detection from Don Morgan, field superintendent, Logan County PSD (304-946-2641). Logan County was under a state of emergency due to major flooding throughout the county. Logan County PSD had several hundred feet of line washed away as well as several creek crossings wash out. William was able to locate several river-crossing washouts in the Logan County PSD distribution system. The loss of water was costing Logan County Public Service District many man-hours as well as lost revenue due to lost water service.

Logan County PSD is located in the small coal mining community of Monaville, which is in the southwestern section of West Virginia. Logan County PSD has 5,500-metered customers, five certified water operators, and provides full-time disinfection at their surface water treatment plant. Their source water for treatment is the Guyandotte River. According to the 2000 Census, Logan County has a population of 36,502 residents. The mean travel time to work is 30.2 minutes. The median household income is $24,603.

During this on-site visit of six and one-half hours, William was able to save Logan County PSD $20,000 per week due to major water loss and lost man hours.
SMALL SYSTEM ELECTRIC POWER USE

OPPORTUNITIES FOR SAVINGS

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May 8, 2008
Executive Summary

Operation of water and wastewater systems is normally a power intensive process, frequently requiring large electric motors for pumping, mixing, and other elements of the treatment and distribution functions. In this era of rapidly increasing energy costs, minimizing this power consumption assumes significant importance both in terms of energy conservation and monetary savings. This paper describes the typical rate structures utilized by United States electric utilities and how these rate structures can most effectively be utilized by water utilities, especially small ones, to minimize their electric costs and thereby save money and energy.

In the US, billing commercial (as opposed to residential) customers for electric power use is normally a two-component procedure. First, the customer is charged for demand which is a measure of the generating, transformer and line capacity needed to be sure that customer has adequate power for his maximum needs at any time. The second element of the power charge is frequently referred to as the energy charge and is the amount of time electricity is consumed at the established demand. Demand is measured in kilowatts (kW) for small to medium amounts and energy in kilowatt-hours (kWh).

The procedures for utilizing these measured kW and kWh amounts to develop power charges can range from simple to highly complex and are normally referred to as rate structures, rate schedules, or tariffs. Regardless of their complexity, these billing schemes frequently have some common characteristics that include:

✔️ Power suppliers don’t like to develop more generating, transforming and transmission capacity than is required to meet customer needs and rates often reflect this with penalties for excess demands developed, especially in high demand periods like summer months. These penalties commonly take the form of ratchet clauses that will be explained further later in the paper.

✔️ It is to the advantage of the supplier to keep it’s power capacity utilized as fully as possible and rates often reflect this with price breaks for usage during so called off-peak hours (normally nighttime and weekend hours). These off-peak rates can be used to great advantage by customers when applicable and can apply to both demand and energy charges.

✔️ Similar to on-peak/off-peak considerations, it is more cost effective and efficient for power devices (motors) to be kept loaded (operating) rather than sitting idle, and rates often encourage this with price breaks for higher kilowatt-hour usage. The point at which this price break occurs is commonly controlled by the demand, so demand control can have a compound effect.

✔️ Demand costs are usually a few dollars per kW whereas energy costs are normally a few cents per kWh.
A survey of typical rate structures in the US showed that:
✓ Demand charges averaged about $7.50/kW with a wide range from less than $1.00/kW to nearly $20.00/kW
✓ Energy charges averaged 4.66 cents per kWh but again with a wide range from about a quarter of a cent to nearly 12 cents per kWh
✓ About half the rates had a demand ratchet clause. Ratchet refers to a provision whereby a customer is never charged less than some percent of the maximum demand established during a previous time period—frequently the past year or the past summer months. This can be a severe and controlling penalty if, for example, a water utility uses an extra pump during a high water demand, but never or seldom uses it again. This ratchet demand can control the entire year’s charges.
✓ About half the rates had a price break for energy use at the higher amounts. The point at which this occurred was controlled by demand in half the rates that had such a provision. The average price reduction for this break was about 1 cent per kWh. Although this may not sound like much, it can generate substantial savings because kWh consumptions are usually in the thousands
✓ Seven of the utilities checked had special water and/or sewer rates available.
✓ Although it wasn’t tabulated, a majority of the utilities have special time-of-day rates available that provide significant price reductions when customers can operate in off-peak hours. These reductions can be in either kW charges or kWh charges or both.

