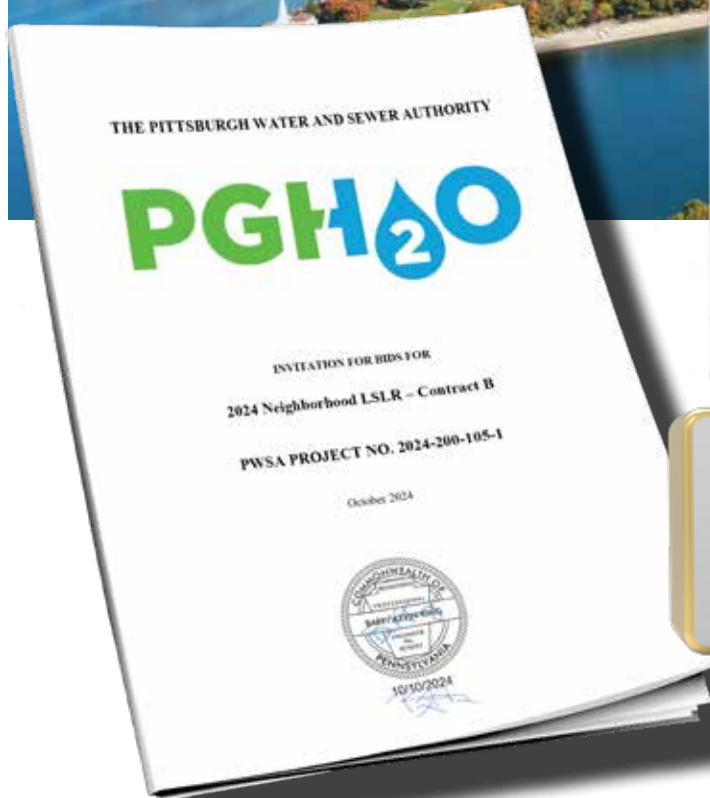


Pittsburgh Water Contract Award

# Replacing 1,600 Lead Service Lines Requires SWORDFISH to Verify Lead



82  
**Pb**  
Lead  
207.2

29  
**Cu**  
Copper  
63.546



*Electro Scan's SWORDFISH, and new SWORDFISH Flow Express, use electrical resistance to determine one or more pipe materials based on their resistivity, including galvanized, plastic, copper, and lead pipes. Given meter locations inside basements, PGH20's project is expected to rely on the company's standard SWORDFISH.*

## A Historical Perspective

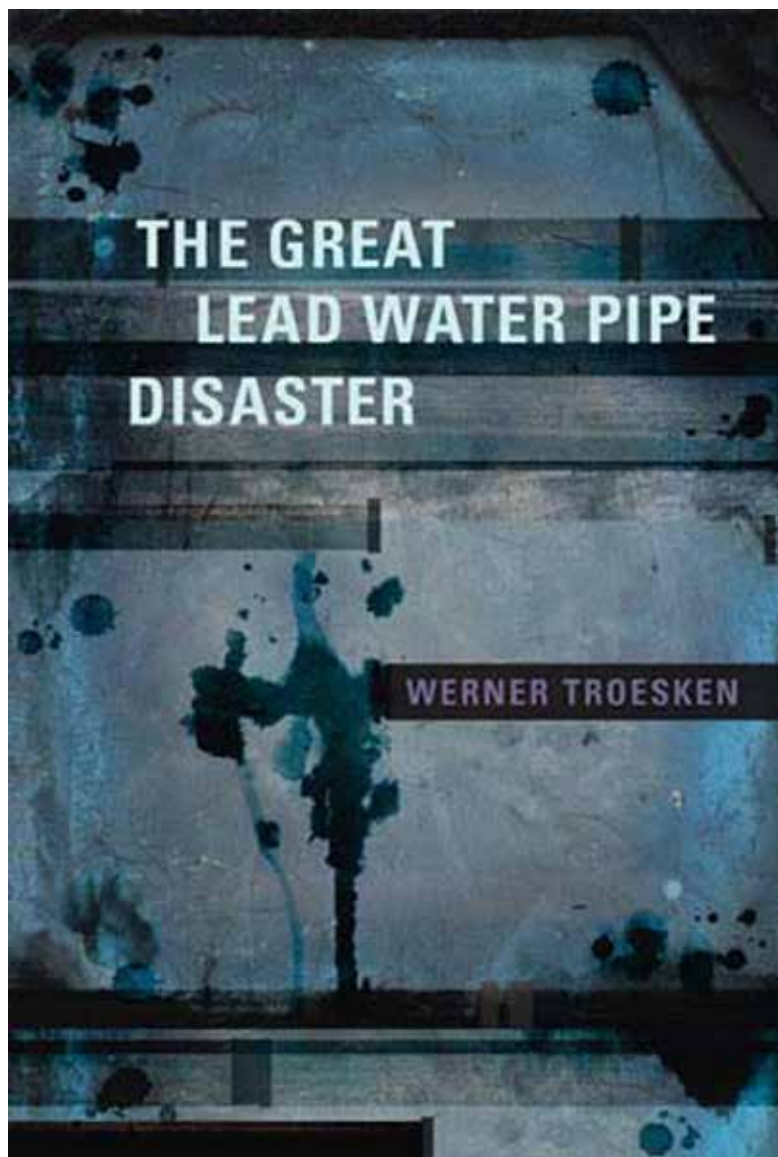
# Where Lead Pipes Were Installed in 1900?

