iHydrant™

Water Distribution Systems and Pressure

New Hampshire Water Works Association
October 22, 2020

Agenda

- Water System Basics
- US History of Water
- Basics of Pressure
- Evolution of Pressure Monitoring
- Industry Challenges and Opportunities
- Introducing the iHydrant™
- Water Loss
- Emergency Response Plan
- Hydraulic Modeling
- Available Resources

Presenters

- Tom Bohrer with iHydrant
- Brett Johnson with Clow Valve Company

Water System Basics

Water Systems and Hydraulics

Drinking Water Distribution System

- Network consisting of an interconnected series of components including:
  - Pipes
  - Storage Facilities (Elevated and ground storage tanks, clear wells)
  - Conveyance Components – Pumps
- Span almost one million miles in the United States

Source: US EPA

Water Systems and Hydraulics

Public Water System

- Depend on distribution systems to provide an uninterrupted supply of pressurized safe drinking water to all consumers. Distribution system mains carry water from either:
  - Treatment plant to the consumer; or
  - Source to the consumer when treatment is absent

Source: US EPA

Water Systems and Hydraulics

Hydraulic

- Operated by the resistance offered or the pressure transmitted when a quantity of liquid (such as water or oil) is forced through a comparatively small orifice or through a tube

Hydraulics

- A branch of science that deals with practical applications (such as the transmission of energy or the effects of flow) of liquid (such as water) in motion

Source: Merriam-Webster

US EPA Safe Drinking Water Act (SDWA)

- **Established in 1974 to protect the quality of drinking water in the U.S.**
  - The Act is administered through programs that establish standards and treatment requirements for public water supplies, finance drinking water infrastructure projects, promote water system compliance, and control the underground injection of fluids to protect underground sources of drinking water
  - The Water Infrastructure Improvements for the Nation Act enacted in 2016
    - Addressed lead in public water systems
    - Increased compliance assistance for small or disadvantaged communities

Source: US EPA

QUESTION #1

iHydrant

In what year was the U.S. EPA Safe Drinking Water Act (SDWA) established?

a) 1875

b) 1955

c) 1974

d) 2011

US History of Water

Evolution of Drinking Water Systems

Introduction of Pipe

- First distribution lines were made of bored-out logs in 7-9’ lengths
- Stagnation and insect infestation
- Engineered gravity systems from source on high ground into catch basin
- Remained in use until 1887

Evolution of Drinking Water Systems

Boston, MA

- 1652 – First incorporated water system in the country
  - Firefighting and domestic use
- 1795 – Water System Expansion
  - 15 miles of 3-inch and 5-inch wooden water pipe constructed
  - New fresh water supply lowered death rate in City

Evolution of Drinking Water Systems

Philadelphia, PA

- 1804 – Introduction of cast iron pipe
- First large-scale waterworks systems

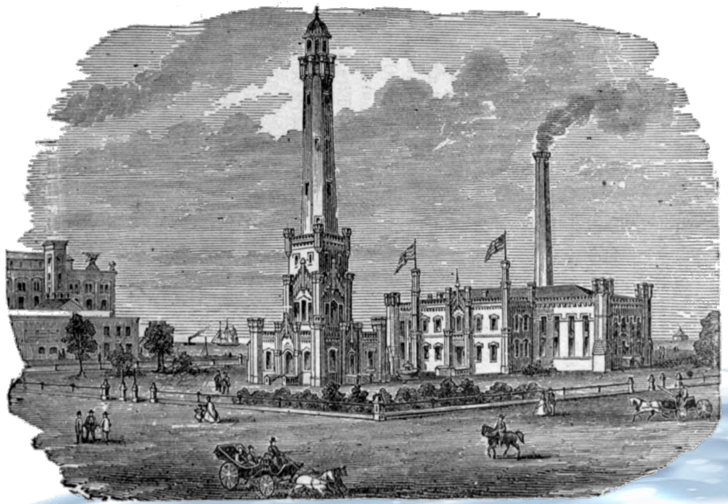
New York City, NY

- 1842 – Water system bringing water from Croton River, 40 miles north of the City
  - 41 miles of gravity channel
  - 16 tunnels
  - 114 culverts
  - Bridge over Harlem River

Evolution of Drinking Water Systems

Chicago, IL

- 1869 – Chicago unveils new engineering feat Chicago Waterpower
  - Twin tunnel system extending two miles out to Lake Michigan
  - 138 foot tall standpipe to equalize pressure
  - Coal-fired, steam-driven engines drew water from the tunnels
  - 15 MGD
- 1906 to Current – Pump Station Improvements
  - Standpipe removed
  - 6 pumps
  - 72.5 MGD average



Evolution of Drinking Water Systems

Steel Pipe

- 1850's – Use in drinking water systems

Ductile Iron Pipe

- 1950's - Introduction

Concrete Pipe Variations

- 1950's – Introduction

PVC Pipe

- 1952 – First reported use in USA
- 1963 – First specification
- 1970's – Widespread use

Basics of Pressure

Definition of Pressure

Textbook Definition

- A force that makes a flow of water strong or weak
- Amount of force per area
- Pressure is the force applied perpendicular to the surface of an object per unit area over which that force is distributed. Gauge pressure is the pressure relative to the ambient pressure

Perception

- Pressure at taps in home
- Pressure swings
- Water quality

Basics of Pressure

iHydrant

How is Pressure Created and Controlled

- Pump Stations
- Valves
- Elevation
- Pressure Tanks
- Pipe Size and Flow
- System Design

How is Pressure Lost?

