CASE HISTORIES OF SELECTED BACKFLOW INCIDENTS

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

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1. - BACKFLOW AT AN AGRICULTURAL PREMISES

DATE OF BACKFLOW INCIDENT: June 1983
LOCATION OF BACKFLOW INCIDENT: Woodsboro, Maryland
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995
- U.S. Environmental Protection Agency, Cross-Connection Control Manual, 1989
- Watts Industries, Inc.; Watts Regulator News/Stop Backflow

CASE HISTORY

In June 1983, "yellow gushy stuff" poured from some faucets in the Town of Woodsboro, Maryland. Town personnel notified the County Health Department and the State Water Supply Division. The State dispatched personnel to take water samples for analysis and placed a ban on drinking the Town's water. Firefighters warned residents not to use the water for drinking, cooking, bathing, or any other purpose except flushing toilets. The Town began flushing its water system. An investigation revealed that the powerful agricultural herbicide Paraquat had backflowed into the Town's water system.

Someone left open a gate valve between an agricultural herbicide holding tank and the Town's water system and, thus, created a cross-connection. Coincidentally, water pressure in the Town temporarily decreased due to failure of a pump in the Town's water system. The herbicide Paraquat was backsiphoned into the Town's water system. Upon restoration of pressure in the Town's water system, Paraquat flowed throughout much of the Town's water system. Fortunately, this incident did not cause any serious illness or death. The incident did, however, create an expensive burden on the Town. Tanker trucks were used temporarily to provide potable water, and the Town flushed and sampled its water system extensively.

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2. - BACKFLOW AT A BEVERAGE BOTTLING PLANT

DATE OF BACKFLOW INCIDENT: December 1987
LOCATION OF BACKFLOW INCIDENT: Spokane, Washington
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

On December 31, 1987, the Spokane, Washington, Water Department received complaints about air in the water and dispatched crews to the scene to flush the water mains. Upon investigation, the City Water Department discovered that a compressor at a soft drink bottling plant had injected air into the public water system.

Personnel at the bottling plant said that a potable water line into a shop area froze often during winter and that they used compressed air to clear the line. Workers normally closed isolating valves before attempting to clear the line, but they forgot to close the valves this time. Consequently, a large amount of air was injected into the public water system surrounding the bottling plant.

The Water Department required the installation of a reduced-pressure principle backflow-prevention assembly at the bottling plant to prevent recurrence of the problem.

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3. - BACKFLOW AT A CAR WASH FACILITY

DATE OF BACKFLOW INCIDENT: February 1979 LOCATION OF BACKFLOW INCIDENT: Seattle, Washington SOURCE(S) OF INFORMATION:
- American Water Works Association, Recommended Practice for Backflow Prevention and Cross-Connection Control, AWWA Manual M14, Second Edition, 1990
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

- U.S. Environmental Protection Agency, Cross-Connection Control Manual, 1989
- Watts Industries, Inc.; Watts Regulator News/Stop Backflow

CASE HISTORY

On February 12, 1979, many residents in the Greenwood District of Seattle, Washington, began complaining about "grey-green and slippery," "muddy," or "soapy" water. One resident brought a water sample to the Seattle Water Quality Laboratory. Preliminary analysis of this sample showed that the water was contaminated with a detergent solution. The Seattle Water Department dispatched an emergency field crew to initiate flushing of hydrants in the affected area. Investigation revealed that recycled wash/rinse water at a large car wash facility had backflowed into the public water system.

On February 10, a high-pressure pump at the car wash facility broke down. This pump was used to pump recycled wash/rinse water to the initial/scrubber cycle of the car wash, which was not normally connected to the potable water system at the car wash. After the pump broke down, workers kept the car wash operating by connecting a two-inch-diameter hose between piping in the rinse cycle of the car wash, which was directly supplied with water by the car wash's potable water system, and piping in the scrubber cycle.

On February 12, the owner of the car wash facility repaired the high-pressure pump and turned it on. However, nobody removed the hose connection between the rinse-cycle piping and the scrubber-cycle piping. Unbeknown to car wash personnel, the high-pressure pump forced a large quantity of recycled wash/rinse water through the hose connection, the rinse-cycle piping, and the car wash's potable water system into the public water system. This recycled wash/rinse water was, in turn, distributed to the potable water systems of homes and commercial establishments in the surrounding area. Sometime later, a car wash employee flushed the toilet in the car wash's rest room and noticed brown soapy water in the toilet bowl. Car wash personnel quickly realized that they had created a cross-connection and removed the hose between the rinse-cycle piping and the scrubber-cycle piping.

After finding the source of the soapy water problem, the City Water Department conducted water main flushing to intercept and limit the scope of the contamination. Because of its prompt response, the City Water Department confined the contamination to an eight-block area. Nevertheless, the City Water Department delivered a public notification statement to six radio and television stations. Two people in the contaminated area reported illness after drinking the water, but investigations by the Seattle-King County Health Department epidemiologist were unable to authenticate either report.

The City Water Department ordered the owner of the car wash facility to install a reduced-pressure principle backflow-prevention assembly in the potable water service connection to the car wash. The owner complied within 24 hours.

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4. - BACKFLOW AT A CHEMICAL PLANT

DATE OF BACKFLOW INCIDENT: October 1986

LOCATION OF BACKFLOW INCIDENT: Lacey's Chapel, Alabama

SOURCE(S) OF INFORMATION:

- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995
- U.S. Environmental Protection Agency, Cross-Connection Control Manual, 1989
- Watts Industries, Inc.; Watts Regulator News/Stop Backflow

CASE HISTORY

On Wednesday, October 8, 1986, an eight-inch-diameter water main of the Bessemer Water Service broke in Lacey's Chapel, Alabama. While repairing the water main, one Bessemer Water Service worker suffered leg burns from an unidentified chemical and required medical treatment.

