



Small System Flushing



Flushing

- Periodic flushing of distribution systems can remove sediment and bio-films built up inside water distribution piping.
- This can reduce chlorine demand and help alleviate some taste and odor issues.

Flushing

- Permit to Operate requires that distribution systems be flushed at least once per year as a Best Management Practice.
- Many systems are flushed twice a year. Once each fall and spring.

Conventional Vs. Automated Flushing

- Conventional (manual) flushing is when the system is flushed by operators.
- Automated is when flushing stations are set up to flush timed intervals.

Things to Consider

- Source Capacity- Can it provide the volume of water to flush?
 - Gravity Fed- Pressure available?
 - Pumped- Can the pumping system provide enough flow to meet flushing demands

Things to Consider

- Infrastructure
 - Size of lines/hydrants

 - PRV's in system

 - Closed valves or issues in system
 - Filter/ Strainer capacity

 - Friction losses

Pressure

- Static Pressure-Pressure reading before water flows.
- Residual Pressure-Pressure reading while water is flowing (measured at an outlet other than the flow outlet)

Hydraulic Gradient

Head

- height to which water would rise in a freely vented standpipe at a particular point

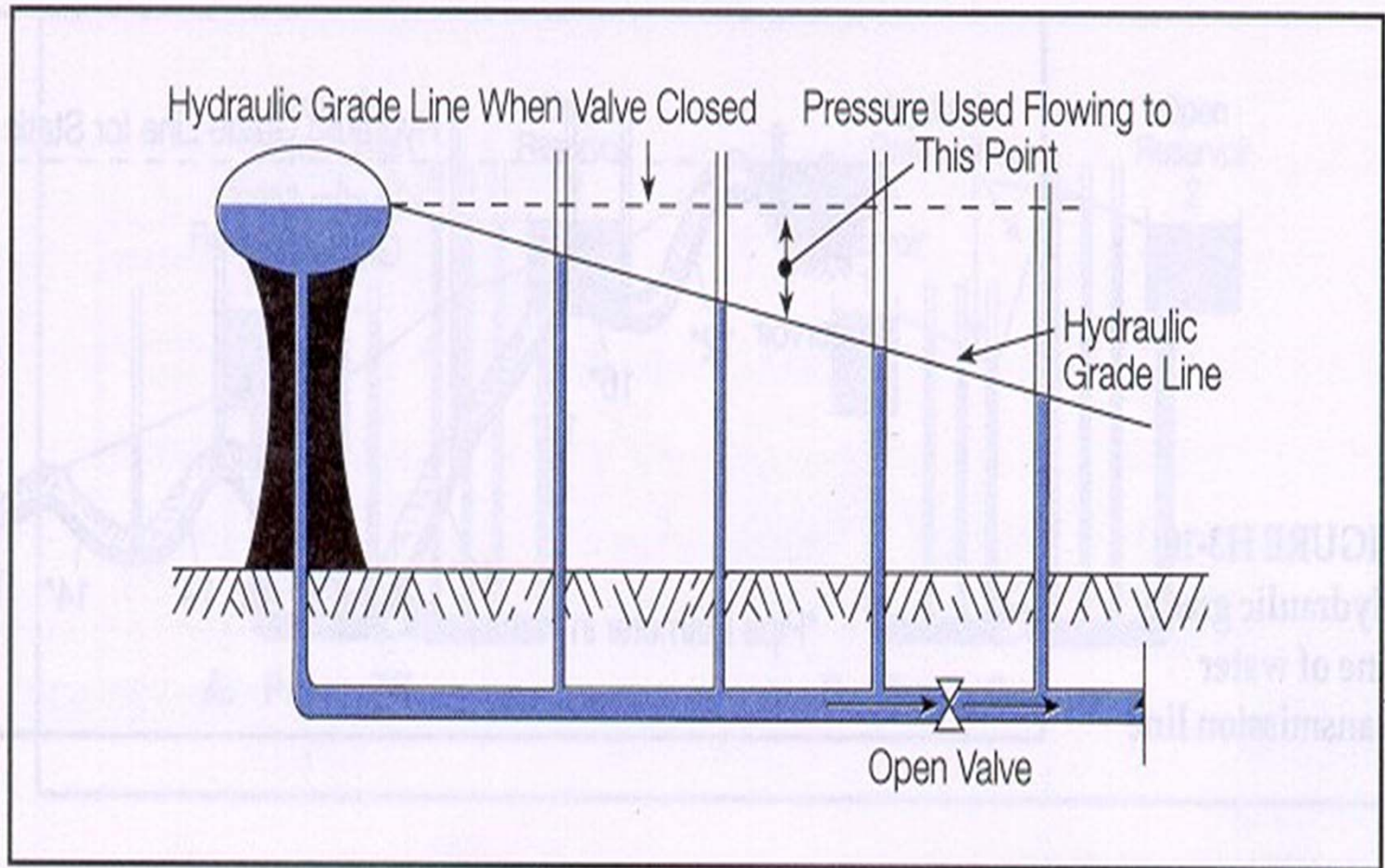
Hydraulic Grade Line (HGL)

