

PIPELINE OWNER
36” CI River Crossing Twin Force Mains
Condition Assessment Report, Standard Analysis



PICA – Pipeline Inspection & Condition Analysis Corporation
(A Subsidiary of Russell NDT Holdings Ltd.)

RFT ILI Tool
36” Cast Iron

River Crossing Twin Force Mains
CITY, STATE

PICA Project: 7074

Inspection Date(s): July 10 & 19, 2018 & January 8, 2019
Report Submission: June 11, 2019
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PIPELINE OWNER

36” CI River Crossing Twin Force Mains

Condition Assessment Report, Standard Analysis

Executive Summary

On July 10th and 19th 2018, and January 8th 2019, PICA (USA), under contract with the PIPELINE OWNER, inspected the twin 36” Cast Iron River Crossing Force Mains using Remote Field Testing (RFT) technology. The southernmost line of the force mains, hereafter referred to as the “*South*” line, was inspected during PICA’s first mobilization in July 2018. Inspection of the northernmost line of the force mains, hereafter referred to as the “*North*” line, occurred during a second mobilization in January 2019. This inspection was part of a larger project involving the inspection of three additional force mains, all owned and operated by the Pipeline Owner.

The South line was inspected using PICA’s “Chimera” RFT tool in its 36” configuration, operating at a frequency of 10Hz. A review of the data immediately following the inspection revealed weak RFT signal strength and defect sensitivity as a result of the ~1” thick cast iron force main attenuating the RFT signal. The South line was reinspected in the following days, with the Chimera operating at a lower frequency of 5Hz. Data collected from the second inspection showed some improvements in quality, however RFT signal strength and defect sensitivity was still less than ideal.

Prior to remobilization for inspection of the North line, modifications were made to the Chimera tool to provide stronger signal strength and increase defect sensitivity inside the ~1” cast iron force main. A new exciter module (responsible for emitting the RFT signal) was installed in the Chimera, with a current draw approximately 4 times higher than the one used in the previous inspection. The North line was then inspected using the modified 36” Chimera tool, operating at a frequency of 7Hz. Data collected from this inspection showed a significant improvement in quality and was deemed acceptable for analysis. Analysts were able to use data from inspection of the North line to gain insight into some of the weaker signals identified in the lower quality data from the South line.

Access to each force main was gained through two points: 1) launch wyes installed near the junction box on the east side of the river, and 2) vertical tees in an excavation on the west side of the river. In both inspections, the RFT tool was inserted into the force main through the respective launch wye and pulled in an east to west direction, where it was removed through the corresponding vertical tee.

Analysis of the RFT data identified the following:

- ***South Line:*** A total of 100 pitting indications were identified across 32 pipe segments. A total of 11 indications measured between 40% and 59% Remaining Wall (RW), with the remaining 89 indications measuring 60% RW or shallower. No through-hole indications were identified.
- ***North Line:*** A total of 106 pitting indications were identified across 38 pipe segments. A total of 91 indications measured 60% RW or shallower. A total of 14 indications measured between 40% and 59% RW, and one (1) indication measured less than 40% RW. No through-hole indications were identified.

Table 1 provides an overview of the RFT findings for the inspected force mains.

Table 1: Feature Indication Summary		
	South Line	North Line
Inspected length:	733.54ft	734.33ft
Total number of pipe sections (including features):	51	51
Total number of analyzed pipe sections:	51	51
Total number of pipes without localized wall loss indications:	19	13
Total number of pipes with localized wall loss indications:	32	38
Total number of wall loss indications reported:	100	106
<i>Total number of defects measuring 60-80% RW:</i>	<i>89</i>	<i>91</i>
<i>Total number of defects measuring 40 - 59% RW:</i>	<i>11</i>	<i>14</i>
<i>Total number of defects measuring 20 - 39% RW:</i>	<i>0</i>	<i>1</i>
<i>Total number of defects measuring <20% RW:</i>	<i>0</i>	<i>0</i>
Total number of possible through-holes (0% RW):	0	0
Total number of Ball & Lock Joints:	52	52
Total number of construction features:	0	0

Figures 1a and 1b illustrate the distribution of localized wall loss with respect to remaining wall and circumferential location along the inspected section of the **South Line** - 36" CI River Crossing Force Mains. Note that there may be some (partially) overlapping data points due to defect proximity.

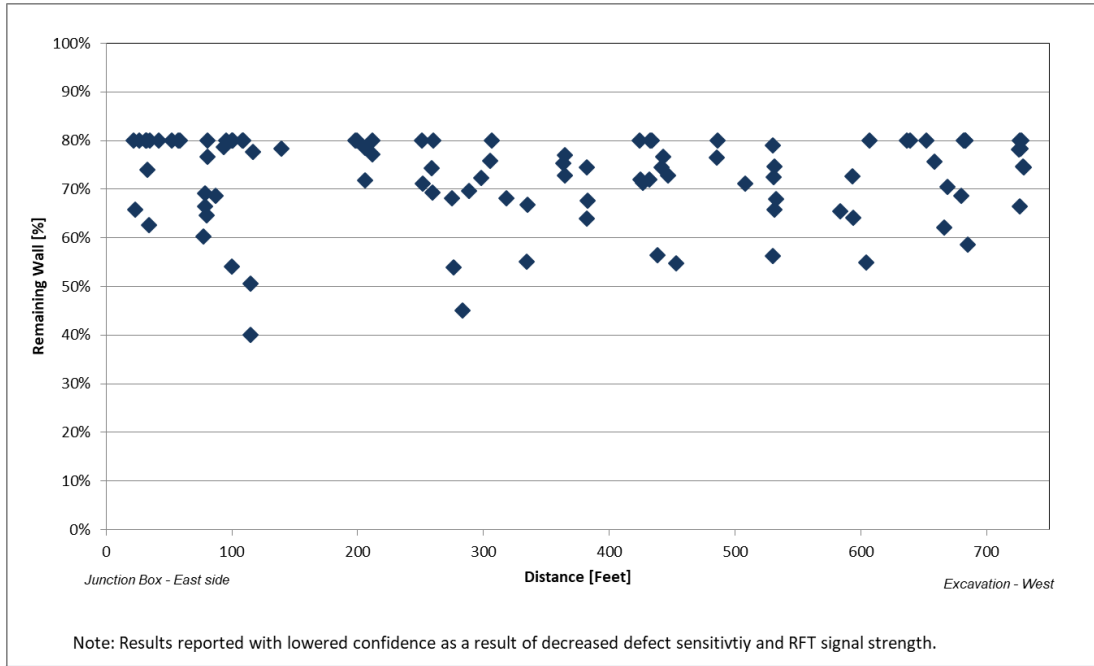


Figure 1a: Distribution of wall loss with respect to remaining wall (%NWT) in pitting regions along the inspected section of the **South Line** of the 36" CI River Crossing FM.

