CROSS CONNECTIONS & BACKFLOW PREVENTION

ST. JOHN'S

DEPARTMENT OF PUBLIC WORKS AND PARKS
ENVIRONMENTAL SERVICES DIVISION

Overview

- Theory
- Documented Examples
- Types of Devices
- Selection of Devices
- City of St. John's Program

Cross - Connection

What is a cross – connection?

- This can be defined as actual or potential connections between a potable and non-potable water supply.
- Example – Hose Bib

Cross - Connection

Why do cross-connections exist?

- Lack of Knowledge - Plumbing connections are frequently installed by individuals who are unaware the inherent dangers of cross connections.
- The cross connections are made as a matter of convenience without regard to the dangerous situation that might be created.
- The connections are made with reliance on inadequate protection (such as a single valve or another mechanical device)

Backflow

What is Backflow?

- This can be defined as fluid flow in an undesirable or reverse direction.

Types of Backflow

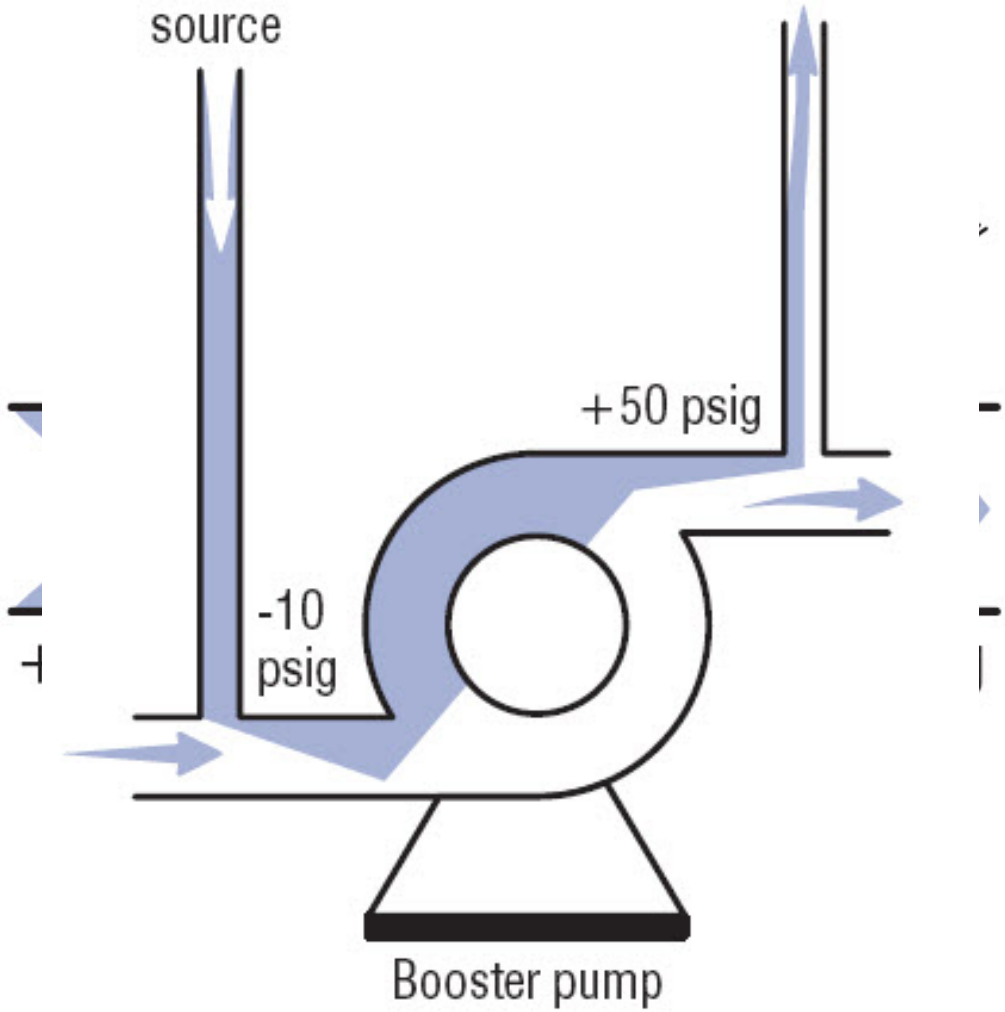
Back Siphonage

- Caused by atmospheric pressure exerted on a pollutant liquid forcing it toward a potable water supply system that is under a vacuum.

Causes of Vacuum in Potable Water System

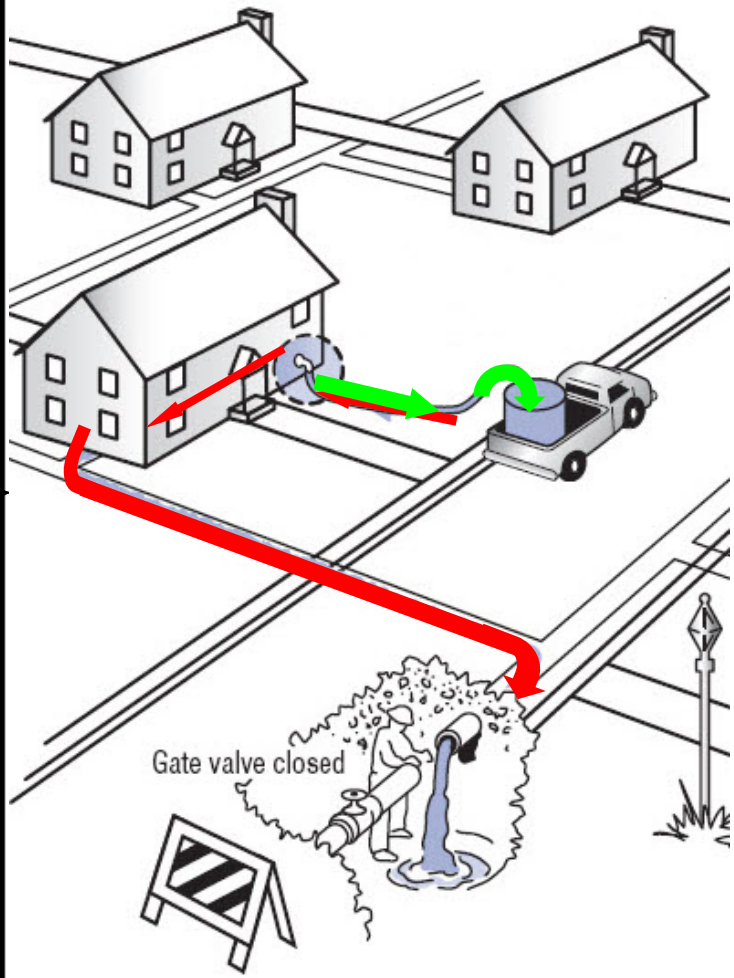
- Water Main Break
- Constricted Flow – Venturi
- Dynamically Reduced Pipe Pressures - Pump

