Asset Management Helping to Move the Detroit Water and Sewerage Department into the 21st Century

2018 OWEA Collection Systems Workshop
Agenda

– Detroit’s Infrastructure Challenges

– Creation of CIPMO and Program goals

– Asset Management Approach to Infrastructure Renewal
  • Where we are today

– The Road Ahead
Challenges

- Years of declining population and investment
- Average water and sewer pipe age is 95 years
- Critical need for coordinated Infrastructure renewal
- DWSD reorganization and 2016 formation of GLWA (water treatment and transmission network > 24 inches)
Collection System

- 3,000 Miles
- 200 sink holes or cave-ins/year in past 5 years
- 15% sewers relined in past 20 years to increase integrity and capacity
- Master plan/changed land use requires reconfiguration
- Need for Green Infrastructure integration plan
Capital Improvement Program Management Organization (CIPMO)

- DWSD plans $400 Million infrastructure investment over 5 years

- Develop and Manage Capital Improvement Program to:
  • Develop and Train a World-Class DWSD Operations, Management and Technical Team for the Future
  • Bring Economic Value to the City
    o Renew and rehabilitate infrastructure and neighborhoods
    o Reconfigure systems to reflect demographic trends and emerging urban plans
    o Re-Landscape the urban environment, embracing “greening of Detroit”
  • Fully Integrate with Other Infrastructure, Master Planning and Land Use priorities of the City of Detroit
Technical Objectives

Sewer System Improvement

- Reduce Sinkholes and Cave-Ins
- Reduce Untreated CSOs
- Minimize Dry Weather Inflow and Infiltration
- Meet Capacity Requirements

<table>
<thead>
<tr>
<th>Improve system performance</th>
<th>Develop and Train DWSD staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop new standards, encourage innovation through use of new tools and technology</td>
<td></td>
</tr>
</tbody>
</table>
Asset Management Underlies CIPMO

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WHAT DO YOU HAVE?
Asset Inventory

Water
- Air Valve Manholes
- Chamber
- Fittings
- Hydrants
- Hydrant Valves
- Stop Box
- Valves
- Water Mains
- Service Connections
- Etc.

Sewer
- Catch Basins
- Chamber
- CSO Basins
- Fittings
- Force Mains
- Gravity Mains
- Lamp Holes
- Manholes
- Service Connections
- Etc.

WHAT WILL IT COST?
(l.e., "What does it cost to improve the assets?")
Spectrum of intervention options:
- Reconstruction in alternative location
- Replacement in situ like-for-like
- Replacement in situ up-grading
- Renewal options:
  - Point repair
  - Reline
  - Pipe bursting
  - Etc.
- O&M options

WHAT TO DO & WHEN TO DO IT?

WHAT IS THE ASSET RISK?
PoF x CoF = Risk

WHAT IS ITS CONSEQUENCE OF FAILURE?
Consequence of Failure (CoF)
- Economic
  - Operational
  - Social
  - Environmental
- Economic / Operational: WRc Consequence Model
  - Environmental
  - Social

WHAT IS ITS CONDITION?
Asset Condition (Probability of Failure or PoF)
- Water
  - Condition
  - Hydraulic
  - Quality
- Sewer
  - Condition
  - Hydraulic

WHAT ARE THE LEVEL OF SERVICE OBJECTIVES?
Levels of Service / CIP Decision Criteria
- Water
  - Reduction in non-Revenue Water
  - Reduction in main breaks
  - Hydraulic Loss: Fire flow & pressure
  - Redundancy
  - Reduction in risk
  - Etc.
- Sewer
  - Reduction in sinkholes & cave-ins
  - Reduction in untreated CSOs
  - Reduction in I&I
  - Meeting flow/capacity requirements
  - Reduction in risk
  - Etc.

CIP
- Projects
- Costs
- Justification
- Justified
- Transparent
- LoS & Risk-Based
- Consistent
- Repeatable
- Automatable

RISK-BASED PRIORITIZATION FRAMEWORK

WHAT DO YOU HAVE?
Asset Inventory

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```
Goals / Benefits of Asset Management

- Repeatable process
- Defensible Decisions
- Long-term vision of infrastructure planning
- Direct program to neighborhoods and individual assets that carry the highest risk
- Improve decision-making process as more condition assessment information is collected
- Ability to articulate plans and align CIP with other agencies (roads, gas, electric, land development, etc.) for overall ROW management
- Provides wise use of available funds
Pilot Program Areas

- Two areas (Cornerstone Village and North Rosedale Park) to initiate the planning, public outreach, design standards, training, and establish the best practices for the rest of the Program.
Pilot Program Establishes the Program Foundation

