



BEST PRACTICES IN BACKFLOW PREVENTION & PROTECTION



SAFE-T-COVER[®]
BY HYDROCOWL

ENCLOSURES DESIGNED FOR THE WORLD'S WATER SYSTEMS™

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The United States is home to one of the safest drinking water systems in the world. Even so, the Centers for Disease Control and Prevention reports that waterborne diseases affect more than seven million people in the U.S. every year. Many of these cases occur when potable water systems lack adequate backflow prevention.

Backflow is the reversal of water flow inside a distribution system, allowing contaminated water to enter piping that carries drinking water. Backflow preventer assemblies are mechanical valve systems that stop reverse flow (cross-connection) and protect public water safety in city mains, commercial buildings and at the point of use.

Despite the risks, more than 60% of public water systems are designed without proper backflow preventers. And those that do install proper prevention may not realize their system designs have introduced other serious health, safety and liability risks.

This guide covers everything civil engineers, water jurisdiction managers and building owners need to know about backflow prevention — from the types of backflow events and prevention assemblies to installation best practices and backflow enclosure standards.

CHAPTER 1: THE NEED FOR CROSS-CONNECTION CONTROL PROGRAMS

Water purveyors follow the strict Statement of Policy on Public Water established by the [American Water Works Association](#) (AWWA), which holds that the return of any water to the public system after it has been used on a customer's premises is unacceptable.

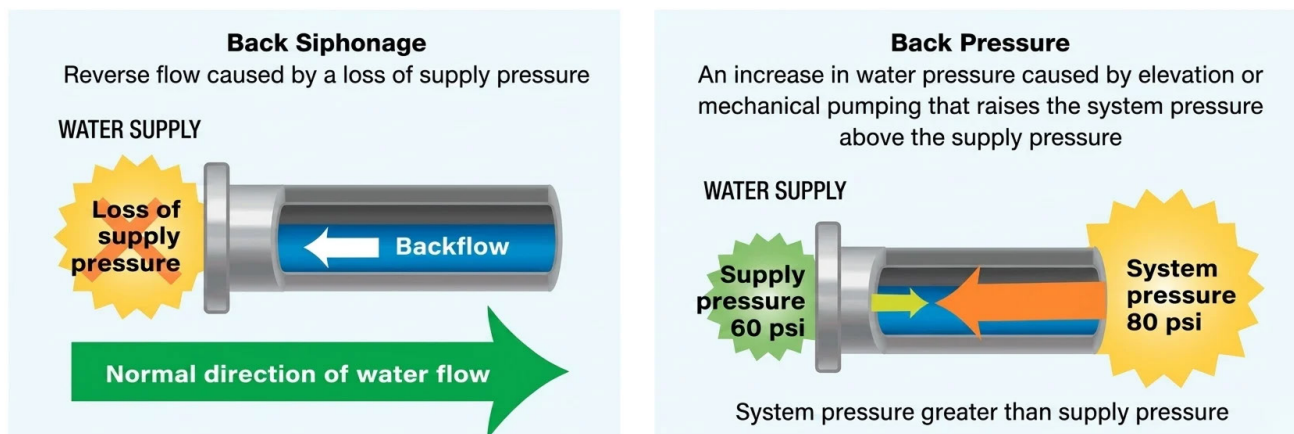
All commercial buildings must have backflow prevention on the supply side of the system to protect public drinking water from contamination. However, standards vary between state and local water jurisdictions regarding where and how backflow preventer assemblies are installed. Many jurisdictions do not require backflow prevention on the private side within the building. Where guidelines do exist, they are often outdated or fail to reflect current best practices.

Without quick access to accurate specifications, civil engineers default to whatever was done on prior projects — often unaware of the consequences of installing backflow prevention inside a mechanical room or underground in a utility vault. Those consequences can range from millions of dollars in property damage to injury or death.

The AWWA encourages the partnering of utilities, property owners and other stakeholders to jointly develop measures for maintaining water quality within premise plumbing systems. At a minimum, those operations should include a [cross-connection control program](#), routine monitoring and response training to prevent, detect, control and resolve water quality issues.

