Condition Assessment of Metallic Force Mains

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Agenda

- Problems with inspecting force mains
- Remote Field Testing Overview
- Introduction of the See-Snake
- PICA Deliverables
- Gull Lake inspection
- Results

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Problems with inspecting force mains

- Very difficult to take out of service due to lack of redundancy
- Pump cycles restrict consistent flows
- Leaks get clogged up with effluent
- Access
- Very messy
- Not a lot of experience – gravity has a lot

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Managed inspections in:

- New Castle County DE
- Calgary
- Winnipeg
- Halton Region
- Gull Lake, MI

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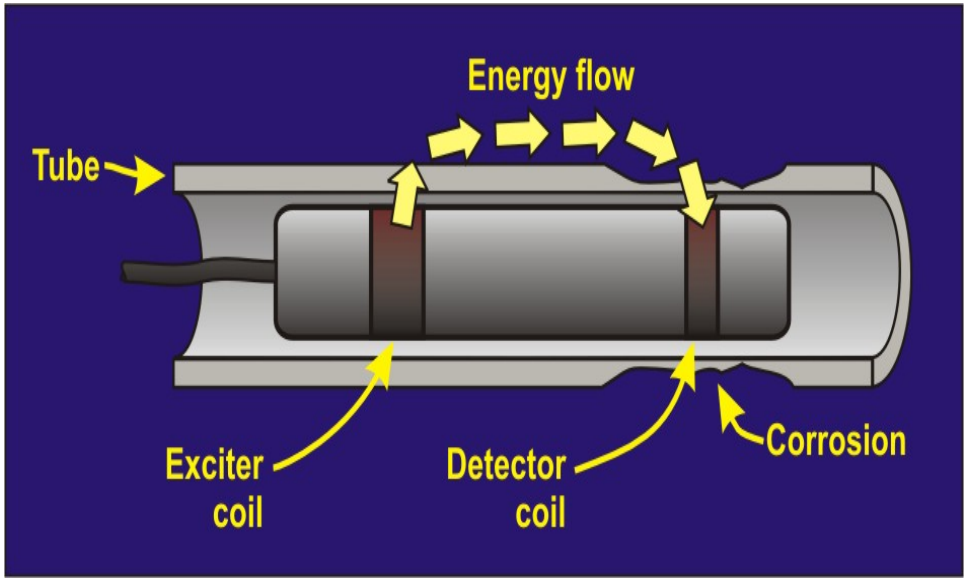
Remote Field Technology

- Proven technology to locate actual remaining wall-thickness
- Identifies localized pitting or cracks
- Allows for “spot repairs or replacement”
- **Can see through liners**
- **Can navigate 90° bends**



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Remote Field Technology

- Equipped with an exciter module that emits an AC electromagnetic field.
- Energy field passes through the pipe wall, travels along the longitudinal axis, re-enters the pipe and is received by a detector array.
- Each detector in the array measures the wall thickness, creating a colour map of the pipe integrity.

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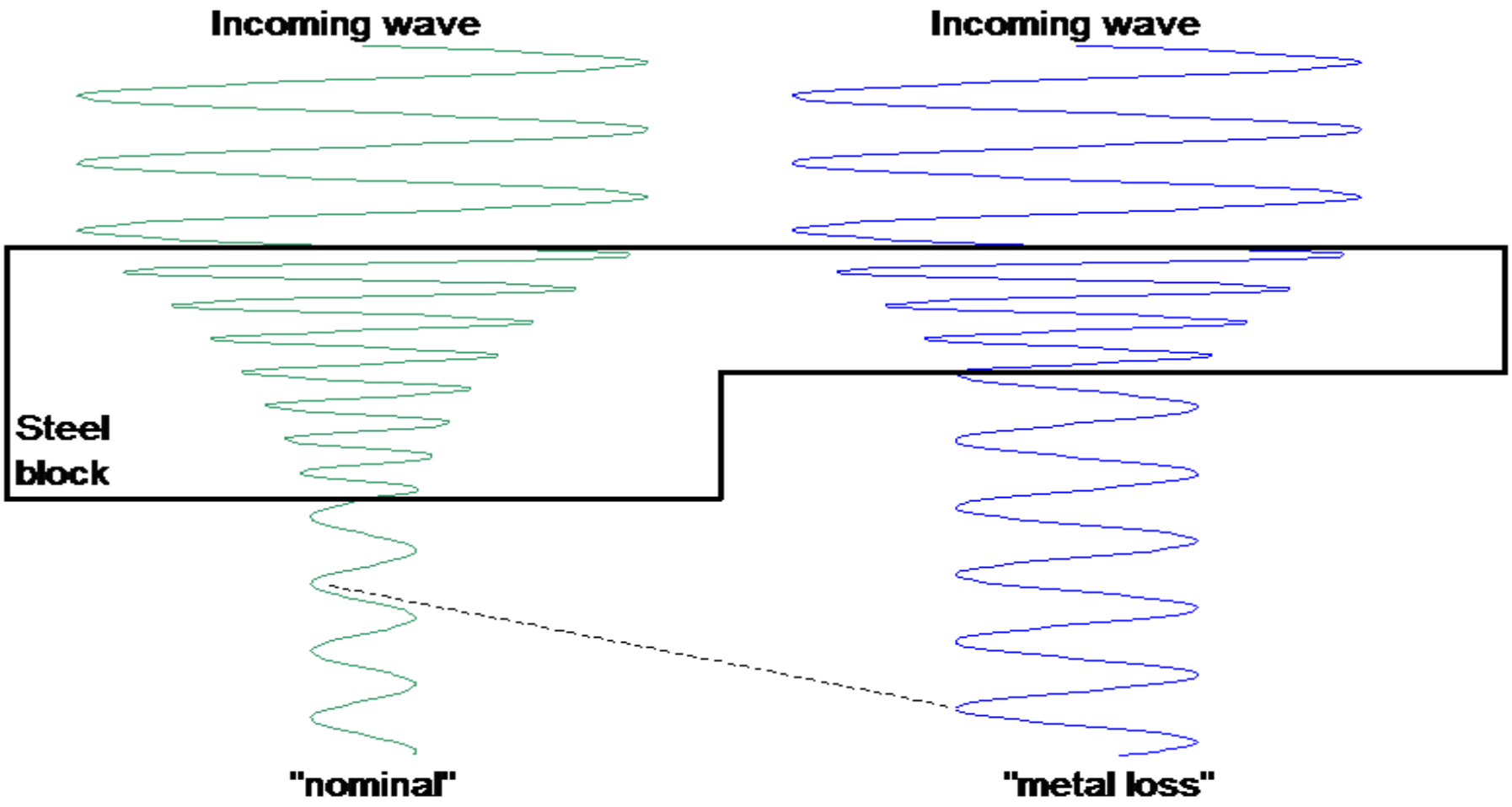
Through-transmission
Wave attenuation and phase shift



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Strip chart Display & Phase-Amplitude Diagrams