Lead pipes in the fifty largest American cities, 1900

| Rank         | City                  | Pipe Material | Population        |
|--------------|-----------------------|---------------|-------------------|
| <b>TOTAL</b> |                       |               | <b>15,247,896</b> |
| 1            | New York, N.Y.        | Lead          | 3,437,202         |
| 2            | Chicago, Ill.         | Lead          | 1,698,575         |
| 3            | Philadelphia, Penn.   | Lead*         | 1,293,697         |
| 4            | St. Louis, Mo.        | Lead          | 575,238           |
| 5            | Boston, Mass.         | Lead          | 560,832           |
| 6            | Baltimore, Md.        | Iron          | 508,957           |
| 7            | Cleveland, Ohio       | Lead          | 381,768           |
| 8            | Buffalo, N.Y.         | Lead          | 352,387           |
| 9            | San Francisco, Calif. | Lead*         | 342,782           |
| 10           | Cincinnati, Ohio      | Lead          | 325,902           |
| 11           | Pittsburgh, Penn.     | Lead          | 321,616           |
| 12           | New Orleans, La.      | Lead          | 287,104           |
| 13           | Detroit, Mich.        | Lead          | 285,704           |
| 14           | Milwaukee, Wis.       | Lead          | 285,315           |
| 15           | Washington, D.C.      | Lead*         | 278,718           |
| 16           | Newark, N.J.          | Lead          | 246,080           |
| 17           | Jersey City, N.J.     |               | 206,433           |
| 18           | Louisville, Kent.     | Lead          | 204,731           |
| 19           | Minneapolis, Minn.    | Lead          | 202,718           |
| 20           | Providence, R.I.      | Lead          | 175,597           |
| 21           | Indianapolis, Ind.    | Lead          | 169,164           |
| 22           | Kansas City, Mo.      | Iron          | 163,752           |
| 23           | St. Paul, Minn.       | Lead          | 163,065           |
| 24           | Rochester, N.Y.       | Lead          | 162,608           |
| 25           | Denver, Col.          | Lead          | 133,859           |
| 26           | Toledo, Ohio          | Lead          | 131,822           |
| 27           | Allegheny, Penn.      | Lead          | 129,896           |
| 28           | Columbus, Ohio        | Lead*         | 125,560           |
| 29           | Worcester, Mass.      | Cement        | 118,421           |
| 30           | Syracuse, N.Y.        | Lead          | 108,374           |
| 31           | New Haven, Conn.      | Iron          | 108,027           |
| 32           | Paterson, N.J.        | ?             | 105,171           |
| 33           | Fall River, Mass.     | Lead          | 104,863           |
| 34           | St. Joseph, Mo.       | ?             | 102,979           |
| 35           | Omaha, Neb.           | Lead          | 102,555           |
| 36           | Los Angeles, Calif.   | Lead*         | 102,479           |
| 37           | Memphis, Tenn.        | Lead*         | 102,320           |
| 38           | Scranton, Penn.       | Lead*         | 102,026           |
| 39           | Lowell, Mass.         | Lead          | 94,969            |
| 40           | Albany, N.Y.          | Lead          | 94,151            |
| 41           | Cambridge, Mass.      | Iron          | 91,886            |
| 42           | Portland, Ore.        | ?             | 90,426            |
| 43           | Atlanta, Ga.          | Lead          | 89,872            |
| 44           | Grand Rapids, Mich.   | Lead          | 87,565            |
| 45           | Dayton, Ohio          | Lead          | 85,333            |
| 46           | Richmond, Va.         | Lead          | 85,050            |
| 47           | Nashville, Tenn.      | Lead          | 80,865            |
| 48           | Seattle, Wash.        | Iron          | 80,671            |
| 49           | Hartford, Conn.       | Iron          | 79,850            |
| 50           | Reading, Penn.        | Lead          | 78,961            |

Source: Baker (1897)

\* Indicates the city used both lead and iron service pipes.



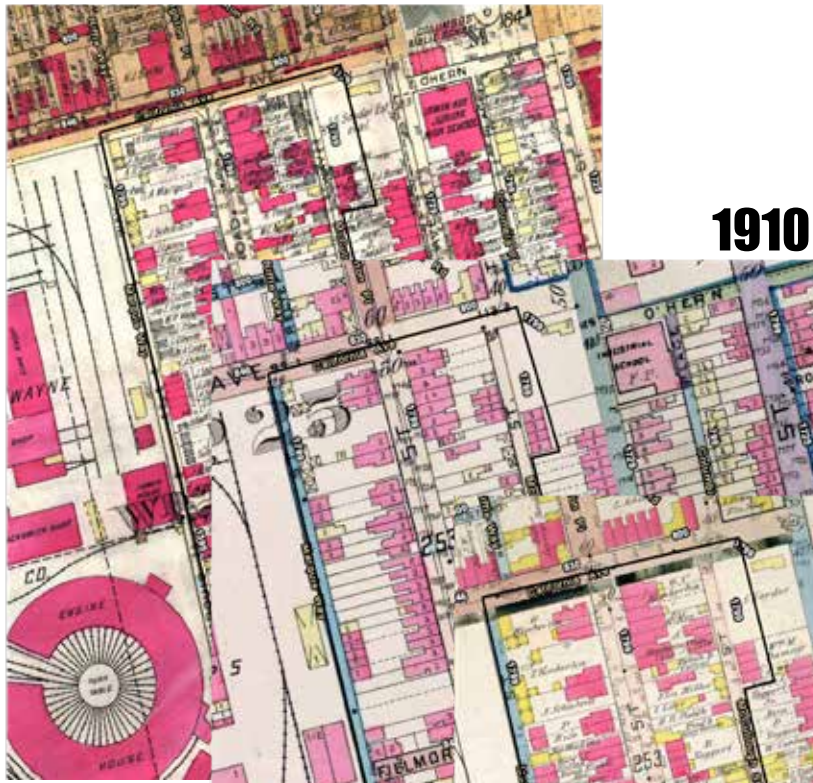
## The Great Lead Water Pipe Disaster By Werner Troesken