CHAPTER 2: WHAT CAUSES BACKFLOW

Backflow occurs when a hydraulic event creates more or less pressure inside a water distribution system's piping. These events trigger two types of backflow.



Back Pressure

Back pressure occurs when downstream pressure on the private side exceeds the pressure of water being delivered through the distribution lines on the public side. Events that can trigger back pressure include severe or widespread power outages that disable electric pumps and draining down a building to make plumbing repairs.

Back Siphonage

Back siphonage is less common. It occurs when insufficient pressure reaches the public distribution lines, causing contaminated water to siphon backward into the drinking water supply. Triggers include broken water mains or distribution pipes and the sudden use of large quantities of water, such as during firefighting operations.

Jurisdictions across the country increasingly acknowledge that without proper prevention for both types of backflow, they cannot comply with the Clean Water Act (CWA), the Cross-Connection Control Manual (CCCM) or the AWWA's standards. In response, water utilities have mobilized efforts to approve and standardize requirements in accordance with the American Society of Sanitary Engineers (ASSE) and the Foundation for Cross-Connection Control and Hydraulic Research (FCCCHR) at the University of Southern California.

These efforts focus on two approaches:

- 1. Isolation at the point of use involves** installing a backflow preventer assembly (BPA) just before the point of use to protect building occupants from contamination. The control valve under a sink is a basic example. This valve is typically left open so users can control flow with the faucet, but a plumber can manually shut off the isolation valve during maintenance to stop water before it reaches the fixture.
- 2. Containment at the point of supply** involves installing a BPA at the building's main water service inlet to prevent contaminated water from backflowing into the public supply, where it could travel to other buildings. The main water shutoff valve between where water enters the building and the utility meter serves this function.

CHAPTER 3:

TYPES OF BACKFLOW PREVENTION ASSEMBLIES

A backflow preventer is a one-way assembly of check valves or breakers that allows water to flow in a single intended direction while mechanically blocking reverse flow. Engineers select the type of BPA based on the hazard level of the system.

Hazard levels are defined by the Clean Water Act and the Environmental Protection Agency (EPA) as either high or low. High-hazard systems involve toxic contaminants that pose a serious and immediate health threat. Low-hazard systems involve pollutants that would not put the public water supply in immediate danger. The CCCM provides broad guidance on what constitutes high- and low-hazard situations, but the classification ultimately falls to the state or local water purveyor.

Selecting a backflow prevention device depends on the hazard level and the type of backflow that can occur: back pressure or back siphonage. The three most widely used assemblies are:

1. Air Gap

An air gap BPA uses a physical separation between the water distribution system (such as a faucet) and the sewer system (such as a drain). Water flows from the faucet to the drain, but it cannot reverse. Air gaps provide the highest level of backflow protection available. However, they are not always practical, especially in appliances with internal water systems such as dishwashers, dialysis machines, dental hygiene instruments or soft drink carbonation systems.

Approved for: back pressure, back siphonage, low-hazard applications, high-hazard applications.

Key considerations: Spatial and design constraints of the application, the ratio between the gap size and the inside diameter of the inlet pipe, and the proximity of the gap to the overflow level.

2. Double-Check Valve Assembly (DC)

A DC valve assembly uses two independently operating spring-loaded check valves. When downstream pressure exceeds public-side pressure, the first check valve closes to stop backward flow. If that valve malfunctions due to debris or mechanical issues, the second check valve closes as a backup. DC assemblies can be installed above grade or below grade in subterranean vaults and are commonly found in fire protection systems.



