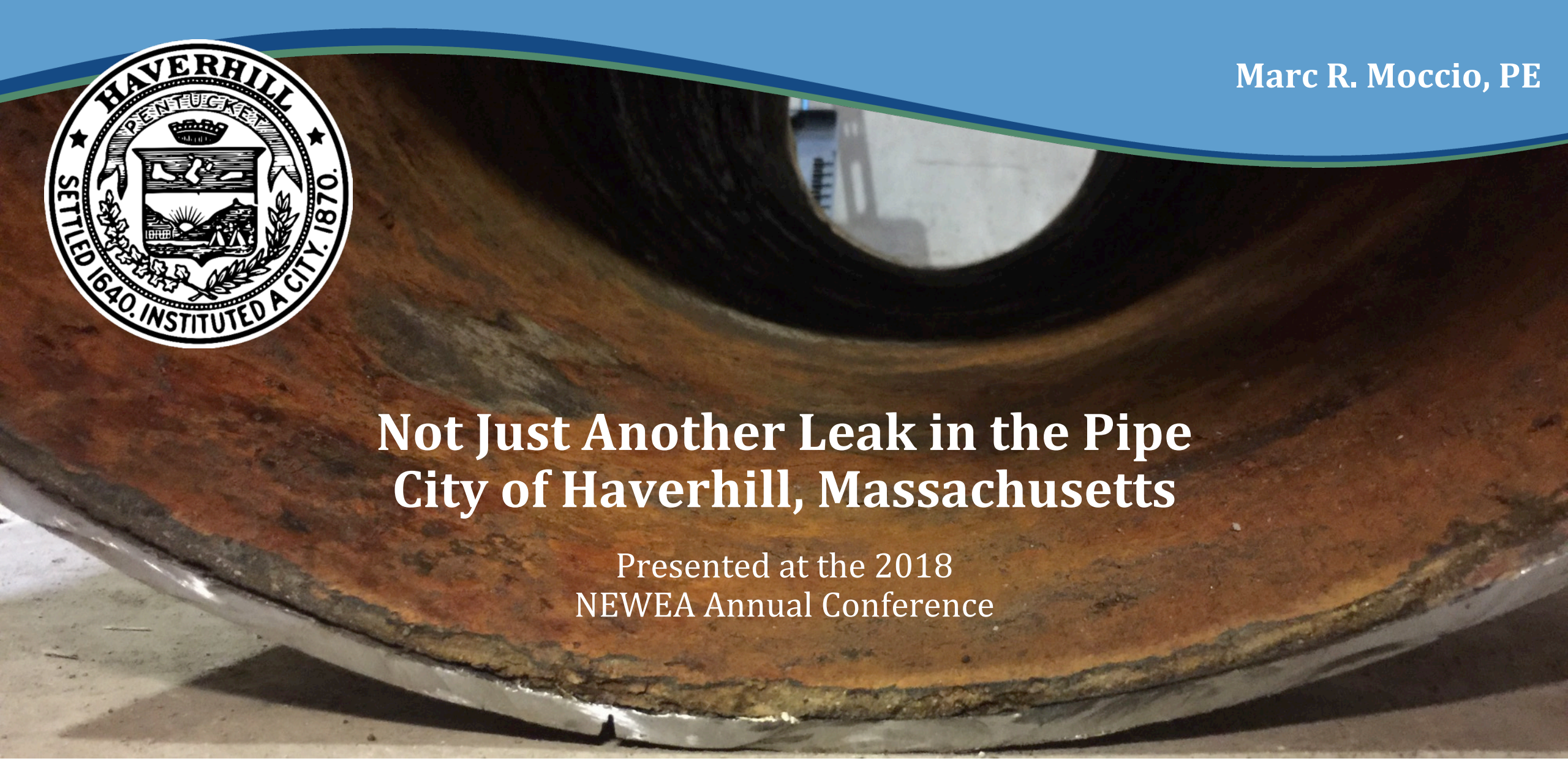
Marc R. Moccio, PE



Not Just Another Leak in the Pipe
City of Haverhill, Massachusetts

Presented at the 2018
NEWEA Annual Conference

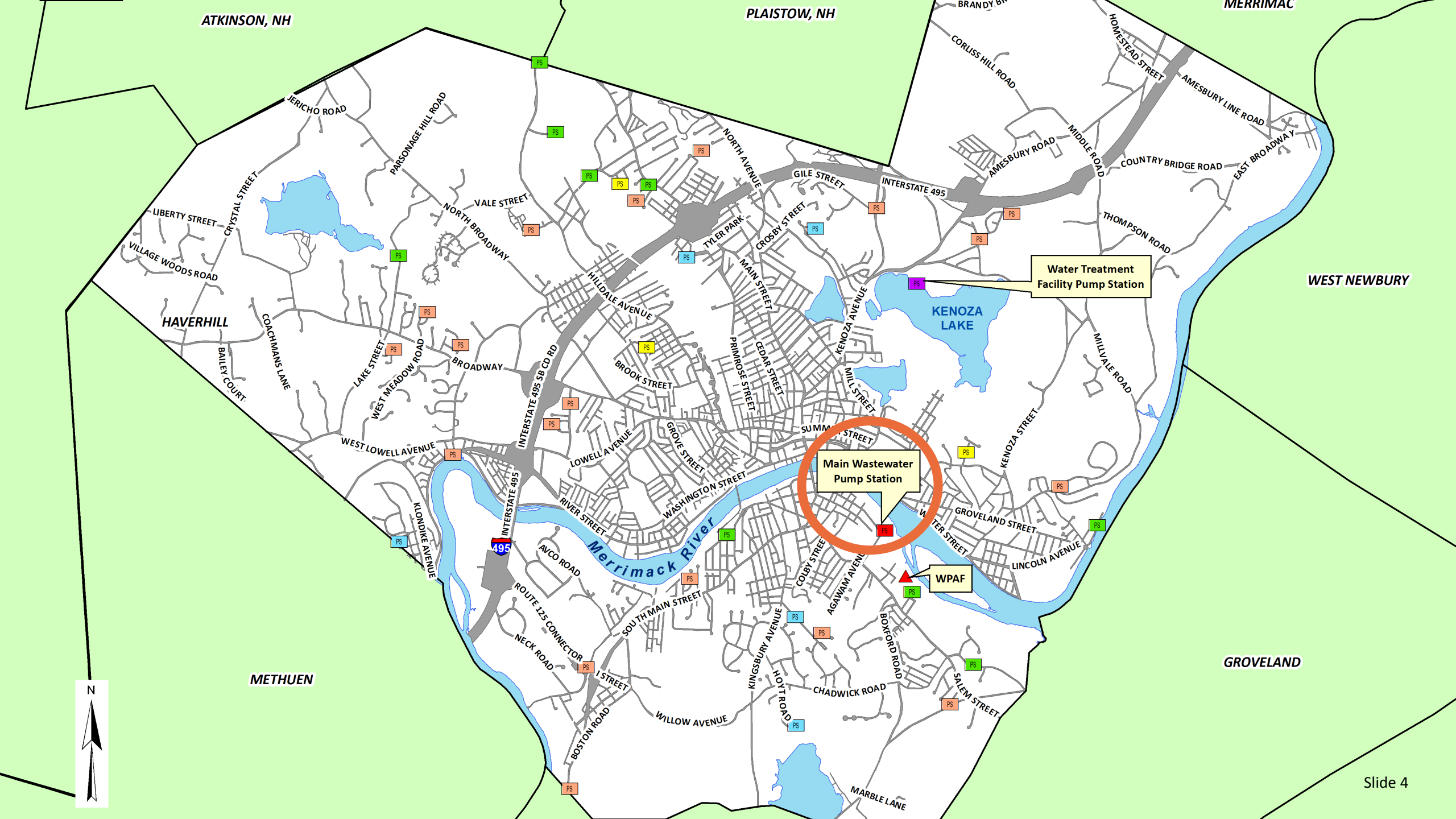
WRIGHT-PIERCE
Engineering a Better Environment

Introduction

- Background
- Main Wastewater Pump Station
- Challenges
- Investigation
- Solutions

Background

- City of Haverhill, Massachusetts
  - Population 60,879 (per 2010 census)
  - Area 35.6 sq. miles
- Collection System
  - 337 miles sewer/stormwater/combined
  - 36 Pump Stations
- Main Wastewater Pump Station
- Water Pollution Abatement Facility
  - Conventional Secondary Treatment Facility
  - Average 10 MGD/Peak 60+ MGD


