

Water Infrastructure: Trenchless Rehabilitation of Aging Water Pipes

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Water is essential to life. Without it, a human can survive for only three days.



The human body contains 66% water by weight.



Blood, muscles, brain matter and bones are also composed of 83%, 75%, 74% and 22% of water, respectively.



In fact, we are all mobile bags of water with a brain floating on top.



Moreover.....



**As much
as 60% of
the world's
illness is
water
related.**

Top Benefits of Drinking Water

Organic  Facts

Helps to maintain
pH balance

Aids in regulating
body temperature

Helps in breathing
and metabolism

Reduces risk of kidney
stones and ulcers

Prevents cardiovascular
disorders

Reduces risk of
osteoporosis and
hip fractures

Prevents constipation, heartburn and migraine



A reasonable conclusion:



Our drinking water is the single most important element we consume for life and health, each and every day of our lives.

And yet, the aging pipes that bring treated water to our houses look like this....

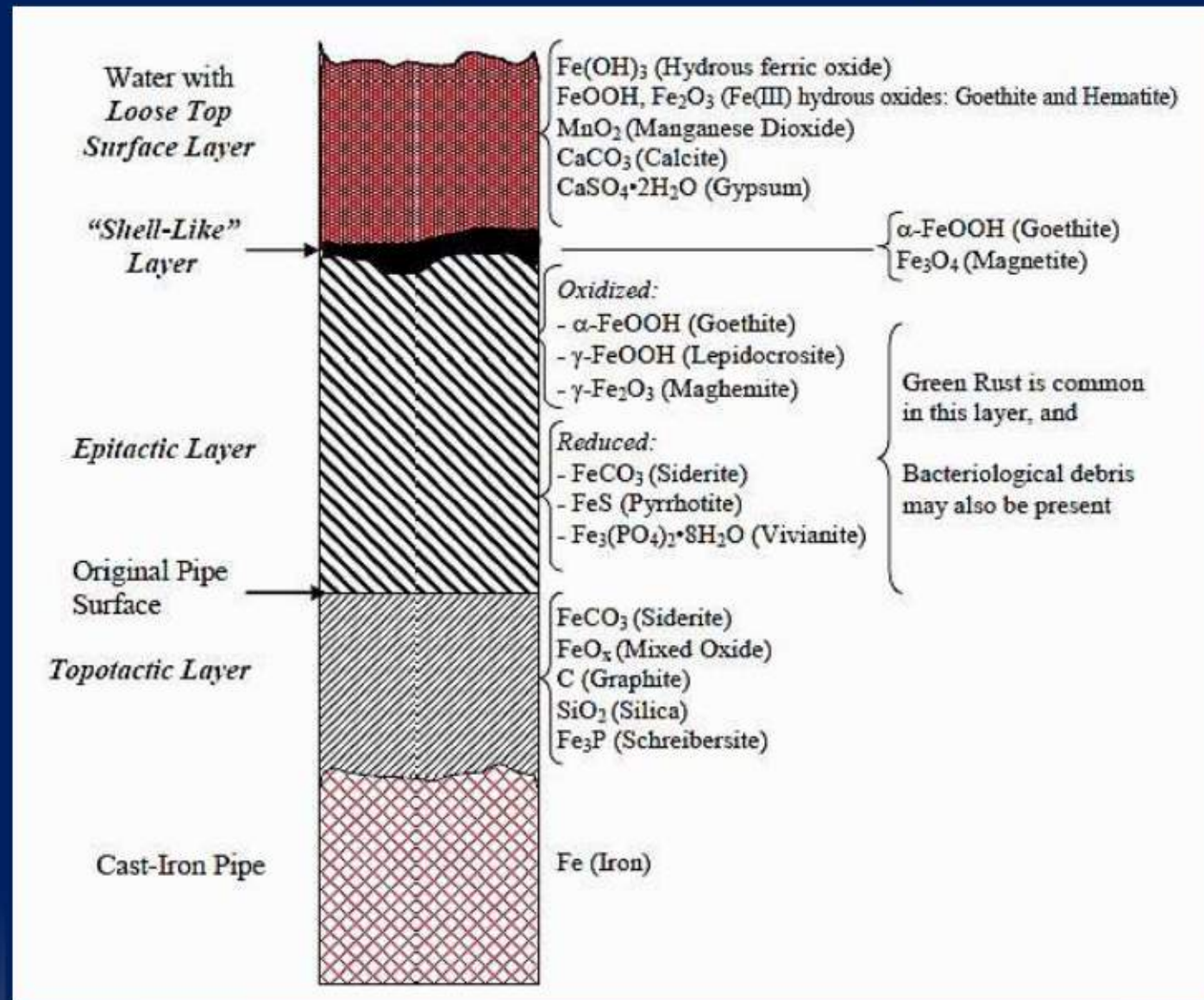


What exactly is in our aging water pipes ?