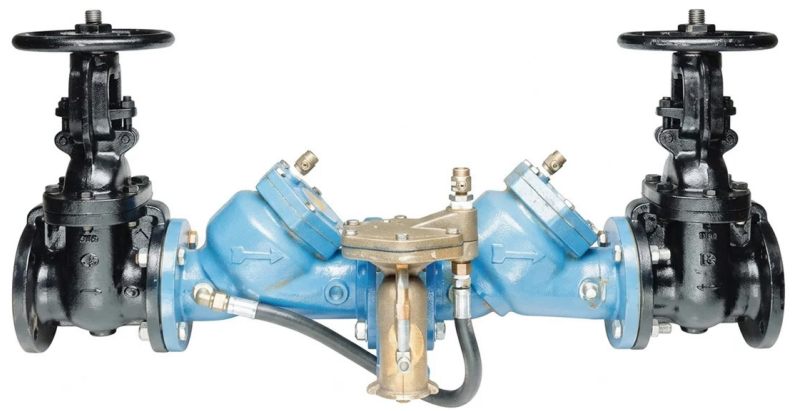
One important limitation: there is no way to detect a check valve malfunction without conducting a full-scale test. For this reason, DC assemblies are not recommended for high-hazard applications.

Approved for: continuous pressure operation, back pressure, back siphonage, above-grade and below-grade installation, low-hazard applications only.

Key considerations: Horizontal installation unless approved for vertical by the local water authority, safe access for inspections and testing, adequate clearance for maintenance, and the risk of undetected valve malfunction leading to cross-connection. Installing this assembly in a concealed location such as an underground utility vault compounds the risk, since malfunctions produce no visible indication.

3. Reduced Pressure Zone Valve Assembly (RPZ)

An [RPZ valve assembly](#) is similar to a DC but features a fail-safe design suited for every cross-connection situation, including high-hazard applications. In addition to two independently operating spring-loaded valves, RPZ assemblies include a hydraulic differential relief valve located between the two check valves. If a backflow event occurs and both check valves fail, the relief valve opens to create an air gap and dispose of the contaminated water.



Unlike DC assemblies, an RPZ's design inherently signals malfunction. If water dumps from the relief valve, the primary valves have a problem. If no water discharges, the primary valves are working properly.

Approved for: continuous pressure operation, back pressure, back siphonage, all hazard levels, above-grade installation only.

Key considerations: Horizontal installation unless approved for vertical, safe access for inspections and testing, adequate clearance for maintenance, proper drainage capacity that meets minimum air gap requirements, and placement inside a commercial building is not recommended.

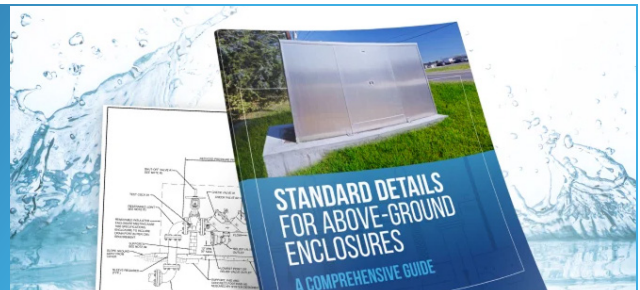
Even if double-check valves were once considered acceptable for a particular installation, it is important to confirm whether local standards have changed. Most municipalities now require RPZ valve assemblies due to their superior reliability.

For the most current list of approved backflow prevention assemblies from the FCCCHR, visit the USC FCCCHR approved list.

Upgrade Your Standard Details

5 editable CAD templates for above-ground backflow specs.