Typical Savings Situations

A number of typical situations are presented that demonstrate how these rate structures can be utilized to save significant money in systems without expenditure of funds for equipment or technical services. A pilot study in New York to validate the suggestions made produced significant results. With only nine systems examined, the project officer was able to state:
1. ”A lot more Operators of water systems than I would have ever imagined had never seen an electric bill until we needed them to collect the data.
2. At one of those systems we were able to discover a meter located on an abandoned storage tank. This meter was generating a bill for $39.00 a month for over ten years. This added up to over $5,000.00 thrown away and would have continued if not for the survey.
3. At another system I was able to show the Operator that he was paying less than $20.00 to produce that month's water supply and over $225.00 that same month to heat a separate building that the water passed through before entering the distribution system. A simple heat tape was installed and the heat turned off since they didn't use the building for anything else anyway.
4. When a system with multiple wells saw the over $2.00/1,000 gallons produced at one well site they decided to only use it in case of emergencies.
5. At yet another system I found a meter with a three-phase service left over from a well pump application that today serves a single 100 watt light bulb in that building.”
6. Bills are often estimated and these amounts are usually higher than actual usage would be. This can be minimized by making electric meters accessible, especially in bad weather.”

The potential for savings in small systems is clearly demonstrated. Using the US Environmental Protection Agency figures for 2007, small community water systems serve about 52 million people. Applying conservative consumption figures and the electric efficiency and cost figures determined in the New York pilot study, it can be estimated that these small water systems spend between $300,000,000 and $500,000,000 per year on electricity. Obviously, if even a small percentage of this amount can be conserved, the savings in money and energy will be substantial.

Introduction

Operation of water and wastewater systems is normally a power intensive process, frequently requiring large electric motors for pumping, mixing, and other elements of the treatment and distribution functions. In this era of rapidly increasing energy costs, minimizing this power consumption assumes significant importance both in terms of energy conservation and monetary savings. This paper describes the typical rate structures utilized by United States electric utilities and how these rate structures can most effectively be utilized by water utilities, especially small ones, to minimize their electric costs and thereby save money and energy. The approaches described are basically simple steps that can be taken by system personnel without need of hiring specialists to design elaborate conservation schemes and without need for significant capital expenditures. Nonetheless, the savings that can be achieved are frequently substantial, amounting to hundreds or thousands of dollars per month with corresponding significant energy savings.

The paper is organized by a discussion of current electric billing practices and rate schedules in use in the US, a presentation of several scenarios that illustrate ways systems can best utilize these rate structures, and presentation of the results of a small pilot study conducted to test the efficacy of the suggestions proposed with actual, current operating experience in several public water systems.

United States Electric Utility Rate Structures and Measurements

In the US, billing commercial (as opposed to residential) customers for electric power use is normally a two-component procedure. First, the customer is charged for demand which is a measure of the generating, transformer and line capacity needed to be sure that customer has adequate power for his maximum needs at any time. This demand is normally measured in kilowatts (kW) for small to medium amounts, and is recorded on a special demand meter. These meters usually take 15 minutes to register the full amount of
demand they see and this demand amount does not reset during the month until the meter reader manually moves it back to zero. Thus these meters record the maximum amount of demand presented to the meter during the month.

The second element of the power charge is frequently referred to as the energy charge and is the amount of time electricity is consumed at the established demand. This energy is measured in kilowatt-hours (kWh) and is recorded on the same meter as the demand. Kilowatt-hours are cumulative and thus the meter records the total accumulation during the month in contrast to the maximums recorded for demand. Special meters can also break both kW and kWh amounts down by the time of day they are accrued.

The procedures for utilizing these measured kW and kWh amounts to develop power charges can range from simple to highly complex and are normally referred to as rate structures, rate schedules, or tariffs. Regardless of their complexity, these billing schemes frequently have some common characteristics that include:

✓ Power suppliers don’t like to develop more generating, transforming and transmission capacity than is required to meet customer needs and rates often reflect this with penalties for excess demands developed, especially in high demand periods like summer months. These penalties commonly take the form of ratchet clauses that will be explained further later in the paper.