A matrix of biology (living and dead bacteria), corrosion products and sediment.



Sectional Anatomy of Water Pipe Debris:



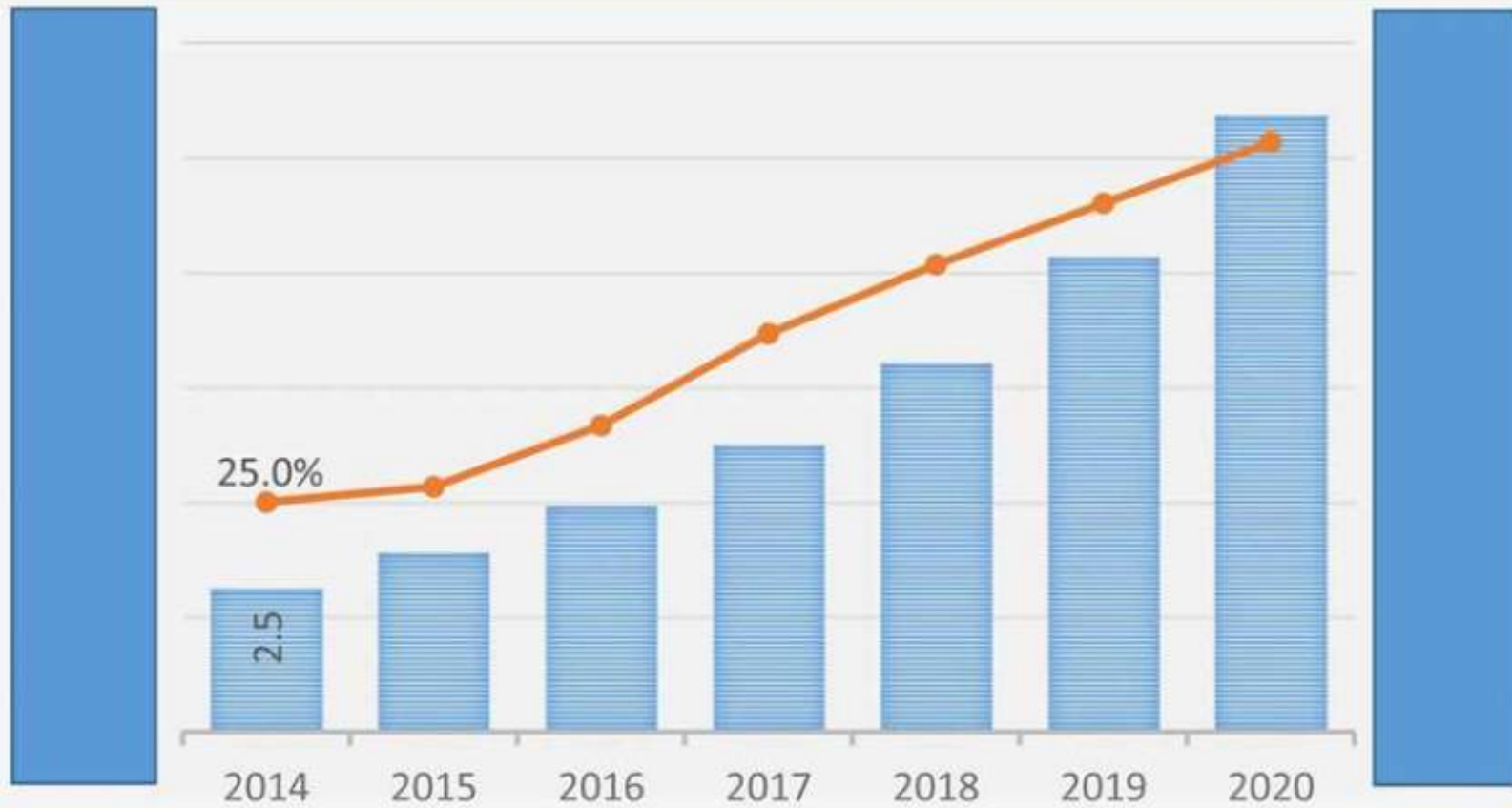
(Adapted from Sontheimer, Kölle, and Snoeyink, 1981)



.....is it any wonder that, increasingly, bottled water is capturing the confidence of the public?