ATKINSON, NH
PLAISTOW, NH
MERRIMAC
HAVERHILL
METHUEN
WEST NEWBURY
GROVELAND
KENOZA LAKE
Merrimack River
Water Treatment Facility Pump Station
Main Wastewater Pump Station
WPAF
JERICHO ROAD
PARSONAGE HILL ROAD
CRYSTAL STREET
LIBERTY STREET
VILLAGE WOODS ROAD
VALE STREET
NORTH BROADWAY
NORTH AVENUE
GILE STREET
INTERSTATE 495
TYLER PARK
CROSBY STREET
MAIN STREET
HILLDALE AVENUE
BROOK STREET
PRIMROSE STREET
CEDAR STREET
MILL STREET
KENOZA AVENUE
BAILEY COURT
COACHMANS LANE
LAKE STREET
WEST MEADOW ROAD
BROADWAY
INTERSTATE 495 SB CD RD
WEST LOWELL AVENUE
LOWELL AVENUE
GROVE STREET
WASHINGTON STREET
RIVER STREET
INTERSTATE 495
KLONDIKE AVENUE
AVCO ROAD
ROUTE 125 CONNECTOR
NECK ROAD
SOUTH MAIN STREET
I STREET
BOSTON ROAD
WILLOW AVENUE
KINGSBURY AVENUE
HOYT ROAD
CHADWICK ROAD
BOXFORD ROAD
SALEM STREET
COLBY STREET
AGAWAM AVENUE
MARBLE LANE
CORLISS HILL ROAD
HOMESTEAD STREET
AMESBURY LINE ROAD
AMESBURY ROAD
MIDDLE ROAD
COUNTRY BRIDGE ROAD
EAST BROADWAY
THOMPSON ROAD
KENOZA STREET
MILLVALE ROAD
GROVELAND STREET
LINCOLN AVENUE
WATER STREET
N


Main Pump Station
Water Pollution Abatement Facility
42" PCCP Force Main
SOUTH KIMBALL STREET
PEABODY STREET
CURTIS AVENUE
SALEM STREET
SOUTH PORTER STREET
MAYNARD STREET
ORCHARD HIL
FORD ROAD
VALLEYVIEW AVENUE
N
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Main Wastewater Pump Station

- Constructed in 1973
- Divided Wet Well with Influent Screening
- Four Vertical Non-Clog Pumps
  - 400 HP/712 RPM
  - Rated 13,860gpm (20 MGD)
- 2003 Upgrades

Force Main Piping

- Interior
  - Carbon Steel, Schedule 20, Cement-lined
  - Pump Discharge 24” Dia. (0.375” Thick)
  - Manifold 36” Dia. (0.500” Thick)
- Exterior
  - 42” Prestressed Concrete Cylinder Pipe (PCCP)
  - Approximately 3,000 linear feet

Main Wastewater Pump Station

24” DIA. DISCHARGE PIPING

36” DIA. HEADER

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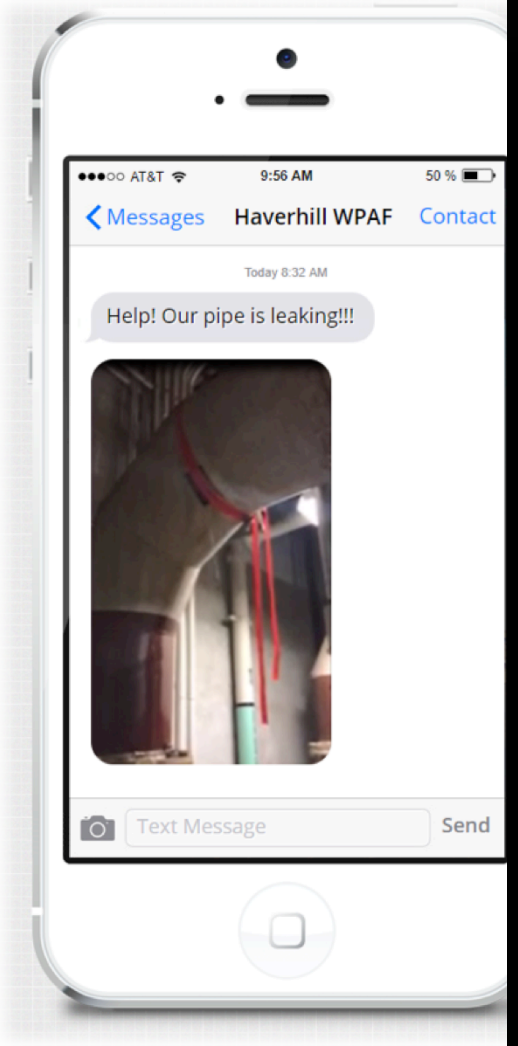
Help!



