



Leak Detection and Condition Assessment for Critical Pipeline Assets

PNWS-AWWA
May 8, 2025



Why does pipeline management matter?



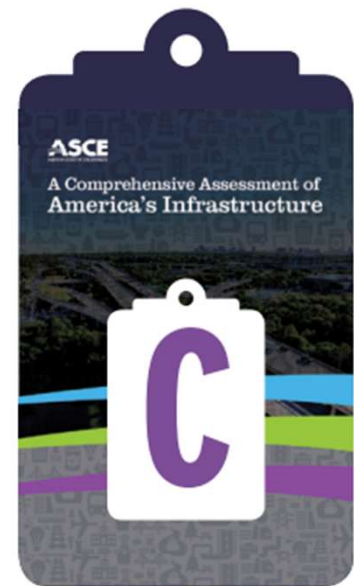
Why does pipeline management matter?



- Ensures water supply
- Reduces water loss
- Regulatory compliance
- Environmental impact
- Capital improvement planning

“When the well's dry, we know the worth of water.”

Aging infrastructure



Aging infrastructure: Drinking Water



<https://infrastructurereportcard.org/>

Pipeline risk

Probability of failure & consequence of failure

“There are known
knowns, known
unknowns, and
unknowns
unknowns”

- Donald Rumsfeld



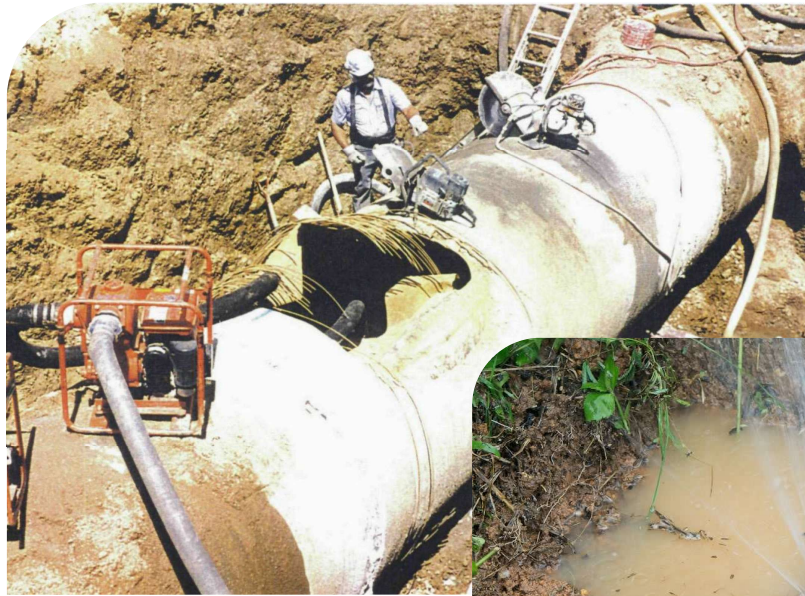
Pipeline failure

Modes, mechanisms, and causes

Pipeline failure modes and mechanisms drive technology development and expected **risk return on investment.**

Examples:

- Broken wire wraps
- Corrosion induced wall loss
- Joint issues



Assessment strategies for assets

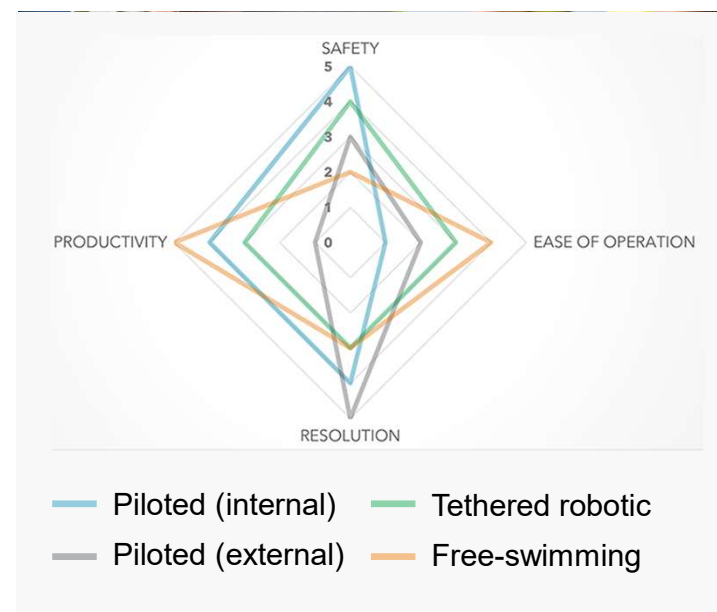
Important determining factors

Technology

- Vendor agnostic
- Sensor or method of collecting data
- Examples:
 - Acoustic technology: leaks and gas pockets
 - Electromagnetic technology: wire breaks and wall loss

Platform

- How technology is deployed
- Piloted, tethered, free-swimming, etc.
- Examples:
 - SmartBall for leak detection
 - PipeDiver for electromagnetic inspection



Both technology and platform impact assessment cost and effort.

Slide 8

- KT0** [@McNealy, Ashan - Xylem] - there's animation on this slide with the technology pictures behind the spider chart
Twigg, Kristina - Xylem, 2024-10-09T14:58:34.984
- KT1** [@McNealy, Ashan - Xylem] - dropping more of your slides here. Feel free to move them where you need them.
Twigg, Kristina - Xylem, 2024-10-10T19:48:54.954

Assessment strategies for assets

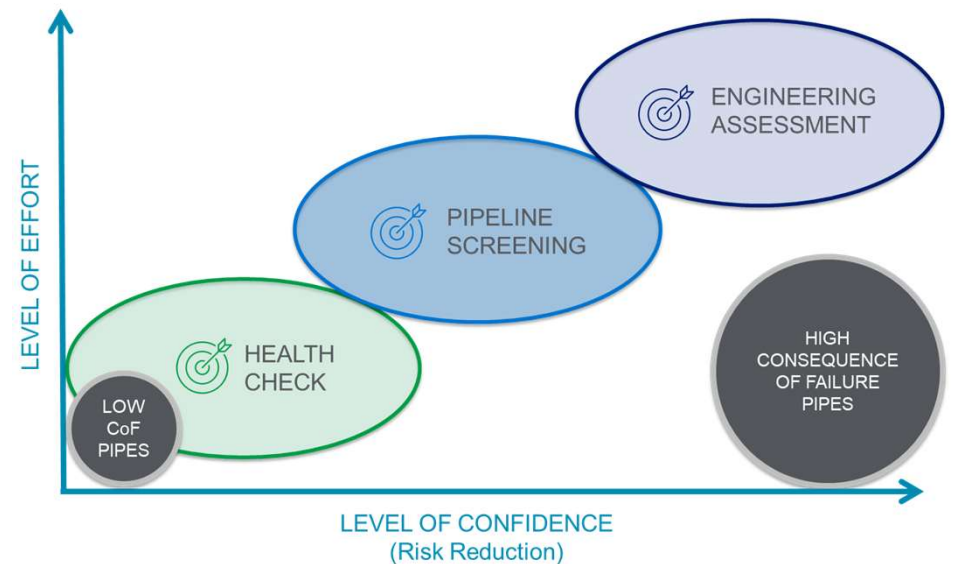
Important determining factors

Risk

Select an appropriate level of assessment for predicted risk.

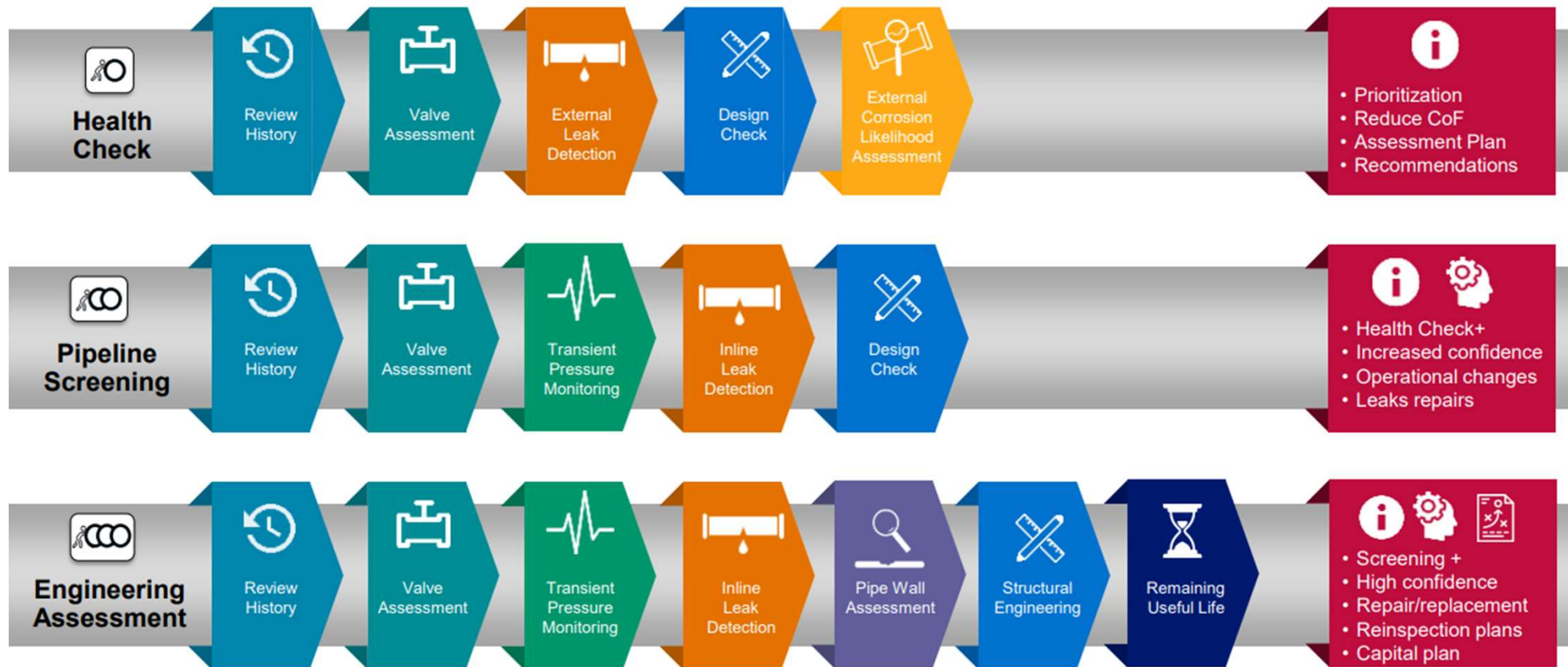
Pipe material

Assessment methods should be tailored to the unique failure mechanisms of each pipe type.



