

Update: Sound to the Ground

Jason Bromirski



With credit to: John Fishburne in developing the program working with Dr. Howitt to develop the hardware.

Agenda

Overview

Technology & Development

Current Employment

Future Utilization

Conclusion

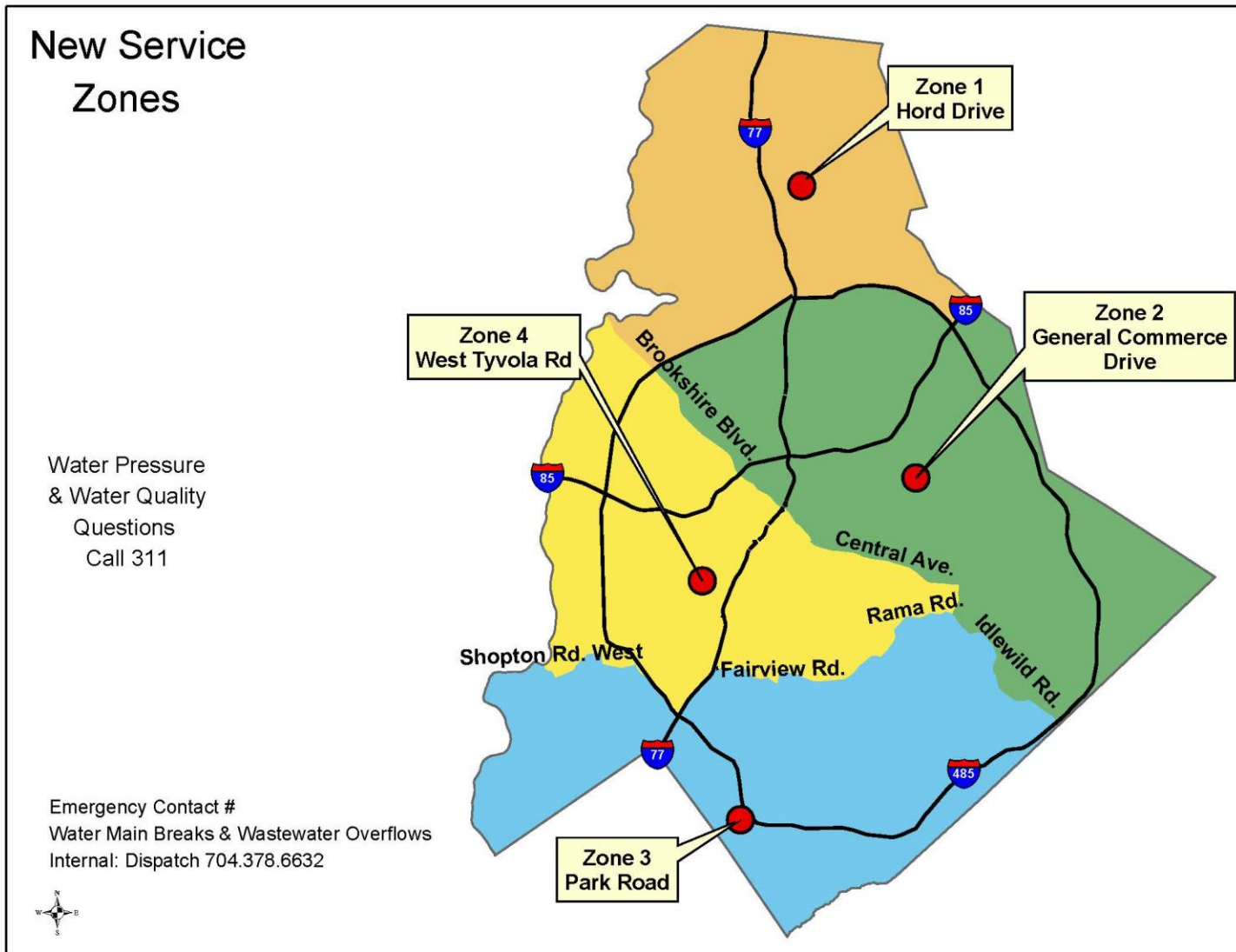
Overview



Overview



Overview

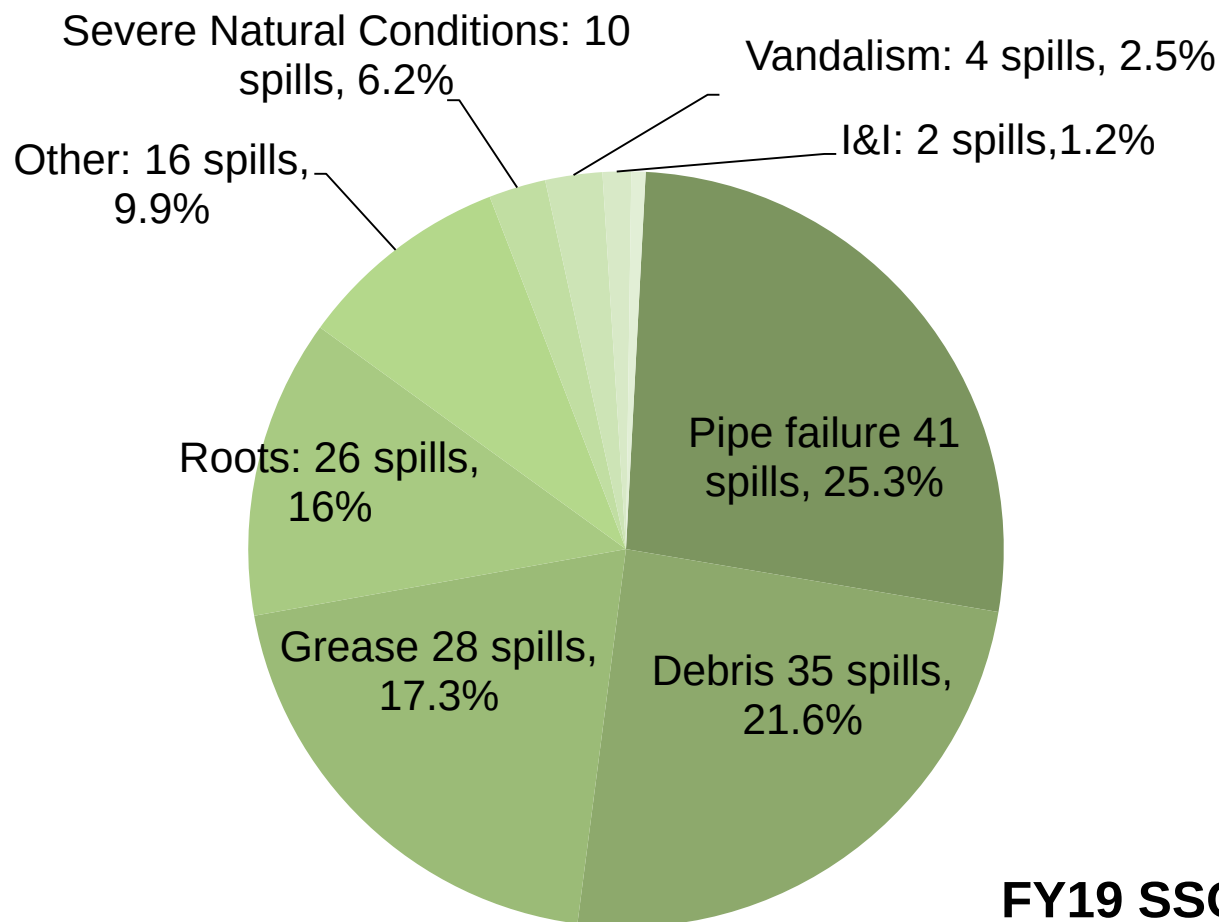


Overview

Charlotte Water's Collection System

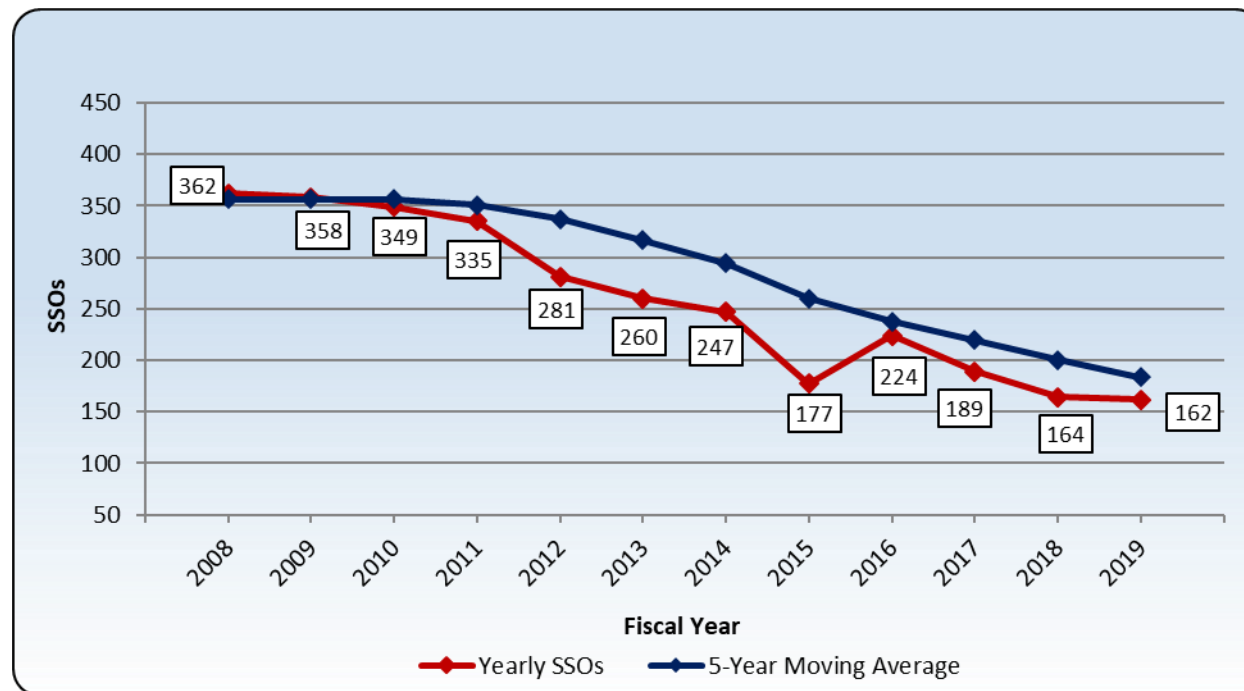
- 1 million+ residents, commuters, and visitors
- 546 sq mi in Mecklenburg County
- 1 city & 8 towns
- 341 Authorized Positions in Field Operations Division,
 - 959 Authorized Positions in Charlotte Water
- 4,300+ miles of Wastewater Main
- 268,000+ service connections
- 82 lift stations
- 162 SSOs in FY2019