Back Siphonage



Real Examples of Backflow

- Insecticide in Water System -



- Contractor applying insecticide treatment, mixing water to dilute chemical from hose bib.
- City workers were completing maintenance on a section of water main.

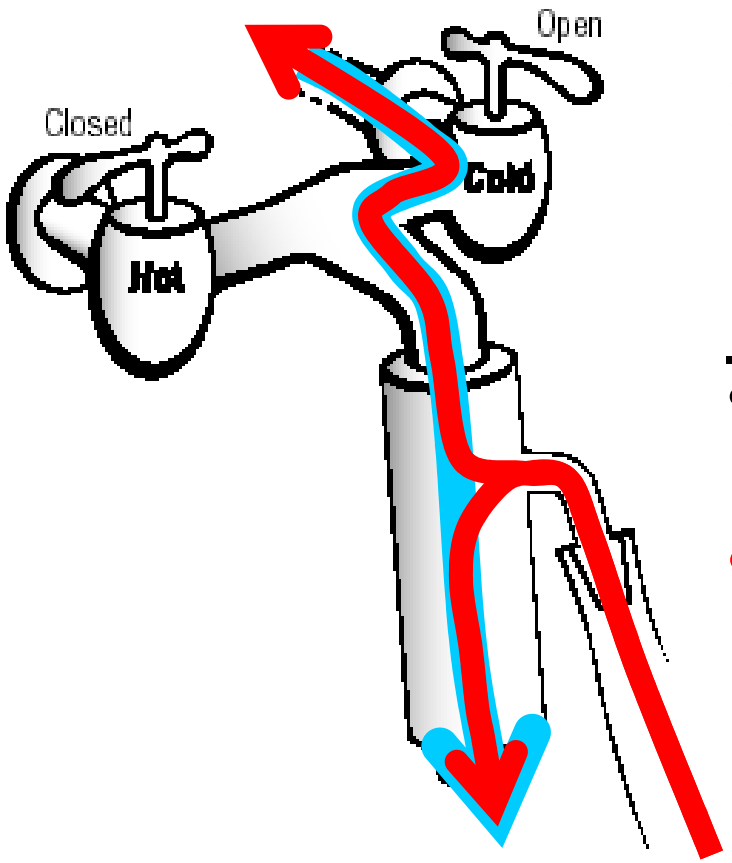
What occurred:

- Combination of low water pressure and simultaneous use of hose submerged in tank.
- **Back Siphonage!!!**

  Instead of water entering the tank, the entire contents of the tank (insecticides) were drawn in the opposite direction, into the potable water supply.

Real Examples of Backflow

- Human Blood in Water System -



- Funeral home using a <u>hydraulic aspirator</u> directly connected to potable water supply.
- Water flow through the aspirator creates suction, utilized to draw body fluids through a hose and needle attached to the suction side of the aspirator.

<u>What occurred:</u>

- Combination of low water pressure and simultaneous use of the aspirator.
- Back Siphonage!!!

  Instead of body fluids flowing into the sanitary drain, they were drawn in the opposite direction, into the potable water supply of the funeral home.

Types of Backflow

Back Pressure

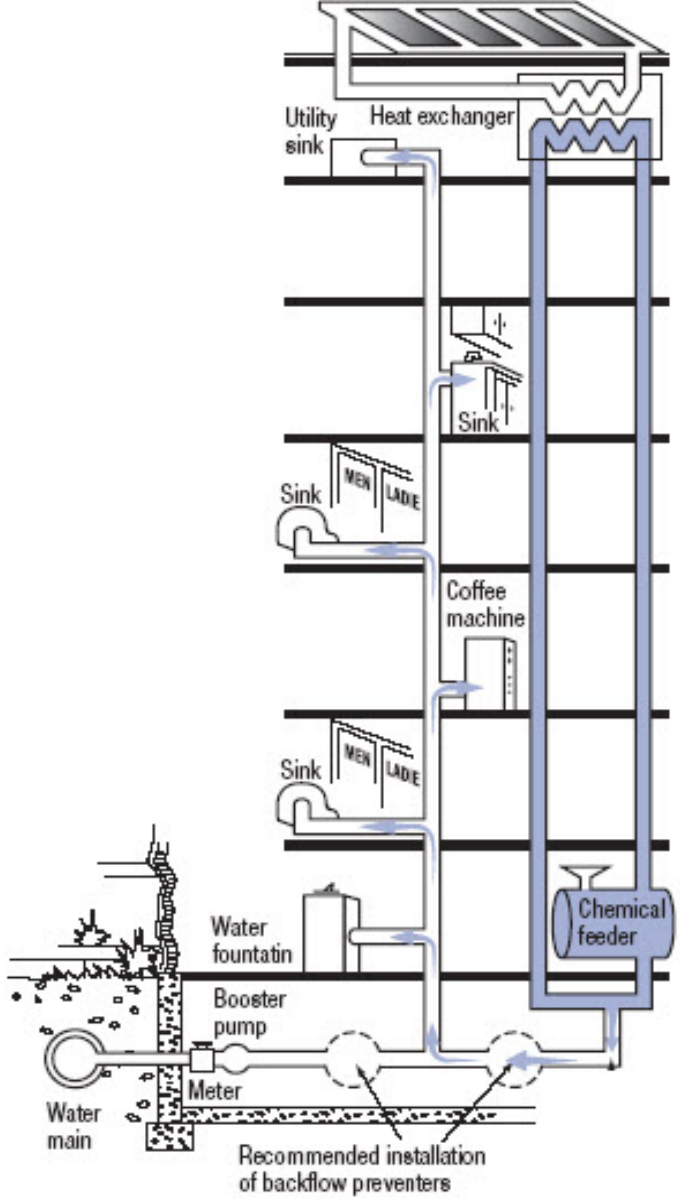
- Any interconnected fluid system in which the pressure of the one exceeds that of the other, may have flow from one to the other as the result of pressure differential.

