Comprehensive Manhole Assessment & Rehabilitation Program – Fond du Lac Case Study

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Sanitary Manholes are Often “Out of Site and Out of Mind...”
...But They Shouldn’t Be!
Same Manhole, After Rehabilitation
Presentation Overview

• Background
• Manhole Assessment and Rehabilitation Project Drivers
• Summary of Assessment Process
• Rehabilitation Products and Processes
• Manhole Condition Summary
• Project Costs
• I/I Removal and Cost-Effectiveness
• Lessons Learned
City of Fond du Lac

- Population: ~43,000
- ~4,100 Manholes
- Several Connections from Outside Sewer Group (OSG) Communities
- Relatively High Groundwater
Background

• SSES Completed in 2005.
• Manholes Likely Contributing Significant I/I
• Need for Comprehensive Manhole Assessment and Rehab
Manhole Assessment and Rehabilitation Drivers

- Structural Deterioration – High Priority in Initial Years.
- I/I
- Corrosion
Manhole Assessment Program Development

• MACP
• Standardized process which results in uniformity of observations
• What information do we need to set up a rehab program?
• What additional information do we want to capture?
• Efficient assessments
• Assessment procedures were modified as program progressed
Assessment Process

- Standardized forms
- Microsoft Access Database
- Tablet Computer
- 1 Person (where possible)
- Overall rating for quick prioritization
- Rehab Recommendations from Field
Manhole Rehabilitation – No One Size Fits All Solution

- Structural vs. I/I vs. corrosion?
- Life of rehabilitation product
- Cost $$
- Established process/product?
- Existing materials
- Location
- Majority of manholes can be rehabilitated.
Cover and Gasket Replacement

• Differing types
• Cover cannot be too worn
• Prep important!
• Marginally successful
Top Replacement

- Brick vs precast cone?
- Compaction – consider flowable fill
- New chimney rings
Cured-In-Place Chimney Liner

- Geometry of chimney
Hand Applied Chimney Liner

- Accommodates changes in chimney geometry
- Prep work, application methods
- Timing of application depends on manhole construction
Cementitious Liners

- Differing materials
- Application methods

Credit: Kim Construction Company, Inc.
Cast-In-Place Manhole

- Existing manhole serves as exterior form
- Minor excavation required

Credit: Hydro-Klean
Bench/Channel Reconstruction
Chemical Grouting

- Differing grout materials
- Differing techniques
Replacement vs. Rehabilitation

• Rehab cost > replacement?

• Consider non-monetary factors
  – Location
  – Duration of construction
  – Compaction
  – Expected life of manhole

• Depth

<table>
<thead>
<tr>
<th>Depth</th>
<th>Approximate Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;4 feet</td>
<td>$6,000</td>
</tr>
<tr>
<td>4 to 6 feet</td>
<td>$7,000</td>
</tr>
<tr>
<td>6 to 8 feet</td>
<td>$8,500</td>
</tr>
<tr>
<td>&gt;8 feet</td>
<td>$10,000+</td>
</tr>
</tbody>
</table>
Construction Observation/Testing

• Verify prep work – Very important for coatings
• Thickness
• Continuity of coatings – holiday testing
• Compressive strength
• Adhesion testing
• Manufacturer’s directions!
### Manhole Condition Summary

<table>
<thead>
<tr>
<th>Overall Condition Rating</th>
<th>1 – Very Bad</th>
<th>2 – Poor</th>
<th>3 – Average</th>
<th>4 – Good</th>
<th>5 – Excellent</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Rehab</td>
<td>47</td>
<td>279</td>
<td>1,079</td>
<td>1,237</td>
<td>1,423</td>
<td>3.9</td>
</tr>
</tbody>
</table>

- All 1’s, and 2’s rehabilitated
- 476 3’s rehabilitated
## Project Costs

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total MH’s</td>
<td>92</td>
<td>123</td>
<td>175</td>
<td>203</td>
<td>177</td>
<td>111</td>
<td>84</td>
<td>802</td>
</tr>
<tr>
<td>Total Cost ($)</td>
<td>255,249</td>
<td>429,238</td>
<td>454,921</td>
<td>321,435</td>
<td>263,038</td>
<td>144,833</td>
<td>172,640</td>
<td>2,041,354</td>
</tr>
</tbody>
</table>

- Overall Average Cost per MH = $2,545
I/I Removal Estimates

<table>
<thead>
<tr>
<th></th>
<th>Low End</th>
<th>High End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total I/I Removed (2010-2014)</td>
<td>929 gpm</td>
<td>3,116 gpm</td>
</tr>
<tr>
<td>Total MH Rehab Cost (2010-2014) ($)</td>
<td></td>
<td>1,723,881</td>
</tr>
<tr>
<td>Actual Unit Cost of I/I Removal (2010-2014)</td>
<td>1,855 $/gpm</td>
<td>553 $/gpm</td>
</tr>
<tr>
<td>SSES Cost-Effective I/I Removal Threshold (adjusted)</td>
<td></td>
<td>860 $/gpm</td>
</tr>
</tbody>
</table>

• Significant portion of rehab was required, regardless of I/I
Lessons Learned - Assessments

• Manholes differ in each community
• Overall ratings and rehabilitation recommendations are most valuable
• Efficiency!
• Photos!
• Take notes of anything out of ordinary
Lessons Learned - Rehabilitation

• Robust specification
  – Contractor/product experience
  – Prep work requirements
  – Testing
• Diligent record keeping is a must!
• Consider extended warranty
Questions?

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Strand Associates, Inc
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Manhole Diagram
Manhole Component Form
Pipe Connections Form
Defects Form
Photos Form
Other Cover Rehabilitation

- Plug pick holes
- Frame gasket
- Inflow dish
- Replace!

Credit: Cretex Specialty Products

Credit: The Man Pan

Credit: Cretex Specialty Products
Internal Mechanical Chimney Seal

- Chimney geometry
- Easily verifiable during construction

Credit: Cretex Specialty Products

Credit: Sealing Systems, Inc.
External Chimney Seal

- Chimney geometry
- Mechanical vs. heat shrink vs. adhesive

Credit: Cretex Specialty Products

Credit: Sealing Systems, Inc.
Epoxy Coatings

- Several different types
- Corrosion protection
- Prep work!!!

Credit: Kim Construction Company, Inc.
Modified Polymer Skin Panel

- Several different types
- Corrosion protection and I/I
- Prep work!!!

Credit: Spectrashield
Structural Polyurethananes

- Several different types
- Corrosion protection, I/I, structural
PVC and HDPE Liners

- Rehabilitation or new construction
- Custom fit

Credit: Predl Systems
Full Depth CIP Lining

- Custom fit liner
- Corrosion protection
- Structural

Credit: Kim Construction Company, Inc.
Credit: LMK Technologies
Channel Lining Systems