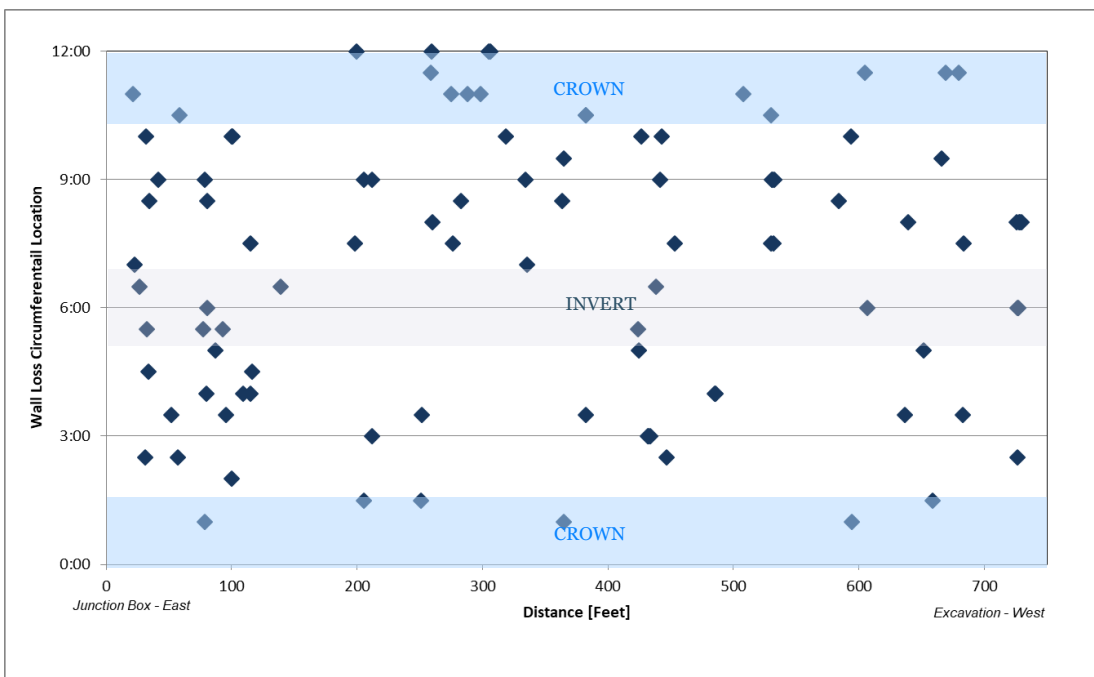


Figure 1b: Circumferential distribution of pitting regions along the inspected section of the **South Line** of the 36" CI River Crossing FM.

Figures 2a and 2b illustrate the distribution of localized wall loss with respect to remaining wall and circumferential location along the inspected section of the **North Line** - 36" CI River Crossing Force Mains. Note that there may be some (partially) overlapping data points due to defect proximity.

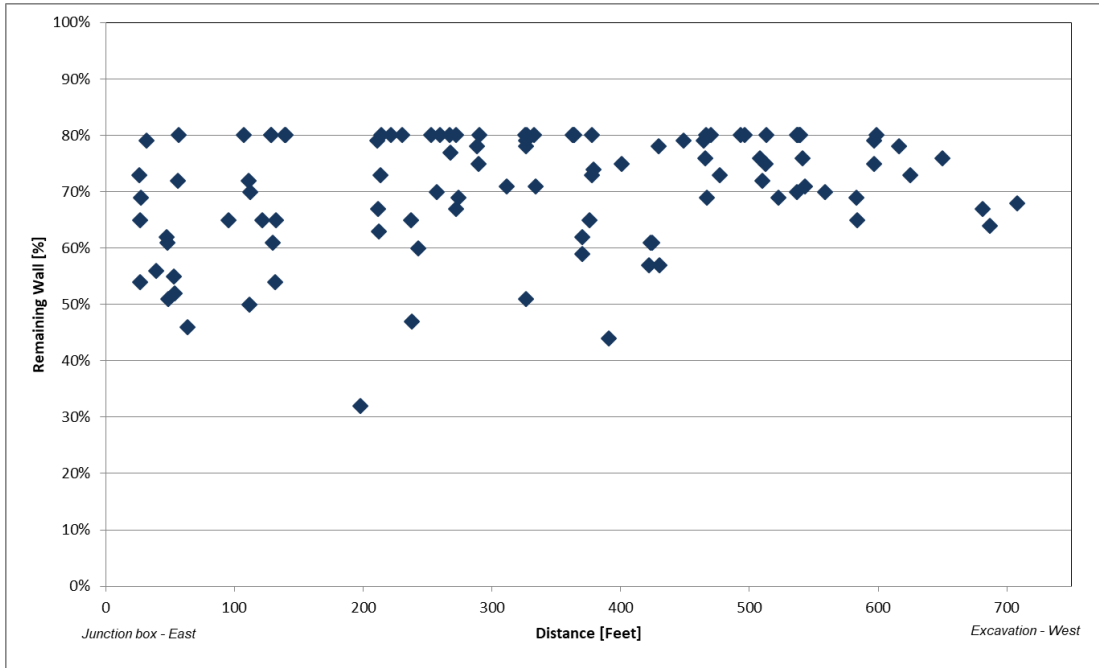


Figure 2a: Distribution of wall loss with respect to remaining wall (%NWT) in pitting regions along the inspected section of the **North Line** of the 36" CI River Crossing FM.