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Challenges

- Leak located on a mitered elbow joint
- No way to isolate
- Fix needed to be done quickly
  - Weld a patch?
  - Epoxy, rubber patch, ratchet strap?
- How extensive was the corrosion?

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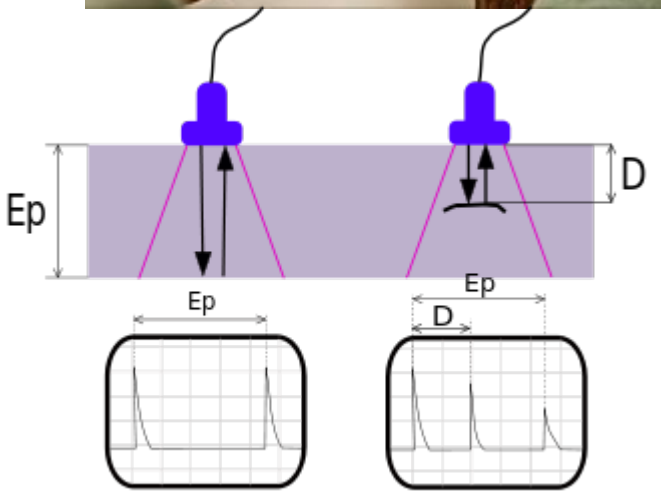
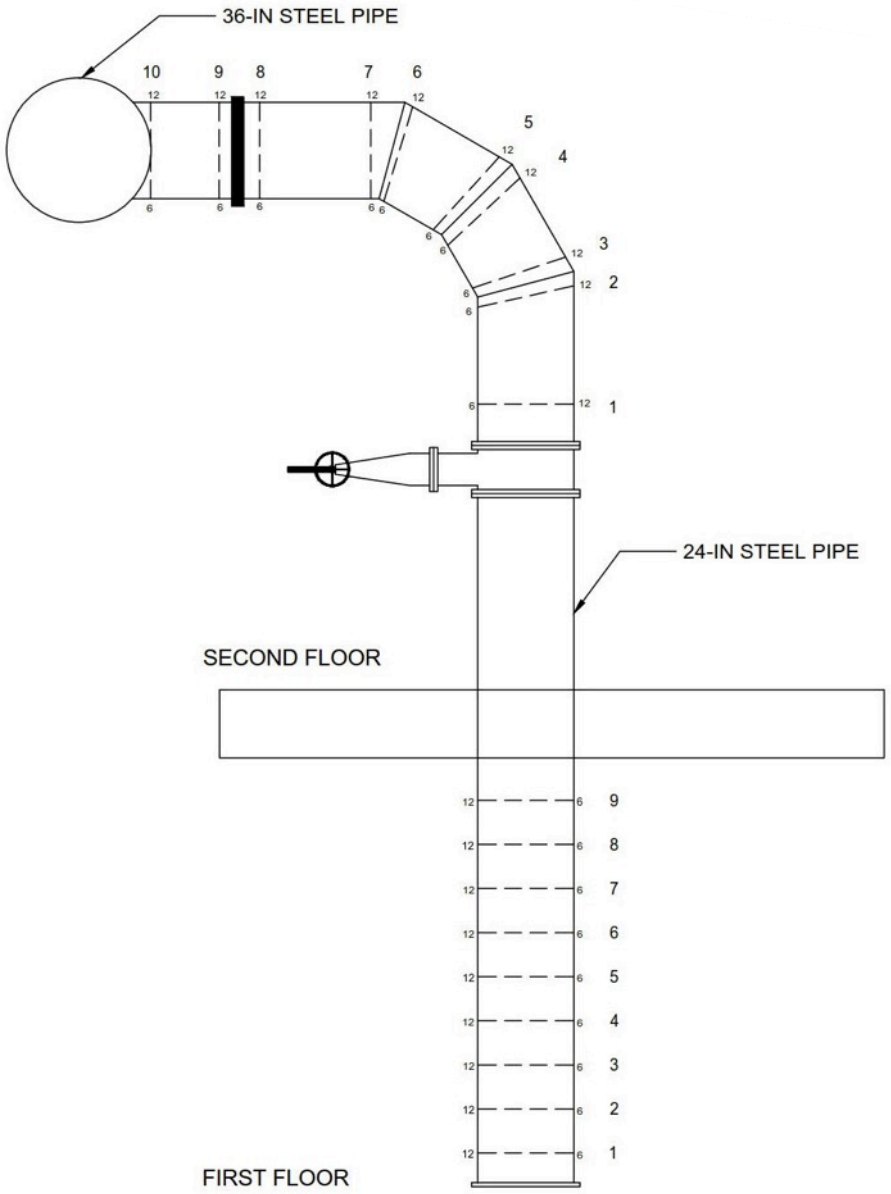
Investigation

