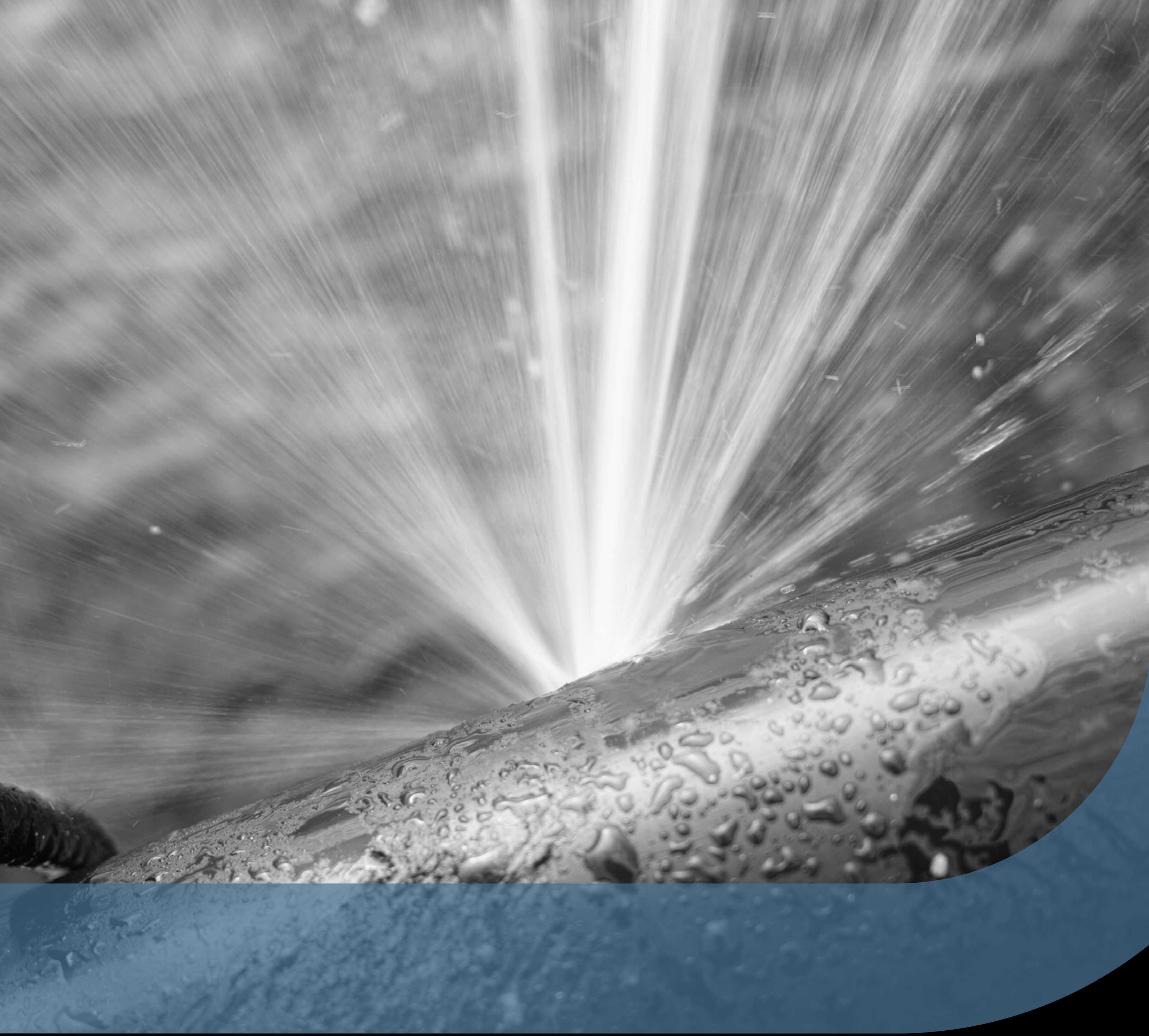


Cast/Ductile Iron Water Mains: Recovery Plan for Decades of Underfunding

Optimization Strategies to Extend the Life of Cast and Ductile Iron

Table of Contents

Introduction

North America's drinking water distribution network spans more than 3.54 million kilometers (2,2 million miles) in the U.S. and 214,000 kilometers (133,000 miles) in Canada. Much of this system—especially cast and ductile iron mains installed before 1975 without cement mortar lining—now shows advanced deterioration from internal and external corrosion.

Nearly 30% of water mains have reached or exceeded their service life. In the U.S., over 1 million miles will require renewal in the coming decades, a demand that would require tripling the current replacement rate—an increasingly unrealistic goal given chronic underfunding. The cost of modernizing North America's systems is projected to exceed $1 trillion USD over the next 25 years.

This white paper supports municipal leaders and utility managers by presenting pragmatic, sustainable, and cost-efficient strategies to extend the life of cast/ductile iron water mains, reduce capital pressures, and maximize return on investment—offering a realistic alternative to full-scale replacement.

Where to Begin...

Contrary to popular belief, many North American municipalities have developed a detailed understanding of the condition of their drinking water systems. Over the past two decades, evolving regulatory requirements and industry best practices have driven utilities to strengthen their monitoring, assessment, and infrastructure renewal planning.

The growing adoption of proactive maintenance strategies—such as unidirectional flushing, leak detection, systematic inspections of valves and hydrants, and trenchless rehabilitation—demonstrates a continent-wide shift toward data-driven and preventative asset management.

By collecting and analyzing data across the three key components of a distribution network—**physical infrastructure** (pipes, hydrants, valves, etc.), **water quality** (e.g., THMs, chronically discolored water), and **hydraulic performance** (e.g., fire flow capacity, pressures affected by urban development)—utilities are now better positioned to conduct comprehensive system evaluations. These insights enable more informed decision-making, helping to prioritize actions and investments that protect system integrity, reduce risk, and extend the service life of critical assets.

