# Managing Water Assets for the Long Term

Sam Ghosn, P.Eng

Thursday, November 13 (10:30 AM) – Salon D

# Principal Aspects: Drinking Water Systems

- Drinking water systems are used to provide service to users and communities. This can typically be described as :

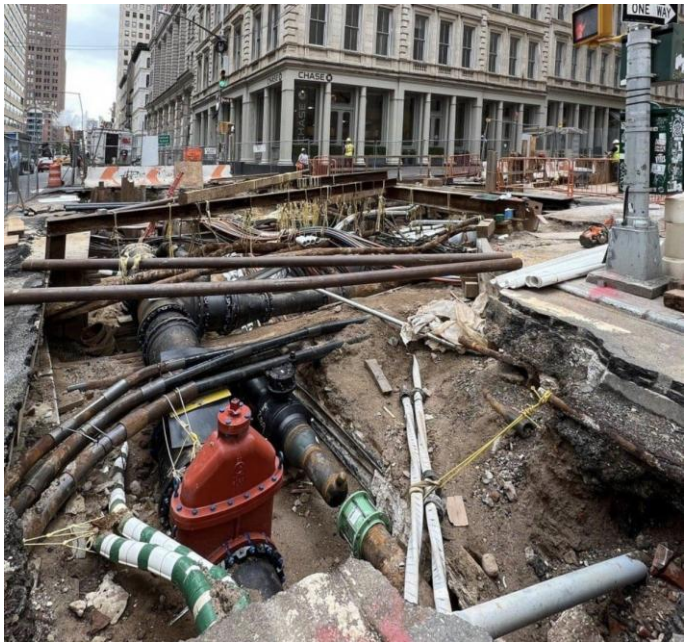
- Delivering of ***Safe Drinking Water*** in the required quality

- Supporting the fire Brigades with water for ***Firefighting***

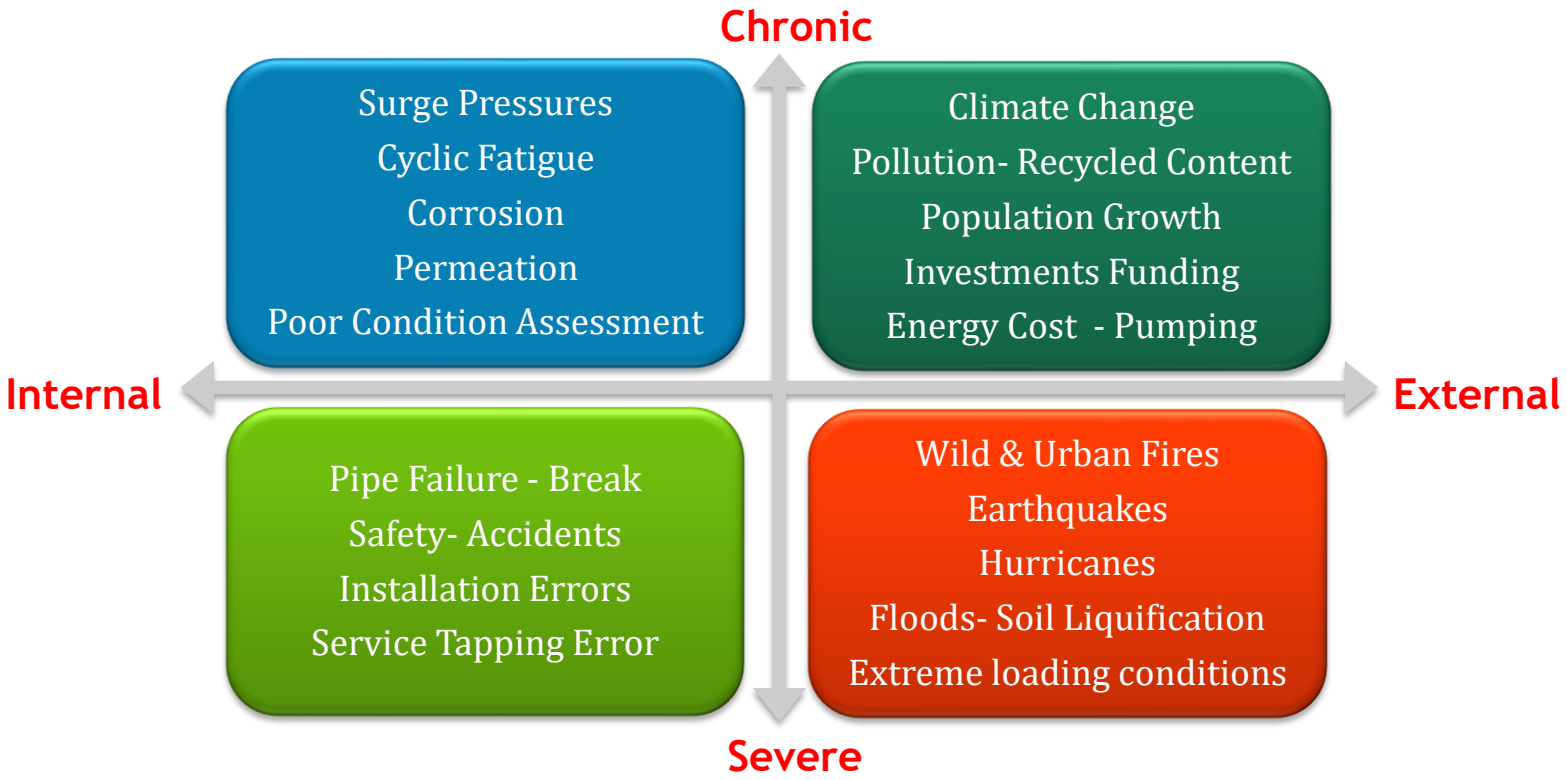
# Utilities - Could be Complicated !!

