

Helium Leak Detection

Redefining Leak Detection

Jeff Austin

Water Systems Consultant

Water Advanced Solutions



Overview

- Introduction
- Current Methods of Leak Detection
 - I. Current Needs
 - II. Understanding Acoustic
 - III. Data Logging
- Helium Leak Detection
 - I. Definition of service
 - II. Principles of the process
- Application of the Technology
 - I. Case Studies
- Questions

Introduction:



Jeff Austin:

- **Water Systems Consultant since 2011**
- **Pacific Northwest**
- **With Utility Service since 2011**
- **CEU Trainer with OAWU and AWWA-PNWC**
- **50+ Asset Inspections Annually**
- **Work with customers to solve maintenance and water quality issues throughout the distribution system**

Water Advanced Solutions

Unique Technologies

Asset Management Programs

Water
Wells



Filters



Tanks



Network
Assets



Meters,
AMI...



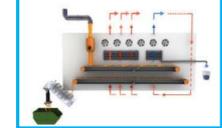
Ice
Pigging



Waste
Water



Biosolids
Drying



The North American leader in Asset Management

- Over 8000 assets under WAS programs

WAS responds by providing customized system Asset Management solutions through:

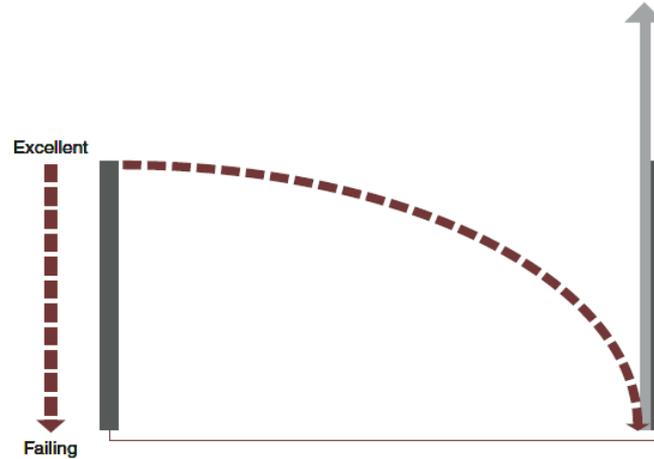
- Local water system consultants
- Regional water system specialists and service centers
- Technical experts in water source, quality, storage, metering & distribution

Water System Maintenance Programs are Designed to Extend the Useful Life of Assets

Run-to-Failure Management Model

Sewer system assets that are not regularly maintained usually deteriorate faster than expected and lead to higher replacement and emergency response costs.

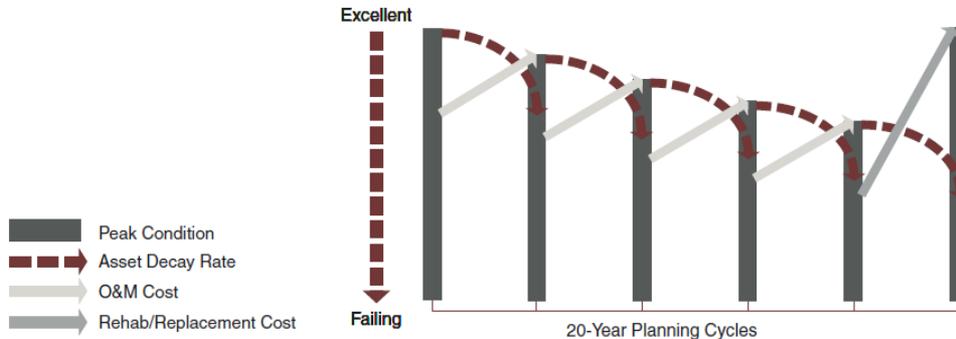
-  Peak Condition
-  Asset Decay
-  Rehab/Replacement Cost



Cost-effective!

Asset Management Model

Components are regularly maintained over long planning cycles, and finally replaced when deterioration outweighs the benefit of further maintenance. Costs are well-distributed over the life of the asset.