Benefit to DWSD:
- Improved levels of service
- Sustainable capital improvements
- Minimize life cycle costs
- Maximize the value for ratepayers.
Program Data Integration Approach
Applications to Support the Program

- CCTV Tracking Dashboard
- CCTV Contractor Inspection
- C-Factor Testing
- Leak Detection
  - Leak Status:
    - Active
    - Corrected
    - No Leak
  - Valve
  - Hydrants
  - Water Main:
    - Subtype:
      - Distribution Main
      - Hydrant Lead
      - Inlet Line
      - Service Line
      - Transmission Main
      - Tunnel
      - Unqualified

CCTV Tracking Dashboard

CCTV Contractor Inspection

C-Factor Testing

Leak Detection
Field Data Collection Program

- CCTV Sewer System Inspections (65 miles)
- Panoramo Manhole Inspections
- Sewer System Flow Monitoring
Pipe Defects

Pipe Collapse

Pavement depression at collapse site

Root balls found in lateral, very common in abandoned house lots
Cross Bores

Cross bore with roots

Excavated gas and sewer lines
Structural/O&M Treatment Assignment

- Evaluate Localized Defect Intervention Methods
- Consolidate Treatment Extents
- Consider Segment Level Intervention Options
## Wastewater System Rehabilitation by Type
### Cost Summary for Both Pilot Areas (Pre-Design)

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Cornerstone Village</th>
<th>North Rosedale Park</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length (LF) / Count</td>
<td>Estimated Cost</td>
<td>Length (LF) / Count</td>
</tr>
<tr>
<td>Lining</td>
<td>24,748</td>
<td>$3,913,730.90</td>
<td>11,052</td>
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<tr>
<td>Lining with External Point Repair</td>
<td>15,690</td>
<td>$2,870,362.00</td>
<td>15,098</td>
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<tr>
<td>External Point Repair</td>
<td>384</td>
<td>$321,232.18</td>
<td>251</td>
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<tr>
<td>Trenchless Point Repair</td>
<td>3,485</td>
<td>$1,775,080.03</td>
<td>1,043</td>
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<tr>
<td>Full Segment Replacement</td>
<td>3,393</td>
<td>$2,889,291.87</td>
<td>2,933</td>
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<tr>
<td>Debris Removal (Flushing) - Immediate</td>
<td>14,074</td>
<td>$157,874.05</td>
<td>11,738</td>
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<td>Debris Removal (Mechanical) - Immediate</td>
<td>140</td>
<td>$26,796.16</td>
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<tr>
<td>Cutting / Grinding of Taps - Immediate</td>
<td>130</td>
<td>$40,594.71</td>
<td>260</td>
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<td>Root Control</td>
<td>16,053</td>
<td>$112,990.57</td>
<td>26,627</td>
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<td>General and/or spot repairs</td>
<td>57</td>
<td>$35,625.00</td>
<td>11</td>
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<tr>
<td>Replace chimney only</td>
<td>13</td>
<td>$24,375.00</td>
<td>8</td>
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<tr>
<td>Manhole cleaning</td>
<td>36</td>
<td>$9,000.00</td>
<td>31</td>
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<tr>
<td>Spray Lining – Structural and for I&amp;I</td>
<td>9</td>
<td>$67,500.00</td>
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<tr>
<td>Internal grouting of chimney only</td>
<td>11</td>
<td>$13,750.00</td>
<td>9</td>
</tr>
<tr>
<td>Benching and channel re-construction</td>
<td>5</td>
<td>$6,250.00</td>
<td>8</td>
</tr>
<tr>
<td>Frame/Cover replacement and/or adjustment</td>
<td>1</td>
<td>$625.00</td>
<td>1</td>
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<tr>
<td>Replace adjusters</td>
<td>1</td>
<td>$1,000.00</td>
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<tr>
<td>Replacement with new manhole by open cut</td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$12,266,077.47</strong></td>
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<td><strong>$6,233,052.58</strong></td>
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</table>
Risk-based Field Assessment and Project Prioritization: Maximizing Value for Each Dollar Spent
Risk Framework – Gravity Main

WRc Consequence Model

<table>
<thead>
<tr>
<th>Non-Brick and ≤ 36in Depth (ft)</th>
<th>Good</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 6</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>≤ 10</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>≤ 13</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td>≤ 17</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>≥ 20</td>
<td>5.5</td>
<td>6.5</td>
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<table>
<thead>
<tr>
<th>Brick OR &gt; 36in Depth (ft)</th>
<th>Good</th>
<th>Poor</th>
</tr>
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<tbody>
<tr>
<td>≤ 6</td>
<td>4</td>
<td>5.5</td>
</tr>
<tr>
<td>≤ 10</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>≤ 13</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>≤ 17</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>≥ 20</td>
<td>26</td>
<td>31</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>33</td>
<td>40</td>
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Traffic Multiplier (TM)