Projected Growth in Bottled Water Sales:

Global Smart Water Bottle Market Size & Forecast (US \$ Mn) and Y-o-Y Growth Rate (%), 2014-2020



So, what are we
doing now with
our aging pipes?



Current water Utility Practice:

A water utility's financial plans include two budget categories:

- 1) Operations Budget: includes the annual plans and expenses for maintaining utility assets.
- 2) Capital Works Budget: includes annual or multi-year financial plans for the improvement of utility assets.

The Operations (O&M) Budget is often 80% of total budget.

While Operations and Maintenance (O&M) budgets fund the upkeep repair of our buried drinking water assets....



...our water pipes are now reaching the end of their useable lives.



Cities throughout North America have 100s of kilometers of aging, congested and leaking pipes.





In North America, we are moving from a maintenance and repair stage to a rehabilitation stage in the life cycle of our drinking water assets.

What are the indicators that we are moving beyond on-going O&M budgets?

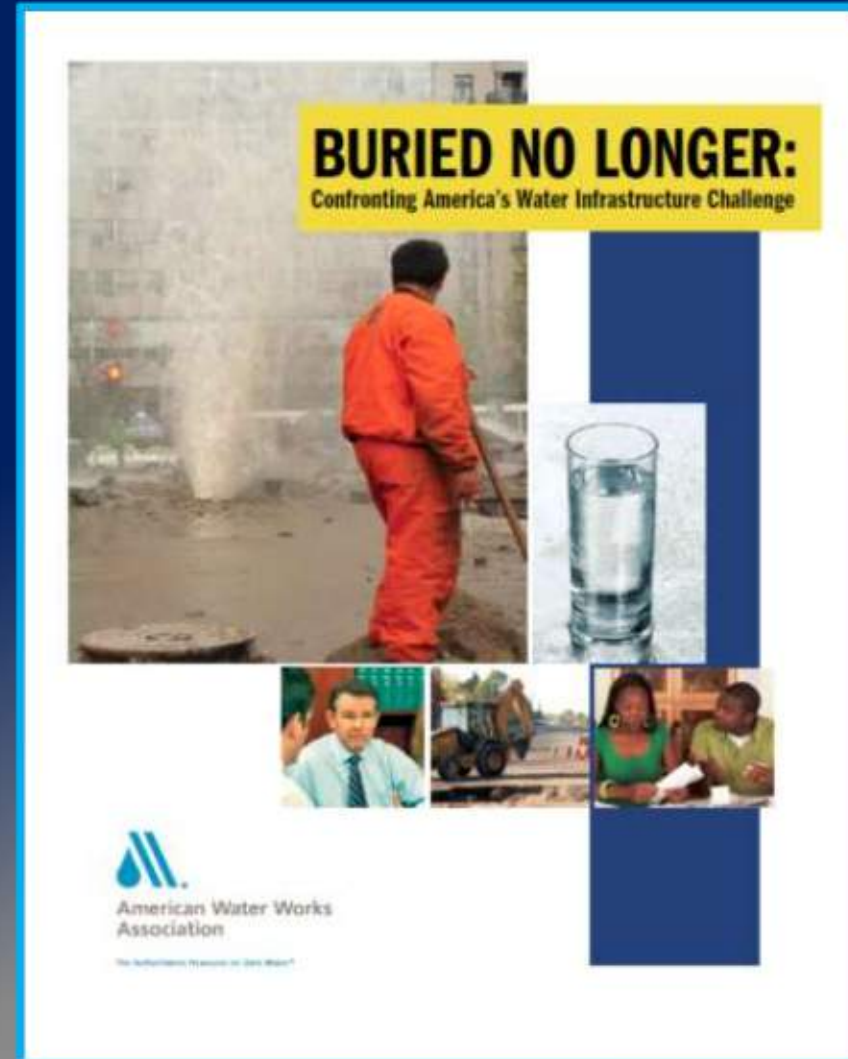
- Service outages are more frequent.
- Increasing damage to infrastructure.
- More poor water-quality incidents.
- Reductions in fire flows.
- Increased energy costs for water supply.



Rehabilitation programs shift the funding focus of Utilities from Operations Budgets to Capital Budgets.



According to AWWA, the funding gap is \$1.0 trillion (U.S.) over the next 35 years.