Causes of Back Pressure in Water System

- High Rise Building – booster pump
- Fire Protection Line – booster pump
- Heating System – recirculation or chemical feed pump

Back Siphonage

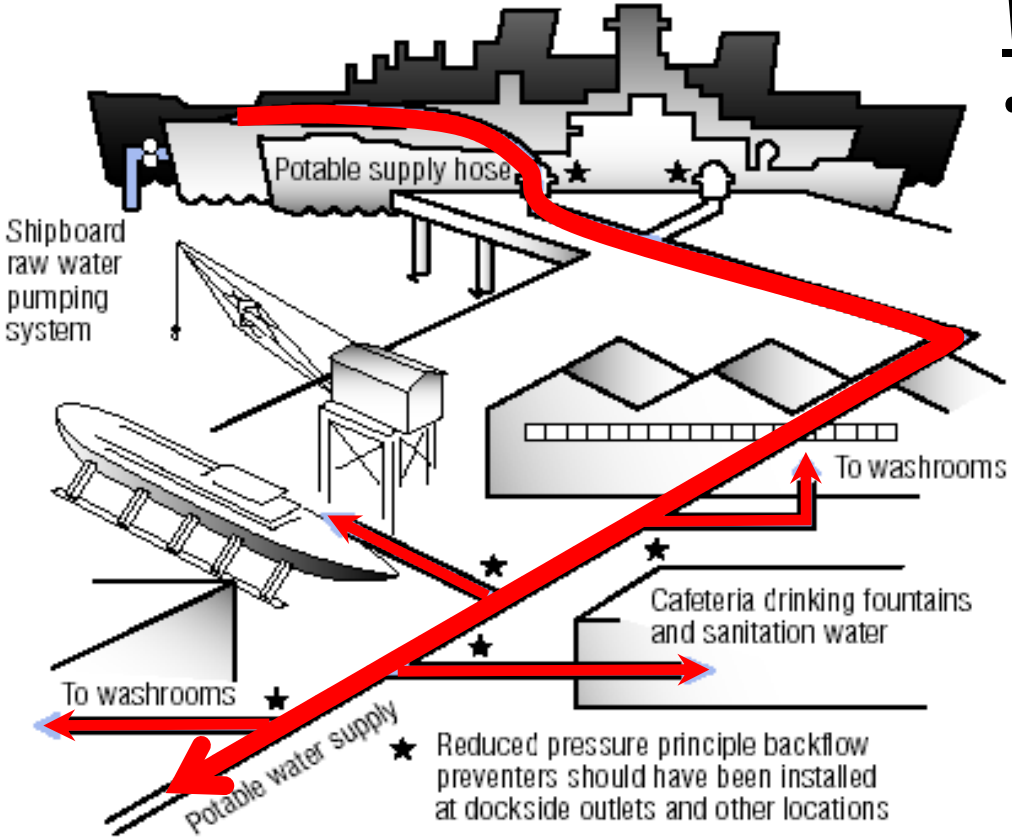
- Any pumped system within a building, could be a possible source of a backflow event.



Real Examples of Backflow

- Shipyard Backflow Contamination -

- Shipyard was aware of the need for backflow protection at the dockside tie up area.
- Waiting on device to be delivered and installed.



What occurred:

- Shipyard potable water supply was connected to a ship at the dock, accidentally creating a direct cross-connection with the on-board salt water fire protection water system.

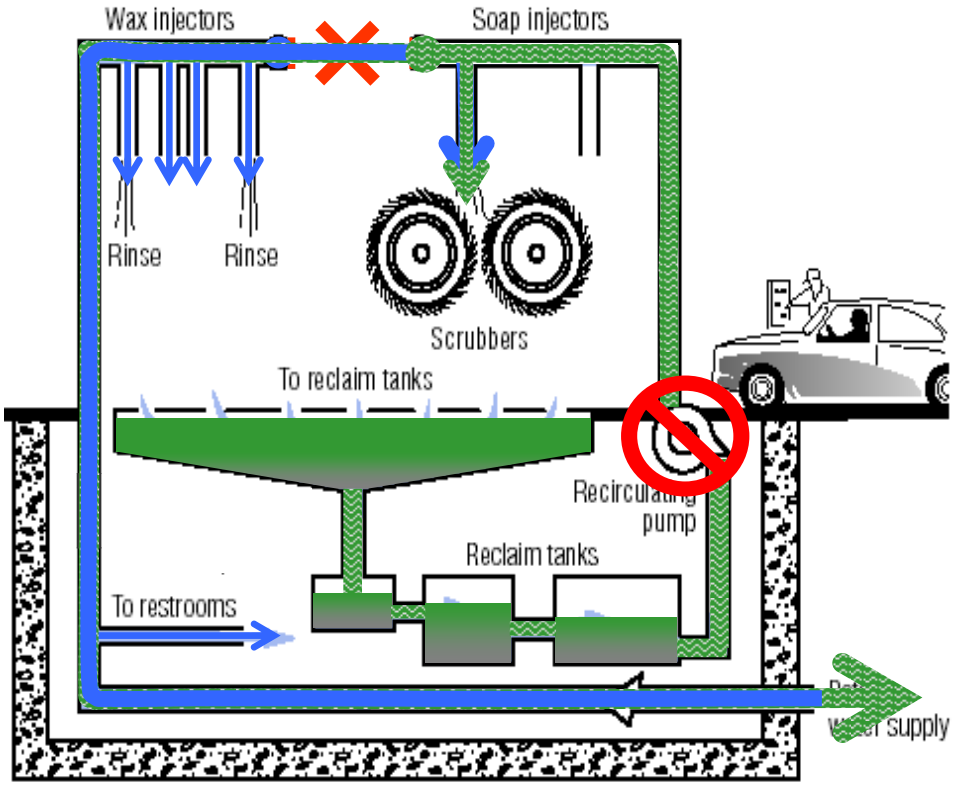
Back Pressure!!