Inventory

The inventory of North America's water infrastructure is based primarily on the *Utah Water Research Laboratory, Utah State University report, Water Main Breaks in the USA and Canada – December 2023*. This database is a key tool for developing a coordinated action plan across North America.

For several years, the Utah WRL has collected strategic information on the condition of water infrastructure, covering more than 400,000 miles (644,000 km) of mains in the U.S. and Canada. This work provides an essential overview to guide decision-making.

Here is an overview of the main findings from this inventory.

Total Network
3,400,000 km

Cast Iron (23%)
782,000 km

Ductile Iron (27%)
918,000 km

Ductile Iron without CML (<1975)*
229,500 km**

1 km of pipe supplies
178 people

Average Expected Life of Installed Pipe
78 Years

Pipe inventory 300 mm or smaller
86%

Water Main Breaks per 100 km/year
6,9 Breaks

Water Main Breaks on CI Pipe Only
17,8 Breaks

Pipe 50 years or olde
1,240,000 km

Pipe Beyond their Useful Life
727,000 km

Investment needed EPA (2023)
$421 B

*DIPRA Ductile Iron Pipe Research Association
** Author Estimation

Based on the *Utah Water Research Laboratory, Utah State University report, Water Main Breaks in the USA and Canada – December 2023.*

Overall Assessment

Structural Integrity of Cast/Ductile Iron Pipes

Among distribution network components—hydrants, valves, pumps—pipes, particularly cast iron, play a central role. Used for centuries, cast iron has demonstrated exceptional durability: one line has supplied Versailles since 1664—over 360 years of service. When protected from corrosion, these pipes maintain remarkable structural integrity.

Is it possible to optimize the durability and structural integrity of our cast/ductile iron water mains?

In North America, water main condition is often measured by break rates per 100 km per year. Across 3.4 million kilometers (2.2 million miles) of mains, about 260,000 breaks occur annually—around 8 per 100 km (13 per 100 miles). Yet each break typically affects only 10 cm (4 inches), or just 0.8 m per 100,000 m of pipe. With an effectiveness rate of 99.999865%, most cast and ductile iron pipes continue to deliver highly reliable service.

Even if cast iron break rates were doubled or tripled, the system would remain in excellent condition—well worth preserving and extending. With a targeted strategy, their durability can be sustained for decades.

"What about water main breaks?"

Repairing a leak on a water main with a diameter of 100 mm to 250 mm (4 to 10 inches) in a residential area typically costs around **$10,000 per intervention** (2025 estimate) and takes **6 to 10 hours**—disrupting residents and municipal services in the process.

By comparison, replacing just **one kilometer** of water main costs roughly **$1.25 million**. In theory, you could repair **up to 125 breaks** before reaching the same cost as replacing a single kilometer.

If experiencing that many breaks is highly unlikely, why not use this **financial margin** to invest in **proactive, preventive strategies** that extend infrastructure life.

An impressive 99.999865% of your cast iron network is still operating without a single failure—proof of its underlying structural integrity.

Out of every 100 kilometers, only **0,8 meter** of pipe exhibit this deficiency

... cast iron, "a durable material—not disposable—and infinitely recyclable."
— France Environnement.

Overall Assessment

Hydraulic Capacity

Until the mid-1960s, most water mains installed in North America were made of cast iron. Among the **782,000 kilometers (485,000 miles)** of these pipes still in service today, one common feature stands out: the **absence of an internal cement lining** to protect against corrosion. At the time, manufacturers applied only a **thin bitumen coating**, which offered limited protection.

For **ductile iron pipes**, an estimated **918,000 kilometers (570,000 miles)** were installed across North America. A similar issue is observed in **pipes manufactured in 1975 or earlier**, where the lack of internal lining contributed to internal corrosion.

It wasn't until **1976** that the **systematic application of cement-mortar linings** effectively addressed this problem. As a result, **pipes installed after this date generally do not exhibit significant hydraulic capacity limitations**.

There is **no precise data** to distinguish how many kilometers of ductile iron pipes were installed before versus after 1975. **For the purposes of this document, we assume that approximately 25% were installed in 1975 or earlier, and 75% in 1976 or later.**

Unlike newer pipes, cast iron and ductile iron pipes installed before 1975 have experienced internal corrosion over time, leading to the buildup of corrosion deposits and a significant reduction in hydraulic capacity.

This type of corrosion is primarily driven by **physical, chemical, and biological processes.** It is estimated that approximately **800,000 kilometers (500,000 miles)** of water mains across North America currently suffer from **moderate to severe hydraulic deficiencies**.

Consequences of Internal Tuberculation

The accumulation of deposits inside water pipes leads to several major issues:

- **Accelerated internal wall corrosion**
- **Increased frequency of pipe breaks**
- **Reduced fire flow capacity,** compromising public safety
- **Constraints on urban development,** limiting network expansion
- **Higher pumping costs** due to reduced hydraulic efficiency
- **Sustained elevated static pressures,** increasing the risk of infrastructure damage
- **Deterioration of water quality,** including undesirable discoloration
- **Increased use of disinfectants,** impacting water treatment processes

Given these challenges, **targeted strategies must be implemented to ensure the long-term performance and reliability of the distribution network**.

Length of cast/ductile iron pipes with moderate to severe hydraulic deficiency per 100 km:
60 kilometers

Most cast/ductile iron pipes installed before 1975 have likely experienced a reduction of 30% or more in their hydraulic capacity.

This phenomenon typically occurs in domestic water distribution systems where cast iron pipes are used for water supply.Tubercles make the inner surface of the pipes rough, which increases pumping costs and pressure within the distribution system, while reducing pump efficiency.In severe cases, it can even lead to pipe failures.

— Corrosionpedia

Overall Assessment

Water Quality

Ensuring the delivery of high-quality drinking water is a key challenge for municipal water managers. While the treated water leaving the treatment plant meets all sanitary standards, **its transit through the distribution system can alter its characteristics**.