**Williams & Wall Sts. New York City, USA. 1915**


**New York City, USA. 2021**

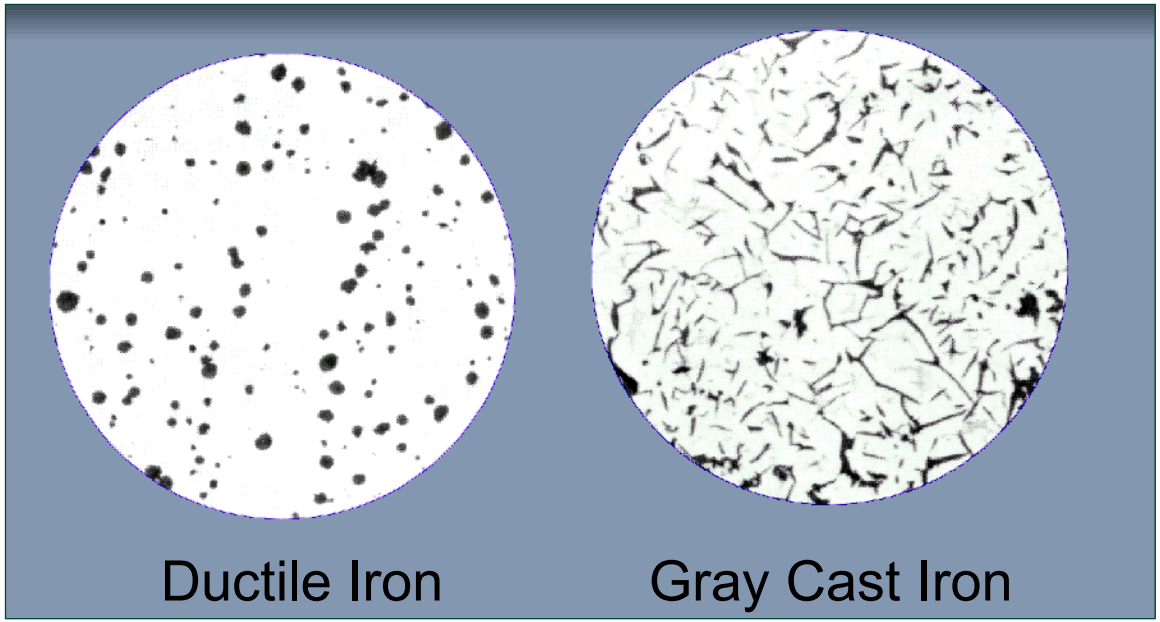


# Threats for Water Pipelines



# From CIP to DIP– What's the Difference ?

- Iron:
  Molten at 2,500° F
- Magnesium:
  Vaporizes at 2,050° F




1960'- Today

1850's- 1960's

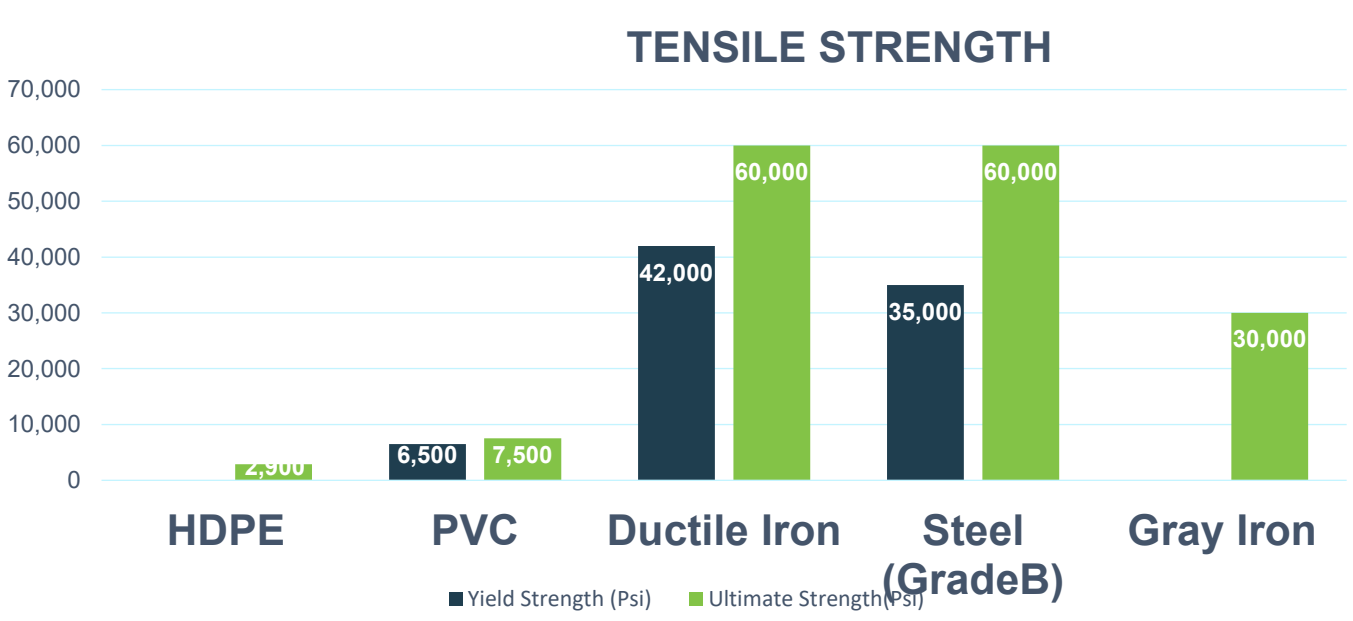
# How Modern DIP is Made ?