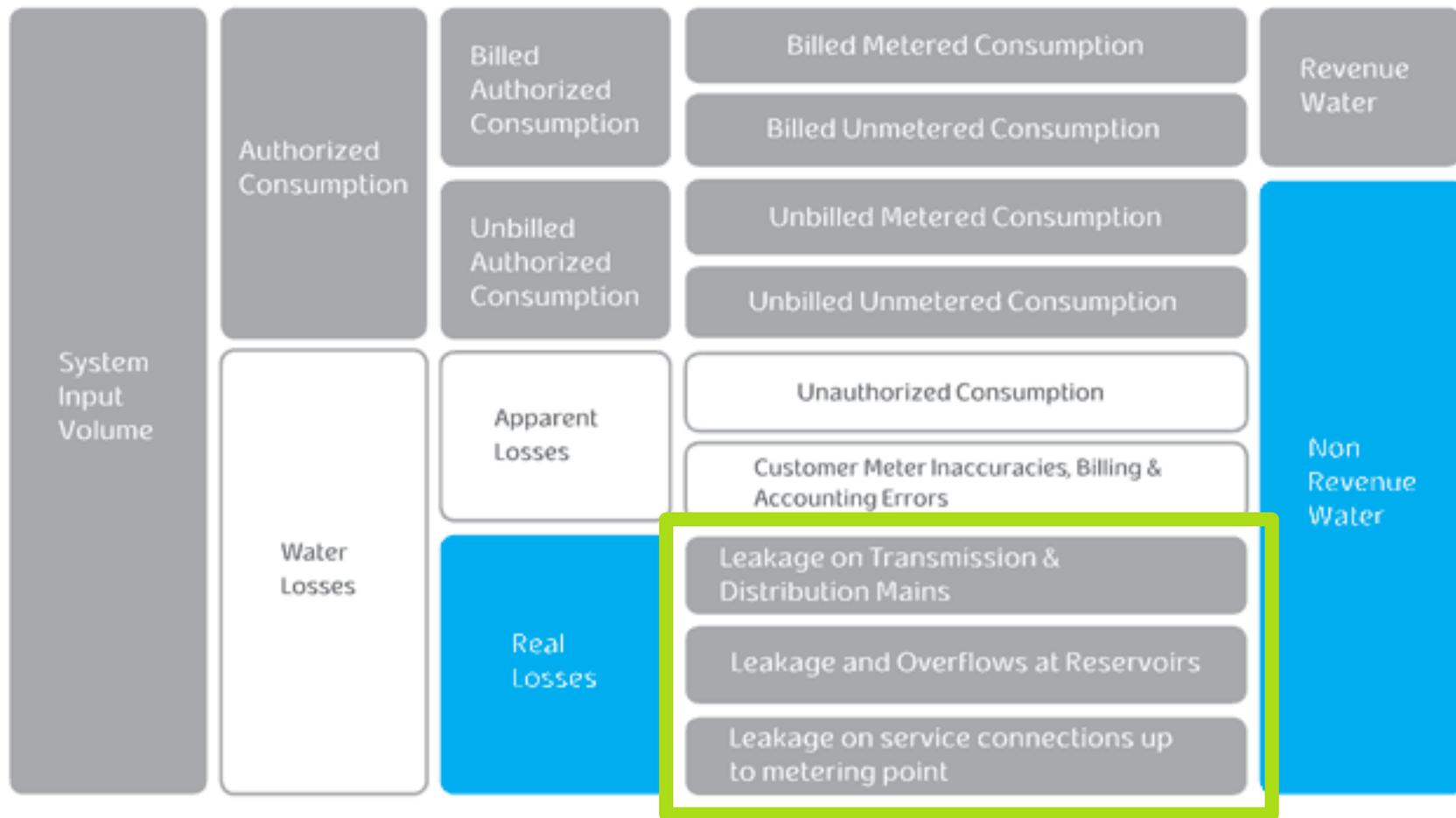


-  Peak Condition
-  Asset Decay Rate
-  O&M Cost
-  Rehab/Replacement Cost

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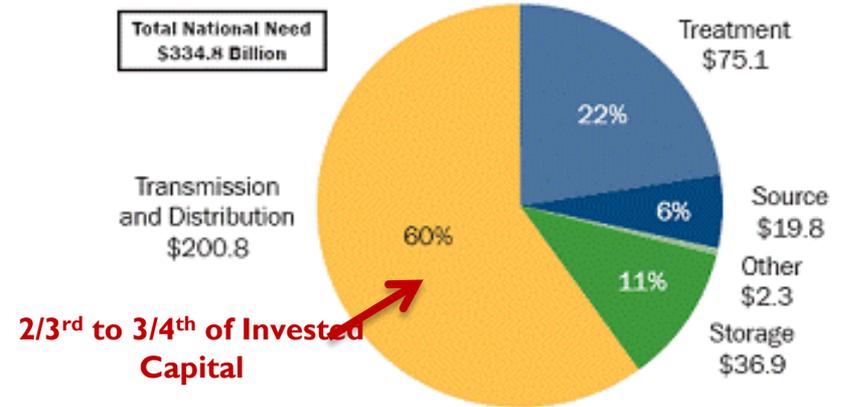
Water Balance



The Investment Bubble

- **AWWA Buried, No Longer Confronting Americas Infrastructure Challenge - \$1 Trillion Need**
- **American Society of Civil Engineers gives drinking water systems a D- Grade**
- **America's drinking water systems face an annual shortfall of at least \$11 billion to replace aging facilities**

