



The Wildlife Protection Act of 1996 helped beavers and other animals while affecting the water of the quaint new England town of Sterling, Mass.

River Contaminates Town's Water Supply

When State Leaves It to Beavers

By Louis Manring

For nearly 70 years, the public water system in the Town of Sterling, Massachusetts operated without incident, delivering clean water to more than 2,000 homes. Because the water from the town's well field was clean and free of contamination, there was no need for a permanent disinfection system. In fact, for many years the only treatment necessary was the addition of potassium hydroxide to make the water slightly alkaline to minimize corrosion in the distribution system.

That all changed in September 1999 when a storm caused by Hurricane Floyd and the state's increasing beaver population combined to cause bacterial

contamination in the town's water supply. Though the water has passed all tests for contamination since December 1999, the Department of Public Works in

Sterling began to study available disinfection technologies and recently installed a new ultraviolet (UV) system that kills coliform bacteria without the use of chlorine or other chemicals.

The Town of Sterling

Sterling, Massachusetts is a New England town of 7,000 people located about an hour's drive west of Boston. The Department of Public Works provides water to about two-thirds of the town's homes, for a total of more than 2,000 service connections. The remaining homes in the town draw water from private wells.

The town's water system was installed in the mid 1930s and has been expanded several times since then. Today, it consists of four wells, a 750,000- and a 250,000-gallon storage tank with a third under construction, and 65 to 70 miles of pipe in the system. Three of the town's four wells

ULTRAVIOLET DISINFECTION



After attending a presentation on ultraviolet disinfection, Louis Manring, superintendent, Department of Public Works, Sterling, Mass., examined it as a means for permanent and primary disinfection at the Sterling water treatment plant.

are in a well field in West Sterling. The fourth well, used only for backup purposes, is located several miles away.

Sterling's water system is capable of delivering up to 1,500 gallons per minute (GPM) of water, though on average only about a third of that capacity is used. The average daily water usage is about 500,000 gallons, but peak daily demand can be as high as 1.5 million gallons of water.

The remnants of Hurricane Floyd hit the Sterling area in September 1999, bringing with it large amounts of rain. In the past, such rainfall would have flowed away in the nearby Stillwater River without any effect on Sterling's well fields and water supply. However, the law of unintended consequences took hold and Sterling was faced with its first contamination problem resulting from new state regulations restricting the use of beaver traps.

Beaver Trapping Restrictions Cause Water Problems

In 1996, citizens of Massachusetts voted to pass the Wildlife Protection Act. As part of that act, animal trappers were prohibited from using specific types of traps to catch beaver and other animals. The result was an exponential growth in

the state's beaver population. Along the Stillwater River, the animals built 17 dams within the first four miles downstream from Sterling's well field. The largest dam (located just 400 yards downstream from the well fields) was four to six feet high and in some areas nearly 100 yards wide.

In the past, water from the Stillwater River flowed slowly, but steadily, away from the well field, rarely getting closer than 200 feet from the town's wells. However, when Hurricane Floyd dumped several inches of rain on the area in a matter of hours, the river got closer to the well fields than ever before. Because of the network of beaver dams, the river came within 20 feet of the wells.

Within days after the rainfall, water from Sterling's wells showed low levels of *E. Coli* and other coliform bacteria. The water department's first action was to immediately begin emergency chlorination of the water system and issue a boil alert to town residents. Since the Sterling Water Department had never chlorinated its water before, the emergency procedures required employees to manually add the chemical to the water from 55-gallon drums.

After five days of treating the water and flushing the water distribution sys-

tem to eliminate the bacterial contamination, the water was once again safe for residents to use without boiling. However, continuing tests showed occasional low levels of coliform bacteria in the wells, forcing the town to continue the chlorination procedures.

Breaching Dam Ends Contamination

Three months after the initial contamination, the Sterling Water Department received permission from the state to breach the two nearest beaver dams and return the Stillwater River closer to its pre-hurricane levels. As soon as the dams were breached and the water receded from the well fields, the coliform contamination stopped. This process confirmed the suspicion that because the water had been closer to the town wells, it was able to enter the wells without undergoing the natural filtration that occurs when groundwater passes through sand and gravel.

Despite the absence of contamination, the Massachusetts Department of Environment Protection ordered Sterling to install a permanent water disinfection system. Although chlorination was the most obvious choice, the Superintendent of Public Works had recently attended a presentation focusing on a small ultraviolet light (UV) disinfection facility recently installed at a nearby municipal well supply and decided to look at that treatment technology closer.

There were several factors that led the Sterling Department of Public Works to look for other alternatives to chlorination. Among those factors were

- Chlorine can be a dangerous chemical and its fumes could pose a serious risk to employees if it were spilled or if the chlorine leaked.
- When chlorine is injected into water that contains organic materials, it can create byproducts that may be carcinogenic.
- Chlorine systems are labor intensive and must be monitored closely.
- Sterling residents have long enjoyed the taste of their water and disliked the taste imparted to it by the tem-

porary chlorination system.

- The raw water supply has low levels of iron and magnesium that are oxidized with the addition of chlorine causing colored water and staining laundry and fixtures.

UV Disinfection Is the Answer

The disinfection system that showed the most promise for Sterling was ultraviolet (UV) light. Though UV has been used throughout Europe for many years and is used in the United States in recreational vehicles and other specialized applications, its use in municipal water systems has been limited.

UV disinfection works by exposing microorganisms to ultraviolet light at a specified intensity over a period of time. Once they have been exposed, the bacteria are unable to reproduce and are therefore unable to cause illness in humans.

When used in municipal water systems, UV disinfection offers advantages such as

- There are no chemicals introduced into the town's water supply, so the water would continue to smell and taste as it has for the past 70 years.
- UV disinfection systems are easy to operate and maintain. They are not labor intensive—maintenance is as simple as changing a light bulb.
- The UV system would be safe for both residents and water department employees.

Though the use of UV disinfection is only now emerging in the United States for the treatment of potable water, one of the few systems in the country, designed by Fay, Spofford and Thorndike, Inc. of Burlington, Massachusetts, had recently been installed in nearby Westford, Massachusetts. After reviewing the results of that installation, the Sterling Department of Public Works decided to engage the engineering firm of Fay, Spofford and Thorndike to design and



LearnMore!

For more information related to this article, go to www.waterinfocenter.com/lm.cfm/we070207

provide services during construction of a UV facility to handle all three of Sterling's main wells.

Town residents voted overwhelmingly to approve funding for the new UV system. The Department of Public Works then prepared an application for a subsidized construction loan through the state Department of Environmental Protection (DEP) and the Massachusetts Drinking Water State Revolving Loan Fund Program. That application was approved and the Town received a zero percent interest loan for the full construction cost of the project. The town and the engineers then set up and conducted a pilot study to help determine if the iron and manganese would foul the UV light sleeves in the reactor vessel.

With funding in place and the pilot-ing successfully completed, the engineers worked closely with DEP to design the system and construction of the UV Treatment Plant was begun in February 2001. The UV system provided by Severn Trent Services included a programmable logic controller (PLC) design that allows water department employees to control and monitor the wells, pumps, storage tanks and UV disinfection system remotely from a personal computer in their office several miles away from the well fields, or from a laptop computer through a dial-up telephone connection.

The project was lengthy and complex, but in the end the town has ended up with a state-of-the-art disinfection facility and the residents are once again enjoying the clean, safe, good tasting Sterling water that they have enjoyed for the last seventy years.

About the Author:

Louis Manning is the Superintendent for the Department of Public Works in the Town of Sterling, Mass.