NEW ENGLAND WATER WORKS ASSOCIATION
ORGANIZED 1882

VOL. CXXX | June 2016 | NO. 2

Case Study: Using Direct Condition Assessment to Improve Your Infrastructure Asset Management Plan

By Edward Brain* and Chris Garrett**

Received June 22, 2015

ABSTRACT

Like many other utilities the City of Mount Pleasant in South Carolina were not overly concerned for the condition of their forcemain infrastructure until late 2009 when they had two mains breaks, with the obvious consequences to the environment and local publicity. They acted as a proactive utility and initiated a system that used attributes from the GIS to start an Asset Management Program. After the information was compiled and analyzed, it was obvious that they needed more information on the Direct Condition Assessment tools available to further their program.

The City contracted Brown and Caldwell to develop a Force Main Condition Assessment Guidance Document, which was designed to review the inventory of force mains, conduct a criticality assessment and start a program to evaluate the condition assessment tools available on the market with budgetary cost estimates for a condition assessment program versus a typical replacement program. Initially Mount Pleasant had a budget of about $300,000 per annum for rehabilitation and replacement. Based on the 10 highest risk force mains, the Guidance Document recommended that there would be a replacement cost of nearly $4M or a condition assessment program cost of $500,000.

The Document clearly identified a particular 16" force main as the best candidate for inspection and indicated that it had a distinct probability of failure based upon its history of six crown corrosion failures. The City was also concerned that a failure could lead to significant environmental spillage with a subsequent financial fallout and inconvenience for local clients. In 2012, Mount Pleasant contracted PICA to do a Direct Condition Assessment of this 4,200' long 16" ductile iron Forcemain.

The PICA SeeSnake tool directly measures the pipe wall thickness changes 360 degrees circumferentially around the pipe and along the complete length in discrete increments to form a high resolution profile of the pipe to locate and size different pipe features, including pitting, graphitization and general wall loss. For reasons of local logistics the pipe was inspected in two sections. The first section spanned ~2,940 feet; the second section spanned ~1,355ft. The SeeSnake has the capability of running with the flow of water and usually it isn't required to dewater the line, however it was decided that due to logistics of the longer section that tethering would be the best method and each section of the line was dewatered and the tool was tethered and pulled through using winches.

Being a Pilot Project, the condition assessment of this line required the cooperative efforts of the engineering and field staffs of the City, Brown & Caldwell and PICA. As this line was not incorporated into any GIS system explicitly, it was logically understood that some sections of the

*Edward Brain, Technical Sales, PICA Corp., 134 Maywood, Ponte Claire, Quebec H9R 3M1 Canada, (514) 703-9009, ebrain@picacorp.com
**Chris Garrett, Manager, PICA USA, 801 Brickell Ave., Suite 935, Miami, FL 33131, (800) 661-0127, cgarrett@picacorp.com

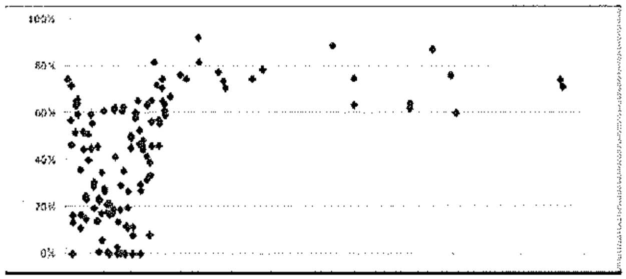

Figure 1: Location and depth of defects found in the Simmons Road force main

pipe should be in better overall condition than others. The reasoning behind this understanding was sound: These sections were at a local low point and always under pressure. This area of pipe saw little pressure variance compared to the other sections. Furthermore, the sections considered to be good had not experienced any failures. The failures that had occurred elsewhere on the line had taken place farther downstream and likely due to anaerobic conditions causing internal corrosion.

Results

Although all expectations and reasonings were based upon sound judgement, the outcome of what was found in the pipeline was to be in almost the exact opposite. The pipe that was thought to be good was found to be heavily corroded and susceptible to failure. PICA found eight areas of through-holes or near through-hole corrosion pits along with a plethora of additional medium and deep-sized corrosion pits. The area with dense corrosion was uniform for the first ~550 feet then after that the deep corrosion subsided. The remainder of the pipe (approximately 3,650 feet) had superficial damage that was measured with a wall thickness of at least 60% of the original pipe wall.

