

“Benefits and Case Study of Integrated Sensor Surveys in wastewater collection systems” by Michael Blackshaw, AquaCoustic Remote Technologies Inc., Vancouver, British Columbia, CANADA (www.aquacoustic.com) and Dr. Arthur G. Self, Artana Solutions Inc. (www.artanasolutions.com)

AquaCoustic Remote Technologies Inc. (‘AquaCoustic.com’) specializes in surveys of assets such as trunk sewers, mine sites, hydro dams, reservoirs, ports, river crossings and bridge abutments using a wide range of sensor technologies. Our clients include civil engineering firms as well as asset owners throughout North America and overseas.

BACKGROUND

Ref. 1 estimates that collection systems in the U.S. have a total replacement value of between \$1 to \$2 trillion. Factors that impact the performance and efficiency of municipal sewerage systems are: design, construction, management, operations, and maintenance. A failure in any one of these areas can pose risks to public health and/or the environment. Ensuring adequate capacity and targeted rehabilitation relies on effective and continuous management and maintenance.

Aging infrastructure has driven survey technology in the direction of sensor integration using CCTV, Laser, Sonar, GPS, gas, and temperature sensing. Also, we have found that historical “as-built” drawings showing pipe sizes and other information may not be accurate. The costs for inserting a work platform, for a video only inspection, are already accounted for; the additional sensors are a small incremental expense and provide substantial benefits. Our proprietary inspection systems can provide comprehensive assessments of trunk sewers during operation. These models serve as valuable references for maintenance, emergencies, design and future expansion. Excavations and construction projects can also potentially damage underground pipes if their locations are not accurately known. Pipe Meander Mapping can help update utility maps and prevent accidental damage. Our sonar and laser pipe profiles can be integrated into design software so that our clients have a full-length 3D data that shows everything from level of restriction for hydraulic computations, losses in flow area, storage volumes and a total volume of solids that our clients can then share with their contractors.

AquaCoustic integrated sensors and platform approach

Typical information deliverables, from a sewer survey include:

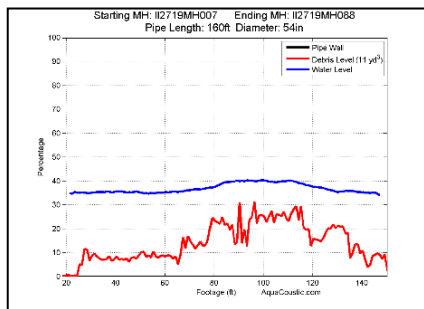
- Pipe location/track.
- Pipe cross-section measurements (e.g., ovality).
- High resolution imaging.
- Pipe restrictions, cross-section restrictions, erosion, encrustation, debris volume.
- Pipe storage capacity values, water levels.
- Any damage to pipes.
- “As-Is” pipe sizes.

CASE STUDY

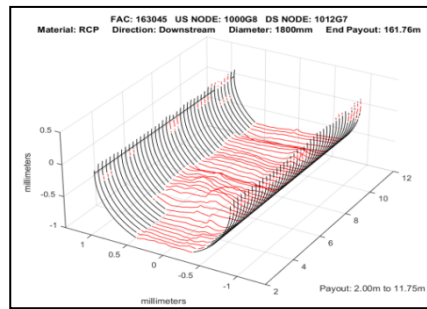
In this paper, we describe a survey in a small town of 12,000 people. The town knew they had an issue with about 4.9-kilometer/3 mile of trunk sewer. People's basements were being flooded, so the municipality knew the pipe capacity was impacted. They needed a condition assessment that included possible collapses as well as volume and position of solids in the sewer lines. The sewer line had not had a condition assessment in recent memory and there was no flushing program due to various difficulties.

In conjunction with a major engineering company, the town needed to put a bid package together for flushing and cleaning. After the initial budgetary numbers were calculated, the engineering company contacted AquaCoustic due to their experience with SONAR surveys. Due to the detailed information provided post survey, the client received bids that were 40% lower than the initial budgetary figure. The cleaning project was also completed in a fraction of the initial time line, thereby reducing traffic disruption and other cleaning impacts.