- Static Elevation
- Friction
- Main Breaks
- Loss of Power/Pumps

Standard Pressures

Minimum Pressures

- Low Pressure – 30-40 psi
- Loss of Pressures - <20 psi
  - Notify EPA of outages expected to exceed 1 hour

Maximum Pressures

- High Pressure - Varies
- Pressure Reducing Valves

Pressure Zones

Definition

- The area bounded by both a lower and upper elevation, all of which receives water from a given hydraulic grade line (HGL) or pressure from a set water surface.
  - The HGL is usually provided by one or more storage tanks located at the same elevations so they share high and low water surfaces.
  - Ideally, pressure zones contain the same pressures and, therefore, the infrastructure within each pressure zone can be designed with a uniform set of design criteria which stresses efficiency, reliability and durability.
  - Source – ArcGIS Prince George Data

Pressure and Water Quality

How Are They Related?

- Dead End's vs. Looping
- Low velocity
  - Oversized pipes – stagnation
  - Seasonal demand fluctuations
- System Flushing

iHydrant

Evolution of Pressure Monitoring

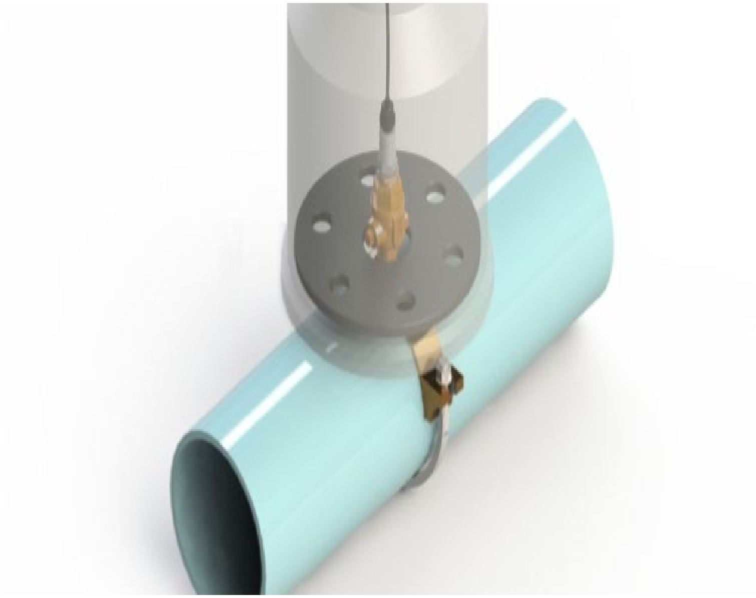
Evolution of Pressure Monitoring

Manual Pressure Reads

- Chart Recorder
- Pressure Gauges

Pump Stations

Smart Technology



Industry Challenges & Opportunities

Challenges In Pressure Monitoring

iHydrant

Maintenance

- Battery Life
- Warranty

Access Points

- Pipe tap in a vault
  - Compromise older pipe
- Existing infrastructure
  - Hydrants
  - Valves
  - Pump Stations

Reception

- Cellular service
- Antennas/Wi-Fi

Backhaul

- How data is transferred

Opportunities for ROI

Water Mains

- Reduce water main breaks by reducing water hammer

Reduced Road & Property Damage

- Much faster response times on breaks

Water Loss

- Reduce water loss by reducing response times
- Alerts/Alarms

Premiums Savings

- Insurance premiums or self insurance savings

Fewer Contracts

- Eliminate engineering yearly contracts for pressure monitor & hydraulic modeling

Overall Enhanced Customer Service

Introducing the iHydrant™

About iHydrant™

iHydrant™ provides remote pressure and temperature monitoring for wet and dry barrel hydrants. Our robust hosted interface provides detailed records, alerts and mapping of your remote hydrant monitors.

- Affordable one-time installation costs and low annual maintenance and support fees
- iHydrant™ can pay for itself by preventing or alerting you in real time of water loss events

iHydrant™ sister companies include:

KENNEDY VALVE

CLOW VALVE CO.

TYLER UNION®

M&H VALVE COMPANY

iHydrant

iHydrant™ is a subsidiary of McWane, Inc.

McWANE

- Leading global manufacturer of ductile iron pipe, valves, hydrants, and fittings
- Founded in 1921
- $2B revenue
- 6,000 employees

Intelligent Hydrant Solutions

Remote Pressure & Temperature Monitoring

Why measure pressure?

