SIPP: Spray-In-Place Pipe Rehabilitation

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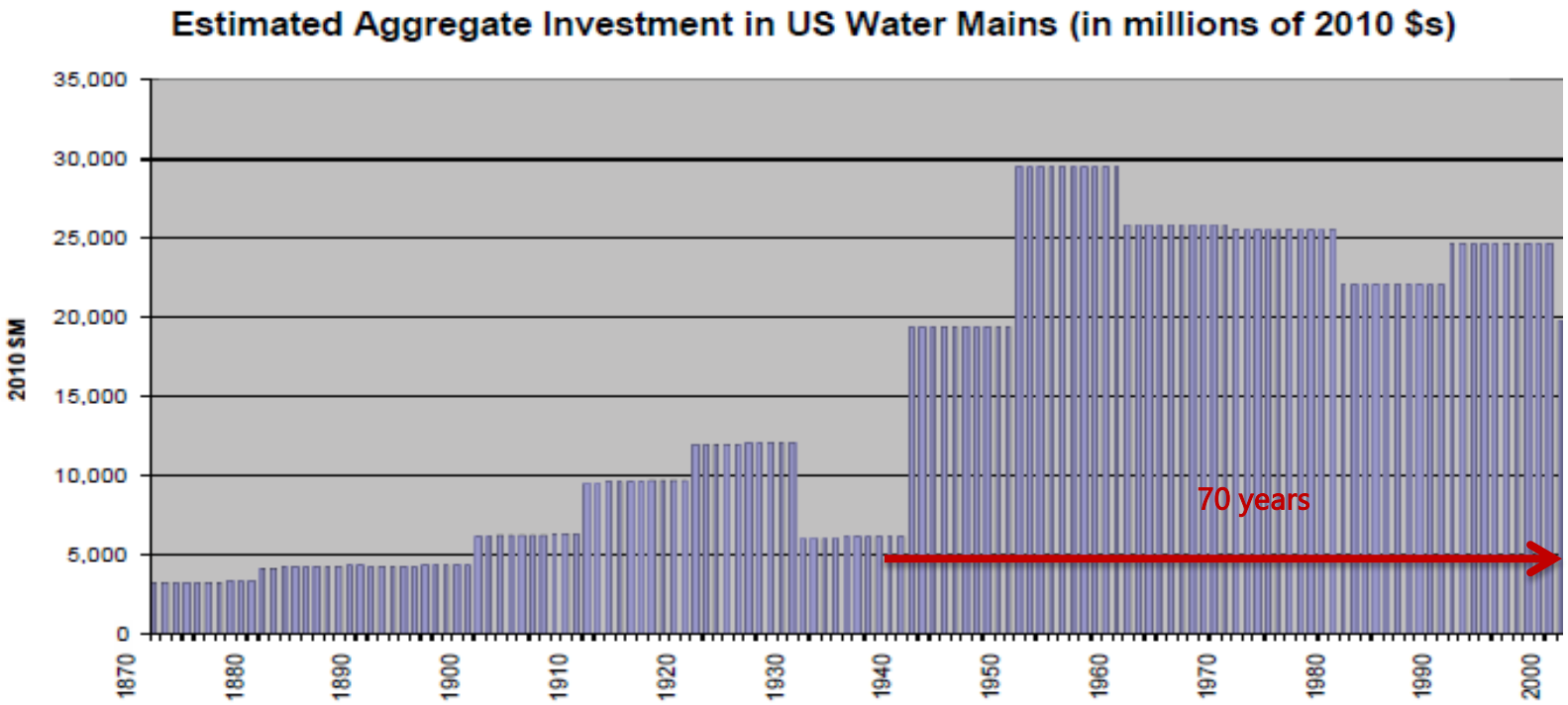
Water System Consultant
Advanced Solutions

Overview

- **Introduction**
- **Current Problems**
- **Pipe Rehabilitation**
- **Spray-In-Place Pipe (SIPP)**
  - Process & Benefits
- **SIPP In Practice**
  - Successful Projects
- **Questions**