The reaction amongst many public utilities has been to squeeze O&M budgets and delay multi-year capital programs.



Is it possible to leverage innovative technologies to
extend the lives of buried pipes under O&M budgets....



.... thereby avoiding capital programs?

Utility Operations Budgets (O&M) Include:

- cleaning and flushing mains;
- fixing water main breaks; and,
- scheduled repairs and replacements.

O&M budgets focus on short-term maintenance functions. e.g. pipe operational cleaning



Unidirectional flushing.



When the water runs clear, has the problem been solved?



No, it has not....

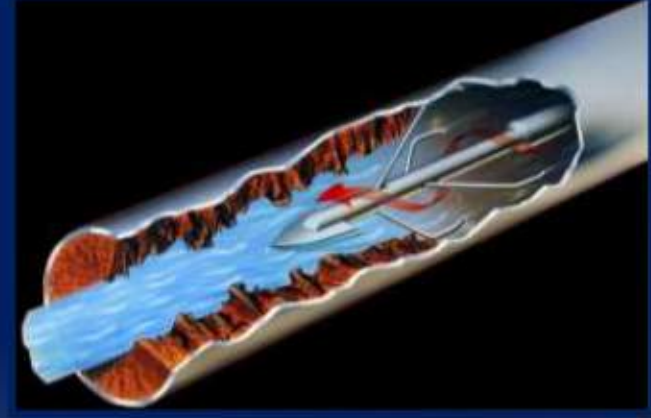


Capital budgeting requires:

- capital planning and priorities for improvement,
- condition assessment of assets,
- development of multi-year capital program,
- development of contract documents & specifications,
- tendering and award of contract,
- construction phase & contract management; and,
- commissioning capital improvements.

Capital system improvements require:

- Access to the pipe.
- Temporary water supply.
- Full removal of corrosion products.
- Inspection and assessment.
- Installation of a liner for life extension/improvement.
- Final inspection.
- Disinfection and return to service.



These improvement services take time.

What happens if you can implement a program to:

1. pre-screen pipe condition without shutdown;
2. quickly and fully remove encrustation/sediment;
3. apply a rapid-setting polymeric lining;
4. complete a speedy pipe disinfection; and,
5. put the pipe back into service within 24 hours?

Would a multi-year program allow you to:

- ✓ avoid years of delays: paralysis by analysis;
- ✓ avoid years and years of expensive condition assessment studies;
- ✓ avoid the expensive strategy of asset replacement projects; and,
- ✓ build better **programs** to fix the right pipe at the right time, using the right method?

Yes it would!



Can we bring innovative technologies to bear to make this happen?

Is it technically possible:

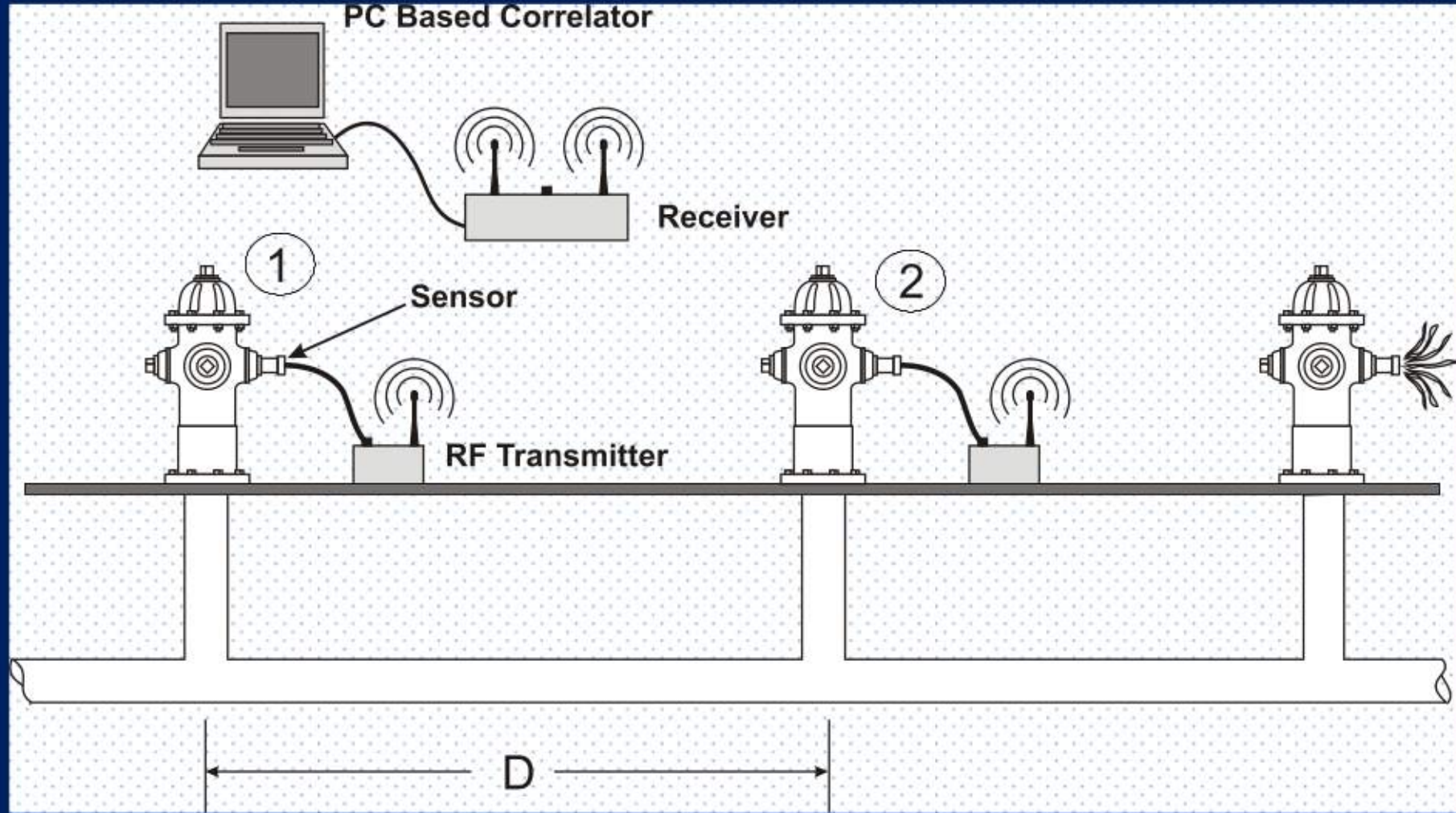
1. To economically pre-screen pipe condition without shutdown.
Yes it is.
2. To quickly remove all encrustation/sediment.
Yes it is.
3. To apply a bonded, NSF 61 polymeric lining.
Yes it is.
4. To put the pipe back into service within 24 hours.
Yes it is.

Start with historical record review and non-destructive, survey-level leak/condition technology.



PC-based leak noise correlator

The majority of pipe failures begin with leaks!



Leak and wall thickness survey locates system problems

Age or pipe type alone are not reliable indicators of condition:

Exhumed cast iron water pipe in Hamilton, dated 1860



Samples from 1860 following sandblasting:



We will need a progressive valve function program to ensure that we can properly isolate parts of the system.



Prioritize pipes and make surgical excavations to access pipes.



Rapidly clean, prepare, dry and inspect the old pipe.



[Click here to view video](#)

The outcome yields immediate results. We remove corrosion faster and better than any system worldwide.



Immediately apply a NSF 61 polymeric barrier lining.



[Click here to view video](#)

Or, rapidly increase the lining thickness for higher-build performance.



Immediately
inspect the
polymeric liner.



Return pipe to service with potable water
precautions...



Now, let's compare costs:

**Dig-and-replace cost:
\$750 - \$1,000/meter –
location dependent**



Now, let's compare costs:



Spray-in-place pipe (SIPP)
\$120 – \$300/meter lining



Cured-in-place pipe (CIPP)
\$400 - \$700/meter lining

50% savings!

Advantages of combining cleaning, inspection & renewal into a program:

- offers “fast-start” O&M program for improved water quality and “C” factor;
- includes an economic, non-destructive survey of pipe condition;
- stretches O&M dollar and allows utilities the option to help perform the work;
- offers utilities the most cost-competitive program; and,
- builds more effective (and smaller) capital programs.

Would such a program allow you to:

- avoid years of delays: paralysis by analysis;
- avoid years and years of expensive assessment and analysis programs;
- avoid the expensive strategy of digging up all your water pipes or using expensive replacement liners everywhere; and
- build a better and more cost effective program to

Fix the Right pipes at the Right time, with the Right method?

Yes it would!



Waterloo - Albert St. Demo – July 2015

Purpose: To demonstrate Tomahawk cleaning and airborne lining process to potential applicators and municipal customers. To validate performance of cleaning and lining as part of joint R&D project.



