USING GIS TO IDENTIFY CRITICAL PIPES IN THE COLLECTION SYSTEM

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Acknowledgement

- Andrea Remias, Project Manager, NEORSD
  - Ms. Andrea Remias is a project manager in the Engineering & Construction Department at the Northeast Ohio Regional Sewer District. She has been managing the implementation of asset management since 2005. The District is in the last 5 months of the Phase I Implementation project which was a 3 ½ year effort to ultimately produce 50-year repair and renewal plans for all 10,000 plant and collection system asset at the District.

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Jeff Claus

- Management Consultant, CDM Smith
• Asset Management (AM) Implementation Phase I Project
  • The 10-year implementation plan was based on a study where the District’s asset-related practices were evaluated and benchmarked against “world’s best practices”
  • Main outcome of Phase I: 50-year Repair and Renewal for all plant and collection system assets
>300 mi

>6000 pipe segments

61 municipalities
Cuyahoga, Summit
Lake and Lorain
Asset Management

“Meeting customer expectations while minimizing cost and risk”

-- I think, therefore I AM
OR....
“Risk is the potential that a chosen action or activity will lead to a loss.”

- Wikipedia
Asset Management >> Risk >> Criticality

- Consequences of failure
  - Social
  - Environmental
  - Financial

[Image of a sinkhole]

Criticality Scoring

- The sum of the three factors
  - Employee / Public Safety (1, 2, 3)
  - Regulatory compliance / Public Impact (1, 2, 3)
  - Fiscal Impact (1, 2, 3)

- Challenges
  - Define criticality
  - Quantify the intangible
  - Measure the invisible
Employee/Public Safety

1. No threat
2. Injury
3. Death

1. $D > 500\text{ft}$ and not under road and not close to railroad
2. $200\text{ft} < D < 500\text{ft}$ or under a local road
3. $D < 200\text{ft}$ or under a highway/arterial road or close to railroad

$D$: the distance to critical locations
Regulatory compliance/Public Impact

1. No violation
2. Violations without fines
3. Violation with penalties

D: distance to critical location or river

1. Dia< 48” and D>100’
2. Dia< 48” and D<100’
3. Dia> 48” and D<100’ or Forcemain
Fiscal Impact

1. < $100,000
2. $100,000 - $1M
3. >$1 M

1. Dia < 48” or d < 25’
2. Dia > 48” or 25’ < d < 50’
3. Tunnel or Over River or Depth > 50’

d: Pipe depth   Dia: pipe diameter
## Criticality Scoring

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee/Public Safety</td>
<td>No threat</td>
<td>Injury</td>
<td>Death</td>
</tr>
<tr>
<td>Regulatory Compliance/Public Impact</td>
<td>No violation</td>
<td>Violation with fine</td>
<td>Violation with penalties</td>
</tr>
<tr>
<td>Fiscal Impact</td>
<td>&lt;$100,000</td>
<td>$100,000-1M</td>
<td>&gt;$1M</td>
</tr>
</tbody>
</table>
Doubts

- You cannot quantify intangible things like environmental impact in dollar values
- It is so hard to estimate the criticality, what happen when a pipe collapsed is too complicated to estimate with such simple calculations
Workshops

- Participants
  - Engineers
  - Operators
  - GIS/IT staff
  - Consultants
- Collective Knowledge
- Unique about the system
Operational Definition

- Visible and tangible
  - Amount of discharge
  - Extent of surface damage
  - People and structures impacted
  - Construction Complexity
  - Material, size and depth of the pipe
  - Location context
Operational Definition

- Measurable
  - Pipe physical attributes
  - Pipe Spatial attributes (Spatial context)
    - Proximity to buildings, rivers, utilities, roads, railroads
    - Proximity to population
Operational Definition

• Feasibility
  • Data availability
  • Data accuracy
  • Processing requirement
Spatial Context

Legend

Employee/Public Safety
eps
1
2
3

Railroad

local_road_10buffer
arterial_road_20buffer
highway_40buffer
railroad_50buffer
critical_location_200buffer
critical_location_500buffer

Sewer
Critical Location
Road
Results

- Large diameter deep pipes
- Close to critical locations
- Forcemain

Legend
Overall Criticality

criticality:
3
4
5
6
7
8
9

Criticality Score

Large diameter deep pipes

Forcemain

CDLZ
Spatial Join

“Joins attributes from one feature class to another based on a spatial relationship.”

--ESRI Help Documentation
Automation

Step 1: Calculate Employee/Public Safety

Calculate the Employee/Public Safety (EPS) score.

EPS: Employee/Public Safety

EPS is calculated as the maximum of the three scores, distance to critical location, under road and under railroad.

\[
EPS = \max(eps_d, eps_road, eps_rail)
\]

```
dim x
x = 1
```
Conclusion

- Criticality is an important metric of a collection system
- Defining criticality is an iterative collaboration process among engineers, operators, other staff and consultants, which convert conceptual ideas into concrete calculations
- GIS is a powerful and effective platform for managing, processing and automating the criticality calculation
Questions
Reference

- I think, therefore I AM, 2011 OWEA Annual Conference, June 22, 2011, Kevin Campanella, John Rogers
Employee /Public Safety

1. No threat
2. Injury
3. Death or significant injury
Regulatory compliance/Public Impact

1. No violation, no impact
2. Violations without fines, impact of hours
3. Violation with penalties, impact more than 1 day
Fiscal Impact

1. < $100,000
2. $100,000 - $1 Million
3. >$1 Million