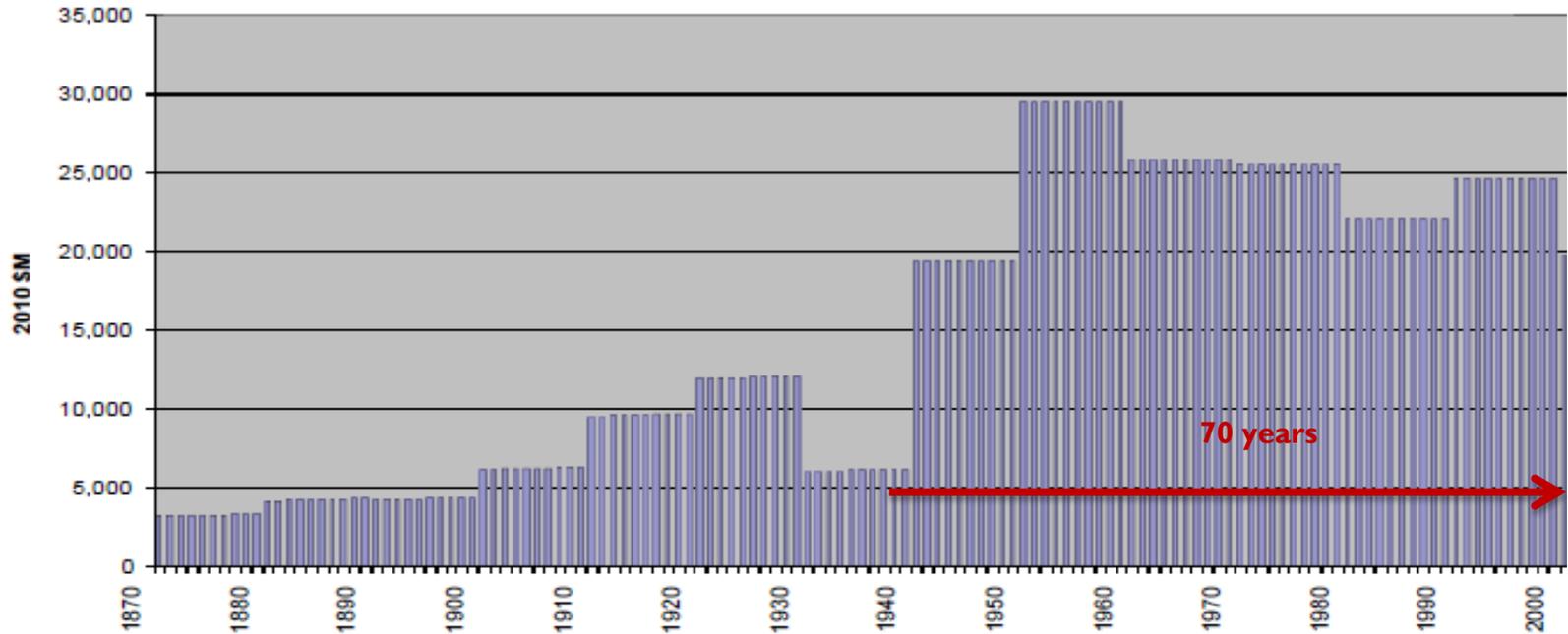
Total 20-Year Need by Project Type (in billions of January 2007 dollars)



USEPA Drinking Water Needs Survey

Pipe Age

Estimated Aggregate Investment in US Water Mains (in millions of 2010 \$s)



Understanding Acoustic LD



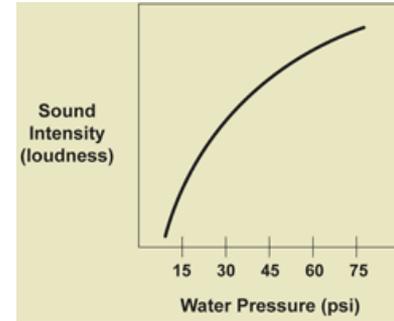
Water leaks in underground, pressurized pipes may make many different sounds:

- “Hiss” or “Whoosh” from pipe vibration and orifice pressure reduction
 - Often sounds like constant static noise
 - Is the only one which is always present for leaks in pipes with 30 psi or higher water pressure.
- “Splashing” or “Babbling Brook” sounds from water flowing around the pipe
- Rapid “beating/thumping” sounds from water spray striking the wall of the soil cavity
- Small “clinking” sounds of stones and pebbles bouncing off the pipe
- **Easier to pickup for leaks in pipes with 30 psi or higher water pressure**
- **Other sounds may or may not be present, and usually they are not as loud. So, we decide “Is there a leak?”**

What Factors Affect These Sounds?

Several factors that affect the loudness and the frequency range of sounds made by leaks transmitted on the pipes and to the surface:

- **Water pressure in the pipe**
- **Pipe material and pipe diameter**
- **Soil type and soil compaction**
- **Depth of soil over the pipe**
- **Surface cover: grass, loose soil, asphalt, concrete slab, etc.**
- **External noise: traffic, urban, industrial, RR**



The loudness or intensity of the leak sound is directly proportional to the water pressure inside the pipe (up to a limit):

How Far Do Leak Sounds Travel

- **Metal pipes, particularly iron mains between 6 inches and 12 inches, copper services, and steel pipes transmit the sounds of water leaks for hundreds of feet in all directions.**
- **Asbestos-cement pipe and PVC pipe do not transmit the sounds nearly as far.**
- **Distances transmitted for the sounds of water leaks are a function of the pipe diameter as well as the pipe material:**
 - Typical distance sound Travels for 2 gpm leak at 60 PSI
 - **6 inch Cast Iron Pipe 600 to 1000 feet**
 - **12 inch AC Pipe 300 to 500 feet**
 - **24 inch PVC Pipe 50 to 100 feet**



Data Logging Applications

- Automatic Meter Reading
- NRW Flow Data
- Customer levels of service
- Network Modeling
- DMA Data
- Flow & Pressure
- Reservoir and Tank Monitoring
- Water Quality
- Treatment Plant Monitoring
- Mains Leakage Data
- Waste Water Monitoring
- CSO
- PRV Sites
- Storm Drain Overflow



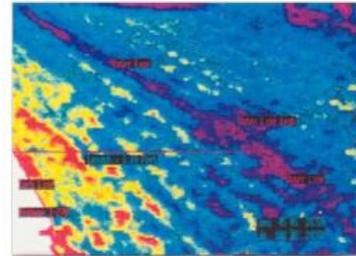
If there is an output we can generally log it !

