By Doug Guenther, Technical Assistant

It's a Bird; It's a Plane! No – It's a Drone Searching for a Water line Leak in Kansas

Kirwin is located in Phillips County in northwest Kansas. KRWA used a drone last February to help assess freeze damage to the city's water storage tank.

A training session a few years ago at a National Rural Water Association (NRWA) conference and in-service demonstrated the use of drones to find water line leaks. I became interested in owning my drone for this purpose, especially to help those water districts that contact me for assistance with leak detection. The rural water districts in western Kansas usually have long distances between valves; pipelines are often located in crop and pasture settings, sometimes with limited access. Given these unique conditions, I thought a drone would be the perfect answer.

In 2014 I started out with a DJI Phantom 3 Advanced Drone. I began using it to help hunt down leaks that may be surfacing. The DJI Phantom was fairly large and complicated to store and deploy, taking up to 15 minutes to set up for flight. The drone only had about 20 minutes of flight time due to battery life. Setup required calibrating the GPS and compass, attaching props and pairing the controller with my smartphone. My smartphone is the eye, so to speak, also referred to as "First Person View", to operate the drone. Then after the flight, it took another five minutes to break down and put back in the protective case when done with the search.

A couple of years ago my first drone had a battery short and crashed, which put me out of the drone business for a year. Last year, I purchased the DJI Mavic Air 2, a more compact drone that I can deploy in less than five minutes and store in about a minute. It also has a longer flight time, which is very handy when flying long runs. I also keep enough battery charge for about two hours of flight time. The

A drone has helped KRWA survey farm fields and pastures for water line leaks in rural water districts.

Mavic Air 2 is considered a consumer drone or toy because of its small size. While the camera is not as good as the old Phantom 3, it still takes great stills and video and has a better range from the controller. As a result, I can search farther away, up to 2.5 miles. It's also somewhat slower but still can fly

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This photo shows the path cut through the cornfield to reach the location of the leak.

This photo shows the path through the cornfield from the wellsite.

almost 40 miles an hour when used in tandem with a vehicle. That is the preferred technique to cover more area.

Finding leaks for rural water districts and cities with a drone or eye in the sky has been a lot more complicated than it seemed from watching videos in training sessions and not quite what I had expected. The best time to fly with a standard color camera is when the sun in highest in the sky, from 10:00 am to 4:00 pm, and on cloudless days and with wind below 15 miles per hour. That's a trick in Kansas for sure. I find that crops such as wheat or corn especially block the view very quickly and if the leak is surfacing as muddy water, it doesn't reflect back well. Clear running water will appear shiny or like jewels in the foliage. An infrared camera drone would be more beneficial, but such a device is also very expensive.

The drone has also been very beneficial to help during inspections of water storage tanks. The drone removes the inherent risk of having to climb the tank. The camera has excellent detail for visual assessments. It has also proven helpful for well, property and sewer lagoon inspection whenever personnel cannot reach them such as during flood conditions. During the recent Natoma flood, access to the sewer plant and a well was not possible. Drone inspection showed me that the sewer plant and lagoons were okay, but the well had to be taken offline due to the high water.

Last August, Harold Holzman, the operator for the city of Kirwin, called me and stated that his wells did not seem to be operating normally. Typically, after signaling for a well to operate, water would start to flow into town after a minute or two, but this was not happening and it would sometimes take more than 12 minutes for water to begin flowing. Kirwin's wells are located about 6.5 miles northeast of town in the North Fork Solomon River basin. The line crosses at least two small valleys or drainages before dropping into the South Fork Solomon River basin where Kirwin is located. The wells are higher in elevation than Kirwin's water storage tank. When the wells shut down, their 4-inch line usually stays full until the next pump cycle, which explains the short two-minute or less response after starting the pump.

Harold also noticed that the production rate had dropped significantly, by about 30 gallons per minute or more and there were several customer complaints of air in the water.