Wednesday night and early Thursday, the Bessemer Water Service received several complaints from the area of Lacey's Chapel served by the broken water main. Some residents complained of burned throats or mouths after drinking the water. Tiny red blisters covered one resident's body after he got out of the shower on Thursday morning. He and several other residents received medical treatment at the emergency room of the local hospital. The Bessemer Water Service shut down water service to the area at 7:00 A.M. on Thursday and initiated an investigation. Sodium hydroxide, a caustic chemical, had backflowed into the public water system from a nearby chemical plant.

The chemical plant distributed chemicals such as sodium hydroxide. Sodium hydroxide was brought to the plant as a liquid in bulk tanker trucks and was transferred to a holding tank and then pumped into 55-gallon drums. When the water main broke on Wednesday, a truck driver was adding water to a tanker truck that had carried sodium hydroxide. On this occasion, the driver was filling the tanker from a connection at the bottom of the tanker. Consequently, the sodium hydroxide in the tanker was backsiphoned into the public water system when the water main broke.

About 60 homes in the area of the broken water main received contaminated water. Measurements of pH were as high as 13 in some homes. The Bessemer Water Service flushed water mains, and health officials made sure that all plumbing was flushed.

There was no backflow preventer at the water service connection to the chemical plant. The Bessemer Water Service did not have a cross-connection control program although State regulations required public water systems to have such a program.

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5. - BACKFLOW AT A CLINIC

DATE OF BACKFLOW INCIDENT: November 1993
LOCATION OF BACKFLOW INCIDENT: Wilson, North Carolina
SOURCE(S) OF INFORMATION:
- Drinking Water & Backflow Prevention, Volume 11 Number 2 (February 1994)
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

On November 17, 1993, the Wilson, North Carolina, Water Distribution Division received a complaint from a clinic. The clinic was complaining about a strange, bitter taste and strong chemical odor to its water. Upon investigation, the City Water Distribution Division discovered that chemicals from a mixer used in x-ray development had backflowed into the clinic's potable water system.

A chemical mixer used in x-ray development at the clinic combined water with chemicals--developer and fixer. Water was added to the mixer using a garden hose connected to a hose bibb. Someone submerged the end of this garden hose in the mixer and, thus, created an indirect cross-connection. A hose bibb vacuum breaker was not in place on the hose bibb as required by code, although such a device had been in place when the local building department issued the final certificate of occupancy for the clinic.

On November 15, 1993, City Water Distribution Division personnel, working with a utility contractor, cut a section from the eight-inch-diameter water main in front of the clinic to replace a leaking tapping sleeve with a tee. They did this work during evening hours because the clinic would lose water service temporarily. While this work was being done, a negative pressure apparently developed in the water supply piping to or in the clinic. As a result, the chemicals in the mixer were backsiphoned through the garden hose mentioned above and into the clinic's potable water system.

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6. - BACKFLOW AT A DAIRY

DATE OF BACKFLOW INCIDENT: September 1979
LOCATION OF BACKFLOW INCIDENT: Portland, Oregon
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

On September 18, 1979, a concrete plant in Portland, Oregon, reported foamy water at the plant. The Portland Water Bureau took water samples at the plant and at three fire hydrants in the area. All but one of these samples showed the presence of a foaming agent. Accordingly, the City Water Bureau dispatched crews to flush water mains in the area. After investigation, the City Water Bureau concluded that a detergent solution at a dairy had backflowed into the public water system.

City Water Bureau personnel suspected that the dairy was the source of the foaming agent because a detergent solution had backflowed from the dairy in 1970. The dairy had installed a reduced-pressure principle backflow-prevention assembly in each of its two water service connections in 1971. Each of these assemblies had passed its last annual performance test in February 1979. However, performance tests of the assemblies in response to the September 18 incident showed that both assemblies were in poor condition. Indeed, one assembly completely failed this latest performance test.
Technicians repaired both of the dairy's reduced-pressure backflow-prevention assemblies by replacing the disks, the gaskets, and all worn parts in these assemblies.

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7. - BACKFLOW AT A DENTAL OFFICE

DATE OF BACKFLOW INCIDENT: November 1990
LOCATION OF BACKFLOW INCIDENT: Kansas
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

Several residents in a community in central Kansas were experiencing air in their water. Employees of the water department traced the source to a dental office.
An air compressor at the dental office supplied air at 80 psig to dental equipment. The water pressure in the public water system varied from 40 to 45 psig. A solenoid valve that isolated the air supply from the potable water system malfunctioned. Consequently, the air compressor was trying to keep 80 psig of air in the entire public water system.
The water department required the dentist to install a reduced-pressure principle backflow-prevention assembly at the water service connection to the dental office.

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8. - BACKFLOW AT A FILMING LOCATION WHERE WATER IS USED FOR SPECIAL EFFECTS

DATE OF BACKFLOW INCIDENT: October 1994
LOCATION OF BACKFLOW INCIDENT: Los Angeles, California
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

In October 1994, a film company was filming at a ranch in Los Angeles, California. In the scene that the company was filming, it was snowing. The film crew was spraying artificial snow from a pressurized 55-gallon tank of Macrojet I Concentrate. The truck that furnished water for generation of the artificial snow failed to work properly. Therefore, a special effects person connected a garden hose between the tank of Macrojet I Concentrate and a hose bibb at the ranch. When the special effects person opened the hose bibb, the pressure in the tank forced the chemical through the ranch's potable water system into California-American's public water system. Approximately 30 gallons of chemical solution backflowed into the public water system.
Residents on the same cull-de-sac as the ranch began calling California-American and complaining about brown soapy water coming from their faucets. California-American employees instructed the consumers to flush both hot and cold water through their faucets until the water ran clear. Meanwhile, California-American flushed its system for several hours until the water ran clear and supplied bottled water to the homes in the area. The water company continued flushing its system for several more hours during the next day until the water was safe to drink.
Filming companies often used this ranch for filming, and California-American wanted to avert future problems. Consequently, California-American required the ranch owner to install a reduced-pressure principle backflow-prevention assembly on the water service connection to the ranch.