- Is my system operating at optimal levels?
- **Too High:** Increased leaks and water loss, pipe breaks, excavation, property damage and potential liability, excessive pumping
- **Too Low:** Increased customer complaints, state mandated minimum PSI, may indicate blockages, reduced revenue, may allow backflow

Why measure temperature?

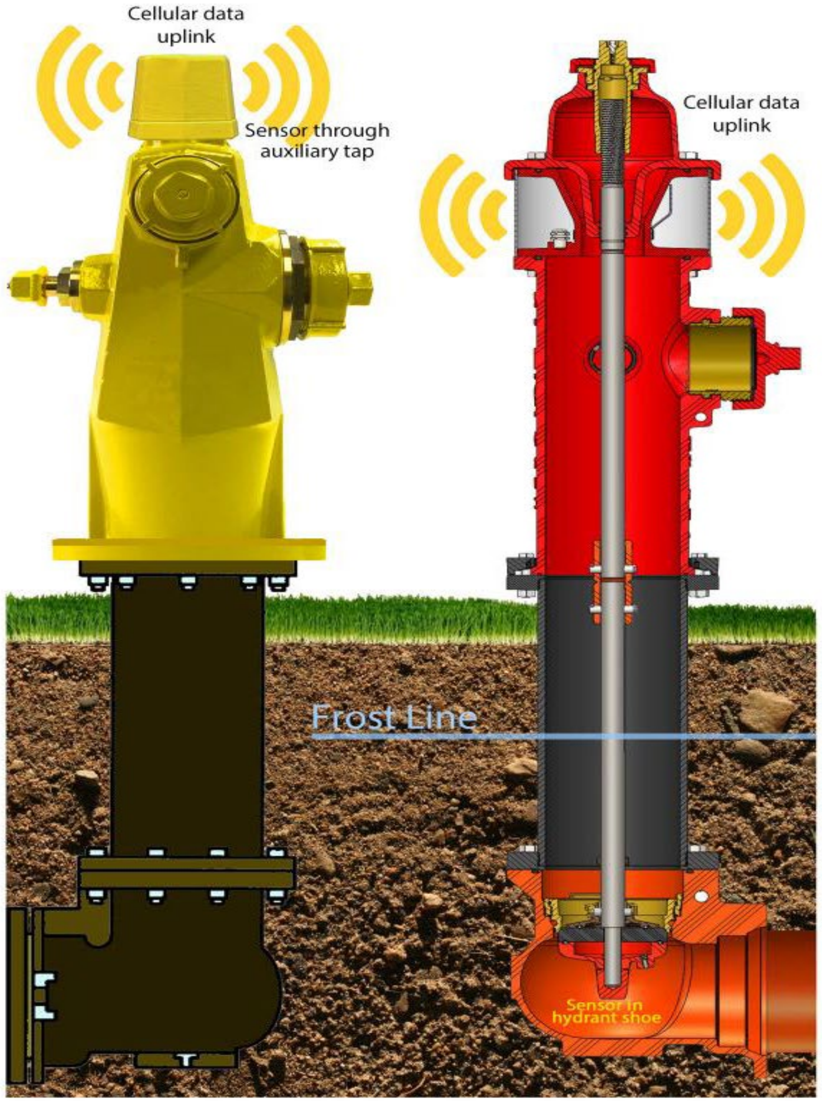
- **Prevent damage from freezing**
- **Too Warm:** May indicate accelerated disinfectant breakdown and conditions for bacterial growth
- **Too Cold:** Warns when pipes are about to freeze: expensive repairs; thermal shrinkage causes leakage when cold joints open up; plastic pipe is more brittle when cold

Why measure in hydrants?

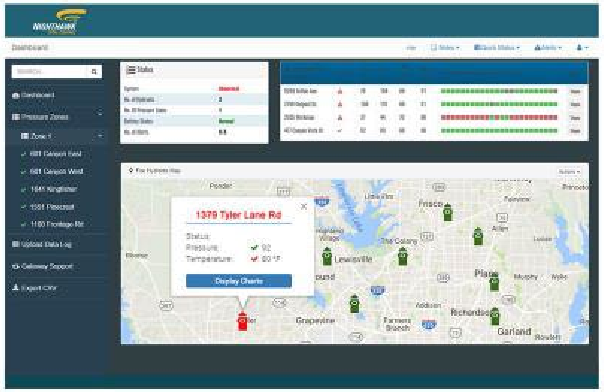
- **Evenly Distributed:** Thereby providing a representative sampling of data across the water system, expecially near distribution end points (e.g. residential subdivisions)
- **Easily Accessible:** Above ground, easy to retrofit with technology and good for cellular communications

Why monitor over time?