The Problem

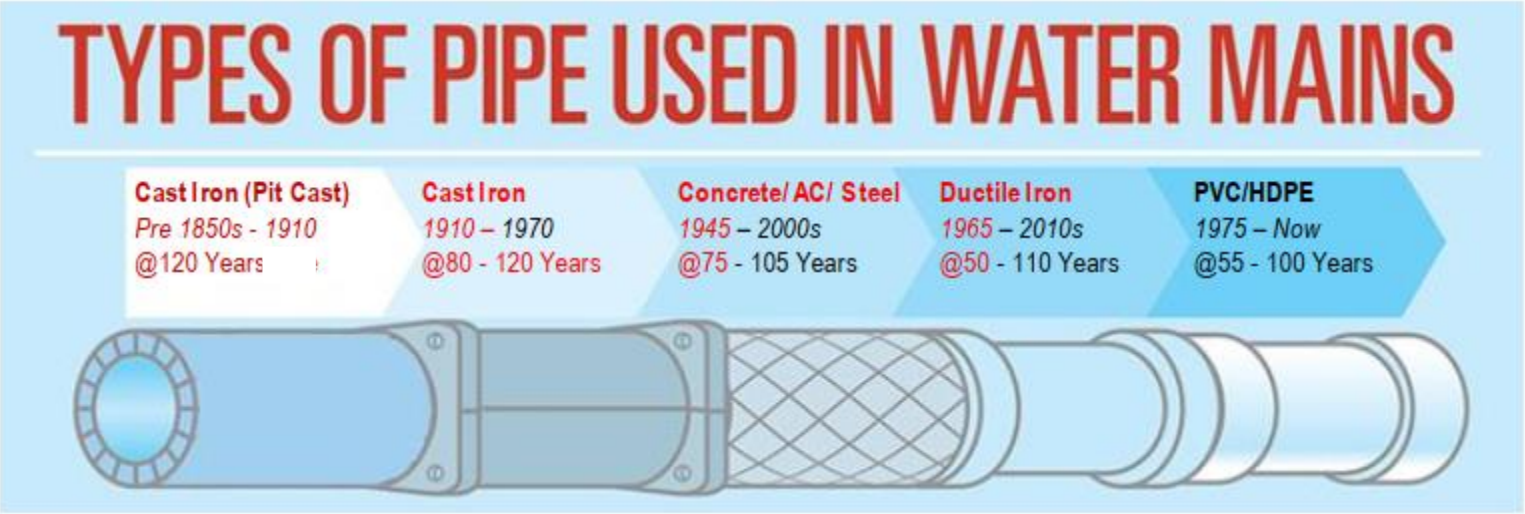
Pipe Age:



The Problem

Aging Infrastructure!

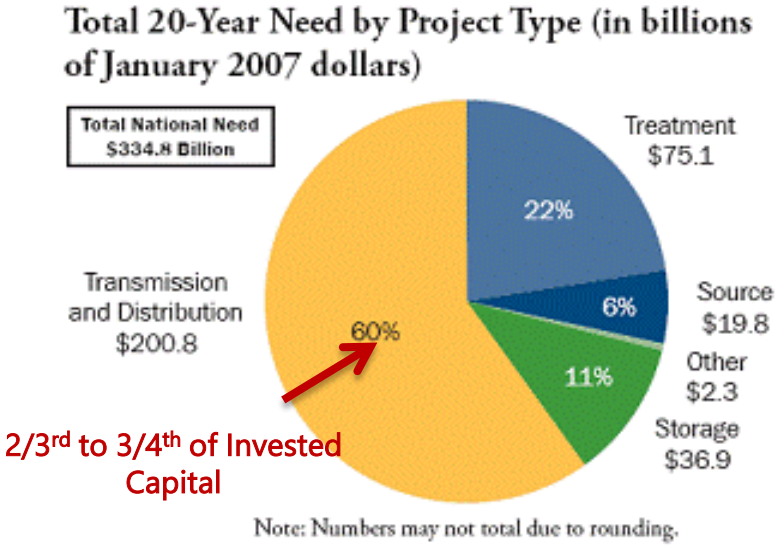
1 million miles of water pipes over 100 years old!



Municipal infrastructure is decaying faster than it's being renewed.
Pipes are surpassing their useful life expectancy.

Stats Within the United States

- **2017 ASCE Report Card – U.S. Drinking Water: D**
  - 240,000 water main breaks occur yearly, 657 per day
- **Nearly 6 billion gallons of treated water lost every day**
  - Could supply 15 million households
- **Estimated $1 trillion investment needed to meet demands over the next 25 years**
- **Estimated 200 years to replace the system (at 0.5% replacement rate)**
- **America's drinking water systems face an annual shortfall of at least $11 billion to replace aging facilities**

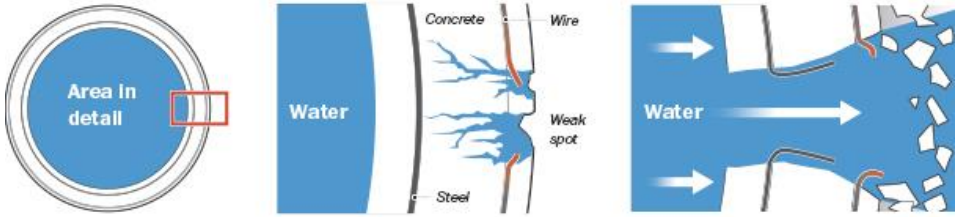


USEPA Drinking Water Needs Survey

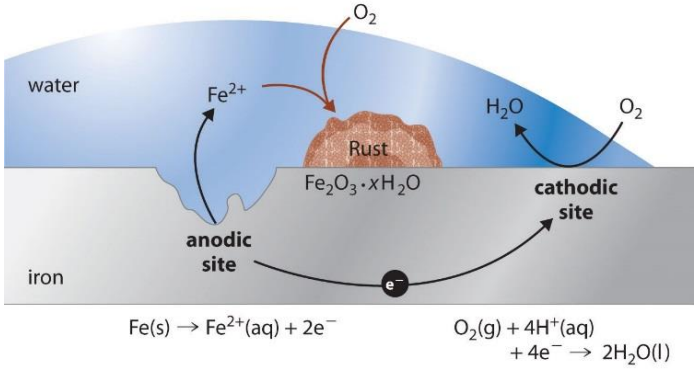
Pipes are surpassing useful life

Out of sight, out of mind… until it leaks!