- the imaginary lines connecting the elevations of head

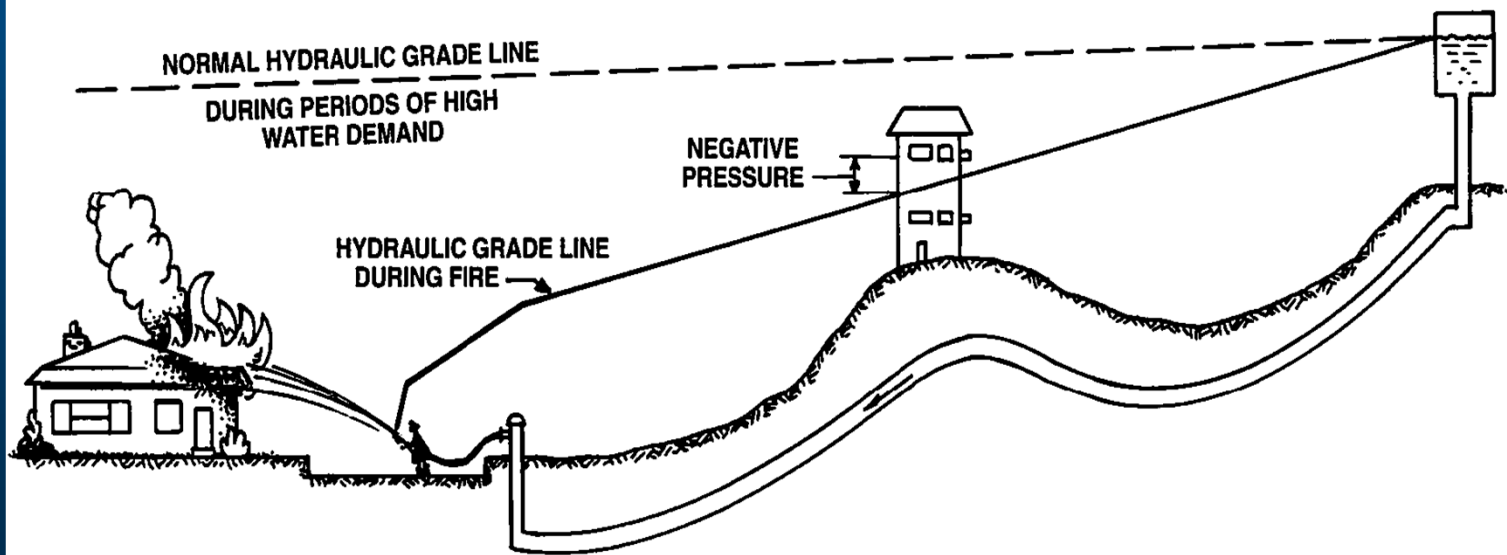
Hydraulic Gradient

- the slope of steepness of the HGL

Hydraulic Gradient



Hydraulic Grade Line



NOTE: Any fixture or faucet above the hydraulic grade line will be exposed to a negative pressure

NFPA 291

- Generally recommend that minimum residual pressure of 20 psi (1.4 bar) should be maintained at hydrants when delivering fire flows.