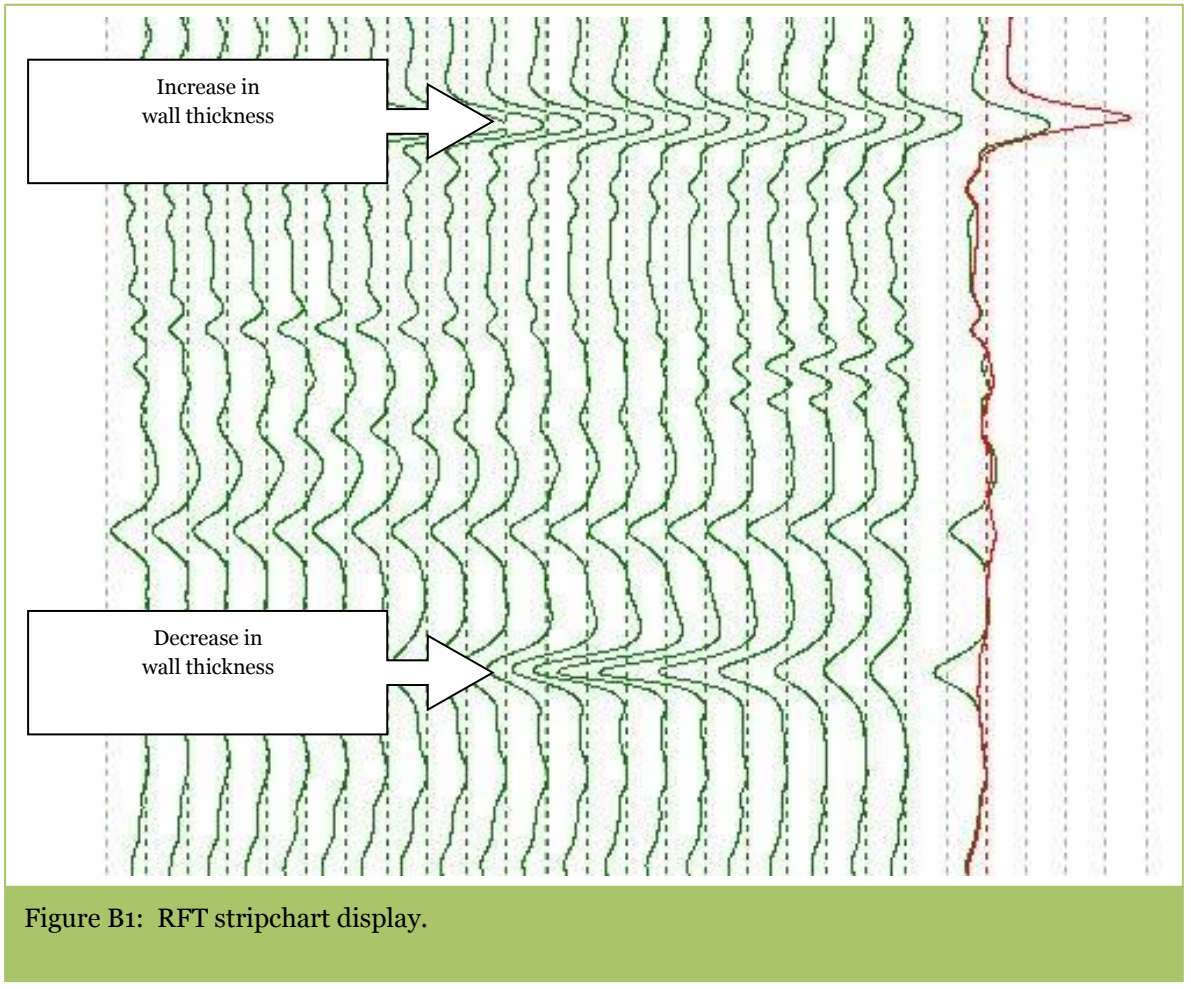

Figure B1: RFT stripchart display.

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See Snake

- Can be used on any ferrous material (Ductile, Cast and Steel)
- Available in tethered and free-swimming
- Can navigate 90 ° (up to 270° bends in total tethered) – unlimited free-swimming
- **Ductile and Cast lined pipe = “sweet spot”**
- Separate water and wastewater tools
- In use since 1992 (AWWA pilot)

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PICA Deliverables

What you get in the final report

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Final Report

- Bar graph of each pipe segment that identifies:
  - average remaining wall thickness, circumferential wall thickness (max and min) and wall loss
- Pit distribution along axis and depth
- Pit distribution by clock position
- Excel spreadsheet of each pipe segment listing:
  - Pipe location (start and finish), average remaining wall thickness, areas of wall loss

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Wall loss terminology

- Average pipe wall thickness (or NWT)
- Circumferential wall thickness
- Average remaining wall thickness
- Areas of wall loss (pitting)

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Average Pipe Wall Thickness

- Wall thickness that would occur by recasting the existing metal on the pipe barrel so that is uniform across the axial length.
- Can vary up to ±15% due to manufacturing.
- Variations outside the normal 15% spread can be an indicator of a different pipe type, aggregate pitting or general wall loss.

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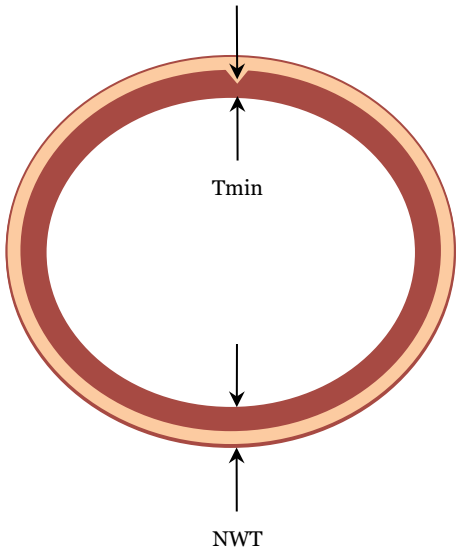
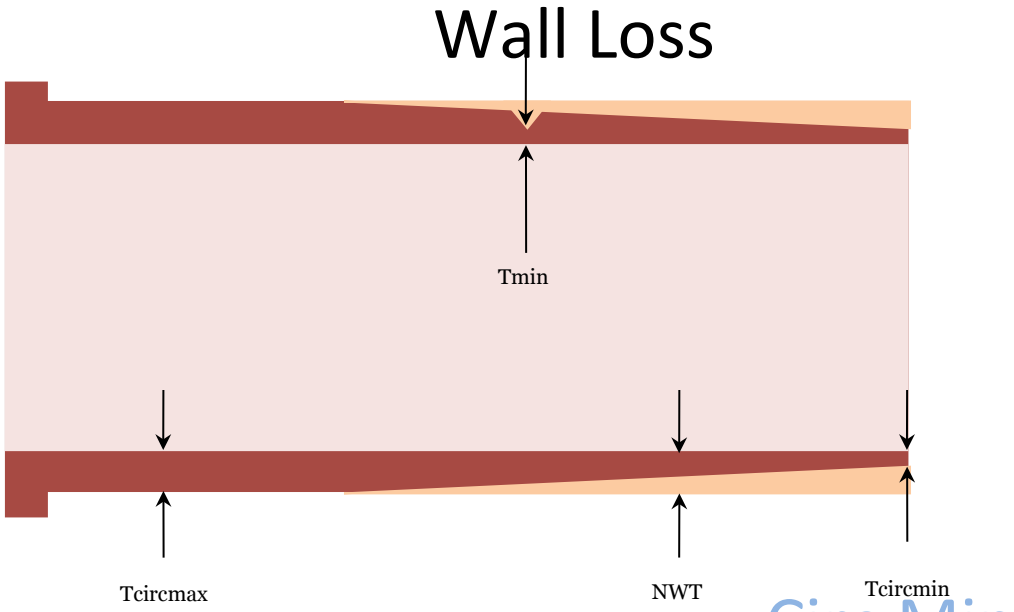
Wall loss terminology displayed