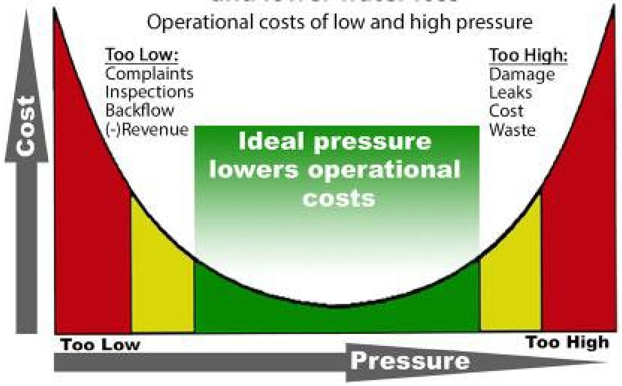
- **Identify Intermittent Conditions:** Recognize patterns of pressure variations which may be unduly straining the system, causing excessive pumping and related wasteful costs
- **Reduce Potential Damage:** Historical data can be used to reduce water loss, pipe breaks, and energy use



Cloud-based head-end system



Optimizing pressure results in reduced leaks, fewer customer complaints, less energy use and lower water loss



Remote monitoring provides valuable insight, automates data collection, enhances SCADA systems and saves utilities time and money

If you cannot measure it, you cannot improve it

Lord Kelvin

iHydrant™ | Product Roadmap

- Pressure and Temperature Monitoring
- Leak Pipeline Condition Assessment (currently testing)
- Operational Technologies (valves, water quality, etc.)

iHydrant™ | About the Solution

- Does not interfere with normal hydrant operation
- Simple installation, requires no digging/tapping
- Wet barrel iHydrant™ can be installed in less than 15 minutes; dry barrel installation in 45 minutes

