

Investigations into CLPP Liners with Over 30 Years of Service in Winnipeg, MB



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Overview

- This presentation covers two investigations into CIPP Liners with long service histories
- In 2011/2012
 - Reviewed performance and physical testing results of CIPP installations in Winnipeg, MB, Canada that were installed in **1978**
 - **34 year old liners (now 35 years old)** are still in service, looked excellent and had excellent physicals
- This year
 - Took closer look at the loading on those liners, and
 - Reviewed a **1984** CIPP installation (**29 years of service**), with a review of both visual and physical characteristics of the liner

CIPP has been installed in Winnipeg, MB for some time...

- 1971 the first CIPP installed in a 1170mm by 600mm brick egg in the London, UK
- In 1977 to North America
 - In 1978, 1st installations in Winnipeg
 - Poor contractor from Fresno, CA + licensee from BC working in Winnipeg winter!
 - 1038 feet attempted
 - 679 feet ~ good
 - 379 ~ bad
 - Walked away 655 feet



*And at the time this wasn't universally
viewed as a success!*

RE: CONTRACT WITH A.B.C. PIPE CLEANING SERVICES LIMITED,
2967 CAMROSS DRIVE, NORTH BURNABY, B.C., TO LINE SEWERS IN
RICHARD AVENUE AND KINGSWAY

Recommendation:

That the contract which the City entered into with A.B.C. Pipe
Cleaning Services Limited to carry out the following work be
terminated:

*Fortunately
there were
still those
who believed
the glass
was half
full...*

One has to ask the question after this experience, is there any hope for this process. The answer in my opinion is yes. After reviewing all of the problems I am of the opinion that the process is viable and has a bright future in Canada. This was a first test under extreme cold conditions and I don't believe that the crew was truly prepared for the problems that arose. This was compounded in that they didn't appear to take kindly to advice from others.

The equipment can be winterized to operate in extreme cold; the boiler capacity can be increased to ensure proper curing times; the recirculating pump can be designed to operate at sewer depths of 25 to 30 feet, and a method to ensure positive inversion of the lining is entirely practical. We have literature that states there are inflatable plugs available that will hold heads from 30 to 40 feet.

Perhaps I'm an eternal optimist but we encountered equally serious problems with AC and PVC watermains which were solved and when the crews return in early spring to complete the work I am convinced that there will be a very much improved result.

Installed in the Winter of 1978

- Predated use of any design methodology
- Both liners 6.0 mm nominal thickness
 - Kingsway 450 mm (18") ~ DR75 liner
 - Richard 762 mm (30") ~ DR127
- Standard unfilled isophthalic polyester resin



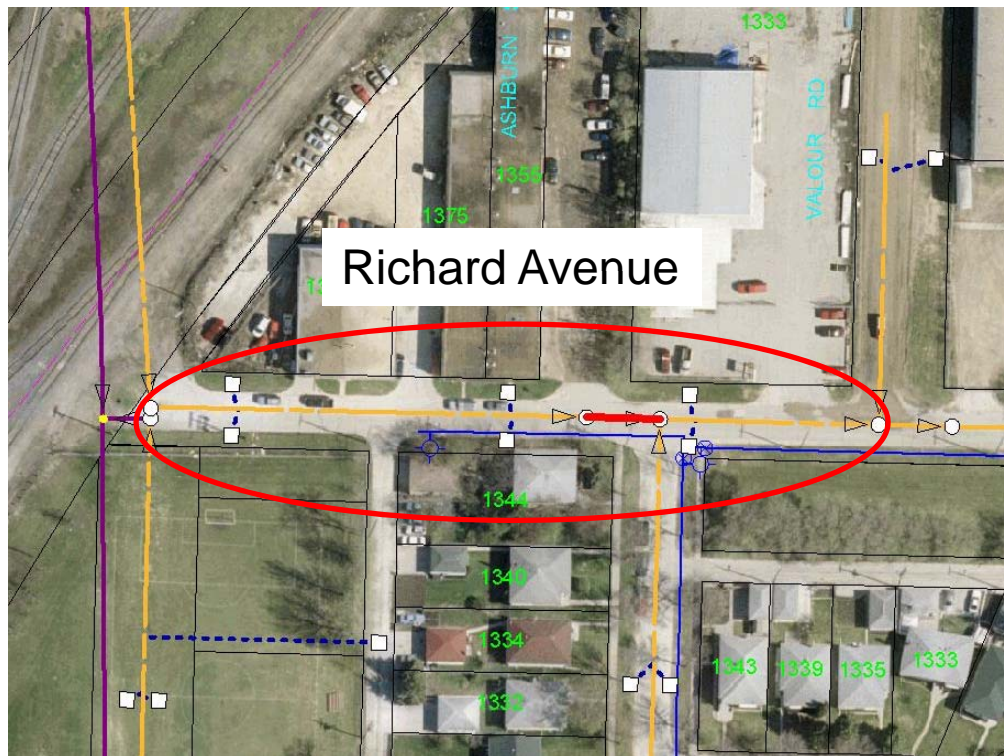
1978 CIPP Liner Installation on Kingsway