Other Leak Detection Technologies

- Smart pigs (Pure, JD7)
- Acoustic sensors (Pure, Echo, Permalog, SubSurface)
- Aerial thermography

Main Drawbacks:

- Cost
- Availability
- Application constraints
 - Pipe diameter
 - Velocity
 - Pressure
 - Geometry
 - Launch site construction



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Helium - NSF Standard 60 Drinking Water Treatment Chemicals Certification

- Helium certified to 99.999% pure

Utility Service Company, Inc.
1230 Peachtree Street Northeast
Suite 1100
Atlanta, GA 30309
United States
678-235-0281
Facility : Madison, NC

Helium

Trade Designation	Product Function
Utility Service Company - Helium Series A	
Utility Service Company - Helium Series B	

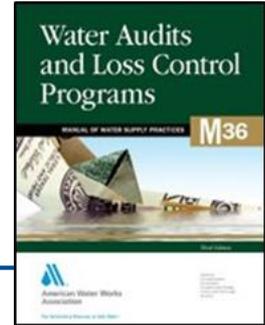


Helium Leak Detection Features

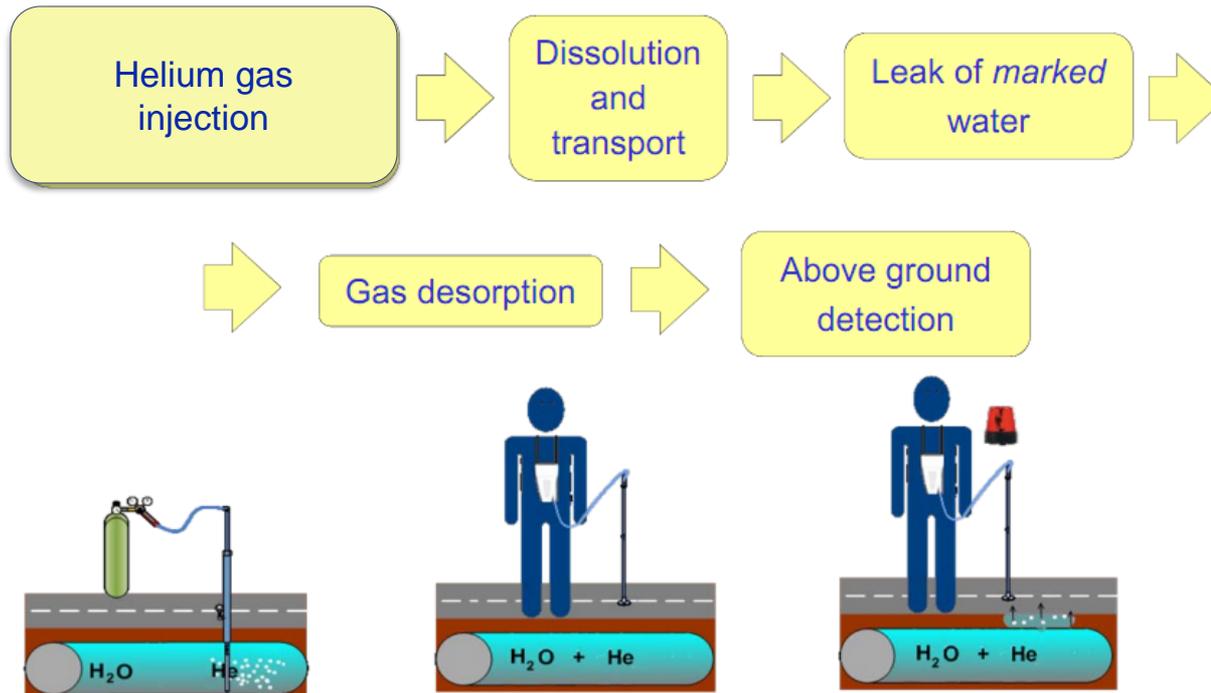


- **In use since 2007**
- **Helium injected into live water mains - no need to depressurize the water system**
- **Particularly suited for plastic & large diameter pipes, although suited for any material**
- **Can be used in challenging conditions**
 - Long runs
 - Intermittent pressures
 - Difficult to locate leaks
- **Injection can be used to pinpoint leaks for up to 5 days**

Principles of Helium LD

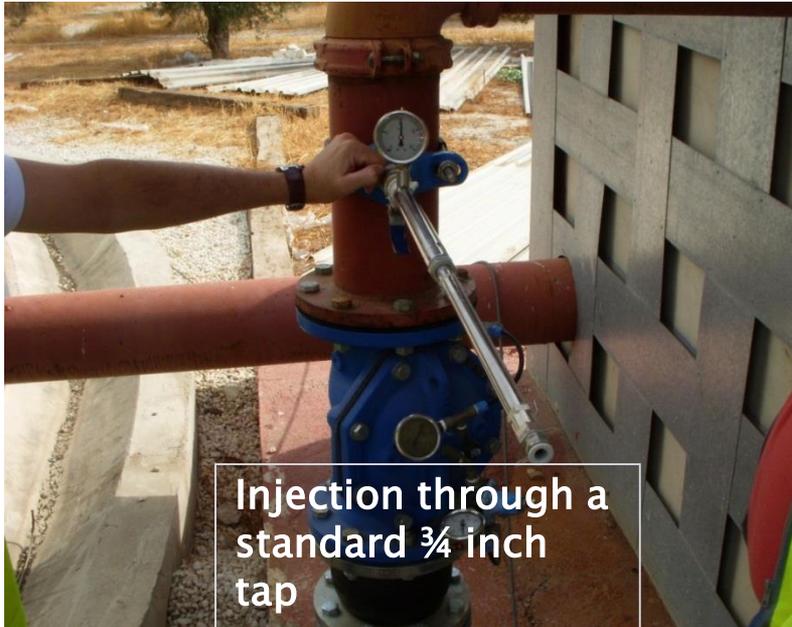


Tracer Gas method for pipes in operation



Insertion / Injection of Helium

Injection Process



Standard Injection Point

Modified Helium Injection Process

Hydrant



Pump



Helium Injection Above Ground (Pressurized)



Hydrant



OR



Helium / water mixture injected into pipe in vault



Helium Distribution Considerations



- Helium Injection Location
- Drawing Helium into the Network
 - Can use normal demand flow or “create” demand by intermittent flowing at select hydrants
- Pipeline Location and Cover
- Dechlorinating & Environmental Protection
- Traffic Control & Safety
- Ensure helium distribution in entire pipe system being surveyed.