- **Internal Corrosion**
- **Tuberculation build up**
- **Loosing wall thickness**
- **Main breaks**



Example of concrete water pipe failure



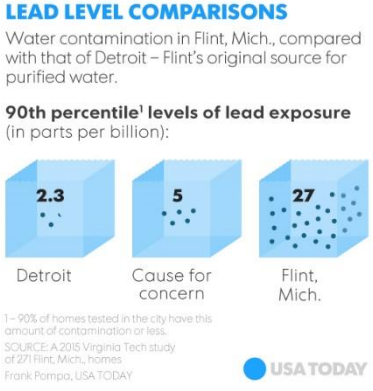
Example of Cast Iron Pipe Corrosion

Run To Failure Approach

Consequences on water distribution:

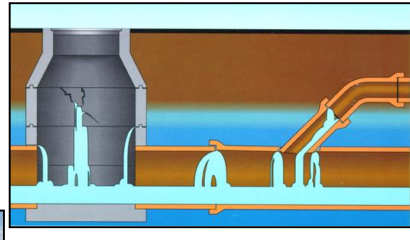
- Loss of hydraulic capacity
- Water loss
- Degradation of water quality / Poisoning
- Collapses

14th Street, Atlanta



Consequences on collection systems:

- Contamination due to Overflows, Violations
- Inflow & Infiltration / Pumping & treatment cost
- Collapses



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Current Practices: Direct Replacement

Process:

- Trench entire length
- New pipe is laid in trench

Advantages:

- Fresh installation
- Increase size if needed

Disadvantages

- Requires Excavation
- Significant Disruption

Current Practices:
Cured In Place Pipe (CIPP)

Process:

- Fabric tube impregnated with thermosetting resin
- Inserted in host pipe and heat cured – 2 Methods
  - Pulled into host pipe and expanded by water pressure
  - Liner turned inside out (Inversion)
- Service connections reinstated by robotic cutters

Advantages:

- Cost effective
- Established technology

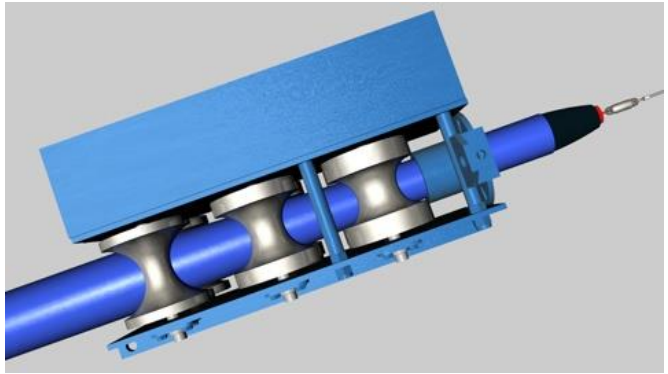
Disadvantage:

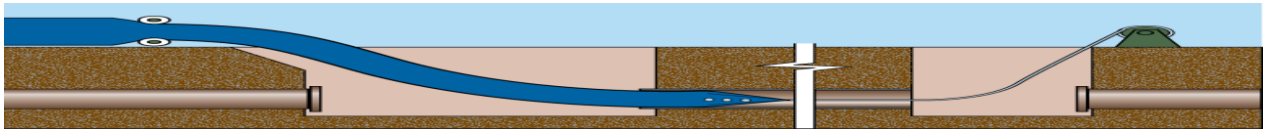
- Requires extensive pre-investigation
- Pipe Bends, Risk of wrinkling
- Chemical agents used in reaction process must be monitored

Current Practices:
Close Fit Sliplining – Diameter Reduction

Process:

- HPPE pipe is pulled into host pipe
- New pipe temporarily deformed
- Two methods
  - Swaging
  - Compression Rollers





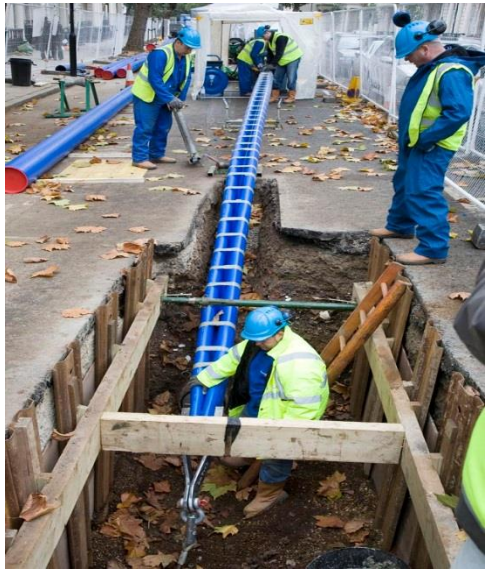
Advantages:

- Limited loss of pipe diameter
- Not reliant on integrity of host pipe

Disadvantage:

- Difficult to install if irregularities in host pipe

Current Practices:
Close Fit Sliplining – Rolldown



Process:

- HPPE pipe is pulled into host pipe
- Liner is heated and folded
- Liner is winched into host pipe and reshaped by heat and pressure

Advantages:

- Not reliant on integrity of host pipe
- Limited loss of pipe diameter and accommodates bends

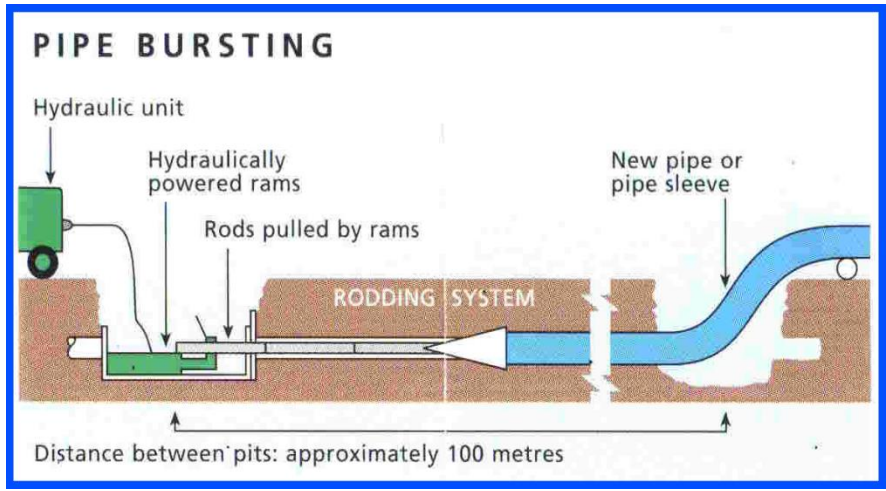
Disadvantage:

- Reversion process may be difficult

Current Practices:
Pipe Bursting/Pipe Splitting

Process

- HPPE pipe is attached to bursting head
- Break and displace host pipe
- Pull replacement pipe into the void



Advantages:

- No cleaning required
- Facilitates upsizing

Disadvantage:

- Difficult in some situations
- May not suitable for Asbestos Cement

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Current Practices:
Spray in Place (SIPP) - old

Process:

- Thorough cleaning of host pipe
- Spray host pipe with a thin lining of resin (typically 1mm thick)

Advantages:

- Minimal excavation

Disadvantage:

- Requires a completely clean and dry host pipe
- No structural rehabilitation

SIPP Solution:
100% Solids Epoxy

Process:

- Computer-controlled, robotic spray application
- Single coat high mil monolithic coating
- NSF 61-approved, 100%-solids epoxy pipe lining

Advantages:

- Minimal excavation, no need to restore connections
- Suitable for small diameters, turns and bends (1 ¼ to 72 inches)
- Rapid cure, Moisture tolerant (i.e. surfaces don't have to be 100% dry)

Disadvantage:

- Considered "New" approach
- Limit to maximum total length

SIPP Solution:
100% Solids Epoxy

Other Advantages:

- **NSF approved and Bisphenol free**
- **Creates internal seal preventing leaks and protecting against contaminants leaching into the system**
- **Works with all piping materials including cast iron, AC, etc. Suitable for small diameters, turns and bends (1 ¼ to 72 inches)**
- **Provides Structural Rehabilitation**

- **Extend service life of pipes**
  - Protects against future corrosion
  - Once cured, the lining moves with the structure, abating leaks caused by settlement
- **Minimize maintenance costs**
  - Rapid cure = less downtime
  - Minimal excavation and Disruption
  - Reduce frequency of maintenance
- **Improve water quality and system efficiency**
  - Could reduce the leaching of lead from soldered joints
  - Enhanced flow capacity - Provides thermal isolation

Coatings Specification Details

STRUCTURALLY ENHANCE & REINFORCE

	ASTM F-1743	SUEZ	%
Tensile Strength	3,000	6,000	233%
Flexural Strength	4,500	10,000	244%
Compressive Strength	Not Listed	12,000	--
Flexural Modulus	250,000	500,000	200%

This compares ASTM F-1743 structural lining standard with specifications of the SUEZ technology when applied at minimum total thickness of 150-250 mils.

- **ASTM F-1743 Standard practice for rehabilitation of existing pipelines and conduits by pulled-in-place installation of cured-in-place thermosetting resin pipe (CIPP) .**
- **ASTM F1216 Standard practice for rehabilitation of existing pipeline standards were utilized and documented by Madero Engineering, Houston, TX. Certified wall thickness of our material comply with this standard.**
- **It's structural, NSF 61 approved and has exceptionally high modulus of elasticity.**
- **SIPP liner is classified as a Class III liner due to need of host pipe being present**

"The ultimate capacity of all specimens exceeds 400 psi hydrostatic pressure."