Fire protection system, being at a greater pressure than the potable supply, forced raw sea water into the shipyard potable supply lines.

Real Examples of Backflow

- Car Wash Water in Water Main -

- High pressure pump used to pump recycled reclaimed wash and rinse water from the reclaim tanks back to the initial scrubbers.
- No potable plumbing connection is normally made to the car wash's scrubbers.



What occured:

- Pump failed → removed for repair.
- "Temporarily" connected a 2-inch hose between the potable water piping and the scrubber cycle piping.
- Pump reinstalled. Hose not removed.

Back Pressure!

Large quantity of reclaimed wash/rinse water pumped into 12-inch water main in street.

Types of Backflow Preventers

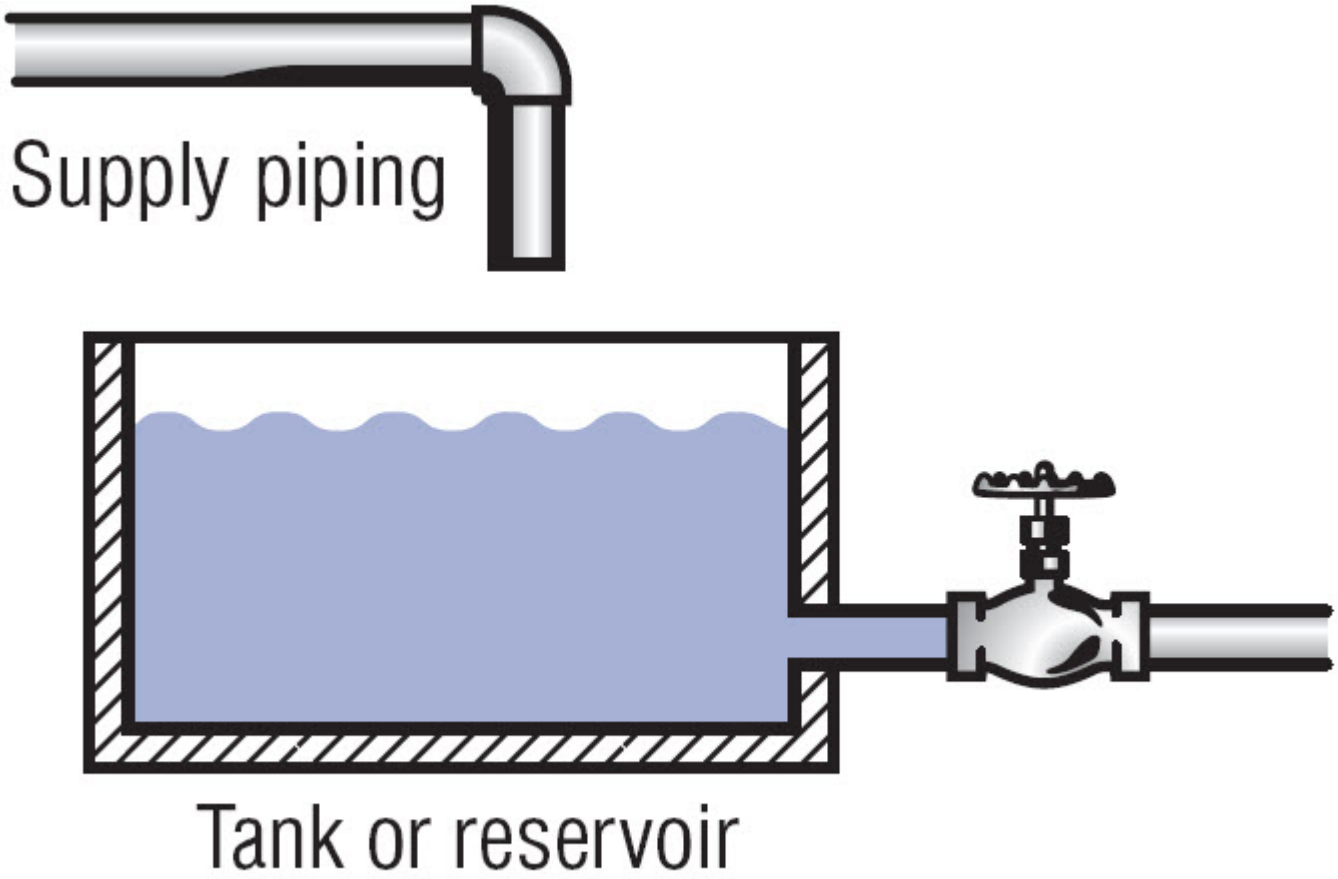
- Air Gap
- Vacuum Breaker
- Dual Check Valve
- Double Check Valve
- Reduced Pressure Principle

Types of Backflow Preventers

Air Gap

- Non mechanical backflow preventers
- Extremely effective device
- Can only be used to prevent backsiphonage
- Requires break in piping layout
- Current standard – outlet must be 2 diameters water surface

Air Gap



Types of Backflow Preventers

Vacuum Breaker - Atmospheric

- Simplest and least expensive device
- Can only be used to prevent backsiphonage
- Water lifts “float”, loss of water causes float to drop and the unit to vent to atmosphere
- Minor or Moderate Hazard

Vacuum Breaker - Atmospheric

Types of Backflow Preventers

Vacuum Breaker – Hose Bib

- Consists of a spring loaded check valve which seals against the atmospheric outlet when the water is turned on. When the water is shut off the device vents to atmosphere.
- Minor Hazard