iHYDRANT™ | INSTALLATION, LADWP

iHYDRANT™ | INSTALLATION, SF

iHydrant™ | Installation Examples

iHYDRANT™ | INSTALLATION, NY

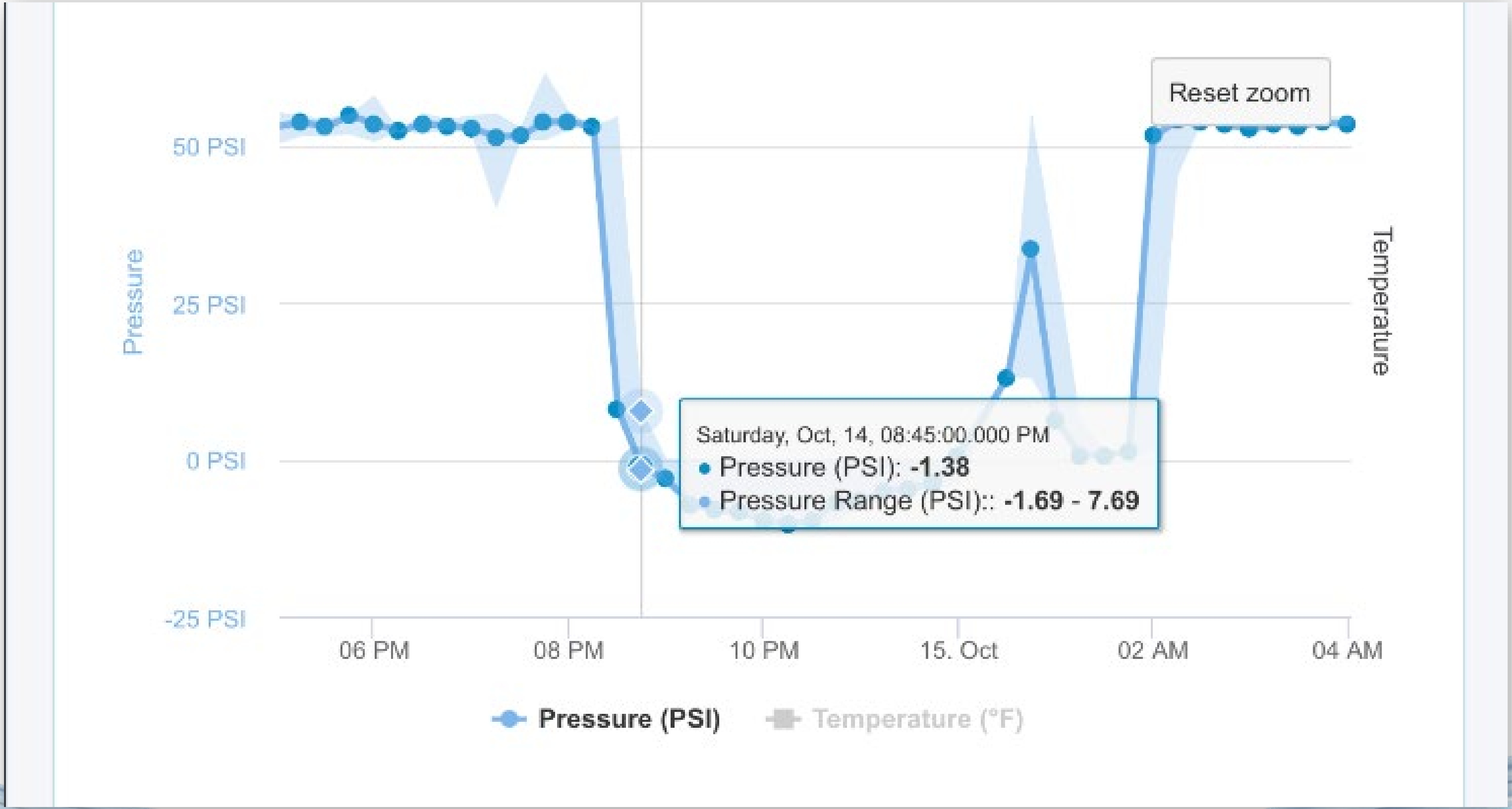
iHYDRANT™ | INSTALLATION, OR

iHYDRANT™ | CUTAWAY VIEW

iHydrant™ | Interior View

iHYDRANT™ | INSIDE SHELL VIEW

iHydrant™ | Hosted Software

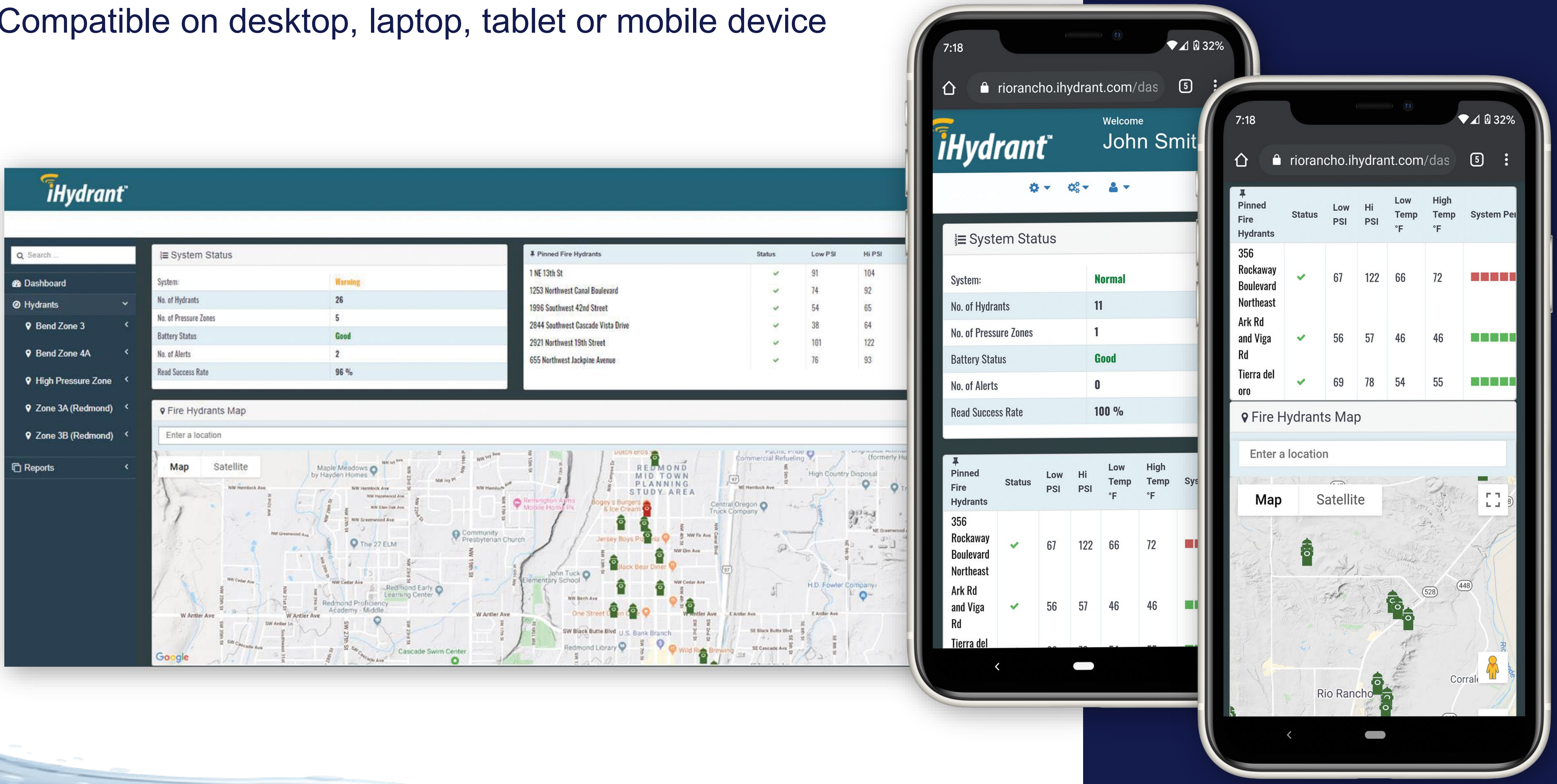


San Francisco Main Break

Oct 14, 2017 with negative pressure

iHydrant™ | Mobile Compatibility

Compatible on desktop, laptop, tablet or mobile device



iHydrant™ | Features & Benefits

iHydrant

Solution Benefits

- Increase accuracy in hydraulic modeling
- Faster response time to main breaks
- Reduce contractor breakage
- Diminish PRV issues
- Decrease loss of road and property damage
- Reduce pipe stress, water hammer
- Optimize actuators in valve operation
- Conserve energy in pump operation

