

Leak Detection Technologies Used at Bonner Springs to Locate Leaks in Distribution System



Bonner Springs contracted with Daniels Excavating of McLouth, KS for the repair of this leak. A chop saw is used to cut the street before the backhoe is brought in. Using this method makes for a neat opening to backfill when the leak repair is finished.

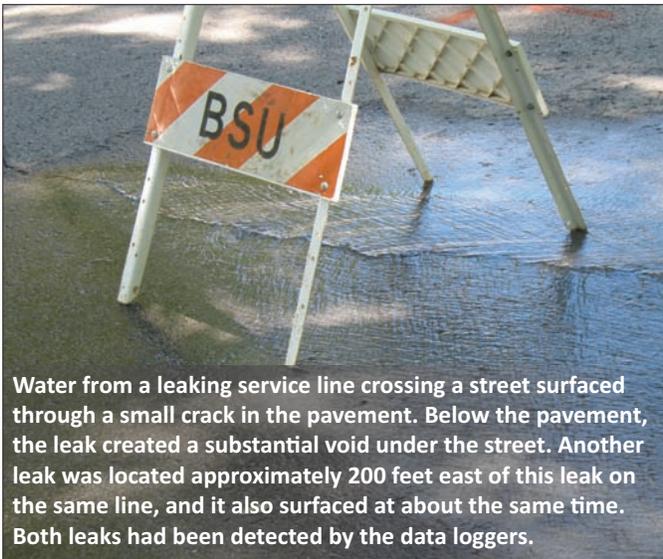
Situated along the north bank of the Kansas River just west of Kansas City, KS, the city of Bonner Springs is reputed to be the first commercial center and white settlement in Kansas. Bonner Springs' history goes back to 1812 when a trading post called Four Houses was established near the present townsite. The city's water source is ground water and is obtained from five wells located along the north bank of the Kansas River. The distribution system consists of approximately 52 miles of water mains, 2,900 meters, 437 fire hydrants, one pump station and two ground storage tanks.

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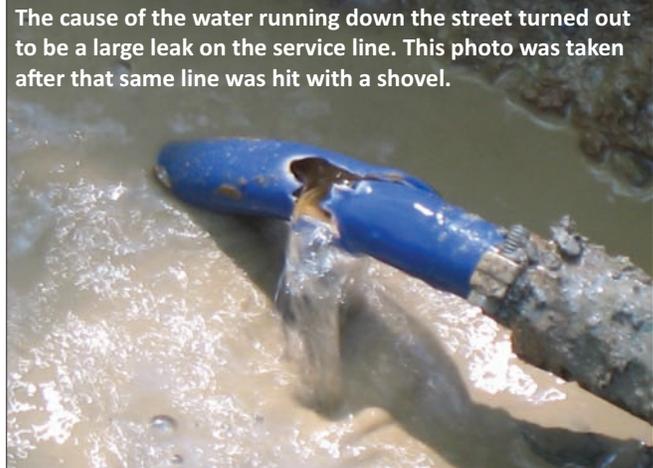
The city's water plant produces an average of 1.15 million gallons of water each day with peak demands in the summer approaching 2.0 million gallons. In addition to providing water to the citizens of Bonner Springs, the city also sells water to Public Wholesale Water Supply District No 6.

The cost of production from Bonner Springs' wells is calculated at only \$0.80 per thousand gallons; the city is also under contract to purchase a minimum of 40 million gallons annually from the Board of Public Utilities, Kansas City, at a cost of \$2.29 per thousand.

Over the years, the city has endeavored to keep water loss to a minimum – and has done so with reasonably good success. Time however, has taken its toll on the city's infrastructure. The cast iron pipelines that were installed many years ago have succumbed to some breakage. Like many urban areas, most of the



Water from a leaking service line crossing a street surfaced through a small crack in the pavement. Below the pavement, the leak created a substantial void under the street. Another leak was located approximately 200 feet east of this leak on the same line, and it also surfaced at about the same time. Both leaks had been detected by the data loggers.



The cause of the water running down the street turned out to be a large leak on the service line. This photo was taken after that same line was hit with a shovel.

city's water lines are installed under the city's streets and sidewalks and when a leak does come to the surface, it can result in a significant expense for the city.

In June 2011, Utilities Director Rick Sailler asked KRWA for assistance in reducing the city's water loss. The loss had increased to 25.6 percent in 2010. The assistance would include field testing all of the master meters for the city's wells, reviewing billing and meter reading practices and detecting

and pinpointing water leaks in the city's infrastructure. After a review of the city's water loss and the steps that the city had already taken, it was decided to begin checking the water distribution system to determine if undetected leakage was the main cause of the water loss.

KRWA has some of the latest in leak detection equipment available to the waterworks industry. That equipment was put to use in the assistance provided to Bonner Springs.

First up – check the maps!

A review of the city water line maps was made to determine the best location to begin the search. The city staff had concluded that the southern half of the city, south of Morse Street, was where they wanted to concentrate the initial efforts.

A water loss survey was started using twenty-one data loggers to try to pinpoint any leaks on the distribution system that were not surfacing. The data loggers are small, lightweight



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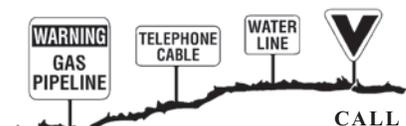
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This set of "data loggers" is but one of many devices KRWA uses to help locate water loss. The small cone shaped units are placed on valves, meter setters or any other part of the distribution system to detect system noise. Typically the units are programmed to turn on at 2 a.m. and then shut off at 3 a.m. The information from each unit is then downloaded into the Commander for analysis. Suspected leakage can then be investigated.

