By Jeff Lamfers, KRWA Consultant

Kansas Water System Contaminated Due to Birds Accessing Storage Tank

This platform was used to access inside of standpipe for purposes of removing bird carcasses and adding sodium hypochlorite solution in order to disinfect with free chlorine.

Waterborne disease outbreaks in public water supplies in the United States are relatively rare. However when they occur, many customers are usually affected. While surface supplies have greater potential to experience such outbreaks, even systems that use deep, properly constructed wells can have an outbreak. Many times the cause of a waterborne disease outbreak is not due to contamination of the system's source of water, but instead, due to contamination in the distribution system. Consequently, adequate maintenance of all distribution system components, including storage facilities, is very crucial.

In 1993, the city of Gideon, Missouri experienced a large waterborne disease outbreak. At the time, Gideon was a city of 1,100 with an unchlorinated public water supply. Gideon was served by two deep wells. The distribution system had two city-owned storage facilities (50,000 and 100,000 gallons) and another privately owned 100,000-gallon tower. Early in November 1993, the city's operators flushed the distribution system by opening each of the system's 50 hydrants for fifteen minutes. This was the first time the system had been flushed in more than three years. The operators began by flushing those hydrants nearest storage facilities and then working out into the rest of the distribution system. Hydrants were flushed at approximately 750 gpm.

Several bacteriological water samples collected in Gideon in December 1993 were positive for both total coliform and fecal coliform. Further testing confirmed the presence of *Salmonella typhimurium* in the city's water. Due to this evidence of contamination, Gideon residents were warned to boil their water by a local radio station. The city eventually delivered written advisories to all households instructing them to boil their water, but waited several days after confirmation that the city's water was indeed contaminated to issue the advisories. The waterborne outbreak in Gideon, Missouri resulted in an estimated 650 cases of gastroenteritis, fifteen individuals requiring hospitalization and seven deaths. All seven deaths occurred among residents of the local nursing home. The rate of absenteeism in Gideon schools increased by 250 percent; sales of medicine to control diarrhea increased by 600 percent.

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In the case of Gideon, state and federal investigators concluded that droppings from pigeons that gained access to the city's 100,000-gallon

storage facility contaminated the city's drinking water. During an inspection of this tower on January 12, 1994, it was discovered that an improper roof vent and uncovered hatch allowed access. Bird feathers were observed inside the tower. Water in this tower was not tested because the city had begun chlorinating once it was confirmed there was a contamination problem. A hydraulic computer model also indicated that during routine operation, water was rarely exchanged in this storage tank. Water pumped by the wells would typically bypass the tower and go directly to customers. But, when the distribution system was flushed in November, flushing likely lowered or even emptied this tower, allowing water contaminated with fecal matter from pigeons to enter the distribution system.

An incident in Kansas, 2011

I have worked in the public water supply field for more than thirty years in Kansas and never encountered such a situation until this past summer. Late on July 7, I received a call from the operator of a small public water supply. According to the operator, one of their customers was having a problem with no water service at their home. The service tap line between the water main and home was checked and no problems were found. But when the customer's meter was removed from its housing, parts of a dead bird were found on the inlet side of the meter. The dead bird was not only blocking the flow of water to the residence, but also likely contaminating the system's water. It was a warning sign that contamination could be a widespread problem.

If vectors such a birds are found in a water system, there are really only two likely avenues for access. First, if any new water line had been laid recently and not checked for vectors such as rodent, birds, etc., they could end up in the distribution system even after chlorinating and flushing. It is not uncommon to find dead rodents in pipe that has been stored in an outside yard.

KRWA Tech Lonnie Boller removes a bird feather from the overflow of the standpipe.

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Second, if storage facilities are not properly maintained, vectors such as birds, can gain access to water inside a tower through openings in vents, hatches, overflow pipes, etc. This becomes even more probable if storage facilities have not been maintained on a routine basis. During my conversation with the small system operator on July 7, he confirmed that they had not installed any new water line recently. Consequently, that narrowed our focus down to the system's only storage facility, a 70,000-gallon standpipe. I also discovered that the standpipe had not been regularly maintained since it was erected about eight years earlier.

I immediately contacted KDHE staff to inform them of the situation and the need to issue a boil water advisory. In

Feathers, bones and other body parts from approximately fifteen dead birds were found after draining the 70,000-gallon standpipe.

This photo shows decomposed bird carcasses flushed from fire hydrant adjacent to 70,000-standpipe.

fact, several system officials had already begun going door-to-door to advise customers that they should boil their water prior to drinking. We also agreed that KRWA staff would arrive on-site the next morning to investigate and determine how birds could have gotten into the meter housing of the residence that was having supply issues.

KRWA techs Lonnie Boller and Tony Kimmi arrived at the water system early on July 8. The 70,000-gallon standpipe was filled to overflow. Bird feathers, etc., were found at the overflow, confirming the standpipe as the source of the bird that was found at the water meter. The standpipe was immediately taken offline; chlorine residuals were checked throughout the distribution system. While residuals were above required levels, that still created concern, as they were combined – and not free chlorine. The system purchases all water from a nearby rural water district which has a surface water source and must add ammonia to prevent the formation of disinfection byproducts. Unfortunately, combined chlorine is a much weaker disinfectant than free chlorine. Bacteriological water samples were collected from the standpipe and various locations in the system. The sample from the standpipe was positive for E. coli. The sample from the

Conclusions drawn from this incident . . .