Installed in the winter of
1978, CCTV Inspection
in 2004



1978 CIPP Liner Installation on Richard



Installed in the winter of
1978, CCTV Inspection
in 2004

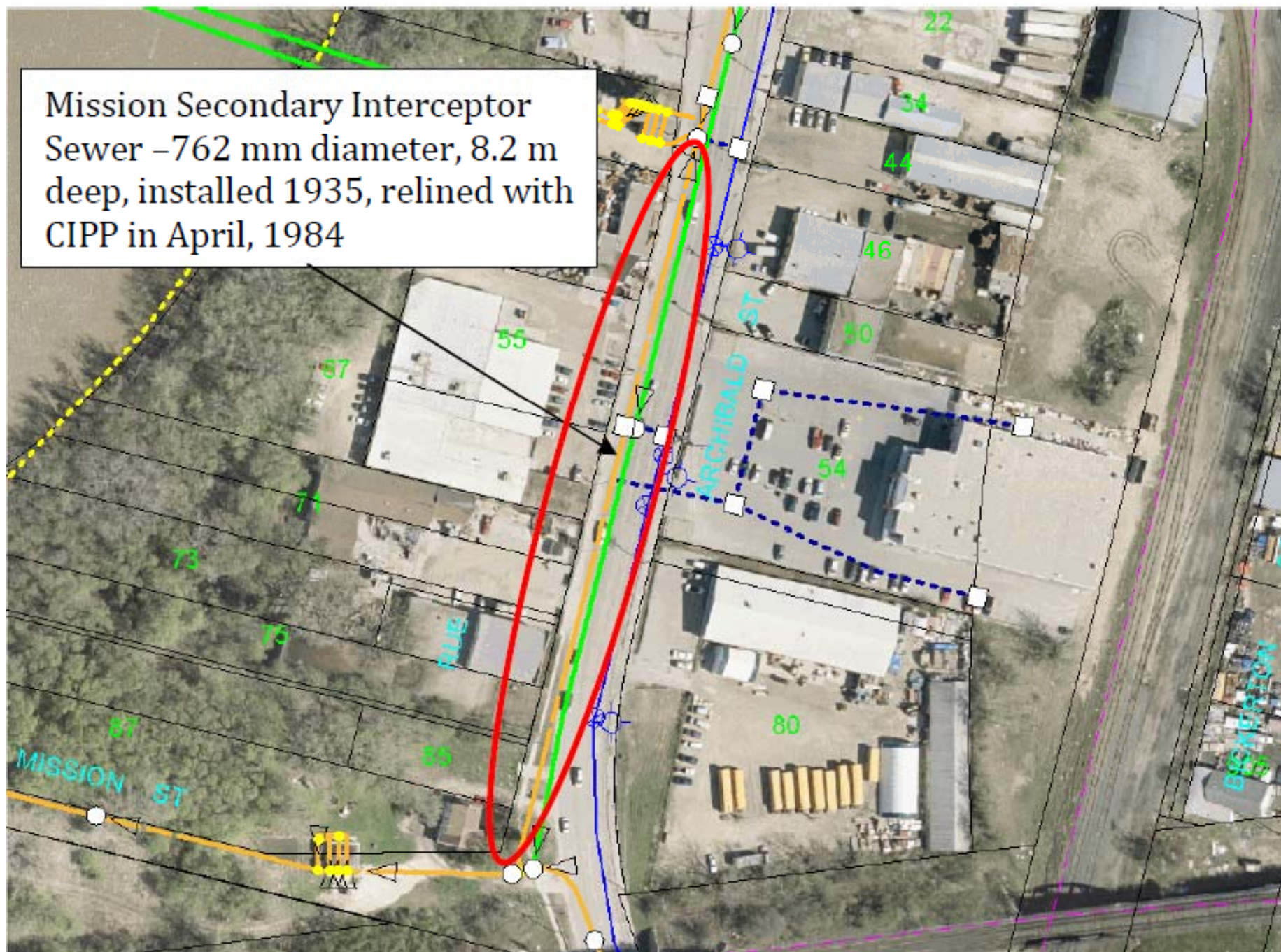


And because there was optimism... CIPP came back

- April 1984 – 2ndary sewer application on Archibald (Mission Secondary Sewer)
- 1986/87 - Henderson Highway – epoxy resin
- 1989 – a vinyl ester resin on Notre Dame Avenue
- Trial installation program annually 1990-1996
- Has been in excess of 75% of the capital sewer upgrading program annually since 1997



Mission Secondary Interceptor
Sewer - 762 mm diameter, 8.2 m
deep, installed 1935, relined with
CIPP in April, 1984



Mission Secondary Sewer

Re: Mission Secondary Sewer Upgrading
Tender No. PD 84-17

RECOMMENDATION:

That this report be received as information.

REASON:

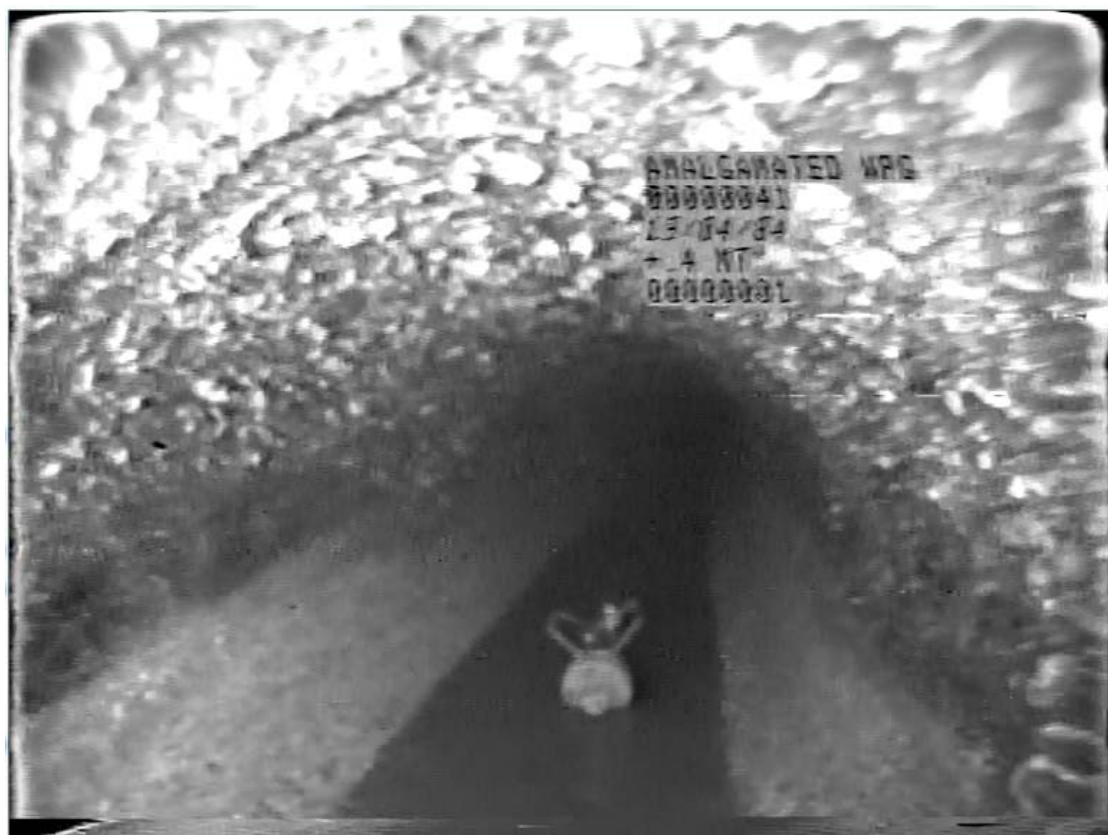
The Commissioner requested a follow-up report on the activities that took place during the construction of this project.

HISTORY

- 1980 Council approved \$200,000 in the 1980 Capital Budget for the upgrading of the Mission Secondary Sewer in the Mission Combined Sewer District.
- 1984 Council approved an additional \$180,000 in the 1984 Capital Budget to cover an estimated project shortfall.
- 1984 03 02 Award of contract to Dominion Construction & Arlington Lumber Ltd. in the amount of \$269,269.00 for the Mission Secondary Sewer Upgrading by the insituform lining process. The project contract documents stipulated that all upgrading works requiring the direct discharge of raw sewage to the Red River were to be carried out during the Easter long weekend only (April 20 to 22, 1984 inclusive) and on an around the clock basis.