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9. - BACKFLOW AT A FILM LABORATORY

DATE OF BACKFLOW INCIDENT: October 1978
LOCATION OF BACKFLOW INCIDENT: U.S. Navy ship at sea
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995
- Watts Industries, Inc.; Watts Regulator News/Stop Backflow

CASE HISTORY

Between July 21 and 31, 1977, 544 crew members aboard a large U.S. Navy ship developed gastrointestinal disease. The illness was characterized by the acute onset of nausea, vomiting, abdominal cramps, and diarrhea lasting for 12 to 36 hours.

On the morning of July 28, 301 crew members from four units with the highest rate of illness were interviewed. Of these 301 crew members, 55 had been sick within the past seven days. Interview responses showed that sick crew members were much more likely to have drunk water while the ship was at sea.

On July 19, two days before the onset of the outbreak, a chilled drinking water system in the forward part of the ship had been used for the first time in more than a year. Because the time relationship seemed to implicate this water system, it was shut down on July 28. Subsequently, investigators learned that photo developer solution had backflowed into this water system.

The chilled water system in the forward part of the ship supplied water to a 40-gallon tank via a rubber hose. Photo developer solution was mixed in this tank and then used in automatic photo developing machines on the ship. The rubber hose was submerged in the tank, creating an indirect cross-connection and allowing the photo developer solution to be backsiphoned into the chilled water system.

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10. - BACKFLOW AT A FIRE PROTECTION SYSTEM

DATE OF BACKFLOW INCIDENT: June 1979
LOCATION OF BACKFLOW INCIDENT: Meridian, Idaho
SOURCE(S) OF INFORMATION:
- American Water Works Association, Recommended Practice for Backflow Prevention and Cross-Connection Control, AWWA Manual M14, Second Edition, 1990
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

On June 18, 1979, residents in the City of Meridian, Idaho, complained that their water had an odor and taste of onions. At this time, the City was routinely flushing fire hydrants in the area of the complaints. The City could not see a consistent pattern to the odor or the complaints.

By isolating portions of the water system and conducting a premises- by-premises inspection, the City narrowed the source of the odor to one area containing a supermarket, a car wash, and a church printing firm. When the City flushed the nearest fire hydrant, the odor became very strong. Inspection revealed that an alarm check valve on a fire sprinkler system in the supermarket was leaking and allowing stagnant water to backflow from the sprinkler system into the public water system.

When the pressure in the public water system was reduced during fire hydrant flushing, the alarm check valve on the fire sprinkler system at the supermarket would leak, but the check valve would not open enough to set off the alarm. The City turned off water service to the supermarket fire sprinkler system, and the odor and taste problem did not occur during hydrant flushing.

Analysis of water samples taken from the supermarket fire sprinkler system showed Clonothrix fusa and Zoogleora ramigera bacteria in sufficient concentration to cause the onion odor and taste problem.

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11. - BACKFLOW AT A GAS STORAGE FACILITY

DATE OF BACKFLOW INCIDENT: August 1982
LOCATION OF BACKFLOW INCIDENT: Connecticut
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995
- U.S. Environmental Protection Agency, Cross-Connection Control Manual, 1989
- Watts Industries, Inc.; Watts Regulator News/Stop Backflow

CASE HISTORY

In August 1982, residents in a Connecticut town reported hissing, bubbling noises coming from washing machines, sinks, and toilets. Faucets sputtered out small streams of water mixed with gas. Propane gas had backflowed into the town's public water system. Local firefighters and other officials asked hundreds of residents to evacuate their homes and businesses.

The town provided water to a propane storage facility in the area. Water was furnished to the facility for both domestic use and fire protection and entered the facility through a single eight-inch-diameter service connection. The facility included 26 subsurface 30,000-gallon liquid propane storage tanks.

On the day of the backflow incident, workers needed to repair a storage tank at the propane storage facility. Before repairing the tank, workers had to purge the tank of residual propane. There are two common methods for purging liquid propane storage tanks. One method is to use an inert gas such as carbon dioxide. The other method is to use water. The use of water is the preferred method because it is a more positive method and will float out any sludge as well as gas vapors. Accordingly, workers attempted to purge the tank using water in this case. They connected a hose to the tank from one of the two fire hydrants at the facility. Unfortunately, the pressure in the propane tank was about 85 to 90 psig, while the pressure in the town's public water system was about 65 to 70 psig. Consequently, propane gas backflowed into the town's public water system. It was estimated that about 2,000 cubic feet of gas flowed into the water system over a period of about 20 minutes. This is enough gas to fill approximately one mile of eight-inch-diameter water main.

Fires were reported at two houses, and fire gutted one of these houses. At another house, a washing machine exploded. Police, propane company workers, and town water works personnel, however, limited damage and injuries by quickly sealing off the affected area. The town flushed fire hydrants and individual building plumbing systems and monitored for gas. The propane company promptly instituted revised propane tank purging procedures at its storage facility.

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12. - BACKFLOW AT A GAS TANK MAINTENANCE FACILITY

DATE OF BACKFLOW INCIDENT: March 1989
LOCATION OF BACKFLOW INCIDENT: Fordyce, Arkansas
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

In March 1989, propane gas backflowed into the public water system in Fordyce, Arkansas. Explosions and subsequent fires destroyed two houses and seriously damaged a local business. Three people in separate buildings were injured when explosions occurred after they flushed toilets. Investigation revealed that the gas had backflowed through a cross-connection between the public water system and a railroad tank car.

A nearby company cleaned and refurbished railroad cars and routinely worked on tank cars that carried propane, methane, or ammonia. When workers found propane in a tank car, they bled the gas off through a tower and burned the gas. Then the workers injected steam, water, and air into the tank car to clean it. Apparently, workers accidentally connected a water hose between the company's potable water system and a railroad tank car still containing pressurized propane. The pressure in the tank car was greater than the pressure in the City's potable water system and, thus, forced propane gas into the water system.

