

#### Northeastern Ontario Water Works Conference



North Bay Ontario, May 16-17



# Managing 100 year old Pipeline

A City of Hamilton Case Study

### The City of Hamilton

- Population of over 500,000 (2016)
- 5th most populous municipality in ON (10th largest in Canada)
- Part of the 'Golden Horseshoe'; i.e. GTA-H (2011 census of 7.2M)
- Roots date back to the war of 1812
- Aging infrastructure
- Change in identity (from heavy industrial to more diverse)
- Resurgence of the down-town core
- Aging Infrastructure!



#### The Beach Rd 900mm diameter Watermain

- Installed in 1912
- Potable water transmission main
- Woodward High Lift Pumping Station (1856 – 1859) to the City's PD1
- PD1 supplies a mix of residential, industrial, commercial customers
- Arcelor Mittal-Dofasco is an influential customer and within PD1
- Due to age and development, the 900mm Beach Rd main is in very congested area.
  - roads (industrial routes)
  - plant access
  - layers of buried utilities (crossings)
  - rail





#### Opportunity

Start here...



### **Critical Watermain Management Program**

Aka. Opportunistic Watermain Inspection and Sampling Protocol

#### When?

- Planned capital work
- Road or culvert work
- Plant works
- Valve replacement
- Main break\*

Why?

- Low cost, low effort
- Takes advantage of other scheduled works "piggy-backing"
- Builds coordination among municipal Public Works departments





#### **Beach Road Watermain: Step 1**

- Communication with Capital Group
- Opportunity to inspect came via a scheduled 900mm tee tie-in.
- Line valves for ISO did not hold
- A second opportunity to inspect came via 'stopple' location
- Exposed pipe at 2 discrete locations
- Q) what inspection / assessment technique will provide most information while taking advantage of these current works?





The COH hired a third-party consultant to perform soil & pipeline material analysis

- Soil bedding and backfill corrosivity
- Pipeline material property testing





Site 1: Soil Bedding & Backfill





Site 2: Soil Bedding & Backfill





Site 1: pipeline material sample





Site 2: pipeline material sample





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Site 1:

Moderately Corrosive

Sample Type	Soil Parameter	Value	Degree of Corrosivity
Backfill	Chloride	130 ppm	Mildly Corrosive
	рН	8.2	Non-Corrosive
	<b>Electrical Resistivity</b>	1851 ohm-cm	Mildly Corrosive
	Sulphate	200 ppm	Negligible
	Chloride	260 ppm	Moderately Corrosive
Podding	рН	8.1	Non-Corrosive
Bedding	Electrical Resistivity	1408 ohm-cm	Corrosive
	Sulphate	400 ppm	Negligible



Site 2:

\*Moderately Corrosive

Sample Type	Soil Parameter	Value	Degree of Corrosivity
Backfill	Chloride	310 ppm	Moderately Corrosive
	рН	8.3	Non- Corrosive
	Electrical Resistivity	1298 ohm-cm	Mildly Corrosive
	Sulphate	400 ppm	Negligible
Bedding	Chloride	330 ppm	Moderately Corrosive
	рН	10.2	None (alkaline)
	Electrical Resistivity	952 ohm-cm	Corrosive
	Sulphate	4200 ppm	Negligible



- **Site 1**: **•** 3" coupon from live-tap
  - Measurement & scratch test
  - No third-party lab

From the as-built drawings provided by the City it was determined that this portion of the WM was installed in 1912. The working pressure in the watermain was measured on site to be approximately 80 psi. Looking at the AWWA 1908 Standard for Cast Iron Watermains found in Appendix B, a 36" Class C 130 psi pipe was required to have a thickness of 1.36". From the measurement shown in Figure 8 of approximately 1.44" (3.6 cm), the thickness of the pipe is greater than the 1908 Standard, however it is not uncommon for old pit cast iron to have a large variance in wall thickness. An approximate 3/16" thick cement mortar liner was applied on the interior pipe surface to protect the pipe from corrosion based on the date of installation the cement mortar was most likely installed sometime after the pipe was installed. In addition to the cement mortar liner, an approximate 1/16" film of sediment (brown area in Figure 8) was found to have built up in the pipe after the cement mortar liner installation was completed.



Site 1:

In additional to taking a core sample at the Tire Site, a scratch test was also completed to inspect the exterior surface of the WM. Upon completion of the scratch test there were no signs of any surface degradation presence on the outer surface (i.e. no material broke or scraped off).