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ISBN-13: 978-0-262-20167-4

ISBN-10: 0-262-20167-4

# California-Kirkbride 1923



1910

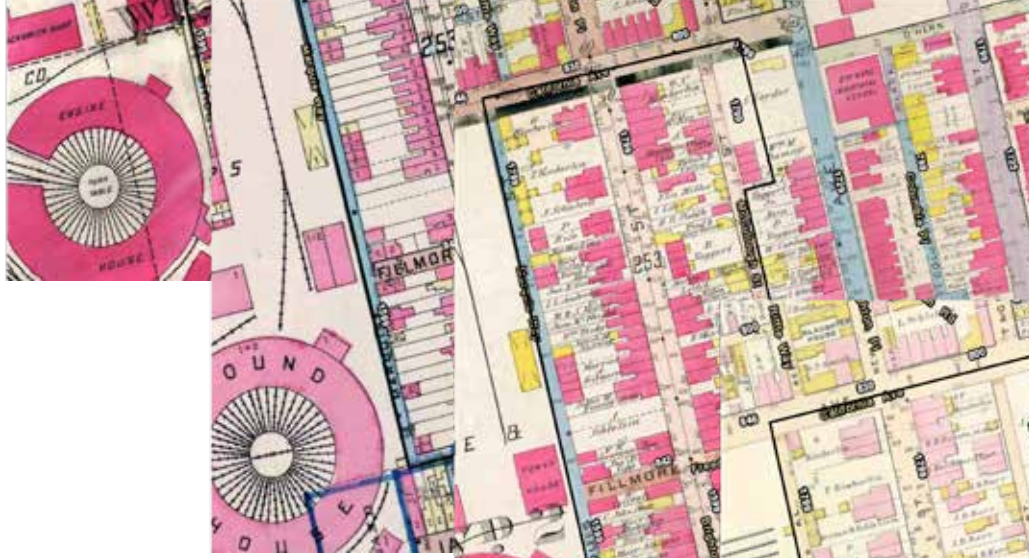


SERVICE AREA  
Sewer Only  
Water and Sewer  
Water Only

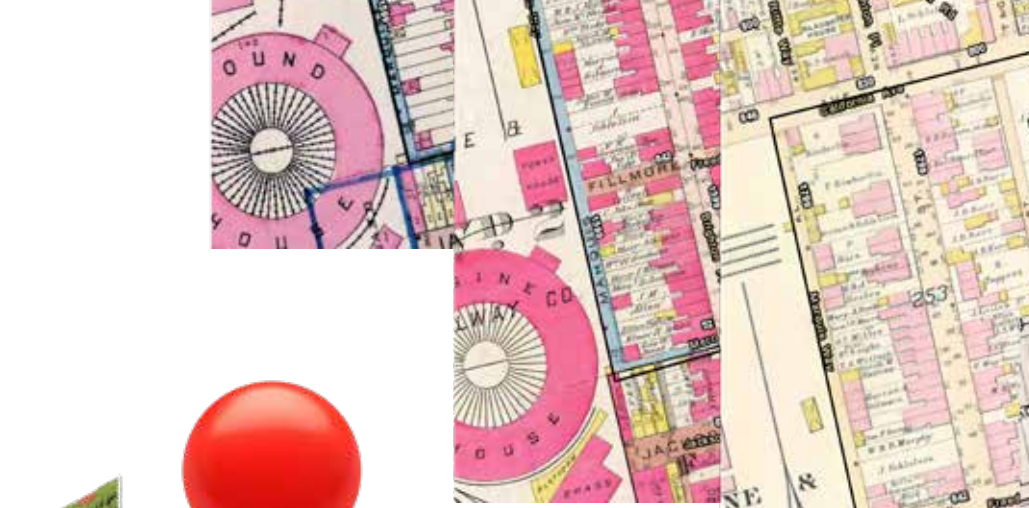
PITTSBURGH WATER  
PGH<sub>2</sub>O



1903



1890



1882



# Construction Specification Verifies Lead Service Lines, Before Replacement

PITTSBURGH WATER AND SEWER AUTHORITY, PENNSYLVANIA  
2024 Neighborhood LSLR – Contract B, PWSA PROJECT NO. 2024-200-105-1

W-83

**Electrical Resistance Technology Verification (Page 255 of 1050)**

Payment shall be made by the unit price bid per EACH service line verified using Electrical Resistance Technology. Measurement shall be based on the number of Electrical Resistance Technology verification completed through each full service line (both public and private) to verify the material composition.

Basis of Payment: Includes furnishing all labor, materials, and equipment necessary to perform the Electrical Resistance Technology required to identify the pipe material over the entire length of the service line, on both sides of the curb stop. This work includes, but is not limited to: obtaining known customer information from OWNER including available phone and e-mail information, using available resources to research and obtain contact information not provided by OWNER, including a minimum of 3 in-person contact attempts (including evening (4-7 pm) and weekend hours), scheduling the Electrical Resistance Technology verification appointment with the property owner, resident or representative; using line locating equipment and metal detector to locate curb box if not immediately visible (and if needed for the testing); measuring the distance for the planned inspection; disinfection of Electrical Resistance Technology; removal and reinstallation of water meter; operating Electrical Resistance Technology; chemical testing to confirm the results of the inspection; flushing the service line; setting and replacing/repairing damaged existing internal plumbing.



