

Distribution System Water Quality

Protecting Water Quality through Cross-Connection Control and Backflow Prevention

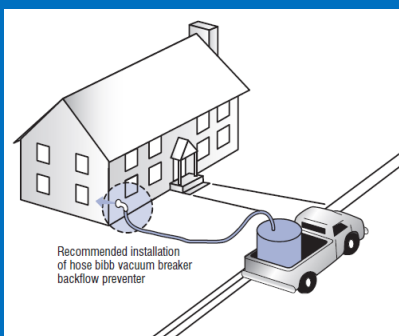


Cross-connections are actual or potential connections between a potable water supply and nonpotable water plumbing. Backflow is the unintended reversal of water flow through a cross-connection, which can result in a potentially serious public health hazard. A cross-connection control and backflow prevention program helps prevent contaminants from entering a drinking water distribution system. This fact sheet is part of EPA's Distribution System Toolbox developed to summarize best management practices that public water systems (PWSs), particularly small systems, can use to maintain distribution system water quality and protect public health.

Examples of Utility Actions

At a western United States (U.S.) PWS serving 2,500 people, a customer created a cross-connection when they connected a surface water irrigation line to the water system without installing an approved backflow prevention assembly. Irrigation water flowed back into the county water system when the pressure in the irrigation line increased. Samples tested positive for *E. coli* and the Department of Water issued a "Do Not Use" notice to customers.

A PWS in the southeastern U.S. serving 500,000 people experienced a cross-connection and backflow incident where aqueous fire-fighting foam was forced into the homes of an estimated 40,000 customers. After review of the incident, the PWS installed a backflow prevention assembly.



Cross-Connection Control, Backflow Prevention, and Water Quality

- Backflow of untreated water through an unprotected cross-connection can lead to serious chemical or microbiological contamination in distribution systems.
- Cross-connections can occur between the PWS distribution system and private irrigation systems, fire sprinkler systems, and other piping systems that receive PWS drinking water.
- When the pressure in a PWS distribution system is lower than in the connected plumbing system, backflow contamination can occur.
- A study published by the Water Research Foundation in 2010, using backflow-detecting water meters, found that 5% of homes registered a backflow incident of 1 gallon or more each year. However, the impact of these residential backflow incidents on distribution system disinfectant residual remains undetermined.
- Cross-connection and backflow prevention programs vary by state and municipality. Additional information may be available from state drinking water programs, building code or plumbing authorities, and health departments.
- Sanitary surveys, conducted at least once every three years for community water systems and once every five years for non-community PWSs, offer opportunities to identify potential cross-connections that put public health at risk.

Indicators of a Cross-Connection and Backflow Incident

- Customer complaints of odor, discoloration of water, or direct physical harm are the primary indicators of a backflow incident.
- Decreases in water pressure can indicate the occurrence of a backflow incident, as well as suggest where the incident may have occurred.
- A short-term reduction in disinfectant residual could indicate a potential backflow incident.
- During periods of reversed flow, water meters might run in reverse.

Example of a double check backflow prevention assembly



Disclaimer: To the extent this document mentions or discusses statutory or regulatory authority, it does so for information purposes only. It does not substitute for those statutes or regulations, and readers should consult the statutes or regulations themselves to learn what they require. The mention of trade names for commercial products does not represent or imply the approval of EPA.

Cross-Connection Control and Backflow Incident Response

- In the case of a backflow incident, reverse the pressure differential that caused the backflow, if possible.
- Identify and eliminate the cross-connection or install a backflow prevention assembly or device that meets local and state requirements.
- Perform a systematic flushing or cleaning of the system while strategically minimizing the risk of drawing contaminants into uncontaminated areas.
- Throughout the incident, continue to sample within and outside of the suspected contamination area to assess the extent of the contamination.
- Maintain compliance with local discharge regulations for disposal of potentially contaminated water.
- After flushing and cleaning, test the drinking water in the affected areas to ensure it meets regulatory standards.

Example Elements of an Effective Cross-Connection Control and Backflow Prevention Program

- **Legal authority:** PWSs may need legal authority to implement and enforce the program, like requiring customers to install and maintain backflow prevention assemblies. Rules may vary from state to state in terms of allowable backflow prevention assemblies for different hazard types, testing frequency, and remedial repair options.
- **Trained personnel:** All backflow prevention staff should be trained and certified in testing backflow prevention assemblies and distribution system operations. Certification requirements may vary from state to state.
- **Recordkeeping:** Recordkeeping should cover testing and repair activities, certification of inspection and repair personnel, and records associated with backflow prevention assemblies in service, including inspection dates and results.
- **Public education:** PWS customers should understand the potential health risks posed by cross-connections and backflow and their responsibilities for testing and repairing backflow prevention assemblies on irrigation systems or other potential cross-connections.

Table 1: Resources and Guidelines for Cross-Connection Control and Backflow Prevention

Resource Title and URL	Relevance to Cross-Connection Control and Backflow Prevention
ASDWA. 2020. Distribution System Survey White Paper. http://www.asdwa.org/	Summarizes survey findings about state cross-connection control programs.
AWWA. 2015. M14 Backflow Prevention and Cross-Connection Control: Recommended Practices. https://www.awwa.org/	Provides an in-depth analysis of causes and prevention of backflow and cross-connections in potable water systems.
University of Southern California Foundation for Cross-Connection Control and Hydraulic Research. 2012. Manual of Cross-Connection Control, Tenth Edition. https://fccchr.usc.edu/ List of Approved Backflow Prevention Assemblies. https://fccchr.usc.edu/list.html	The manual covers all aspects of cross-connection control and backflow prevention. Associated resources available on the FCCCHR website include a list of tested and approved backflow prevention assemblies and field test kits, training videos, and sample forms to be used in a cross-connection control program.
USEPA. 2006. Cross-Connection Control: A Best Practices Guide. http://nepis.epa.gov/	A concise summary of best practices for cross-connection control.
USEPA. 2003. Cross-Connection Control Manual. http://nepis.epa.gov/	Defines, describes, and illustrates typical cross-connections and suggests simple methods and devices by which cross-connections can be eliminated without interfering with the functioning of plumbing or water supply distribution systems.