NWT



Circ Max

Circ Min

Figure A.1 Wall loss terminology

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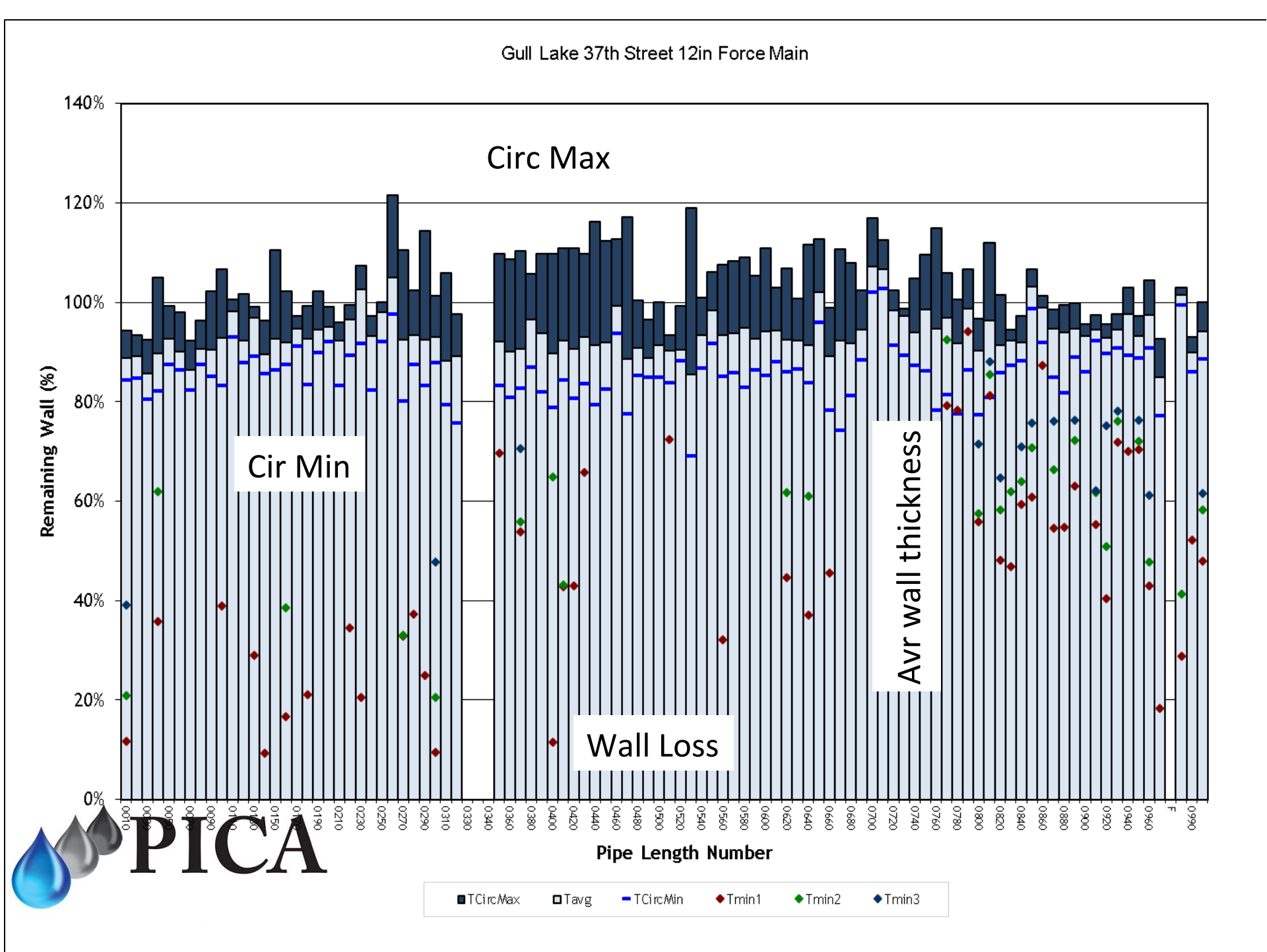
Gull Lake 37th Street 12in Force Main
Circ Max
Cir Min
Wall Loss
Avr wall thickness
Remaining Wall (%)
140%
120%
100%
80%
60%
40%
20%
0%
Pipe Length Number
TCircMax
Tavg
TCircMin
Tmin1
Tmin2
Tmin3
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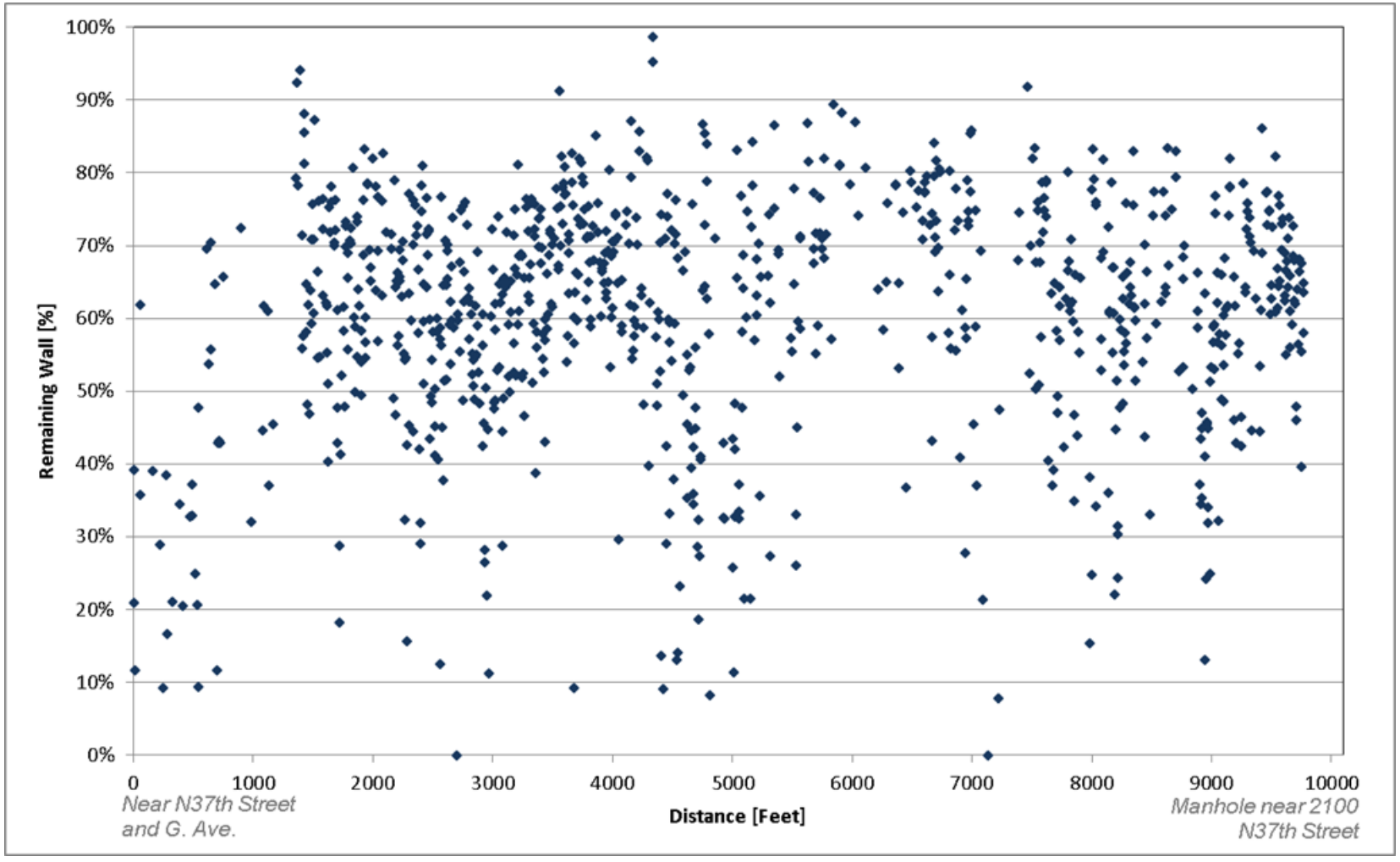
Pit distribution