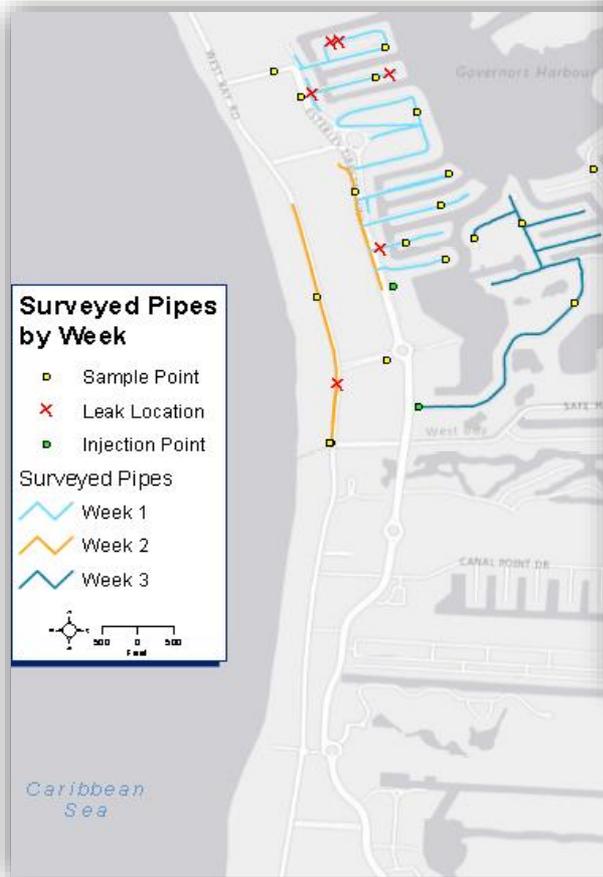
Sampling at a hydrant to insure helium distribution

Detection Process

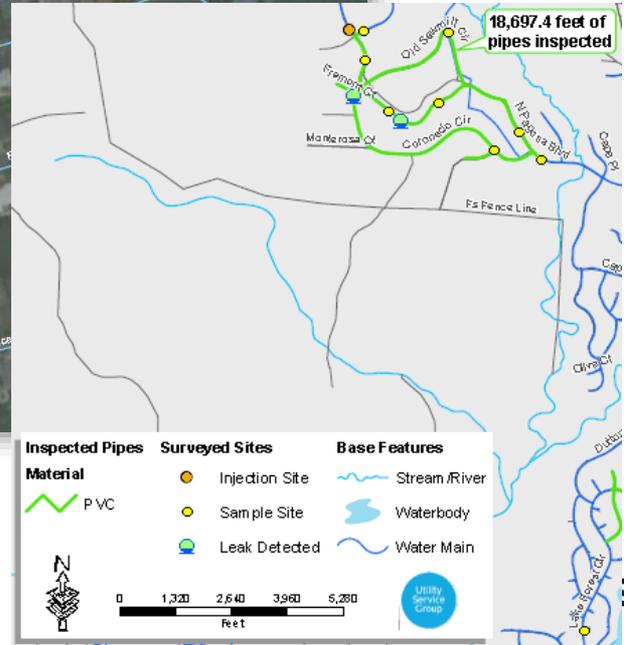
- **Drilling / hand probe of small holes needed in non-porous surfaces to allow HE gas into atmosphere.**
 - Fully automated cart
 - Hand Drilling
 - Leak detection / pinpointing
- **Looking for levels above ambient conditions.**
- **GPS location of “leaks” for mapping**