The causes of this deterioration are the same as those that contribute to the **buildup of internal deposits in water mains**:

- **Chemical causes:** Lack of protective lining, pH fluctuations, presence of THMs, and others.
- **Physical causes:** Water stagnation, temperature variations, and others.
- **Biological causes:** Growth of iron bacteria and microorganisms, among others.

Photo of a drinking water distribution pipe in a municipality in North America

Photo of a drinking water distribution pipe in a municipality in North America

Pipe corrosion leads to the release of iron, an element that promotes the growth of microorganisms.

To limit this phenomenon, **precise dosing of disinfectants is essential** in order to eliminate **biofilms and bacteria hidden beneath internal deposits**.

Photo of a drinking water distribution pipe in a municipality in North America

In addition, utility managers must address public concerns related to water aesthetics and safety—such as color, odor, and potability—while deploying targeted strategies to maintain reliable and secure distribution.

Length of cast/ductile iron mainswith this deficiencyper 100 km:
60 kilometers

A dosage of 1.27 mg/L of free chlorineis required to control 1 mg/L of iron (Fe).

"Drinking water distribution systems are dynamic, living systems where biological, chemical, and physical processes interact, affecting both water quality and infrastructure condition."
— American Water Works Association, M68 Water Quality in Distribution Systems

Main Cause

An analysis of anomalies affecting the three principal components of the network—infrastructure, water quality, and hydraulic capacity—points to a predominant factor behind most malfunctions: **corrosion**, whether internal or external. It is the leading cause of deterioration in cast/ductile iron networks.

Controlling this phenomenon is a strategic priority. By limiting corrosion, municipalities can effectively **"stop the clock"** on pipe aging, extend infrastructure lifespan, preserve structural integrity, and provide users with reliable, long-term service.

We invite you to explore the underlying causes of corrosion and discover practical measures to mitigate its impact.

Corrosion—not age—is to blame for most water main breaks.

Water World

— Jim Lary, NACE-certified corrosion engineer and Vice President at Corrpro

External Corrosion of Ductile/ Cast Iron Water Mains: Causes and Impacts

Numerous studies, theses, and specialized publications worldwide address the corrosion of metals. In this document, we focus on the most relevant aspects, identifying the most common anomalies and the appropriate corrective measures.

External corrosion of cast/ductile iron mains is primarily caused by three factors:

- **Soil characteristics**
- **Galvanic corrosion**
- **Stray currents**

Soil characteristics and their impact on corrosion

Soils have varying properties that influence their potential to corrode metallic pipes. Factors such as resistivity, aeration, pH, microbial activity, and backfill quality all play a key role in the long-term degradation of infrastructure.

Each region presents unique conditions, making it difficult to define a single type of corrosion. However, one common factor stands out: **soil acidity**, often worsened by the use of calcium chloride for road de-icing—a phenomenon widely observed in municipalities.

Galvanic corrosion: an electrochemical process

Metals have distinct electrochemical potentials. When in contact, the more reactive metal sacrifices itself to protect the more noble one.

For example, a brass service connection (potential: –0.370 V) coupled with a cast iron main (–0.500 V) will cause corrosion of the cast/ductile iron, which donates its electrons to the brass Over time, this process progressively weakens the integrity of the network.

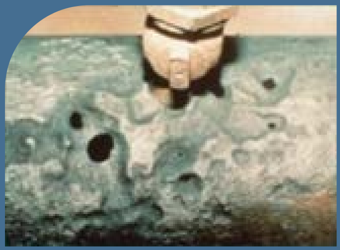


Photo Matergenics

> *« Water main breaks are mainly due to corrosive soil, pipe material, galvanic action, stray current corrosion, or microbiologically induced corrosion (MIC). »*
> *— M. Zamanzadeh, in Water Main Breaks – High Time to Learn from Mistakes and Avoid Further Breaks (2021)*

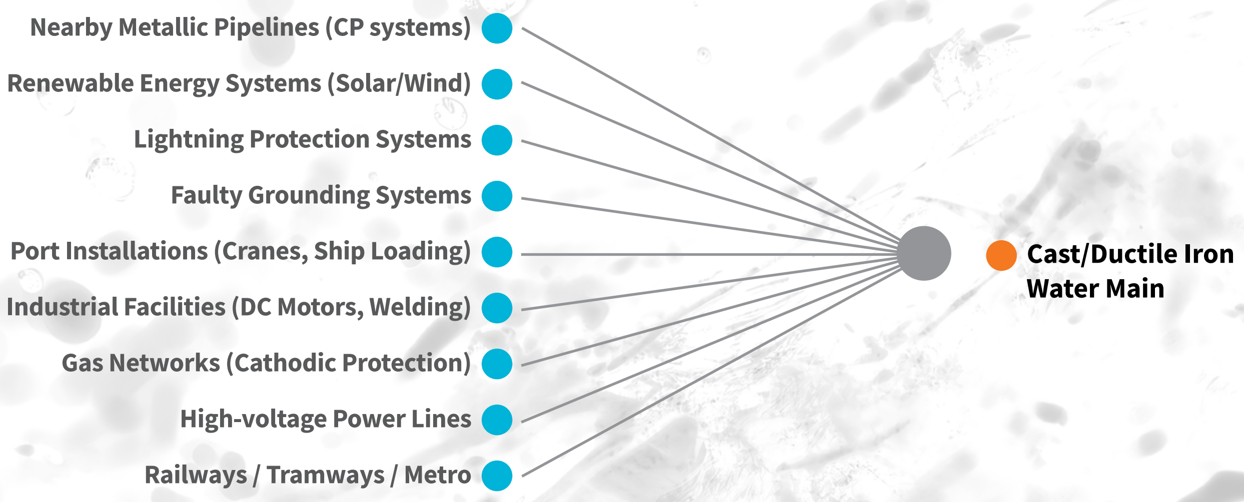
Stray Currents: An Insidious Threat

Stray currents can originate from various electrical infrastructures (see graphic below), including railways, high-voltage power lines, cathodic protection systems for gas networks, industrial facilities, and other nearby installations.