INSTRUCTIONS TO BIDDERS  
FOR CONSTRUCTION CONTRACTS

Prepared by



Issued and Published Jointly by



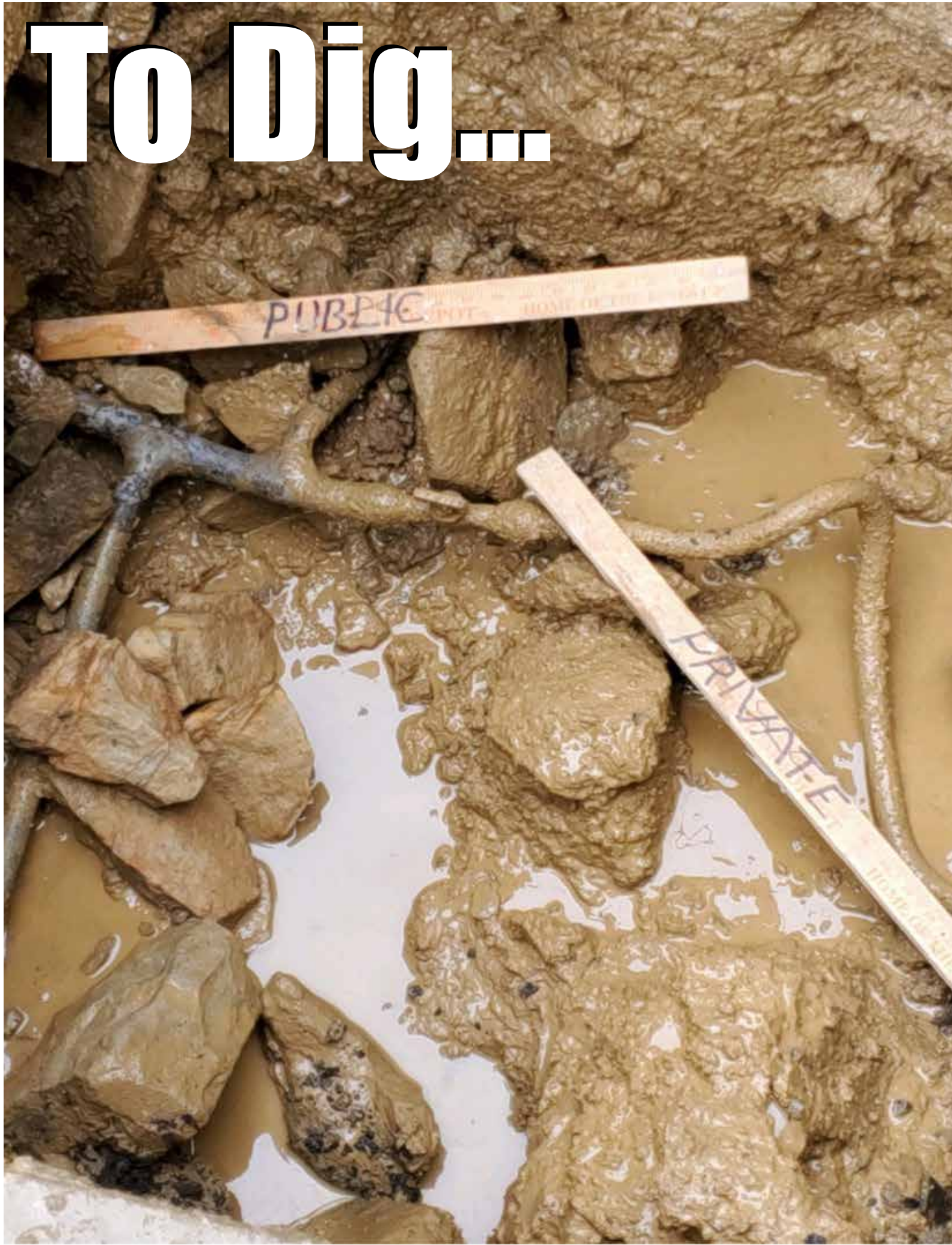


A piece of a broken service line, stamped with the date 1899, was removed by Pittsburgh Water at a home in Pittsburgh Homewood neighborhood. PHOTO: Justin Merriman for the Wall Street Journal

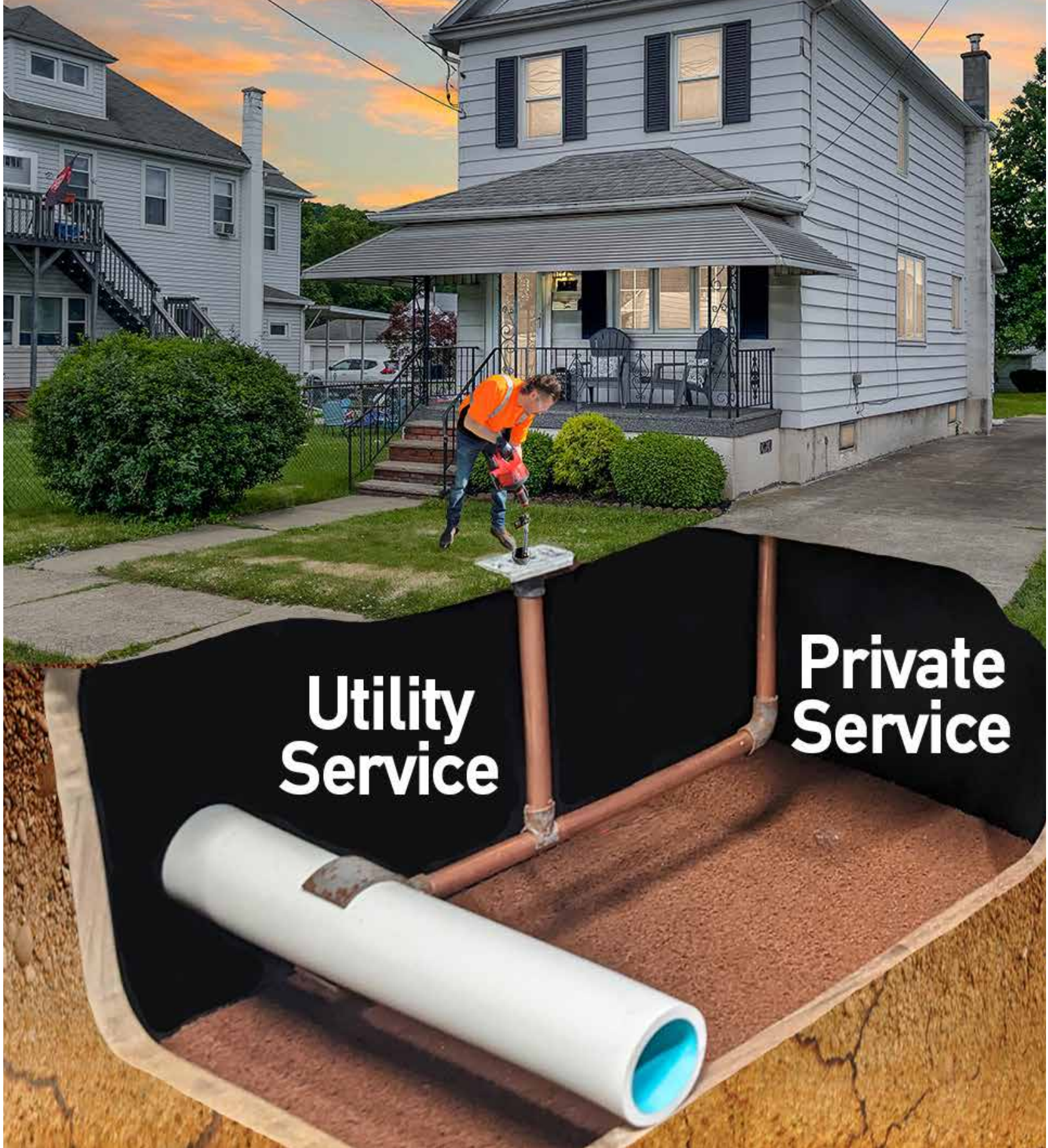


(Left) Will Pickering, CEO, Pittsburgh Water, speaking at an event celebrating the removal of PGH20's 12,000<sup>th</sup> lead water pipe. On track to eliminate all lead water service lines by 2027.

# To Dig...



# ...or Not to Dig?



# Basement Lead Pipe Assessments





# Curbside Lead Pipe Assessments



Turning 'Unknowns' Into 'Knowns'

# Why did Predictive Models Failed to Live Up to Their High Expectations?

**Field Conditions Had Too Many Variations of Pipe Connections and Changes in Pipe Materials.**

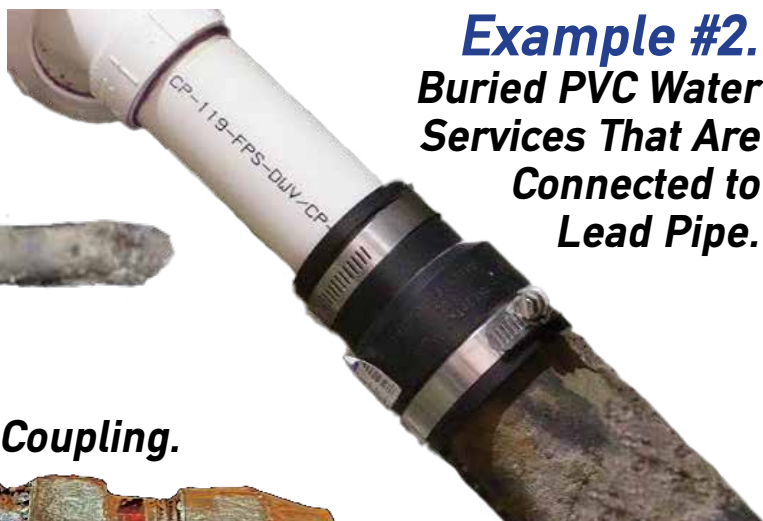
## Example #1.