Data loggers and correlators help locate leaks

A data logger is an electronic device that records data over time or in relation to location either with a built in sensor or via external instruments and sensors. A primary benefit of using data loggers is the ability to collect data on a 24-hour basis, or longer. Left unattended, a data logger used for water line leak detection measures and records information over the monitoring period. The data loggers interface with a personal computer; special software is used to view and analyze the collected data. Data loggers can be placed on valves, hydrants, meter setters or any location that is connected to the pipeline being checked for leakage. With a data logger, it is possible to determine if water is escaping from a pipeline, but the logger does not actually locate the leak. Loggers can be used as single units and can also be used in conjunction with an acoustic detector. Typically the data loggers are programmed to activate or collect data during early morning hours (e.g., between 2 a.m. and 3 a.m.) when water system use would normally be lowest. The data is downloaded into a small command unit and from there to a computer. A print-out will show the frequency and volume level in the area. The data can be placed on a map of the distribution system to help determine which area has the suspected leak. The loggers can be used in city and rural areas. However sound does not carry far on PVC pipe so these units are limited on distance for leak detection, depending on the pipeline materials.

Use of a leak correlator involves microphones or acoustic sound sensors that are placed in contact with the pipe, at two or more points, to record the sound created by a leak (e.g. a hissing noise) somewhere between the points. The sound data is processed (correlated) to compare the two recordings to determine the difference in the times it takes noise to travel from the site of the leak to each of the sensors. If the distance between the sensors is known in advance, this timing information can be used to determine the location of the leak. If all of the data entered into the correlator is correct, this type of leak detector can give a very accurate location of a water leak. The correlator works on real time information and can quickly produce a location. It is unaffected by most traffic noise.

After the cleaning, we lowered one of the KRWA data loggers onto the top of the valve. The logger collects a reading over a pre-selected period of time.

portable devices that are placed on valves, hydrants, meter setters or any location to monitor flowing water. Data loggers monitor the "noise" in a pipeline over an extended period, helping to determine when water is flowing through the pipeline. The loggers are programmable units. The data from the loggers is downloaded into a small command unit and from there into a computer. The data will show if water is flowing and also the frequency of any sounds. This data is mapped out to locate lines that have flow over a pre-determined period.

Before the data loggers could be placed on the valves, some valve boxes had to be cleaned. The city chose to use its vac truck to do this job. This made the cleaning job a lot quicker and easier for everyone. The vac truck used a high pressure water hose to loosen the dirt and rocks in the valve box. Next, a vacuum hose was used to suck all of the debris out of the valve riser. After the cleaning, we lowered one of the KRWA data loggers onto the top of the valve. The logger collects a reading over a pre-selected period of time. In this case, we set the loggers to collect



KRWA Tech Gary Armentrout lowers one of the two microphones used to correlate the location of a pipeline leak onto a valve. If all of the information entered into the computer is correct, the correlator will locate a leak to within six inches.



Some valve risers needed to be cleaned in order to place the data loggers. The city chose to use its vac truck to make this aspect go very efficiently with high pressure water to loosen the dirt and rocks in the valve box and then a vacuum hose to suck all of the debris from the risers.

readings between 1:00 a.m. and 5:00 a.m. daily. The data was then downloaded into a command unit and then transferred to a computer for review. After all of the data was reviewed, it was transferred to a copy of the city's map so that operators and KRWA could see the correlation between the different logger readings.

When the loggers indicated unusual noise on the pipeline, the next step was to employ the leak correlation equipment. The correlator is a computer-based leak locating device that collects sound vibrations through pipe or valves using microphones in two locations. The correlator unit that KRWA uses consists of several components. The first component is the computer. It was used to input data such as pipe size, pipe type and length. The second components are microphones that were attached to valves or hydrants. At the time a vibration is noted by the microphones, the correlator measures the time it takes the sound to travel to both microphones. This time is correlated into a distance from each point and is then plotted on a graph that is created from this data. If all of the data, such as pipeline materials, size, etc. that was entered into the correlator is correct, this unit then can accurately provide a location of a water leak down to within six inches. The important element to remember about using a correlator is that the information entered at the start will have a direct effect on the suggested location of

the leak that the correlator will provide. Like any computer, the entry data is critical for accuracy of the analysis.

Using the data loggers and the correlator, as of September 15, 2011, KRWA has been able to locate and pinpoint six leaks in the Bonner Springs' distribution system. At the time of writing this article, the project was not completed. Various other leaks were detected between valves; it will be necessary to use the correlator to pinpoint the location of those leaks.

Kansas Rural Water can assist you in locating your system's water leaks. We have some of the latest leak detection equipment available to assist you in your search for your water losses. Every gallon of water that is lost in your system is lost revenue that will not and cannot be

recovered. I encourage all water operators to monitor the KRWA Web site for training sessions that deal with water loss and become familiar with the technologies that are available. Give KRWA a call at 785-336-3760 if you are interested in further discussions.

Gary Armentrout has been a Technical Assistant for KRWA since December 1999. Gary holds a Class 1 Wastewater Operator certification and worked in a water plant for more than six years.



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