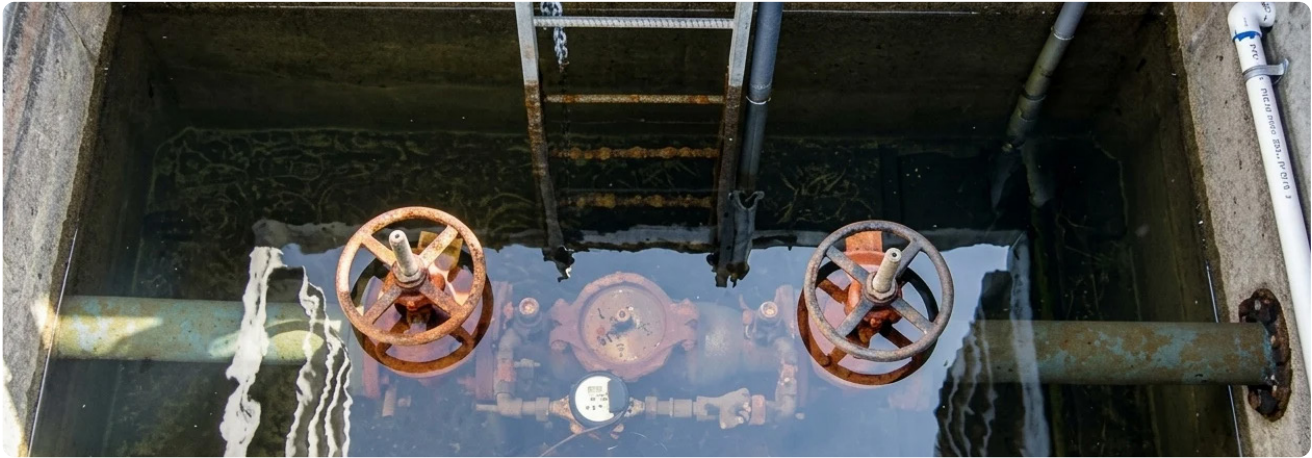
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CHAPTER 4: COMMON INSTALLATION METHODS AND THEIR RISKS

One of the most important design considerations for backflow prevention is placement. The consequences of choosing an unsafe location can be catastrophic.

Underground Utility Vaults



Despite numerous risks, subterranean utility vaults remain among the most common housing options for backflow preventer assemblies. Underground vaults are constructed of reinforced concrete or brick. Their subterranean location protects equipment from the elements and vandalism while minimizing the appearance of utility boxes on commercial properties.

However, their location frequently requires variances that diverge from recommended standards. In 2016, the FCCCHR [updated its stance](#), urging water utilities to avoid installing assemblies in subterranean vaults.

According to OSHA, vaults and other confined spaces contribute to nearly 100 deaths and more than 11,000 injuries every year.

Additional drawbacks of underground vaults include: higher cost compared to other installation methods, longer lead times for construction and installation, safety concerns related to air quality and slips and falls, poor accessibility due to location and limited internal space, flooding that can damage equipment and create additional hazards, cross-connection risk caused by flooding, regulatory restrictions that prohibit RPZ assemblies below grade, and deterioration that can require costly vault rehabilitation.

Vaults must also comply with additional OSHA standards for confined work environments, remain watertight with adequate drainage, and include protective measures for falls, ventilation and gas detection.

Designers and contractors should also consider building ownership changes. If a building's use changes, the hazard threshold can shift from low to high, putting the owner at risk for noncompliance unless they retrofit with an RPZ valve assembly — which cannot be installed below grade.

Inside Buildings



Another common option is installing BPAs inside commercial buildings, such as in a mechanical room or basement. Indoor installation provides easy access, climate control and protection from vandalism. However, if the system is high-hazard and requires an RPZ assembly, [building owners face serious flood risk](#).

Depending on the assembly and pressure combination, an RPZ malfunction can dump approximately 375 gallons of water per minute, resulting in millions of dollars in damages.

Additional drawbacks of indoor installation include the fact that BPAs are often larger than building owners expect, creating spatial constraints, the need for greater liability coverage due to elevated flood risk, and the potential for cross-connection caused by flooding.

Indoor installations require an adequate drainage system with capacity to prevent catastrophic flooding, compliance with building codes for proper clearance around assemblies, and awareness that it is never advisable to install an RPZ assembly with a pipe size of 2-1/2 inches or larger indoors.



CHAPTER 5:

ABOVE-GROUND ENCLOSURES: THE SAFEST, MOST COST-EFFECTIVE OPTION

The safest and most cost-effective housing option for backflow preventer assemblies is an outdoor above-ground utility enclosure. These enclosures come in stock sizes or can be customized to fit around equipment with adequate clearance.

Compared to underground vaults, above-ground enclosures get approved twice as fast on average and can be ordered and installed in less than half the time. They eliminate the threat of technician injury, flooding, property damage and unnecessary liability while protecting equipment from vandalism, extreme temperatures, harsh weather and cross-connection with contaminated water.

