Using Acoustic Inspection to Prioritize Sewer Cleaning

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PRESENTATION OUTLINE

• Acoustic Inspection Overview
• Acoustic Inspection Economics
• Case Studies
• Conclusion
WHAT IS THE PROBLEM?

• Overflows are a Symptom – Not the Problem
PROBLEM: INFORMATION

- Cleaning a pipe costs about the same as inspecting a pipe.
- >80% of pipes less than 12”, accounts for >90% of SSOs.
- Historical GIS – Helpful – But Insufficient.
- Where & When to Deploy Cleaning Resources.
- Cost Effective & Timely Condition Information.
INSPECTION METHODS

Manhole Inspection

Push Camera

ACOUSTIC

- CCTV/Robotic Camera
- Pipe Wall Defect Scanners
- Pipe Profiling / Robotic Multi-Sensor

Zoom Camera
INSPECTION METHODS

Acoustic
Blockage
Pipe Condition
Pipe Wall Defect
Detailed Pipe Profiling
Wastewater Pipe Condition Assessment
Applications

Inspection Resolution

Relative Cost

Contact with Flow:

No Contact with Flow:

Manhole Inspection
Zoom Camera
Push Camera
CCTV

OWEA Collection Systems Workshop
May 14, 2015 – Lewis Center, OH
ACTIVE ACOUSTIC PIPE INSPECTION BACKGROUND

- Patented technology
- Gravity-fed sewer focus
- Developed in Charlotte with CMUD as key partner

- Over 20M feet inspected
- Rapid assessment helps better focus cleaning and CCTV resources
ACOUSTIC INSPECTION TECHNOLOGY

• How Does it Work?

Transmitter “Yells”

SL-RAT Sewer Line Rapid Assessment Tool

Blockage

Receiver “Listens”
ACOUSTIC INSPECTION TECHNOLOGY

• Scoring System

- No Obstructions
- Root Fibers Limited Growth
- Grease Limited Build Up
- Root Fibers and/or Grease Robot Can Pass Through
- Root Fibers and/or Grease Robot Cannot Pass Through
- Obstructed
ACOUSTIC INSPECTION TECHNOLOGY

• Scoring System

CCTV Blockage Assessment 10

CCTV Blockage Assessment 5

CCTV Blockage Assessment 7

CCTV Blockage Assessment 2

CCTV Robot was able to Pass Through Root Fibers
ACOUSTIC INSPECTION TECHNOLOGY

• What acoustic inspection does NOT tell you:
  – Type of blockage
    • Could be one big thing, or a lot of small things
    • Aggregate score of entire pipe segment
  – Location of blockage
  – Presence of small structural defects (fine cracks, joints, etc.)
IMPACT OF PIPE SAGS

- Straight Pipe
- Partial Pipe Sags
- Full Pipe Sag
KEY FEATURES OF ACOUSTIC INSPECTION

• No Flow Contact / No Confined Space Entry
• Simple to use – train operators in minutes
• Low Cost—Pennies/foot
• Rapid Onsite Results – Under 3 min./segment
• Portable < 30 lbs
• GIS Integration – GPS Enabled
• Archive Pipe Segment Blockage Assessments
ACOUSTIC INSPECTION APPLICATIONS

• Focus Cleaning Effort – Reduce Cleaning by Over 50% and Enable Condition Based Maintenance

• Eliminate Repeat and Downstream Overflows

• Post Cleaning – Quality Assurance

• Quick Collection System Condition Assessments When Taking Over New Areas
In order for rapid pipe inspection to be economical, two conditions must be satisfied:

- Substantially cheaper than current inspection methods
- Significant number of pipes do not require immediate attention
COST EVALUATION

SL-RAT Acoustic Inspection Cost

• U.S. EPA Study (June 2014) $0.149/ft

• Less than 1/10th the cost of CCTV inspection cost performed in same study

• Cleaning cost is typically $1.00/ft

EPA Study available for download at: http://nepis.epa.gov/Adobe/PDF/P100IY1P.pdf
**HOW MUCH CLEANING IS WASTED?**

Acoustic Inspection Results  
~6 Million Feet of Pipe

- **Target Historical Problematic Areas**
  - >70% Pipes Essentially Clean
  - <10% Need Immediate Action

- **Cleaning a Clean Pipe** ⇒ Wastes Resources
- **Not Cleaning a Dirty Pipe** ⇒ SSO
FINANCIAL IMPACT

• Assumptions:
  – Cleaning cost is $1.00/ft
  – Acoustic inspection cost (SL-RAT) is $0.15/ft
  – Inspect 10,000 linear feet of sewer pipe per day (using acoustic inspection)
  – 50% reduction in cleaning
FINANCIAL IMPACT (cont’d)

