

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

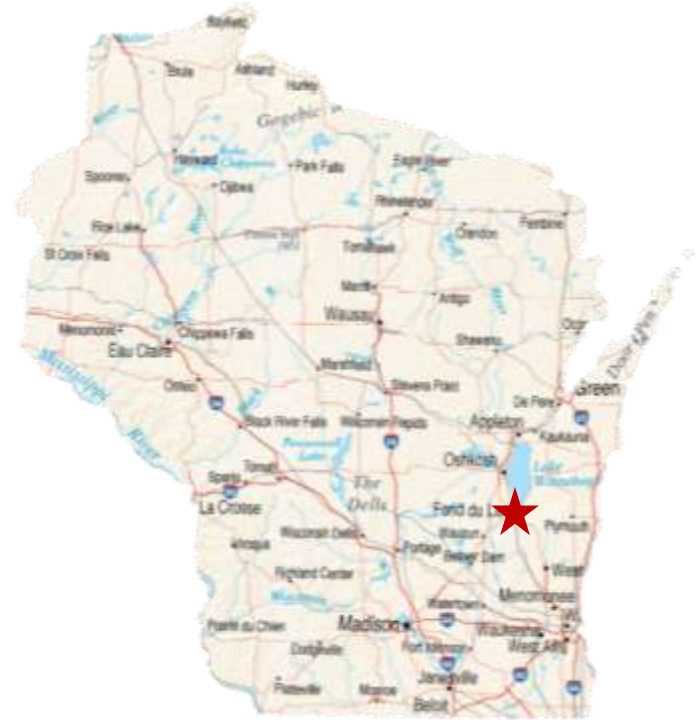


Presentation Overview

- 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

The screenshot displays the 'Manhole Inspection Form' interface. At the top, it shows 'Default Surveyor: 3 = ST' and 'Default Weather: 1 = Dry'. Navigation buttons include 'Change Defaults', 'Return to Main Menu', and 'Add New MH'. The 'Manhole ID Selector' is set to 'BD-3-23', with a 'Duplicate ID?' checkbox. The form is divided into tabs: 'Manhole Inspection' (selected), 'Component Observations', 'Pipe Connections', 'Defects', and 'Photos'. The 'Manhole Inspection' tab contains various fields: 'System_Owner_[2]:' (Davenport), 'Drainage_Area_[4]:' (Bettendorf-Duck Creek), 'Location_Code_[38]:' (C = Light Highway), 'Curb_Material:' (C = Concrete (Non-Reinforced)), 'Manhole_Surface_Type_[40]:' (Concrete Paver), 'Manhole_Surface_Condition:' (Severe Cracking), 'Rim_to_Invert_[ft]_[13]:' (8), 'Rim_to_Grade_[ft]_[15]:', 'Potential_for_Runoff_[41]:' (Sheeting [5]), 'Close_To_Curb:' (No), 'Evidence_Of_Surcharge_[49]:' (No), 'Use_of_Sewer_[20]:' (SS = Sanitary), and 'Purpose_of_Survey_[34]:' (D = Pre Rehabilitation Survey). On the right side, there are fields for 'Surveyor_Name_[1]:' (3 = ST), 'Date_Inspected_[8]:' (5/13/2015), 'Time_Inspected_[9]:' (3:44:40 PM), 'Weather_[37]:' (1 = Dry), 'PreCleaning_[36]:' (Z = Not Known), 'Date_Cleaned_[36a]:', 'Additional_Information_[39]:', 'Access_Point_Type_[42]:' (Manhole (AMH)), and 'Inspection_Status_[48]:' (Surface Inspection (SI)). At the bottom, there are buttons for 'Back to Photos' and 'Forward to MH Component Observations'.

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



Credit: Hydro-Klean

- Existing manhole serves as exterior form
- Minor excavation required



Bench/Channel Reconstruction



Chemical Grouting



Credit: Great Lakes TV Seal, Inc.

- Differing grout materials
- Differing techniques



Credit: Great Lakes TV Seal, Inc.

Replacement vs. Rehabilitation

- Rehab cost > replacement?
- Consider non-monetary factors
 - Location
 - Duration of construction
 - Compaction
 - Expected life of manhole
- Depth

Depth	Approximate Replacement Cost
<4 feet	\$6,000
4 to 6 feet	\$7,000
6 to 8 feet	\$8,500
>8 feet	\$10,000+

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

Overall Condition Rating	1 – Very Bad	2 – Poor	3 – Average	4 – Good	5 – Excellent	Mean
Pre-Rehab	47	279	1,079	1,237	1,423	3.9

- All 1's, and 2's rehabilitated
- 476 3's rehabilitated

Project Costs

Year	2010	2011	2012	2013	2014	2015	2016	Total
Total MH's	92	123	175	203	177	111	84	802
Total Cost (\$)	255,249	429,238	454,921	321,435	263,038	144,833	172,640	2,041,354

- Overall Average Cost per MH = \$2,545

I/I Removal Estimates

	Low End	High End
Total I/I Removed (2010-2014)	929 gpm	3,116 gpm
Total MH Rehab Cost (2010-2014) (\$)	1,723,881	
Actual Unit Cost of I/I Removal (2010-2014)	1,855 \$/gpm	553 \$/gpm
SSES Cost-Effective I/I Removal Threshold (adjusted)	860 \$/gpm	