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<thead>
<tr>
<th>CFCC Category</th>
<th>Divertible</th>
<th>Non-Divertible</th>
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<tbody>
<tr>
<td>A32 - Minor/Residential</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>A31 - Principal</td>
<td>1.9</td>
<td>6.3</td>
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<tr>
<td>A2 - State HWY</td>
<td>2.6</td>
<td>10.8</td>
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<tr>
<td>A1 - Interstate</td>
<td>3.1</td>
<td>13.8</td>
</tr>
<tr>
<td>Alley / Backyard</td>
<td>6</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Critical Location</th>
<th>RCF x TM</th>
<th>Critical</th>
<th>Score</th>
</tr>
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<tbody>
<tr>
<td>≤ 50 ft Railroad</td>
<td>≤ 3</td>
<td>YES</td>
<td>10</td>
</tr>
<tr>
<td>≤ 50 ft ESA</td>
<td>≤ 6</td>
<td>NO</td>
<td>1</td>
</tr>
<tr>
<td>≤ 50 ft Critical Customer</td>
<td>&gt; 6</td>
<td>YES</td>
<td>10</td>
</tr>
<tr>
<td>Under Structure</td>
<td></td>
<td>NO</td>
<td>10</td>
</tr>
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</table>

Condition 50%

<table>
<thead>
<tr>
<th>Category</th>
<th>Criteria / Information Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations / Economic</td>
<td>1. WRc Consequence</td>
</tr>
<tr>
<td></td>
<td>2. Blind Connections</td>
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</tbody>
</table>

Environmental 25%

<table>
<thead>
<tr>
<th>Category</th>
<th>Criteria / Information Used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. In SSO/CSO catchment</td>
</tr>
<tr>
<td></td>
<td>2. Potential BBUs</td>
</tr>
<tr>
<td></td>
<td>3. Proximity to ESA</td>
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</tbody>
</table>

Social 30%

<table>
<thead>
<tr>
<th>Category</th>
<th>Criteria / Information Used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Census Tract Population Density</td>
</tr>
<tr>
<td></td>
<td>2. Employment</td>
</tr>
<tr>
<td></td>
<td>3. Near Bus Line</td>
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</table>

Probability 50%

<table>
<thead>
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<th>Category</th>
<th>Criteria / Information Used</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1. PACP, or Weibull RUL</td>
</tr>
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</table>

Hydraulics 50%

<table>
<thead>
<tr>
<th>Category</th>
<th>Criteria / Information Used</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1. Undersized Pipe</td>
</tr>
<tr>
<td></td>
<td>2. High HGL</td>
</tr>
<tr>
<td></td>
<td>3. High ADWF</td>
</tr>
<tr>
<td></td>
<td>4. Pipe meets 10SS</td>
</tr>
<tr>
<td></td>
<td>5. Recorded BBUs</td>
</tr>
</tbody>
</table>

Good / Bad soils determined by soil cohesion as per Universal Soil Classification System
Gravity Main Risk
Neighborhoods by Gravity Main Risk
## Top 25 Neighborhood Ranking—Integrating Risk and Additional Considerations