**Raw Material : + 95% Recycled Scrap Steel & Iron**

**Centrifugal Casting Process**

# Pipe Materials Comparative Strength

## Pipe Mechanical Properties





# Internal Corrosion – Unlined Iron Pipes

**Historical Problem :**

Internal Corrosion (Tuberculation) in Unlined Iron Pipe

**Solution:**

**Cement lining**

**Modern Ductile Iron Pipe**

# External Corrosion – Unprotected Pipes

**Corrosion will have an effect on…..**

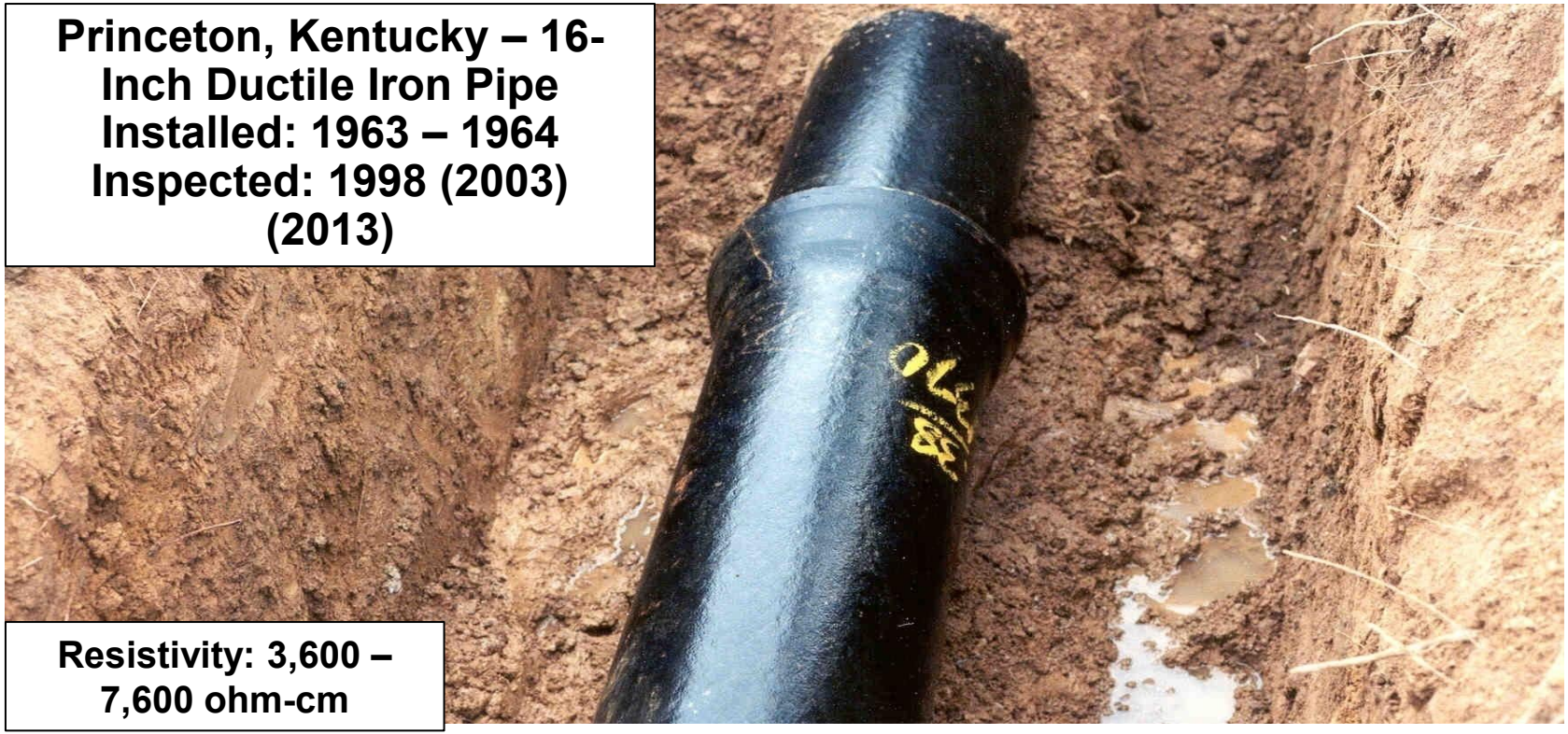
- **Cast Iron Pipe**
- **Ductile Iron Pipe**
- **Steel Pipe**
- **Concrete Pressure Pipe**
- **All metallic appurtenances or accessories used with Plastic Pipes (PVC, HDPE)**

**Common causes:**

- **Low-resistivity soils**
- **Anaerobic bacteria**
- **Dissimilar metals**
- **Differences in soil composition**
- **Differential aeration of the soil**
- **around the pipe**
- **Stray current from external sources**