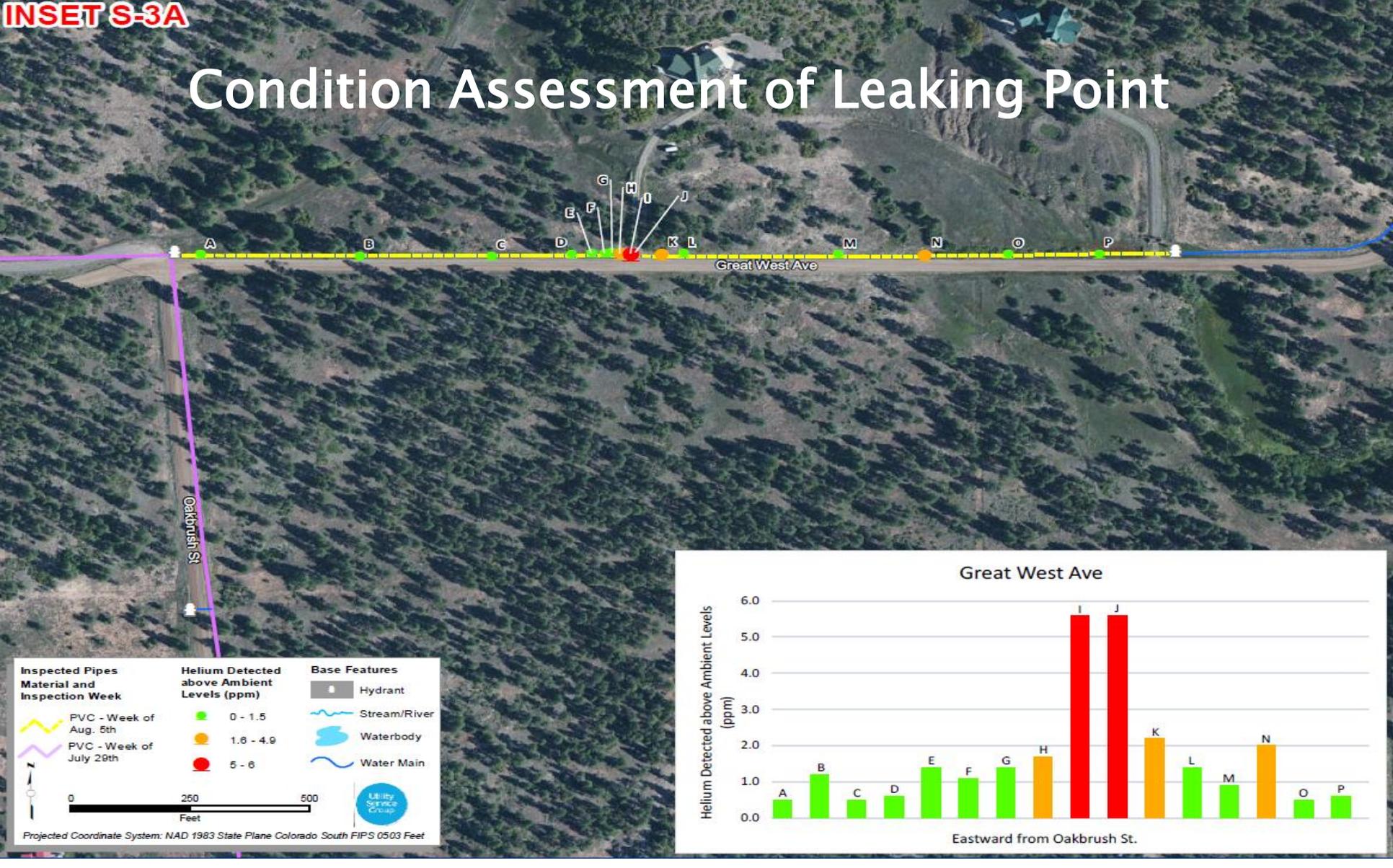
Leak Survey Mapping



Surveyed Pipes		
Date	Week/Day	Length (ft)
3/17/2014	clay 2	978
3/17/2014	clay 2	3,001
3/17/2014	clay 2	3,590
3/17/2014	clay 3	2,610
3/17/2014	clay 4	4,700
3/17/2014	clay 3	1,447
3/17/2014	clay 3	252
3/17/2014	clay 4	214
3/17/2014	clay 4	3,448
3/17/2014	clay 5	2,448
Subtotal		15,234



Condition Assessment of Leaking Point

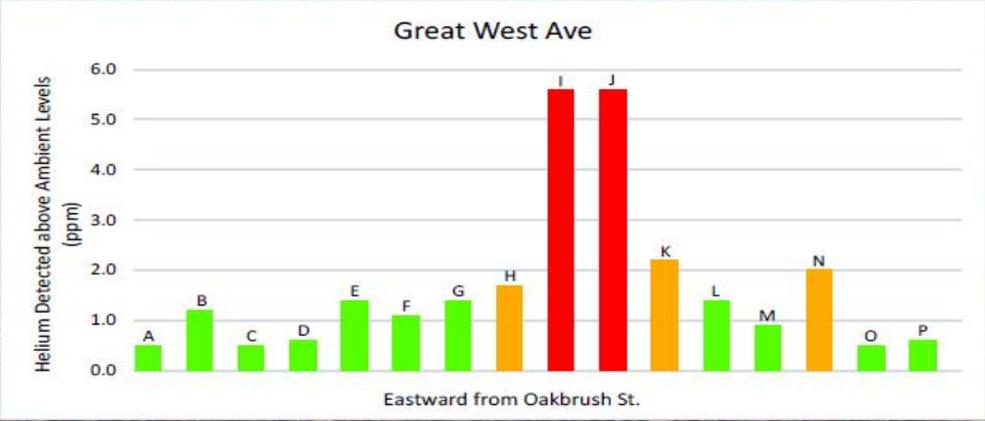


Inspected Pipes Material and Inspection Week	Helium Detected above Ambient Levels (ppm)	Base Features
PVC - Week of Aug. 6th	0 - 1.5	Hydrant
PVC - Week of July 29th	1.6 - 4.9	Stream/River
	5 - 6	Waterbody
		Water Main