#### Site 2:

- Thickness measurements
- Metallographic examination
- Thickness variance from 34mm to 45mm (11mm)
- Minimal pitting on both internal and external surfaces





#### Site 2:

- Cross-sections were prepared in accordance with ASTM E3-11
- Little to no surface corrosion
- Little to no pitting
- Thickness measurements in accordance with the original design
- Mortar lining that was installed in 1960's was holding up









#### **Step 2: Leak Detection**

- Known leakage, but undefined extent
- Observed soil moisture, some evidence at ground level
- Suspected joint leakage (age related)
- Lead joint seals





#### **Leak Detection**

#### **Correlator results:**

- 3 leaks reported
- 1 discovered during repair
- All at joints, all repaired using bellend clamp





#### **Turning Point**

Actionable Information...







### **Condition Assessment Table**

Study	Known	Unknown	Goal (Answers)
1. Soil	Corrosivity levels	<ul> <li>Satisfied*</li> </ul>	<ul> <li>Are soil conditions deleterious to pipe wall?</li> </ul>
2. Material property	<ul> <li>Actual wall thicknesses</li> <li>Extent of visible corrosion</li> <li>Material property (quality of manufacturing)</li> </ul>	<ul> <li>Satisfied*</li> </ul>	<ul> <li>What's left of this pipe after 105 years?</li> <li>Is pipe wall holding up?</li> <li>Do we need to budget for replacement?</li> </ul>
3. Leakage	<ul> <li>Leaks are present at joint locations</li> </ul>	• Extent?	<ul> <li>What rehabilitation options are on the table?</li> <li>Abandon?</li> </ul>

\* "satisfied" due to favorable results (recognizing the small sample size). If results were unfavorable, more resources would have been allocated here, more samples taken.

#### In-Line, Free-Swimming Leak Location Technology



- Value in inspecting the entire line for complete leak assessment (extent)
- Inspection distance ~4km in a single run
- Leak and Gas Pocket information







#### **Tracking Locations:**



#### In-Line Leak Detection (SmartBall®) Results:

Table 1.2: SmartBall Inspection Results				
Acoustic Anomalies Characteristic of Leaks:	15			
Total Leak Volume (Approximate):	107 L/min			
Acoustic Anomalies Characteristic of Pockets of Trapped Gas:	0			
Duration of the Inspection:	2 hours and 46 minutes			
Average SmartBall Tool Velocity:	0.4 m/s			





#### In-Line Leak Detection (SmartBall®) Results:





#### In-Line Leak Detection (SmartBall®) Results:

· · · ·			Description of Leak
#8	273.8 metres after Drain Valve #HB21V008 (SBR 6 at 28+54)	Small (~1.8L/min)	Joint
#9**	339.8 metres after Drain Valve #HB21V008 (SBR 6 at 28+54)	Medium (~11.8L/min)	Suspected Feature (cross)
#10	497.7 metres after Drain Valve #HB21V008 (SBR 6 at 28+54)	Small (~1.9L/min)	Joint
#11**	514.9 metres after Drain Valve #HB21V008 (SBR 6 at 28+54)	Small (~4.2L/min)	Joint
#12	536.9 metres after Drain Valve #HB21V008 (SBR 6 at 28+54)	Medium (~7.9L/min)	Joint
#13**	<b>478.2 metres</b> before Air Valve #HB19V060 (SBR 8 / Extraction at 39+92)	Medium (~16.6L/min)	~2m before the ~80- deg Bend from Beach Rd onto Ottawa St N
#14**	<b>426.4 metres</b> before Air Valve #HB19V060 (SBR 8 / Extraction at 39+92)	Small (~4.5L/min)	Joint
<mark>#15</mark>	221.4 metres before Air Valve #HB19V060 (SBR 8 / Extraction at 39+92)	Small (~2.9L/min)	Joint





### Dig & Repair: Leak





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### Dig & Repair: Leak No.12



### Dig & Repair: Leak No.13





#### **Assessment to Action**

Extent known, now what?



#### **Actionable Information**

- Enough information (data collected and interpreted) to make decisions
- Continue to 'dig and fix' (6 fixed already, 12more to go, wait for more to come)



Abandon & Replace





#### Local Example: North Bay – Marshal Ave Forcemain





TECHNOLOGIES

#### Local Example: North Bay – Marsh



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#### **Local Example: Actionable information**



Figure 4.2: MAFM Pipeline Profile





## Thanks

Questions?