Goal is to determine the best tools for the asset based on common failure modes, operational requirements, and your risk reduction goals.

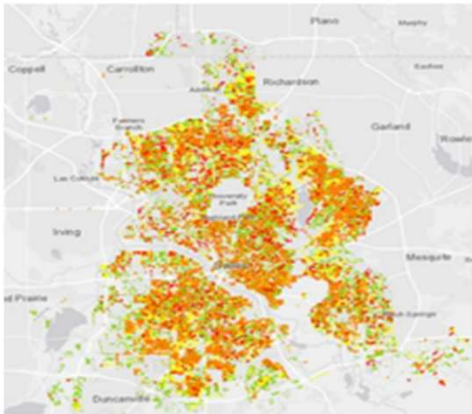
Pipeline Condition Assessment



The Right Analysis for Each Pipe Network

Distribution Mains

Primarily Managed By Rehabilitation and Replacement



Goal: To Reduce Break Rates

Transmission Mains

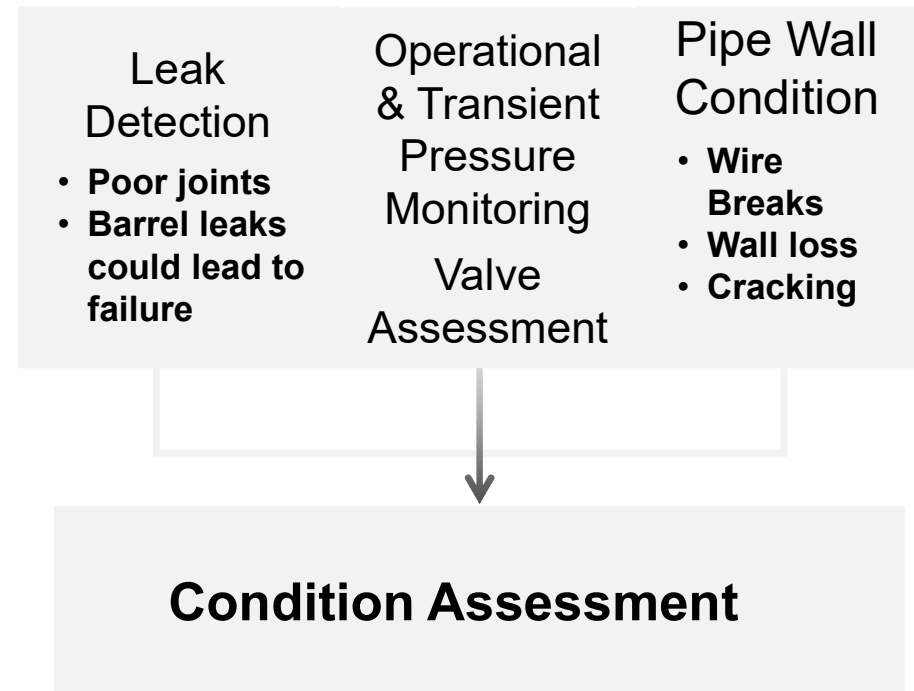
Primarily Managed By Inspection/Point Repairs