Buried Copper Pipe Connected to Lead Pipe.



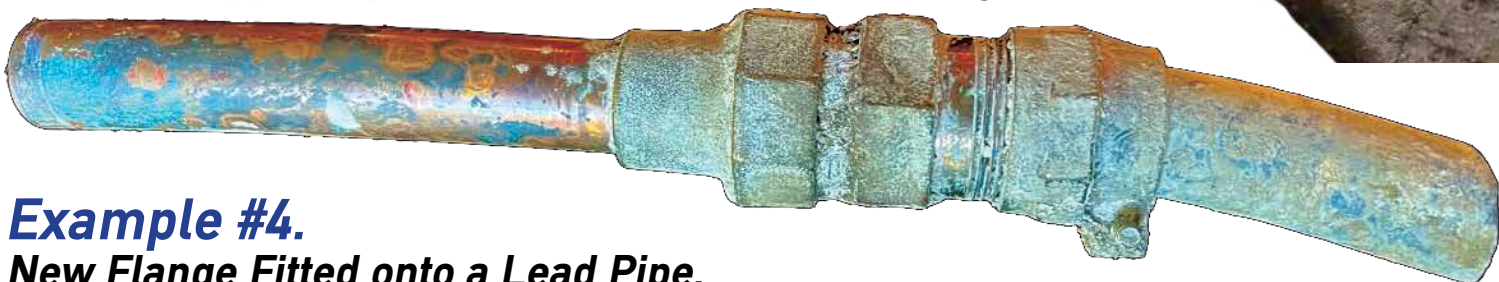
## Example #2.

Buried PVC Water Services That Are Connected to Lead Pipe.



## Example #3.

Buried Copper Pipe Connected to a Lead Coupling.



## Example #4.

New Flange Fitted onto a Lead Pipe.



## Example #7.

Continued use of melted lead ingots for use in soldering copper joints.



## Example #5.

Poorly Relined Lead Pipes Using CIPP.



## Example #6.

Soldered Lead Connecting Copper to Lead Pipe.





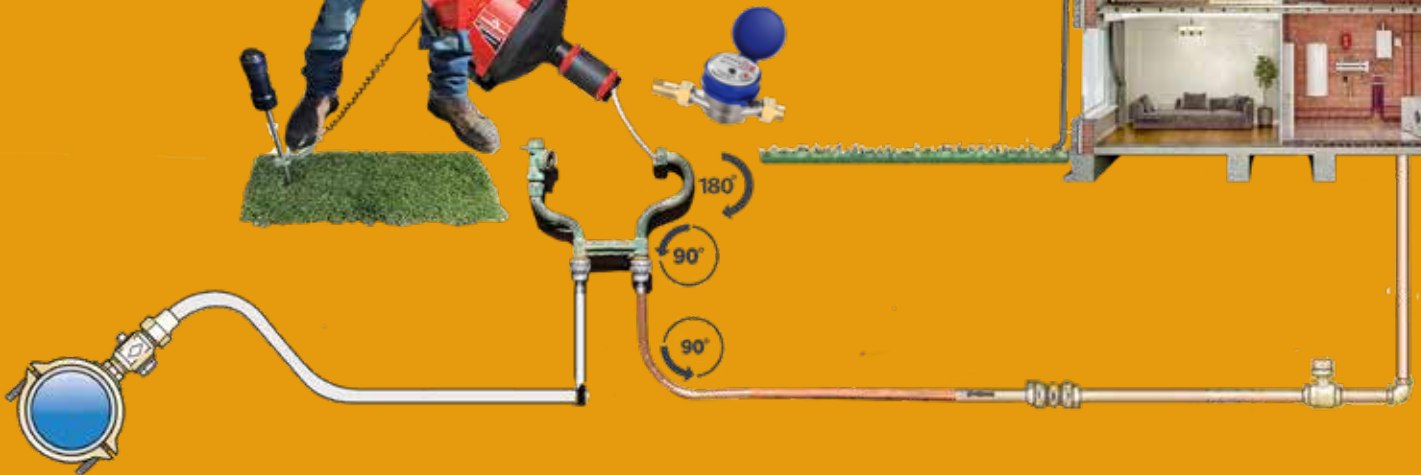
**Critical H<sub>2</sub>O**

# Water Service Line Inventory Reporting in Minutes.



The screenshot displays a report from 'electro scan' with the following details:

- Agency:** Lehigh County Authority, 1202 Markle Luther King Blvd, Allentown, PA, 18102, 610-765-3400
- Address:** 2708 West Highland Street, Allentown, PA, 18104
- Contractor:** matt@electroscan.com
- Location:** A map showing the service line location.
- Load Test Results:**
  - Result: No Load
  - Test Date: 06/14/2022
  - Performed: 11:18:40 AM (Central Standard Time)
  - Pipe Type: Galvanized steel (GSS)
  - Pipe Diameter: 8" ID
  - Pipe Load: 85
  - Pipe Entry Method: Meter - Inside Home
  - Operator Name: [Redacted]
- Graphs:** A line graph showing the load test results over time.
- Photos:** Four photographs showing the technician performing the inspection at a residential property.



**Utility -Owned**

**Privately-Owned**

# Schools & University Lead Pipe Assessments



**SWORDFISH**



**TRIDENT**



DETECTION  
LOCATION &  
INSPECTION

WINNER

2024

## Chuck Hansen

Chairman & CEO  
Electro Scan Inc.