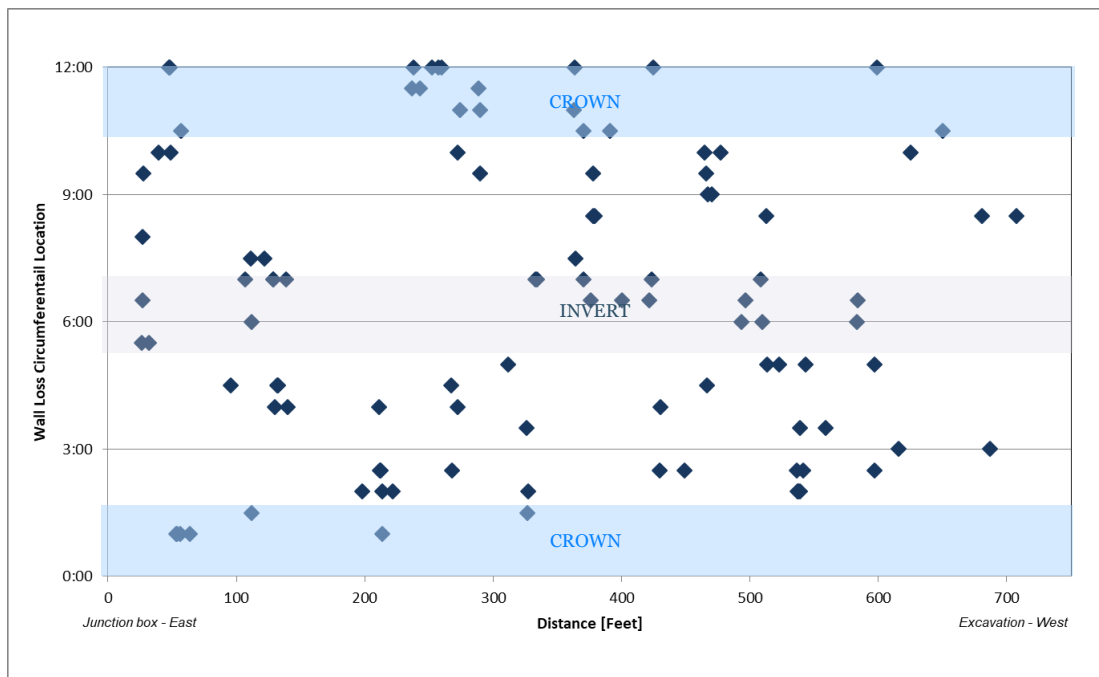


Figure 2b: Circumferential distribution of pitting regions along the inspected section of the **North Line** of the 36" CI River Crossing FM.

Inspection Overview

RFT Tool Information

The 36” CI River Crossing Force Mains were inspected using PICA’s “Chimera” RFT tool in its 36” configuration. The Chimera is PICA’s adaptive RFT tool that can be converted to inspect a range of diameters, from 16” to 48”.

Figure 3 shows the Chimera in its 36” configuration, prior to inspection of the South force main.



Figure 3: PICA’s 36” Chimera prior to inspection of the South force main.

Inspection Details

South Line

Prior to the start of the inspection, a tag line was placed inside the force main. On July 10th, 2018, PICA technicians set up winches at both access points and attached winch lines to the tag line. The tag line was used to pull the winch line from the western access point at the vertical tee to the eastern access point at the launch wye. The winch lines were then attached to the Chimera tool, which was inserted into the force main through the launch wye for the inspection.

The RFT tool was pulled through the force main until it arrived at the vertical tee at an inspection velocity of approximately 4ft/min. Attempts were made to winch the tool back to the launch wye for removal, but technicians were unable to successfully pull the tool across the river in a west to east direction. It is suspected that the configuration of the ball joints prevented the Chimera's wheels from passing when traveling west to east. As a result, the tool was pulled back to the vertical tee for removal. Removal of the tool through the vertical tee required assistance from Ace Pipe Cleaning, with manned entry being necessary to maneuver the tool around the 90° tee. Due to time constraints, the tool was left in the pipe overnight and successfully removed the following morning.

A cursory review of the data led PICA to request a re-inspection of the South line, with a change in the RFT tool's operating frequency. Re-inspection occurred on July 19th, following the same procedure as the initial inspection. After arriving at the vertical tee, no attempts were made to pull the tool back to the launch wye. Crews on site assisted in removing the tool through the vertical tee, and data was downloaded on site. A cursory review of the data showed an improvement in quality from the first inspection, however RFT signal strength and defect sensitivity was still less than ideal.

North Line

Prior to the start of the inspection, a tag line was placed inside the force main. On January 8th, 2019, PICA technicians set up winches at both access points and attached winch lines to the tag line. The tag line was used to pull the winch line from the western access point at the vertical tee, to the eastern access point at the launch wye. The winch lines were then attached to the Chimera tool, which was inserted into the force main through the launch wye for the inspection.

The RFT tool was pulled through the force main until it arrived at the vertical tee at an inspection velocity of approximately 4ft/min. As with the south line, manned entry was required to maneuver the tool around the 90° elbow and remove it from the force main. Due to time constraints, the tool was left in the pipe overnight and successfully removed the following morning. Data was downloaded on site and reviewed by an on-site PICA analyst. A cursory review of the data determined it to be of acceptable quality for analysis.

Figures 4a and 4b below show the PICA’s Chimera tool being lowered into the launch wye and removed through the vertical tee during inspection of the South line.



Figure 4a (left): PICA’s Chimera is lowered into the launch wye of the South line; 4b (right): the Chimera is removed through the vertical tee of the South line at the end of the inspection.

Table 2 shows an overview of the inspected section and a more detailed log of the daily inspection events. Figure 5 on page 9 provides a map overview of the inspected section.