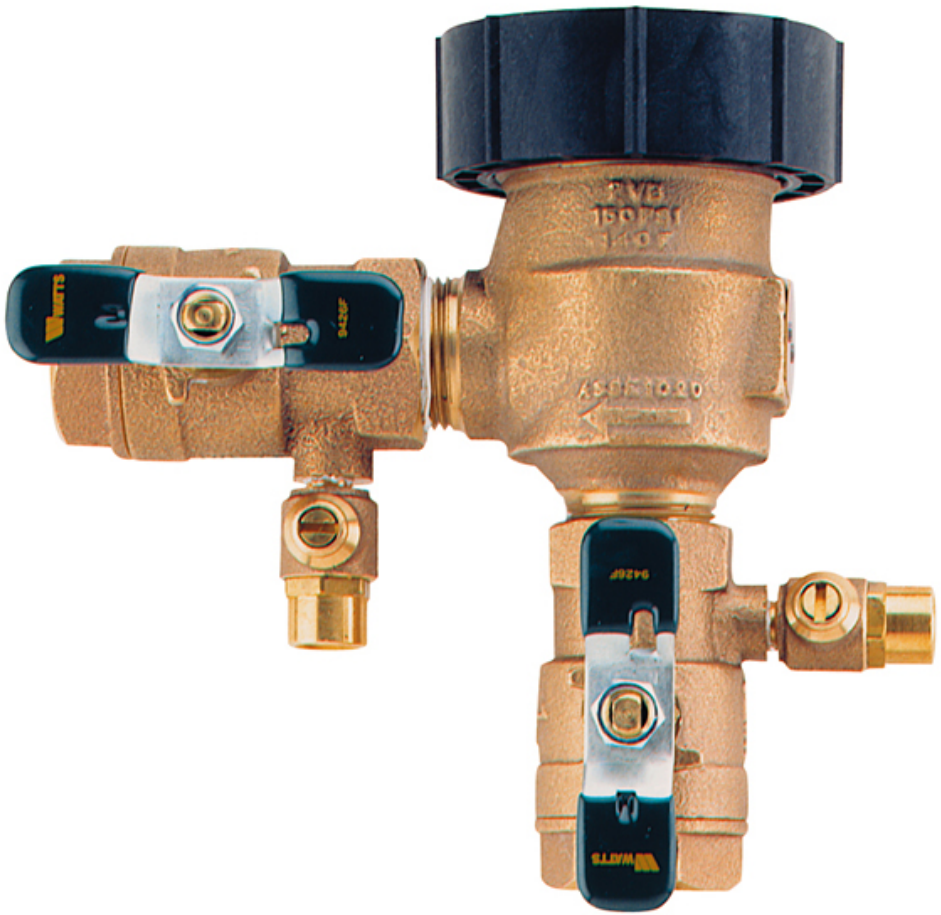
Vacuum Breaker – Hose Bib

Types of Backflow Preventers

Vacuum Breaker – Pressure

- This type of vacuum breaker could be used under constant pressure and has test cocks.
- This device will not protect against backpressure conditions
- Device must be installed 150mm to 300mm above outlet.
- Minor, Moderate or Severe Hazard against back siphonage ONLY

Vacuum Breaker – Pressure

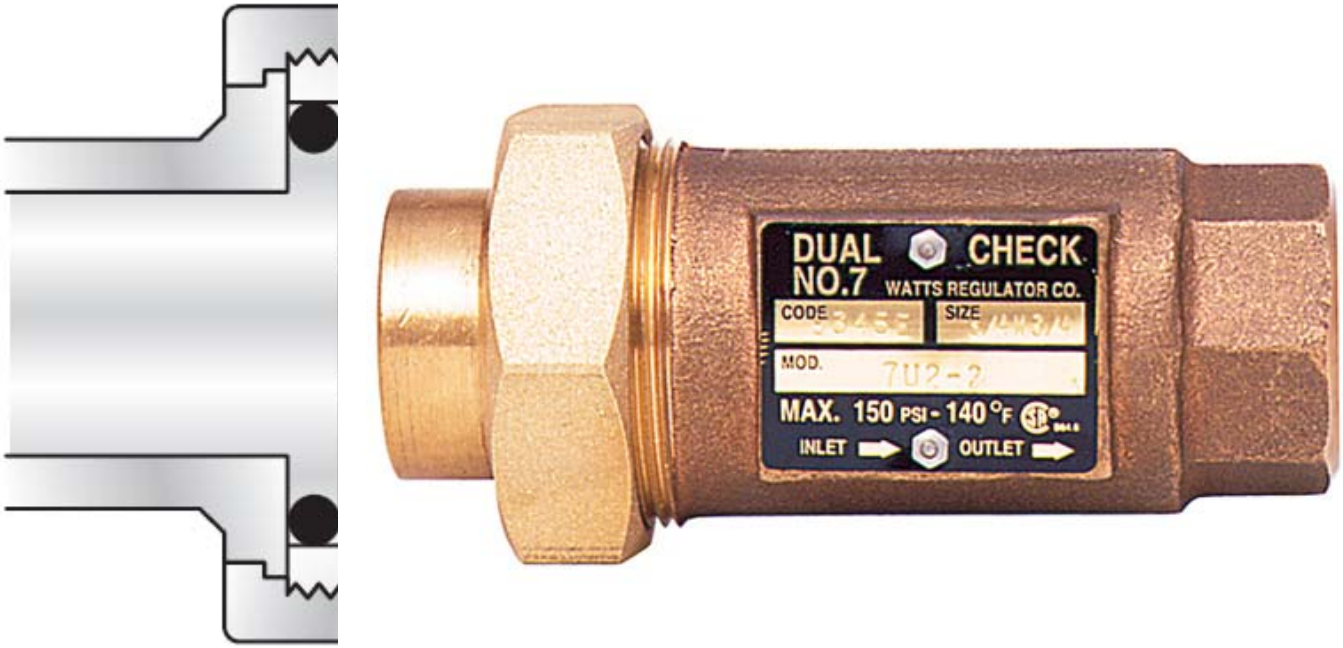


Types of Backflow Preventers

Dual Check Valve

- Consist of two independently acting internally loaded check valves with or without an atmospheric vent.
- Are not equipped with test cocks.
- Primarily Residential Applications.
- Minor Hazard Only

Dual Check Valve



Types of Backflow Preventers

Double Check Valve

- Consist of two independently acting internally loaded check valves either force or internally loaded.
- Will prevent backflow if either check valve fails to close
- Equipped with Test Cocks for regular testing.
- Minor or Moderate Hazard

