Sewer Network Asset Analysis for Rehabilitation and Spill Prevention

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Presentation Topics

Consent Decree (CD) Program Background, Status and Approach – Darren Eastall

Tools and Project Coordination – Sarah Brannon

Assessment and Data Management – Gavin Richards

Data Scoring, Decision Logic, and Rehab Plans – Burhan Shaikh
Central Themes

Reduce Sanitary Sewer Overflows (SSO)

- Maintenance
- Corrective actions
- Rehabilitation projects

How is this determined?

- Consolidate data sources and manage through GIS
- Field assessment of areas of concern, chosen by high incidence of SSOs or aging infrastructure
- Analyze field assessments for risk, likelihood of failure, and consequence of failure using GIS and GIS related tools
- Review recommendations with engineering judgement
  - Maintenance Issue? Place main / manhole in cyclical work order for maintenance
  - Localized problem? Point repair work order
  - Systemic problem? Rehabilitation project
  - Capacity problem? Rehabilitation project
DeKalb County Department of Watershed Management’s (DWM) Sanitary Sewer System

System:
- 3 Basins / 35 Sewersheds
  - ~2,600 miles of sewers
  - ~70,000 manholes
- 65 pump stations

Priority Areas:
- Multi-variable selection
- 48 Priority Areas:
  - ~795 miles of sewers
  - ~27,000 manholes
SSO Overview

Sanitary Sewer Overflows
- Main causes - Storm, Grease, Roots
- Flat/reverse grade
- Capacity limited

Backups (Contractor caused)
- Cleaning
- Low lying private laterals, basements

Consent Decree identified the Priority Areas based on prior studies and data
- Prioritized based on SSO data
- Age of sewer (> 50 Yrs)
- Areas with calculated “R-Values” > 3%
- Known areas needing assessment and rehab
DeKalb County enters into a consent decree with EPA and EPD

2011

2012

Anticipated Consent Decree projects completion

2020

NTP for Consent Decree Program Manager

2014

Program development and EPA approval

2015

Assessment programs began

Current Progress

Consent Decree Major Timeline Dates

6/29/2017
Assessment Project Overview

Assessment Contract specifics:

- 3 sewer groups
- 1 contract per sewer group
- 3 tiered assessment approach
- Contract completion end of 2017
- Priority based on SSO severity and occurrence
- Prioritized County to focus on 35% of the County’s assets with high Likelihood of Failure
- Projected to rehab 25% to 30% of assessed assets
Assessment Project Background

Project Background
- Identification and verification of County assets
- Identification of data gaps and prioritization of assessment assignments
- Hydraulic modeling of majority of the system
- Prioritization of rehabilitation projects throughout County (cost effectiveness)

Additional Challenges
- Consolidation of existing County information
- Geodatabases, tables, access databases into RDMS (relational database management system)
- No integrated CMMS (computerized maintenance management system) with GIS
- Tracking and records through spreadsheets and email
- Assessment data decentralized
Integrated Enterprise Software/Hardware Platforms Support Assessment and Capacity Applications/Tools

Diagram:
- **InfoWorks CS**
- **GIS**
- **CMMS (Asset WO Tracking Tool)**
- **InfoMaster (GIS Replica)**

Connections:
- InfoMaster Output to GIS
- Model Output to GIS
- Data Updates to GIS
- Risk Condition Scores to GIS
- InfoMaster Results to GIS
- GIS Replica Refresh
- WO Data to CMMS
- Inspection db to CMMS
- Condition/LOF Scores to CMMS
- Photos & Videos to CMMS

Note:
- WO = Work Order
- LOF = Likelihood of Failure
- Db = Database
Applications Utilized

ArcGIS 10.2.2
- Desktop
- Server
- SDE
- Collector

Access Database
- NASSCO PACP/MACP

SCREAM 8.0

Innovyze InfoMaster 7.0

Work Order Tracking in CMMS
Mobile Mapping Tool: Real-Time Updates and Data Collection

Web view of the ArcGIS Online maps used for tracking assessment progress
Mobile Mapping Tool: Design in ArcCatalog and publish feature service

Steps for creating schema and publishing web maps
Mobile Mapping Tool: Real Time Updates and Data Collection

Views of mobile maps from smartphone and tablet
Mobile Mapping Tool: Identify Sources of I/I via Smoke Inspections

Filter the data for Inflow & Infiltration (I&I)
Data Requirements Enhanced by Robust QC Tools