\$1.77/m/mm of diameter

- Host pipe constructed 1935
- Suffered serious H₂S deterioration
- Worst industrial loads in city
- Relined with CIPP in 1984 during the Easter long weekend – Contractor from Ann Arbor, Michigan



Archibald_MA70028467_Pre Lining_April 19_1984

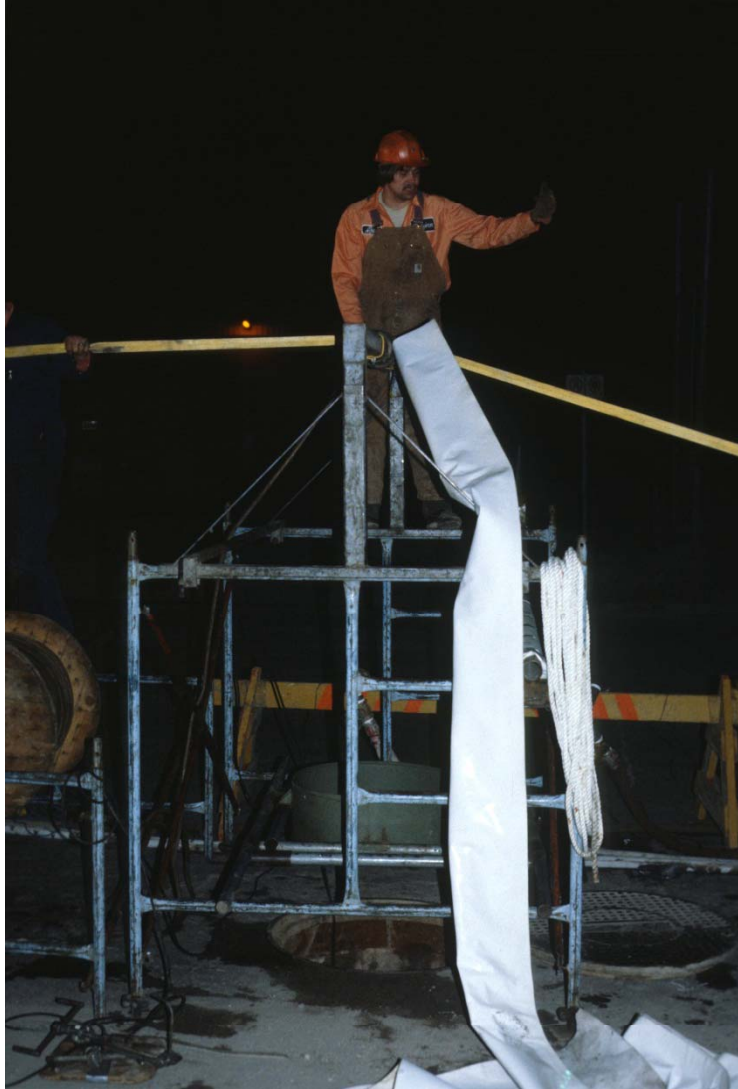
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Another conventional hot water cure with a standard unfilled isophthalic polyester resin

- Starting at 2:00 am on a Friday night and running until noon on the following day
 - Installation was challenging
 - 200 m (656 feet) of 21 mm nominal thickness tube in a 762 mm (30 inch) host pipe that was 8.2 m (27 feet) deep
 - While many of issues associated with the 1978 installs were resolved this was still pushing the limits of the day
 - How hot and how long do we cook these things for?
 - 12 hour cure followed by a 5 hour cool down



COM



A lot had transpired from 1978 to 1984 – liner design had commenced!

Street	Host Pipe Size (mm)	Liner Thickness (mm)	DR	Depth to Invert (m)	Spec Sheet on Resin		Current Design Standard Thickness (mm)		Actual Nominal Thickness
					Flex Modulus (Mpa)	Flex Strength (Mpa)	Partially Deteriorated	Fully Deteriorated	
Kingsway	454	6.0	76	3.76	1654	56.5	8.0	9.0	6.0
Richard	762	6.0	127	5.40	1654	56.5	15.5	17.6	6.0
Archibald	762	21	36	8.17	1654	56.5	18.2	21.9	21.0



1978
Kingsway

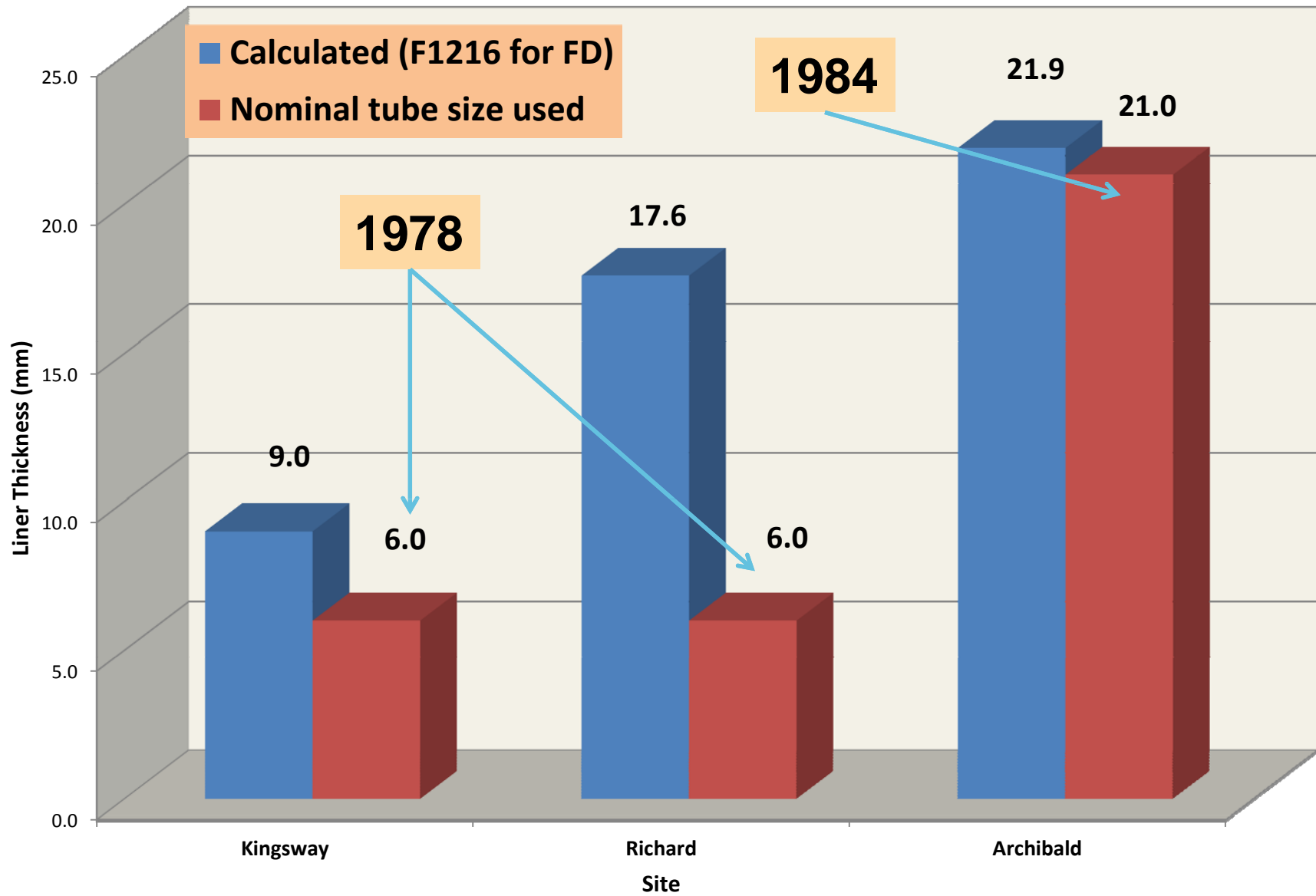


1978
Richard



1984
Archibald

ASTM F1216 Calculated versus Actual Nominal Tube Size Used



1978 Installs – sampled 2011



Figure 6: Kingsway and Richard CIPP Liners - sampled Dec 2011

Mission 2ndary Sewer (Archibald Liner) – Sampled 2013 – there is a lot more beef!