Solution Features

- High/low temperature and pressure alarms
- Instant notifications of system changes
  - Readings every 5 seconds, logs every 15 minutes, and cloud uploads every 12 hours
- Theft deterrent
- Critical Customers

iHydrant™ | Our Value to Utilities

iHydrant

Benefits for Utilities:

- Monitor main breaks during the night, reduce hydrant water theft, and identify contractor breakage
- Utilities change pump patterns to reduce line stress and save energy costs

Dry Barrel Versions

- Kennedy Valve
- Clow & Clow Canada
- M&H Valve Company

KENNEDY VALVE

CLOW VALVE CO.

M&H VALVE COMPANY

Case Study

iHydrant impact for LADWP in first nine months:

- Over 3.5 million pressure samples in 4 monitors
- 4210 pressure alarm events (LADWP defined thresholds)
- 725 alarm events over 200 PSI; 432 alarm events below 30 PSI

iHydrant™ | Utility Deployment Strategies

iHydrant

1 of every 20 hydrants
iHydrant recommendation

Pressure zones
Multiple units throughout zones

Areas of known pipe issues or hard to reach areas

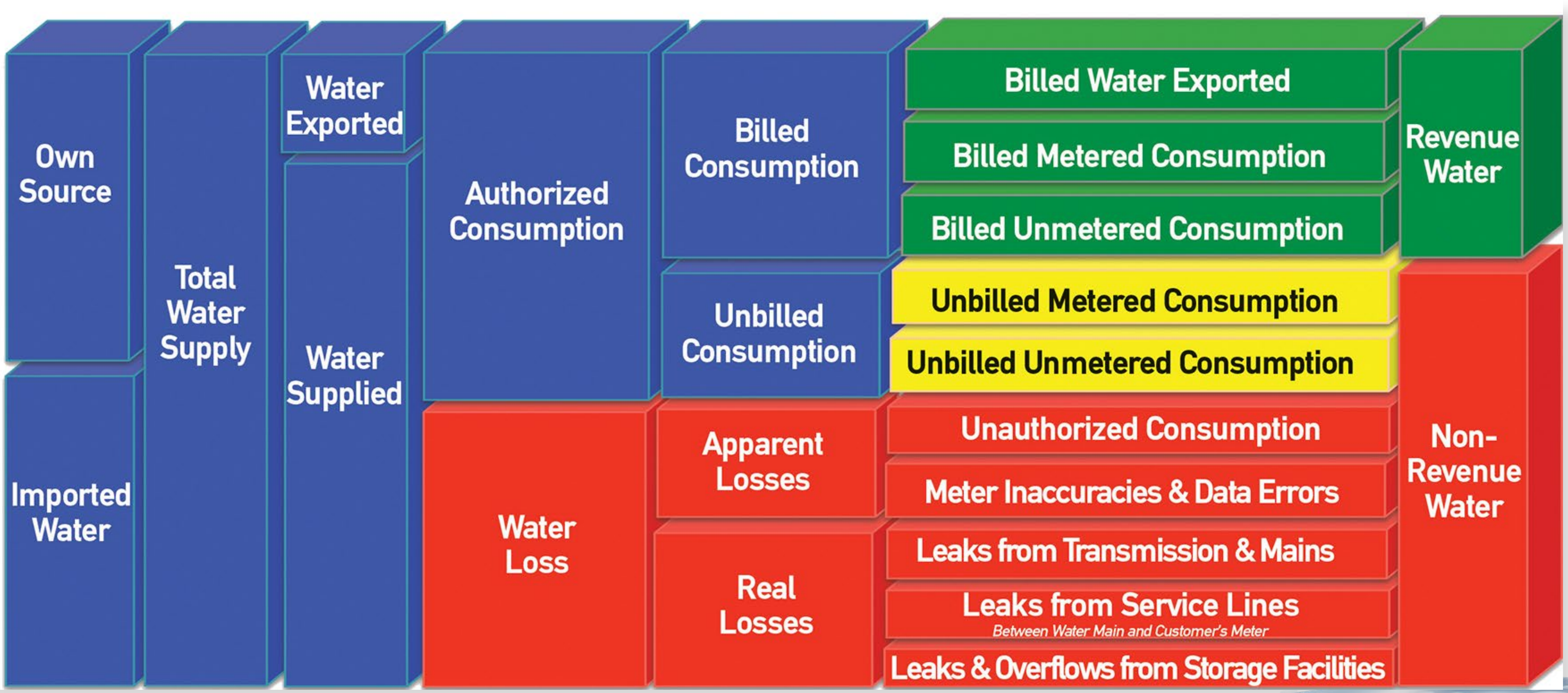
Specifications at your discretion
Allows for contractors/developers to pay for your infrastructure of pressure/temperature monitoring

Spend as part of Capital Budget when ordering hydrants

Major areas of concerns
Transmission lines under highways, etc.