Goal: To Avoid Costly Catastrophic Failures

Inspection & Monitoring

Getting high quality data, safely

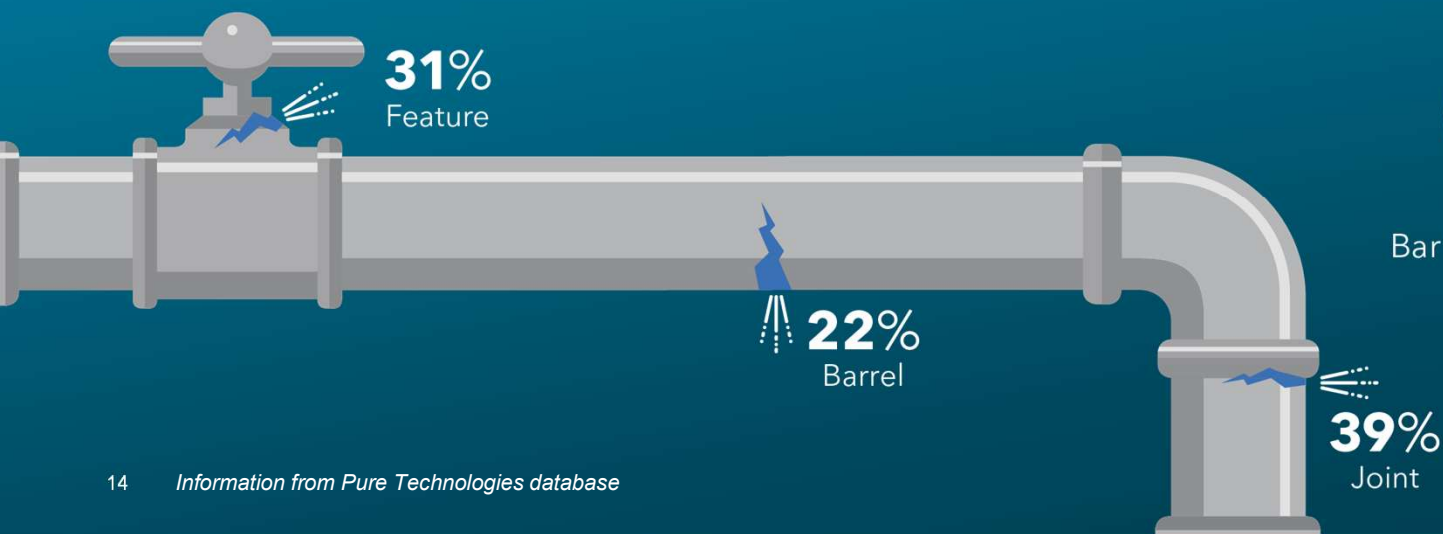




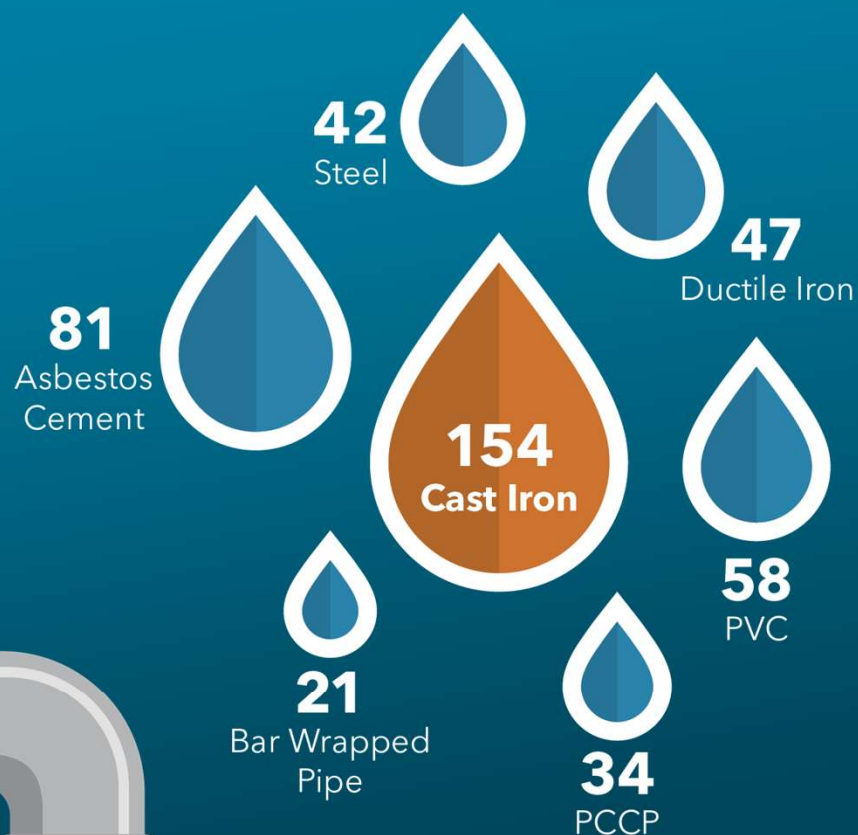
Assessment Practices and Technologies

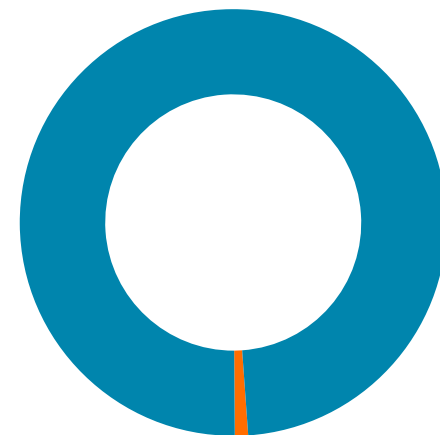
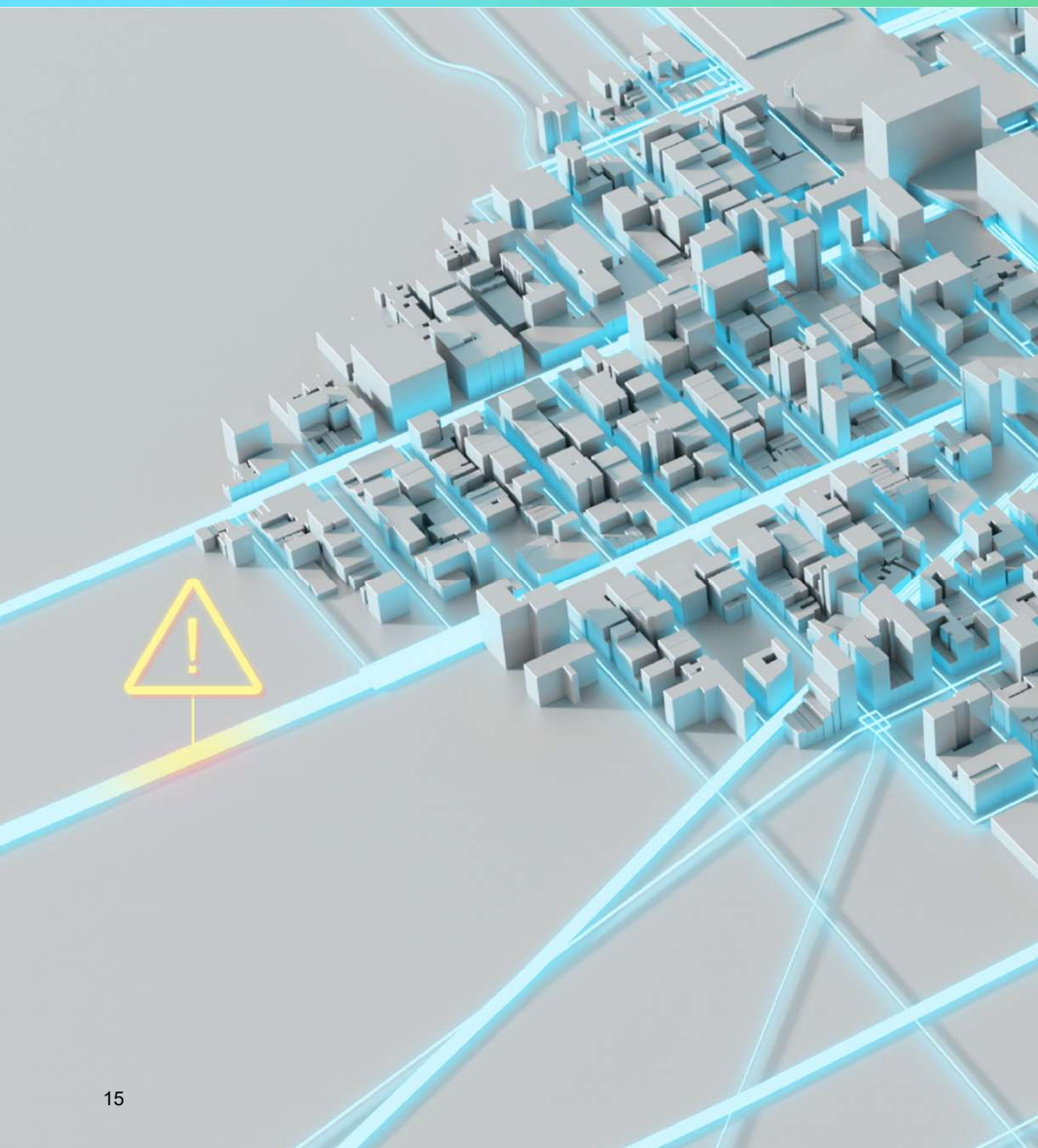


Over 60% of leaks were reported to be at a joint or on the pipe barrel. **These types of leaks can be a precursor to failure.**



LEAKS PER 100 MILES

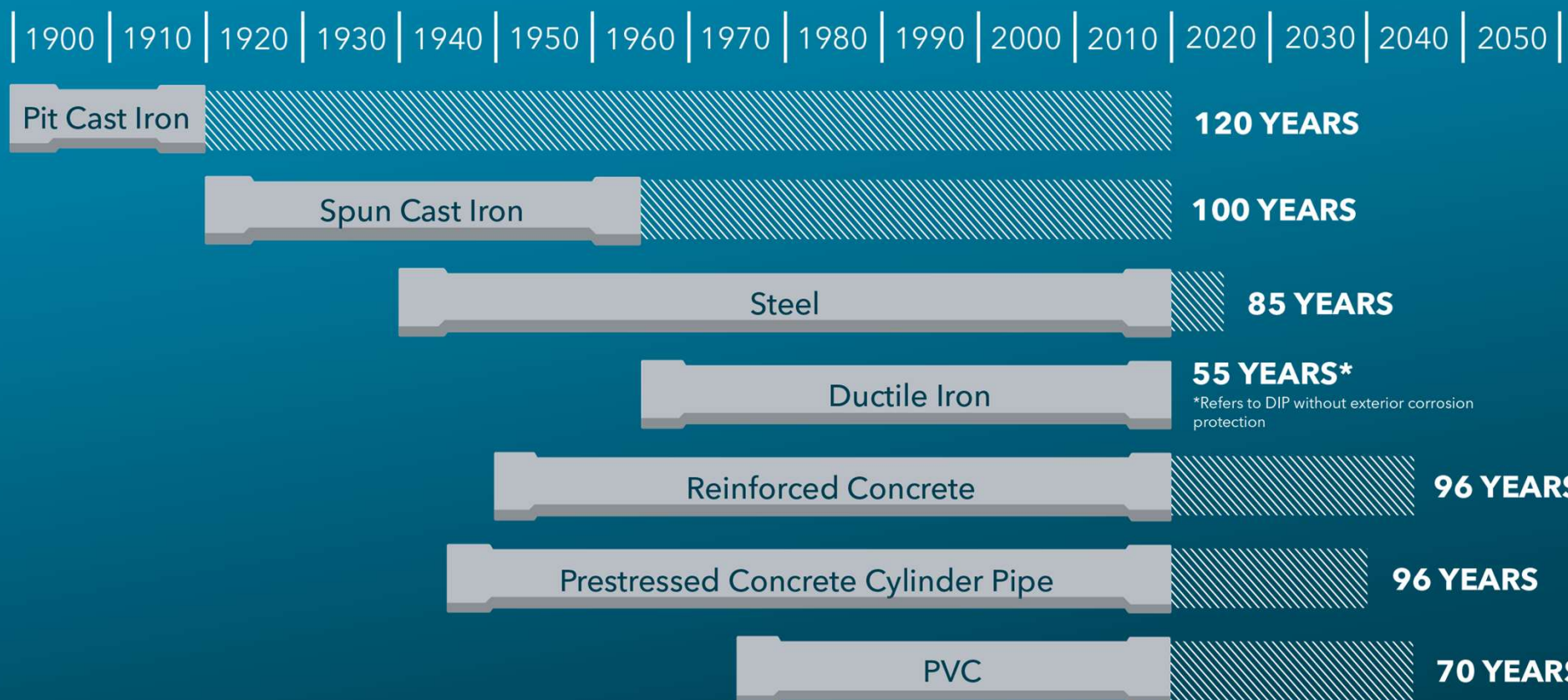




1%
of pipes need
immediate attention

Pipelines can be managed at a
fraction of the cost of replacement.

Tens of thousands of miles of pipe will safely exceed its 'theoretical' useful life