✓ It is to the advantage of the supplier to keep it’s power capacity utilized as fully as possible and rates often reflect this with price breaks for usage during so called off-peak hours (normally nighttime and weekend hours). These off-peak rates can be used to great advantage by customers when applicable and can apply to both demand and energy charges.

✓ Similar to on-peak/off-peak considerations, it is more cost effective and efficient for power devices (motors) to be kept loaded (operating) rather than sitting idle, and rates often encourage this with price breaks for higher kilowatt-hour usage. The point at which this price break occurs is commonly controlled by the demand, so demand control can have a compound effect.

✓ Demand costs are usually a few dollars per kW whereas energy costs are normally a few cents per kWh.

There are hundreds of electric power utilities across the country and as many rate structures. However, it was desired to obtain a picture of the typical structure as it applies to small water utilities and a sample of at least one rate from each state was obtained from utility web sites. Insofar as possible, the supplier serving the largest majority of the state was chosen and the rate for that supplier that would most likely apply to small systems was examined. If a supplier had a special rate for water pumping, which several had, that was also noted. Application of these criteria was highly subjective, and the results should not be assigned any high degree of accuracy regarding how typical they are. However, they should be reasonably representative. The rate characteristics were compiled in an Excel database, and this is printed out as Figure 1
### TYPICAL ELECTRIC RATE STRUCTURES FOR SMALL SYSTEMS

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count 50
average $7.51 4.66 3.837784
A summary of these rate characteristics is:

- Demand charges averaged about $7.50/kW with a wide range from less than $1.00/kW to nearly $20.00/kW
- Energy charges averaged 4.66 cents per kWh but again with a wide range from about a quarter of a cent to nearly 12 cents per kWh
- About half the rates had a demand ratchet clause. Ratchet refers to a provision whereby a customer is never charged less than some percent of the maximum demand established during a previous time period – frequently the past year or the past summer months. This can be a severe and controlling penalty if, for example, a water utility uses an extra pump during a high water demand, but never or seldom uses it again. This ratchet demand can control the entire year’s charges.
- About half the rates had a price break for energy use at the higher amounts. The point at which this occurred was controlled by demand in half the rates that had such a provision. The average price reduction for this break was about 1 cent per kWh. Although this may not sound like much, it can generate substantial savings because kWh consumptions are usually in the thousands.
- Seven of the utilities checked had special water and/or sewer rates available.
- Although it wasn’t tabulated, a majority of the utilities have special time-of-day rates available that provide significant price reductions when customers can operate in off-peak hours. These reductions can be in either kW charges or kWh charges or both.

The following sections illustrate how these rate characteristics can be utilized by utility managers to save money and energy.

**Typical Savings Situations**

There are almost as many possible system operating conditions that are amenable to possible electrical savings as there are systems. In this discussion, three typical scenarios involving (1) pumping efficiency evaluation, (2) demand control, and (3) kilowatt-hour management are presented. It is hoped that the principles involved are sufficiently clear that the readers can apply these principles to their own individual situations. Because this author is familiar with rate structures used in Alabama, the appropriate rate from Alabama Power, which is the principal power supplier in the state, is used in these examples.

**Pumping Efficiency Evaluation**

This type of savings opportunity seems so logical and self-evident that it should not require illustration, but it is surprising how few system managers take advantage of it. The opportunity referred to is typified by the situation where multiple pumps are operated for the same purpose, but all are not required 100 percent of the time to meet the pumping demand. An example would be a water system with multiple wells on separate meters, with any two of the wells able to satisfy the water demand. In this situation, managers often logically try to operate all the wells about equal amounts of time to spread the pump
and motor wear evenly. However, this can have significant electrical cost disadvantages in one or more ways.