To ensure maximum protection and value, select only above-ground enclosures that are ASSE 1060-certified. This multi-level standard ensures your solution includes the necessary exterior protection, interior temperature control, locking mechanism and drainage for the environment.

Additional advantages of above-ground enclosures:

- Enclosures can be fully customized to meet the exact needs of an application, including [custom enclosure designs](#) for nonstandard projects.
- Costs are significantly lower due to the absence of heightened compliance and liability risks. The four primary cost factors are the physical equipment and enclosure, a concrete pad for support and stabilization, running an electrical line for heated enclosures, and labor for design, installation, testing and maintenance.
- Easier access allows technicians to maintain equipment health and extend the enclosure's lifespan. [Safe-T-Cover enclosures](#) typically last more than 30 years.



Important installation factors for above-ground enclosures:

- BPAs should be installed above the 100-year flood level to prevent external flood damage.
- The enclosure must meet OSHA 29 CFR 1910.145 and ASSE 1060 Class 1.
- The enclosure must house all required piping and meet clearance requirements for maintenance.
- Designs must include a tamper-resistant locking mechanism for vandalism protection. Safe-T-Cover's [LOK-360](#) and [MUNI-LOK](#) systems are engineered specifically for this purpose.
- If heated, enclosures must include a thermostatically controlled electric heater that meets Section 49 of UL 943 NEMA 3R and maintains a constant temperature of 40°F. Learn more about [Safe-T-Cover's slab-mounted heaters](#).

CHAPTER 6: UNDERSTANDING ASSE 1060 COMPLIANCE



The ASSE 1060 is the national standard for performance requirements of outdoor enclosures that protect backflow prevention assemblies and water-conveying components. Selecting the correct class requires knowing the worst-case low temperature at the installation site.

SPECIFICATION	REQUIREMENT
Class I — Freeze Protection (Heated)	Maintains minimum internal temperature of 40°F with external temperature of -30°F. Minimum R-value of 8.0.
Class II — Freeze Retardant	Maintains minimum internal temperature of 40°F for a 24-hour period. May or may not include a heater. Minimum R-value of 8.0.
Class III — Non-Freeze Protection	No freeze protection. No minimum R-value. Designed for security and access control only.
Structural Strength	Must support a minimum vertical load of 100 pounds per square foot.
Drainage Capability	Must prevent water from submerging equipment. Water rise shall not exceed eight inches during full RPZ discharge. Drain rates range from 27 GPM (1/4" to 1/2" pipe) to 710 GPM (4" and above).
Testing and Maintenance Access	Test cocks and valve handles must be within 24 inches of access opening. Hinged panels must be restrained in both open and closed positions. Unrestrained panels must weigh 70 lbs. or less.
Security and Vandalism Protection	Access must be lockable via keyed devices or padlock capability.
Exterior Materials	Aluminum, galvanized steel, prepainted galvanized steel, stainless steel, natural stone or fiberglass-reinforced plastic with gelcoat.
Interior Materials	Cedar, redwood, closed-cell foam insulation (1% maximum water absorption), glass fiber-reinforced facers or approved external materials.

Recommendation: Even in traditionally warm regions, a Class I heated enclosure is increasingly the defensible specification. Freeze events in Florida, Texas and Arizona have caused thousands of assembly failures in jurisdictions that assumed freeze protection was unnecessary.

For the complete ASSE 1060 specification breakdown, visit Safe-T-Cover's ASSE 1060 resource page.

CHAPTER 7: MUNICIPALITIES LEADING THE WAY

Across the country, forward-thinking jurisdictions have already updated their standards to require above-ground backflow prevention. Here are three examples.

📍 ARLINGTON, TEXAS

Arlington manages about 3,000 high-hazard backflow assembly sites. After a [two-year survey](#) of 1,220 DFW civil and plumbing engineers conducted by EnviroDesign and Safe-T-Cover, city officials found a critical gap between local practice and recommended best practices from the AWWA and American Society of Plumbing Engineers (ASPE). Three out of four respondents agreed that local water guidelines lacked needed standard details for above-ground installations. **Almost 97% said the survey enhanced their understanding of backflow prevention.**

In 2016, [Arlington](#) became the first city in north-central Texas to publish containment and isolation backflow preventer guidelines for nonresidential projects. Today, builders have exact installation details they can copy directly into plans — eliminating guesswork and expediting the design process.