- Determine the extent of corrosion
- Ultrasonic Thickness Testing
  - Non Destructive
  - Steel & Cement Lining Thickness
  - Full Inspection of 24” and 36” force mains
  - Two Technicians/Two Days

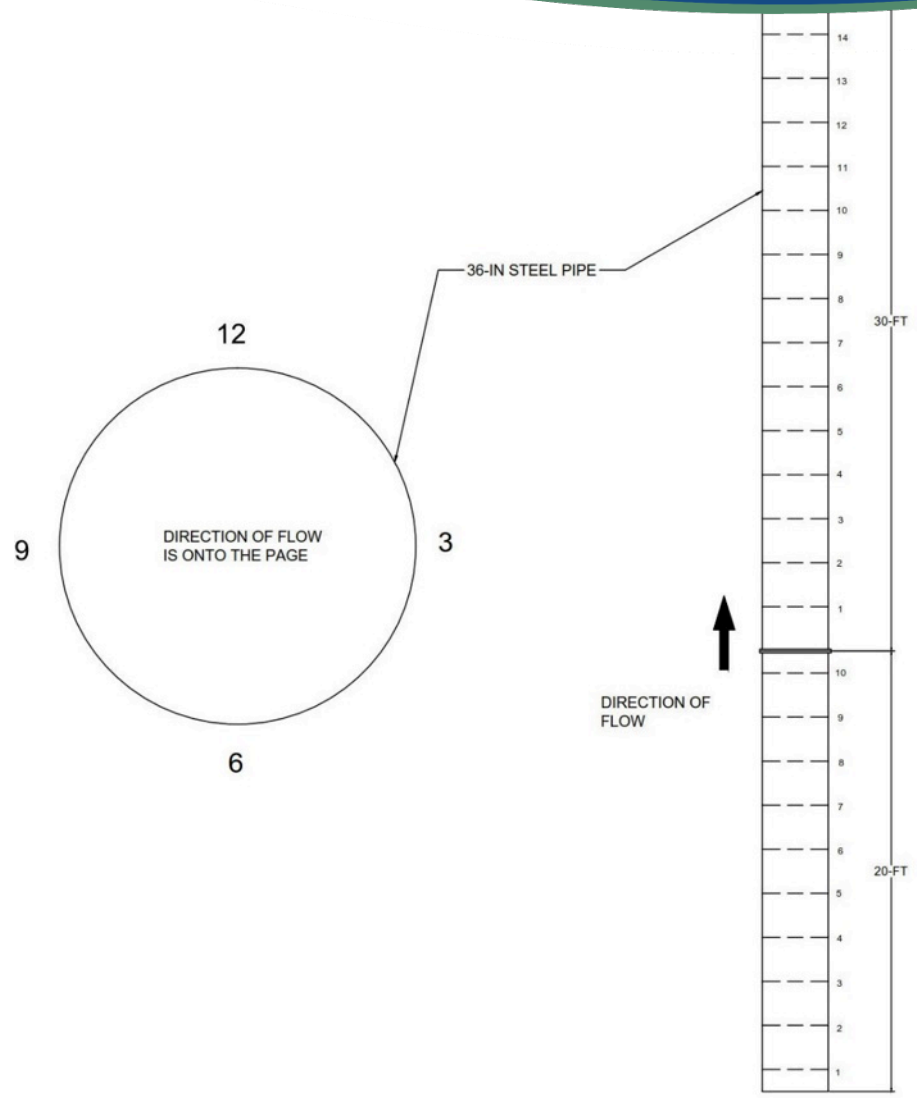
Danatronics Echo 9



Investigation



24” Piping Testing Locations



36” Piping Testing Locations

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Investigation

- Ultrasonic Testing Results
  - Extensive Corrosion Throughout Steel Piping System
  - Cement Lining Essentially Gone
  - Exposed Steel Throughout
- Increased Urgency