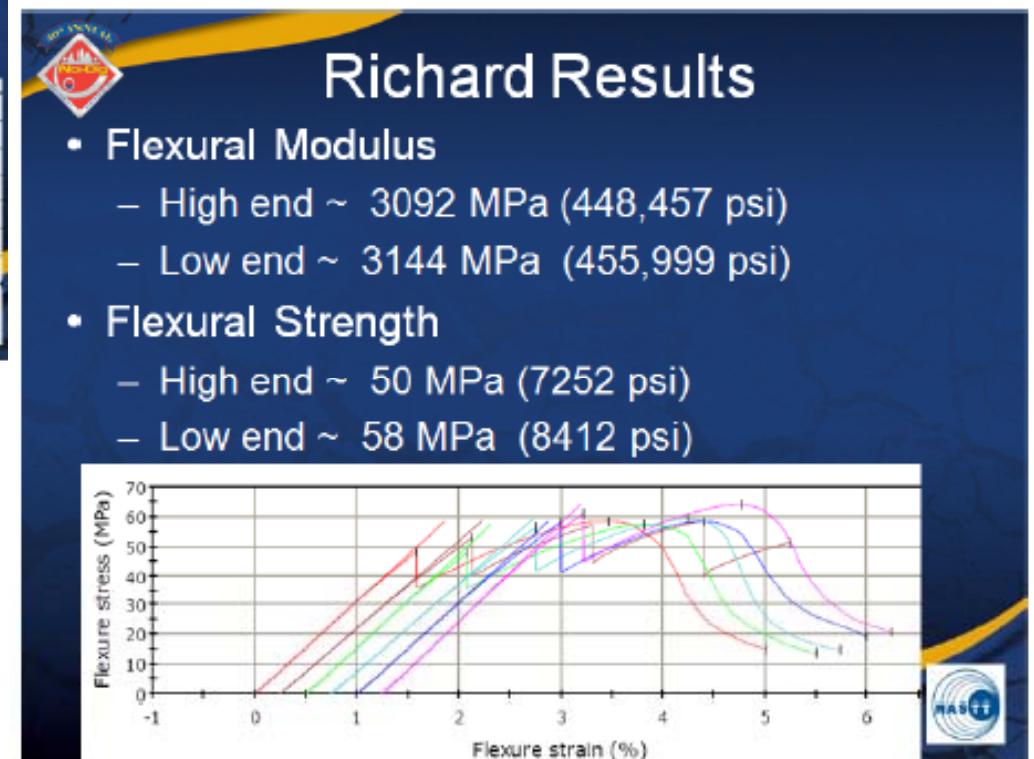
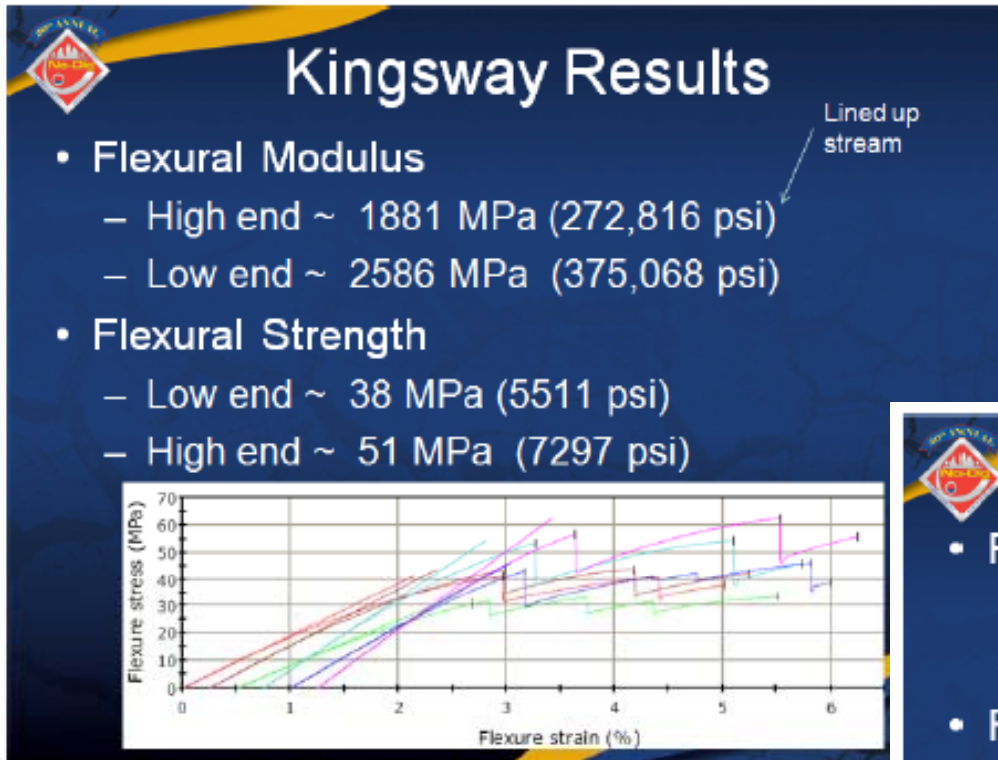


The only vintage spec sheet we have of the resin comes from the 1978 installs

Technical Properties		
Structural	Tensile Strength	4130 psi $2.8 \times 10^7 \text{ N/m}^2$
	Flexural Strength	8200 psi $5.7 \times 10^7 \text{ N/m}^2$
	Modules of Elasticity	240,000 psi $1.7 \times 10^9 \text{ N/m}^2$
	Impact Strength	2 ft. lbs./in. 1.1 N-m/cm
	Shear Strength	7,400 psi $5.1 \times 10^7 \text{ N/m}^2$