# High Resistivity Soils – Unprotected Iron Pipe's Life Expectancy of +100 Yrs

**Princeton, Kentucky – 16-Inch Ductile Iron Pipe**
**Installed: 1963 – 1964**
**Inspected: 1998 (2003) (2013)**



**Resistivity: 3,600 – 7,600 ohm-cm**

# Ohm's Law

**The magnitude of the current is directly proportional to the driving potential and inversely proportional to the circuit resistance.**

$$I = \frac{E}{R}$$

$$\text{Current} = \frac{\text{Driving Potential}}{\text{Circuit Resistance}}$$

# DIP Coating – Polyethylene Encasement as Dielectric Barrier

ANSI/AWWA C105/A21.5-18
(Revision of ANSI/AWWA C105/A21.5-10)

American Water Works Association
*Dedicated to the World's Most Important Resource®*

AWWA Standard

Polyethylene Encasement for Ductile-Iron Pipe Systems

# Dig-up Investigations, Highly Corrosive Environments

**4-Inch**
**Cast Iron Pipe**

**Installed in**
**Lafourche Parish,**
**Louisiana**

**<u>Soil</u>**
**Resistivity: 320 ohm-cm**
**pH: 6.9**
**Redox: - 30 mV**
**Sulfides: Positive**
**Saturated**

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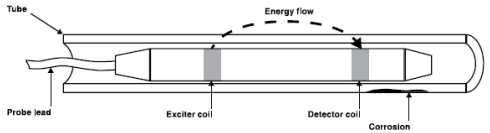
# Dig-up Investigations, Highly Corrosive Environments

# Condition Assessment Techniques

- CCTV Camera Inspection
- Visual Inspection
- Soil Corrosivity Surveys
- Acoustic Velocity Testing
- Electromagnetic Testing
- Ultrasonic Testing
- Metallographic Analysis

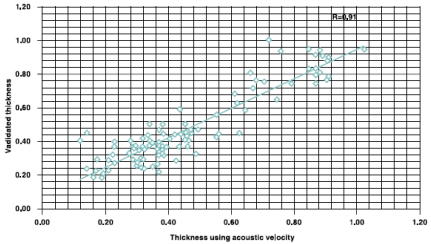
*Source:* Rock Solid Group

Figure 11-5 Example of a manually winched tool




Adapted with permission from PICA

Figure 11-7 Simple probe for remote field testing



# Data For Iron Pipe Networks

**Preliminary :**

**Criticality of the water main :** Low , Medium or High ?
**Failure Rate :** Number & frequency of breaks
**Age :** Installation date ?
**Pipe Material :** Grey or Ductile Iron ?
**Corrosion Protection :** PE, GA, CP, None ?
**Hydraulics :** Pressure and Flow rate ?
**Pipe wall Assessment :** Remaining thickness

