Introduction
The recent advances for assessing the remaining life of ageing water and sewer pipeline systems are a key area for the development of a future maintenance plan. One method that has been employed is the replacement of pipelines after a certain number of pipe ruptures have occurred. However, proceeding with this method results in the replacement of up to 90% of pipeline in good condition.

The most cost-effective method on the market today is to use p-CAT™, which is able to identify these key locations of potential failure, saving the cost of replacing whole pipelines.

How does p-CAT™ work?
A controlled pressure wave is injected into the pipeline, and monitored by sensors installed on existing pipe fittings. The transient wave experiences partial reflection when it encounters any change in pipeline structure. These changes include known system components and other concerning issues related to pipe deterioration.

p-CAT™ signal analysis uses two main techniques:
• Sub-Sectional Pipeline Condition Assessment
  Assessing the level of pipe deterioration in a sub-section, to 10 m spatial accuracy.
• Localised Fault Detection
  Analysis of significant anomalies such as air pockets, blockages, the sealing status of valves and unknown pipeline features.

Water Main

Project
This aging pipeline was selected as a section of interest as it had a history of leaks and is considered critical infrastructure with a predicted large demand in the near future.

Pipeline Details
Pipeline Material: OD 965MSCL
Installation Date: 1982-1983
Testing Undertaken: 2016

Water Main Results
The pipeline wall condition was identified during the p-CAT™ analysis:
• The pipeline was found to have a remaining wall thickness of between 74 to 89%.
• Two HIGH priority anomalies representing the presence of large pockets of permanently entrapped air were identified during the signal analysis.

Sewer Main

Project
This pipeline was identified as a section of interest as it was one of only two sewer mains supplying the area. The other sewer mains was intended for replacement and so the condition of this pipe was of interest.

Pipeline Details
Installation Date: Unknown
Length of pipeline: 1.2 km
Testing Undertaken: 2016

Sewer Main Results
The pipeline wall condition was identified during the p-CAT™ analysis:
• The pipeline was found to have a remaining wall thickness of between 63 to 90%.
• Six HIGH priority anomalies representing zones of permanently entrapped air of various lengths were identified during the signal analysis.

Conclusion
P-CAT™ was able to be successfully applied to not just water but also sewer mains resulting in the assessment of pipeline wall condition and the identification and locations of anomalies including zones of entrapped air.

Acknowledgements
This work was undertaken with the support of the involved water authorities whom provided information on the infrastructure and helped facilitate the testing.