NFPA 291 -4.1.5

A primary concern should be the ability to maintain sufficient residual pressure to prevent developing a negative pressure at any point in the street mains which could result in:

- collapse of mains or other water system components
- Back siphonage of polluted water from some other interconnected source

Negative Pressure

- Negative pressure (vacuum) can cause a backflow from a non-potable source and contaminate the distribution system.
- As mentioned before this could also cause the collapse of a pipe.

Diagnosis of System

- A hydraulic assessment, whereby each hydrant's static and dynamic (flow) pressure is taken throughout the network in order to identify hydraulic weaknesses caused by leakage, closed valves, etc...

Measuring Pressures



Measuring Pressures



Velocities

- Minimum velocity required for flushing is around 3 ft/sec
- Optimal velocity required for flushing is 5 ft/sec

Minimum Flushing Flows

- 150 mm/6 inch line requires 260 US gpm to achieve 3.0 ft/sec velocity
- 200 mm/ 8 inch line requires 450 US gpm to achieve 3.0 ft/sec velocity

Optimal Flushing Flows

- 150 mm/6 inch line requires 440 US gpm to achieve 5 ft/sec velocity
- 200 mm/ 8 inch line requires 785 US gpm to achieve 5 ft/sec velocity

Flushing Program Results

- Greater than sixty percent of sequences achieved five feet per second
- Greater than 90 percent of sequences achieved three feet per second

Scouring Velocity



Using 2.5 Inch Opening



Field Testing

- Several municipalities could not maintain minimum pressure when flushing through hydrant nozzle
- Hydrants cannot be throttled so there is no control of flow from a fully open hydrant

Options

- We are going to have to reduce the outlet size in order to gain more control over flow from the system
- Restrict the opening to 1.5 inches and using a gate valve on the hydrant will give you greater control



Measuring Flow

- Pressure gauges connected to the other nozzle outlet
- Pitot gauges
- Spreadsheet to show flows and velocities

Pitot Gauges



Nozzle Gauges



Nozzle Gauges



Spreadsheet

| AQUA DATA Atlantic | | Length of pipe: | 600 | Length of Pipe divided By Velocity divided by 60 | | | |
|---------------------------------------------------------------------------------------------------------------------|---------------|---------------------|---------------------|-----------------------------------------------------|----------------------|----------------------|----------------------|
| | | Velocity: | 5 | | | | |
| | | Flushing Time: | 6 | | | | |
| FLOW AND VELOCITY FUCTION OF RESIDUAL PRESSURE USING A Chart values are approximative for field use only. | | | | 1.5" OUTLET 45° Elbow | | | |
| Pressure (psi) | Flow (gpm) | Velocity | | | | | |
| | | Pipe diameter 4" | Pipe diameter 6" | Pipe diameter 8" | Pipe diameter 10" | Pipe diameter 12" | Pipe diameter 14" |
| 2 | 67 | 1.8 | 0.8 | 0.4 | 0.3 | 0.2 | 0.1 |
| 4 | 94 | 2.5 | 1.1 | 0.6 | 0.4 | 0.3 | 0.2 |
| 6 | 115 | 3.0 | 1.4 | 0.8 | 0.5 | 0.3 | 0.2 |
| 8 | 133 | 3.5 | 1.6 | 0.9 | 0.6 | 0.4 | 0.3 |
| 10 | 149 | 3.9 | 1.7 | 1.0 | 0.6 | 0.4 | 0.3 |
| 12 | 163 | 4.3 | 1.9 | 1.1 | 0.7 | 0.5 | 0.4 |
| 14 | 176 | 4.6 | 2.1 | 1.2 | 0.7 | 0.5 | 0.4 |
| 16 | 188 | 5.0 | 2.2 | 1.2 | 0.8 | 0.6 | 0.4 |
| 18 | 200 | 5.3 | 2.3 | 1.3 | 0.8 | 0.6 | 0.4 |
| 20 | 211 | 5.6 | 2.5 | 1.4 | 0.9 | 0.6 | 0.5 |
| 22 | 221 | 5.8 | 2.6 | 1.5 | 0.9 | 0.6 | 0.5 |
| 24 | 231 | 6.1 | 2.7 | 1.5 | 1.0 | 0.7 | 0.5 |