Overview

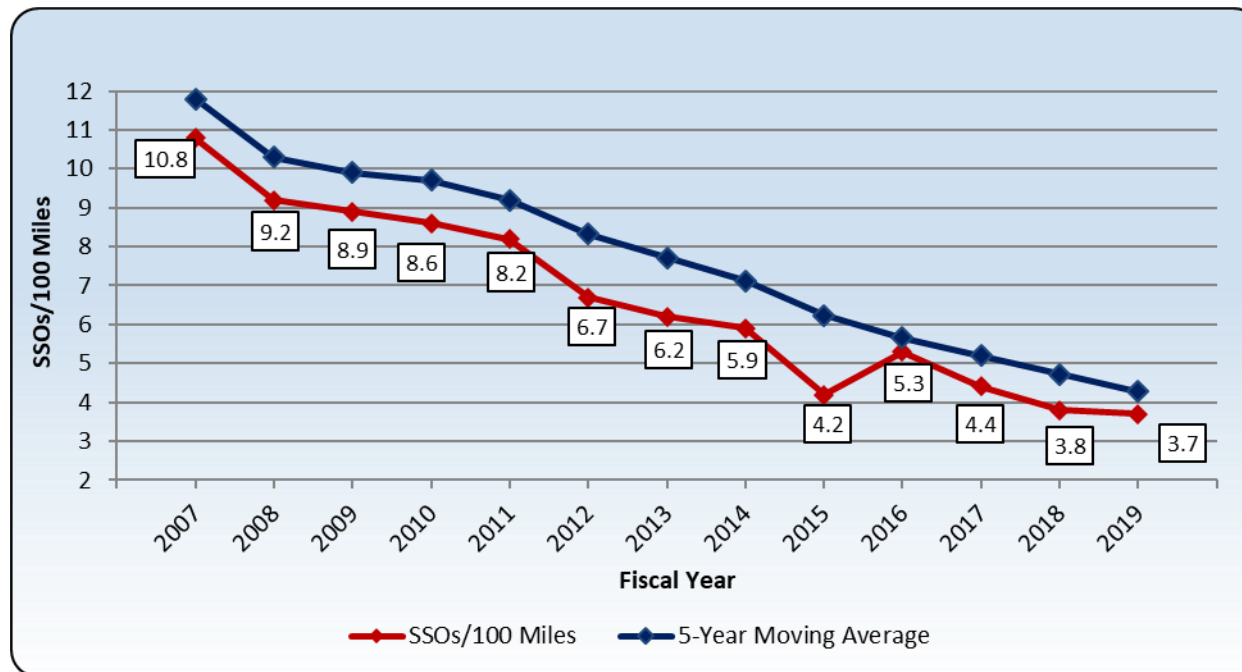


FY19 SSOs, 162 Total

Yearly SSOs vs 5-Year Moving Average



Number of SSOs/100 Miles vs 5-Year Moving Average



SSOs Caused By Nature, Contractor and Non-Operational Events

SSO Cause - Number of Spills:

Hurricane / Tropical Storm Florence - 8

Vandalism - 5

Contractor Hit Line - 5

Bypass Failure - 5

Construction Debris - 3

Low Pressure Sewer System (LPSS) – Vehicle Damage - 3

Incomplete Construction - 2

Fallen Tree - 2

Hurricane / Tropical Storm Michael - 1

Flooded Lift Station (Heavy rain event) - 1

Grand Total - 35

Technology & Development

Early Days of Development

- In early 2000s Charlotte Water, then Charlotte-Mecklenburg Utility Department (CMUD), was working on ways to minimize a growing SSO problem.
- In 2005 there was an initial meeting with UNC-Charlotte concerning a multitude of problems facing wastewater collection operators.
- Ivan Howitt, Ph.D., began researching wave propagation in gravity sewer lines with John Fishburne, PE.