10.05.18 08:07:10 7:21M
256 albert st watermain northbound



Waterloo water main
before cleaning
inspection video

[Click here to view video](#)

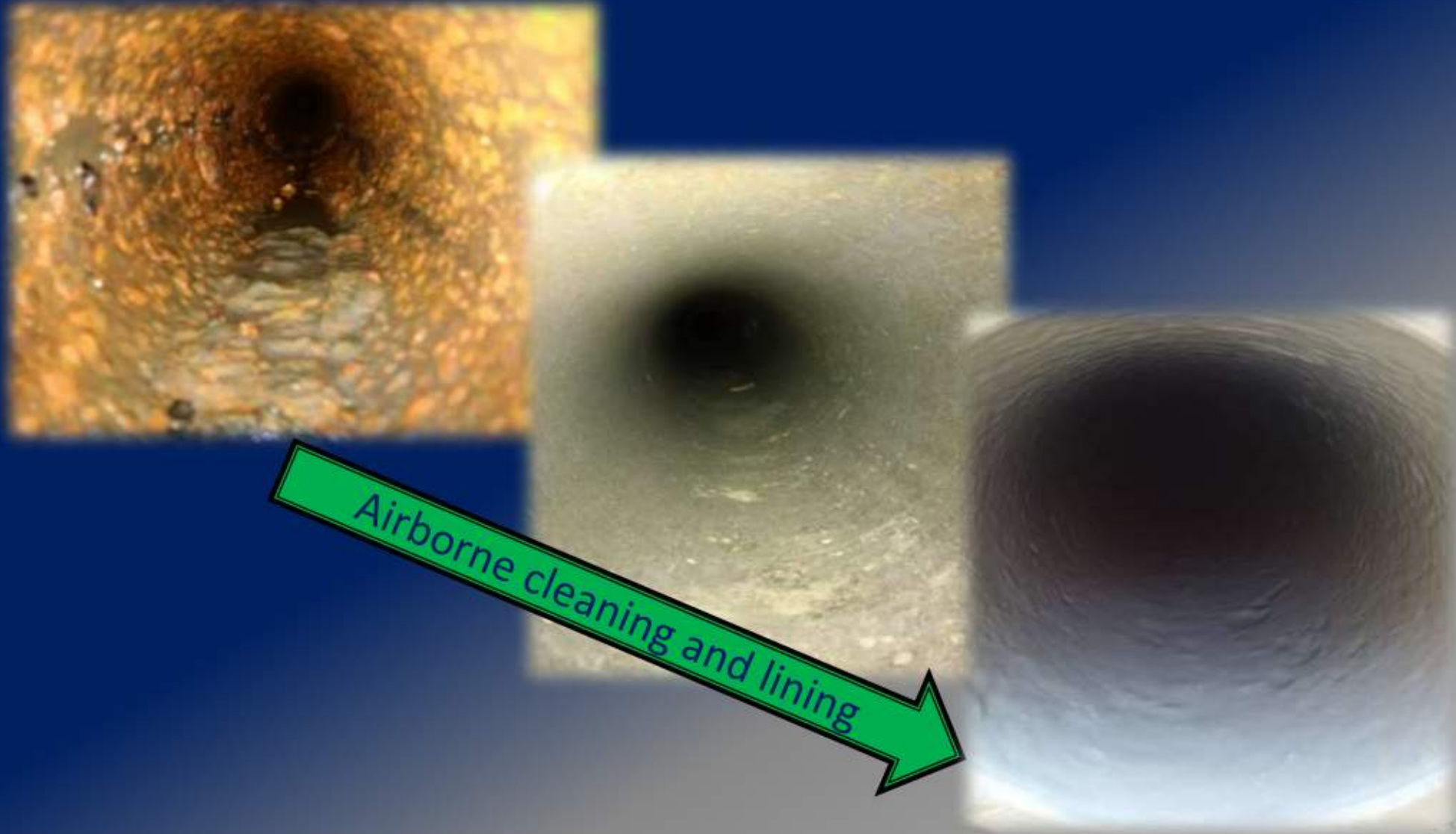
Waterloo water
main after stone
cleaning and lining
inspection video

[Click here to view video](#)

10.12.12 10:07:10 12:00M
249 albert northbound - after lining



City of Waterloo: July 2015 – 24 hour Results



We have a buried problem with our aging drinking water assets that will continue to deteriorate, and may undermine public confidence.



We need reliable programs to get us back to the tap:



**We are here to
help you answer
your questions
and help you get
started with your
program.**