A straightforward way to identify this problem is simply to examine several month’s electrical bills for these pumping stations and compare the total kilowatt-hours from each bill with the number of gallons pumped corresponding to that kilowatt-hour amount. To do this it is convenient to divide the water pumped in 1000s of gallons by the kilowatt-hours. When this is done, it will often be found that one or more wells are significantly less efficient than the others from the standpoint of gallons pumped per kilowatt-hour. Then it is simply a matter of shifting the water production to the most efficient wells. Depending on the rate structure involved, at least one other savings possibility can arise in this situation and this will be discussed in a subsequent section.

**Demand Control**

There are a variety of ways that demand management can affect power bills. One of the simplest illustrations is a water booster station with a primary pump and a backup pump configured so that one or both pumps can be operated at the same time. Normal practice for the operator is to operate only the primary pump, but on occasion he wants to fill tanks faster and turns the backup pump on also for an hour or two. For a given month, assume he only operated the second pump for one hour. Unfortunately, due to the nature of demand electric meters, that meter will register the combined demand of both pumps for that month and the customer will pay a demand charge based on the combined figure. Numbers make this easier to understand. If each pump is rated at 50 horsepower, the combined demand will approach 100 kW. Demand is frequently billed at about $8.00/kW, so the demand charge for that month would be about $800 whereas if only one pump had been operated, the charge would have been $400. In other words, that hour of convenience cost the system at least $400 that month.

Compounding this cost penalty are at least two other common aspects of many electric power rate structures. If that second pump was turned on in high electric use months, the customer may be required to pay no less than some percent of that highest demand for the next 11 months – the so-called ratchet provision of rates. In Alabama that percentage is 90% so the customer would never pay less than $720 demand charge for the next 11 months even though only $400 worth of actual demand was used in those months. Adding to this penalty in many rate structures such as that of Alabama Power, the demand level also controls the point at which a price break on kilowatt-hour charges occurs. Power suppliers like to see electric equipment utilized as fully as possible for reasons of efficiency and economics. To encourage this, they frequently include price discounts for higher kWh usages. With Alabama Power this break occurs at 250 kWh/kW. In other words, for a 100 kW demand, the break would occur at 25000 kWh. This discount can be substantial – 2 cents/ kWh in Alabama. To illustrate, assume that our hypothetical system uses 50,000 kWh at a billing demand of either 50 kW or 100 kW. At 50 kW the price break comes at 12,500 kWh but at 100, it comes at 25,000 kWh. This is an added cost of $250 making the total penalty for that one hour of convenience $650.
Kilowatt-hour Management

Kilowatt-hour management refers to ways in which electric power, primarily with regard to timing, is used at an established demand level. Two preferences of power suppliers govern the way their rate structures are formulated with respect to kWh charges. First, these suppliers like to shift as much power usage from high use periods to low use periods as possible. These periods are termed On Peak and Off Peak and most electric companies offer some price reduction for kilowatt-hours accumulated during off peak times. These reductions can be substantial and well worth the effort required to shift usage.

Second, suppliers prefer to see equipment run for longer rather than shorter times or to stay “loaded” as much as possible. Again, price breaks are frequently offered in the form of lower kWh cost rates at higher kWh usages to encourage this practice. The case presented in the previous illustration of demand control is one example of this practice. Another is the situation presented in the example under Pumping Efficiency Evaluation; namely, where multiple pumps on separate meters are available to move water, but not all are needed 100% of the time to meet water demand. The natural tendency is to run each pump about an equal amount of time to equalize wear. However, this can have significant financial penalties as the following hypothetical numbers show. Suppose five wells are available to produce water and each has a 50 horsepower pump. Further suppose that any three of the wells can meet the water demand if operated 20 hours per day, but instead all five are operated 12 hours a day for the same total of 60 pumping hours per day. Under Alabama Power rates again, the kWh charges for the 3-pump operation versus the 5-pump operation would be:

- **3-pump** – each well - 50kW x 20 hours x 30 days = 30,000 kWh
  - of this 30,000 kWh 12,500 is billed at about 6 cents/kWh or $750 and 17,500 at 4 cents or $700. Total 3 wells = $4350

- **5-pump** – each well – 50 kW x 12 hours x 30 days = 18,000 kWh
  - of this 18,000 kWh 12,500 is billed at about 6 cents/kWh or $750 and 5500 at 4 cents or $220. Total 5 wells = $4850

Thus, this production shift could save $4850 - $4350 = $500/month not counting possible demand savings on idle wells. The pump wear problem could be managed by rotating the idle wells each month.