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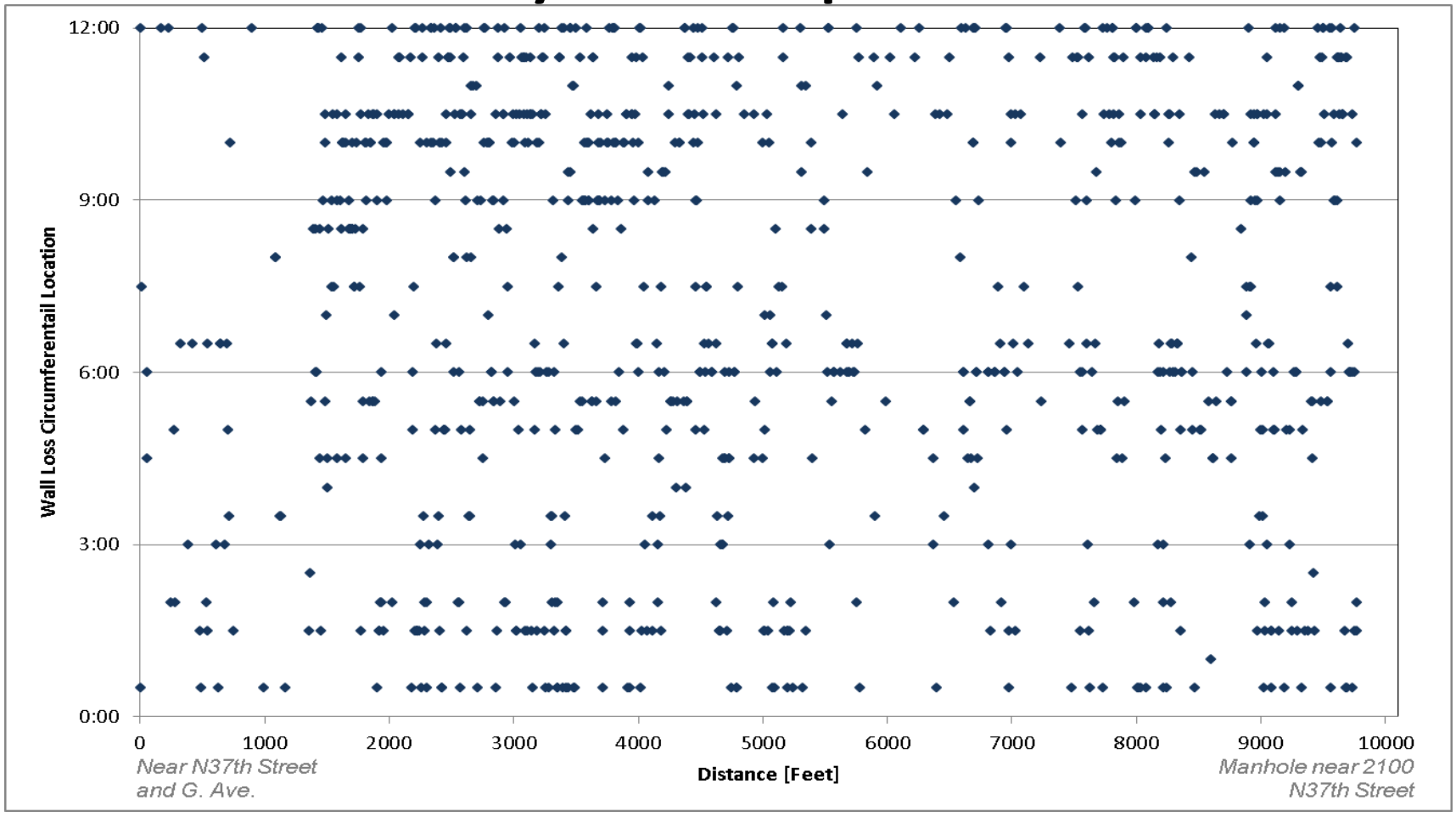
Pits by clock position



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Pipes 1 - 20

Pipe Number	Pipe Location			Tavg RW (%)	Circumferential Wall Thickness		Local Wall Thickness *Clock positions are referenced with a North to South persepective (ie 3:00=West, 9:00=East).								
							Tmin1			Tmin2			Tmin3		
	Start Location [ft]	End Location [ft]	Length [ft]		Tcircmax RW [%]	Tcircmin RW [%]	RW (%)	Location [ft]	Clock Position	RW (%)	Location [ft]	Clock Position	RW (%)	Location [ft]	Clock Position
0010	0.00	15.27	15.27	89%	94%	84%	12%	9.73	7:30	21%	0.74	0:30	39%	1.70	12:00
0020	15.27	33.42	18.15	89%	93%	85%									
0030	33.42	51.60	18.18	86%	92%	81%									
0040	51.60	69.74	18.14	90%	105%	82%	36%	54.78	4:30	62%	57.08	6:00			
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0150	251.79	269.89	18.10	93%	111%	86%									
0160	269.89	288.18	18.29	92%	102%	87%	17%	283.64	2:00	38%	273.96	5:00			
0170	288.18	306.38	18.20	95%	97%	91%									
0180	306.38	324.57	18.19	93%	99%	83%	21%	323.64	6:30						
0190	324.57	342.76	18.19	94%	102%	90%									
0200	342.76	360.95	18.19	95%	99%	92%									

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Wall loss terminology

- Pipe wall average thickness
- Circumferential wall thickness
- Nominal wall thickness
- Pitting

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Pipe Average Wall Thickness

The wall thickness that would occur by recasting the existing metal on the pipe barrel so that is uniform across the axial length. The average pipe wall can vary up to ±15% due to manufacturing. Variations outside the normal 15% spread can be an indicator of a different nominal wall thickness or pipe type, or a point towards a problem like aggregate pitting or general wall loss.

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Circumferential Wall Thickness

Metal loss that is uniform in depth around the pipe's circumference at a given axial location. The "maximum" circumferential wall thickness (Tcircmax) indicates the thickest circumferential wall thickness for a single pipe while the "minimum" circumferential wall thickness (Tcircmin) indicates the thinnest.

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Nominal Wall Thickness (NWT):

The thickness of the pipe wall where there is assumed to be no corrosion or circumferential wall loss (i.e.: 100% RW). Normally, a manufacturer will designate a NWT or NWT range (in mm or inches) for a specific pipe material, diameter and class.