These unintended electrical currents can travel through cast iron mains, significantly accelerating corrosion. In fact, a stray current of just **one ampere** can dissolve up to **9 kg of cast/ductile iron per year**, causing rapid and costly infrastructure deterioration.

Photo Webcorr

Potential Sources Of Stray Currents Affecting Cast/Ductile Iron Water Mains



Internal Corrosion of Cast/Ductile Water Mains: Causes and Impacts

Infrastructure assessments reveal that internal corrosion in cast/ductile iron mains is generally more uniform across the network than external corrosion, leading to premature system degradation (see photos). Two major factors are responsible:

- **The corrosive nature of the water**
- **The accumulation of internal deposits inside the mains**

Impact of Corrosive Water

Water, by its nature, can actively degrade metals. Imagine placing a clean copper penny and a piece of bare steel side by side in a jar of tap water. After only a few days, the steel will darken and show visible pitting, while the copper remains largely unaffected. This simple demonstration highlights how water chemistry—and the presence of different metals—can accelerate corrosion, just as it does inside cast/ductile iron mains over years of service.

To limit these effects, the U.S. Environmental Protection Agency (EPA) requires cities to treat not only surface water supplies but also any water deemed corrosive with corrosion inhibitors, in accordance with the Lead and Copper Rule. This regulation aims to reduce the leaching of lead and copper into drinking water, while also controlling water corrosivity to protect cast/ductile iron mains and minimize the overall impacts of corrosion on infrastructure.

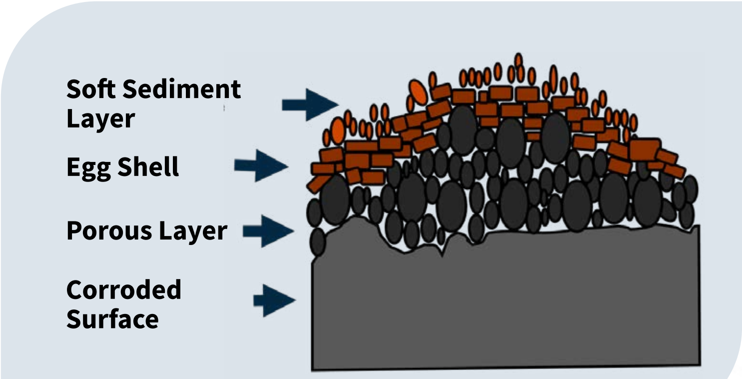
No external corrosion — only internal corrosion.

Internal Deposits: A Silent Threat

The accumulation of internal deposits inside water mains creates multiple issues:

- **Bacterial growth and the development of harmful biofilms**
- **Deterioration of water quality and color**
- **Increased energy costs due to reduced hydraulic efficiency**
- **Lower flow rates, compromising water supply for firefighting and urban development**

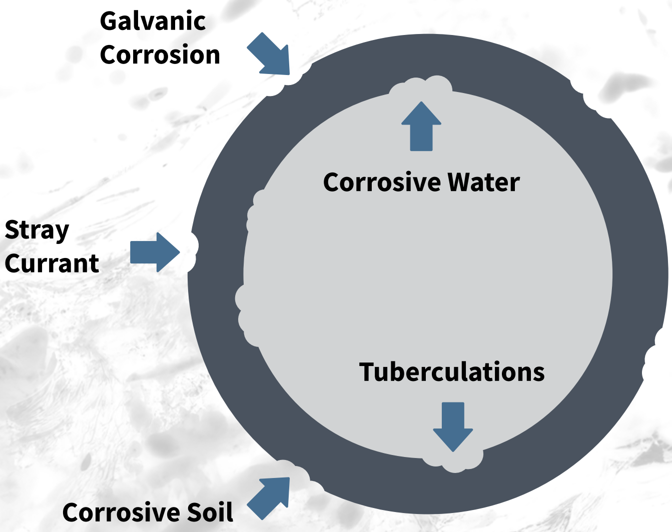
In addition, these deposits contain porous cavities that trap water, causing localized acidification and a drop in pH. This process accelerates the internal corrosion of the mains, weakens the cast iron structure, and reduces long-term durability.

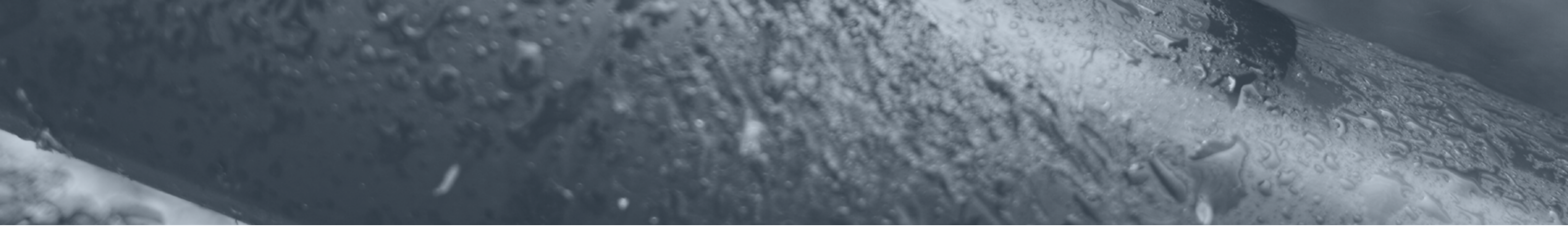


Sarin et al. (2004)

In Summary

The main factors responsible for the deterioration of cast/ductile iron mains are the following anomalies:





Moving on to Solutions: Exploring Global Best Practices

After identifying the main factors contributing to the deterioration of cast/ductile iron mains, it is essential to examine the most effective practices for controlling both internal and external corrosion. Worldwide, several techniques have been proven to limit the harmful effects of corrosion and extend the integrity and lifespan of infrastructure.