– Kent Harries, Ph.D., FACI, P.E.

Associate Professor of Structural Engineering and Mechanics University of Pittsburgh.

Coating Specification Details

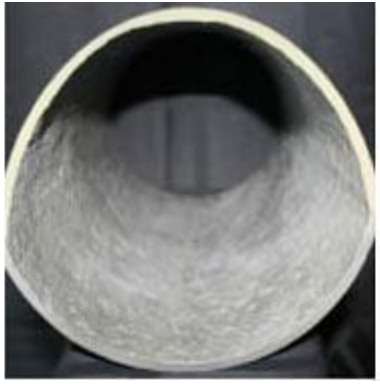
- **Coatings are able to withstand prolonged exposure to heat, chemical and aggregate**
- **Situational applicable coatings include:**
  - Domestic Water
  - Sewer
  - HVAC
  - High Temperatures
  - Cooling Tower
  - Fire hydrant lines / stand pipe
  - Steam vaults
  - Steam condensate lines
  - Cogeneration

Structurally Enhance & Reinforce

Before

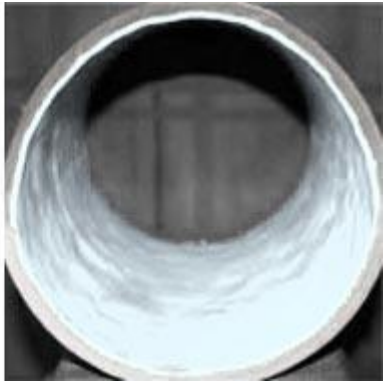
Severely corroded

During



Completely cleaned

After



Epoxy lined

Perfect solution for the restoration of aging underground piping systems

- Cast iron, ductile, and AC infrastructures

State-of-the-art robotic spray application

- Computer-controlled for more refined application and curing

Material bonds to your piping system

- Prevents and seals cracks
- Moves with the structure, abating leaks caused by settlement.

Spray-In-Place Pipelining Process

System Analysis	Map system with customer provided data	Utilize CCTV to evaluate	Review findings	Develop restoration plan
Surface Preparation	Power Boring	Drag Scraping	High Pressure Water Jetting	CCTV inspection
Repair	Identify current piping issues	Repair or replace damaged pipe sections	Determine correct SIPP application	Prep for epoxy liner
Epoxy Lining & Reassembly	Begin SIPP application	Computer-controlled, robotic spray application	No excavation at service connection	Cures At Low Temperature, High Humidity
Final Inspection & Testing	CCTV inspection	Inspection of epoxy lining thickness	Chlorination and disinfection	Restoration of system

The Process

SIPP Demo

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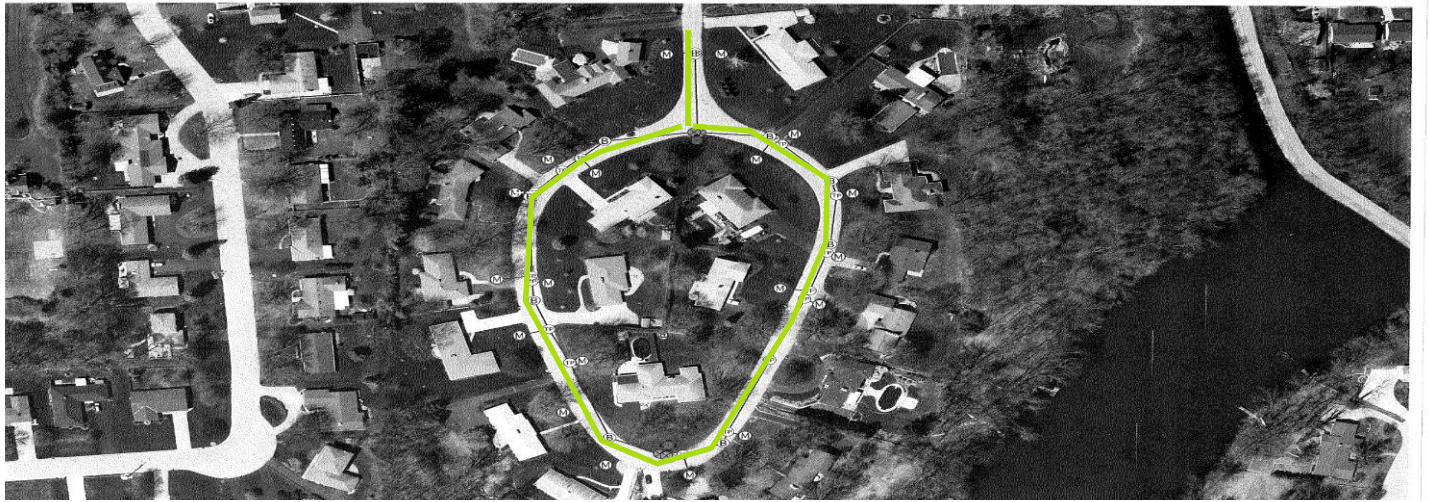
100% Solid Epoxy In Practice