Table 2: Inspection Overview			
Pipeline Owner:	Pipeline Owner	Location:	City, State
Line Identifier:	<i>North & South Lines - 36" CI River Crossing Force Mains</i>		
Pipe Diameter and Material:	36" Cast Iron	Nominal Wall	~ 1-in
Joint Type:	Ball joint	Repair History:	Unknown
Year Installed:	~1965		
Inspection Date(s):	North – January 8 th , 2019 South – July 10 th & 19 th , 2018	Inspected Length:	North – 734.33 ft South – 733.54 ft
Technicians:	B. Senka, D. Russell, A. Russell, G. Bouchard, P. Ryhanen, S. Popovic, N. Downs		
Launch Access:	Wye near junction box on eastern side of the River		
Extraction Access:	Vertical tee in excavation on western side of the River		
<u>Operational Overview:</u>			
July 10, 2018 (South Line)			
<ul style="list-style-type: none"> • 07:00 – PICA technicians arrive on site and begin preparations for the inspection. • 08:00 – Winches are put in place at both access points, winch line is pulled from west to east. • 08:45– Winch lines are attached to the tool at the upstream access, and the tool is inserted into the line through the launch wye. Tool travels at an inspection velocity of approximately 4ft/min. • 13:00– RFT tool arrives at the vertical tee on the western side of the river. Attempts are made to pull the tool back to the launch wye for removal. • 15:00- Tool cannot pass over ball & lock joints when traveling west to east, and will need to be removed through the vertical tee. Tool is winched back to the vertical tee. • 17:00 – Manned entry necessary in order to maneuver tool around the 90° elbow. Crews will be on site in the morning to assist with removal of the tool. 			
July 11, 2018 (South Line continued)			
<ul style="list-style-type: none"> • 07:00 – PICA technicians arrive on site and begin preparations for tool removal. • 09:00 – Ace Pipe Cleaning arrives on site, tool removal procedure begins. • 11:00 – RFT tool is removed from the force main through the vertical tee, data is downloaded on site. 			
July 19, 2018 (South Line re-inspection)			
<ul style="list-style-type: none"> • 07:00 - PICA technicians arrive on site and begin preparations for the inspection. • 08:00 – Winches are put in place at both access points, winch line is pulled from west to east. • 09:00– Winch lines are attached to the tool at the upstream access, and the tool is inserted into the line through the launch wye. Tool travels at an inspection velocity of approximately 3ft/min. • 14:00 – RFT tool arrives at the vertical tee on the western side of the river. Crews on site assist in maneuvering the tool around the 90° elbow and removing it from the line. Data is downloaded on site and reviewed by a PICA analyst. 			
January 8th, 2019 (North Line)			
<ul style="list-style-type: none"> • 07:00 – PICA technicians arrive on site and begin preparations for the inspection. • 12:00– Winch lines are attached to the tool at the upstream access. • 13:00 – RFT tool is inserted into the force main through the launch wye, and travels at an inspection velocity of approximately 3ft/min. • 17:00– RFT tool arrives at the vertical tee on the western side of the river. Crews will be on site in the morning to assist with removal of the tool. 			
January 9th, 2019 (North Line continued)			
<ul style="list-style-type: none"> • 07:00 – PICA technicians arrive on site and begin preparations for tool removal. • 09:00 - RFT tool is removed from the force main through the vertical tee, data is downloaded on site. 			

Table 2: Inspection Overview

Inspection Overview:

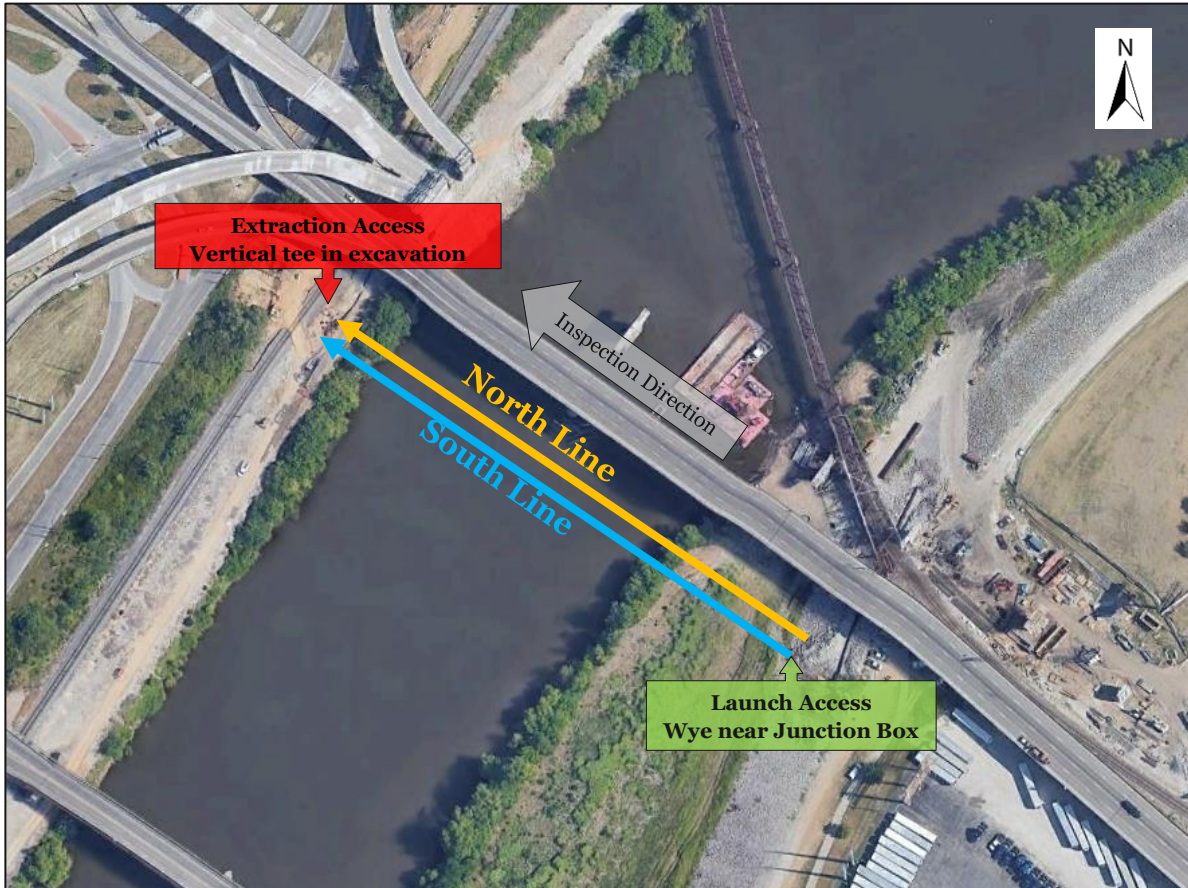


Figure 5: Overview of the 36" CI River Crossing Force Mains.

**Note: The above map is a general overview of the inspection path and does not represent the exact location of the pipeline or access points.*

Analysis Results

Location Reporting, Pipe Lengths & Features

The total logged distances for inspection of the 36” CI River Crossing Force Mains was 734.33ft for the North line, and 733.54ft for the South line. The inspected distance spans the entire length between the launch wye near the junction box on the eastern side of the river and the extraction point at the vertical tee on the western side of the river. The zero datum point for each line was set approximately 4 ft from the open flange of the launch wye near the junction box on the eastern side of the river.

Excluding the launch wye and vertical tee at the extraction point, no construction features were identified in either force main. The pipe segments in both inspected sections were connected using ball joints, with the North line having a standard pipe length of 14.98 ft and the South line having a standard pipe length of 15.03ft.