Investigation

Pump No. 2

Location	12:00	2:00	4:00	6:00	8:00	10:00	Average Thickness	Size	Nominal	Deviation*	Comment
1	301	312	293	277	296	294	296	24"	375	-21.20%	Vertical
2	298	281	282	276	280	310	288	24"	375	-23.24%	Vertical
3	284	295	292	296	266	293	288	24"	375	-23.29%	Vertical
4	282	293	268	304	286	267	283	24"	375	-24.44%	Vertical
5	290	289	256	305	290	301	289	24"	375	-23.07%	Vertical
6	293	291	294	283	279	298	290	24"	375	-22.76%	Vertical
7	302	269	256	282	290	276	279	24"	375	-25.56%	Vertical
8	288	274	277	316	305	268	288	24"	375	-23.20%	Vertical
9	304	306	280	319	290	282	297	24"	375	-20.84%	Vertical
1	275	255	276	283	277	283	275	24"	375	-26.71%	Vertical
2	275	285	305	258	250	268	274	24"	375	-27.07%	Vertical
3	245	262	267	251	254	261	257	24"	375	-31.56%	Elbow
4	280	270	264	266	272	258	268	24"	375	-28.44%	Elbow
5	261	256	271	246	251	231	253	24"	375	-32.62%	Elbow
6	248	258	258	233	221	266	247	24"	375	-34.04%	Elbow
7	471	466	448	472	473	473	467	24"	375	24.58%	Horizontal; Unknown Thickness
8	484	453	433	398	364	523	443	24"	375	18.00%	Horizontal; Unknown Thickness
9	508	515	486	391	454	522	479	24"	375	27.82%	Horizontal; Unknown Thickness
10	492	517	348	324	310	505	416	24"	375	10.93%	Horizontal; Unknown Thickness

*Thickness of Sch. 20 Pipe (375/1000 Inches) plus Specified Thickness of Cement Lining (125/1000 Inches) Results in a Original Deviation of 50%

Less than 50% Cement Lining Remains (Assume 125/1000 Inches Thickness)

Less than or Equal to 375/1000 Inches (Exposed Steel)

Solutions

Immediate

Short-Term

Long-Term

Immediate Solution

- More permanent fix for leak
- WP recommended a knitted fiberglass wrap with urethane resin
- Pipe retains its pressure rating
- Contractor, RH White, installed over the course of 1 day

"Oh no! Not again!"

Pump No. 2 develops a second leak!

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Pipe Replacement

- Pumps No. 2 and 4 Discharge Piping
- Ability to Isolate (Below 24” Gate Valve)
- Type of Pipe?
  - Ductile Iron
  - Carbon Steel
- Type of Lining?
  - Cement
  - Glass
  - Ceramic Epoxy

Short-Term Solution

- Bid August 2017
- Construction January 2018
  - Contractor: Kinsmen Corporation