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13. - BACKFLOW AT A HOSPITAL / AUTOPSY FACILITY

DATE OF BACKFLOW INCIDENT: December 1964
LOCATION OF BACKFLOW INCIDENT: Michigan
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

For some time, nurses at a Michigan hospital complained about rusty water coming from a hospital drinking fountain. When maintenance personnel finally looked into the matter, they discovered it was actually blood that the nurses were encountering at the drinking fountain. This blood had backflowed into the hospital's potable water system from an autopsy table.

Hospital autopsy tables have a sump to collect blood and washing from the autopsy procedure. These tables also have a hose-spray unit for washing off organs, etc. On an autopsy table at the Michigan hospital, there was no hook to hang up the hose-spray unit, so pathologists placed the unit in the table sump when they were not using it. There also was no vacuum breaker in the water supply line to the hose-spay unit on this table, and the hospital had severe backsiphonage problems. Therefore, blood and other washing from the autopsy table were sucked into the hospital's potable water system. The drinking fountain where the nurses were encountering the blood was about two doors from the autopsy room.

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14. - BACKFLOW AT AN INDUSTRIAL FACILITY WHERE A CHEMICAL IS USED IN PROCESSING A PRODUCT

DATE OF BACKFLOW INCIDENT: May 1988
LOCATION OF BACKFLOW INCIDENT: Edgewater, Florida
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

On Friday, April 29, 1988, it was reported that the potable water system at a paint factory in the City of Edgewater, Florida, had been contaminated by a chemical, propylene glycol. The contamination had actually occurred Thursday afternoon but was not reported until Friday afternoon. The production manager at the factory thought the chemical contaminant was confined to the factory's potable water system. He had shut off the factory's water service connection to the City's public water system and had flushed the factory's potable water system. The Florida Department of Environmental Regulation ordered a ban on water usage throughout the City as a precaution, and the City notified its 5,700 water customers not to use tap water for drinking, cooking, or bathing.

The paint factory used propylene glycol to keep paint from breaking down after exposure to weather. The contamination occurred when a valve at the factory malfunctioned causing the chemical to flow into the factory's potable water system.

Propylene glycol can irritate the eyes and skin upon contact. Although it is relatively nontoxic, it can cause heart and urological damage if consumed in large doses. Analysis of samples collected Friday from the City's potable water system did not show the presence of propylene glycol. No one sought medical aid from the local hospitals for an illness related to the consumption of contaminated water.

The City ordered that a double check valve backflow-prevention assembly be installed at the water service connection to the paint factory.

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15. - BACKFLOW AT AN INDUSTRIAL FACILITY WITH A PROCESS WATER SYSTEM

DATE OF BACKFLOW INCIDENT: 1992
LOCATION OF BACKFLOW INCIDENT: Edmonton, Alberta, Canada
SOURCE(S) OF INFORMATION:

- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

In 1992, a plastics manufacturing plant in Edmonton, Alberta, telephoned the City Water Department complaining about sudsy water in their hot and cold water lines. An investigation revealed that plant process water had backflowed into the plant's potable water system.

To prime a process water pump at the plant, workers connected a hose between the pump and a potable water hose bibb. A vacuum breaker was originally installed at this hose bibb when the plant was constructed. However, workers considered the vacuum breaker to be a nuisance because it sprayed water every time they turned on the process water pump. Therefore, they removed the vacuum breaker and connected the priming hose directly to the hose bibb. This solved the water spraying problem but created a direct cross-connection. The process water pump produced a pressure greater than the pressure in the City's public water system and forced process water, containing potassium hydroxide and calsolene oil, back through the priming hose and into the plant's potable water system.

Workers that were drinking water during the day of the backflow incident complained about raw throats. But, fortunately, no one became seriously ill.

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16. - BACKFLOW AT A LABORATORY

DATE OF BACKFLOW INCIDENT: October 1989

LOCATION OF BACKFLOW INCIDENT: Edmonton, Alberta, Canada

SOURCE(S) OF INFORMATION:

- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

On October 25, 1989, staff at the laboratory and offices of a research facility in Edmonton, Alberta, noticed a smell coming from the hot water at the facility. A growth nutrient for microorganisms had backflowed from the laboratory into the facility's domestic hot water system.

Laboratory personnel were injecting a soupy, nontoxic fluid used as a growth nutrient into a fermenting vessel. Hot water, used for dilution, was directly cross-connected to this vessel. Because the injection pressure was greater than the pressure in the domestic hot water system, as much as 150 liters of the growth nutrient backflowed into the domestic hot water system.

Although the growth nutrient itself was not considered a health risk, the growth nutrient could have promoted the growth of any bacteria in the potable water system. Thus, the potable water system at the facility was chlorinated and flushed.

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17. - BACKFLOW AT A MORTUARY

DATE OF BACKFLOW INCIDENT: ?

LOCATION OF BACKFLOW INCIDENT: ?

SOURCE(S) OF INFORMATION:

- U.S. Environmental Protection Agency, Cross-Connection Control Manual, 1989

CASE HISTORY

The chief plumbing inspector in a large southern city received a telephone call advising that blood was coming from drinking fountains at a mortuary (i.e., a funeral home). Plumbing and health inspectors went to the scene and found evidence that blood had been circulating in the potable water system within the funeral home. They immediately ordered the funeral home cut off from the public water system at the meter. City water and plumbing officials did not think that the water contamination problem had spread beyond the funeral home, but they sent inspectors into the neighborhood to check for possible contamination. Investigation revealed that blood had backflowed through a hydraulic aspirator into the potable water system at the funeral home.

The funeral home had been using a hydraulic aspirator to drain fluids from bodies as part of the embalming process. The aspirator was directly connected to a faucet at a sink in the embalming room. Water flow through the aspirator created suction used to draw body fluids through a needle and hose attached to the aspirator. When funeral home

personnel used the aspirator during a period of low water pressure, the potable water system at the funeral home >became contaminated. Instead of body fluids flowing into the wastewater system, they were drawn in the opposite direction--into the potable water system.