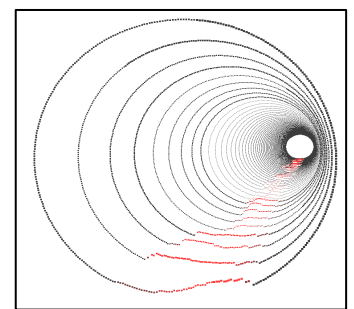
The survey took eleven (11) days to complete due to some of the difficult conditions, including buried manholes, high water levels, high debris levels and some equipment issues. Our four-wheel drive, steerable tractor and our pontoon float were used for this project. For the pontoon float, a tow line was established between manholes. Approximately 5,000 ft. of tow line and umbilical cable was available. The float was towed through the line collecting payout, CCTV and SONAR data. Additional information such as pipe sags, unmarked and buried manholes were noted.



Graphed Water Level and Debris Volume



Sonar Data Showing Sediment



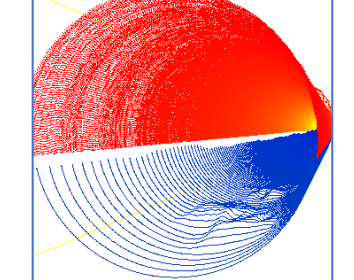
Sonar Data Showing Sediment in a Syphon

General Comments						
Station	Water Level	Water Temp	Water Velocity	Water Depth	Water Turbidity	Water Color
100	0.0	0.0	0.0	0.0	0.0	0.0
101	0.0	0.0	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0	0.0	0.0
103	0.0	0.0	0.0	0.0	0.0	0.0
104	0.0	0.0	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0	0.0	0.0
107	0.0	0.0	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0	0.0	0.0
110	0.0	0.0	0.0	0.0	0.0	0.0
111	0.0	0.0	0.0	0.0	0.0	0.0
112	0.0	0.0	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0	0.0	0.0
114	0.0	0.0	0.0	0.0	0.0	0.0
115	0.0	0.0	0.0	0.0	0.0	0.0
116	0.0	0.0	0.0	0.0	0.0	0.0
117	0.0	0.0	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0	0.0	0.0

MS Excel Worksheet Observations Table



Selected Frame Grabs of Defects



Merged Sonar (blue) and Laser (red), CAD ready point cloud data.

Key Client Feedback

Significant Cost Savings

- “Because of the information provided by AquaCoustic, a contractor was confident that they did not need to bypass pump. The project was accomplished with a savings of 60% of the estimated cost; it was a huge win for the client. And that was all due to the level of detail in the condition assessment data that we got from AquaCoustic.” (Author Note: this translated into 8 days of work versus the up to 6 weeks planned budget).

Integrated sensor scans

- “Your sonar equipment was able to give us accurate measurements per asset to 0.1 cubic meters of how much sediment was in each line. We were able to put that

information into a tender package for flushing and cleaning. Because we were able to put AquaCoustic's detailed report in the tender, we had a contractor who was confident; that they were going to be able to flush and clean without bypass pumping."

- 3.2) Laser profiling into CAD systems
 - "In terms of laser profiling you can integrate the laser profiles into CAD systems and put it right into a design software' so that we could have full length 3D pictures in our design system. It was really, really easy to read. It was a very good tool to pass on to the flushing contractors. We received no questions from any of the contractors about what they were looking at. It led to very detailed bids; everybody knew what they were getting into."

- 4) Delivered Reports
 - "AquaCoustic's reports are easy to understand, having never seen the laser graphs and printouts or the sonar printouts, I was able to pick it up easily. I do have an engineering background, I look at graphs more often than a layman, butit was laid out in such a way that you described each technology in the first few pages, and then you reiterated that and went through the data of each page."

References

1. EPA Condition Assessment of Underground Pipes April 2015 With excerpts from: Condition Assessment of Wastewater Collection Systems, EPA/600/R-09/049