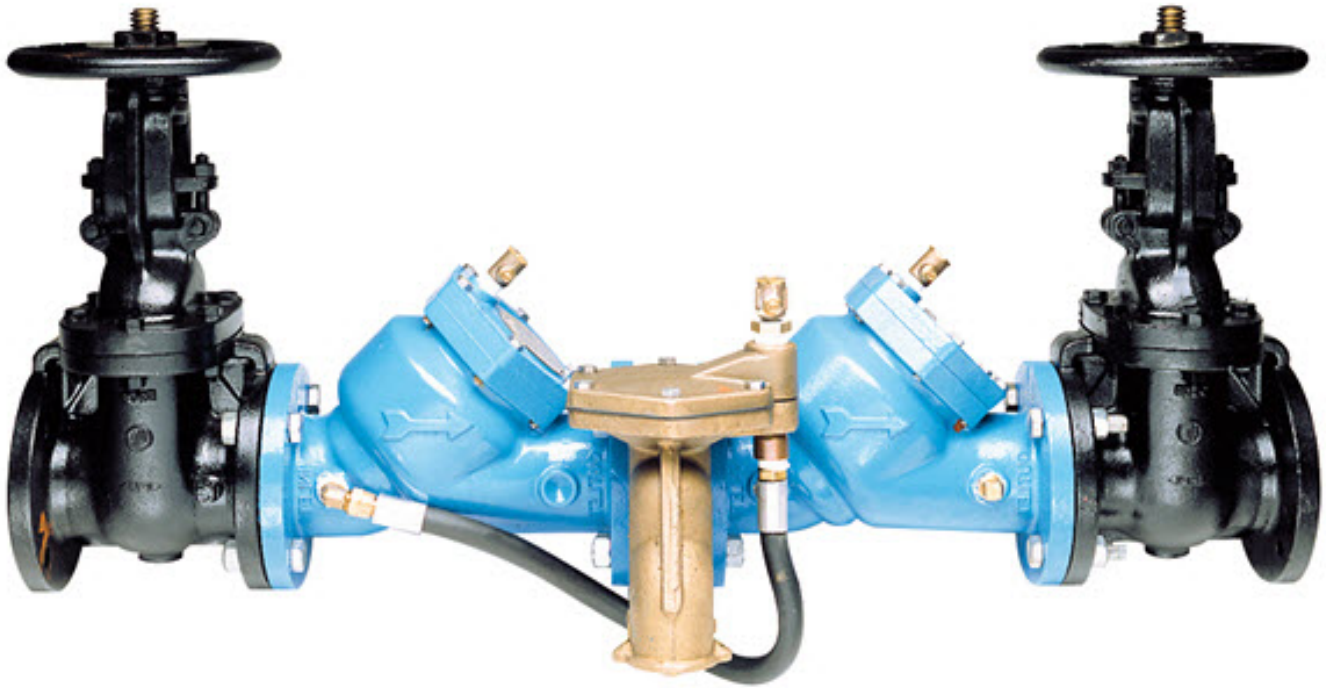
Double Check Valve

Types of Backflow Preventers

Reduced Pressure Zone Assembly

- Consist of two independently acting internally loaded check valves separated by a reduced pressure zone.
- During normal operation the pressure between the two check valves is maintained at a pressure lower the supply pressure (reduced pressure zone). If a backflow occurs the second check valve closes and if the pressure increases in the reduced pressure zone as it approaches the supply pressure the relief valve will open.
- Can be used for Severe Hazard

Reduced Pressure Zone Assembly



Selection of BFP Device

Need to Determine the following:

- The probability of back siphonage will cause backflow;
- The probability of back pressure will cause backflow;
- The severity of the hazard;
- The type of building.

Selection of BFP Device

Severity of the Hazard – CSA definition

- Minor Hazard – any type of cross-connection or potential cross-connection that involves a substance that constitutes only a nuisance that results in a reduction in only the aesthetic qualities of water
- Cannot create a danger to health.

Selection of BFP Device

Severity of the Hazard – CSA definition

- Moderate Hazard – any minor hazard that has a low probability of becoming a severe hazard.
- Connections involving water where the aesthetic qualities of water have been reduced and under certain conditions can create a danger to health.

Selection of BFP Device

Severity of the Hazard – CSA definition

- Severe Hazard – any type of cross-connection or potential cross-connection involving water that has additives or substances that under any concentration can create a danger to health.

Selection of BFP Device

Table B.1
Guide to degree of hazard — Point of use cross-connections
(See Clauses 5.4.1 and B.2.)

Source of pollution or contamination	Degree of hazard
Agricultural chemical (sprayer)	Severe
Air compressor oil cooler	Moderate
Animal watering	Moderate
Aspirator (non-toxic)	Moderate
Aspirator (toxic)	Severe
Autoclave	Severe
Autopsy and mortuary equipment	Severe
Auxiliary water supply	Severe
Baptistery	Moderate
Basin	Moderate
Bathtub (all)	Moderate
Bedpan washer	Severe
Beverage dispensing equipment (no carbonator)	Minor
Beverage dispensing equipment (with carbonator)	Moderate

Selection of BFP Device

Table B.2
Guide to degree of hazard — Premises
(See Clauses 5.3.1.2, 5.3.4, and B.2.)

Type of building or facility	Degree of hazard
Airport	Moderate
Animal feed lot	Moderate to severe
Animal stock yard	Moderate to severe
Apartment building	Moderate
Aquaculture farm	Severe
Aquarium (public)	Severe
Arena	Moderate
Asphalt plant	Severe
Water filling station	Severe
Water park	Moderate
Water treatment plant	Severe
Water treatment pump station	Severe

Selection of BFP Device

Table 2
Selection guide for backflow preventers
(See Clauses 5.3.1.1 and 5.4.1.)