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18. - BACKFLOW AT A PACKING HOUSE

DATE OF BACKFLOW INCIDENT: October 1979
LOCATION OF BACKFLOW INCIDENT: Marshalltown, Iowa
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995
- Watts Industries, Inc.; Watts Regulator News/Stop Backflow

CASE HISTORY

In October 1979, $2,000,000 worth of pork was contaminated at a Swift and Company packing house in Marshalltown, Iowa. The meat became contaminated when employees unknowingly sprayed nonpotable water on hog carcasses during the normal cleaning process. Food safety and quality service officials concluded that a cross-connection had been created between the potable water system and the nonpotable water lines in the packing house. This cross-connection allowed wastewater from the kill floor and water used to deodorize rendering operations to get into the potable water system.
The packing house was shut down for a long time while officials searched for the cause of the contamination, monitored decontamination and sterilization procedures, and decided what to do with the contaminated pork. Swift and Company reportedly spent more than $3,000,000 because of the problem, and 200 people were unemployed while the packing house was shut down.

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19. - BACKFLOW AT A PAPER PRODUCT PLANT

DATE OF BACKFLOW INCIDENT: November 1987
LOCATION OF BACKFLOW INCIDENT: Burnaby, British Columbia, Canada
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

On November 2, 1987, a break occurred in a municipal water main supplying water to industrial properties in the City of Burnaby, British Columbia. While the City was repairing the broken water main, dirty water discharged from the main into the excavation though isolating valves on the main were closed. Upon investigation, the City determined that the dirty water was coming from a paperboard plant along the Fraser River. The plant's only source of potable water was the municipal water main that was disrupted during the main repair. Hence, the City realized that the plant must have an auxiliary water supply and that water was backflowing from the plant's auxiliary water supply into the municipal water system.
The paperboard plant was maintaining two water systems. One system was a combined fire, industrial, and domestic system supplied with potable water from the municipal water system. The other system was a process system supplied with water from the Fraser River. To keep the plant in operation after the municipal water main break, plant workers connected a fire hose between the two systems. Consequently, river water was pumped through the plant's combined fire, industrial, and domestic water system into the municipal water system.
The City ordered personnel at the paperboard plant to remove the fire hose cross-connection, flush and disinfect the plant's domestic water system, and install a reduced-pressure principle backflow-prevention assembly at the plant's service connection from the municipal water system. City workers flushed and disinfected the municipal water main contaminated by the backflowing river water.

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20. - BACKFLOW AT A PEST CONTROL COMPANY

DATE OF BACKFLOW INCIDENT: June 1987
LOCATION OF BACKFLOW INCIDENT: Fair Lawn and Hawthorne, New Jersey
SOURCE(S) OF INFORMATION:
- Drinking Water & Backflow Prevention, Volume 5 Number 3 (March 1988)
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995
- Watts Industries, Inc.; Watts Regulator News/Stop Backflow

CASE HISTORY

On June 24, 1987, a construction crew inadvertently broke a water main while widening a bridge in New Jersey. Several hours after the water main was repaired, a customer called the water department to complain that the water was milky and smelled bad. Pesticides had backflowed into the public water system.

The backflow incident happened at the time the bridge construction crew broke the water main. Because of the water main break, a siphoning action occurred in the water mains. Concurrently, a pest control company employee was rinsing a tank that contained a weak solution of the pesticides heptachlor and chlordane. The hose that the employee was using had the pesticide Dursban on it. One to three gallons of the pesticides were sucked through the pest control company's potable water system and into the public water system.

Several people drank, and watered their gardens with, the contaminated water. Fortunately, however, there were no immediate illnesses or injuries. After receiving the complaint about milky and bad smelling water, the water department immediately shut off the water supply to the 63 customers affected by the water main break and notified them not to drink the water or use it to cook, bathe, or wash clothes.

The 63 homes and businesses went without usable water service for several days while affected water mains and plumbing were flushed and disinfected. A tank truck provided potable water for drinking and cooking. Shower facilities at the local public high school and middle school were made available for use by affected residents. Because the pesticides stuck to piping, the plumbing at nine locations had to be replaced. At all other locations, analysis of water samples showed that the pesticides were not detectable.

The pest control company assumed responsibility for the backflow incident and paid for the necessary replacement of plumbing. Nevertheless, 21 homeowners sued the pest control company for $21,000,000. They claimed that the pest control company irreparably damaged plumbing fixtures, that residents continue to suffer physical injury, and that residents have been subjected to mental distress, inconvenience, and loss of property. In addition, the homeowners asked the pest control company to pay medical expenses incurred because of the incident and to >maintain a health surveillance program for affected residents.

The water department ordered the pest control company to cease operating until a backflow preventer was installed at the water service connection to the pest control company. Following installation of a backflow preventer, the pest control company resumed operating.

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21. - BACKFLOW AT A PLATING PLANT

DATE OF BACKFLOW INCIDENT: June 1987
LOCATION OF BACKFLOW INCIDENT: Kitchener, Ontario, Canada
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

On June 14, 1987, the employees at an electroplating plant in Kitchener, Ontario, noticed that the water from a plant drinking fountain "looked like Kool-Aid" and had a metallic taste. By June 19, 29 workers reported being exposed to nickel contamination. Eleven workers were in the hospital, and six workers were under observation by a family doctor.

The nickel most likely entered the plant's potable water system by backsiphonage through a submerged inlet to a plating rinse tank. On June 14, the plant shut down its potable water system for repair work. There was no backflow preventer in the potable water line supplying the plating rinse tank.

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22. - BACKFLOW AT A POULTRY FARM

DATE OF BACKFLOW INCIDENT: June 1991
LOCATION OF BACKFLOW INCIDENT: Casa, Arkansas
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995
- Watts Industries, Inc.; Watts Regulator News/Stop Backflow

CASE HISTORY

During the week of June 23, 1991, residents near a poultry farm in Casa, Arkansas, became concerned when their water appeared discolored. In response to complaints from one water customer, it was discovered that the public water system had been contaminated by backflow from a chicken house at the poultry farm.