**Pilot Study**

The previous sections have presented a few of the many ways systems can manage their electric power consumption to maximize money and energy savings. There are too many possible savings scenarios to list, but hopefully the principles illustrated give the reader sufficient understanding to recognize potential savings opportunities in specific situations. As an aid to evaluating individual systems or collections of systems for savings, it is helpful to collect simple operating and billing information and compile this information in a database or spreadsheet format such as Excel. With the initiative and cooperation of the New York Rural Water Association (NYRWA), a project to do this
was started and preliminary results of this effort are presented to demonstrate the value of such information collection and to show how some of the previous savings scenarios can be applied in a real-world situation.

The basic information that is needed for a preliminary evaluation is readily available from power bills and system operating information. Essential parameters include demand in kilowatts (kW), energy use in kilowatt-hours (kWh), cost for kW and kWh and total cost, and water production at each electric metering station. Additional information that may be helpful in pinpointing specific problem areas and solutions includes billing versus actual demand and horsepower or kW ratings of major power consumers (motors, heaters, etc.).

An Excel spreadsheet was prepared to record these data and is presented in Figure 2 with data for 9 systems entered. Systems are given letter designations to protect their identity.
## FIGURE 2

### SYSTEM ENERGY CONSERVATION PROJECT

#### System Electric Use and Billing Data

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The headings for columns in the spreadsheet are reasonably self-explanatory, but are defined in detail in Table 1 of the Appendix. This spreadsheet is formatted to calculate electrical efficiency in terms of water production per kilowatt-hour and water electrical cost in terms of dollars per 1000 gallons. These results are charted in Figures 3 and 4. For chart clarity, only seven of the systems are included.

FIGURE 3

Referring to Figure 3, it can be readily seen that System B on average has a lower electrical efficiency and higher cost than the other locations, which provides a convenient flag for further investigation. In Figure 4, electrical efficiency and electrical cost per 1000 gallons are charted for each of the 6 wells at System B. This figure clearly demonstrates that two of the wells at System B have a low electrical efficiency and significantly higher cost than the others. These comparisons suggest that as a minimum the town should consider shifting as much water production as possible from these wells to the others. There are numerous other options for savings that can be investigated as discussed in subsequent paragraphs, but this quick chart analysis is an efficient means for identifying potential savings areas. At the writing of this paper, sufficient time had not been available to investigate these other options in the case of the System B location, but this will be done.
The on-site project manager for this study and coauthor of this paper made the following observations from the few systems visited to date.

1. A lot more Operators of water systems than I would have ever imagined had never seen an electric bill until we needed them do collect the data.
2. At one of those systems we were able to discover a meter located on an abandoned storage tank. This meter was generating a bill for $39.00 a month for over ten years. This added up to over $5,000.00 thrown away and would have continued if not for the survey.
3. At another system I was able to show the Operator that he was paying less than $20.00 to produce that month's water supply and over $225.00 that same month to heat a separate building that the water passed through before entering the distribution system. A simple heat tape was installed and the heat turned off since they didn't use the building for anything else anyway.
4. When System B saw the over $2.00/1,000 gallons produced at the one well site they decided to only use it in case of emergencies.
5. At yet another system I found a meter with a three-phase service left over from a well pump application that today serves a single 100 watt light bulb in that building.
6. Bills are often estimated (see E designations in Billing Month column of Figure 2) and these amounts are usually higher than actual usage would be. This can be minimized by making electric meters accessible, especially in bad weather.
Beyond these specific examples and depending somewhat on the particular electric rate structure involved, there are a variety of conditions that can contribute to inefficient electrical operation and high costs. Each case needs to be carefully evaluated individually, but the following bullet list covers a number of the more common instances that can occur.