General Wall Thickness

All inspected pipe segments in both lines longer than 10.00ft were analyzed to obtain the average remaining wall thickness calculated over the length of the pipe. This average remaining wall thickness is referred to as the “PARW” value (Pipe Average Remaining Wall). Due to manufacturing tolerances in cast iron, fluctuations of $\pm 15\%$ in the individual PARW values are common. Variations outside the normal $\pm 15\%$ spread can be an indicator of a different nominal wall thickness or pipe type, or point towards a problem like aggregate pitting or general wall loss. The following summarizes the PARW values for the 36” CI River Crossing Force Mains:

- ***South Line:*** All inspected pipes were found to be within the expected tolerances.
- ***North Line:*** Most inspected pipes were found to be within the expected tolerances. P0320 and P0350 were identified as being slightly heavier walled than expected, with PARW values of 124% and 120% respectively. Given the minimal departure from the normal $\pm 15\%$ spread, these variances are likely due to manufacturing tolerances.

Figures 6 and 7 on pages 12 and 13 plot the measured PARW values in addition to the minimum circumferential (T_{circmin}) and maximum circumferential remaining wall (T_{circmax}) for each pipe in the inspected section. All numerical values for these figures can be found in Tables A1 and A2 in Appendix A.

Local Wall Thickness

Analysis of the RFT data identified the following pitting indications.

- ***South Line:*** A total of 100 pitting indications were identified across 32 pipe segments. A total of 11 indications measured between 40% and 59% Remaining Wall (RW), with the remaining 89 indications measuring 60% RW or shallower. No through-hole indications were identified.
- ***North Line:*** A total of 106 pitting indications were identified across 38 pipe segments. A total of 91 indications measured 60% RW or shallower. A total of 14 indications measured between 40% and 59% RW, and one (1) indication measured less than 40% RW. No through-hole indications were identified.

Figure 6 shows an overview of the structural condition of the **South Line**. This figure plots the minimum circumferential (Tcircmin), maximum circumferential (Tcircmax) and average (Tavg) remaining wall of each segment of pipe, as well as the three deepest pitting indications within each pipe segment.

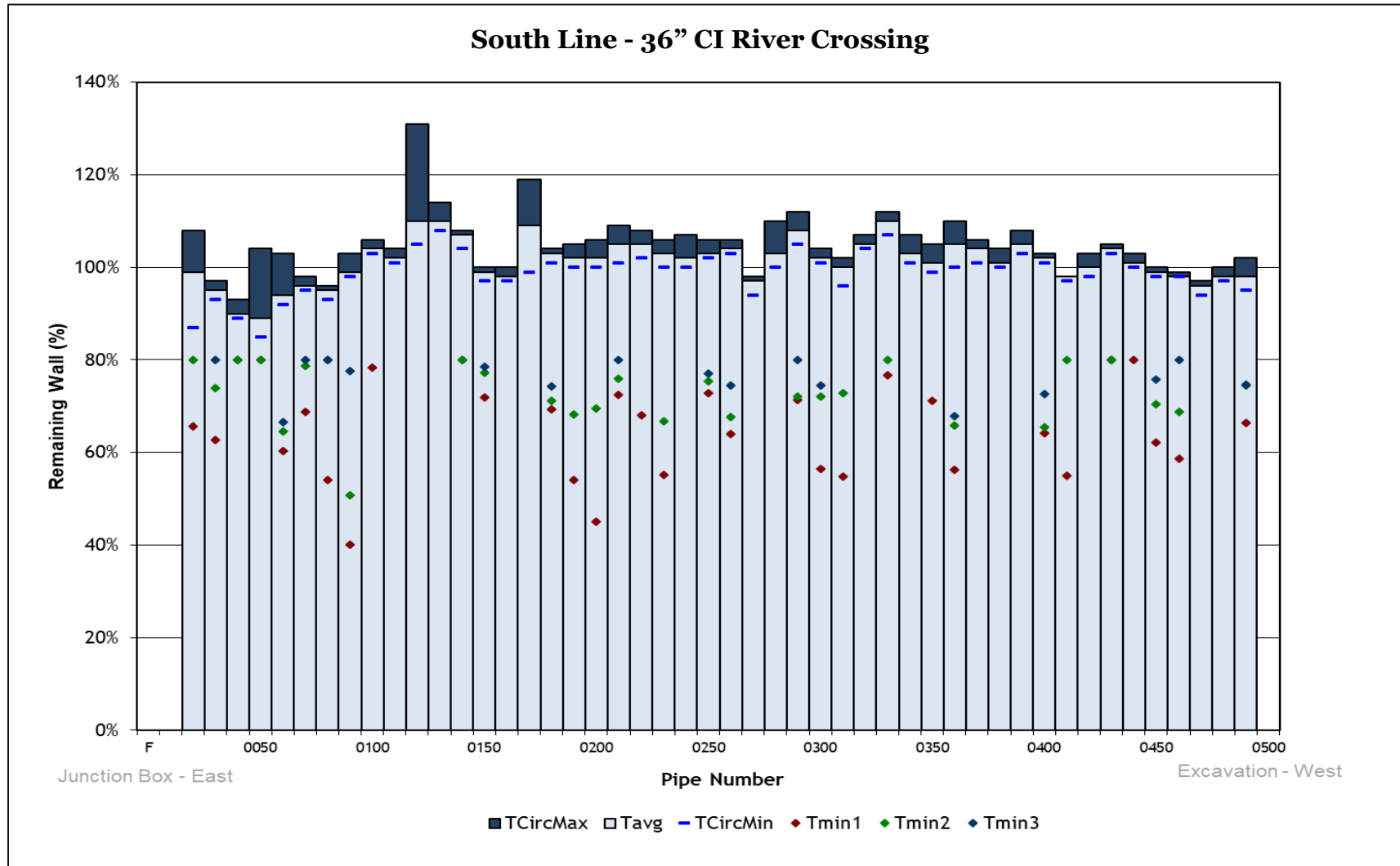


Figure 6: Structural Condition Assessment Summary – **South Line** 36" CI River Crossing

Figure 7 shows an overview of the structural condition of the **North Line**. This figure plots the minimum circumferential (Tcircmin), maximum circumferential (Tcircmax) and average (Tavg) remaining wall of each segment of pipe, as well as the three deepest pitting indications within each pipe segment.