0 250 500 Feet

Utility Service Group

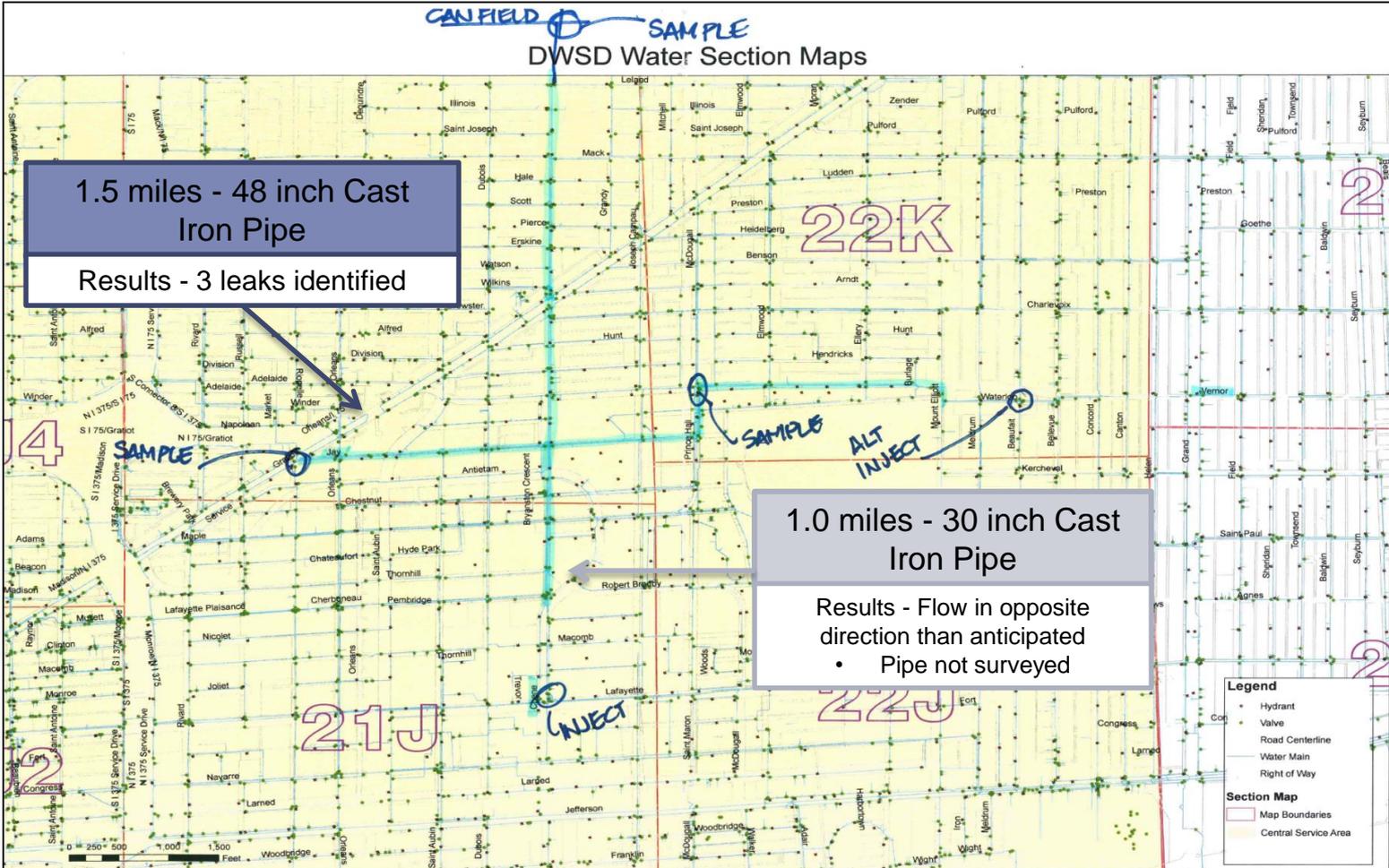
Projected Coordinate System: NAD 1983 State Plane Colorado South FIPS 0503 Feet



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Detroit - 48" and 30" Cast Iron Transmission Mains – 100 Year Old Water System



Detroit Project Challenges

- **Drilling in paved roadways up to 36 inches in depth**
 - Multiple layers of pavement including blacktop, cement concrete and brick
- **Locating of century old pipelines with old mapping**
- **Plumbing & connections**
 - American / Canadian threads
- **Deep wet vaults**
- **30 inch transmission main flow direction**
- **Limited sampling points with no option to “create” demand. Dependent on system demand.**
- **Weather - Rain, sleet, cold conditions**
- **Traffic control**



PROJECT RESULTS - Cayman Islands

- PVC is elastic – expand and contract with pressurization
- No leak when line was under pressurized.
- In a months time found \$1.2M worth of water loss. Payback was less than 3 months.