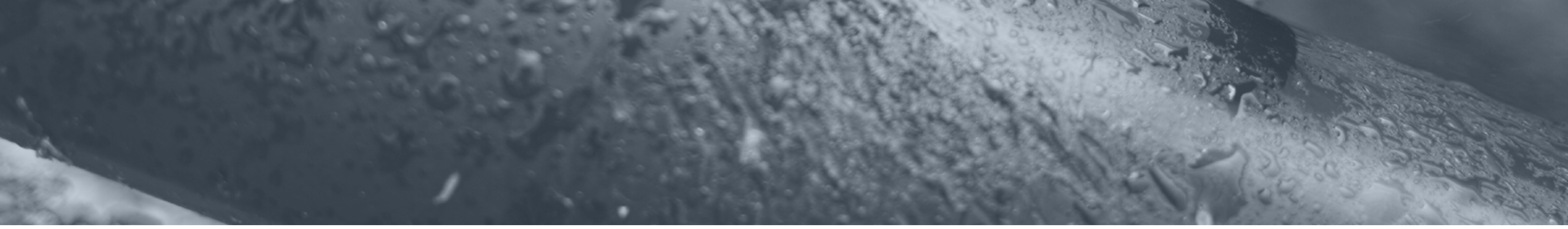
External Corrosion: A Challenge Mastered in Other Sectors

Cathodic Protection: A Proven Technology

When looking at industries that operate infrastructure similar to water distribution networks—underground metallic pipelines carrying pressurized liquids—the oil and gas sector stands out as a benchmark. What strategies have these industries adopted to combat external corrosion on their pipelines?

Cathodic protection works by controlling electrochemical reactions within the material. Although the principle was first discovered in 1824 in London, where it was used to preserve ship hulls, it wasn't until the 1930s that it was applied to pipelines transporting oil and gas in North America. Initially, it relied on sacrificial anodes, which released electrons to protect the pipelines.

Since the 1990s, a more efficient and cost-effective approach has gained prominence: impressed current cathodic protection. Today, this technology is widely used to protect cast/ductile iron infrastructure, offering more precise control and optimized protection for buried pipelines.



Growing Adoption of External Corrosion Control

In North America, several cities—such as **Philadelphia, Denver, Ottawa, Des Moines, San Francisco and Calgary**—have already implemented cathodic protection to safeguard their water distribution networks. This approach has helped reduce leaks, minimize maintenance costs, and extend the service life of infrastructure.

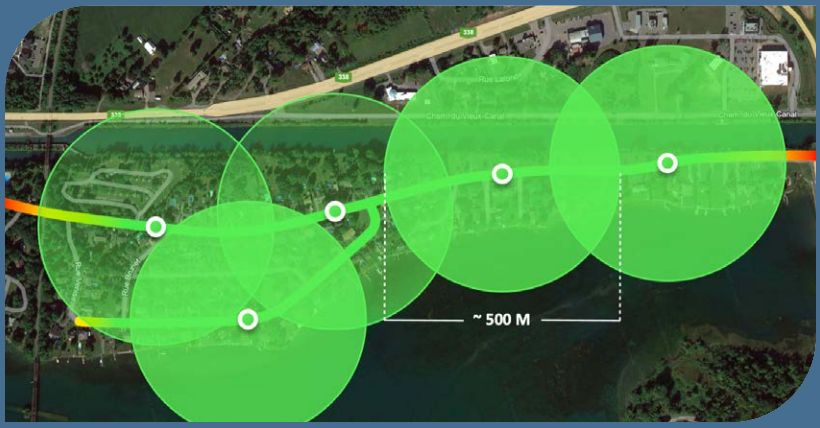
Depending on the network and soil conditions, two cathodic protection methods can be applied:

- **Sacrificial anodes,** which protect the mains by corroding in their place.
- **Impressed current systems,** which provide active, long-term corrosion control.

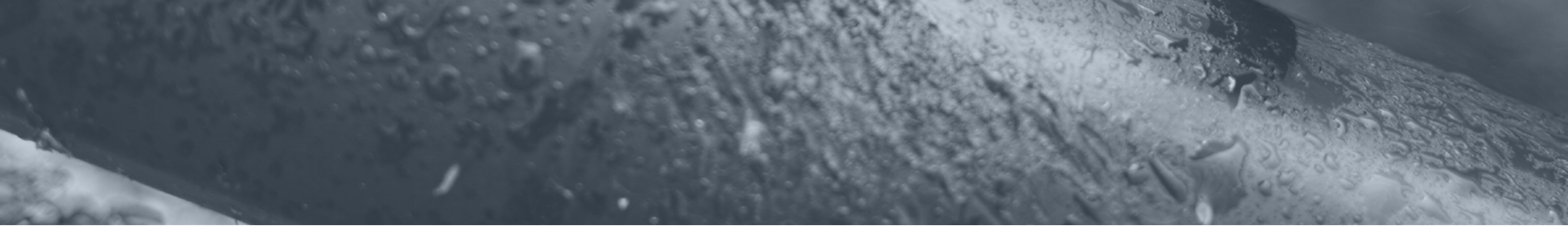
These solutions effectively combat several corrosive phenomena, including:

- **Stray currents**
- **Aggressive soil conditions**
- **Galvanic corrosion**

Integrating cathodic protection into water network management represents a major step forward in ensuring infrastructure durability and optimizing long-term performance.



Cathodic Protection Plan with Impressed Current by Techno Protection



Internal Corrosion of Cast/Ductile Mains: A Manageable Challenge

Analysis of internal corrosion in cast/ductile iron mains highlights two major issues:

- **Water aggressiveness**, which accelerates the deterioration of internal walls.
- **Accumulation of tubercles**—iron oxide deposits that promote corrosion and reduce hydraulic performance.