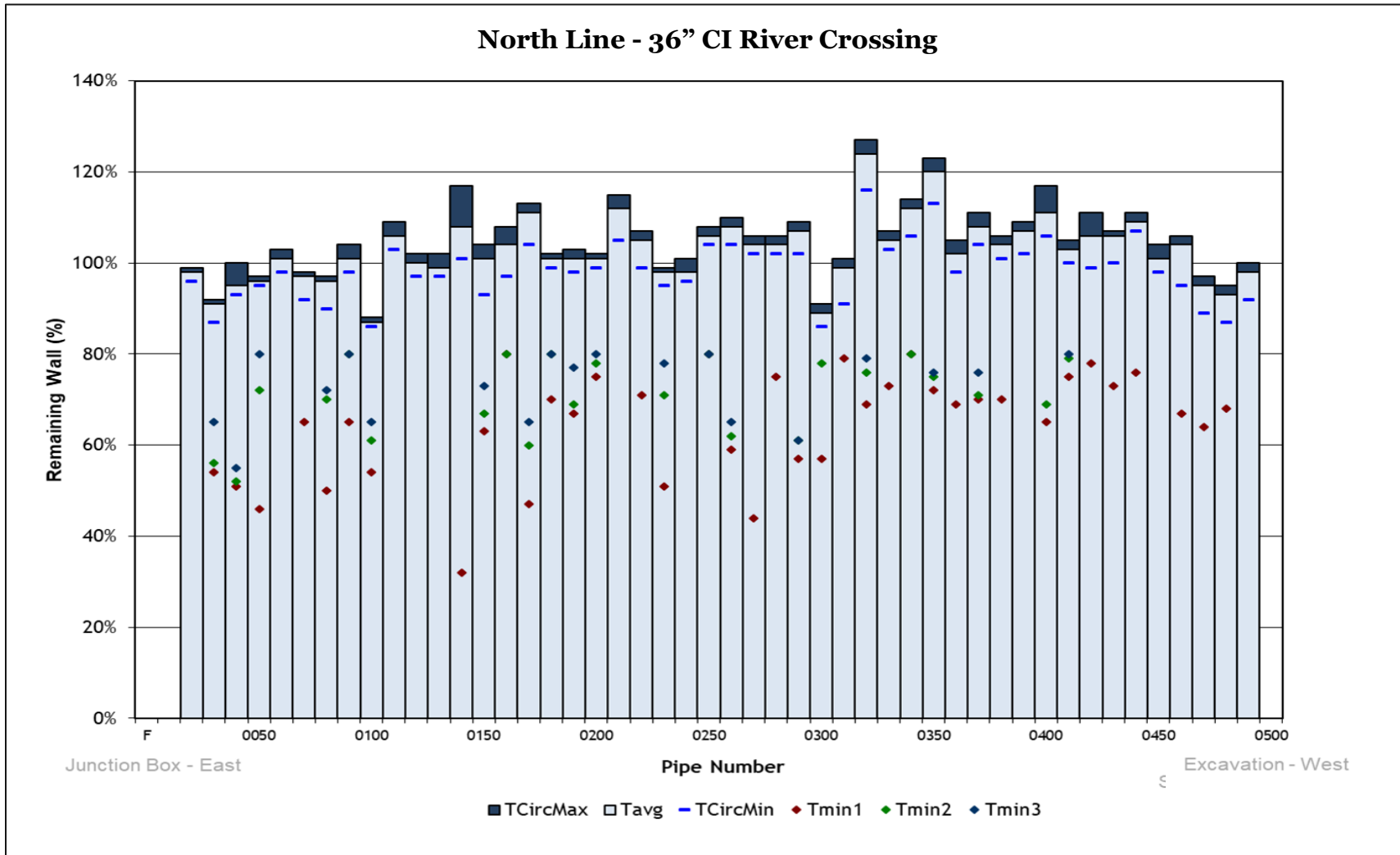


Figure 7: Structural Condition Assessment Summary – **North Line** 36" CI River Crossing

Appendix A - Pipe List and Wall Thickness Readings

Table A1: Pipe List and Wall Thickness Readings South 36" CI River Crossing																
Pipe No.	Joint Location			Tagg RW (%)	Circumferential Wall Thickness		Local Wall Thickness <i>Clock positions are with an East to West perspective (e.g. 3:00=North, 9:00=South).</i>									Comments <i>*Station numbers obtained from the 1965 Plan & Profile drawings.</i>
	Start (ft)	End (ft)	Length (ft)		Min Circ RW (%)	Max Circ RW (%)	Tmin1			Tmin2			Tmin3			
							RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position	
F	0.00	5.01	5.01	N/A	N/A	N/A										Zero datum point approximately 4ft from the open flange of the access wye near the junction box on the east side of the river. ~STA 7+80
0010	5.01	9.98	4.97	N/A	N/A	N/A										
0020	9.98	24.69	14.71	99%	87%	108%	66%	22.93	7:00	80%	21.75	11:00				
0030	24.69	39.73	15.04	95%	93%	97%	63%	33.92	4:30	74%	32.68	5:30	80%	34.66	8:30	This pipe contains 3 additional defects all with 80% RW.
0040	39.73	54.91	15.18	90%	89%	93%	80%	52.13	3:30	80%	41.62	9:00				
0050	54.91	69.42	14.51	89%	85%	104%	80%	57.05	2:30	80%	58.38	10:30				
0060	69.42	84.26	14.84	94%	92%	103%	60%	77.64	5:30	65%	79.66	4:00	66%	78.83	1:00	This pipe contains 3 additional defects between 69% and 80% RW.
0070	84.26	98.91	14.66	96%	95%	98%	69%	87.13	5:00	79%	93.20	5:30	80%	95.56	3:30	
0080	98.91	113.84	14.93	95%	93%	96%	54%	100.02	2:00	80%	108.28	12:30	80%	100.61	10:00	This pipe contains two additional defects both with 80% RW.
0090	113.84	128.97	15.13	99%	98%	103%	40%	114.78	7:30	51%	114.97	4:00	78%	116.68	4:30	
0100	128.97	143.92	14.95	104%	103%	106%	78%	139.38	6:30							
0110	143.92	158.65	14.74	102%	101%	104%										
0120	158.65	173.46	14.80	110%	105%	131%										
0130	173.46	188.56	15.10	110%	108%	114%										
0140	188.56	203.77	15.21	107%	104%	108%	80%	198.02	7:30	80%	199.44	12:00				
0150	203.77	219.35	15.58	99%	97%	100%	72%	205.73	1:30	77%	211.86	9:00	78%	205.77	9:00	This pipe contains an additional defect with 80% RW.
0160	219.35	234.23	14.89	98%	97%	100%										
0170	234.23	249.56	15.33	109%	99%	119%										
0180	249.56	264.86	15.30	103%	101%	104%	69%	259.48	12:00	71%	251.65	3:30	74%	258.74	11:30	This pipe contains two additional defects both with 80% RW.