Marymont Drive – Piqua, Ohio



	SUEZ Epoxy Cleaning and Lining	Traditional Pipe Replacement
Time Required	**3-5 days**	4-6 weeks
Access Requirements	**4 access points needing just 3 feet of pipe access**	Trench the entire street causing severe and long traffic disruptions

Franklin Avenue - Salem, Ohio

Time Required	**SUEZ Epoxy Cleaning and Lining**	**Traditional Pipe Replacement**
	3-5 days	4-6 weeks
Access Requirements	**4 access points needing just 3 feet of pipe access**	Trench the entire street causing severe and long traffic disruptions

Benefits of Protective Coatings

- Extends service life of piping & components (up to 75 years)
- Reduced maintenance costs, disruptions, and system down-time
- Protects against future corrosion & degradation
- Enhances water quality
- Enhances flow capacity and system efficiency
- Suiteable for metal and AC Pipes, turns and bends, small to large diameters (1 ¼ to 72 inches)

Questions?

Additional Information Available:

Jeff Austin
503-713-8823
jaustin@utilityservice.com
www.utilityservice.com

Technology Benchmarking

No Excavation in sewer	✓
Minimal Excavation in water	✓
Structural Rehabilitation	✓
Stronger than the host pipe	✓
Not exhaust cleaning	✓
Moisture tolerant	✓
Keeps Connections	✓
Suitable for angles, turns, elbows	✓
Less downtime and significant savings	✓
No significant pipe diameter loss	✓
Does not depend on soil conditions	✓
NSF approved Rapid cure coating	✓
Suitable for all materials	✓
No limitations in small diameter pipes	✓

SUEZ Experience

- **SUEZ annually maintains more than 150,000 miles of pipes globally**
- **Pipeline renewal programs implemented in more than 7,300 miles of pipes in multiple water systems in North America:**
  - 800,000 people served in Bergen, Hudson, Sussex and Hunterdon counties
  - 264,152 people served in Jersey City, NJ
  - 66,238 people served in Bayonne, NJ
  - 12 water systems in Pennsylvania serving approximately 166,000 people
  - Westchester, NY
  - Nassau County, NY
  - 240,000 people served in Boise, ID

- **In the next 5 years, Suez North America plans to invest between 70 and 100 million per year in underground assets; therefore, finding and identifying the "right" solution is critical**

Epoxy Features

Tensile Strength	**48 MPa**	***Cures At Low Temperature***	✓
Flexural Strength	**75 MPa**	***Cures At High Humidity***	✓
Flexural Modulus	**3.4 GPa**	***Withstand Frost***	✓
Size Of Pipe	**1¼ - 72 inches**	***Withstand Heat***	✓
Coating Thickness	**Up to 6mm in one run**	***Withstand Chemicals***	✓
Product Lifetime	**Indefinite**	***Withstand Aggregate***	✓
Cure Time	**Allows for margin of error**		

Technology Summary

	Spray Lining (New)	Spray Lining (Old)	Cement Mortar Lining	Sliplining	CIPP	Pipe Bursting	HDD
No Excavation in sewer	✓	✓	✓	✓	✓	✗	✗
Minimal Excavation in water	✓	✓	✓	✓	✓	✓	✓
Structural Rehabilitation	✓	✗	✗	✓	✓	✓	✓
Stronger than the host pipe	✓	✗	✗	✗	✗	✓	✓
Not exhaust cleaning	✓	✗	✓	✗	✗	✓	✓
Moisture tolerant	✓	✗	✓	✗	✗	✓	✓
Keeps Connections	✓	✓	✓	✗	✗	✗	✗
Suitable for angles, turns, elbows	✓	✓	✓	✗	✗	✗	✗
Requires extensive pre-investigation	✓	✗	✓	✗	✗	✓	✓
No significant pipe diameter loss	✓	✓	✓	✗	✓	✓	✓
No depends on soli conditions	✓	✓	✓	✓	✓	✗	✗
Rapid Cure	✓	✓	✗	✗	✗	✓	✓
Suitable for all materials	✓	✓	✗	✓	✓	✗	✓
No limitations in small diameter pipes	✓	✓	✗	✗	✗	✓	✓