Both the public water system and an auxiliary water well supplied water to the plumbing in the chicken house. The water service connection from the public water system to the chicken house included two single check valves in series for backflow prevention. Workers were using the water in the chicken house to administer an antibiotic solution to the chickens.

When the Casa water system manager became aware of the problem, the manager shut off water service to the chicken house and flushed the public water main serving the area. He later removed the water meter serving the chicken house until a proper backflow preventer could be installed.

The feeding of antibiotic solutions and live virus vaccines into water to treat and immunize chickens is a popular practice at poultry farms. Such antibiotic solutions could cause severe adverse effects in humans who are hypersensitive to the drugs, and most of the virus vaccines used to immunize chickens are pathogenic to humans. Therefore, poultry farms should be considered a significant health hazard to public water systems, and a reduced-pressure principle backflow-prevention assembly should be installed at the water service connection to each poultry farm.

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23. - BACKFLOW AT A PREMISES WHERE THE CONSUMER'S POTABLE WATER SYSTEM SUPPLIES A COOLING SYSTEM

DATE OF BACKFLOW INCIDENT: July 1989
LOCATION OF BACKFLOW INCIDENT: Cincinnati, Ohio
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

On July 27, 1989, the Health Commissioner's office in Cincinnati, Ohio, received reports of blue water in a >government office building. An investigation found that an algae-retarding chemical had backflowed into the building's potable water system from the building's air conditioning system.

A blue liquid known as Acid Blue 9 was being used to prevent algae in the condenser of the government building's air conditioning system. A cross-connection existed between the building's air conditioning system and the building's potable water system. Backflow of the algae-retarding chemical occurred while crews were working on the air conditioning system.

The backflow incident apparently caused 12 illnesses. The Health Commissioner stated that anyone who drank from the drinking fountains in the building on July 27 or 28 could become ill with diarrhea or vomiting, especially after drinking alcoholic beverages.

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24. - BACKFLOW AT A PREMISES WHERE THE CONSUMER'S POTABLE WATER SYSTEM SUPPLIES A HEAT EXCHANGER

DATE OF BACKFLOW INCIDENT: February 1984
LOCATION OF BACKFLOW INCIDENT: Riverbend, Oregon
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

On February 13, 1984, the Oregon Health Division received a call from a resident of a mobile home park in Riverbend, Oregon. The resident described his water as having an oily substance mixed with it. When a representative of the Oregon Health division visited the home on February 15, there were no visible impurities in the home's tap water. However, the homeowner had saved a sample of the oily water. The sample was cloudy white with a layer of yellow oil floating on the surface.

Evidence suggested that the problem was isolated to the individual home. Because only the hot water tap had produced the oily water, the home's hot water tank was drained to observe its contents. A slight oily film was present on the surface of the water from the tank. The home had a solar hot water heating system, and the homeowner stated that the system had not been operating properly. Thus, the Oregon Health Division representative concluded that the solar hot water heating system was the probable source of the water contamination.

On February 17, an employee of a local heating company inspected the home's solar hot water heating system. The system used dichlorofluoromethane gas as the heat transfer medium and had a single-wall heat exchanger. Mineral oils were also used in the system. The piping used for circulating the gas heat transfer medium was filled with water. Apparently, the single wall separating the heat transfer medium from the domestic hot water in the heat exchanger had begun to leak and had created a cross-connection between the heat transfer medium circulating system and the domestic hot water system.

Dichlorofluoromethane is not considered toxic. However, any chlorinated compound is be suspect from a health standpoint. Also, the public water system had no assurance that this solar hot water heating system would not be altered in the future to utilize a toxic heat transfer medium.

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25. - BACKFLOW AT A PREMISES WHERE THE CONSUMER'S POTABLE WATER SYSTEM SUPPLIES AN IRRIGATION PIPING SYSTEM

DATE OF BACKFLOW INCIDENT: October 1991 LOCATION OF BACKFLOW INCIDENT: Southgate, Michigan SOURCE(S) OF INFORMATION: - Drinking Water & Backflow Prevention, Volume 9 Number 6 (June 1992)
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995
- Watts Industries, Inc.; Watts Regulator News/Stop Backflow

CASE HISTORY

On October 1, 1991, two homeowners in the City of Southgate, Michigan, found parasitic worms, or nematodes, in their water. One homeowner found the worms swimming around in his bathtub when he started filling the tub for his child. He also found rust and other debris in his water. The Wayne County Health Department determined that water had backflowed through a residential irrigation system into the public water system.

An atmospheric vacuum breaker on the residential irrigation system had malfunctioned because the device's air inlet valve had stuck to the device's air inlet port. There was a water main break, which caused a vacuum in the public water system. The vacuum in the public water system sucked some water--and some nematodes--from the irrigation system into the public water system.

Crews from the City's Department of Public Services opened fire hydrants and flushed all the water mains located three blocks north and south of where the backflow incident occurred. Analysis of subsequent water samples collected by the Department of Public Services showed no detectable coliform bacteria.

The County cited the owner of the irrigation system for improper installation of the system. The contractor that this resident employed to install the irrigation system did not have a City permit and used a "cheap" atmospheric vacuum breaker.

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26. - BACKFLOW AT A PREMISES WHERE THE CONSUMER'S POTABLE WATER SYSTEM SUPPLIES A SPACE HEATING HOT-WATER BOILER

DATE OF BACKFLOW INCIDENT: January 1990
LOCATION OF BACKFLOW INCIDENT: Brighton, Colorado
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995
- Watts Industries, Inc.; Watts Regulator News/Stop Backflow

CASE HISTORY

On January 30, 1990, authorities closed Overland Middle School in Brighton, Colorado, after an antifreeze-like chemical was found in the school's potable water system. They sent nine students complaining of flu-like symptoms to an area hospital for treatment. The hospital released the students after treating them for ethylene glycol poisoning. Ethylene glycol had backflowed into the school's potable water system from the school's hot-water heating system. During a routine maintenance check of the Overland Middle School's hot-water heating boiler, maintenance workers left open a valve on the potable water line feeding the boiler. This allowed boiler water containing the antifreeze ethylene glycol to backflow into the school's potable water system. There was no backflow preventer on the feed line to the boiler.