Technology & Development

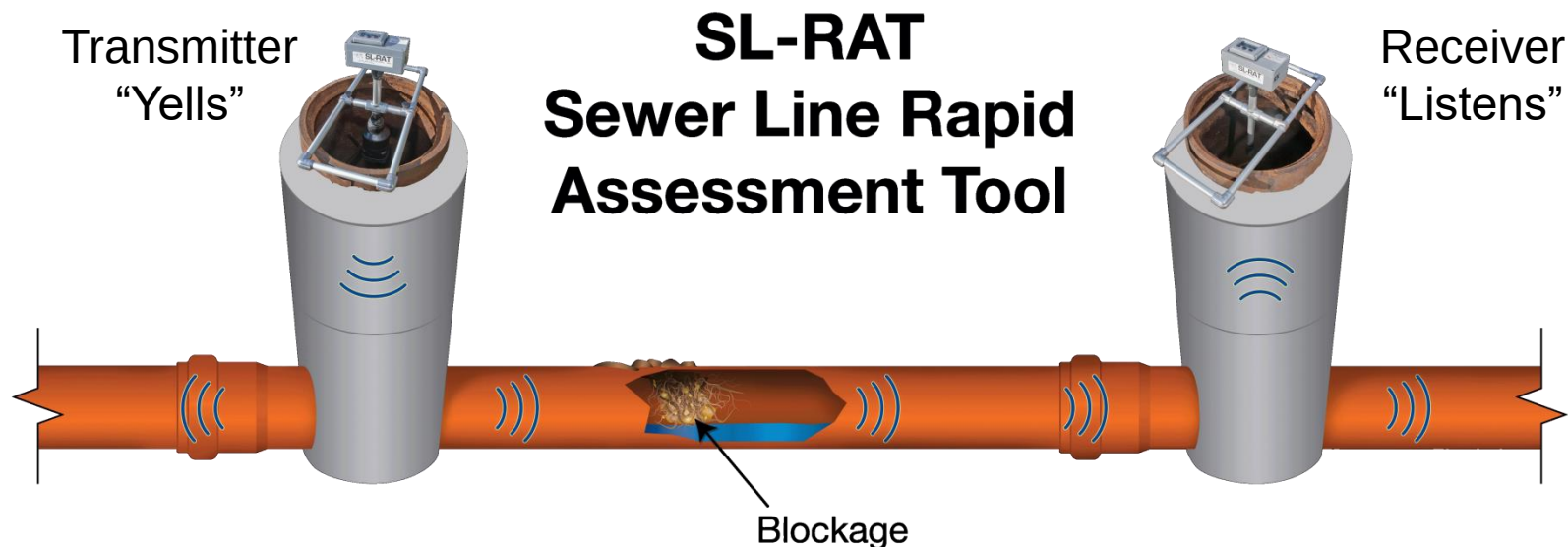
Early Days of Development

- In late 2006 CMU signs Consent Agreement/Final Order with USEPA Region IV, neither confirming nor denying allegations in agreement.
- Main focus of CA/FO was to reduce the amount of SSOs occurring in the collection system.
- At the time **grease** constituted over 50% of SSOs by cause, followed by **roots** at nearly 25%
- FY2007-419 total SSOs, 10.8/100 mi
- FY2019-162 total SSOs, 3.7/100mi
- 2.0/100 mi is the goal

Technology & Development

Acoustic Inspection Design Concept

- Sewer Lines – Natural Acoustic Wave Guides
- Obstructions – Acoustic Signals Absorb & Reflect
- Diagnostic Tool – Evaluates Aggregate Blockage



Technology & Development

Acoustic Inspection Design Concept

- Prototype circa 2007
- Audio Transmitter
 - Custom Speaker
 - Audio Amplifier
 - Sound Source
- Audio Receiver
 - Audio Spectrum Analyzer
 - Recorded to NetBook via USB Cable