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Pitting

Localized corrosion of a metal surface that is confined to a point or small area. Up to the three deepest pitting regions in each pipe are provided in this report as Tmin1, Tmin2, Tmin3.

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Wall loss terminology displayed

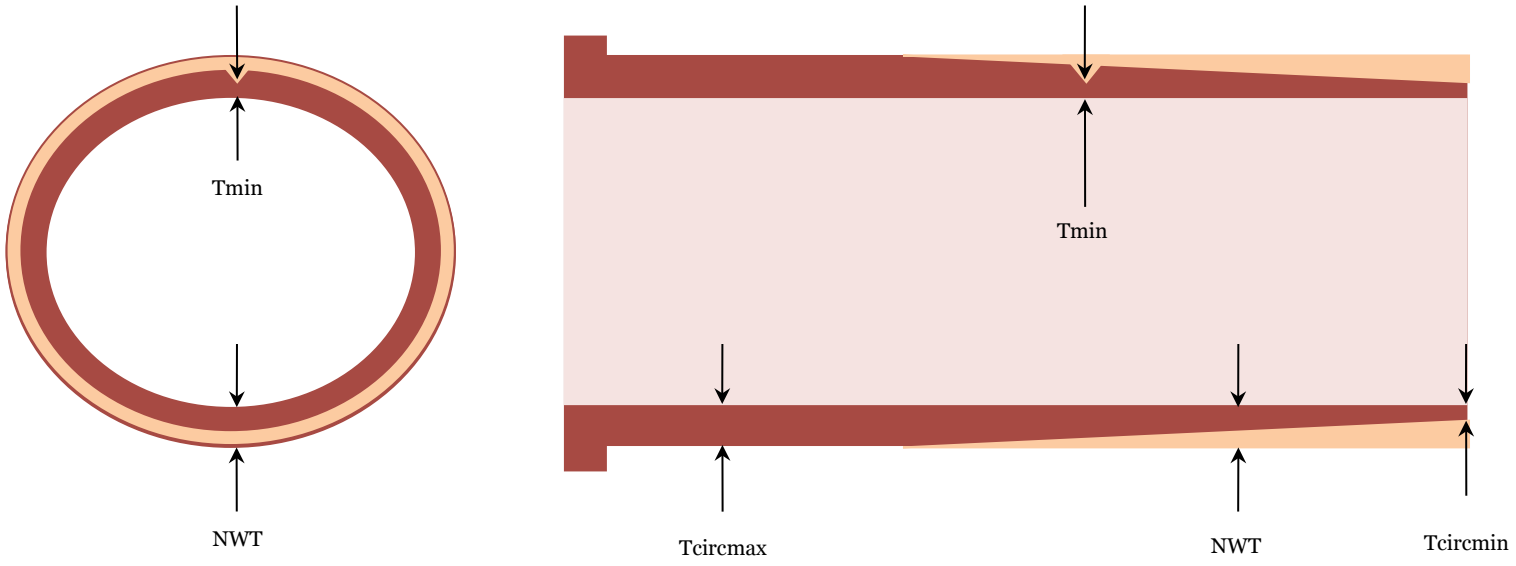

Figure A.1 Wall loss terminology

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Gull Lake
1.94 mile 12” DIP forcemain inspection

November 16 – 20, 2014

Richland, MI

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History

- PICA was contacted by Gull Lake Sewer and Water Authority (GLSWA) in May 2014
- Like most municipalities in Michigan(MI) $ is tight, however MI has allocated $millions for Condition Assessment
- Rich Pierson (Director) applied for and received a SAWS grant, used part of funds for PICA inspections

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Lead-Up

- Initial meeting in May, 2014
- GLSWA decided to undertake a site visit by one of PICA's engineers in June
- PICA determined that the inspection needed to be done in 2 phases
- Phase 1 to be inspected in Fall 2014, Phase 2 summer 2015

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Line overview

- 12 inch DIP forcemain
- 10,237 ft in length
- Multiple peaks and valleys
- Installed 1983
- Never cleaned or inspected
- Manhole discharge used as a retrieval point

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Problems in the pipe

- Calcium build-up identified in last 100’ of discharge manhole
- GLSWA attempted to clean pipe – no noticeable improvement
- Replaced final 200’ with PVC

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PICA arrive to inspect

- Winter arrived early!
- Flights were delayed, schools were closed, took one employee 2 days to get in
- Like good Canadian folks we put on an extra layer and started on Tuesday

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Launch Site

- 14” launch barrel installed prior to arrival
- Used water from a pumper truck to propel tools through the line
- Barrel inserted in a wye and then the forcemain
- Low flow rates > 1.2ft per second

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Cleaning Pig

- Pig took about 2 hours to complete its run
- Looked really good
- Crew was very positive the gauge pig run would go as smoothly
- NOT!

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Gauge Run

- Due to low flows needed a lot of water to get into pipe
- Used a high frequency ~ 47 MHz because of data quality in received in test facility
- Difficulty tracking the tool because pipe gives off similar frequency
- Effectively lost tool but due to consistent flows able to calculate its arrival

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Gauge Run

- About 15 minutes before the tool was supposed to arrive the water discharge turned very black
- Manhole started to fill up with a tar-like substance
- Couldn’t see tool

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Gauge Run

- Due to freezing temperatures (10°F) GLSWA's pumper truck froze so we couldn't use it
- Called in local company to assist
- Sludge was about 7ft deep
- Almost 2500 gallons was extracted
- Tool was found in manhole

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Why all the discharge

- Since there was 3 peaks and valleys and low normal flow (>1.2 feet/sec) it was summarized that there was not enough flow to move the slit through the pipeline
- After the gauge run GLSWA now has a really clean pipe!

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Inspection

- Launched the following night at 5 pm – taking advantage of lower demands
- Winter still here!
- Used E-Vac truck to help launch tool
  - Brought in the big boys!

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Inspection

- Tool got hung up in the launch barrel for about 20 mins.
- Tried to execute launch with only the truck
- Tool was poking in the line but needed all the flow from the Pumping Station to catch it and launch
- Tool ran for about 1000 feet then normal velocity of 120gpm maintained

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Inspection

- Stakes were placed every 1000 feet
- Tool was tracked using AGMs – frequency changed to 41MHz
- Since it was a rural road at night 2 trucks used to protect 3 trackers from any traffic