Chief Advisor  
Lead Pipe Assessment  
Crown Electrokinetics  
Corp. (NASDAQ: CRKN)



*“Two global awards for our game-changing technology in less than 30 days. Responding to climate change and water quality issues have totally up-ended antiquated results from Acoustic Sensors and CCTV (and AI-CCTV) to address our infrastructure challenges. Thanks to our great customers & great team, and especially our families & friends.”*

- Chuck Hansen

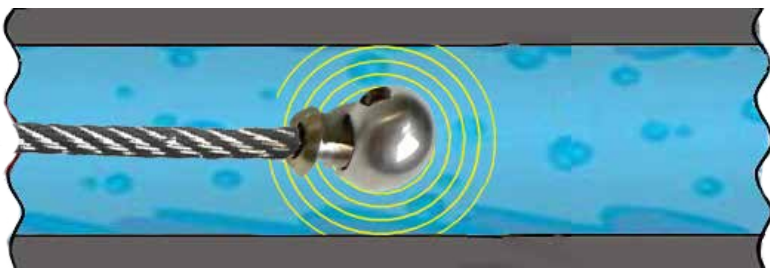
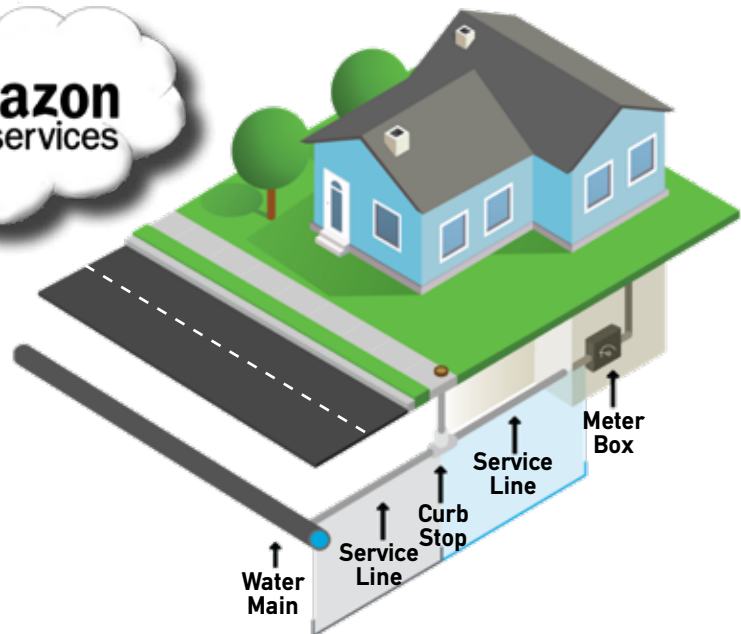
# Congratulations!



# electro scan



- **SWORDFISH** is the world's first hand-held buried lead pipe detection tool using an 18V battery with automatic system for cable feed in pipe diameters from ½ to 3 inches (12mm - 76mm)
- **SWORDFISH** is based on Electro Scan's patented machine-intelligent technology, developed in accordance with the American Water Works Association, Manual M77, Water Main Condition Assessment, to measure electric resistance using low-voltage conductivity to locate buried lead pipes.
- **SWORDFISH's** design enables users to grip the device with one hand and have the other hand free to guide the Electro Scan probe and cable in and out of the companion service line pipe insertion device.
- **SWORDFISH's** cable feed system maintains a selected feed speed with its rotating action allowing users to navigate multiple 90° pipe bends.
- **SWORDFISH's** fully enclosed drum eliminates free spinning parts, providing users with more protection to work in and around basement meters, bends and other obstructions.
- **SWORDFISH** readings are captured in real-time with data transmitted and processed in Electro Scan's Critical H<sub>2</sub>O cloud application, with results independently verified using a commercially available lead test kit for 100% verification of lead pipe.



*Field operation requires full compliance with EPA guidelines for drinking water pipe entry.*

### KEY FEATURES

1. Probe entry.
2. Cable feed and retraction.
3. Gripping surface.
4. Light beam.
5. Guard test.
6. Grounding reel and stake.
7. Electro Scan readings.
8. Fully enclosed drum.
9. On-Off switches
10. Rechargeable batteries.



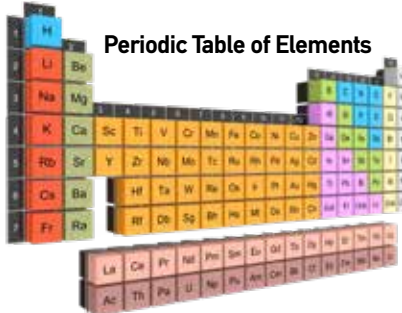
*Electro Scan probes confirms lead pipe with an approved independent Lead Test Kits. Testing of probe is required after each survey.*



*Images shown are representation only. Electro Scan adapted M18 FDCPF8, Milwaukee Electric Tool Corporation ("Milwaukee Tool").*

### A Breakthrough in Buried Lead Pipe Detection

Electro Scan's SWORDFISH is a breakthrough in accurately & consistently locating buried lead pipes. Using its patented machine-intelligent low-voltage (i.e. non-acoustic, non-electro magnetic) technology, Electro Scan first discovered its ability to locate lead pipes when it was used to assess Asbestos Cement (AC) pipes; finding lead soldered joints used to seal pipe joints. Aided by the major difference in resistivity of pipe materials, Electro Scan developed SWORDFISH to enter pressurized pipes with 1/2-inch diameters with multiple 90° bends.



| TECHNOLOGIES      | Locate Buried Lead Pipes |
|-------------------|--------------------------|
| Acoustic Monitors | NO                       |
| Fiber Optics      | NO                       |
| Acoustic Sensors  | NO                       |
| CCTV Inspection   | NO                       |