Main menu page of the multi-functional CCTV quality control tool

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Options</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Clear Tool</td>
<td>Clear Tool</td>
</tr>
<tr>
<td>2</td>
<td>Import and convert to SCREAM Format</td>
<td>CIES Granite XP, Standard PACP Exchange, IT Pips, Non-Standard PACP Exchange, PipeLogix, WinCan, PipeTech, Other</td>
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<tr>
<td>3</td>
<td>Map Values</td>
<td>QC Mapped Values</td>
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<tr>
<td>4</td>
<td>Quality Control</td>
<td>Quality Control Checks</td>
</tr>
<tr>
<td>5</td>
<td>Optional Review</td>
<td>Reports</td>
</tr>
<tr>
<td>6</td>
<td>Check Photos and Videos</td>
<td>Check Photos and Videos</td>
</tr>
<tr>
<td>7</td>
<td>Upload Inspections to SCREAM SQL Master DB</td>
<td>Upload Inspections to SQL</td>
</tr>
</tbody>
</table>
Integrated Delivery Tools: Innovyze InfoMaster
Integrated Enterprise Software/Hardware Platforms Support Assessment and Capacity Applications/Tools

InfoWorks CS

Inspection Data

Tier 1 Inspection

Tier 2 Inspection

Tier 3 Inspection

InfoMaster Output

Model Output

Data Updates

Risk Condition Scores

InfoMaster Results

GIS Replica Refresh

WO Data

CMMS (Asset WO Tracking Tool)

Inspection db

Photos & Videos

Server (Access files saved location)

GIS

Condition/LOF Scores

InfoMaster (GIS Replica)
- Risk Scoring
- Rehab Recommendations
- Capacity Integration

Note:
WO = Work Order
LOF = Likelihood of Failure
Db = Database
Advanced Assessment Planning Improves Implementation Delivery

Data standardization
- Expedites data submittal processing
- Improved efficiency of data analysis (QA/QC)
- Supports flexible decision thresholds
- Improves timing of invoice approvals
- Integrates with GIS asset inventory

Field implementation sequencing
- Improves compliance of data quality standards
- Prioritizes “escalated” areas
- Promotes complete basin coverage before additional assignment
Tiered Assessment Approach

Tier 1 Assessment:
- Manhole inspection
- Zoom camera inspection
- Smoke/dye testing
- Acoustical testing

Tier 2 Assessment:
- Closed Circuit Television (CCTV)
- Sonar/TISCIT

Tier 3 Assessment:
- As needed
- Robotics/advanced

Requires data systems planning, development, and integration
Tiered Assessment Approach

Approach required by Consent Decree

Tier 1 Assessment:
- Manhole inspection
- Zoom camera inspection
- Smoke/dye testing
- Acoustical testing

Tier 2 Assessment:
- Closed-Circuit Television (CCTV)
- Sonar/TISCIT

Tier 3 Assessment:
- As needed
- Robotics/advanced

Requires data systems planning, development, and integration
Data Delivery from Receipt to Accepted

Assign work by technology
- Acoustic, MCA, Smoke, Dye, CCTV, TISCIT
- Point repairs, MH raising

QC data (steps, 10% QC)
- QC tools, visual check

Data upload (SCREAM)

Closeout work orders and ready for rehab review
- Sync between work orders and uploaded data
- QC’d databases then prepared for rehabilitation packaging

6/29/2017
Integrated Enterprise Software/Hardware Platforms Support Assessment and Capacity Applications/Tools

Note:
WO = Work Order
LOF = Likelihood of Failure
Db = Database
How Scores are Assigned

**Inspection Data (NASSCO PACP/MACP Format)**
- Defects (Structural, Maintenance)
- Defect location (Joint, Clock Position)
- Defect type (Defects, Connections, Continuous)

**Scoring (LOF)**
- Defect scores are based on NASSCO PACP/MACP standards
- Defect scores have a scale and vary between Base and Max score
- Scores are never lower than the worst defect score
- Scores range from 0 (no defects) to 100 (collapse).

**COF**
- Proximity to water bodies (Rivers, Lakes, Streams)
- Proximity to critical facilities (Schools, Hospitals, Public Health)
- Gravity main attributes (Diameter)
How Scores are Assigned (cont.)