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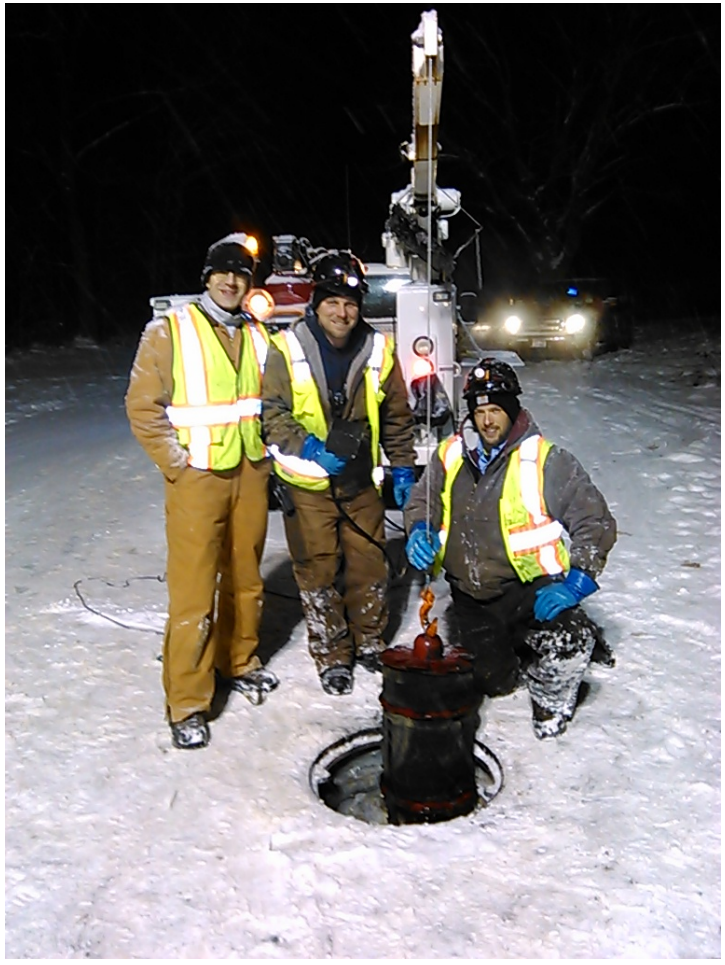
Inspection

- Approximately 8 hours later the tool arrived in good shape at the manhole
- Tool extracted and taken back to shop to download data
- Very happy and cold crew!



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Inspection Results

Prepared by Jake Regala, Scott Popovic and Cathy Shi

Reviewed by Ad Shatat

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Pipeline summary

Total distance inspected	9780 feet (215 feet of PVC)
# of pipe segments	544 (5 too short to measure)
# of pits detected	897

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Pit breakdown

Classification	# of pits in each category	% of total pipeline
Shallow (≥ 65% RW)	405	45%
Medium (40 – 64% RW)	393	44%
Deep (20% - 39% RW)	77	9%
Advanced (< 20 RW)	22	2%
Total	897	100%

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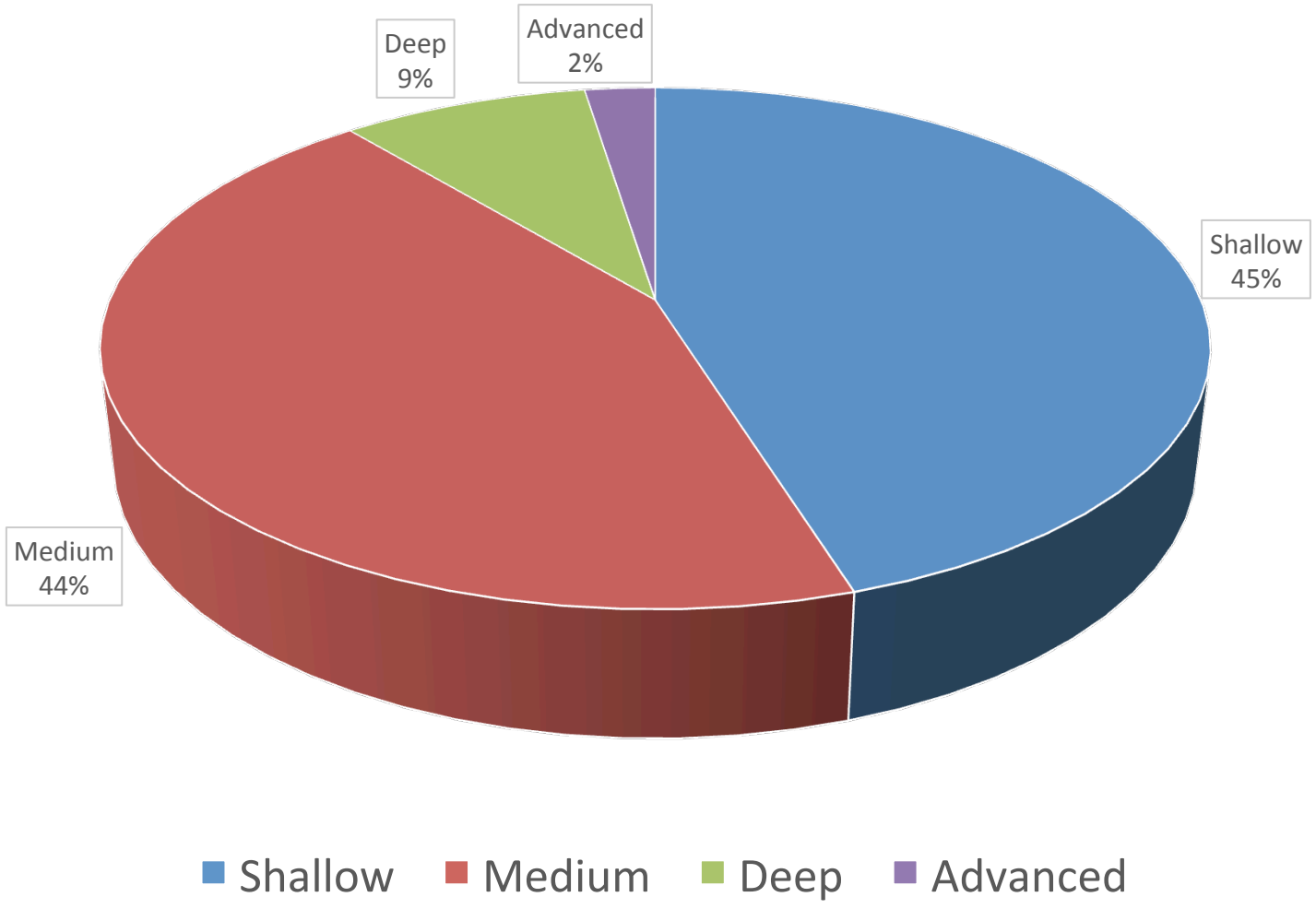
Pit Break Down



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PICA pipe classification

Classification	# of pipes in each category	%
Good (> 74% RW)	194	36
Fair (50 – 74% RW)	217	40
Poor (< 50% RW)	133	24
Total	544	100