- 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



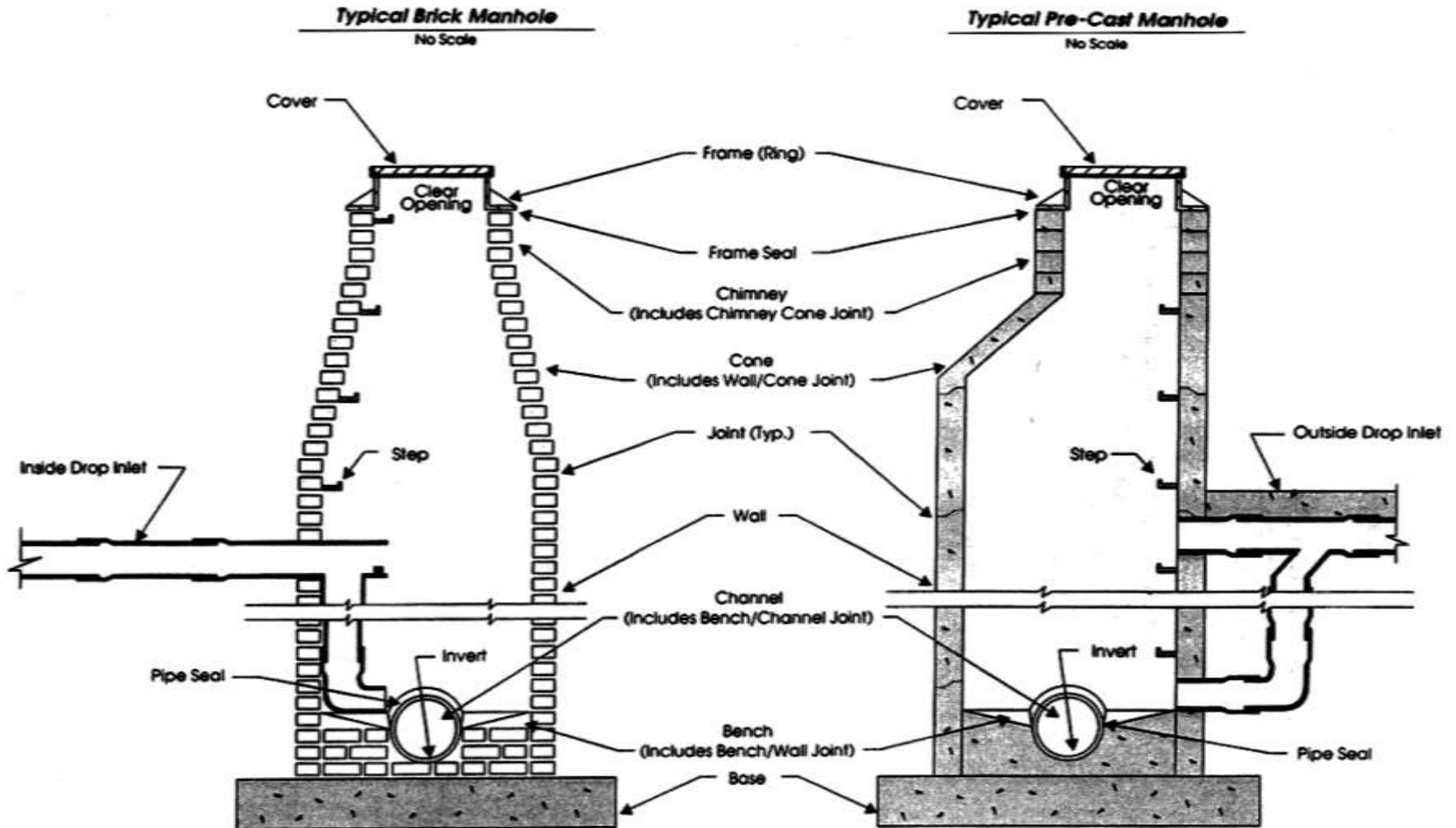
Questions?