EFFORT



Outside the pipe: Reduce risk across your network

01

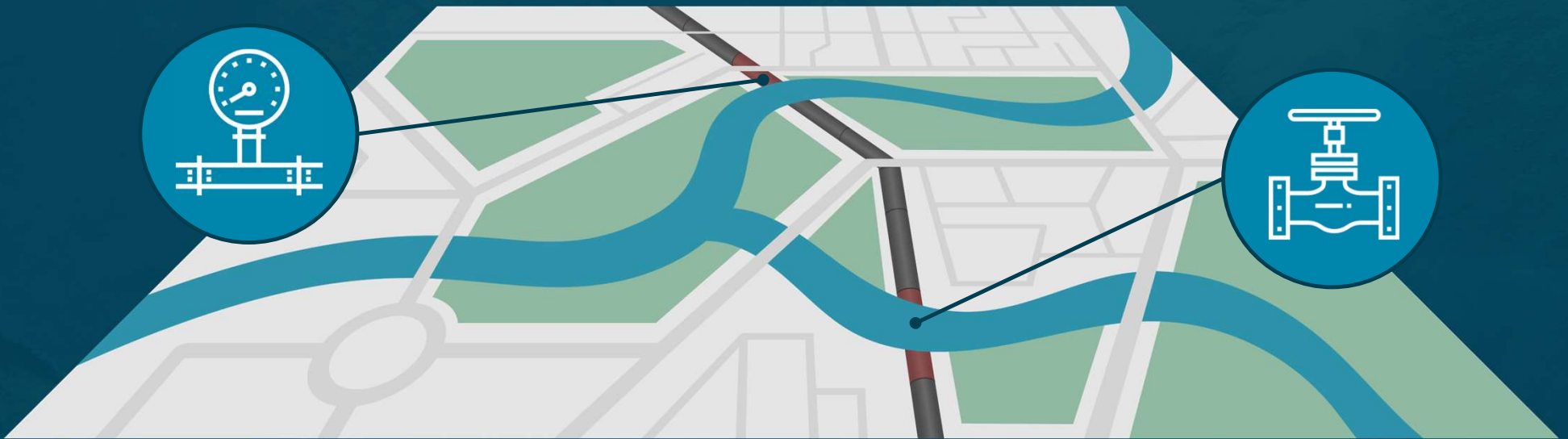
Review history &
design check

02

Valve
maintenance

03

Transient pressure
monitoring



Outside the pipe: System control

Levels of valve assessment



01

LEVEL 1

Visual inspection with the lowest torque application



02

LEVEL 2

Inspect all moving parts within the gearbox

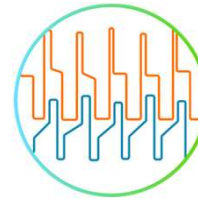
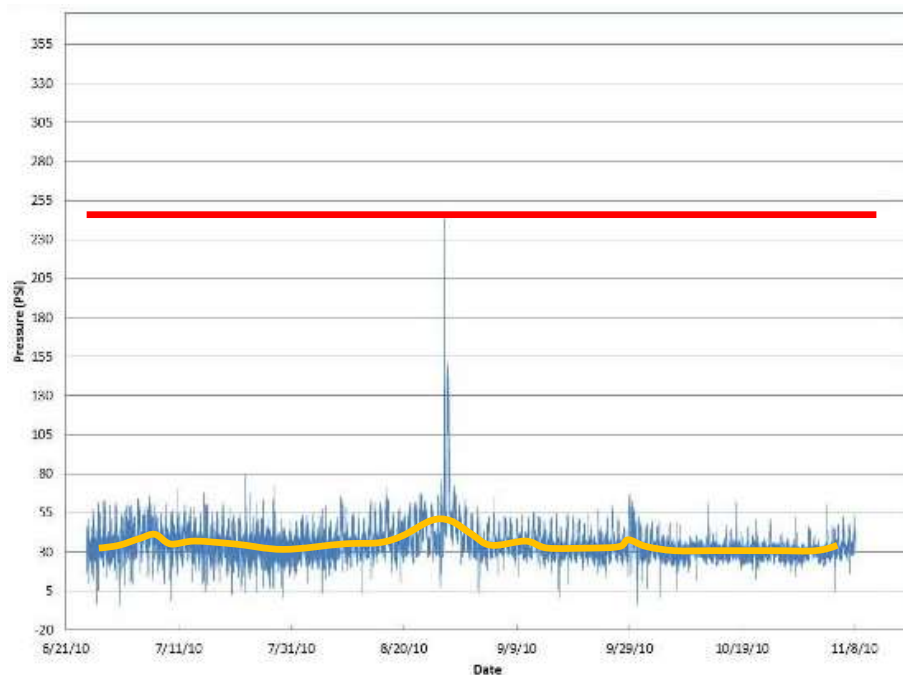


03

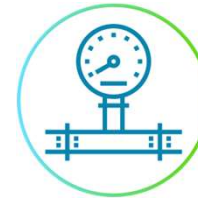
LEVEL 3

Inspect all internal valve components

Outside the pipe: Transient pressure monitoring



How many pressure transients?
Frequency



How severe are the pressure transients?
Amplitude



What is causing transient pressures?
Can we control it?

Outside the pipe: Leak detection

Localize.



Localize the water loss down to a specific area or zone (using DMA or noise logging)



Locate.



Locate the position of the leak (using leak noise correlators and/or correlating noise loggers)



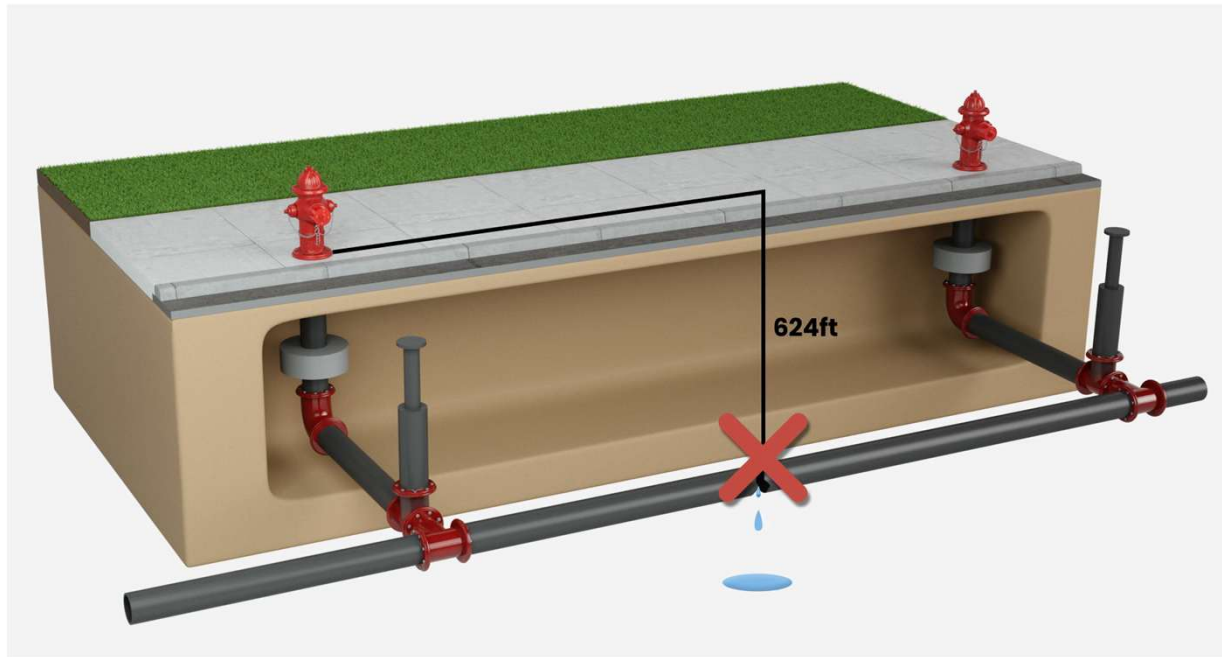
Pinpoint.



Pinpoint leaks prior to excavation (using ground microphones & listening sticks).



Outside the pipe: Permanent leak detection devices



Graphic source: Orbis Intelligent Systems, Inc.

Inside the Pipe

Advances in inline inspection technology



Five steps to get the pipeline data you need

- 01 Select the **sensing** layer
- 02 **Enable** the inspection
- 03 Get equipment **into** the pipe
- 04 Get equipment **through** the pipe
- 05 Get equipment **out** of the pipe