**Table A1: Pipe List and Wall Thickness Readings
South 36” CI River Crossing**

Pipe No.	Joint Location			Tavg RW (%)	Circumferential Wall Thickness		Local Wall Thickness <i>Clock positions are with an East to West perspective (e.g. 3:00=North, 9:00=South).</i>									Comments <i>*Station numbers obtained from the 1965 Plan & Profile drawings.</i>	
	Start (ft)	End (ft)	Length (ft)		Min Circ RW (%)	Max Circ RW (%)	Tmin1			Tmin2			Tmin3				
							RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position		
0190	264.86	280.21	15.35	102%	100%	105%	54%	276.44	7:30	68%	275.23	11:00					
0200	280.21	295.27	15.07	102%	100%	106%	45%	283.19	8:30	70%	288.33	11:00					
0210	295.27	310.21	14.93	105%	101%	109%	72%	298.28	11:00	76%	305.12	12:00	80%	306.52	12:00		
0220	310.21	325.27	15.06	105%	102%	108%	68%	318.38	10:00								
0230	325.27	340.26	14.99	103%	100%	106%	55%	334.48	9:00	67%	335.29	7:00					
0240	340.26	355.31	15.05	102%	100%	107%											
0250	355.31	370.07	14.76	103%	102%	106%	73%	364.94	9:30	75%	363.24	8:30	77%	365.04	1:00		
0260	370.07	385.25	15.18	104%	103%	106%	64%	382.05	10:30	68%	382.50	10:30	74%	382.33	3:30		
0270	385.25	400.34	15.08	97%	94%	98%											
0280	400.34	415.25	14.92	103%	100%	110%											
0290	415.25	430.22	14.97	108%	105%	112%	71%	426.56	10:00	72%	424.56	5:00	80%	423.93	5:30		
0300	430.22	445.50	15.28	102%	101%	104%	56%	438.60	6:30	72%	431.58	3:00	74%	441.40	9:00	This pipe contains 3 additional defects between 77% and 80% RW.	
0310	445.50	460.51	15.01	100%	96%	102%	55%	453.27	7:30	73%	446.80	2:30					
0320	460.51	475.59	15.08	105%	104%	107%											
0330	475.59	491.11	15.52	110%	107%	112%	77%	485.38	4:00	80%	485.86	4:00					
0340	491.11	506.16	15.05	103%	101%	107%											
0350	506.16	521.25	15.09	101%	99%	105%	71%	508.17	11:00								
0360	521.25	536.50	15.26	105%	100%	110%	56%	530.21	7:30	66%	531.62	7:30	68%	532.31	9:00	This pipe contains 3 additional defects between 73% and 79% RW.	
0370	536.50	551.35	14.84	104%	101%	106%											
0380	551.35	566.41	15.06	101%	100%	104%											
0390	566.41	581.48	15.07	105%	103%	108%											
0400	581.48	596.30	14.82	102%	101%	103%	64%	594.15	1:00	65%	583.87	8:30	73%	593.44	10:00		
0410	596.30	611.13	14.83	98%	97%	98%	55%	604.60	11:30	80%	606.88	6:00					

**Table A1: Pipe List and Wall Thickness Readings
South 36” CI River Crossing**

Pipe No.	Joint Location			Tavg RW (%)	Circumferential Wall Thickness		Local Wall Thickness <i>Clock positions are with an East to West perspective (e.g. 3:00=North, 9:00=South).</i>									Comments <i>*Station numbers obtained from the 1965 Plan & Profile drawings.</i>	
	Start (ft)	End (ft)	Length (ft)		Min Circ RW (%)	Max Circ RW (%)	Tmin1			Tmin2			Tmin3				
							RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position		
0420	611.13	626.25	15.12	100%	98%	103%											
0430	626.25	641.65	15.40	104%	103%	105%	80%	638.97	8:00	80%	636.65	3:30					
0440	641.65	656.67	15.01	101%	100%	103%	80%	651.92	5:00								
0450	656.67	671.70	15.04	99%	98%	100%	62%	666.05	9:30	70%	669.12	11:30	76%	658.49	1:30		
0460	671.70	686.64	14.93	98%	98%	99%	59%	684.99	12:30	69%	679.71	11:30	80%	682.84	3:30	This pipe contains two additional defects both with 80% RW.	
0470	686.64	701.66	15.02	96%	94%	97%											
0480	701.66	716.67	15.01	98%	97%	100%											
0490	716.67	731.63	14.97	98%	95%	102%	66%	726.48	2:30	74%	729.41	8:00	75%	728.61	8:00	This pipe contains 4 additional defects between 78% and 80% RW.	
0500	731.63	733.54	1.91	N/A	N/A	N/A											End of run approximately 13ft from the 90° elbow in the excavation on the west side of the river, ~STA 0+05