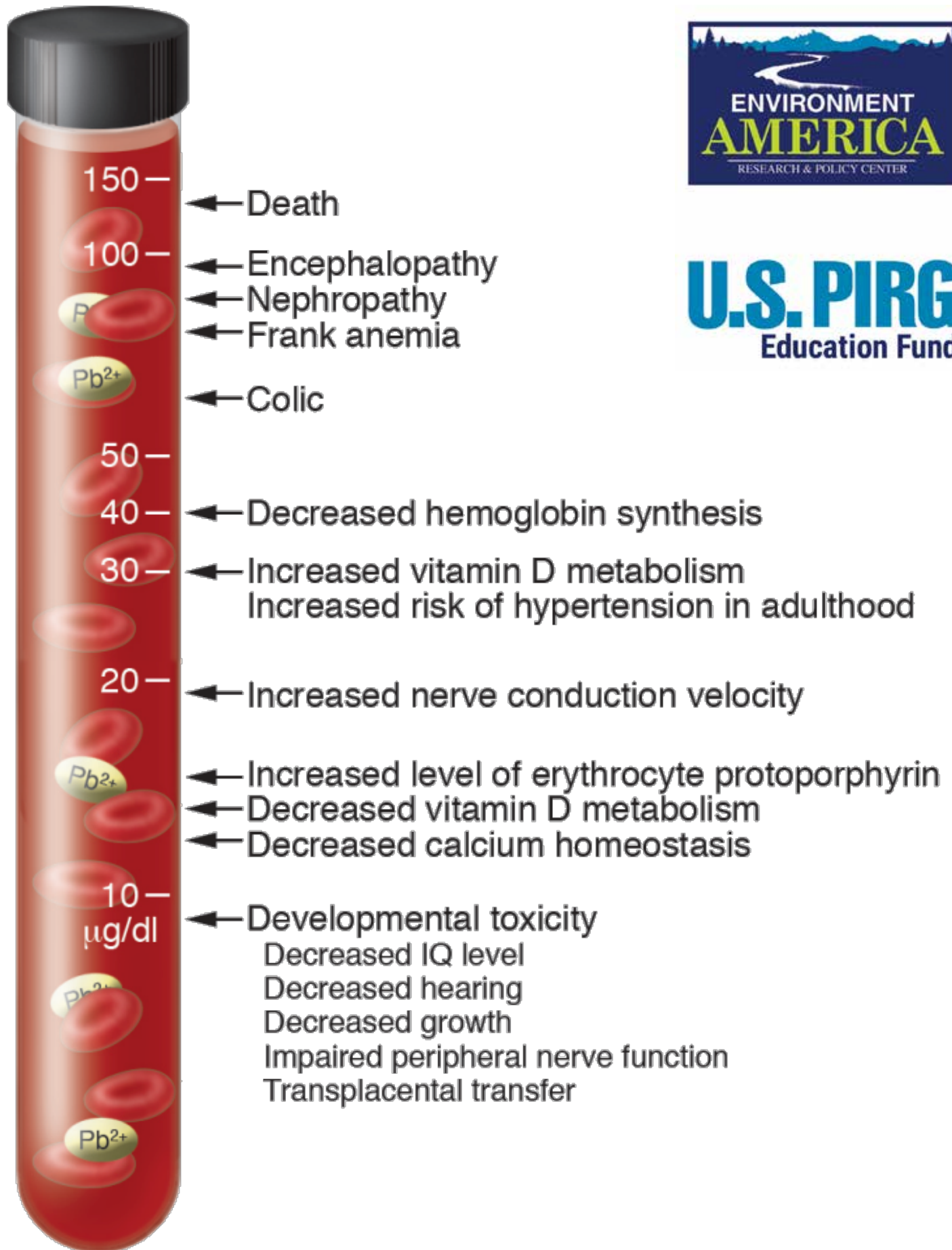
## EPA Guidelines

Office of Water (4606M)  
EPA 816-B-22-001  
August 2022

## "Electrical Resistance Testing"

|   |                               |                         |   |   |
|---|-------------------------------|-------------------------|---|---|
| <p><b>SWORDFISH HARDWARE</b></p>                    | <p><b>PROBES</b></p>          | <p><b>FIELD APP</b></p> | <p><b>INSERTION TUBE</b><br/>Chlorination Chamber, Plus Footage Encoder</p> | <p><b>GROUNDING STAKE</b></p>                         |
| <p><b>CHARGER</b></p> <p><b>LITHIUM BATTERY</b></p> | <p><b>LEAD TEST SWABS</b></p> | <p><b>SUPPORT</b></p>   | <p><b>RE-DIRECT TUBE</b><br/>For Meter Fitting Navigation</p>               | <p><b>CRITICAL H<sub>2</sub>O CLOUD REPORTING</b></p> |

# Levels of Lead in Drinking Water





# 134-Page SWORDFISH Training Manual

How to Create, Verify and Validate Your Water Service Line Inventory.

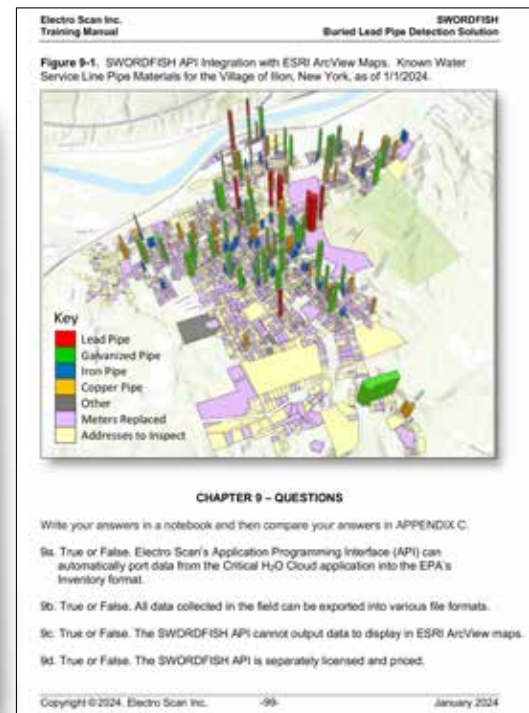
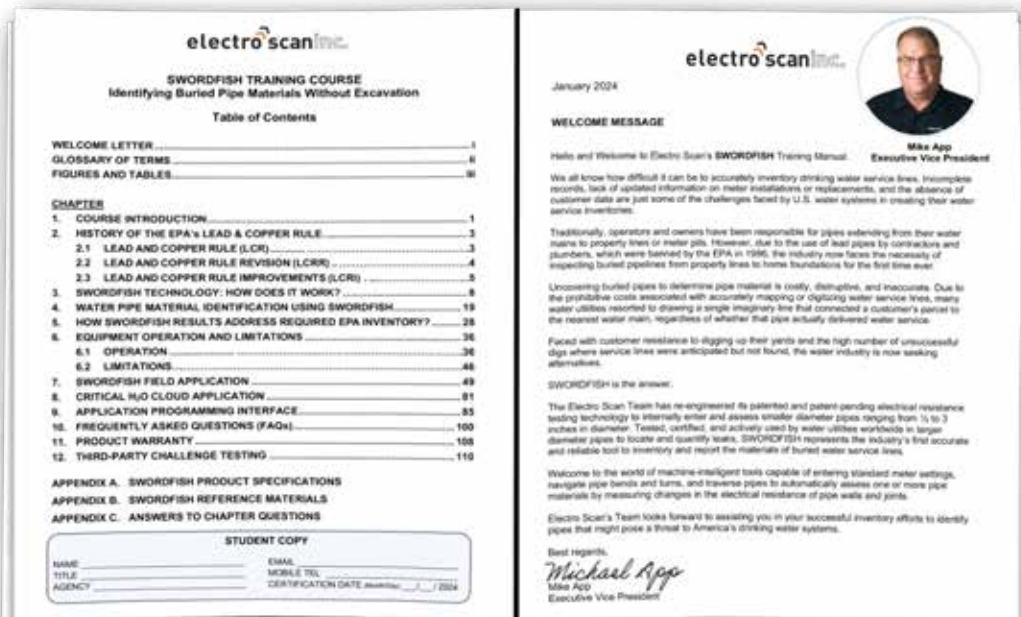
## Release 1.5



### What's Inside?

- Expanded Content
- LCR, LCRR, LCRI
- Example Scans
- Single v. Multiple Pipe Materials.
- New Chapter on API
- New Chapter on FAQs
- Chapter Tests

Learn from Water Industry Insiders How to Report!