A scatter graph representation of the corrosion can be seen in Figure 1, the depth and position of the corrosion pits is shown by the blue diamonds. The X-axis depicts the complete length of the inspected pipe ~4,200 feet with 0 feet at the left. The Y-axis represents the depth of the pit as a percentage of the remaining pipe wall with the dots on the x-axis constituting through holes or extremely deep pits. Presenting the data in this form it is very evident that the first ~550 has experienced a different environment than the remaining pipe.

Verification

It is without doubt that the results were a surprise to everyone. Brown & Caldwell reasoned that it would be beneficial to do verification digs to confirm the PICA results. PICA put together dig sheets and sent a technician back to South Carolina to assist in the location of certain defects. The third pipe length tested had shown multiple deep defects and was located in an area that could be exhumed easily.

The pipe was exhumed by a local civil contractor and brought to the yard for cleaning and inspection. During the power wash a large graphitized plug fell out revealing a 2" x 4" hole within a few inches of the exact location indicated by PICA.

Constructing a New Hypothesis

The outcome of the results meant that everyone had to go back to the proverbial drawing board to better understand the mechanism that causes the corrosion to be surprisingly prevalent near the low point of the line. Surveilling the surrounding landscape, it is noticeable that the area heavily affected by corrosion is near the marshlands and tidal estuaries, as seen in Figure 3, the section in red corresponds to the approximately 550 feet of heavily corroded pipe. The line highlighted in green is actually the line that experienced much less corrosion showing that as the line leaves the marshland the corrosion likelihood decreases. Without any finite analysis it is suspected that the surrounding soil has a high corrosive nature with the added change in tides accelerating the corrosion activity.