**Table A2: Pipe List and Wall Thickness Readings
North 36” CI River Crossing**

Pipe No.	Joint Location			Tavg RW (%)	Circumferential Wall Thickness		Local Wall Thickness <i>Clock positions are with an East to West perspective (e.g. 3:00=North, 9:00=South).</i>									Comments <i>*Station numbers obtained from the 1965 Plan & Profile drawings.</i>	
	Start (ft)	End (ft)	Length (ft)		Min Circ RW (%)	Max Circ RW (%)	Tmin1			Tmin2			Tmin3				
							RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position		
F	0.00	4.97	4.97	N/A	N/A	N/A											Zero datum point approximately 4ft from the open flange of the access wye near the junction box on the east side of the river, ~STA 7+80
0010	4.97	9.87	4.90	N/A	N/A	N/A											
0020	9.87	24.57	14.70	98%	96%	99%											
0030	24.57	39.42	14.85	91%	87%	92%	54%	26.99	8:00	56%	39.33	10:00	65%	27.01	6:30		This pipe contains 3 additional defects between 69% and 79% RW.
0040	39.42	54.36	14.94	95%	93%	100%	51%	48.61	10:00	52%	53.77	1:00	55%	52.95	1:00		This pipe contains two additional defects with 61% and 62% RW.
0050	54.36	69.53	15.17	96%	95%	97%	46%	63.81	1:00	72%	56.00	1:00	80%	56.90	10:30		
0060	69.53	84.36	14.83	101%	98%	103%											
0070	84.36	98.90	14.54	97%	92%	98%	65%	95.62	4:30								
0080	98.90	113.84	14.94	96%	90%	97%	50%	111.76	1:30	70%	112.06	6:00	72%	111.17	7:30		
0090	113.84	128.94	15.09	101%	98%	104%	65%	121.68	7:30	80%	128.70	7:00	80%	128.81	7:00		This pipe contains an additional defect with 80% RW.
0100	128.94	143.65	14.71	87%	86%	88%	54%	131.63	4:30	61%	129.98	4:00	65%	132.33	4:30		This pipe contains two additional defects both with 80% RW.
0110	143.65	158.44	14.79	106%	103%	109%											
0120	158.44	173.28	14.85	100%	97%	102%											
0130	173.28	188.08	14.80	99%	97%	102%											
0140	188.08	203.08	15.00	108%	101%	117%	32%	198.01	2:00								
0150	203.08	218.21	15.13	101%	93%	104%	63%	212.25	2:30	67%	211.40	2:30	73%	213.32	1:00		This pipe contains two additional defects with 79% and 80% RW.
0160	218.21	233.03	14.82	104%	97%	108%	80%	221.68	2:00	80%	230.28	12:30					
0170	233.03	248.45	15.42	111%	104%	113%	47%	237.89	12:00	60%	242.78	11:30	65%	236.96	11:30		
0180	248.45	263.58	15.14	101%	99%	102%	70%	257.38	12:00	80%	252.59	12:00	80%	259.75	12:00		
0190	263.58	278.94	15.35	101%	98%	103%	67%	272.24	4:00	69%	274.24	11:00	77%	267.78	2:30		
0200	278.94	293.85	14.91	101%	99%	102%	75%	289.46	9:30	78%	288.28	11:30	80%	289.98	11:00		This pipe contains two additional defects both with 80% RW.

**Table A2: Pipe List and Wall Thickness Readings
North 36" CI River Crossing**

Pipe No.	Joint Location			Tavg RW (%)	Circumferential Wall Thickness		Local Wall Thickness <i>Clock positions are with an East to West perspective (e.g. 3:00=North, 9:00=South).</i>									Comments <i>*Station numbers obtained from the 1965 Plan & Profile drawings.</i>	
	Start (ft)	End (ft)	Length (ft)		Min Circ RW (%)	Max Circ RW (%)	Tmin1			Tmin2			Tmin3				
							RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position		
0210	293.85	308.67	14.83	112%	105%	115%											
0220	308.67	323.65	14.97	105%	99%	107%	71%	311.36	5:00								
0230	323.65	338.61	14.96	98%	95%	99%	51%	326.19	3:30	71%	334.01	7:00	78%	326.44	1:30		
0240	338.61	353.47	14.86	98%	96%	101%											
0250	353.47	368.54	15.07	106%	104%	108%	80%	362.84	11:00	80%	363.47	12:00	80%	364.09	7:30		
0260	368.54	383.48	14.94	108%	104%	110%	59%	370.37	7:00	62%	370.31	10:30	65%	375.95	6:30	This pipe contains two additional defects with 73% and 74% RW.	
0270	383.48	398.36	14.88	104%	102%	106%	44%	391.02	10:30							This pipe contains an additional defect with 80% RW.	
0280	398.36	413.27	14.91	104%	102%	106%	75%	400.54	6:30								
0290	413.27	428.11	14.84	107%	102%	109%	57%	421.81	6:30	61%	423.48	7:00	61%	424.67	12:00		
0300	428.11	443.07	14.96	89%	86%	91%	57%	430.13	4:00	78%	429.37	2:30					
0310	443.07	458.12	15.05	99%	91%	101%	79%	449.10	2:30								
0320	458.12	473.24	15.13	124%	116%	127%	69%	466.81	9:00	76%	465.82	9:30	79%	464.45	10:00	This pipe contains two additional defects both with 80% RW.	
0330	473.24	488.61	15.37	105%	103%	107%	73%	477.09	10:00								
0340	488.61	503.57	14.96	112%	106%	114%	80%	493.18	6:00	80%	496.58	6:30					
0350	503.57	518.59	15.02	120%	113%	123%	72%	509.82	6:00	75%	512.55	8:30	76%	508.27	7:00	This pipe contains an additional defect with 80% RW.	
0360	518.59	533.59	15.00	102%	98%	105%	69%	522.80	5:00								
0370	533.59	548.66	15.06	108%	104%	111%	70%	537.24	2:00	71%	543.45	5:00	76%	541.17	2:30		
0380	548.66	563.73	15.08	104%	101%	106%	70%	558.82	3:30							This pipe contains 4 additional defects all with 80% RW.	
0390	563.73	578.66	14.93	107%	102%	109%											
0400	578.66	593.45	14.78	111%	106%	117%	65%	583.94	6:30	69%	583.31	6:00					
0410	593.45	608.20	14.75	103%	100%	105%	75%	596.96	5:00	79%	596.68	2:30	80%	598.92	12:00		
0420	608.20	623.08	14.89	106%	99%	111%	78%	615.95	3:00								
0430	623.08	638.44	15.36	106%	100%	107%	73%	624.95	10:00								

**Table A2: Pipe List and Wall Thickness Readings
North 36” CI River Crossing**

Pipe No.	Joint Location			Tavg RW (%)	Circumferential Wall Thickness		Local Wall Thickness <i>Clock positions are with an East to West perspective (e.g. 3:00=North, 9:00=South).</i>									Comments <i>*Station numbers obtained from the 1965 Plan & Profile drawings.</i>
	Start (ft)	End (ft)	Length (ft)		Min Circ RW (%)	Max Circ RW (%)	Tmin1			Tmin2			Tmin3			
							RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position	RW (%)	Location (ft)	Clock Position	
0440	638.44	653.60	15.16	109%	107%	111%	76%	650.17	10:30							
0450	653.60	668.66	15.06	101%	98%	104%										
0460	668.66	683.74	15.08	104%	95%	106%	67%	680.94	8:30							
0470	683.74	698.64	14.90	95%	89%	97%	64%	686.87	3:00							
0480	698.64	713.93	15.29	93%	87%	95%	68%	707.72	8:30							
0490	713.93	728.73	14.80	98%	92%	100%										
0500	728.73	734.33	5.60	N/A	N/A	N/A										End of run approximately 10ft from the 90° elbow in the excavation on the west side of the river, ~STA 0+05

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