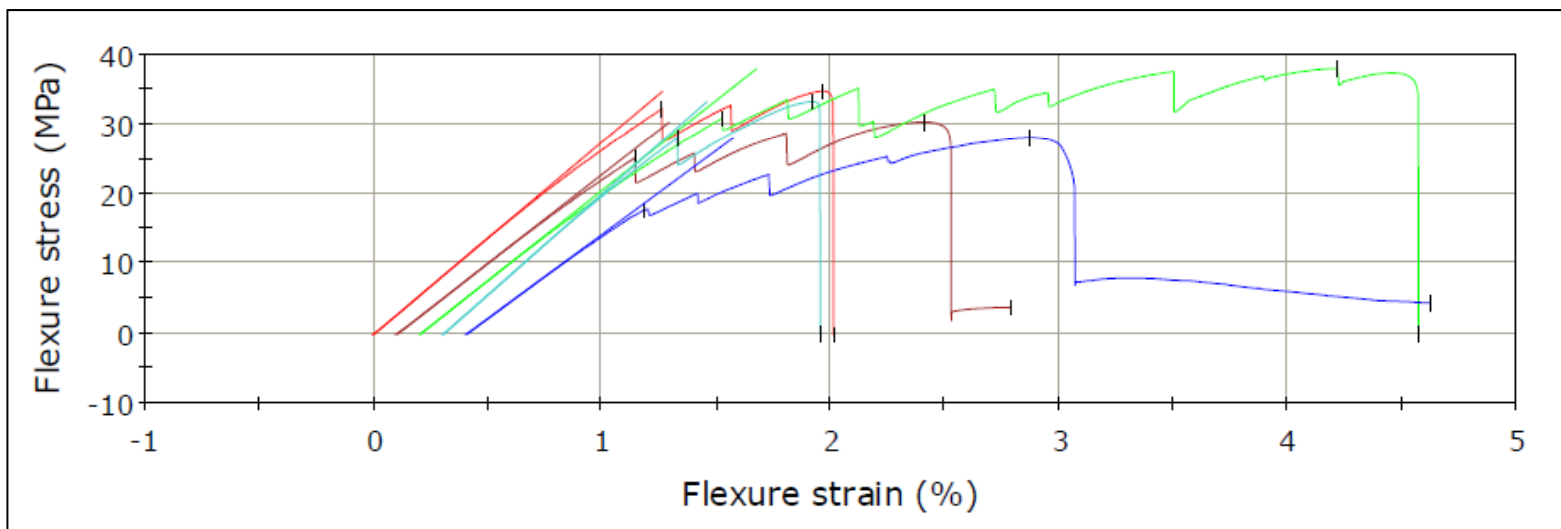
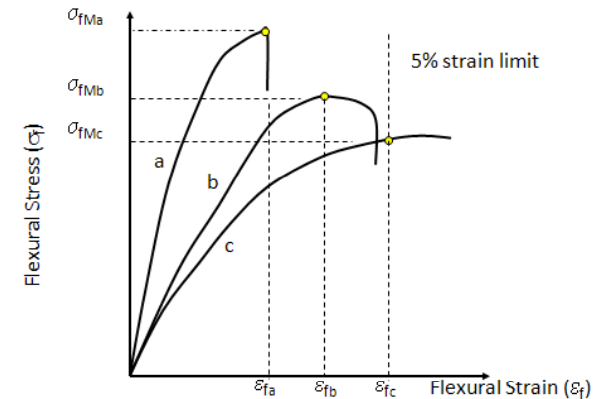
Based on discussions with Insituform and the 1978 spec sheets, all resins for these two projects were standard unfilled isophthalic polyester resins

The results for the 1978 installs were impressive...



Physicals for Archibald were excellent as well; *Well above ASTM F1216 min values*

- Average flexural modulus
 - 2621 MPa (380,186 psi)
- Average flexural strength (ultimate)
 - 32.8 MPa (4758 psi)
- Good resin/felt composite behavior (b/c Stress versus Strain curves)



Additional testing on Archibald liner showed quite a bit of variation across pipe wall

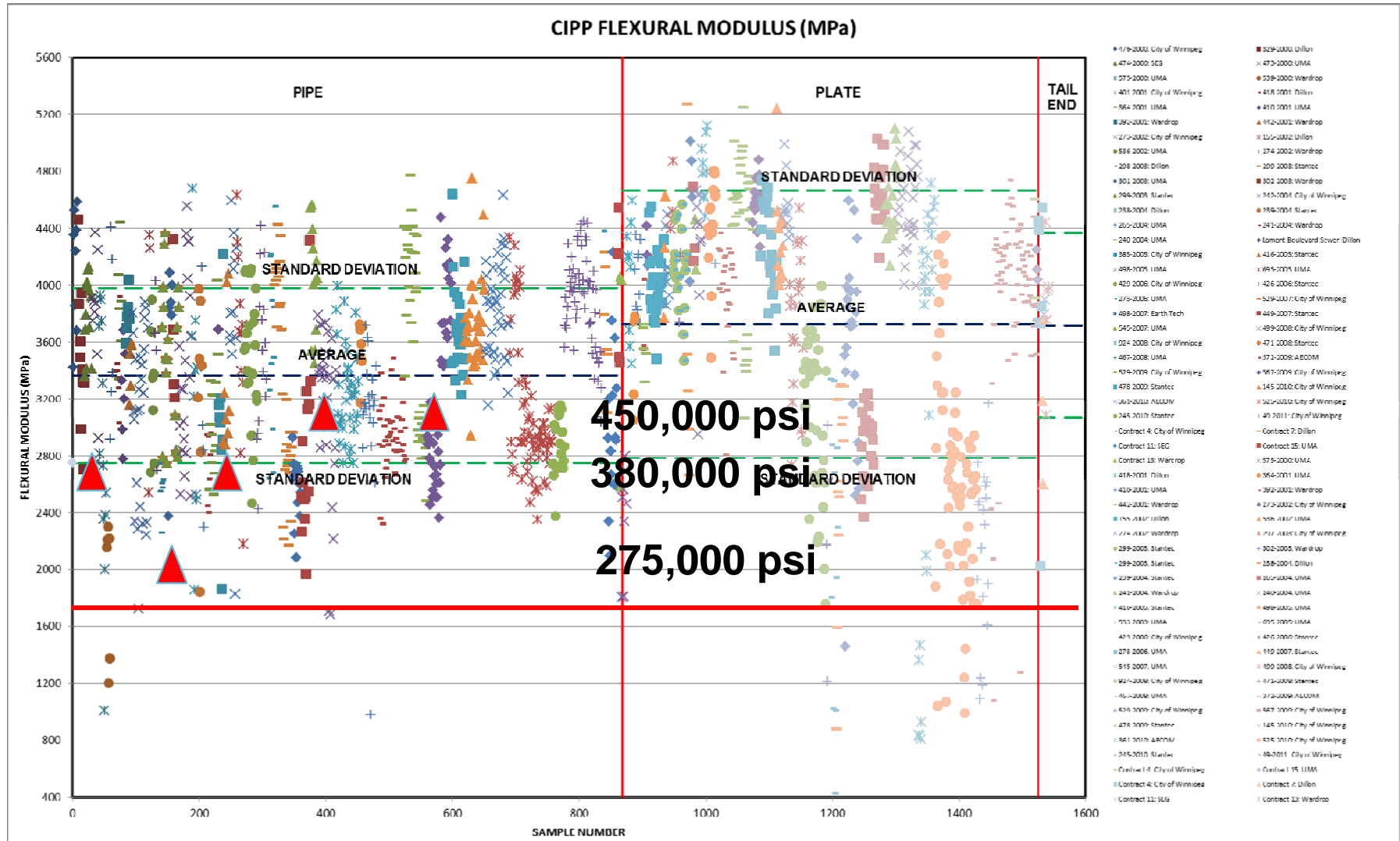
- Thin strips tested off the inner and outer surfaces
 - Varied from as low as 1388 MPa (201,334 psi) on outer surface to about 2397 MPa (347,694 psi) on inner surface
 - So some evidence that they were still trying to get a handle of full cure requirements



Rationalization of the design of the 1984 liner by present day standards is a little easier with than the 1978 liners

Street	Host Pipe Size (mm)	Liner Thickness (mm)	DR	Depth to Invert (m)	Actual Physicals		Current Design Standard Thickness (mm)		Actual Thickness (mm)
					Flex Modulus (Mpa)	Flex Strength (Mpa)	Partially Deteriorated	Fully Deteriorated	
Kingsway	454	6.0	76	3.76	2233	44.7	7.2	8.1	6.5
Richard	762	6.0	127	5.40	3119	53.9	12.6	14.2	6.4
Archibald	762	21.0	36	8.17	2621	32.8	15.6	18.8	22.0

