Setting Priorities for Stormwater Infrastructure to Achieve “Best” Results Using a Risk Analysis

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Aging stormwater infrastructure brings significant challenges through increased O&M costs, decreased capacity, and potential risk of system failures.

A sound method of setting priorities for infrastructure rehabilitation will provide the best return on the investment through cost savings and improved system performance.
A Risk-Based Method of Setting Priorities Based on Condition & Criticality

Condition (Probability of Failure)

High

Low

Criticality (Consequence of Failure)

Lowest Priority

Medium Priority

Highest Priority

Medium Priority

Lowest Priority

Medium Priority

Highest Priority

Lowest Priority

Medium Priority

Highest Priority
Condition & Criticality Factors Are Tailored to Each Individual System

- **Culverts, Conduits**
  - **Condition**
    - **Capacity**
      - Modeling
      - Development
      - Flooding Issues
    - **Structural**
      - Material
      - Age
    - **Maintenance**
      - Recurring Blockages
      - Work Orders
      - Corrosion
      - Preventative Maintenance
  - **Criticality**
    - **Environmental Impact**
    - **Size**
    - **Transportation Impact**
    - **Water Quality**
    - **Structural Flooding**
Surrogate Factors Can Set Priorities for Condition Assessment (Example – System Age)
Work Order Data Can Identify Maintenance Problems and Direct Further Condition Assessment Work
How Do You Combine Multiple Factors to Get a Single Condition or Criticality Rating?

Approach 1: Use Average of Factors

```
+---+---+---+
| 2 | 5 | 2 |
+---+---+---+
```

Average (Can Be Weighted)

```
<p>| | | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>3</td>
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```

Can mask critical factors

Approach 2: Use Maximum Factor

```
+---+---+---+
| 2 | 5 | 2 |
+---+---+---+
```

Maximum

```
<p>| | | |</p>
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Retain other factors to Support rehab decisions
GIS Mapping Helped Assign Criticality Ratings

Criticality Example -- Proximity to Flood-Prone Areas

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5
- Unknown
The Best Infrastructure Management Approach Is Based on the Risk Profile of Each Asset

Risk = Probability of Failure x Consequence of Failure

<table>
<thead>
<tr>
<th>Condition</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>Mid Priority Program Rehab</td>
<td>Mid Priority Program Rehab</td>
<td>High Priority Program Rehab</td>
<td>Immediate Action</td>
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<td>Mid Priority Program Rehab</td>
<td>High Priority Program Rehab</td>
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<td>Immediate Action</td>
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<tr>
<td>3</td>
<td>Low Priority</td>
<td>Low Priority</td>
<td>Regular Monitoring</td>
<td>Frequent Maintenance &amp; Assessment</td>
<td>Frequent Maintenance &amp; Assessment</td>
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<tr>
<td>2</td>
<td>Low Priority</td>
<td>Low Priority</td>
<td>Regular Monitoring</td>
<td>Frequent Maintenance &amp; Assessment</td>
<td>Frequent Maintenance &amp; Assessment</td>
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<td>1</td>
<td>Low Priority</td>
<td>Low Priority</td>
<td>Regular Monitoring</td>
<td>Regular Monitoring</td>
<td>Regular Monitoring</td>
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</table>
Highest Priority Assets from “Immediate Action” Category

Immediate Action

All Others
Data Collection Tools Help Streamline Infrastructure Inventory and Condition Assessment
Investigation Tools Include Manhole and Zoom Camera Inspections to Save Time and Cost
Evaluation of the Stormwater and Sanitary Sewers In Priority Areas

Manholes In Need Of Rehabilitation

Numerous Potential Sources Of Stormwater/Sanitary Cross Connections

Numerous Sewers With Broken Pipe
Laser Profiling and Sonar Can Be Provide Additional Condition Information Beyond CCTV

- Accurate Ovality, Deflection, and Pipe Sizes
- Wall Deterioration and Corrosion
- Debris Depths
Subsurface Utility Engineering (SUE) Helps Confirm Utilities Locations

- Utility Designating and Locating
  - No-Cuts –
    - Gas, power, telephone, communications
  - Ground Penetrating Radar
    - Finds untraceable utilities
    - Locates other potential conflicts
- Soft Dig/Vacuum Extraction
  - Exposes utility to verify vertical & horizontal location
- Locations to be used
  - Potential conflict points
Based on Prioritization and Confirmed Field Condition Assessments, Wilmington Conducted a Downtown Infrastructure Rehabilitation Project

- Risk of failure high due to structural and maintenance issues
- New Convention Center Increased Focus on Downtown Needs.
- Water, sewer, and stormwater system condition assessment was all conducted together to coordinate rehabilitation needs.
- Streetscape project on Front Street also coordinated with needed infrastructure rehabilitation.
The City and CFPUA Coordinated Design & Construction of Stormwater, Water & Sewer Rehabilitation and Streetscape Projects
Streetscape Improvements Were Designed in the Front Street Business District

Infrastructure Improvements Needed to Reduce Risk of Failure in Historic Districts

Existence of Old Trolley Tracks Along Front Street and Other Obstructions Were Considered in the Investigations
Construction Was Coordinated to Minimize Impacts to Downtown Businesses

- All utilities addressed simultaneously
- Public communications critical
- Nighttime work to reduce impacts
- Business access emphasized
Final Streetscape Improvements
Incorporated All Underground Stormwater, Water, and Sewer Rehabilitation Needs
Summary and Conclusions

- Aging Infrastructure Problems Are Leading to Higher O&M Costs, Decreased Capacity, and More System Failures
- Customers and Elected Officials Are Expecting Increased System Performance at a Reasonable Cost
- The Described Risk-Based Prioritization Method Provides a Sound Basis for Setting Priorities for Where to Invest in System Evaluations and Rehabilitation
- Understanding System Condition Leads to Program Savings by Fixing Problems Before They Occur
- Strategic Condition Assessment Better Coordinates Rehabilitation of Stormwater, Water, Sewer, and Transportation Infrastructure
- Understanding and Addressing These Infrastructure Needs Is Vital to the Long-Term Economic Viability of Our Communities