The Overland Middle School was closed for an additional day while workers flushed the potable water piping at the school and "repaired the hot-water heating system leak." Presumably workers installed a proper backflow preventer in the potable water line feeding the hot-water heating boiler.

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27. - BACKFLOW AT A PREMISES WITH AN AUXILIARY WATER SYSTEM

DATE OF BACKFLOW INCIDENT: July 1993
LOCATION OF BACKFLOW INCIDENT: Coos Bay, Oregon
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

The occupants of a house in Coos Bay, Oregon, installed an auxiliary water system that consisted of irrigation piping supplied by water pumped from a drainage pond. The water in this pond was probably highly contaminated because it flowed from a fill area previously used for septage disposal. Eventually, the pump at the drainage pond failed. While the pump was at a repair shop, the wife noticed that the lawn needed watering, so she connected a hose from the house's potable water system to the irrigation piping. The husband returned with the repaired pump, installed it, and turned it on. The pump forced pond water through the hose connection, through the house's potable water system, and into the public water system.

Fortunately, a water meter reader was at the house at the time the water from the drainage pond was pumped into the public water system. The meter reader notified his office, and water system personnel isolated the contaminated portion of the public water system.

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28. - BACKFLOW AT A PREMISES WITH A RECLAIMED WATER SYSTEM

DATE OF BACKFLOW INCIDENT: September 1996
LOCATION OF BACKFLOW INCIDENT: Hillsborough County, Florida
SOURCE(S) OF INFORMATION:
- Hillsborough County Water Department

CASE HISTORY

On September 18, 1996, a meter reader with the Hillsborough County Water Department noticed that the water meter at a home in northwest Hillsborough County was registering backwards. A cross-connection had been created between the potable and reclaimed water systems at this premises, and reclaimed water was backflowing into the public potable water system.

Apparently, the County's reclaimed water service connection to this residential premises had recently been hooked up to an existing irrigation system at the premises. The irrigation system, which was previously supplied with water from the home's potable water system, was not disconnected from the home's potable water system. Furthermore, a backflow preventer was not installed at the County's potable water service connection to the premises. The County Water Department estimated that about 50,000 gallons of reclaimed water backflowed into the public potable water system.

After discovering the cross-connection, County Water Department personnel immediately shut off reclaimed water service to the residential premises where the cross-connection was found and notified the County Health Department of the cross-connection. County Water Department personnel then began flushing potable water mains in the area and advised the owner of the premises where the cross-connection was found to flush all water outlets at the premises. Based upon analysis of water samples collected by its Environmental Laboratory staff, the County Water Department reckoned that the cross-connection's impact was limited to that portion of the public potable water system within 1,000 feet of the cross-connection.

On September 19, the owner of the residential premises where the cross-connection was found hired a plumber to eliminate the cross-connection.

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29. - BACKFLOW AT A REFINERY

DATE OF BACKFLOW INCIDENT: May 1979

LOCATION OF BACKFLOW INCIDENT: Winnepeg, Manitoba, Canada

SOURCE(S) OF INFORMATION:

- American Water Works Association, Recommended Practice for Backflow Prevention and Cross-Connection Control, AWWA Manual M14, Second Edition, 1990

CASE HISTORY

On May 25, 1979, personnel at a local refinery in Winnepeg, Manitoba, called the City because the drinking water at the refinery had an oily, gasoline-type odor. The City took a water sample, and a test of this sample showed a hydrocarbon in the water. It was determined that a backflow had occurred in the refinery's laboratory.

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30. - BACKFLOW AT A SHIPYARD

DATE OF BACKFLOW INCIDENT: January 1981

LOCATION OF BACKFLOW INCIDENT: Norfolk, Virginia

SOURCE(S) OF INFORMATION:

- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995
- U.S. Environmental Protection Agency, Cross-Connection Control Manual, 1989
- Watts Industries, Inc.; Watts Regulator News/Stop Backflow

CASE HISTORY

On January 29, 1981, a nationally known fast food restaurant in the City of Norfolk, Virginia, complained to the City Water Department that all their drinks were being rejected by customers because the drinks tasted salty. The City Water Department inspected all potable water lines at the restaurant for cross-connections but found none. Then the City Water Department checked with adjacent customers and received another salty water complaint from a shipyard. The same water main lateral served both the restaurant and the shipyard. City Water Department personnel promptly conducted an inspection of the shipyard and discovered that sea water had backflowed into the City's public water system.

The shipyard had a high-pressure fire protection system supplied by sea water. The sea water was delivered by both electric and diesel pumps, which were primed by using a potable water line connected directly to the high-pressure

fire protection system. Workers left this priming line open. Thus, while the electric pumps were trying to maintain high pressure in the fire protection system, they were pumping sea water back through the priming line and into the City's public water system. A backflow preventer had been previously installed at the water service connection to the shipyard. However, the backflow preventer froze and burst earlier in the winter and was removed and replaced with a spool piece to maintain potable water service to the shipyard.

To correct the problem, the potable water priming line to the fire protection system pumps was removed. Also, a new backflow preventer was installed at the water service connection to the shipyard. Heat tape was wrapped around the new backflow preventer to prevent freezing of the backflow preventer.

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31. - BACKFLOW AT A TEMPORARY WATER LOADING STATION

DATE OF BACKFLOW INCIDENT: November 1976

LOCATION OF BACKFLOW INCIDENT: Wenatchee, Washington

SOURCE(S) OF INFORMATION:

- American Water Works Association, Opflow, May 1977
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

In November 1976, approximately 300 gallons of liquid containing 1.2 pounds of the pesticide Endrin was backsiphoned from a pesticide applicator's truck into a small public water system serving 21 residents near Wenatchee, Washington. Endrin is a very toxic chlorinated hydrocarbon applied to orchards in late fall to control mice.