At the end of the day, however, they are just typical values when reviewed versus all other testing from the past 15 years



1984 Post Lining

AMALGAMATED WPC
00000001
21/04/84
+100.0 MT
00000001

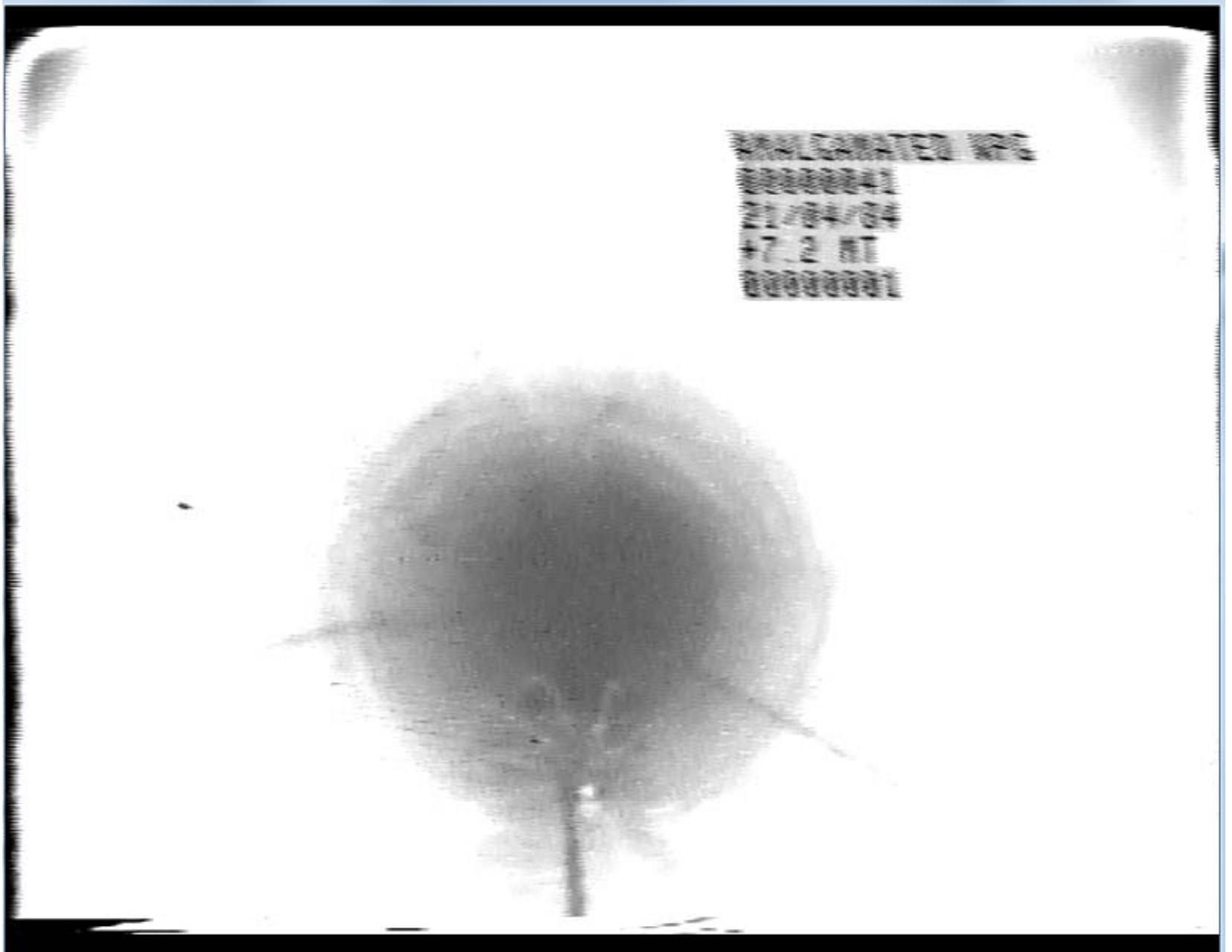


1984

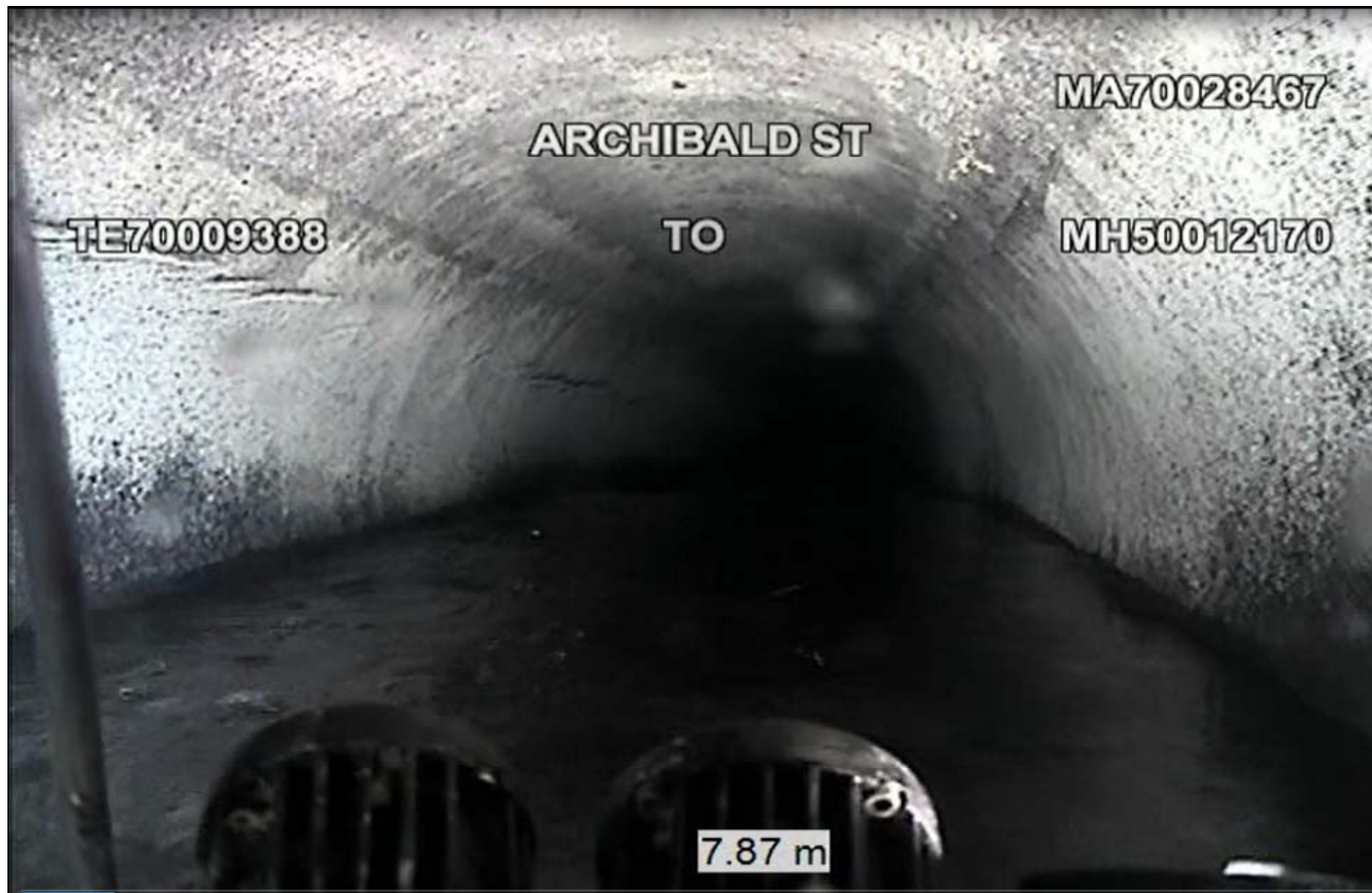
2011

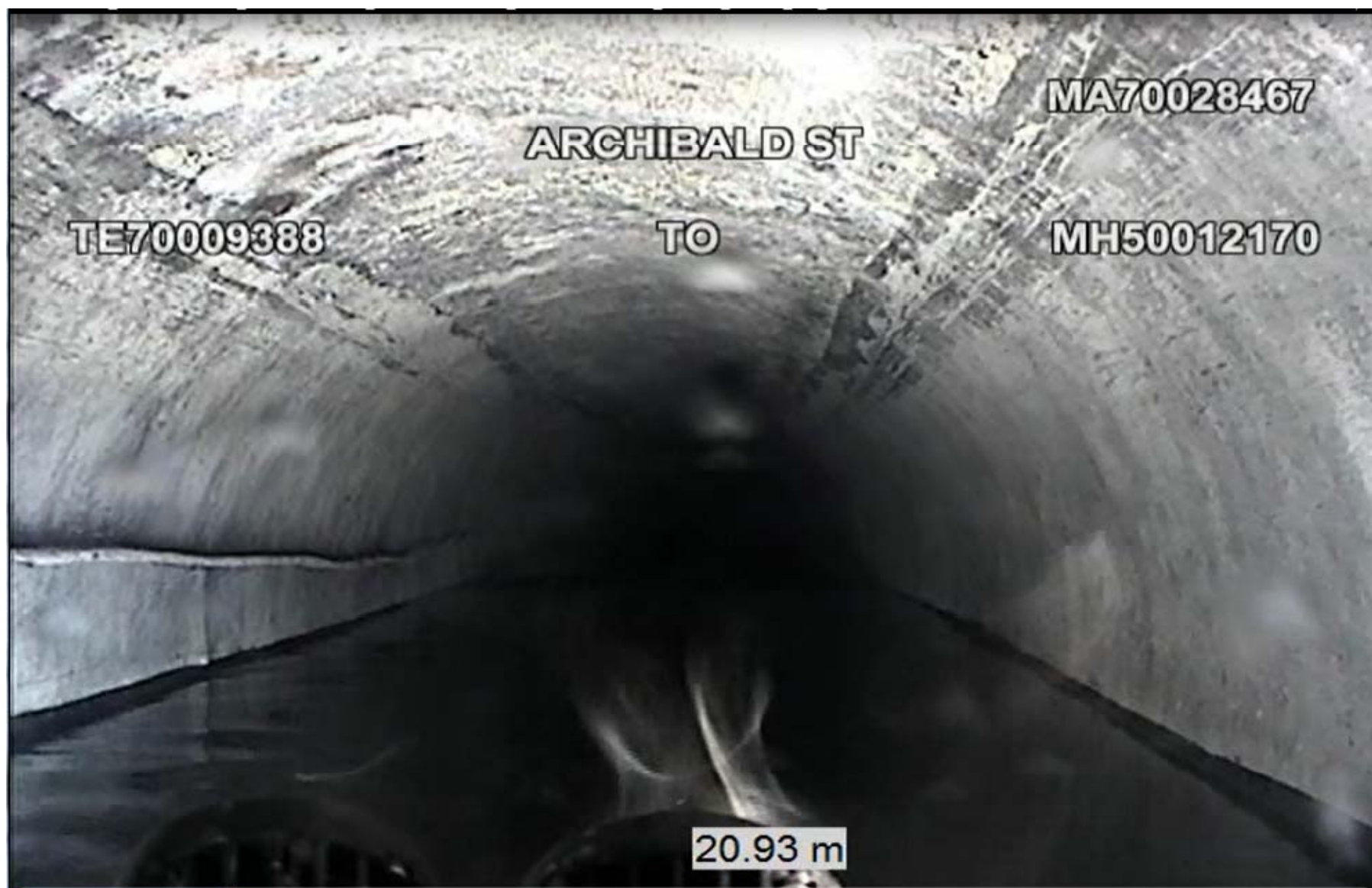


1984 – Post install off a Beta Max tape!