✓ As with any metering operation, meters can malfunction or be read improperly or not at all. A visual inspection of each meter should be made and readings compared to what appears on bills, especially in regard to demand.
✓ Total horsepower or kW of demand being fed through the meter should be compared with billing demand. If readings are significantly different, causes other than meter malfunction or misreading can be:
  o Contract demand is controlling. Most electric suppliers require customers to pay some minimum contract demand regardless of actual demand. If pumps or operations have been changed significantly since transformers were set, demand can be significantly less than reflected in the contract. These contracts can often be changed on customer request.
  o Ratchet demand is controlling. As discussed previously in the paper, instances arise where for various reasons a pump or other device is used infrequently, but may control the billing demand for the next year. A classical example occurs in treatment plants that use a separate pump for backwashing filters. These pumps are usually of high horsepower and are operated infrequently. A common practice is to just turn the backwash pump on whenever a filter needs washing. However, it is usually possible to turn off a high service pump or raw water pump to compensate for this added demand during the short time the backwash pump must operate. The savings resulting from this simple pump scheduling can be dramatic.
✓ Electric metering stations are on different rate schedules. Over time, new pumping stations are added or other system changes made and the new meters may be on a more or less efficient rate schedule than others. Many suppliers have specific water or pumping rate schedules that are more economical than others and most suppliers offer reduced rates for time-of-day metering. Normally, customers would have to request change of rate schedules – power suppliers won’t initiate this.

There are many other savings scenarios that can be postulated depending on specific local conditions. It is essential that system managers meet with their power suppliers and thoroughly understand their rate structures. Then the system must be carefully evaluated for possible changes to take advantage of these rate structures.

**Summary and Conclusions**

With today’s high cost of energy it behooves water and wastewater systems, which are energy intensive in operation, to take advantage of any savings opportunities that are available. Fortunately, electric rate structures that govern the cost of electricity to these
utilities offer numerous opportunities for such savings, frequently without necessity for capital outlays. These utilities are classed as commercial customers by electric utilities and the governing rates for such customers usually involve charges for electrical demand and for the time electricity is used at this demand. A survey of typical rate structures used in all 50 states showed that:

✔ Demand charges averaged about $7.50/kW with a wide range from less than $1.00/kW to nearly $20.00/kW
✔ Energy charges averaged 4.66 cents per kWh but again with a wide range from about a quarter of a cent to nearly 12 cents per kWh
✔ About half the rates had a demand ratchet clause. Ratchet refers to a provision whereby a customer is never charged less than some percent of the maximum demand established during a previous time period — frequently the past year or the past summer months. This can be a severe and controlling penalty if, for example, a water utility uses an extra pump during a high water demand, but never or seldom uses it again. This ratchet demand can control the entire year’s charges.
✔ About half the rates had a price break for energy use at the higher amounts. The point at which this occurred was controlled by demand in half the rates that had such a provision. The average price reduction for this break was about 1 cent per kWh. Although this may not sound like much, it can generate substantial savings because kWh consumptions are usually in the thousands
✔ Six of the utilities checked had special water and/or sewer rates available.
✔ Although it wasn’t tabulated, a majority of the utilities have special time-of-day rates available that provide significant price reductions when customers can operate in off-peak hours. These reductions can be in either kW charges or kWh charges or both.

The above facets of electric rate structures provide a variety of opportunities to save money and the energy these savings represent. Specific opportunities are too numerous to present, but typical situations are described which illustrate ways that demand can be managed to advantage and kilowatt-hour charges can be shifted into the lowest rates without compromising water production.

A simple protocol is presented that permits identification of the systems within a group of systems or electric use stations within a system that are most likely candidates for savings. When this protocol was followed to evaluate a few small systems in New York State, several systems were quickly identified with the potential for savings.

Using the US Environmental Protection Agency figures for 2007, small community water systems serve about 52 million people. Applying conservative consumption figures and the electric efficiency and cost figures determined in the New York pilot study, it can be estimated that these small water systems spend between $300,000,000 and $500,000,000 per year on electricity. Obviously, if even a small percentage of this amount can be conserved, the savings in money and energy will be substantial.
Because of the background of the authors, the material in this paper centers primarily around drinking water systems. However, it is expected that much of the information presented is equally applicable to wastewater systems. It is hoped that these discussions will stimulate similar treatments directed specifically at small wastewater systems.