Type of device	CSA Standard designation	Degree of hazard			Device under continuous pressure
		Minor	Moderate	Severe	
Air gap	—	✓	✓	✓	No
AVB	B64.1.1	✓	✓	✓*	No
DCAP	B64.3	✓	✓†	—	Yes
DCAPC	B64.3.1	✓	✓	—	Yes
DCVA	B64.5	✓	✓	—	Yes
DuC	B64.6	✓	—	—	Yes
DuCV	B64.8	✓	✓†	—	Yes
HCDVB	B64.2.1.1	✓	✓†	✓*	No
HCVB	B64.2	✓	✓†	✓*	No
LFVB	B64.7	✓	✓†	✓*	No
PVB	B64.1.2	✓	✓	✓	Yes
RP	B64.4	✓	✓	✓	Yes

Cross Connection Control Program

The AWWA recognizes water purveyors have the responsibility to supply potable water to their customers. In the exercise of this responsibility, water purveyors must implement, administer and maintain ongoing backflow prevention and cross-connection control programs to protect public water systems from the hazards originating on the premises of their customers and from temporary connections that may impair or alter the water in the public water systems. The return of any water to the public water system after the water has been used for any purpose on the customer's premises or within the customer's piping system is unacceptable.

Cross Connection Control Program

Development of a Program

- CSA B64 states that to protect the municipal or private potable water supply systems from contamination the authority administering the local cross connection control program has several options available when determining the location of backflow preventers within industrial, commercial and residential properties.

Cross Connection Control Program

Development of a Program - Option 1

Containment Theory

- Backflow prevention is installed on the incoming service, providing premise isolation that utilizes a minimum number of backflow preventers to isolate the municipal potable water system from the private system. But this does not protect the consumer from the source of internal contamination within the building.

Cross Connection Control Program

Development of a Program - Option 2

Internal Protection

- Backflow preventers are either installed on individual usages or zones of usage. This approach protects the private potable water system from internal contamination but does not adequately protect the municipal potable water system because of the complexity of the internal plumbing system.

Cross Connection Control Program

Development of a Program - Option 3

<u>Containment & Internal Protection</u>

- Combines both Options 1 & 2 to ensure that both the public and private potable water supply systems are protected.
- The City of St. John's has selected Option #1

CSJ Premise Isolation Program

CSJ's Water Distribution System Permit to Operate

"The owner should recognize the importance of putting in place a cross connection control program with ongoing testing and maintenance of cross connection control equipment within its facilities and also to address existing and potential cross connections in the water distribution system such as bleed lines into manholes, unprotected watering stations, commercial and industrial establishments, private water supplies, etc."

CSJ Premise Isolation Program

Development of a Program

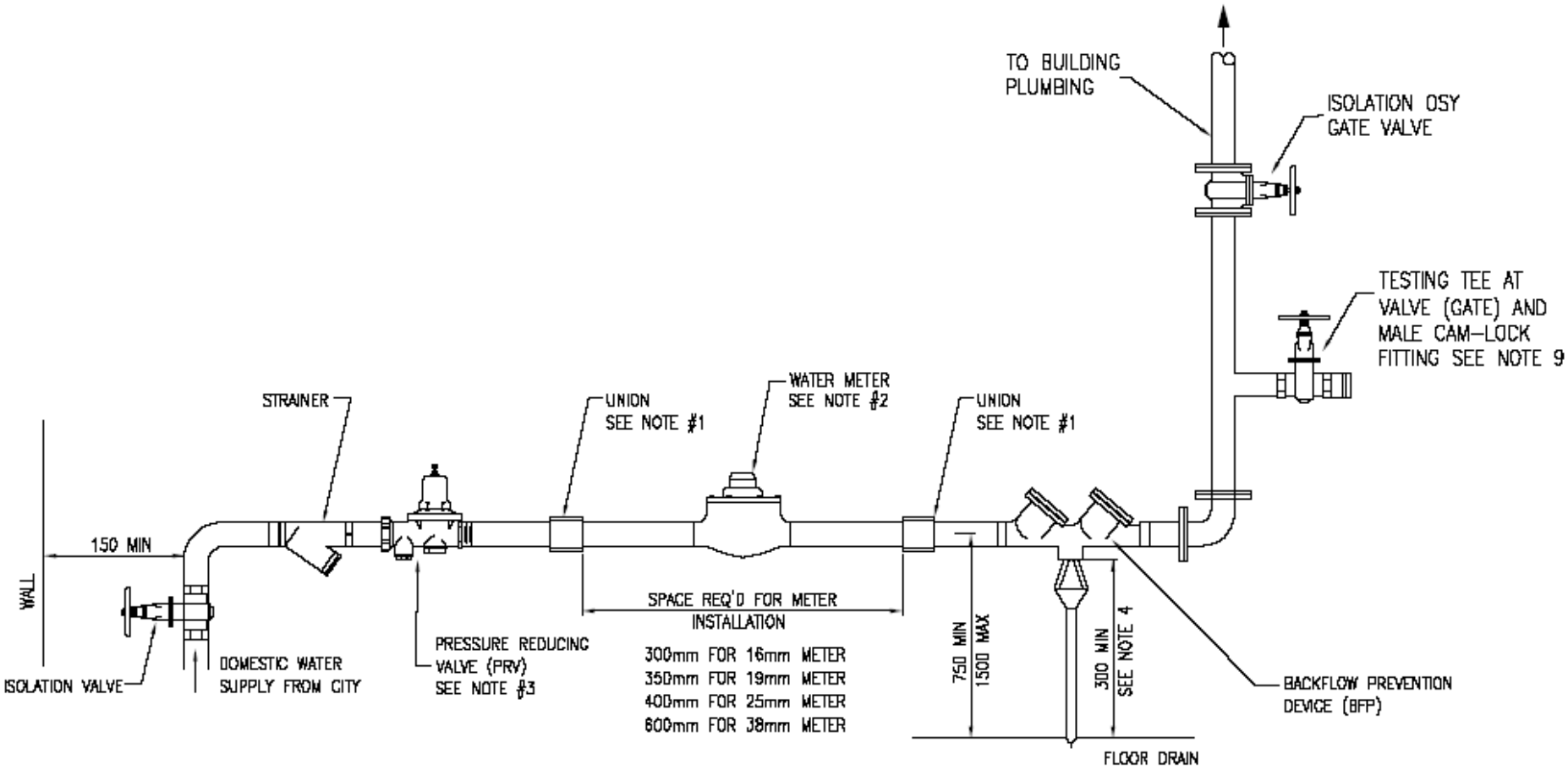
- 2007 – researched existing programs & developed draft document.
- Feb. 26, 2008 – presented Premise Isolation Policy to Public Works Committee
- March 3, 2008 – Council passed Premise Isolation Policy for new developments
- Currently developing By-Law