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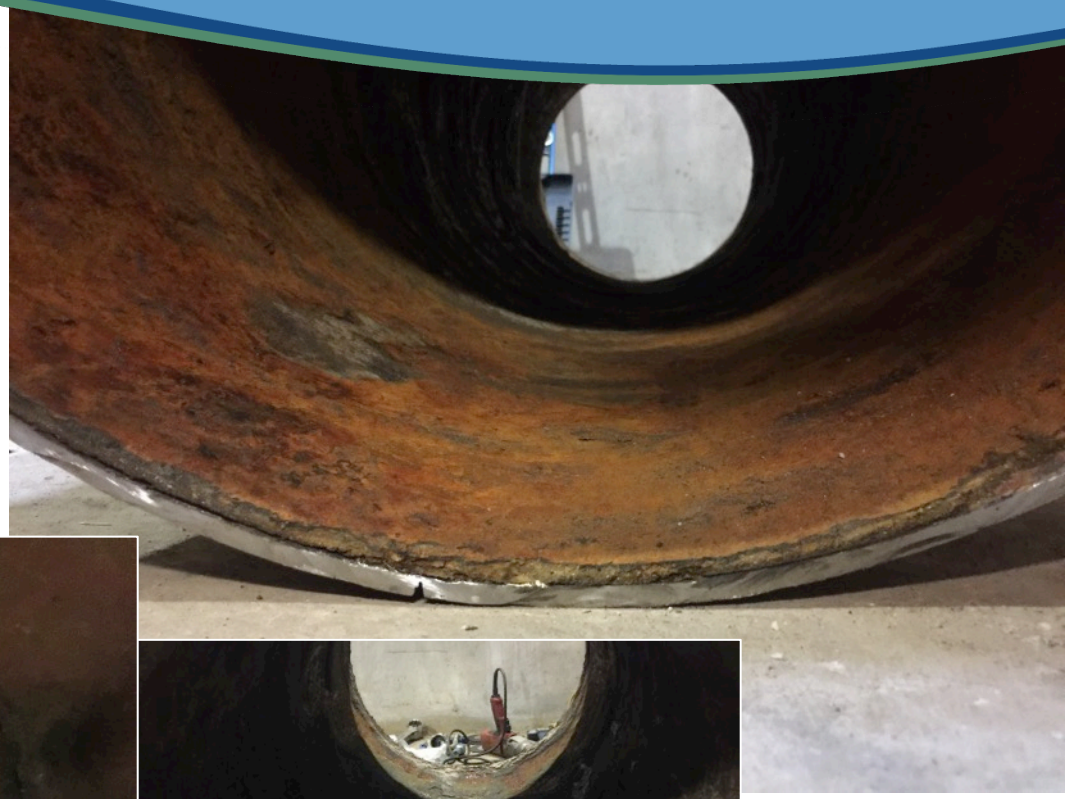
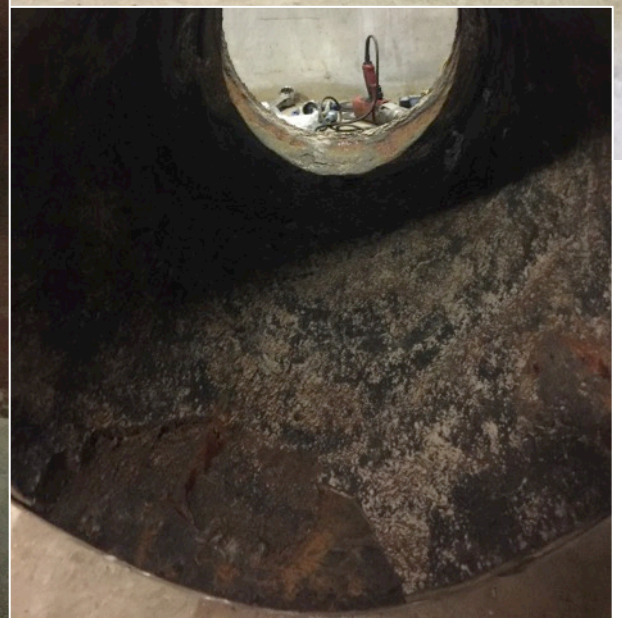
Short-Term Solution

Existing Pipe

- Discovery: 24” Pipe is actually Schedule 10 NOT Schedule 20
- 0.25” vs. 0.375”





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Short-Term Solution

Pump No. 2

Location	12:00	2:00	4:00	6:00	8:00	10:00	Average Thickness	Size	Nominal	Deviation*	Comment
1	301	312	293	277	296	294	296	24"	250	18.20%	Vertical - Replaced
2	298	281	282	276	280	310	288	24"	250	15.13%	Vertical - Replaced
3	284	295	292	296	266	293	288	24"	250	15.07%	Vertical - Replaced
4	282	293	268	304	286	267	283	24"	250	13.33%	Vertical - Replaced
5	290	289	256	305	290	301	289	24"	250	15.40%	Vertical - Replaced
6	293	291	294	283	279	298	290	24"	250	15.87%	Vertical - Replaced
7	302	269	256	282	290	276	279	24"	250	11.67%	Vertical - Replaced
8	288	274	277	316	305	268	288	24"	250	15.20%	Vertical - Replaced
9	304	306	280	319	290	282	297	24"	250	18.73%	Vertical - Replaced
1	275	255	276	283	277	283	275	24"	250	9.93%	Vertical
2	275	285	305	258	250	268	274	24"	250	9.40%	Vertical
3	245	262	267	251	254	261	257	24"	250	2.67%	Elbow
4	280	270	264	266	272	258	268	24"	250	7.33%	Elbow
5	261	256	271	246	251	231	253	24"	250	1.07%	Elbow
6	248	258	258	233	221	266	247	24"	250	-1.07%	Elbow
7	471	466	448	472	473	473	467	24"	250	86.87%	Horizontal; Unknown Thickness
8	484	453	433	398	364	523	443	24"	250	77.00%	Horizontal; Unknown Thickness
9	508	515	486	391	454	522	479	24"	250	91.73%	Horizontal; Unknown Thickness
10	492	517	348	324	310	505	416	24"	250	66.40%	Horizontal; Unknown Thickness

*Thickness of Sch. 10 Pipe (250/1000 Inches) plus Specified Thickness of Cement Lining (125/1000 Inches) Results in a Original Deviation of 50%