Condition scoring:
- Provides method of combining scores from multiple inspections on the same asset
- Converts scores (1-100 scale)
- Facilitates effective data manipulation
- Facilitates ranking and rehab prioritization

Condition and risk thresholds:
- Provides basis for Tier 2 (CCTV) assignments
- Provides basis for rehab recommendations
Integrated Delivery Tools: Multiple Assessment Decision Logic

- Start Inspection Process for Assigned Area
  - Is Sewer in SSO Reduction Escalation Cluster or Capacity Limited?
    - Y
      - Start Pipe Tier 1 and MH Tier 2 Inspections
    - N
  - N

- Document Action in FALCON
  - Emergency Action Completed
    - Y
      - Perform Acoustic Test
        - Y
          - Perform Smoke Test
            - Y
              - Perform Zoom Camera Inspection of Pipes
                - Y
                  - Perform Manhole Inspection
                    - Y
                      - Action needed based on Emergency Defects and Emergency Action Decision Matrix
                        - Y
                          - Urgent Action Requested?
                            - Y
                              - Urgent Action Completed and Perform MH Reinspection, If Rehab Performed
                                - Y
                                  - Action needed based on Urgent Defects and Urgent Action Decision Matrix
                                    - Y
                                      - Schedule FALCON for Tier 2 CCTV Inspection
                                        - In InfoMaster Determine is Threshold Score of ≥ 60?
                                          - Y
                                            - In InfoMaster Determine is Threshold Score of ≥ 75?
                                              - Y
                                                - In InfoMaster Determine is Threshold Score of ≥ 80?
                                                  - Y
                                                    - In InfoMaster Determine is Risk Threshold Score of ≥ 70?
                                                      - Y
                                                        - Combine Scores in SCREAM
                                                          - In InfoMaster Determine is Risk Threshold Score of ≥ 70?
                                                            - N
                                                              - In InfoMaster Determine is Risk Threshold Score of ≥ 85?
                                                                - Y
                                                                  - Urgent Action Requested?
                                                                    - Y
                                                                      - Urgent Action Requested?
                                                                        - N
                                                                          - Urgent Action Requested?
                                                                            - Y
                                                                              - Urgent Action Requested?
                                                                                - N
                                                                                  - Urgent Action Requested?
 Adamant

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Integrated Delivery Tools: Rehab Decision Logic and Planning

START
(Have Scores and NSL Loaded in IM)

Is Pipe a Peak Flow Concern? (From Hydraulic Model)

Is Cost Effective Risk Reduction ≥ 15$/M?

Priority Rehab Pipe? (SCREAM Score >= 75)

Is Number of Major Defects < 2 /100 LF (Severe Structural Degradation ID in IM)

Length of Major Defects < 75% of Pipe Length (Segment)?

Repair for Lining and Full Lining < 80% of Replacement Cost?  

Length of Major and Minor Defects > 75% of Pipe Length (Segment)?

Is Cost of Point Repairs < 80% of Replacement Costs?

Export IM’s Next Step Matrix Action to WO Tool (Maintenance)

Recommend REPLACEMENT (OPEN CUT OR PIPE BURSTING) to D/B

Recommend LINING to D/B

Recommend POINT REPAIRS to D/B

Recommend CAPACITY UPSIZING to D/B

Recommend Y/N Y/N Y/N Y/N Y/N Y/N Y/N

Recommend Y

6/29/2017
Integrated Delivery Tools: InfoMaster Rehab Decision Logic Results (Cont.)
Rehab and Capacity Recommendations Leading to Design-Build Contracts

Projects are packaged based on array of variables, such as:

- Clarity of work scope
- Need for pre-construction activities
- Type of rehab methodology
- Priority based on reported SSO or EPA defined projects
- Geospatial proximity and distribution (If possible and not clashing with Priority)
Rehab Overview
Remaining Work Activities

Work Activities

- Complete tiered inspections by end of 2017
- Ongoing updates to the hydraulic model
- Integrate capacity assurance
- Complete the identified rehab projects by June 2020
Conclusions and Observations

- Receipt of quality data and storage capability is critical.
- Contractor and staff training promotes compliance and cooperation; qualifications over low-bid.
- Automated process allows for logic/threshold flexibility.
- GIS/Mapping integration is critical to program delivery.
Conclusions and Observations (cont.)

- Scoring risk and condition on a numerical scale quickly identifies and prioritizes action.
- Typical GIS field equipment and software can be leveraged for real-time data collection.
- Tracking at the asset level will provide historical account of asset work and risk scores.
- Technology advancements and lessons learned under the PASARP Program can be applied for ongoing system maintenance and rehab.
Thank You! Any Questions?