Technology & Development

Sewer Line Segment Assessment Process

- Assessment Time
 - Measurement <30s to 2min
 - Setup time - Variable



Technology & Development

SL-RAT Beta Test

- Jonathan Beam (CMUD) circa 2009



Technology & Development

SL-RAT Current Test

- Ron Eversley (CLTW) -- 2018



Technology & Development

SL-RAT Current Test

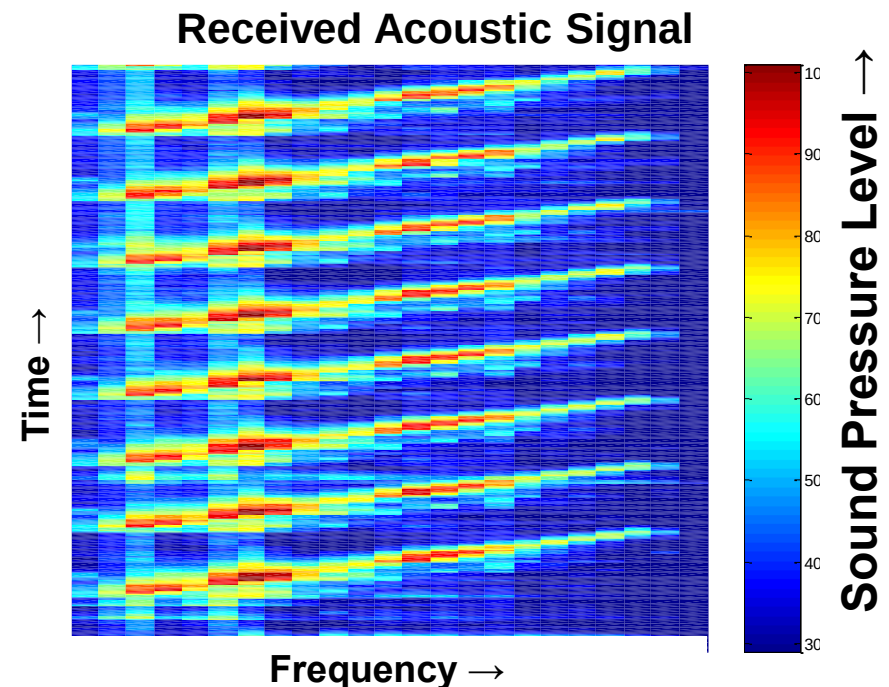
- Ron Eversley (CLTW) -- 2018



Technology & Development

Sewer Line Segment Assessment Process

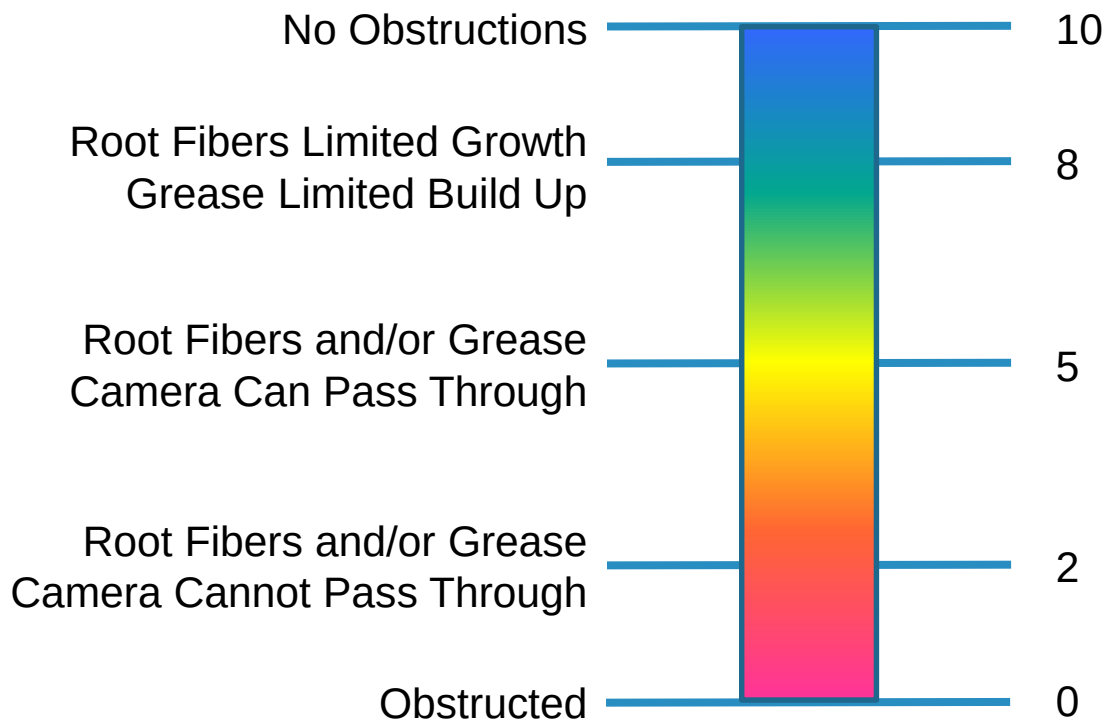
- Blockage Assessment Algorithm
 - User Input – Segment Length
- Received Acoustic “Signature” vs. Anticipated Signature
 - Assessment Measures
 - Blockage Probability
 - Measurement Confidence
 - Decision Support System