A Proven Approach in the United States

To better understand how to manage water-induced corrosion, it is useful to examine practices in countries with similar infrastructure. In the United States, the **Environmental Protection Agency (EPA) implemented the Lead and Copper Rule** in 1991, a regulation covering 67,000 water systems and a population of 300 million.

Its goal: reduce the dissolution of heavy metals (lead and copper) by requiring the addition of corrosion inhibitors in networks supplied primarily by surface water (lakes, rivers, etc.).

Cities such as **Chicago, Boston, Washington,** and **Philadelphia** already apply this approach, protecting their infrastructure while improving the quality of water delivered to their residents.

An Effective Solution: The Orthophosphate–Zinc Blend

According to water treatment experts, combining orthophosphate and zinc is one of the most effective methods to limit internal corrosion. This blend forms an invisible protective film on pipe walls, reducing metal dissolution and extending the lifespan of the infrastructure.

EPA Lead & Copper Rule

Several authors have reported that orthophosphate reduces iron concentrations (Benjamin et al., 1996; Lytle and Snoeyink, 2002; Sarin et al., 2003), iron corrosion rates (Benjamin et al., 1996; Cordonnier, 1997), and the frequency of "red water" events (Shull, 1980; Cordonnier, 1997). Phosphate-based inhibitors—particularly orthophosphate—can also reduce heterotrophic bacterial populations, as measured by plate counts, as well as the number of coliforms in cast iron distribution systems, by limiting corrosion.
— Guidance Document on Corrosion Control in Drinking Water Distribution Systems,
Government of Canada

A Cost-Effective, High-Performance Investment

The use of corrosion inhibitors offers numerous advantages:

- **Reduces water corrosivity,** lowering pipe wear and extending service life.
- **Prevents discoloration issues** caused by the dissolution of metals.
- **Optimizes disinfectant efficiency,** thereby improving the quality of the water supplied.

This low-cost yet highly effective solution enables municipalities to ensure greater infrastructure longevity while consistently delivering high-quality drinking water to their citizens.

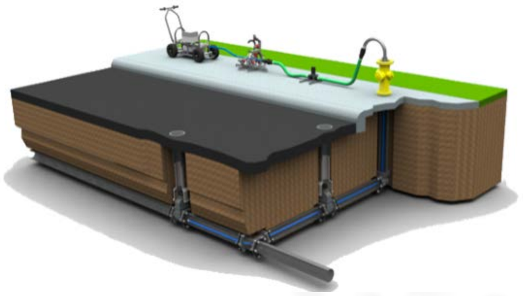
Water Main Cleaning: An Innovation Transforming Network Maintenance!

Water utility managers now have access to a ground breaking solution for maintaining drinking water mains. Developed in North-America, this revolutionary technique removes internal deposits without excavation. Using fire hydrants as access points, it employs specialized hoses and nozzles capable of reaching up to 150 meters in each direction, enabling effective cleaning of nearly the entire network without invasive work.

Operating at low hydraulic pressure, the method removes over 95% of iron deposit attached to pipe walls. It is the most cost-effective and high-performance solution to:

- **Improve available flow rates** and meet firefighting flow requirements.
- **Eliminate water discoloration** caused by deposit accumulation.
- **Optimize water quality** by enhancing the effectiveness of disinfectants.
- **Reduce pumping costs** through lower static pressures while maintaining the same water volume in different city sectors.
- **Decrease internal corrosion** by removing deposits that contribute to its formation.

A major step forward for the **management and long-term preservation** of drinking water infrastructure.



Before

After

Comparative Table of Flow Rates and Dynamic Pressures After Cleaning

Fire Hydrants	Flow at 20 psi **before** cleaning (L/min)	Flow at 20 psi **after** cleaning (L/min)	Dynamic pressure **before** (psi)	Dynamic pressure **after** (psi)
PI-01	3475	3802	30	41
PI-02	3407	4644	30	43
PI-03	2036	4377	20	42
PI-04	1743	4092	18	43
PI-05	1685	5445	15	51
PI-06	1464	2928	12	29

Maximizing the Durability of Water Mains: An Integrated and Cost-Effective Approach

Understanding Infrastructure Condition and the Causes of Degradation

For several decades, underfunding of drinking water infrastructure has led to the progressive deterioration of cast/ductile iron water mains. This lack of investment has amplified issues related to internal and external corrosion, causing reduced flow rates, deterioration of water quality, and increased risks of clogging.

However, it is important to note that the structural condition of cast iron mains remains excellent. Data shows a **structural reliability of 99%**, indicating that the vast majority of existing mains can be restored and optimized without the need for replacement.