Things to Consider

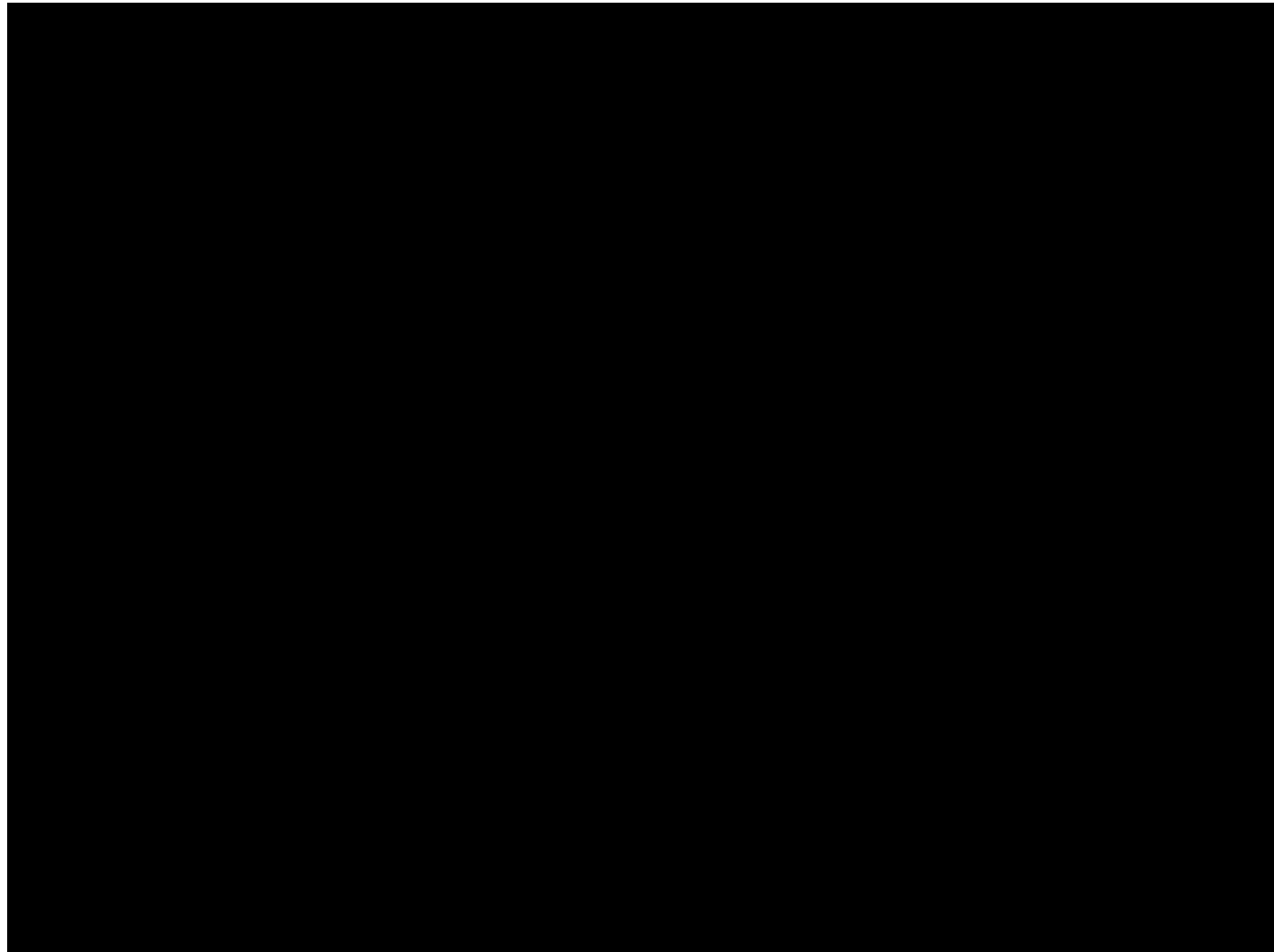
- Water Hammer
- Negative Pressures
- System Head – Friction Losses
- Size of Lines
- Infrastructure