**Soil :**

**Soil Resistivity**
**PH**
**Sulfides**
**Moisture**
**Chlorides**

**Inspection :**

**Leak Detection – Ultrasonic study**
**Type of break**
**Visual Inspection**
**Corrosion Pit depth**

# Decision Making

REPAIR

REHAB

REPLACE

NEW INSTALLATION

# Decision Making : Repair and Asset Life Extension

## Leak Repair Clamps

## Galvanic Anodes

# Decision Making:
# Clean and Rehab Unlined Cast Iron Pipes

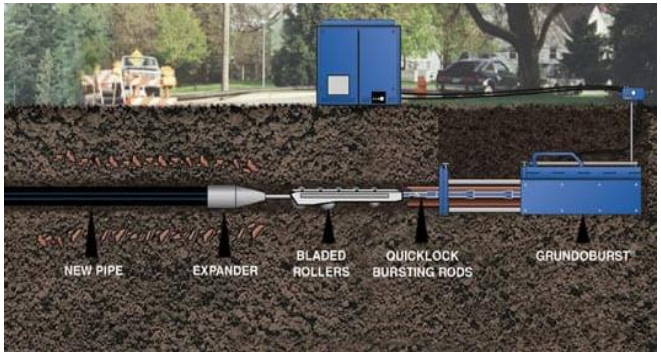
## Cured-In-Place Pipe Lining

## Clean, flush and Cement or Epoxy lining

# Decision Making:
# Replace - Open Cut or Trenchless

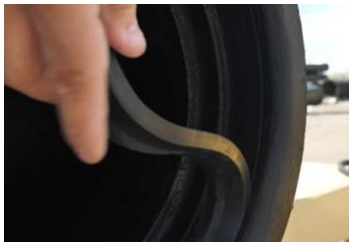
## Open Cut

## Trenchless Technologies
## Pipe Bursting with HDD



# New Installations – Design Considerations

- Size, Length, and Thickness Design For Ductile Iron Pipe
- Type of Joints, Lining, Gaskets, etc.
- Soil Conditions
  Corrosion Control Design Decision Model
- Proper Installation Monitoring and Inspection



**+100 YEARS OF SERVICE**

# DIP Joints Deflection

## Push on Joint

Deflection up to 5°

## Mechanical Joint

Deflection up to 8°

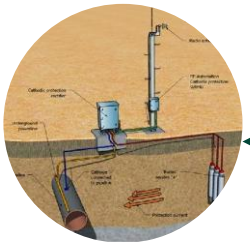
## TR-Flex® Joint

Deflection 1.5°–5°

# Decision Making: Corrosion Control Selection – DDM®

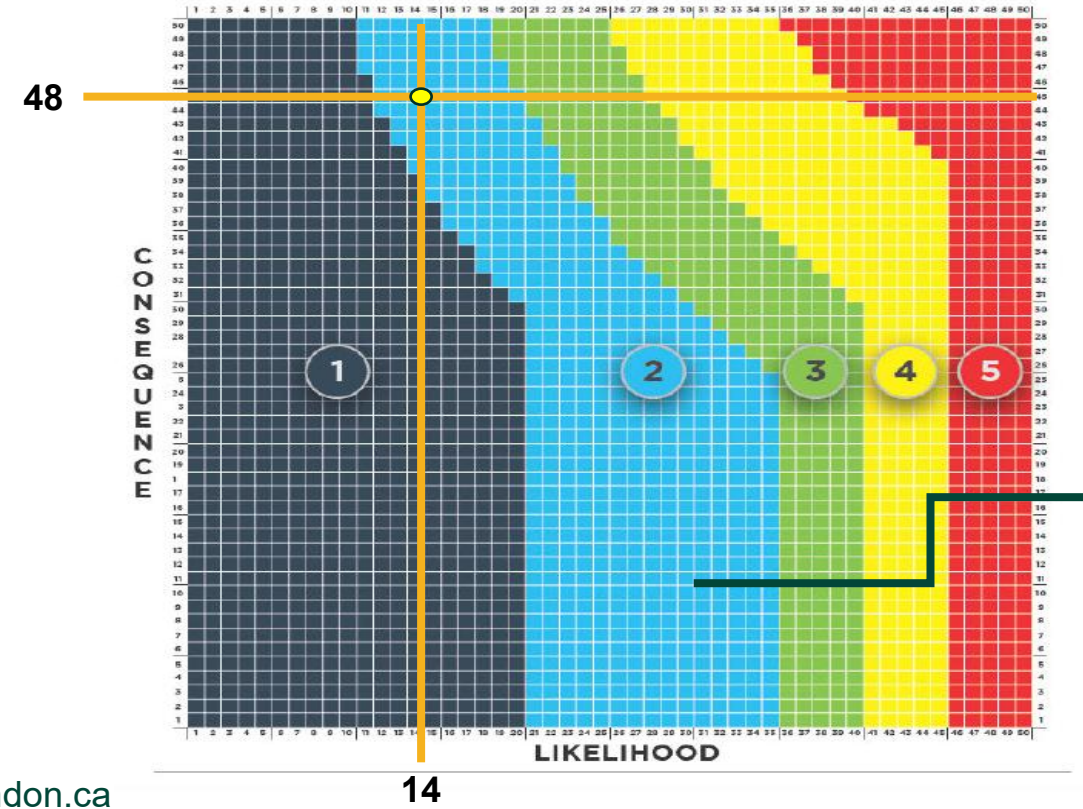
- Risk Based Approach
- Assess the Likelihood of Corrosion through Soil Analysis
- Assess the Consequence of a failure through Criticality of watermain