# OLD WAY

## Aboveground Lead Test: **Exposed Pipe**



*Disruptive. Expensive. Inaccurate. Messy.*



**Magnetic Test**

Sticks →



steel pipe

Doesn't Stick

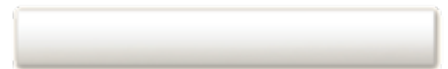
**Scratch Test**

Color of a Penny →



copper pipe

No Shine →

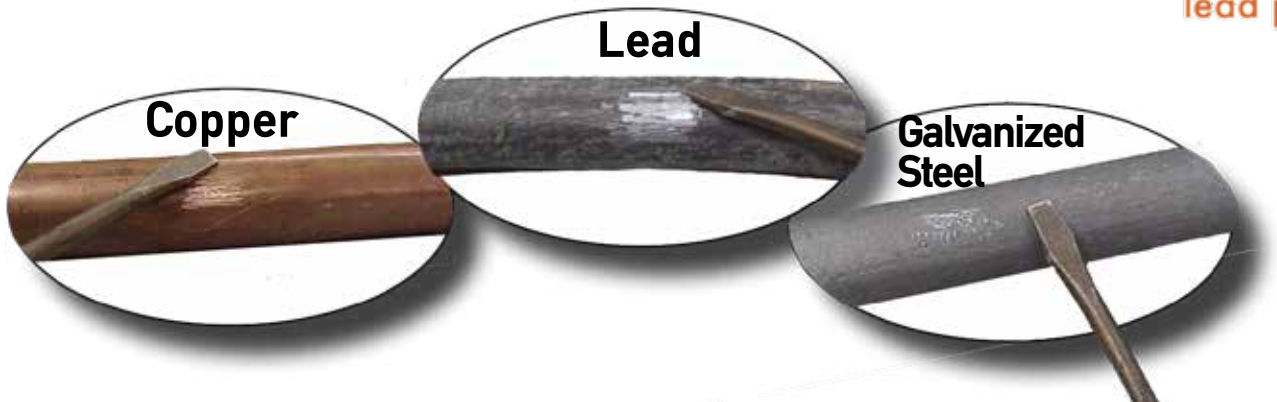


plastic pipe

Silver Streaks →

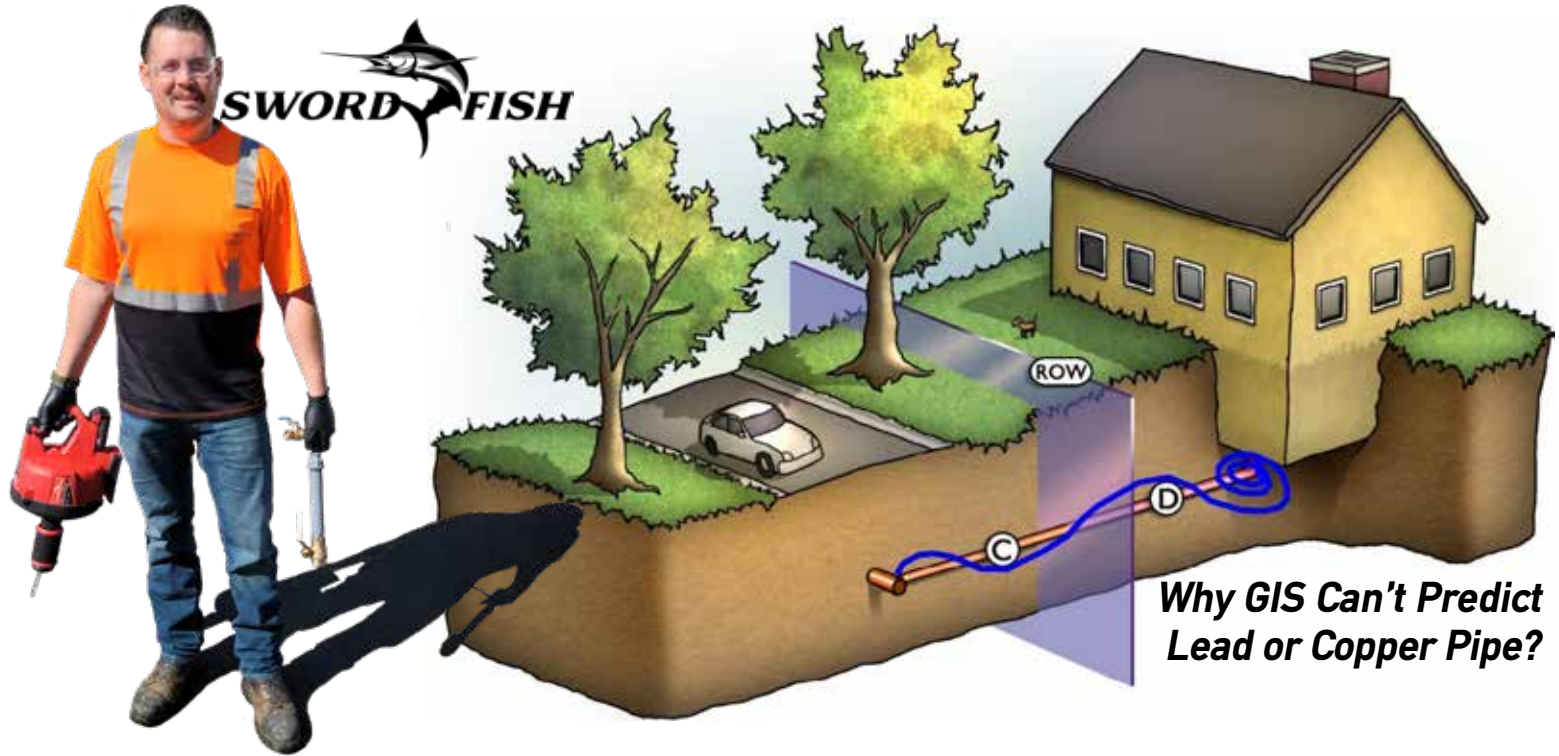


lead pipe



# NEW WAY

## Below Ground Lead Test: **Buried Pipe**



*Accurate. Direct Access. Fast.*



# CONTACTS



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Since August 2024

**Are you Still Using CCTV Cameras to Find Infiltration? No Wonder You Still Have SSOs.**



## SWORDFISH



## TRIDENT



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