A Financial Challenge: The Limitations of Trenchless Rehabilitation Techniques

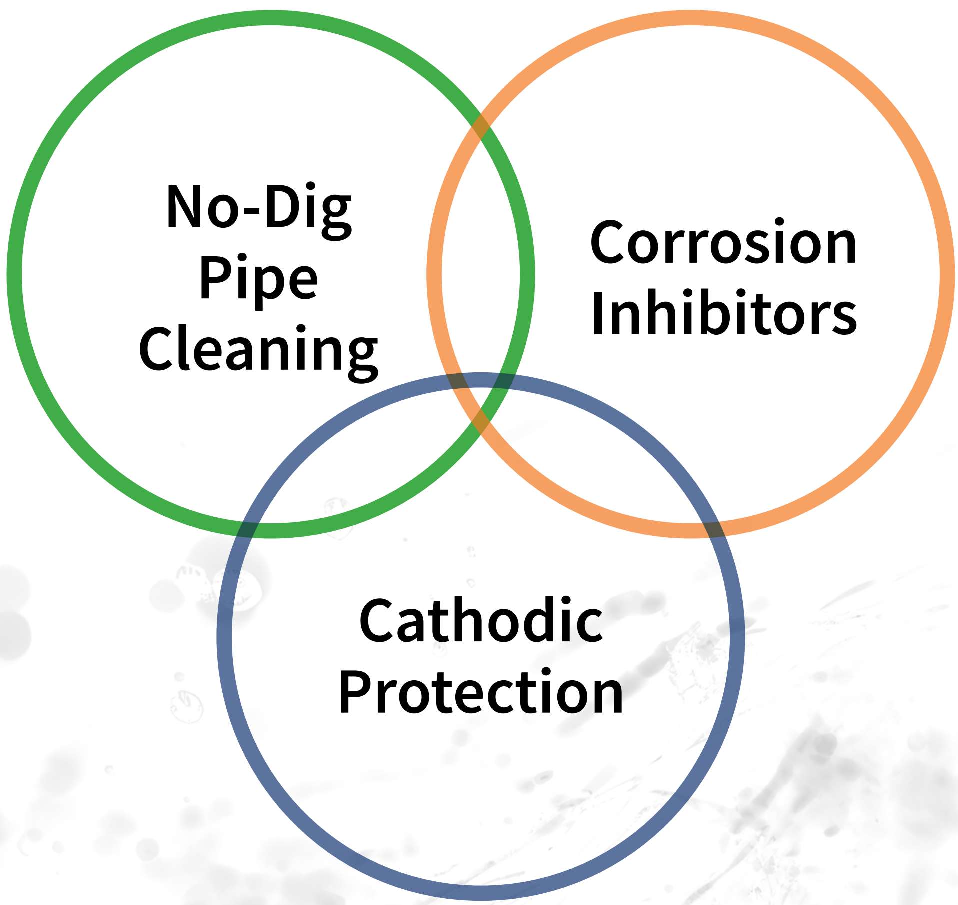
Currently, some trenchless rehabilitation solutions exist—such as CIPP (cured-in-place pipe lining), pipe bursting, and spray-applied lining. While these techniques are effective under specific conditions, they remain extremely costly on a large scale and are not necessary for most cast/ductile iron mains.

Rather than investing heavily in these expensive technologies, it is possible to optimize the existing network through an approach that is more economical, sustainable, and tailored to the realities of municipalities.

Three Complementary Techniques to Eliminate Corrosion and Restore Network Performance

To address these challenges, an integrated approach based on three solutions can extend the lifespan of existing infrastructure and effectively mitigate the effects of corrosion:

1. **Cathodic Protection** – Protects mains against external corrosion
2. **Corrosion Inhibitors** – Reduce internal corrosion and prevent the formation of harmful deposits.
3. **Non-Dig Pipe Cleaning** – Effectively removes tubercles and accumulated deposits.



What Happens When These Three Techniques Are Combined?

Applying cathodic protection, corrosion inhibitors, and non-excavation pipe cleaning simultaneously creates a preventive and corrective strategy that is far more affordable and sustainable than trenchless rehabilitation methods—while addressing the root causes of deterioration.

Key benefits of this integrated approach include:

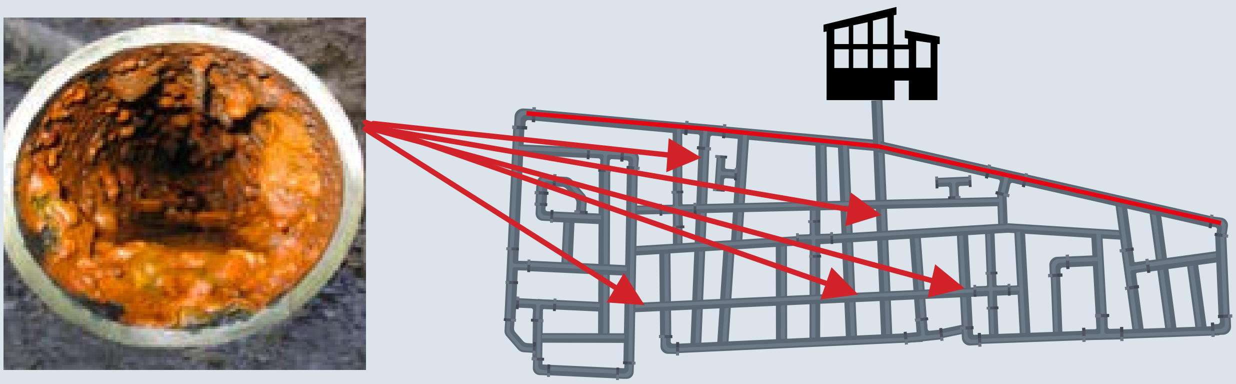
- **Optimized flow rates** and compliance with firefighting standards by restoring full hydraulic capacity.
- **Preservation and extension of service life** for cast iron mains, allowing them to function efficiently for decades.
- **Immediate and lasting improvement in water quality** by eliminating discoloration, enhancing disinfectant performance, and reducing the dissolution of lead and copper.
- **Significant reduction in maintenance and operating costs** through proactive management, fewer breaks and leaks, and lower pumping costs.
- **Effective recovery from decades of underfunding** by maximizing return on investment.
- **Long-term cathodic protection** against external corrosion (up to 50 years).
- **Environmental benefits** from extending useful life and reducing the need for heavy construction.