This incident occurred when, by coincidence, three applicators were filling their trucks from three separate hydrants on a water main connecting the public water system's well to a storage tank. The storage tank was about « mile away from, and about 200 feet above, the well. The withdrawal of water to fill two trucks at the lower end of the water main (near the well) created a negative pressure in the higher end of the water main (near the storage tank), and the contents of the truck at the higher end of the water main were backsiphoned into the public water system.

The public water system did not employ a full-time operator. Consequently, the contamination problem went undetected and unreported until two days after the incident. During that time, several families drank, and bathed in, the contaminated water. Fortunately, the chemical was greatly diluted in its passage through the storage tank, and therefore, no illnesses were reported.

When the State was notified of the contamination problem, it ordered the public water system to shut down, advised consumers of the situation, and initiated a sampling program. Initial samples showed 130 parts per billion of Endrin in the water. The system drained and scrubbed its storage tank and flushed

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32. - BACKFLOW AT A TIRE RETREADING PLANT

DATE OF BACKFLOW INCIDENT: March 1988

LOCATION OF BACKFLOW INCIDENT: Eugene, Oregon

SOURCE(S) OF INFORMATION:

- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

On March 31, 1988, superheated water from a boiler in a tire retreading plant in Eugene, Oregon, backflowed into the plant's potable water system. The hot water, which contained an unidentified boiler treatment compound, broke (i.e., melted) the two-inch-diameter PVC water service pipe to the plant and damaged the City's water main.

An unapproved backflow device consisting of two single check valves was installed in the potable water feed line to the boiler at the tire retreading plant. Both check valves failed. There was no backflow preventer at the service connection to the plant.

The water utility ordered the immediate installation of a reduced-pressure principle backflow-prevention assembly at the water service connection to the tire retreading plant.

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33. - BACKFLOW AT A VETERINARY OFFICE

DATE OF BACKFLOW INCIDENT: June 1983
LOCATION OF BACKFLOW INCIDENT: Calgary, Alberta, Canada
SOURCE(S) OF INFORMATION:
- American Water Works Association, Recommended Practice for Backflow Prevention and Cross-Connection > Control, AWWA Manual M14, Second Edition, 1990

CASE HISTORY

On June 23, 1983, the City of Calgary, Alberta, received complaints from several homes about poor tasting water flowing from their taps. The City had its waterworks division collect water samples and forward them to a laboratory for analysis. Analyses showed high plate counts in some samples and detectable traces of Escherichia coli in one sample. As a result, the City had its water works division immediately begin flushing water mains in the area and dispatched plumbing inspectors to find out if a cross-connection was responsible for the detection of Eschericia coli. After water mains in the area were flushed for several hours, the City collected new water samples. Analyses of these samples showed lower plate counts, but Escherichia coli was still detectable in the samples. After a 32-hour investigation of premises within the area, plumbing inspectors found several cross-connections at a veterinary office. The City ordered the installation of backflow-prevention assemblies at the veterinary office. Analyses of water samples collected after installation of the assemblies showed no evidence of water contamination.

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34. - BACKFLOW AT A WASTEWATER TREATMENT PLANT

DATE OF BACKFLOW INCIDENT: December 1983
LOCATION OF BACKFLOW INCIDENT: San Antonio, Texas
SOURCE(S) OF INFORMATION:
- American Water Works Association, Recommended Practice for Backflow Prevention and Cross-Connection Control, AWWA Manual M14, Second Edition, 1990

CASE HISTORY

In December 1983, effluent from a wastewater treatment plant in San Antonio, Texas, backflowed into the potable water system at the plant because of maintenance activities.
Eight employees reportedly suffered gastrointestinal problems. Fortunately, a reduced-pressure principle backflow-prevention assembly was in place at the water service connection to the plant. This assembly contained contamination within the plant site.

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35. - BACKFLOW AT A WINERY

DATE OF BACKFLOW INCIDENT: December 1970
LOCATION OF BACKFLOW INCIDENT: Cincinnati, Ohio
SOURCE(S) OF INFORMATION:
- Pacific Northwest Section of the American Water Works Association, Summary of Backflow Incidents, Fourth Edition, 1995

CASE HISTORY

In December 1970, wine backflowed into the public water system in Cincinnati, Ohio.
At a winery in the City, someone inadvertently left open a water supply valve to a wine distilling tank after flushing out the tank. During a subsequent fermenting process, wine backflowed from the tank into the City water mains and out of the faucets of nearby homeowners. This reversal of flow through the water piping occurred because the pressure in the wine distilling tank was greater than the pressure in the City water system.

Worst Waterbourne Disease Outbreaks (1986-1994)

STATE	LOCALE	DATE	CAUSE	CASES
Nevada	Las Vegas	Jan.-April 1994	Cryptosporidium	100 19 deaths
Missouri	Gideon	Nov. 1993	Salmonella	486 4 deaths
Wisconsin	Milwaukee	Mar. 1993	Cryptosporidium	400,000 104 deaths
Oregon	Talent	May 1992	Cryptosporidium	3,000
Pennsylvania	Reading	Aug. 1991	Cryptosporidium	551
Michigan	Yankee Springs	June 1991	Acute gastrointestinal	1,320
Tennessee	Brentwood	May 1990	Acute gastrointestinal	1,000
Missouri	Cabool	Dec. 1989	E. coli bacteria	243
Alabama	Collinsville	Sept. 1989	Acute gastrointestinal	700
Arizona	Sedona	April 1989	Norwalk-like virus	900
Texas	Travis County	May 1988	Shigella sonnei	900
Pennsylvania	multiple sites	Sept. 1987	Norwalk-like virus	5,000
Pennsylvania	Blossburg	April 1987	Giardia	513
Georgia	Carrollton	Jan. 1987	Cryptosporidium	13,000

Source: Centers for Disease Control; EPA