Recoverable Water Loss

Water Balance Table



QUESTION #1

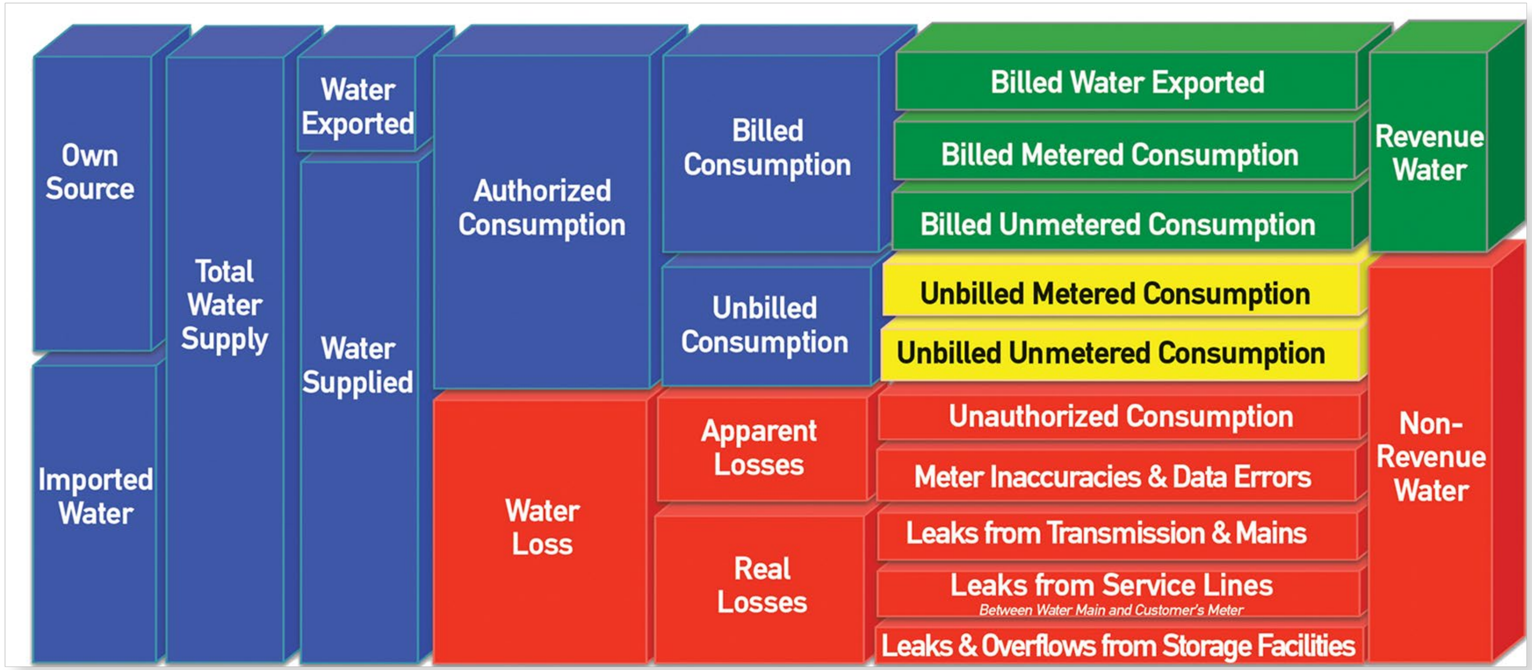
According to the AWWA Water Balance Table, what percentage of water loss, apparent losses, non-revenue water, unauthorized consumption, leaks from transmission & mains, etc. is estimated to be recoverable?