Sensing for primary threat detection

Inline Inspection



METALLIC PIPE

Wall loss



PRESTRESSED CONCRETE PIPE

Broken wire wraps



BAR-WRAPPED PIPE

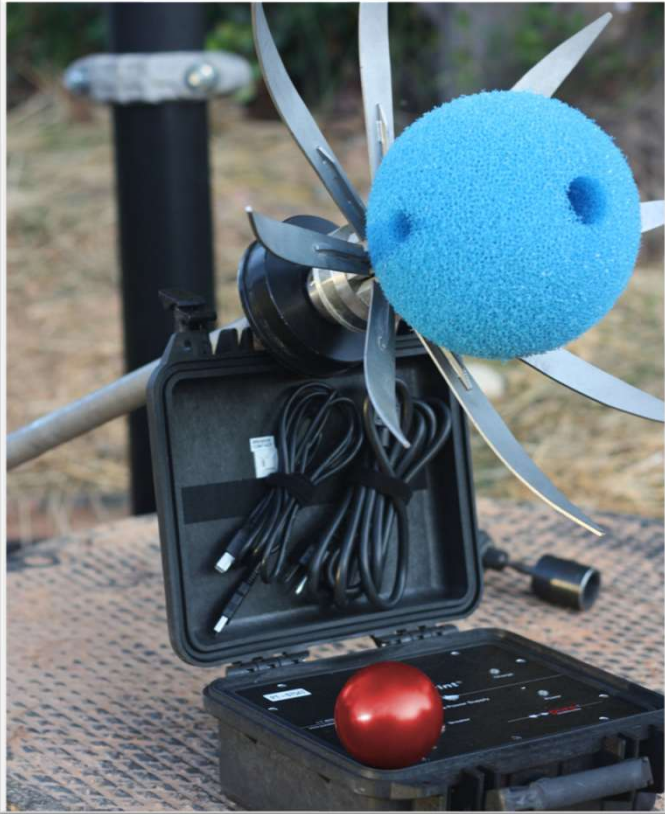
Broken bar wraps and
cylinder wall loss



Sensing layers for common failure modes: Leak detection



Free swimming devices

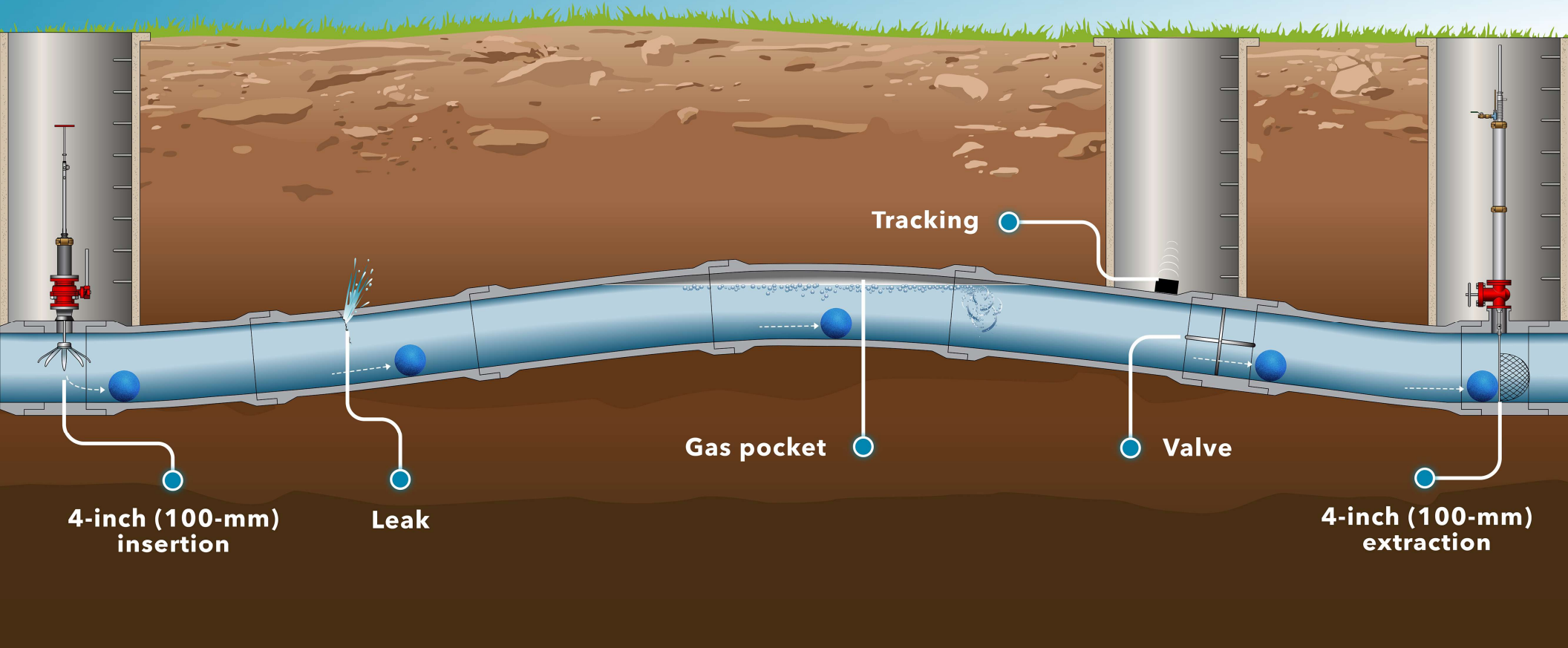


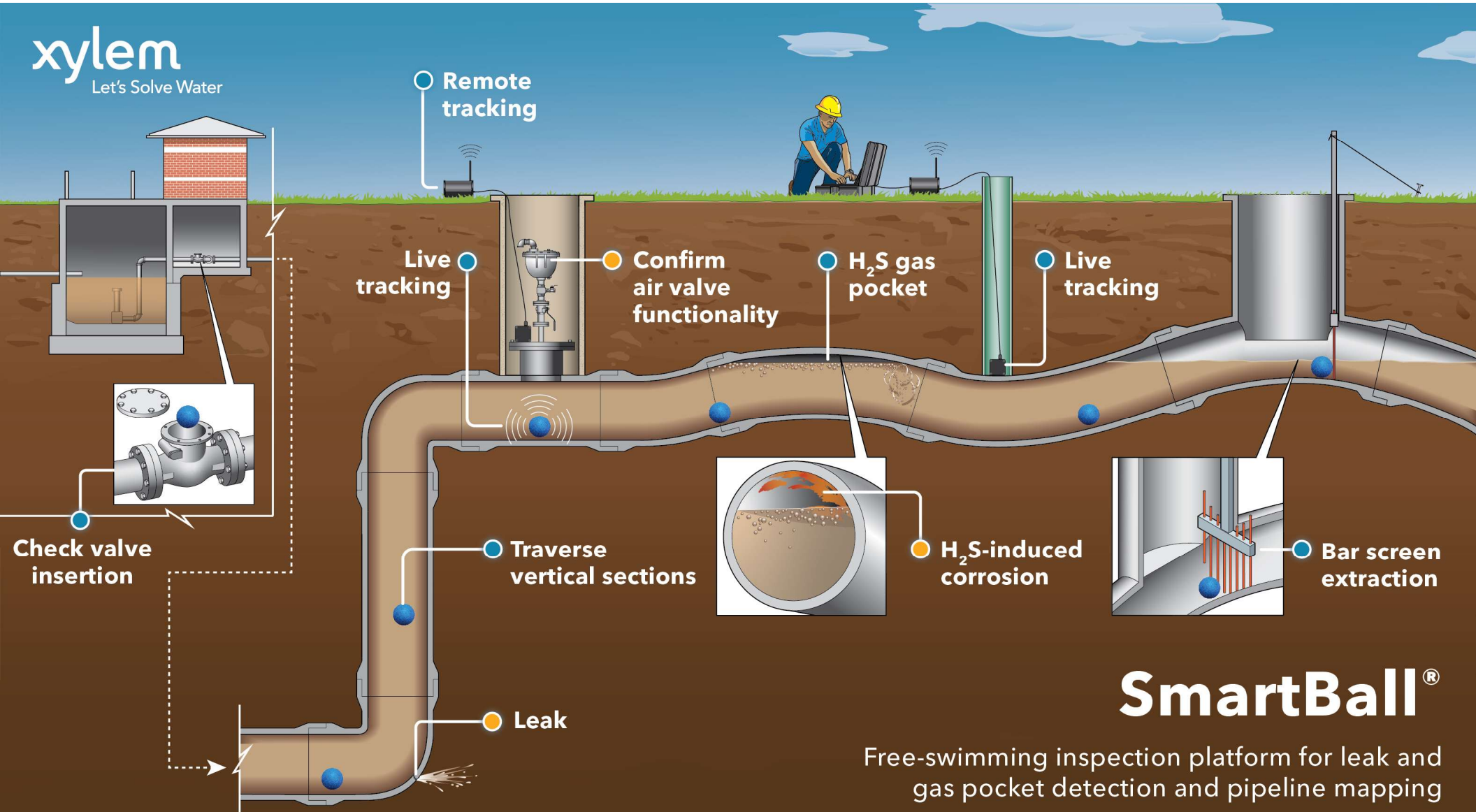
- Identifying and locating leaks and gas pockets
- Mapping the pipeline to confirm alignment
- Identifying and locating potential undocumented features and pipe type changes

SmartBall®

Free-Swimming Inspection Platform for Leak and
Gas Pocket Detection and Pipeline Mapping

xylem
Let's Solve Water





Benefits of SmartBall® like devices



Ease of deployment



Minimal service disruption



Live tracking



Long distance in single deployment

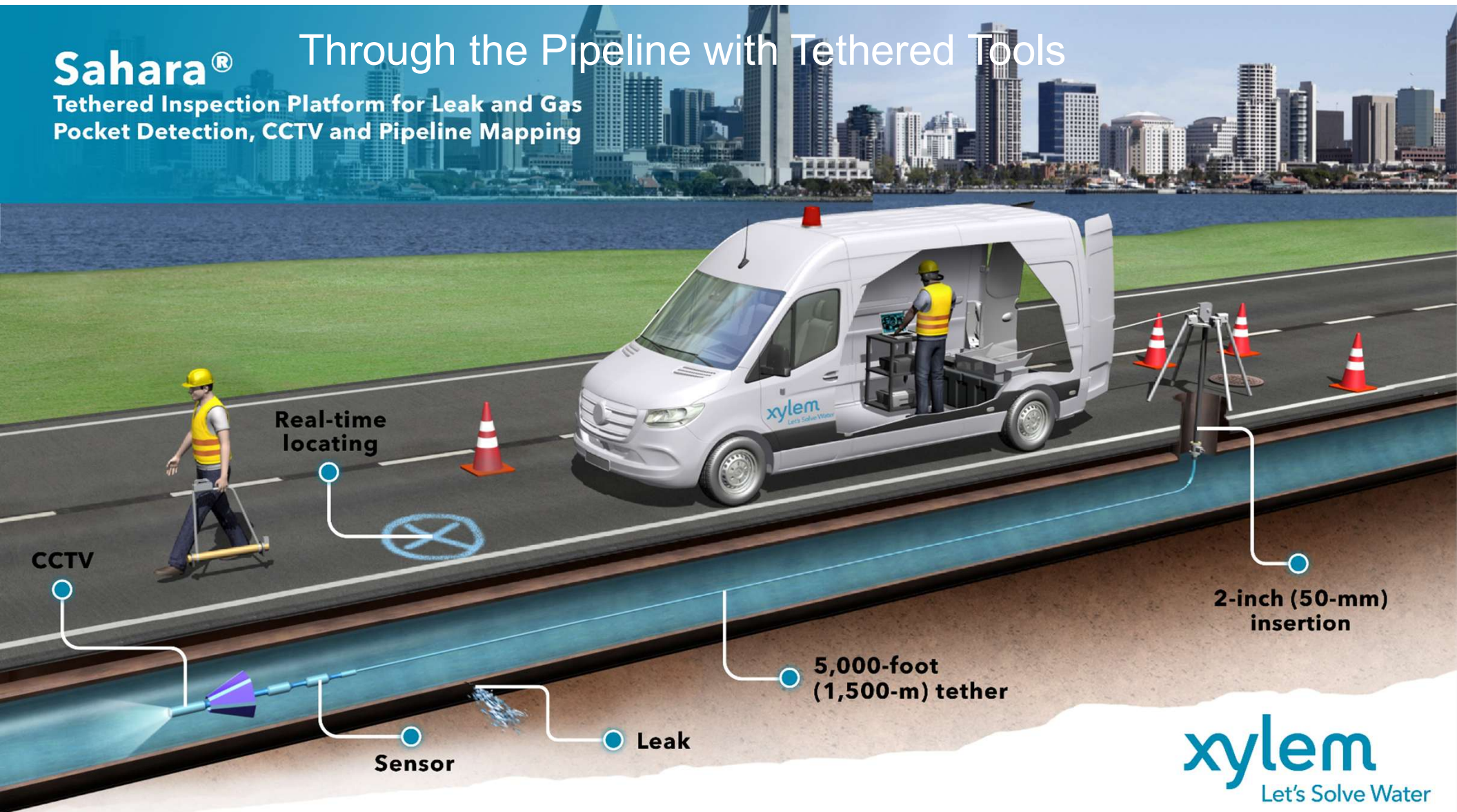


Collects multiple types of data
in one inspection

Sahara®

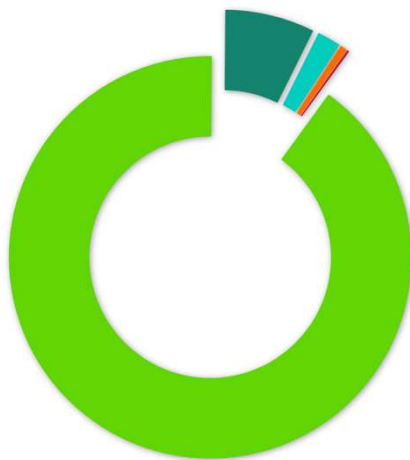
Tethered Inspection Platform for Leak and Gas
Pocket Detection, CCTV and Pipeline Mapping