• Upfront equipment cost ~$25,000

• 10,000 ft/day of inspections → 50,000 ft/week
  Acoustic operating cost – $7,500/week (@$0.15/ft)

• Cleaning reduction (50%)
  25,000 ft/week → $25,000/week (@$1.00/ft)

• PAYBACK PERIOD of LESS THAN TWO WEEKS
CASE STUDIES

• Charlotte, NC
• Augusta, GA
• Virginia Beach, VA
• METRO – Nashville, TN
Goal: Prep Downtown Charlotte, North Carolina prior to DNC

Approach: Use SL-RAT to quickly identify/prioritize cleaning needs for crews

Effectiveness:
- 2 SL-RAT crews inspected 143k ft of pipe in ~ 2 weeks
- Saved $100k + versus traditional approach
- Focused on 10-15% of pipes that are the most blocked & prioritized the remainder

“You can see immediately what needs to be cleaned, so it takes the guesswork out and focuses your efforts.” – CharMeck Engineer
AUGUSTA, GA

• Founded 1822
• Combined operations with Richmond County in 1996
• Population Served 190,000

• 1,040 miles of sewer pipe
• Covers 280 square miles
• Under GA EPD Consent Order
AUGUSTA, GA

• Using SL-RAT since February 2013

• Currently using 3 devices

• 20,000 segments inspected

• Over 5 million feet of pipe (950 miles)
AUGUSTA, GA

Histogram of Acoustic Scores

Acoustic Score

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<thead>
<tr>
<th>Score</th>
<th>#</th>
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<tbody>
<tr>
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<tr>
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<td>9</td>
<td>643</td>
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<tr>
<td>10</td>
<td>78</td>
</tr>
</tbody>
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VIRGINIA BEACH, VA

- 1,200 miles of gravity sewer mains
- “Hot Spot” program created in 2006 to reduce SSOs
- Cleaning cycles range from 30 days to 1 year
- Current program includes 813,000 ft
- 68,000 ft need cleaned per month
VIRGINIA BEACH, VA

- 4 month pilot study
- 62 segments (30, 60, 90 day cycles)
- Total of 112 inspections performed
“Hot Spot” Pilot Study
Histogram of Acoustic Scores

2.7% Poor
11.6% Fair
85.7% Good

Acoustic Score
• METRO under consent decree by EPA
• Bio-Nomic Services/Ace Pipe has inspected over 4,000,000 ft. since 2013
  – Expected 15 million ft. by 2017
• 6 Acoustic crews running daily
  – Averaging 50-70K ft. per day
METRO – NASHVILLE, TN
ACOUSTIC PROJECT

- SSO’s down an estimated 60%!

- Approximately 4,000,000 feet tested to date
  - 10% scored 5 or lower
  - 90% scored 6 or higher
  - Less than 1% received a score of zero

- CCTV dollars saved:
  At $1/ft = $3,600,000 savings

- In one month crews were able to test 800,000ft of pipe.

- Found an absolute need for GIS tracking and 3 tier data validation. GPS/TimeSheets/Maps

- CCTV 4M’ @ 2000’ per day, 2 crews = 4 years
# APPLICATION OF ACOUSTIC INSPECTION

<table>
<thead>
<tr>
<th>Application Area</th>
<th>How to Use Acoustics</th>
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<tbody>
<tr>
<td>Pre-Cleaning Assessment</td>
<td>Prioritize/focus cleaning often see &gt;50% cleaning reduction – “focus on cleaning the dirtiest pipes”</td>
</tr>
<tr>
<td>Condition Surveys</td>
<td>Quickly &amp; economically assess large areas for asset management &amp; planning</td>
</tr>
<tr>
<td>Cleaning Interval Determination</td>
<td>Only clean specific segments when below blockage threshold</td>
</tr>
<tr>
<td>Post-cleaning QA</td>
<td>Low-cost method to check cleaning effectiveness and prevent downstream SSO’s</td>
</tr>
<tr>
<td>Optimize SSES Contract Resources</td>
<td>Use acoustics to prioritize pre-cleaning &amp; camera resources for contract advantage</td>
</tr>
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<td>Performance-Based Contracting</td>
<td>Use acoustic inspection to enable SSO targets in cleaning/inspection contracts</td>
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<td>Condition Based Maintenance Program</td>
<td>The “holy grail” – economics of acoustics enables a CBM strategy to focus maintenance activity</td>
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CONCLUSION

- Inspection is much Cheaper than Cleaning
- Acoustic Inspection is an Effective Method to Make Blockage Assessments
  - Quick
  - Cheap
  - Easy / Safe
- Acoustic Inspection Enables CBM Capability
- Acoustic Inspection Does Not Replace Cleaning or Detailed Inspection
  - Helps Determine how to Effectively Deploy Cleaning and CCTV resources
QUESTIONS?

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