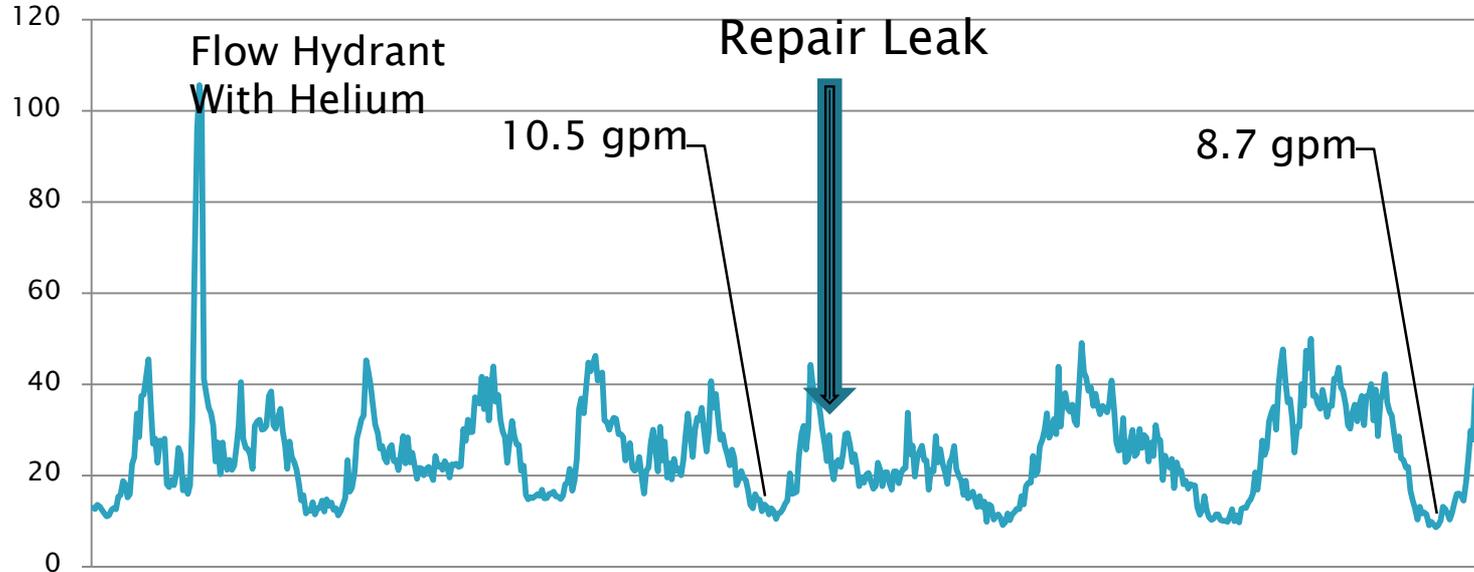
Case Study – Harrisburg, PA



3/4" Service at 410 Pleasantview replaced

Repair & Results

President's Drive Flow (Gal/min)



President's Drive DMA	4/13/13 – 4/19/13	4/19/13 – 4/22/13
Minimum Daily Flow	34,888 gpd	30,894 gpd

SUMMARY

- **Reliable and Highly Accurate**
- **Deployed in “live” fully operable water system with no impact on operations**
- **Effective on all pipe sizes and materials**
- **Not limited by “noise” or electrical interference, or to system geometry or length of pipe(s)**
- **Less intrusive than other technologies**
 - Standard tap OR fire hydrants only needed for injection.
 - Nothing to get stuck or lost traveling through pipe.
- **Fast to implement (especially in relation to other tests in large pipes)**
- **Works in areas with few or very distant access points (like transmission mains)**



Questions?

Jeff Austin

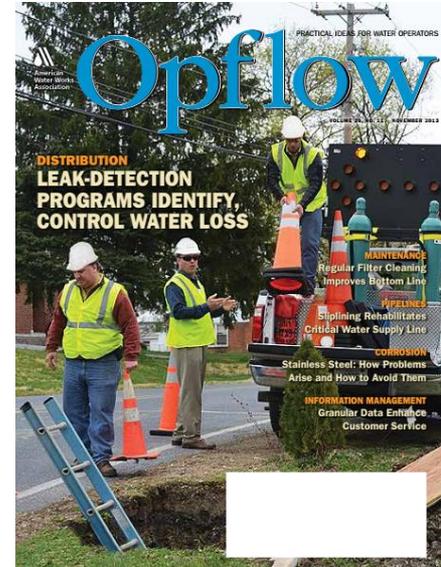
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Distribution

An effective leak-management program is an important part of asset management. Numerous leak-detection technologies and approaches are available, but a customized program will deliver the best results.

BY RUSSELL G. TITUS, BOB MERTON, JEFF JOHNSON, PAUL MESCHING, AND RANDY MOORE

LEAK-DETECTION PROGRAMS IDENTIFY AND CONTROL WATER LOSS

Editor's Note: This is the last of a three-part series of articles based on a series of AWWA webinars on distribution system issues. The first article, *Bigfilm Control: Develop an Effective Strategy to Preserve Quality, Ensure Compliance* (September 2013 issue), described bigfilm control strategies. The second article, *Maintenance: Well Asset Management Increases Service Life* (October 2013 issue), reviewed water well rehabilitation technologies. This article covers an array of available leak-detection strategies that can be incorporated into a leak-detection program. For more information, visit www.awwa.org/webinars.

LEAKAGE IS ALWAYS AN ISSUE with underground water conveyance systems. A water utility can control underground leakage only by conducting a painstaking survey of the entire system. The earliest leak-location method was for an operator to place one end of a listening stick to the ground above a water main and the other end against his or her ear. Water under pressure is a form of potential energy. When the pressure is released to atmospheric pressure, it changes to kinetic energy. Some of the energy is in the form of audible sound. Different types of leaks and leaks in various kinds of pipe materials produce different sounds.

4 Opflow November 2013

www.opflow.net

Understanding Acoustic Leak Detection



What are the Sounds of Water Leaks?

- “Hiss” or “Whoosh” from pipe vibration and orifice pressure reduction
- “Splashing” or “Babbling Brook” sounds from water flowing around the pipe
- Rapid “beating/thumping” sounds from water spray striking the wall of the soil cavity
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- The “Hiss” or “Whoosh” sound, which often sounds like constant static noise, is the only one which is always present for leaks in pipes with 30 psi or higher water pressure. The other sounds may or may not be present, and usually they are not as loud. So, we decide “Is there a leak?” by listening for the “Hiss” or “Whoosh.”

Celebrating 100 Miles of Helium Leak Detection in North America Since 2013

- **Pipe sizes 3/4 inch to 48”**
- **Materials**
 - Non Metallic
 - PVC
 - PE & HDPE
 - VC
 - Metallic
 - DIP
 - CIP
 - Steel
- **Municipal, Fire Systems, Industrial, Government**
- **All pressure situations**
- **Over 98% confirmed leaks**
- **Components**
 - Distribution mains
 - Transmission mains
 - Services
 - Service connections
 - Meter boxes
 - Valves
 - Hydrants
- **New pipes that fail pressure testing**