Through the Pipeline with Tethered Tools



Sensing layers for common integrity threats: Electromagnetic

Inspection data shows:



90%
NO ANOMALIES

7%
REPAIRED

0%
> 50 BWW

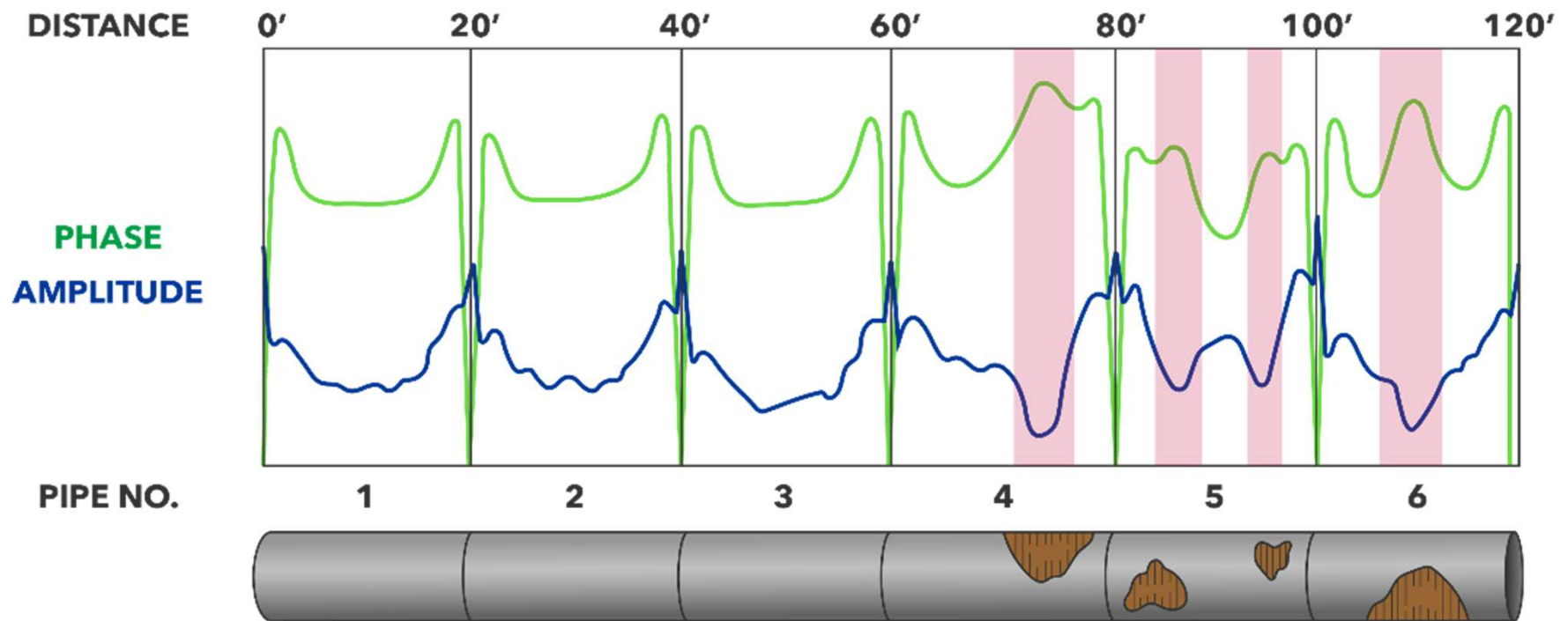
1%
> 25 BWW

2%
< 25 BWW

Most PCCP in the ground today is in good condition.



Electromagnetic Data Analysis



What Does an Electromagnetic Scan Detect?



METALIC PIPE – STEEL, CAST IRON, AND DUCTILE IRON

Identifies, locates, and quantifies **localized areas of wall loss**



BAR-WRAPPED PIPE (BWP)

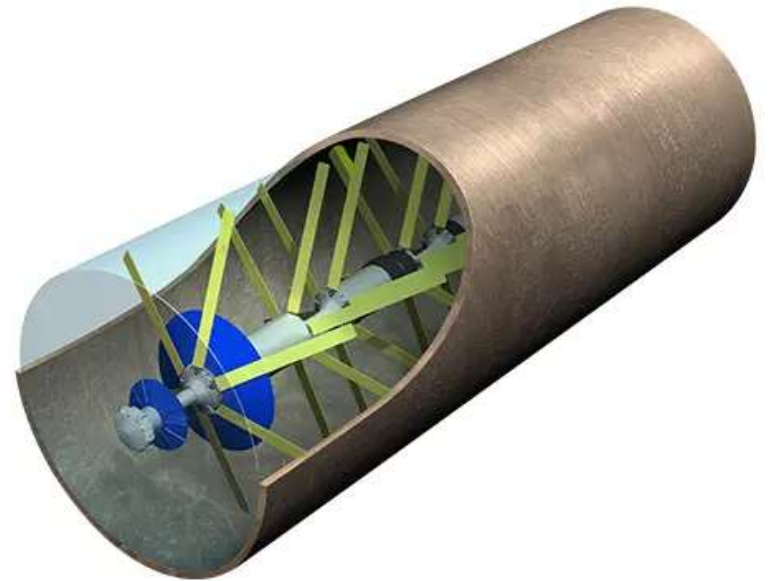
Identifies, locates, and quantifies **broken bar wraps** and **localized areas of wall loss in the cylinder**



PRESTRESSED CONCRETE CYLINDER PIPE (PCCP)

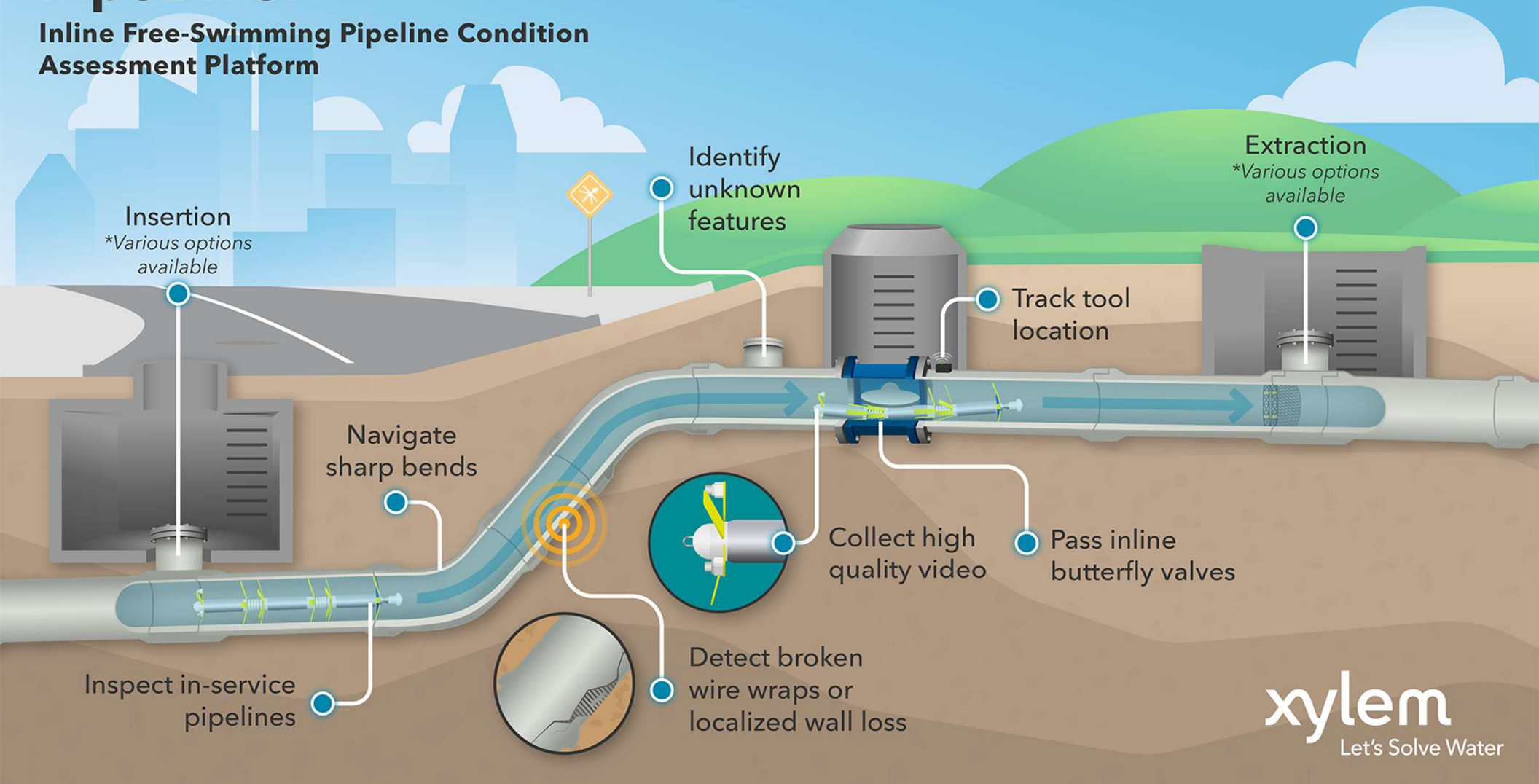
Detects, locates, and quantifies **broken wire wraps**