A concrete example:

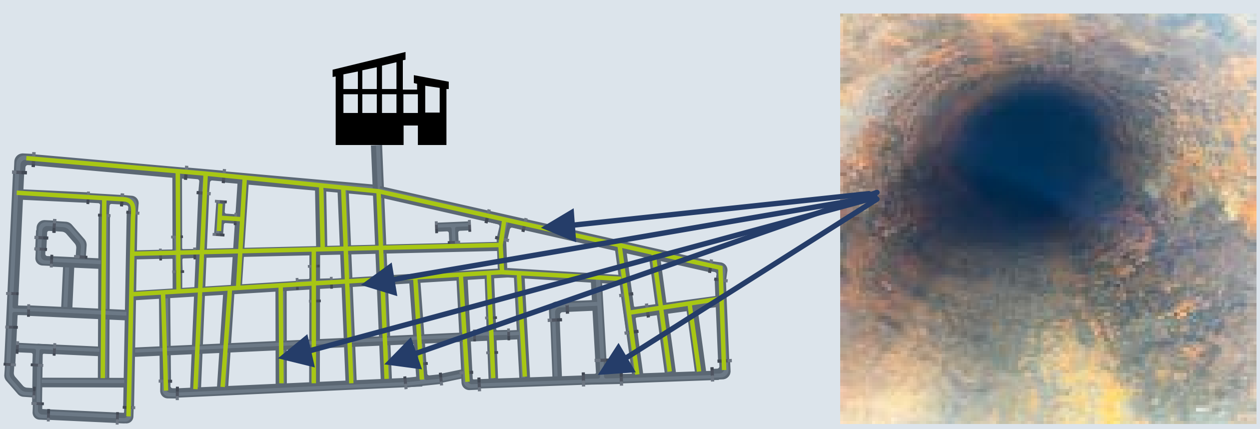
Instead of spending $2.5 M to replace 2,000 m of mains, the same budget can optimize 14,000 m of network—delivering a complete performance recovery, stopping internal corrosion, restoring Hazen-Williams coefficients, and preserving the structural integrity of cast/ductile iron.

Why settle for 2,000 m when you can optimize 14,000 m?

Replacing 2,000 meters
costs **$2,500,000**



Optimizing 14,000 meters
costs **$2,500,000**



Pragmatic Action Plan for Municipalities: Moving Toward Integrated Infrastructure Management

To successfully transition to an integrated infrastructure management approach, municipalities can follow this **four-step plan:**

1. Identify Critical Mains

Objective: Pinpoint the mains most vulnerable to corrosion in order to prioritize interventions.

Actions:

- Locate cast iron and ductile iron mains installed before 1975 using archive plans, GIS, and field surveys
- Assess their condition using inspection data (leaks, breaks, and maintenance history).

2. Chemical Optimization of Water with Corrosion Inhibitors Objective:

Objective: Adjust water treatment to reduce its aggressiveness and extend the service life of mains.

Actions:

- Characterize the quality of water distributed in at-risk zones (pH, alkalinity, hardness, temperature, etc.).
- Determine the Langelier Saturation Index (LSI) to assess whether the water is corrosive, scale-forming, or balanced.
- Formulate a customized corrosion inhibitor based on water composition and network materials—working in collaboration with a specialized laboratory or supplier.

3. Planning for Pipe Cleaning

Objective: Remove accumulated deposits, biofilms, and sediments to restore network performance.

Actions:

- Develop a structured cleaning plan, similar to a unidirectional flushing program, specifying:
  - Cleaning sequence
  - Start and end points
  - Target flow rate
  - Duration of operations
- Identify field equipment requirements:
  - Fire hydrants for nozzle and hose access
  - Distribution network valves to isolate sections for cleaning
  - Service connections to prevent deposits from entering residents' plumbing.

4. Plan for Cathodic Protection

Objective: Protect metallic mains against corrosion through impressed current systems.

Actions :

- Develop a cathodic protection plan detailing system scope, materials to be used, and expected lifespan.
- Verify the electrochemical continuity of metallic mains, as any discontinuity would compromise system efficiency.
- Identify optimal locations for current rectifiers (accessible, secure areas near the mains to be protected).

Conclusion

An Effective Recovery Plan for a Sustainable Network

In the face of chronic underfunding, the accelerated aging of cast/ductile iron mains, and increasing regulatory demands, network managers must rethink their strategies. This white paper presents a structured, proven, and economically viable approach built on the combination of three complementary techniques.

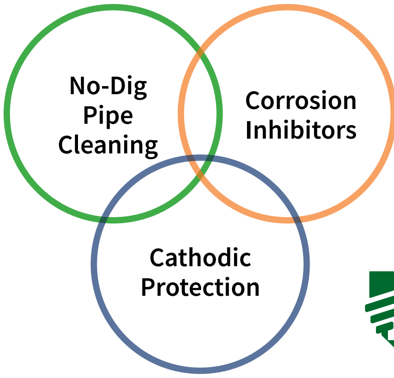
By leveraging non-excavation cleaning, corrosion inhibitors, and cathodic protection, it is possible to restore hydraulic capacity, extend the service life of mains, and protect water quality—without resorting to costly and invasive works. For the same budget as replacing a single kilometer of pipe, up to seven kilometers of network can be optimized.

Most importantly, by stopping both internal and external corrosion, it is as if time itself is halted: cast/ductile iron stops weakening, structural degradation is brought under control, and the network regains stability for decades to come.

A modern, sustainable strategy—ready for deployment.

Our Partners

SOLENO SERVICE



Environor
SOLENO GROUP MEMBER

TECHNO PROTECTION
LA CORROSION S'ARRÊTE ICI

This white paper draws upon a set of specialized and recognized sources, including:

Technical datasheet:
Clow Canada *– Technical datasheet: ductile iron pipes, consulted in 2023*

Websites:
DIPRA *– Ductile Iron Pipe Research Association, consulted March 2025*
PVCPIPE Association *– Official website, "Technical Resources" section, consulted March 2025*
France Environnement *– Official website, consulted March 2025*
Ministère des Affaires municipales et de l'Habitation *– Official website, consulted March 2025*
NPJ Clear Water *– Official website, consulted March 2025*
Webcorr *– The Corrosion Clinic, Official website, consulted April 2025*

Downloadable guide or report:
CERIU *– Technical guide for prolonging the integrity of cast iron mains, 2022*
CERIU *– Portrait des infrastructures en eau des municipalités du Québec (PIEMQ), 2023 edition*
Utah State University *– Water Main Break Rates in the USA and Canada (2023)*
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Personal communication or internal documentation:
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