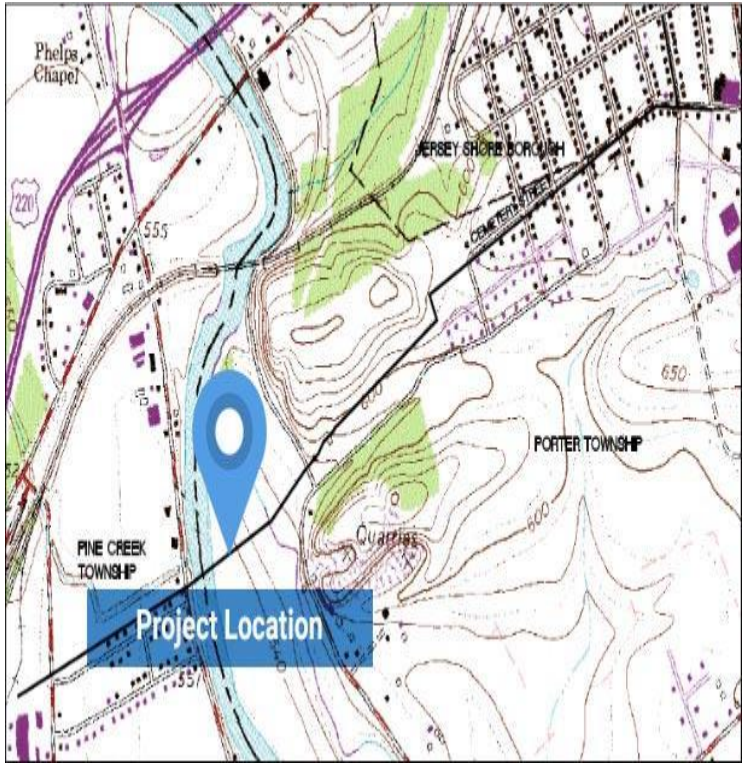
Feature Project

Merrick Road – New York American Water Works

- **Restored a 100-year-old water main with a history of leaks, severe corrosion and poor water quality in Massapequa, NY**
- **Successfully lined over a 2 month period in Spring 2016**
- **Using our proprietary SIPP process, a structural 3 mil (1/8th”) epoxy coating was evenly applied through the entire length of 2 miles of 12” cast iron domestic water pipe under strict zero-VOC policy**
- **Developed logistics to minimize disruption to 4-lane highway, despite multiple adverse conditions, such as multiple trapezoid sweeps, including underneath small rivers and other utility services**

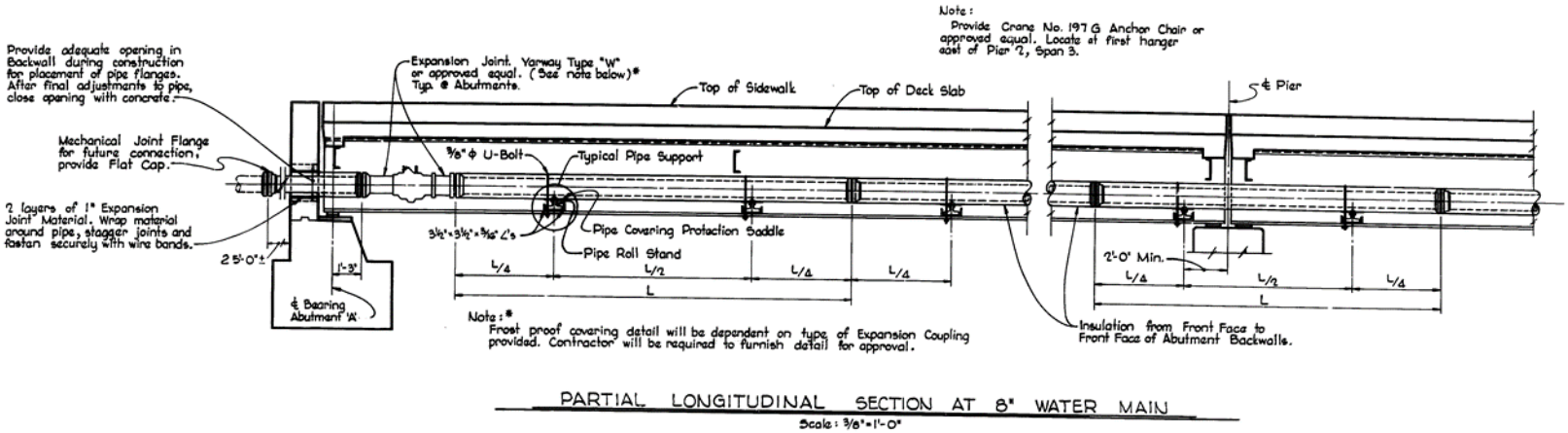
Feature Project

Jersey Shore Pennsylvania Domestic Water Lining Project



- **Rural town of Jersey Shore, Pennsylvania, has a gravity fed domestic water distribution system.**
- **Successfully lined two miles of pipe on time and on budget.**
- **Base infrastructure 16” and 12” cast iron mains originally installed in the 1890s, to supply steam locomotive station**
- **System’s lead sealed joints had tuberculation levels as high as 50%**
- **Bypass system for approximately 150 residences installed and successfully maintained Several trapezoidal pipe layouts under streams and rivers were successfully lined in place.**
- **This was a turn key project: attended to all site safety, excavation, mechanical and road restoration.**

Rte. 42 bridge – Woodstock, Virgina



	Epoxy Cleaning and Lining	Traditional Pipe Replacement
Time Required	**2-3 days**	2-4 weeks
Access Requirements	**2 access points needing just 3 feet of pipe access**	Close half of the bridge down causing severe and long traffic disruptions

Past Performance Examples

Kent County Courthouse
Dover, DE

U.S. Government GSA
Washington, D.C.