<table>
<thead>
<tr>
<th>Neighborhood</th>
<th>Average Sewer Risk Score</th>
<th>Length Weighted Average Risk (LWAR)</th>
<th>Total Sewer Length (ft)</th>
<th>Rank</th>
<th>PDD 20-Minute Neighborhood</th>
<th>Current / Recent Planning Study</th>
<th>Recent Demolition Activity*</th>
<th>Council District</th>
<th>PDD Score</th>
<th>Planning Score</th>
<th>Demo Score</th>
<th>Total</th>
<th>Final Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downtown</td>
<td>18.20</td>
<td>19.35</td>
<td>186,785</td>
<td>1</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>6</td>
<td>1.6</td>
<td>1.6</td>
<td>0</td>
<td>21.40</td>
<td>2</td>
</tr>
<tr>
<td>Greektown</td>
<td>17.76</td>
<td>18.50</td>
<td>10,035</td>
<td>2</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>5</td>
<td>1.6</td>
<td>1.6</td>
<td>0</td>
<td>20.96</td>
<td>3</td>
</tr>
<tr>
<td>Midtown</td>
<td>17.31</td>
<td>18.84</td>
<td>118,974</td>
<td>3</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>6</td>
<td>1.6</td>
<td>0</td>
<td>1.6</td>
<td>20.51</td>
<td>6</td>
</tr>
<tr>
<td>Brewster Douglas</td>
<td>16.87</td>
<td>17.11</td>
<td>13,950</td>
<td>4</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>5</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
<td>21.67</td>
<td>1</td>
</tr>
<tr>
<td>New Center Commons</td>
<td>16.31</td>
<td>16.54</td>
<td>21,436</td>
<td>5</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>5</td>
<td>1.6</td>
<td>0</td>
<td>0</td>
<td>17.91</td>
<td>8</td>
</tr>
<tr>
<td>Foxtown</td>
<td>16.21</td>
<td>16.86</td>
<td>21,108</td>
<td>6</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>6</td>
<td>1.6</td>
<td>1.6</td>
<td>0</td>
<td>19.41</td>
<td>13</td>
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<tr>
<td>New Center</td>
<td>16.18</td>
<td>16.72</td>
<td>18,495</td>
<td>7</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>5</td>
<td>1.6</td>
<td>0</td>
<td>0</td>
<td>17.78</td>
<td>14</td>
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<tr>
<td>North Corktown</td>
<td>16.17</td>
<td>17.19</td>
<td>93,757</td>
<td>8</td>
<td>Yes</td>
<td>No</td>
<td>Yes - very little</td>
<td>6</td>
<td>1.6</td>
<td>0</td>
<td>0</td>
<td>17.77</td>
<td>15</td>
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<tr>
<td>Lafayette Park</td>
<td>16.11</td>
<td>16.88</td>
<td>46,777</td>
<td>9</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes - very little</td>
<td>5</td>
<td>1.6</td>
<td>1.6</td>
<td>0</td>
<td>19.31</td>
<td>9</td>
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<tr>
<td>Brewster Homes</td>
<td>15.90</td>
<td>17.23</td>
<td>13,172</td>
<td>10</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>5</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
<td>20.70</td>
<td>4</td>
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<tr>
<td>Southwest Detroit</td>
<td>15.80</td>
<td>15.84</td>
<td>329,888</td>
<td>11</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes - very little</td>
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<td>1.6</td>
<td>1.6</td>
<td>0</td>
<td>19.00</td>
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<tr>
<td>Piety Hill</td>
<td>15.63</td>
<td>15.75</td>
<td>35,322</td>
<td>12</td>
<td>Yes</td>
<td>Yes - partially</td>
<td>Yes</td>
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<td>0</td>
<td>1.6</td>
<td>18.83</td>
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<tr>
<td>Corktown</td>
<td>15.60</td>
<td>16.79</td>
<td>89,987</td>
<td>13</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>6</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
<td>20.40</td>
<td>11</td>
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<tr>
<td>Hubbard Farms</td>
<td>15.27</td>
<td>15.82</td>
<td>22,748</td>
<td>14</td>
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<td>Yes</td>
<td>Yes</td>
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<td>1.6</td>
<td>1.6</td>
<td>20.07</td>
<td>16</td>
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<td>Virginia Park</td>
<td>15.17</td>
<td>15.71</td>
<td>2,987</td>
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<td>1.6</td>
<td>1.6</td>
<td>0</td>
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<td>LaSalle Gardens</td>
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<td>15.15</td>
<td>36,578</td>
<td>16</td>
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<td>0</td>
<td>0</td>
<td>1.6</td>
<td>16.76</td>
<td>17</td>
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<td>Medical Center</td>
<td>15.11</td>
<td>15.03</td>
<td>24,409</td>
<td>17</td>
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<td>1.6</td>
<td>0</td>
<td>0</td>
<td>16.71</td>
<td>18</td>
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High Risk Sewer Gravity Mains
Data Uncertainty

- For every COF/POF element assign qualitative measure of uncertainty
  - 0 to 1 scale
- Example:
  - RUL estimates: 1
  - Critical customer location: 0
- Propagate uncertainty through risk model (COF, POF, Risk)
Going Forward

- Moving on to field work next set of pilot areas
  - Condition assessment of high risk pipes
- Develop detailed design for initial pilot areas
- CIP project delivery
- Documenting of lessons learned
- Risk model 2.0 (and 3.0, 4.0, …)
  - Improve data quality
    - Updated asset attribute data
    - Updated external COF data
  - Close the loop on risk model COF/POF
    - Revise remaining useful life models using condition assessment
    - Integrate data from hydraulic model
- Integrate INFOMASTER with other enterprise level systems (GIS, INFONET, CITYWORKS)
Detroit Has Already Made Good Progress… but we’re just getting started
Questions and Answers

Christopher Pawlowski, AECOM

Palencia Mobley, DWSD