Less than 50% Cement Lining Remains (Assume 125/1000 Inches Thickness)

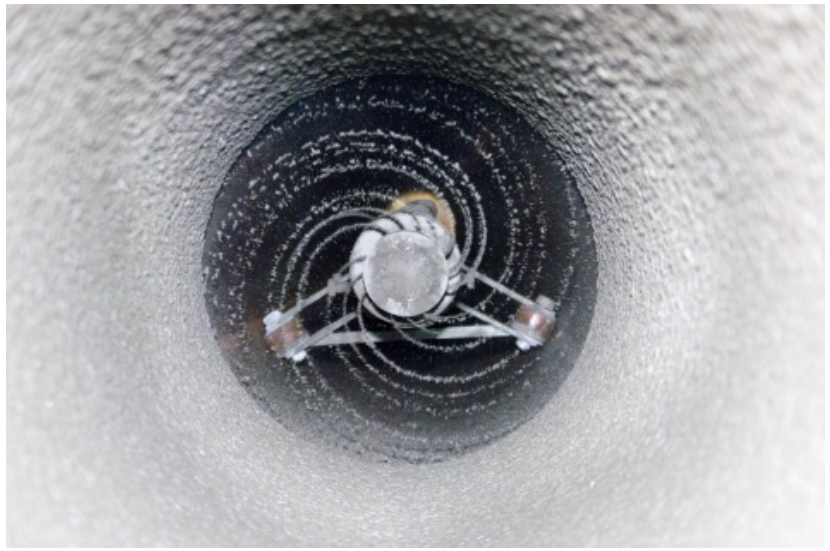
Less than or Equal to 250/1000 Inches (Exposed Steel)

Overall Station – Pipe Evaluation

- Ductile Iron vs. Carbon Steel

Overall Station Evaluation

- Interior Lining



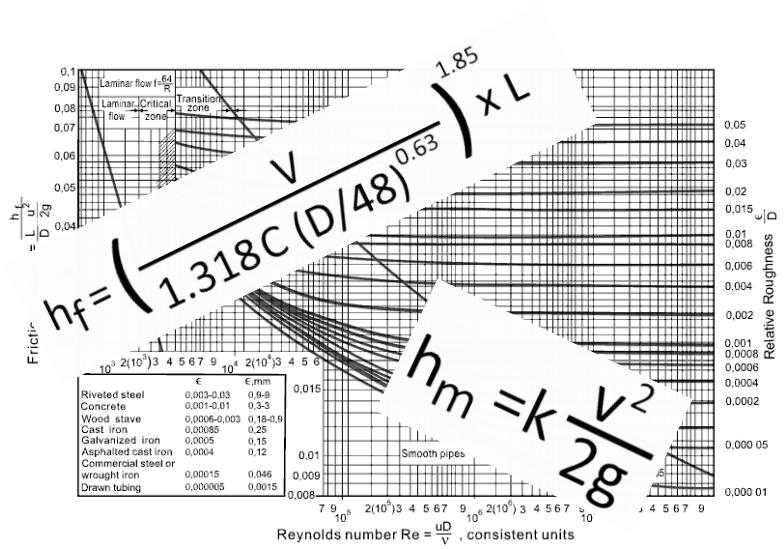
Cement

Glass

Ceramic Epoxy

Overall Station – Pipe Evaluation

- Increased Flexibility
  - Isolation Capabilities
  - Additional Flange/Grooved Coupling Joints
- Hydraulic Evaluation



Overall Station – Bypass Evaluation

- Temporary Bypass Pump and Piping Setup
  - Previous Experience (Mother's Day Storm of 2006)
  - Diesel Pumps and HDPE Piping Cross Country to WPAF

Long-Term Solution

Overall Station – Bypass Evaluation

- Permanent Bypass Pump Connections
  - Suction Connection at Modulating Gate Structure
  - Discharge Connection into 42” PCCP Force Main
- Cost Saving Measures
  - Potential use of City-Owned Diesel Pumps
  - Pre-purchase HDPE Piping

Summary

- Not Just Another Leak in the Pipe
- Reactive and Proactive
- Short-and Long-Term Planning
- Effectively Budget

Acknowledgements

OWNER

Robert Ward
Deputy DPW Director

Fred Haffty
Facility Manager

Paul Jessel
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Bruce Constantino
Maintenance Supervisor

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Kinsmen Corporation

RH White

ENGINEER

Kevin Olson, PE
Senior Project Manager

All of the Wright-Pierce Team!

Marc R. Moccio, PE

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