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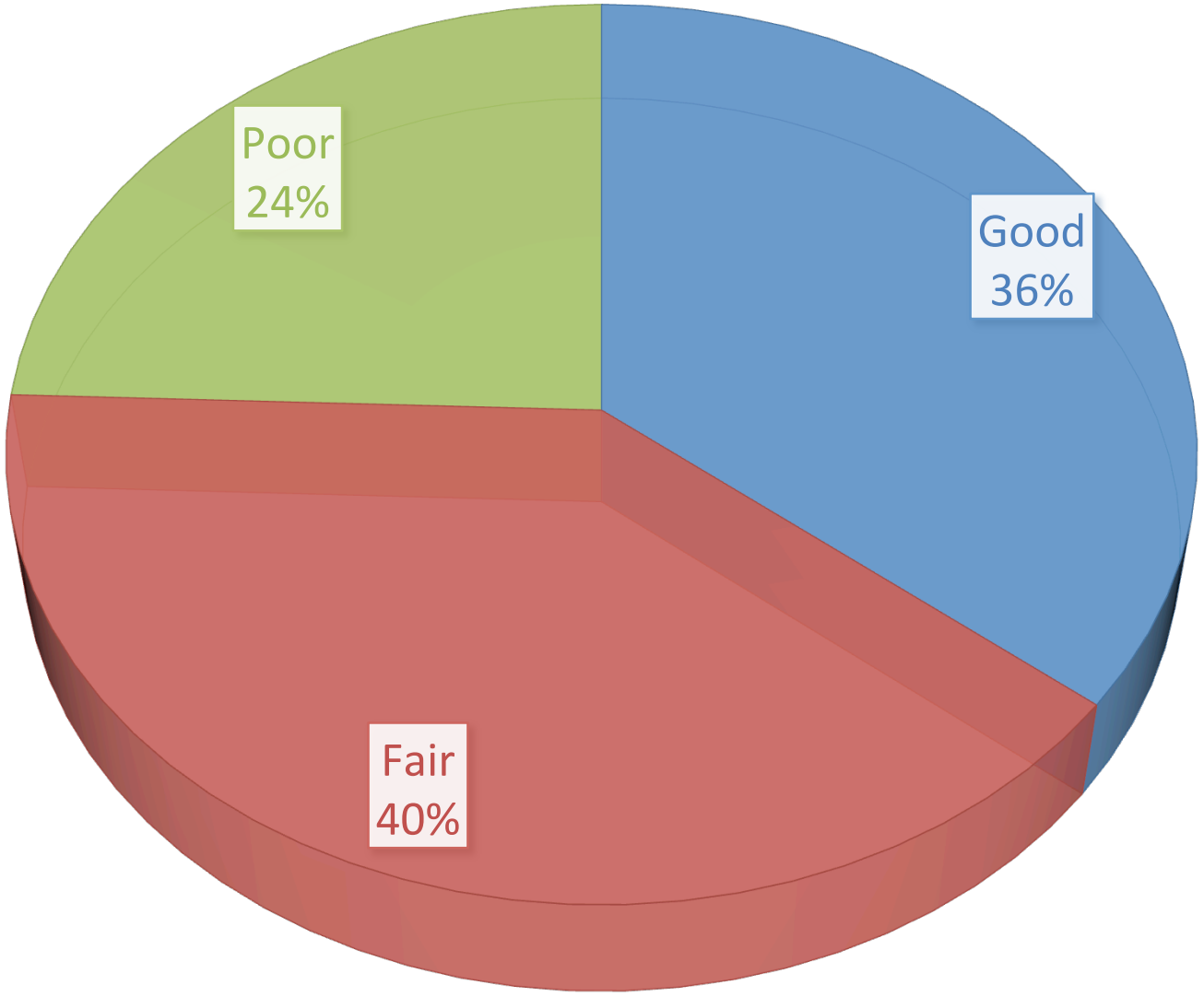
PICA PIPE CLASSIFICATION



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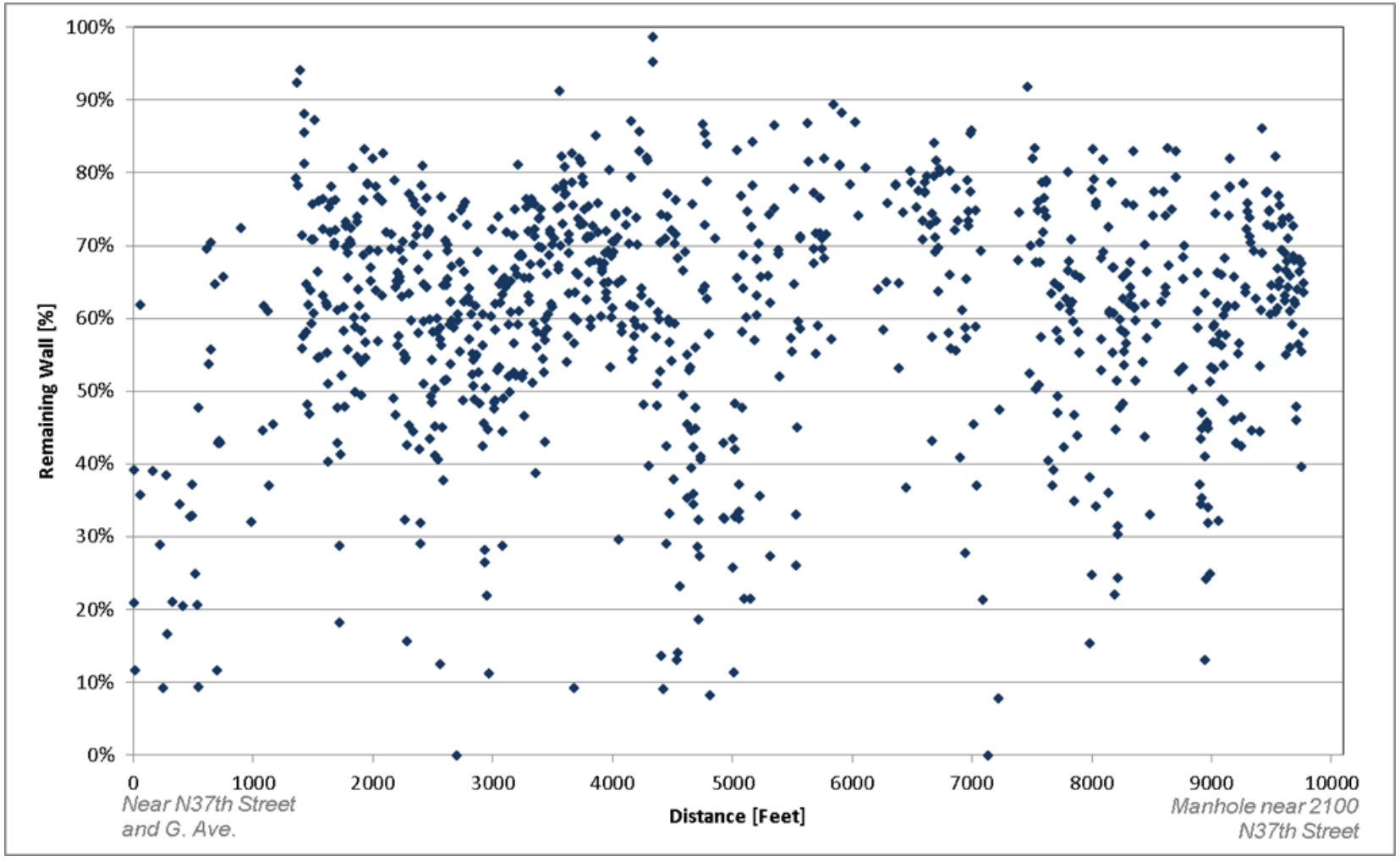
Pit distribution