Water Hammer

- Water Hammer is caused by suddenly stopping moving water, or suddenly starting water to move that is stopped
- Suddenly stopping water is done by quickly closing a valve
- Suddenly starting water to move is done by starting a pump

- Water Hammer is a sudden increase or decrease in water velocity

Hydrant Opening



System Head

- The longer the system and greater the numbers of valves bends and fittings the greater the loss of head will be in the system

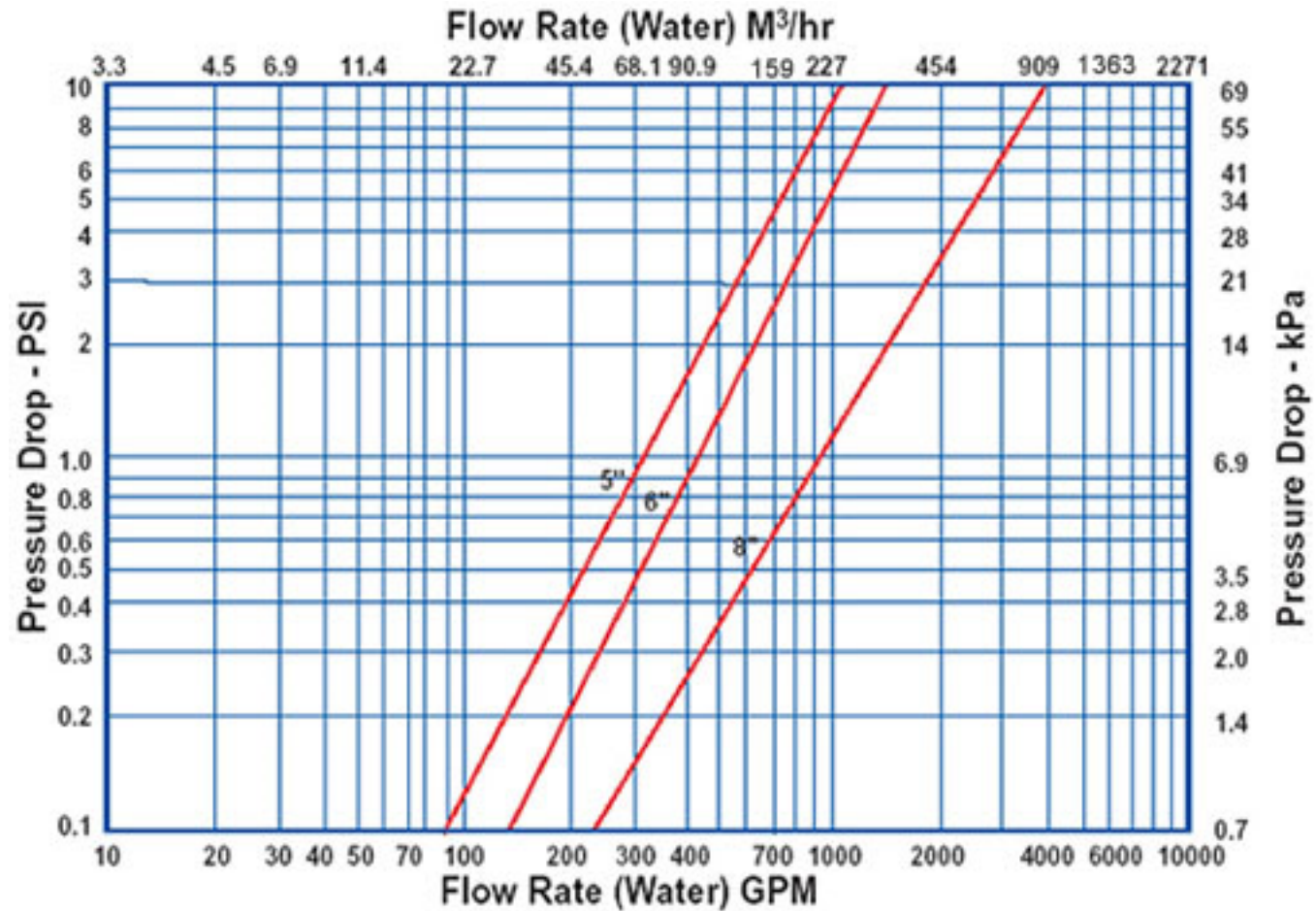
Line Sizes

- Never flow from a hydrant that is being supplied by a smaller pipe.

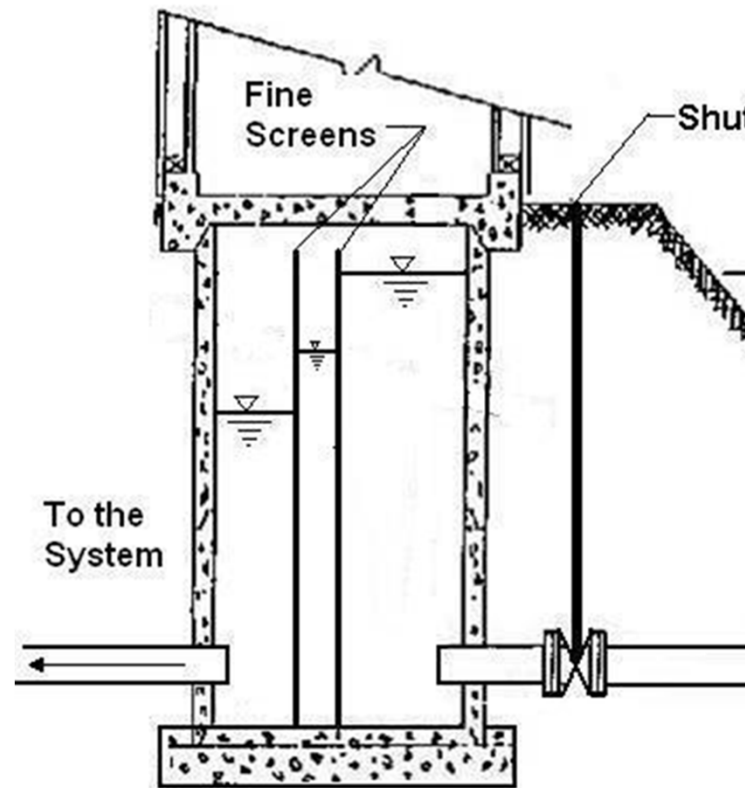
Basket Strainers



Flow Through Strainer



Wet Well



Water Distribution System Flushing



Results to Date

- The infrastructure in some towns cannot handle proper flushing and may not be able to under any circumstances

Thanks

- Jeff Jensen – Mueller Canada
- Tom Cameron- Aquadata Atlantic
- Don Antle – Wolseley

Questions?