Free swimming electromagnetic tool



PipeDiver® Through the Pipeline with Free-Swimming Tools

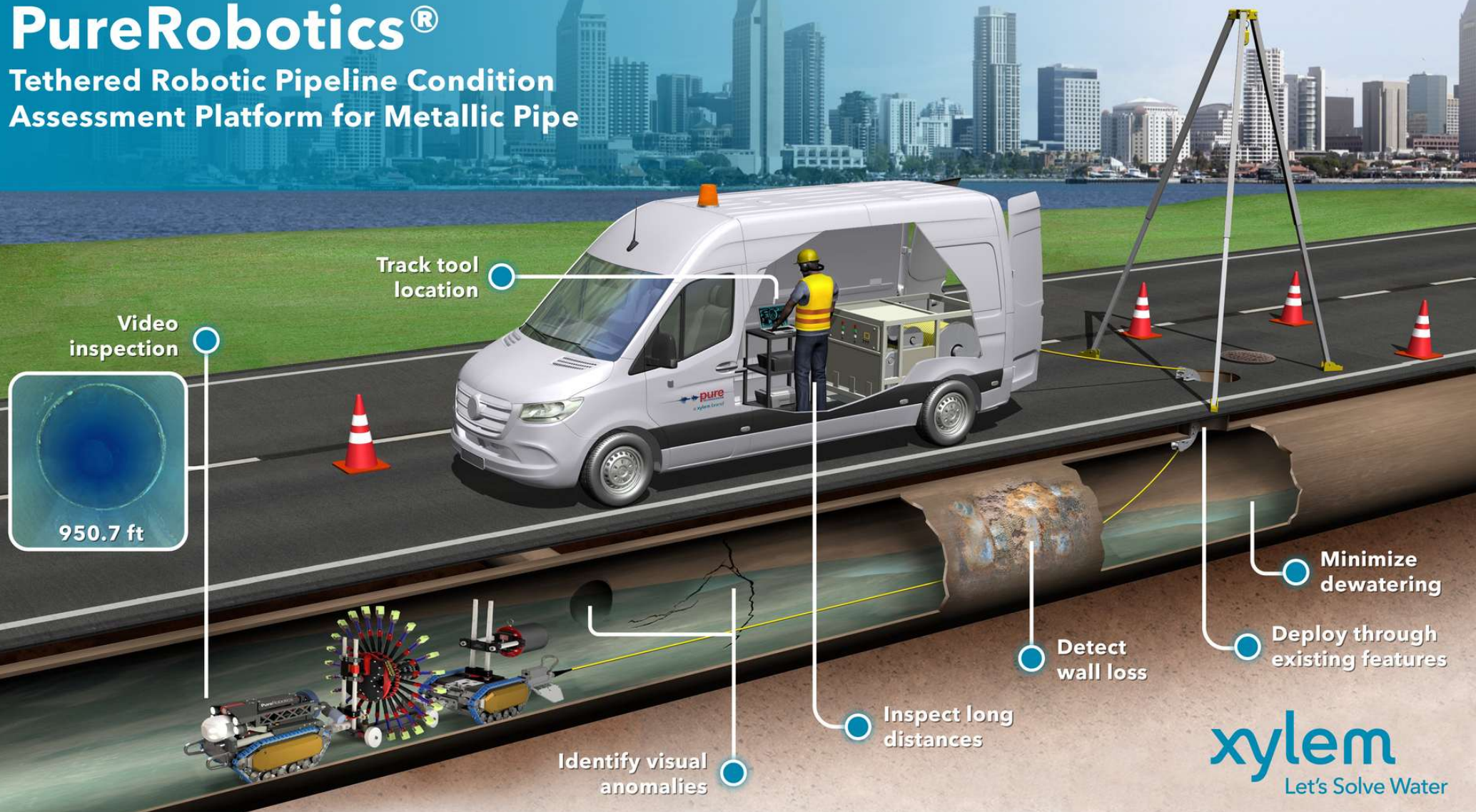
Inline Free-Swimming Pipeline Condition Assessment Platform



xylem
Let's Solve Water

PureRobotics®

Tethered Robotic Pipeline Condition Assessment Platform for Metallic Pipe



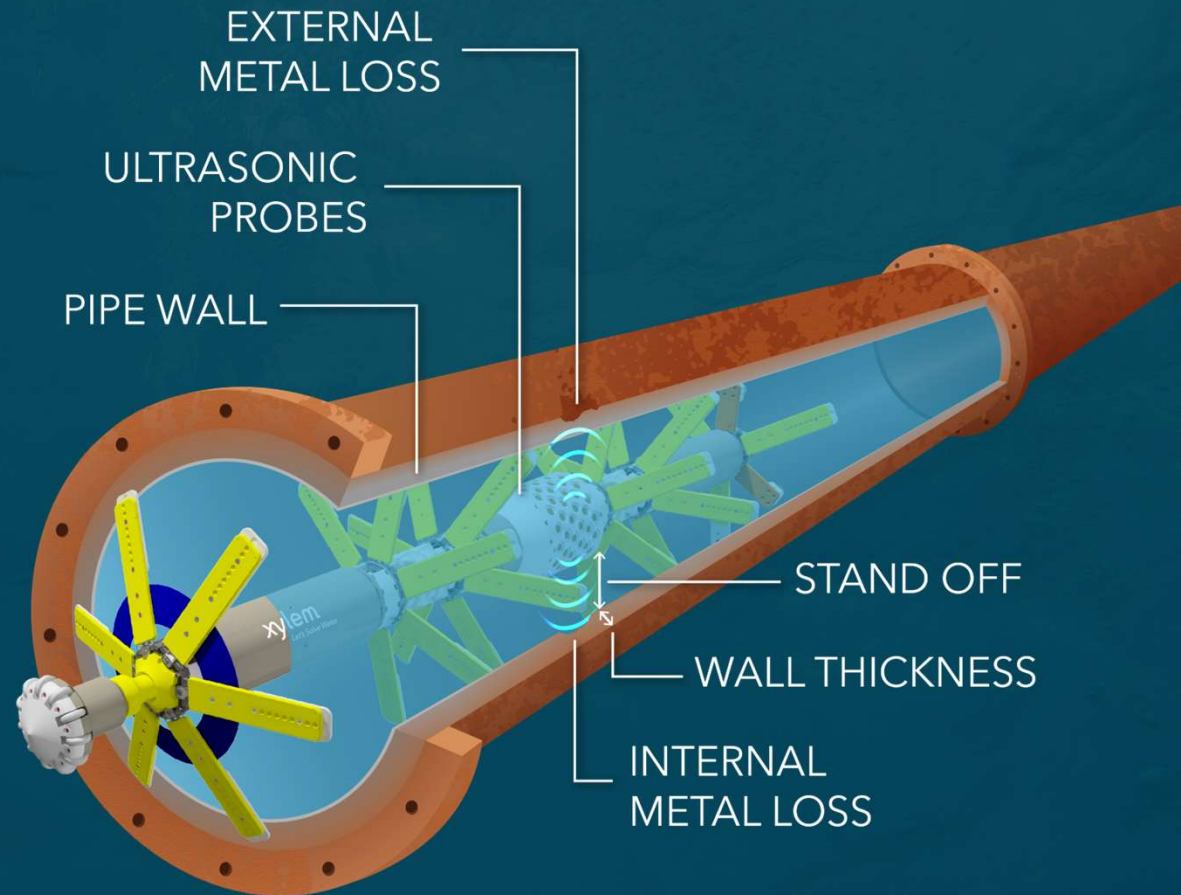
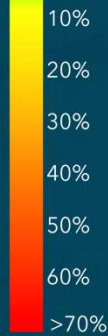
Sensing layers for common integrity threats: Ultrasonic Wall Loss



VALIDATED PIPE DEFECT

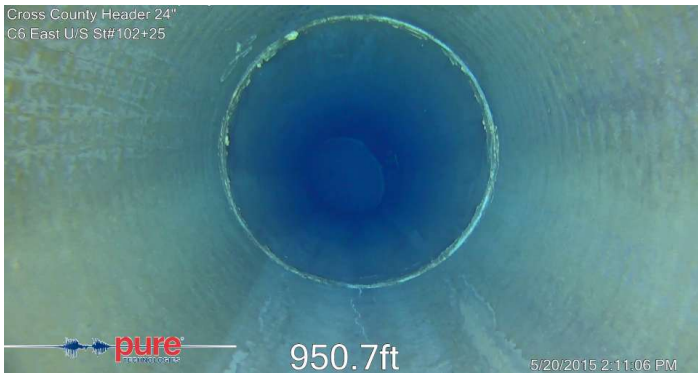
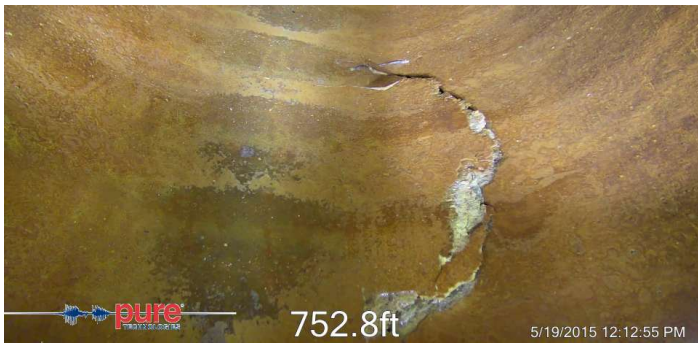


