Distribution System Infrastructure

Learning Objectives

- Be able to describe components of the DS, and how they can impact water quality
- Be able to describe potential areas of water quality concern in your system, and consider ways to improve these

Components we will discuss

- Distribution piping systems
- Valves
- Cross connections
- Storage tanks
- Hydrants
Pipe systems

- Different aspects of pipe networks can have impacts on water quality
  - Dead ends
  - Cross connections
  - Main breaks

Pipe systems - dead ends

- Effect on water quality
  - Extended water age
  - Decay of chlorine residual
  - Increased DBPs
  - Increased microorganisms

*If there is a failure – some customers will not have water service.*
- As such, try to prevent a failure event as best you can!

Solutions to dead ends

- Pipe loops
- Flushing valves
- Flushing program
Dead end solutions - pipe loops

- Pipe loops make the distribution system more robust
- Allow more than 1 way for water to get to different points of distribution system
- Effect on water quality
  - Decrease water age
  - Help maintain disinfectant residual
  - Potentially reduce DBP and microbiological concentrations

Dead end solutions – flushing

- Flushing valves
- Flushing programs

Experiences with Dead Ends?

- Has anyone addressed a dead end in your system?
- What did you do?
Valves

- Most commonly operated and widely dispersed components of distribution systems
- Types of valves
  - Flushing
  - Pressure regulating
  - Flow control
  - Isolation
  - Backflow prevention
  - Air release
  - Buried-under-the-pavement valves

Valves - Uses

- Isolate parts of the distribution system in case of leaks, maintenance, or water quality emergencies
- Control flow and/or pressure
- Release air that can accumulate in high points of the distribution system

Valves - Effect on Water Quality

- Closed valves create dead ends in the distribution system
  - Stagnation
  - Increased water age
  - Biofilm development
  - Sediment built up
- If opened or closed rapidly, water hammer can develop
Valves - Solutions

What can be done to limit water quality impacts?
- Survey valves to be sure they are open
- Exercise valves
- Open and close valves slowly

Cross Connections

• Any point in a water distribution system where chemical, biological, or other contaminants may come into contact with potable water

• These contaminants can be drawn or pushed back into the water distribution system during a backflow event

What is the Cross Connection?
Storage Tanks

Purpose
- Improve system hydraulics
- Peak flow/fire flow
- Balance treatment needs

Factors that Impact Water Quality in Storage
- Stratification vs mixing
- Inlet/outlet configuration
- External contamination
- Increased water age
- Loss of chlorine residual
- Formation of DBPs
- Microscopic critters in the water
- BIG critters in the water

What can be done to maintain or improve water quality in storage?
- Reduce water age
- Booster chlorination
- Inspection and maintenance
Some common storage tank problems

- Finished water storage not properly covered
- Cracks in the walls or storage cover
- Accesses and vents not protected with proper screen or other approved devices
- Storage facility not structurally sound
- Lack of normal maintenance and inspection schedule for storage tanks

Loss of integrity of storage facilities

Knot hole in a spring box

Hole in storage tank wall

Courtesy Robert Clement, USEPA

At least 3 bloated mice

At least 7 snakes

Inside the spring box with a knot hole

Courtesy Robert Clement, USEPA
Hydrants

- Fire protection
- Flushing
  - To improve water quality
- Caution – *water hammer*

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Hydrant Impacts on Water Quality

- Flushing, scouring and cleaning (planned/unplanned)
- Cross connection potential
- Poor sampling points
  - Water can be trapped in the barrel of the hydrant when closed, resulting in unrepresentative samples

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EPANet Demonstration

Identify vulnerable aspects of the distribution system, dead ends, pipe loops, storage etc.

[http://www.epa.gov/water-research/epanet](http://www.epa.gov/water-research/epanet)
Activity: Where would you expect to find water with the greatest age?

Where would you expect to find water with the greatest age?
Questions?