📍 LAS VEGAS, NEVADA

Nevada's harsh climate was wearing down underground vault infrastructure. Concrete walls deteriorated, rebar lost structural stability and rehab projects grew increasingly expensive. Full vault rehabilitation takes at least a month and may yield only another 10 years of service. Vaults also cost up to \$5,000 annually in safety preparations alone.

Las Vegas standardized the use of above-ground enclosures and began placing backflow preventers and water meters in the same enclosure — reducing the equipment footprint on each property. After a detailed cost analysis, **the city found that as much as \$60,000 could be saved per installation.**

📍 NEW JERSEY

New Jersey water systems complete 200,000 or more mark-outs each year as part of their 811 "Call Before You Dig" program. These programs are funded by the Federal Pipeline Safety Act and exist in every state to ensure that utility service lines including gas, water, and electric are marked by an 811 representative from the tap to the meter. When meters were installed inside buildings, Public Water System representatives had to knock on doors, request access and depend on building occupants for entry. Ratepayers shouldered the cost burden.

The state updated its guidelines to require above-ground installation for all new nonresidential meters and containment backflow preventers, located close to the curb for quick access. According to the New Jersey Board of Public Utilities, "board staff has investigated incidents in which it has concluded that unmarked water underground facilities contributed to the loss of life, property damage, and injuries to the public." Moving meters and backflow preventers above ground saved lives while reducing costs.

CHAPTER 8: ADDRESSING AESTHETICS AND COMMON MISCONCEPTIONS

Concerns about the appearance and security of above-ground enclosures are common but often based on outdated assumptions.



MISCONCEPTION:

Above-Ground Enclosures Are Too Large

Traditional enclosures were often oversized. Today, enclosure designs are up to 70% smaller, making them far easier to integrate into a site plan. Many jurisdictions also combine backflow preventers and water meters in the same above-ground enclosure, further reducing the equipment footprint.

Use the [Safe-T-Cover sizing guide](#) to find the right enclosure for your project.

MISCONCEPTION:

Above-Ground Enclosures Are Aesthetically Displeasing

Contractors have many options to help enclosures blend in with building facades or landscaping:

Color: Enclosures are available in a full spectrum of weather-resistant colors and finishes, applied using prefinished sheet metal coating rather than paint to prevent chipping, discoloration and weathering.