# Decision Making:
# Corrosion Control Selection – DDM®



| Recommendations | |
|---|---|
| 1 | As Manufactured with Shop Coat |
| 2 | V-Bio® Enhanced Polyethylene Encasement |
| 3 | V-Bio® Enhanced Polyethylene Encasement, or<br>V-Bio® Enhanced Polyethylene Encasement with Joint Bonds |
| 4 | V-Bio® Enhanced Polyethylene Encasement with Metallized Zinc Coating, or<br>V-Bio® Enhanced Polyethylene Encasement with Life Extension Cathodic Protection |
| 5 | V-Bio® Enhanced Polyethylene Encasement with Metallized Zinc Coating, or<br>V-Bio® Enhanced Polyethylene Encasement with Cathodic Protection |

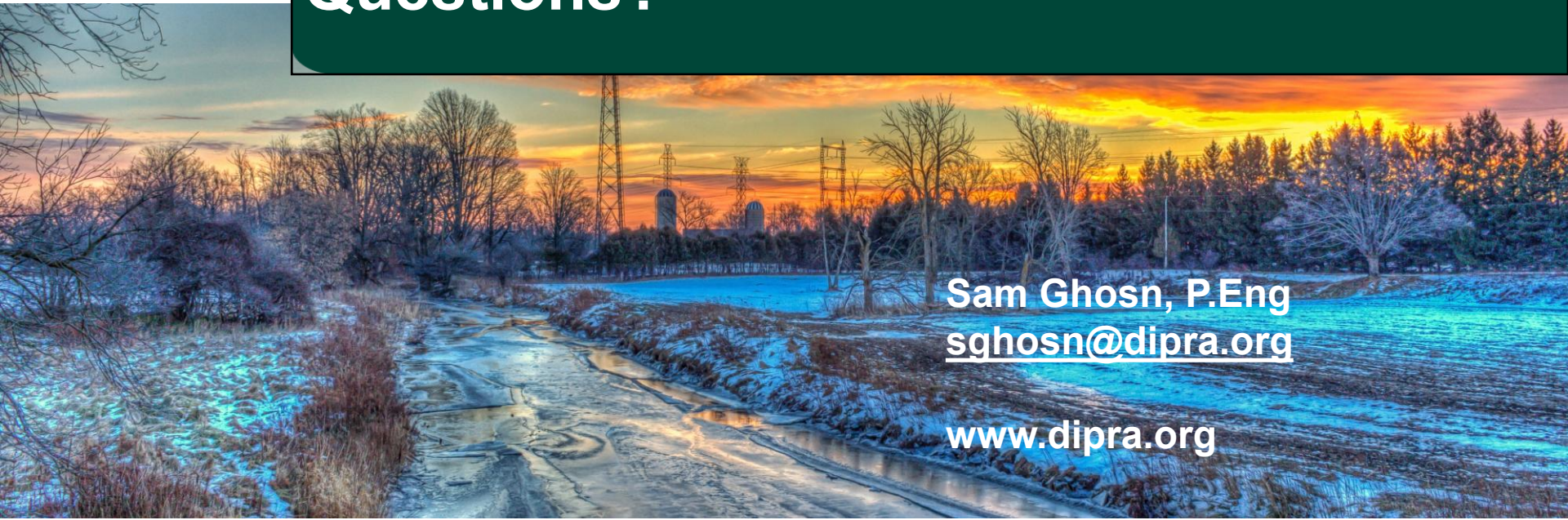

# Decision Making Example
# Corrosion Control Selection – DDM®




# Tapping Ductile Iron Pipe – No Saddles Required

Laboratory Tests

# Questions?



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