This event draws attention to water quality as affected by storage. All public water system officials should review the instances of birds contaminating water tanks in Missouri and Kansas. System officials need to consider how their water system would prevent and/or handle such a situation. Lessons learned include:

- All storage facilities must be routinely inspected, cleaned and repaired to ensure vectors cannot gain access. All vents and overflow pipes must be inspected to ensure they are adequately screened and that birds have not compromised such screens. Entry hatches should be inspected to ensure they are closed and locked to prevent vandalism/sabotage and limit liability. In the case of Gideon, Missouri, had the city had their 100,000-gallon tower inspected routinely, the waterborne disease outbreak may have never occurred. This also applies to the situation with the small water system in Kansas. It appears that the 2-inch port on top of the standpipe had been open for an extended period. Had the standpipe been routinely inspected, the deficiency would have surely been discovered and corrected.
- Make sure KDHE design standards are met. KDHE standards require all storage facility vents be screened to exclude birds, animals, insects, rain and dust. Vents should be screened with 16-mesh, non-corrodible screen.
- If the water system retains a contractor to inspect its storage facilities, make sure to ask if all completed work left the tower intact and capable of keeping out vectors such as birds, animals and insects. Most reputable contractors provide a written report, including photographs, once work is completed.
- Public water systems need to overflow all storage facilities several times each year for several reasons. But one very important reason is to visually ascertain whether or not any contaminants (such as bird feathers, bones, etc.) are in the water. KDHE standards require that all overflow pipes terminate one to two feet above the ground surface. The overflow must be screened with non-corrodible screen with 0.25-inch openings or fitted with a self-closing flap gate. When overflowing a tower, water coming out of the overflow pipe should be observed closely to see if any foreign material is present. If so, further investigation is warranted.
- If in doubt during the early stages of a waterborne outbreak, it is prudent to consider issuing a formal boil water advisory even if testing has not yet confirmed the presence of contaminants. Of course issuing such an advisory prematurely can result in accusations of over-reacting on the part of the water system. But the water system is in a more defendable position than if a boil water advisory is not issued and testing later confirms an outbreak has occurred. In my opinion, it is always best to error on the side of caution in such situations. It is advisable to give all customers the information contained in a boil water advisory and let them make their own personal choices about whether or not to boil water for consumption.
- All public water systems should have a bacteriological sampling plan (as required by the Total Coliform Rule) that includes collecting water samples from all parts of the distribution system, especially from customers near storage facilities. Results from routine bacteriological monitoring can alert a water system to problems with contaminants in their storage facilities.
- Finally, public water systems cannot become complacent when maintenance is required. Frequently when finances are tight, boards and councils will delay maintenance. That can have disastrous effects such as in Gideon, Missouri. Boards and councils must take the responsibility for properly operating and maintaining all components of your water system seriously.

This open 2-inch port on top of the standpipe was the access point for birds to enter the storage facility.

residence with the bird in the meter housing was positive for total coliform.

The standpipe was drained for cleaning and more bird carcasses were found. Parts of at least fifteen dead birds were eventually found. It was also discovered that a 2-inch port on top of the standpipe was open. The screw-in plug was setting on top of the standpipe next to the open port. The

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open port was just large enough to allow birds to fly into the tower, but they were unable to escape. KRWA staff did their best to clean the tank and super-chlorinate by adding sodium hypochlorite, but refilling with water that had combined chlorine was not sufficient to kill all pathogens in the tower. The system's supplier also boosted the combined residual, but even that was not sufficient to kill pathogens. Retesting of water in the standpipe confirmed this fact. The boil water advisory remained in effect.

On July 12, KDHE and KRWA agreed that the standpipe had to be super-chlorinated to AWWA standards using free chlorine. The AWWA standard requires that a minimum 10 mg/L free residual remain after 24 hours of contact time. Calculations were made to determine how much sodium hypochlorite was needed to reach breakpoint and still provide a free residual in the standpipe greater than 10 mg/L. This required adding fifteen gallons of 10 percent sodium hypochlorite and five gallons of six percent. The standpipe was then refilled, beginning the 24-hours contact time. The contact period ended on the afternoon of July 13. The residual in the standpipe was checked and met the required minimum 10-mg/L free residual. The water inside the standpipe containing free chlorine was then used to thoroughly flush the distribution system. Homeowners were encouraged to remove and clean screens on the end of all household taps and flush all plumbing within their homes. Adequate free residuals were eventually found throughout the system.

It was jointly decided to wait several days before retesting the water quality to allow maximum free chlorine contact time in the distribution system. On July 18, water samples were collected at various locations. All samples were negative for coliform and E. coli. Consequently the boil water advisory was lifted. To my knowledge, there have not been any reports of medical problems among the system's customers.

In conclusion, I encourage all water systems in Kansas to have their storage facilities inspected at least every three to five years. Annual inspections would be ideal. Obviously more frequent inspections allow for an earlier detection of problems. Maintaining the storage facilities in any water system is a must and an important factor in providing safe drinking water to all customers.

Jeff Lamfers began work for KRWA in November 2008. Jeff has more than thirty years of regulatory experience in the oversight and operation of water and wastewater systems with the Kansas Department of Health and Environment. He is a graduate of the University of Kansas with a degree in Environmental Studies with an emphasis in aquatic biology.