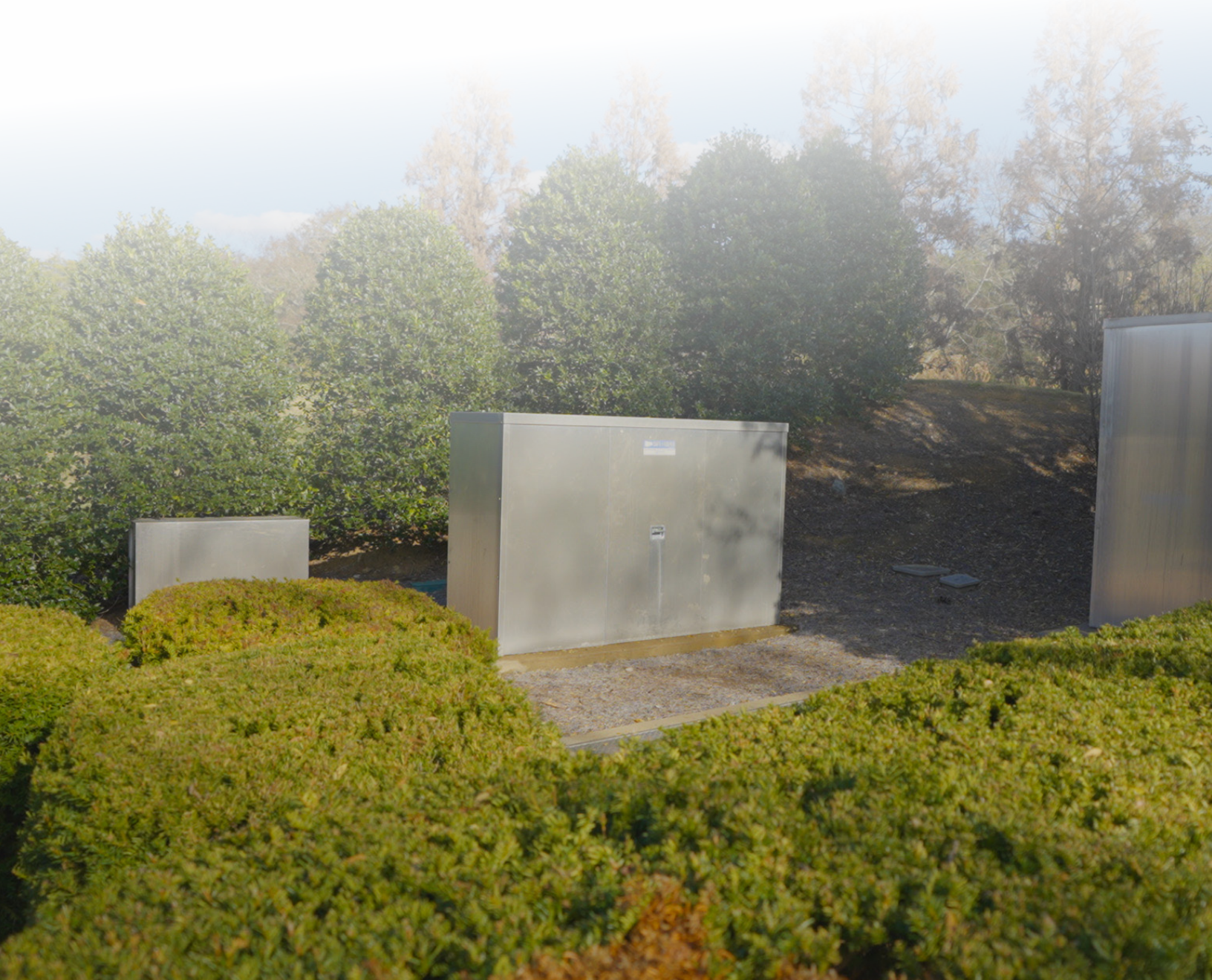
Vinyl wraps: Some building owners choose high-resolution vinyl graphic wraps to showcase a company logo, advertise a product or feature art. Wraps also protect enclosures from UV and precipitation exposure.

Landscaping: Creative placement of trees, shrubs and bushes can conceal enclosures of any size. Certain species of privet grow up to 12 feet tall and can be hedged for year-round concealment.



MISCONCEPTION:**Above-Ground Enclosures Invite Vandalism**

[Backflow cages can result in theft and vandalism](#), but ASSE 1060-certified enclosures are designed to protect and secure equipment. These enclosures are constructed of marine-grade aluminum and include a tamper-resistant locking mechanism on the access panel that has been tested and approved for safety and security.



DESIGN FOR THE WORST. PLAN FOR THE BEST.

There is no penalty for overprotecting water and the people responsible for maintaining water systems. Incorporate these best practices into your next design project and work with local water jurisdictions, property owners and contractors to develop a comprehensive cross-connection control program with standardized guidelines for backflow prevention.

As more jurisdictions move to prohibit underground vaults, these best practices will keep your specifications well ahead of the curve. From better cost control and lead times to greater accessibility and maintenance efficiency, the advantages of above-ground enclosures are significant — but nothing compares to the safety they provide for people, buildings and assets.

Get the Free Standard Details Guide

Ready to modernize your backflow prevention specifications?

The Standard Details Guide includes five editable CAD templates for above-ground backflow installations, ASSE 1060 compliance checklists, real examples from municipalities that have already upgraded and time-saving tips for faster, safer installs.

[Download the Free Guide + CAD Files](#)