WALL THICKNESS MAP
FROM PIPEDIVER ULTRA



Sensing layers for common integrity threats: visual inspection

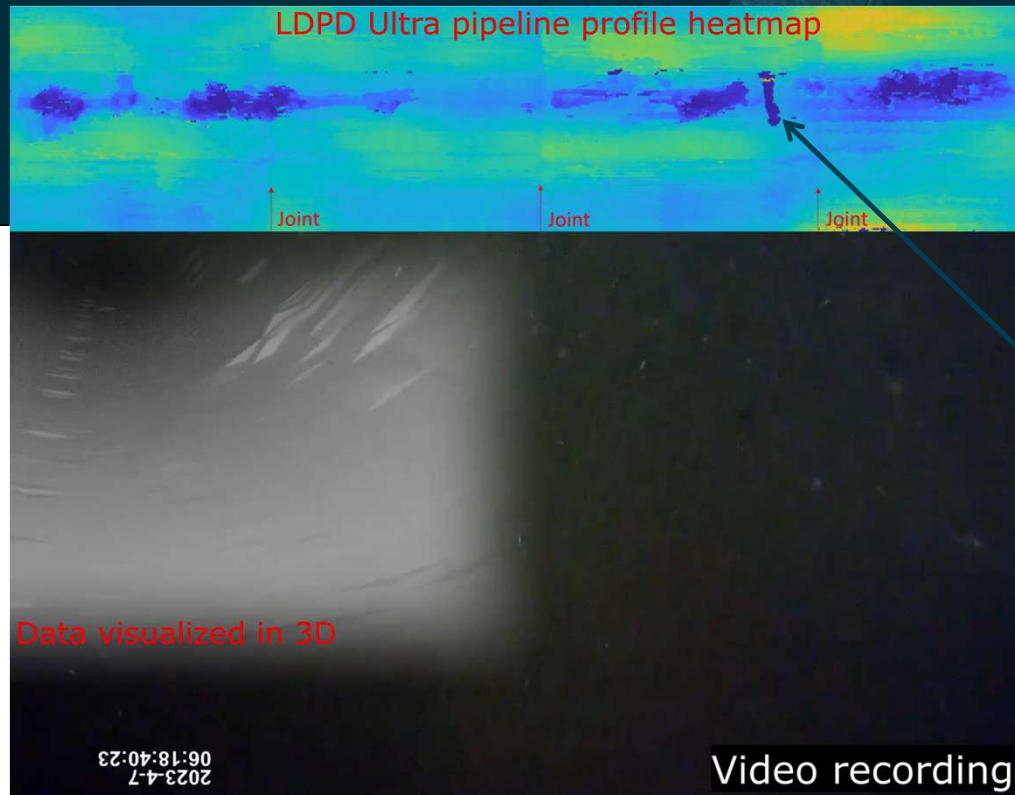
Robotics



Free-swimming



Sensing layers for common integrity threats: Multiple

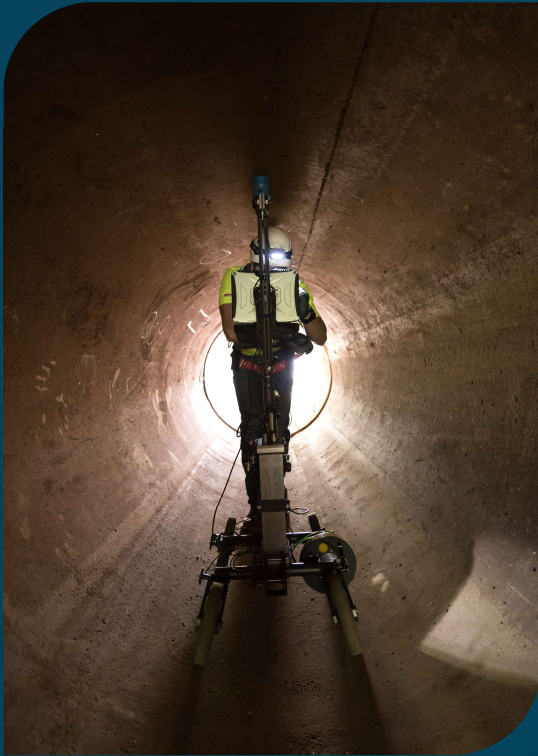


Debris visible in
both **ultrasonic**
and **video data**

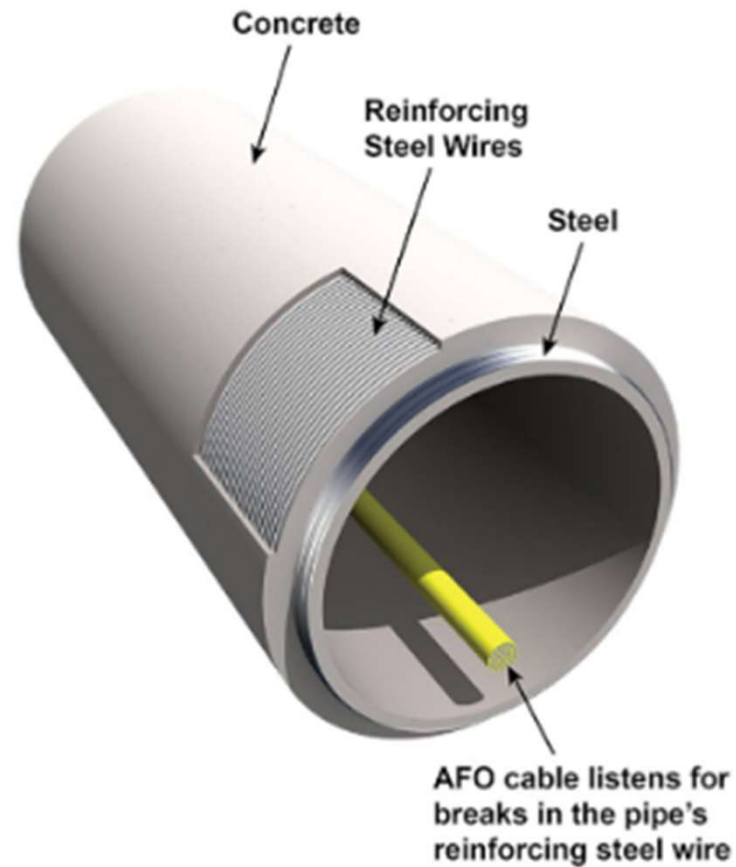
Advanced ultrasonic data analysis



Through the pipeline: PipeWalker + visual inspection



Sensing layers for common integrity threats: multi-layer monitoring



Considerations for enabling inspections: Safety



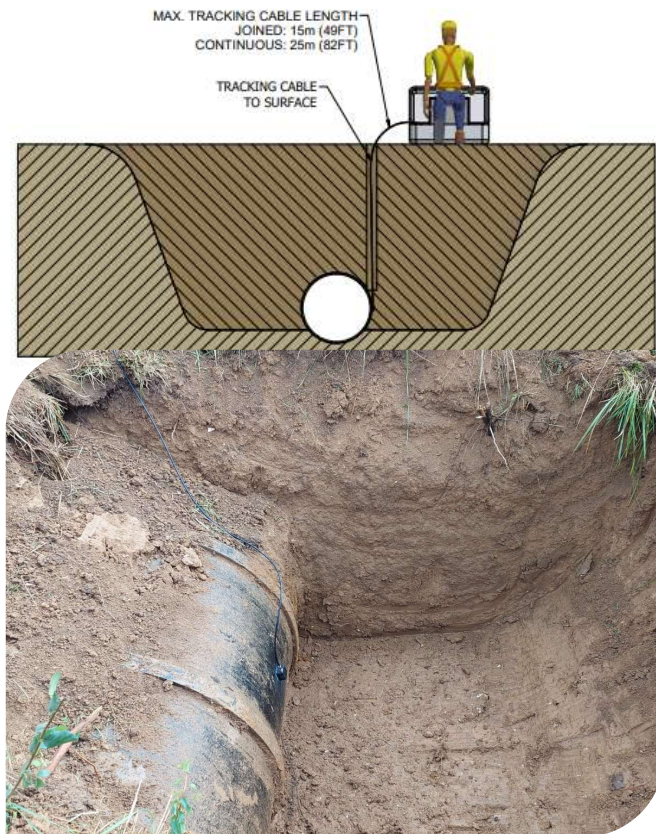
Traffic control



Confined space rescue

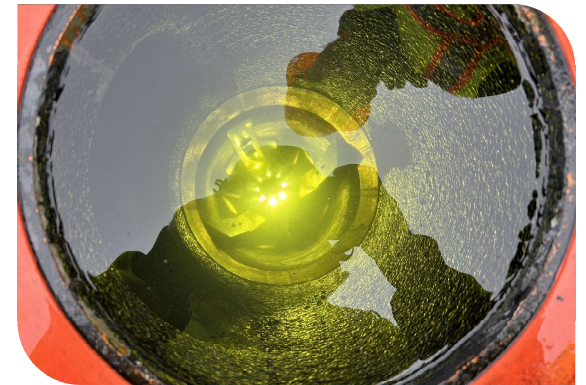
Considerations for enabling inspections: Tool access

Excavation and Hot Tapping



Considerations for enabling inspections

Dewatering, bypass & supplemental pumping



Inline tools empower data-driven pipeline management.



Gather high-resolution condition data without service disruptions.



Shift from reactive to planned maintenance.



Make confident long-term decisions and prioritize investments.



Maintain reliable infrastructure at the lowest lifecycle cost.

Slide 46

KTO

[@Toffin, Eric - Xylem] this is the slide I was referring to in my earlier comment

Twigg, Kristina - Xylem, 2024-11-01T16:18:24.143



Contact



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Slide 47

KT0

[@McClintic, Doug - Xylem] here is your contact slide. I added a QR code to your LinkedIn profile should you wish to invite folks to connect with you. If not, feel free to delete it.

Twigg, Kristina - Xylem, 2024-11-04T21:56:03.367