Indian Head Naval Base
Indian Head, MD

Bechtel
San Francisco, CA

DuPont Facility
Wilmington, DE

Horizon House
Naples, FL

JFK Airport
New York, NY

Saks 5th Ave
New York, NY

WTC Tower 4
New York, NY

299 Park Ave
New York, NY

Christie Street
New York, NY

The Prince
Marco Island, FL

NEW YORK AMERICAN WATER

Lehigh County Authority

GSA

PennState

pepco

Pipeline Asset Management Program

Network Condition Assessment

Machine learning technology calculates Likelihood of failure using GIS + other customer data sources

Risk-based program design

Combines Likelihood of failure • Consequence of failure • Water quality to **identify hot spots**

Strategic Pipeline condition assessment

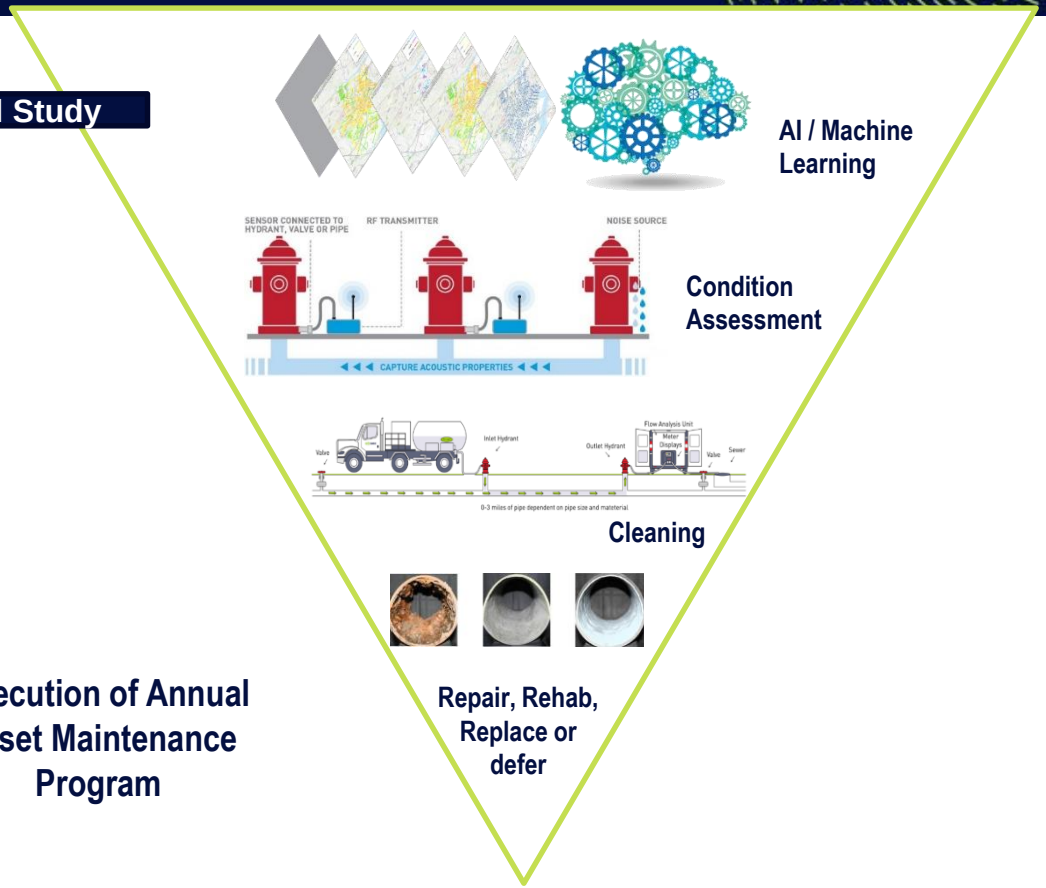
Non-intrusive acoustic inspections in hot spots help finalize risk map and **determine areas to clean, replace, rehab, repair or defer**

Optimized Pipe renewal & maintenance plan

Implementation of scheduled work as per condition

Most efficient technique for every case • Costing and financial solution for each project • **Results logged into the machine learning tool**

Initial Study



Execution of Annual Asset Maintenance Program

Pipeline Asset Management Program: Summary

- Preventive maintenance approach to **prioritize** and **minimize** investment needs
- Risk-Based analysis to identify **hot spots** using basic utility data and other external databases
- Pipe condition assessment in hot spots to **validate** segments that need to be renewed
- Data collected annually helps to improve **accuracy** and measure **performance** (WQ, leaks, pipe life)
- Unique technologies brought by SUEZ:
  - Network Condition Assessment with Machine learning
  - Non Intrusive Pipeline Surveys
  - Pipe cleaning to extend expected life
  - High Performance coatings