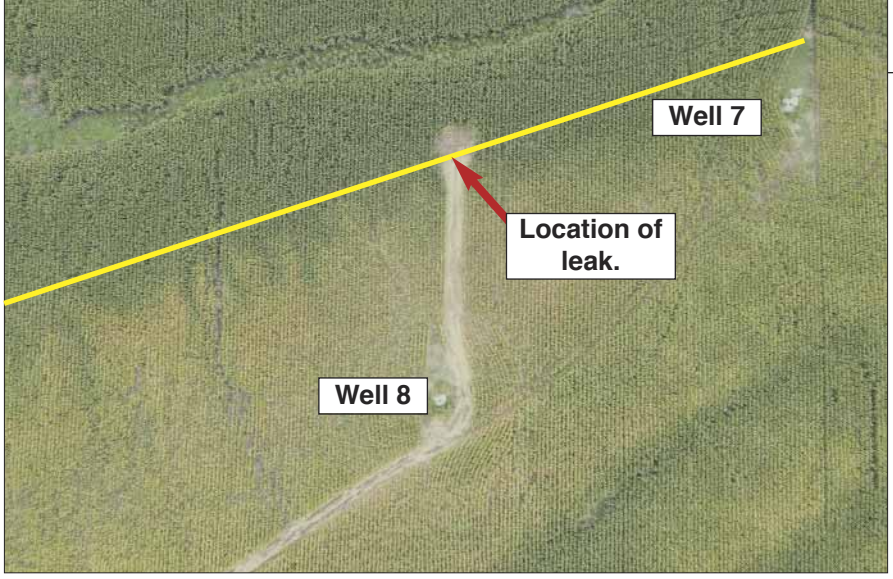
This photo provides an idea of how tall corn grows on irrigated land in western Kansas.

Harold had a hunch the transmission line was leaking, but no surface leak could be found. In working with Harold for many years, he has been spot-on most of the time when he has had a hunch. But I also suspected that it might have been a pump problem instead.

Harold asked if I could bring the drone to get close-ups of the city's overhead storage tank that had freeze damage last February. I explained I had a second drone and would bring it, which proved to be very valuable for the tank's assessment. But the present problem was not a single object like a tank to circle around. The city's transmission line from the wells has no valves except at the wellfield and the other is at the chlorination meter building at the point of entry in town. He stated that he could not find any leaks on his travels back and forth to town and the corn and soybean fields were very lush which made it difficult to see anything. A complication is that when the city acquired these well sites, no arrangement was made for an access road to the well sites. If any repairs are needed to the wells or transmission line, the city is responsible for crop damage. As a result, it is challenging to access the wells. When the city does, they use a two-person team to reach them. One person has to stay on the road high enough to see the pump gate enclosures, while another travels through the cornfield with a flag on a stick to take directions. This has to be one of the most unique situations anywhere that operators have to deal with.

Upon arrival, I flew my drone up to about 100 feet above the corn to both well sites. I then dropped down to about 15 feet above ground to inspect

Typically, when there's a high volume leak from a water line, the result is a blow hold such as this found near Kirwin.



This view from the drone shows the location of the leak and the path through the corn to reach it. The break was at the point where the pipeline from Well 8 connects to other transmission line.

the wells and the area around the wells. I could not see any leakage. The corn was already about 10 feet tall and this is the lowest I could safely take the drone down. I then took the drone back up, and with Harold's instructions, I flew along the line location as best as possible. All I could see was corn. After draining one battery and going up again, I flew the drone 200 feet up, and still I couldn't see anything but corn. Before the battery charged dropped below 30 percent, I flew the drone over the waterway just south of where Harold said the intersection of the pipelines from each well connect to a single transmission line. I spotted something shiny in an opening in the grassed waterway. I dropped down to 15 feet again and could see clear water running. This location was approximately 150 feet south of the junction of the two pipelines.

Since the area had received no rain for weeks, I was confident that this was where we needed to look for the leak. I walked into the corn field from the south. Harold walked into the field from the east well and then south towards my location. Visibility was about five yards and along with the sun's location, we were able to stay on course to the location where the view from the drone showed clear water at the waterway. We located the leak at the point of the junction of the two well lines. I followed the water about 150 feet to a blow hole that was not visible from the drone.

The leak was repaired the next day. The estimate on the crop damage to the corn was $700 as a temporary path had to be made to the repair site. If this leak had not been spotted, it would probably not have been discovered until corn harvest in late October.

Doug Guenther has worked as a Technical Assistant for KRWA for 16 years. Doug worked for the City of Oakley in the Water and Electric Department for eight years. He has also worked several years for an industry supplier. Doug is a Class II Certified Water Operator.