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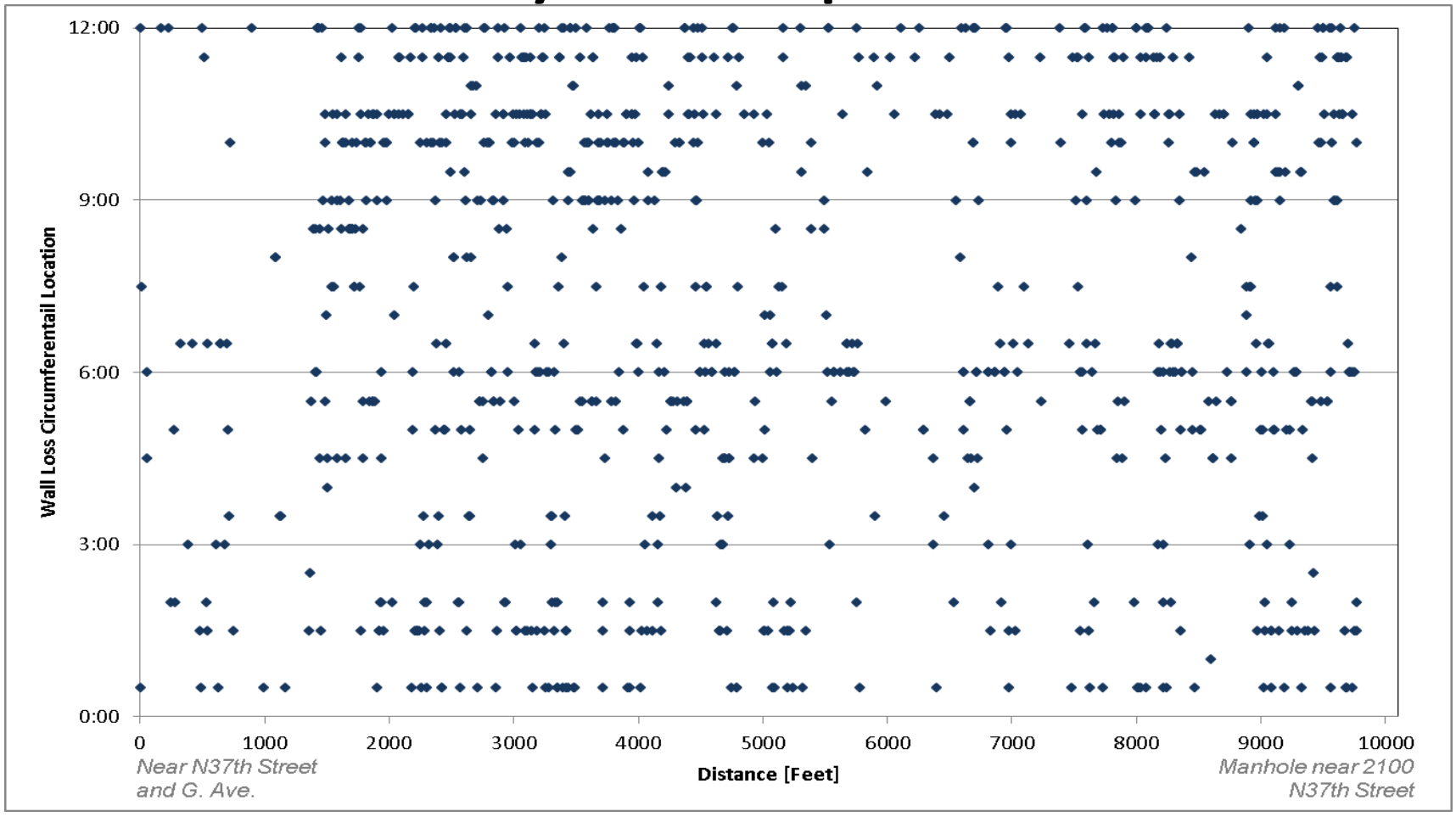
Pits by clock position



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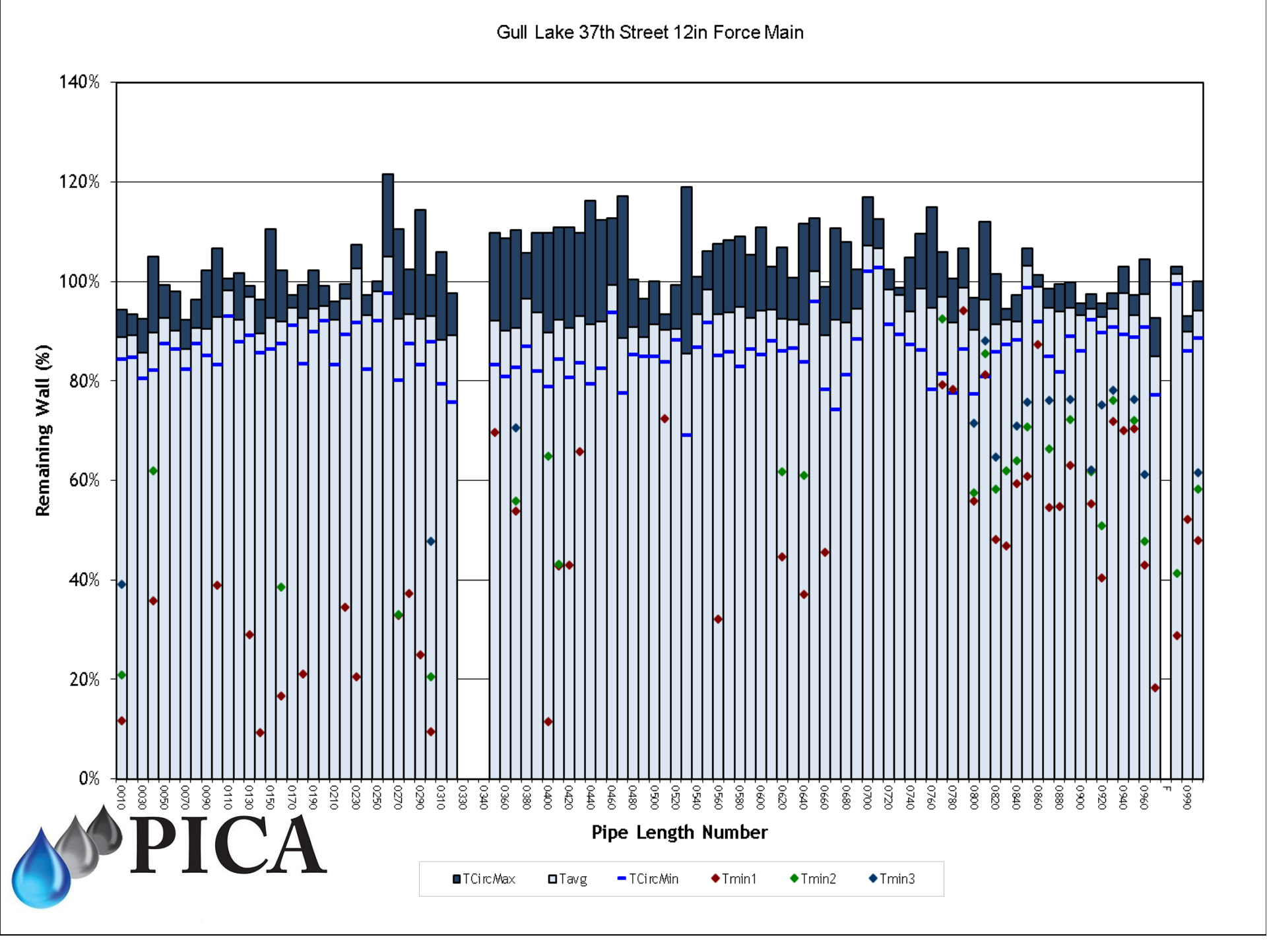
Gull Lake 37th Street 12in Force Main
140%
120%
100%
80%
60%
40%
20%
0%
Remaining Wall (%)
0010
0030
0050
0070
0090
0110
0130
0150
0170
0190
0210
0230
0250
0270
0290
0310
0330
0340
0360
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0860
0880
0900
0920
0940
0960
F
0990
Pipe Length Number
TCircMax
Tavg
TCircMin
Tmin1
Tmin2
Tmin3
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Questions?

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