Technology & Development

Sewer Line Blockage Assessment

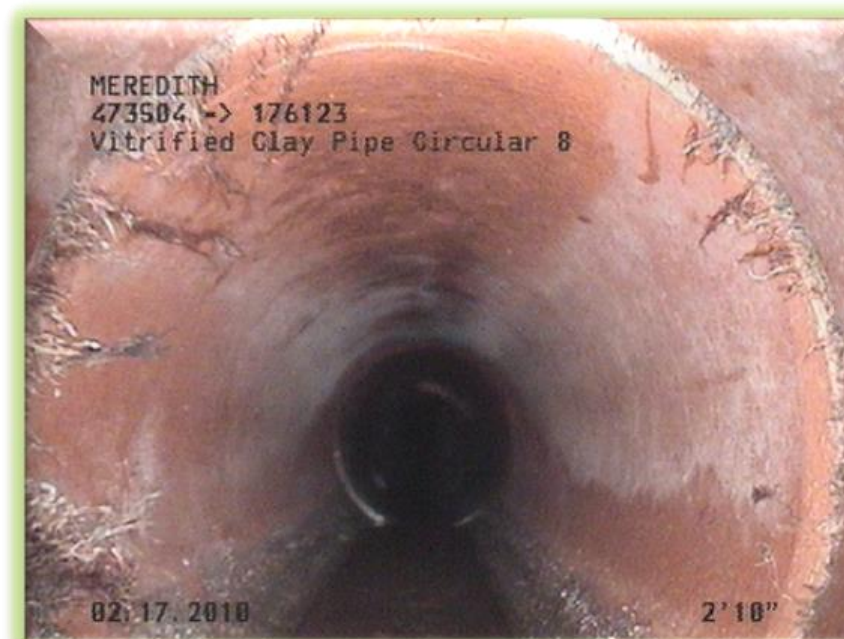
- Confirmation with CCTV



Technology & Development

Sewer Line Blockage Assessment

- CCTV Blockage Assessment – 10



Technology & Development

Sewer Line Blockage Assessment

- CCTV Blockage Assessment – 7



Technology & Development

Sewer Line Blockage Assessment

- CCTV Blockage Assessment – 5
- Camera able to travel through roots



Technology & Development

Sewer Line Blockage Assessment

- CCTV Blockage Assessment – 2
- Camera unable to travel through blockage



Technology & Development

Sewer Line Blockage Assessment

- CCTV Blockage Assessment – 0
- Complete blockage, impassable



Technology & Development

Evaluation for Implementation

- John Fishburne made business case for future expansion
- Evaluated in 2012:
 - SL-RAT vs. CCTV accuracy – Repeated Measurements and analyzed to increase confidence in 1st test
 - Costs per linear foot – \$0.09/ft. tested
 - Productivity levels – varied between 5-28 tests daily avg.
- Evaluation in 2018:
 - SL-RAT vs. CCTV accuracy – Known areas where sags in line exist increase confidence
 - Costs per linear foot – \$0.09-\$0.23 actual testing
 - Productivity levels – varied between crews: 21 tests highest avg.

Current Employment

Inspection Crew

- 3 Teams, Total of 6 personnel
- Use UTVs for rough terrain and transport around inspection area
- Visually inspect manholes while acoustic test is being conducted
- Report surcharging/standing manholes and issues needing immediate attention



Current Employment

Employment Utilization

- Sanitary Sewer Overflow (SSO) follow-up
- Current Operational SOP is 1,000 LF radius from spill must be cleaned
- SL-RATs used to minimize area cleaned



Current Employment

Employment Utilization

- Holiday “Blitzes” and other cleaning “Blitzes”
- Helps to identify areas that need cleaning more than others. Rule out areas that are already clean
- SL-RATs used to focus blitzes on areas needing cleaning the most



Current Employment

Employment Utilization

- Preliminary condition assessments, basin approach
- Some areas in overgrown ROWs have not been cleaned and assessed by Field Operations Zones in recorded files
- Inspection Crews assess the condition of line using SL-RATs and determine if cleaning is needed or can be postponed
- New “donated” systems in subdivisions need to be assessed due to no 1-year developer warranty



Future Utilization

Expand Usage

- Additional crews or contracted crews employed
- Newer technology
- Emerging technology
- Increases in productivity
- Greater integration with planning of jobs and SSO response

Conclusion

Any Questions?