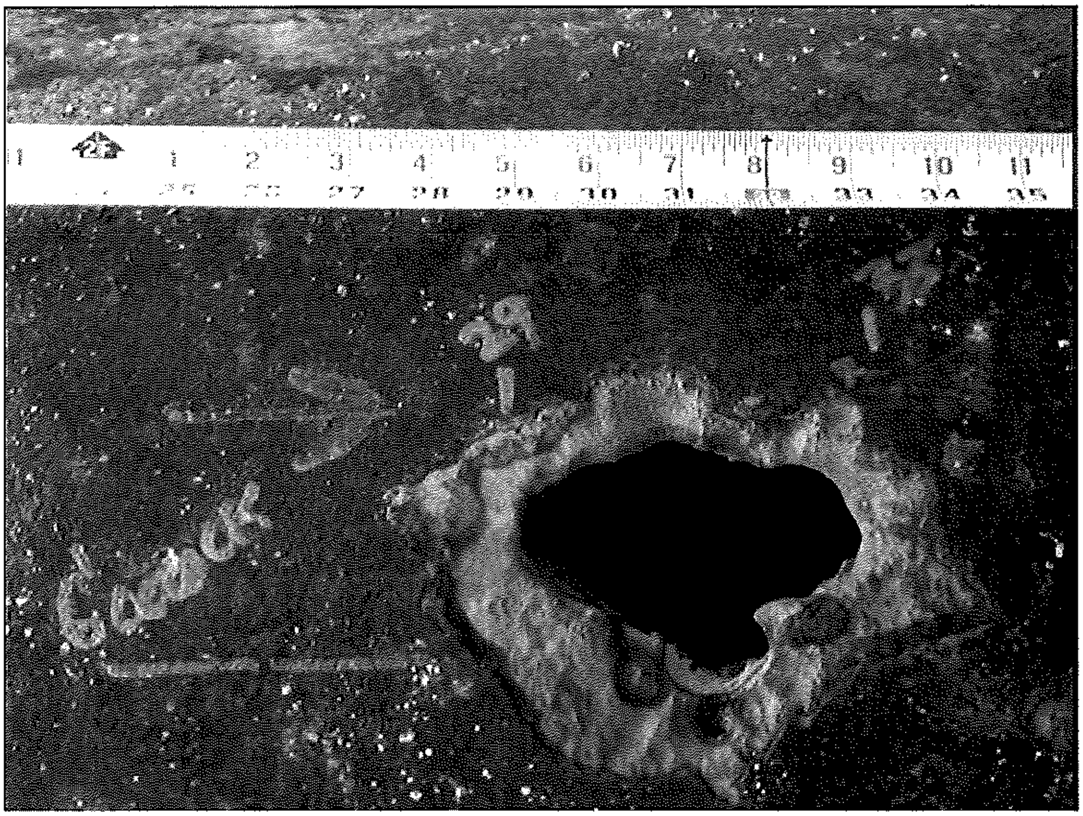

Figure 2: The through-hole located in Pipe 0030. While sludge and backfill had prevented any leaks here to date; the integrity of the pipe had been compromised due to corrosion

Figure 3: Satellite view of the 16" Force Main. The red section identifies pipe that is highly corroded; the green section identifies pipe that experienced minimal corrosion

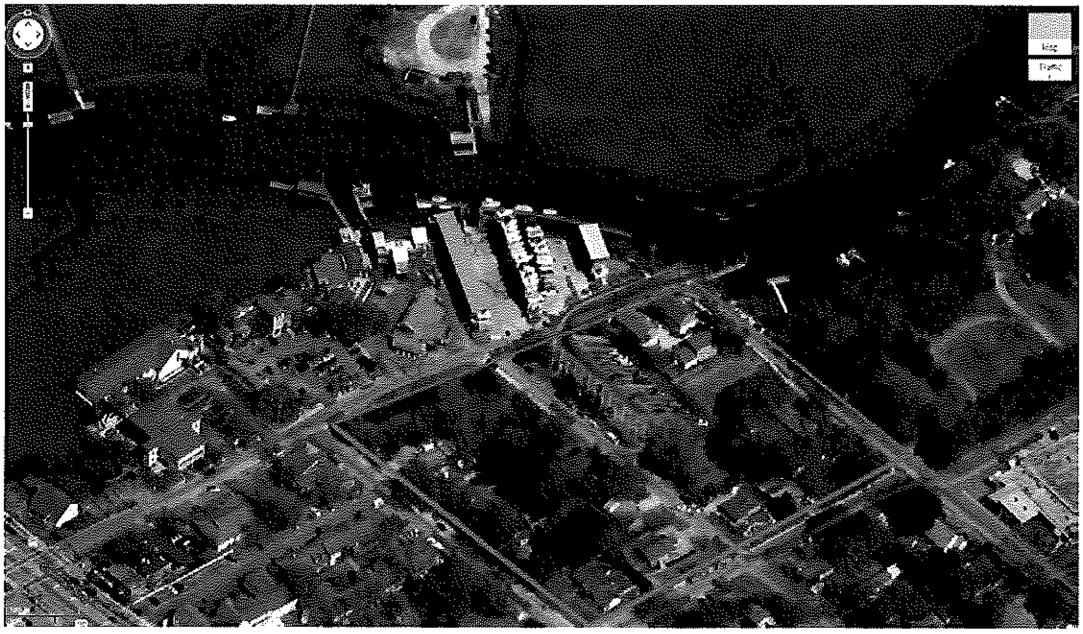

Figure 4: Satellite view of the new 20" PVC relative to the original DI pipeline. The PVC section is in blue

New Construction

It was a simple solution for the City of Mount Pleasant to re-engineer the pipeline and reroute a new line that detours around the areas causing high corrosion rates. The replacement was a 20" PVC pipe and re-routed to be farther away from the marshlands. As seen in Figure 4, the new PVC line joins up with the original 16" force main in an area that recorded very little corrosion.

Dollars and Sense

Based upon the results of this inspection, it allowed the City of Mount Pleasant to more effectively utilize money that had been allocated for rehabilitation of their pipelines. As an example prior to this Pilot Project this 4,200 foot force main was slated for replacement in the next five years due to condition concerns at a cost of $4M. As we see from the PICA data it is clear that only parts of the pipe need to be replaced and the actual replacement cost was $1.5M. The utility was able to save $2.5M.

Consequently PICA is scheduled to complete the inspection of 2 more sections (~28,000') of a critical 12" pipe and another pipe of ~25,000' is under consideration.