2011





ARCHIBALD ST

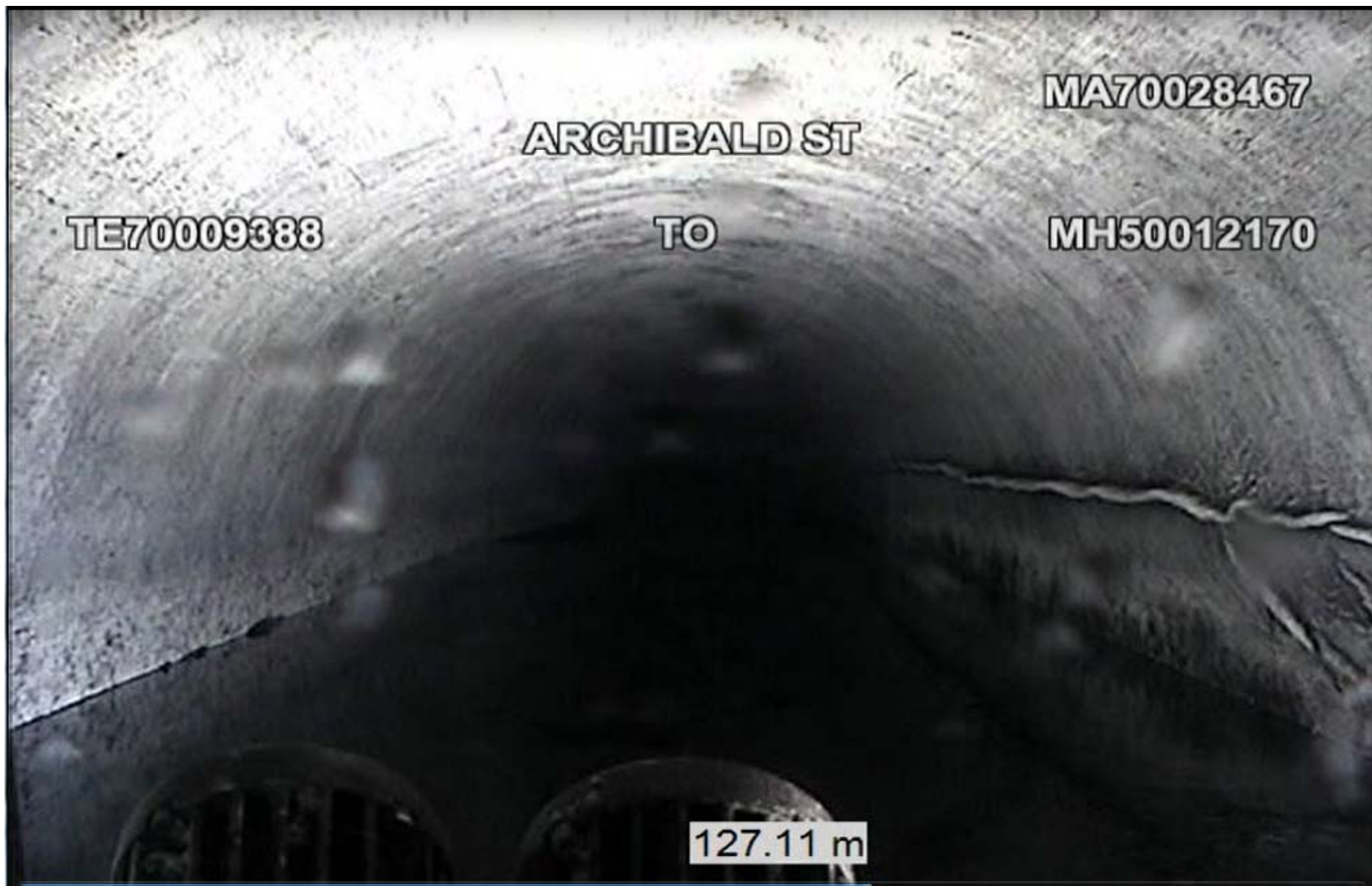
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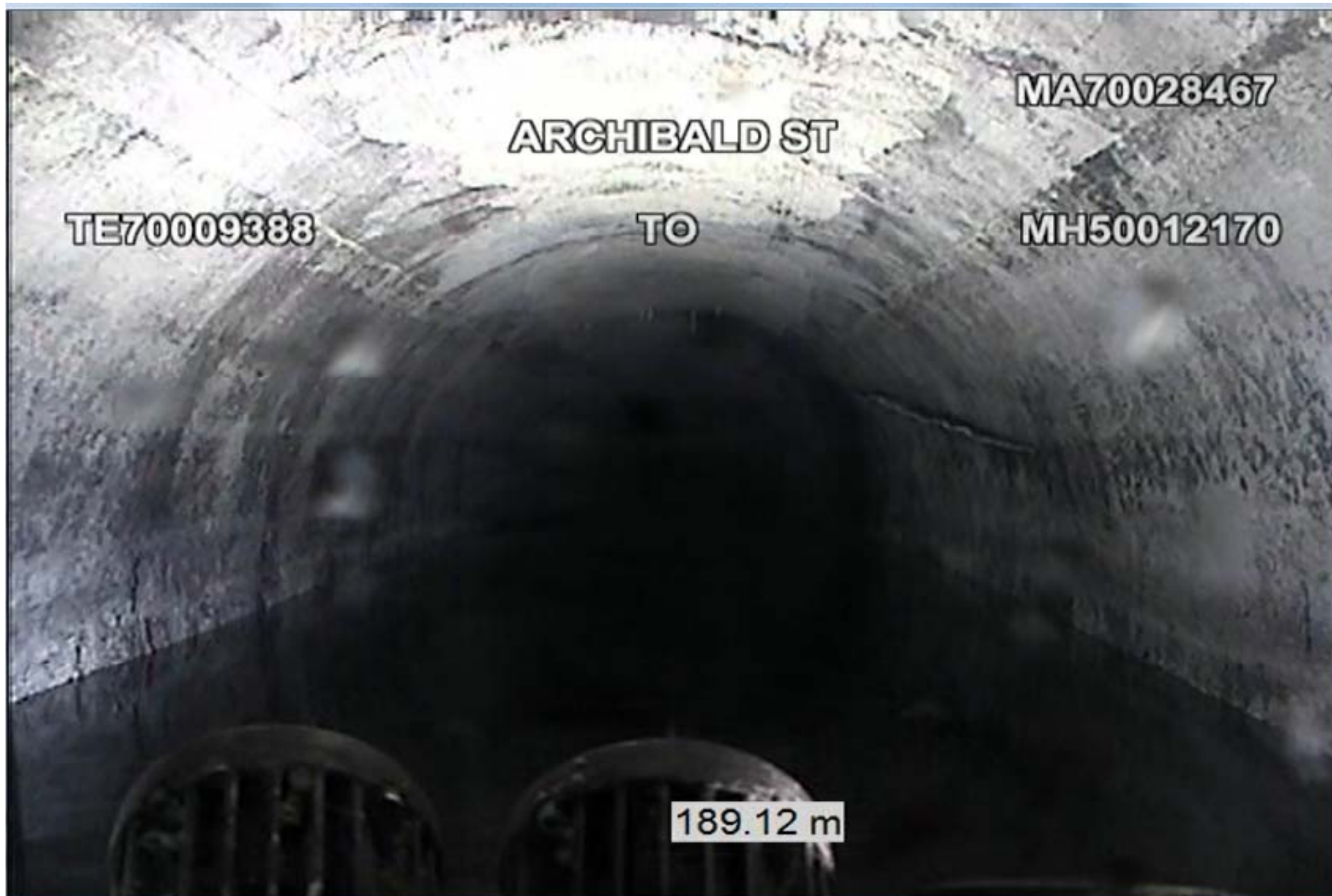
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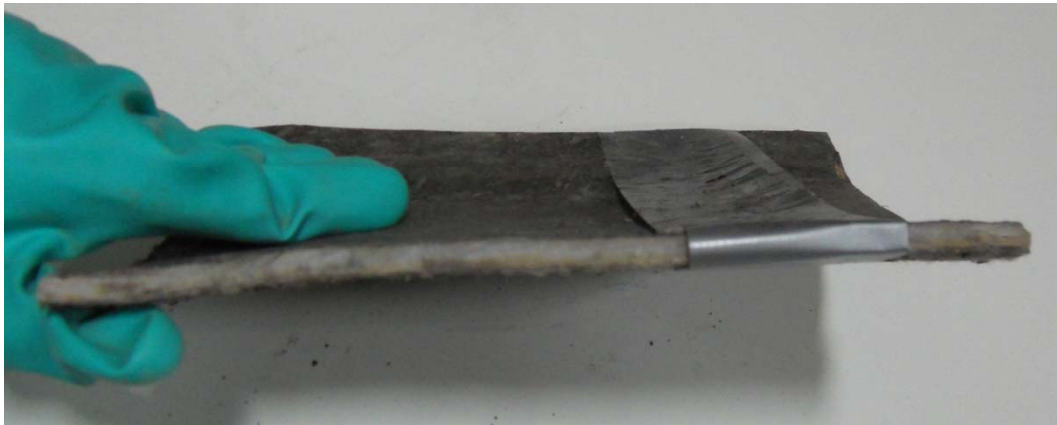
20.93 m





Summary

- 1978 CIPP – no design, but when installed well has “like-new” physicals and no signs of degradation
- 1984 CIPP – designed, has serious applied loads and ugly, ugly sewage load.
 - Physicals “like-new and no sign of material degradation whatsoever as well!



Queries... chris.macey@aeacom.com



Tera-tons of thanks to the City of Winnipeg, Water and Waste Department; their foresight from many years ago and sticking with it today to provide immense insight into the future of CIPP!

And Insituform installed all these liners!!