a) 25%

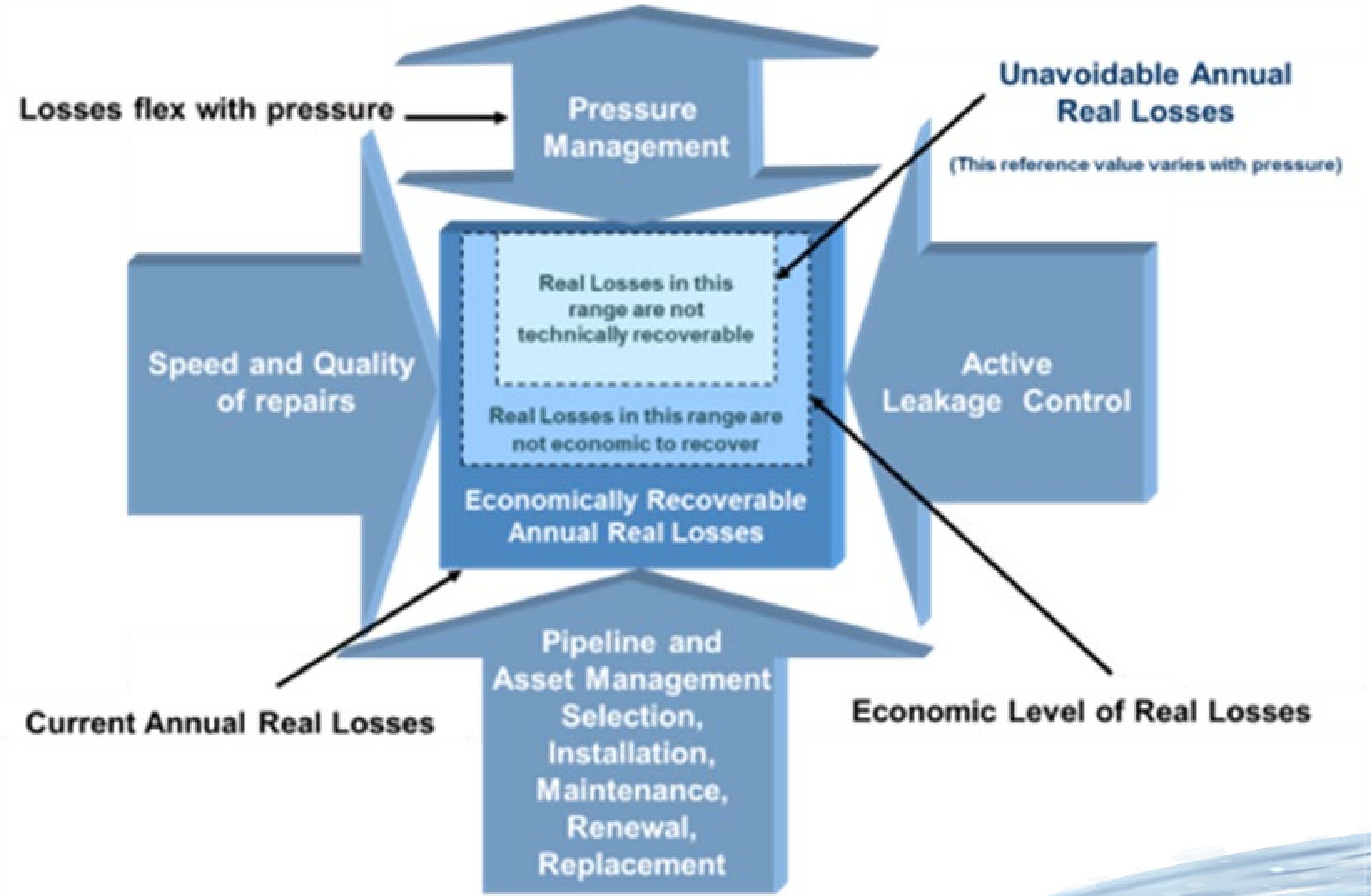
b) 50%

c) 75%

d) 100%



Effects of Non-Revenue Water Loss



Source: AWWA M36 Manual (4th Ed.)

Emergency Response Plans

Emergency Response and Resiliency

Emergency Response Plans (ERP)

- React, Respond and Recover

Risk and Resiliency Assessments (RRA)

- Strengthen infrastructure
- Inclusion in plan
- Large scale natural disaster planning

Emergency Management Plan

Hydraulic Modeling

Hydraulic Modeling

Calibration

- More accurate predictions for repairs and large scale shutdowns

Real Time Modeling

- Importation of live data into SCADA and hydraulic model
- Where technology is headed

Water Quality Modeling

- Predictive modeling

System Design and Master Plans

- CIP Planning

Grants and Incentive Programs

Grants and Incentive Programs

- **Federal and Local Incentives**
- **Smart City Initiatives**

Available Resources

Available Resources

- **AWWA**
  - Manuals of Practice
    - M36 - Water Loss
    - M68 - Water Quality in Distribution Systems
    - M32 – Computer Modeling of Water Distribution Systems
  - Councils and Committees
  - Technical Reports
- **Water Research Foundation**
  - Case Studies
  - Guidance Manuals and Frameworks
- **Partnership for Safe Water**
  - Distribution System Optimization

QUESTION #3

True or False:

According to the Partnership for Safe Drinking Water, it's recommended that for an optimized pressure monitoring system, pressure monitors be present at both high- and low-pressure sites within each pressure zone.

Sources

- US EPA
- Merriam-Webster
- The History of Plumbing in America www.theplumber.com
- "Environmental Works" Encyclopedia Britannica www.britannica.com
- “ A Brief History of Drinking Water Distribution” - West Virginia University
- www.mwra.state.ma.us
- New York Times
- AWWA
- ArcGIS Prince George Data

iHydrant™

For Additional Questions or to Request More Information, please Contact Brett Johnson at Brett.Johnson@clowvalve.com or 603-944-7479

Thank You

iHYDRANT.COM