CSJ Premise Isolation Program

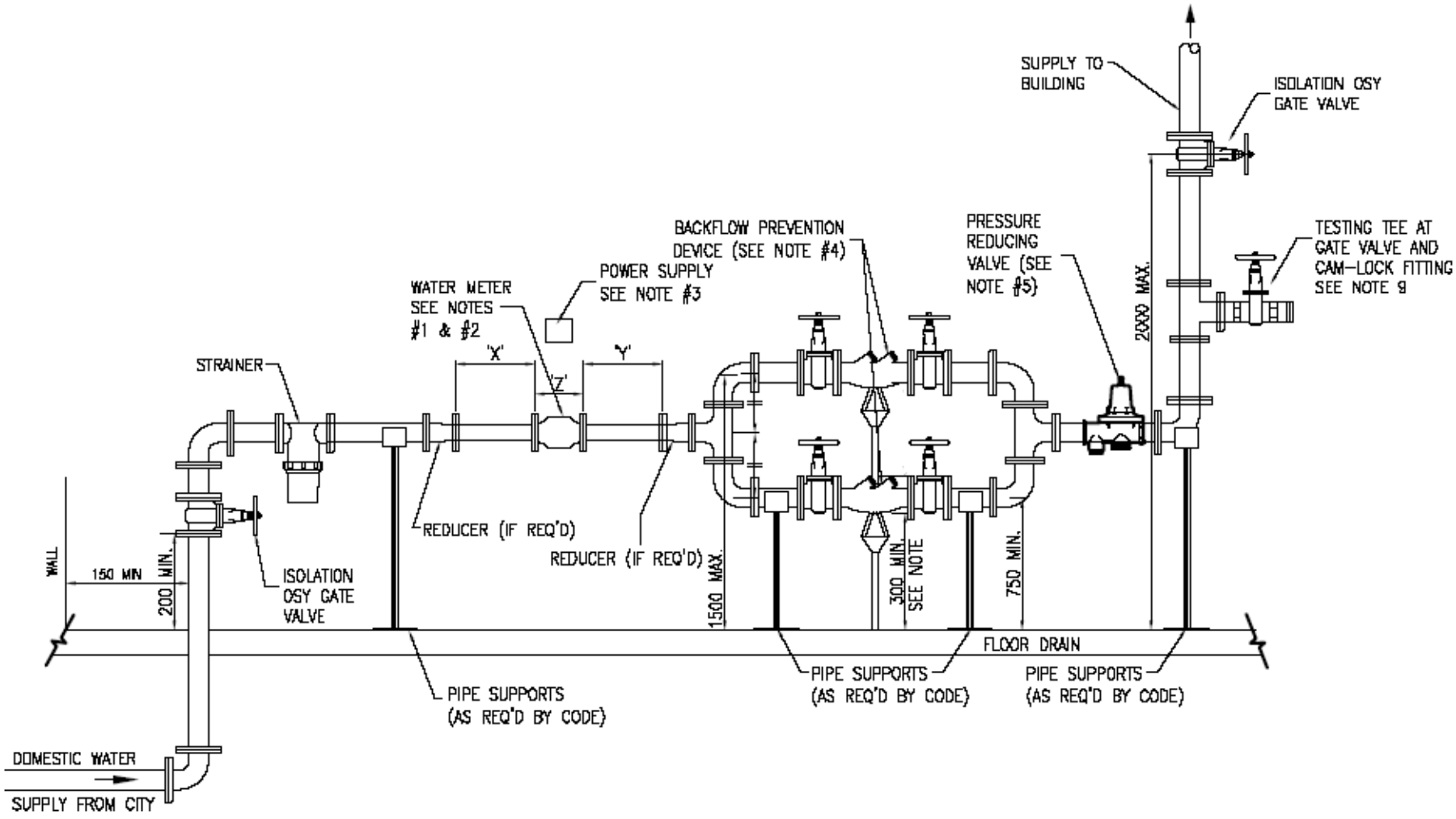
Details of Program

- Applies to all properties with the exception of residential with two dwelling units and residential properties with home office.
- Premise Isolation BFP device to be installed on water service line prior to any branch.
- Includes domestic, sprinkler and hydrant lines.
- BFP device selected by Hazard Classification.
- Annual Testing of BFP Device.

CSJ Premise Isolation Program



CSJ Premise Isolation Program



CSJ Premise Isolation Program

Other Details

- Properties with Fire Hydrants:
  - BFP device to installed at property line inside heated enclosure; or
  - BFP device located inside a building with the hydrant line supplied from the building.
- Acceptable BFP devices are Double Check or Reduced Principle types Only. These are testable devices.

CSJ Premise Isolation Program

Future Plans

- Hire a Cross Connection Control Officer
  - Review plans;
  - Conduct inspections;
  - Conduct spot testing of BFP devices;
  - Ensure annual testing of BFP devices;
  - Educate designers and contractors .
- Continue to develop City By-Law.

CSJ Premise Isolation Program

Noted Problems

- Understanding Premise Isolation Theory;
- BFP installed on service line to provide isolation from the Municipal Water Distribution system. Uses the least number of devices.
- Example – Restaurant
  - Table B.2 defined as Moderate hazard
  - Table B.1 Ice Machine for Commercial restaurant can moderate or severe.

CSJ Premise Isolation Program

Noted Problems

- Inspection process between divisions and groups;
  - Plumbing inspected by Building Dept.
  - BFP and Meter inspected by Env. Services Division
- Wrong type of device selected / installed;
- Installation not constructed according to approved plans;
- Protecting fire hydrants.

Selection of BFP Device

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Basin	Moderate
Bathtub (all)	Moderate
Bedpan washer	Severe
Beverage dispensing equipment (no carbonator)	Minor
Beverage dispensing equipment (with carbonator)	Moderate

Thank You