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Manhole Diagram



Manhole Component Form

Manhole Inspection Form		Default Surveyor: 3 = ST	Change Defaults	Return to Main Menu
Default Weather: 1 = Dry <td colspan="3"></td>				
Manhole ID Selector	BD-3-23	Add New MH	Manhole ID	BD-3-23
		Duplicate ID? <input type="checkbox"/>		
<div> <div>Manhole Inspection</div> <div>Component Observations</div> <div>Pipe Connections</div> <div>Defects</div> <div>Photos</div> </div>				
Cover_Shape:	C = Circular	Cone_Type:	Conical Centered (CC)	
Cover_Material:	CAS = Cast Iron	Cone_Material:	BR = Brick	
Cover_Type:	Vented/Slots	Int_Cone_Coating_Liner:	None (NC)	
Number_Vent_Holes:	8	Ext_Cone_Coating_Liner:		
Vent_Hole_Diameter:	0.10	MH_Diameter_1_ft:	3	
Cover_Frame_Fit:	Good (G)	MH_Diameter_2_ft:		
Cover_Condition:	Sound	Wall_Material_1:	BR = Brick	
Gasket_Condition:		Wall_Material_2:		
Adjusting_Ring_Type:		Int_Wall_Coating_Liner:	None (NC)	
Adjusting_Ring_Condition:		Ext_Wall_Coating_Liner:		
Adjustment_Ring_Height_ft:		Bench_Present:	Yes (Y)	
Frame_Material:	CAS = Cast Iron	Bench_Coating_Liner:	None (NC)	
Frame_Condition:	Sound	Bench_Material:	C = Concrete (Non-Rei)	
Frame_Seal_Condition:	Sound	Channel_Installed:	Yes	
Frame_Offset_Distance_ft:		Channel_Material:	VCP = Vitrified Clay Pipe	
Chimney_Material_1:	BR = Brick	Channel_Type:	Pipe (P)	
Int_Chim_Coating_Liner:	None (NC)	Channel_Exposure:	Fully Open (F)	
Condition IntChim Coating Lnr		Number_Steps:	3	
Ext_Chim_Coating_Liner:		Step_Material:	Metal (M)	
Condition ExtChim Coating Lnr		Step_Condition:	Good	
<div> <div>Back to Manhole Inspections</div> <div>Forward to Pipe Connections</div> </div>				

Pipe Connections Form



Manhole Inspection Form

Default Surveyor: 3 = ST
Default Weather: 1 = Dry

Change Defaults

Return to Main Menu

Manhole ID Selector

BD-3-23

Add New MH

Manhole ID

BD-3-23

Duplicate ID?

☐

Manhole Inspection

Component Observations

Pipe Connections

Defects

Photos

Cxn1_Compass_Dir:

SW

Cxn1_Direction:

Out

Cxn1_Special_Condn:

Cxn2_Compass_Dir:

N

Cxn2_Direction:

In

Cxn2_Special_Condn:

Cxn3_Compass_Dir:

E

Cxn3_Direction:

In

Cxn3_Special_Condn:

Cxn4_Compass_Dir:

S

Cxn4_Direction:

In

Cxn4_Special_Condn:

Cxn5_Compass_Dir:

Cxn5_Direction:

Cxn5_Special_Condn:

Cxn6_Compass_Dir:

Cxn6_Direction:

Cxn6_Special_Condn:

Cxn7_Compass_Dir:

Cxn7_Direction:

Cxn7_Special_Condn:

Cxn8_Compass_Dir:

Cxn8_Direction:

Cxn8_Special_Condn:

Back to Component Observations

Forward to Defects

Defects Form

Manhole Inspection Form		Default Surveyor: 3 = ST	Change Defaults	Return to Main Menu
		Default Weather: 1 = Dry		
Manhole ID Selector	BD-3-23	Add New MH	Manhole ID	BD-3-23
			Duplicate ID?	<input type="checkbox"/>
<div>Manhole Inspection Component Observations Pipe Connections Defects Photos</div>				
Overall_Structural_Condition:		3 Average		
Overall_I/I_Condition:		3 Average		
Rehab Method 1:	Rebuild Top	Rehab Method 3:	Replace Cover	
Rehab Method 2:	Resurface Manhole	Rehab Method 4:		
D1_Location:	CH = Chimney	D2_Location:	CO = Cone	
D1_Code:	MBR = MissingBricks/Mortar	D2_Code:	MBR = MissingBricks/Mortar	
D1_Rating:	Minor	D2_Rating:	Minor	
D1_It:	Stains (IS)	D2_It:	Stains (IS)	
D1_Comments:				
D3_Location:	WA = Wall	D4_Location:		
D3_Code:	MBR = MissingBricks/Mortar	D4_Code:		
D3_Rating:	Minor	D4_Rating:		
D3_It:	Stains (IS)	D4_It:		
D3_Comments:				
D5_Location:		D6_Location:		
D5_Code:		D6_Code:		
D5_Rating:		D6_Rating:		
D5_It:		D6_It:		
D5_Comments:				
		Back to Pipe Connections Forward to Photos		

Photos Form



Manhole Inspection Form

Default Surveyor: 3 = ST
Default Weather: 1 = Dry

Change Defaults

Return to Main Menu

Manhole ID Selector

BD-3-23

Add New MH

Manhole ID

BD-3-23

Duplicate ID?

☐

Manhole Inspection

Component Observations

Pipe Connections

Defects


Photos

Manhole Photos

Add Manhole Photo

Take Picture

Description	Photo Name	
	WIN_20150513_154935.JPG	X
	WIN_20150513_154945.JPG	X



Back to Defects

Forward to Manhole Inspection

Other Cover Rehabilitation

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



Credit: Cretex Specialty Products



Credit: The Man Pan

Internal Mechanical Chimney Seal



Credit: Cretex Specialty Products

- Chimney geometry
- Easily verifiable during construction



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



Credit: Kim Construction Company, Inc.

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

Modified Polymer Skin Panel

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



Credit: Spectrashield



Structural Polyurethanes



- Several different types
- Corrosion protection, I/I, structural

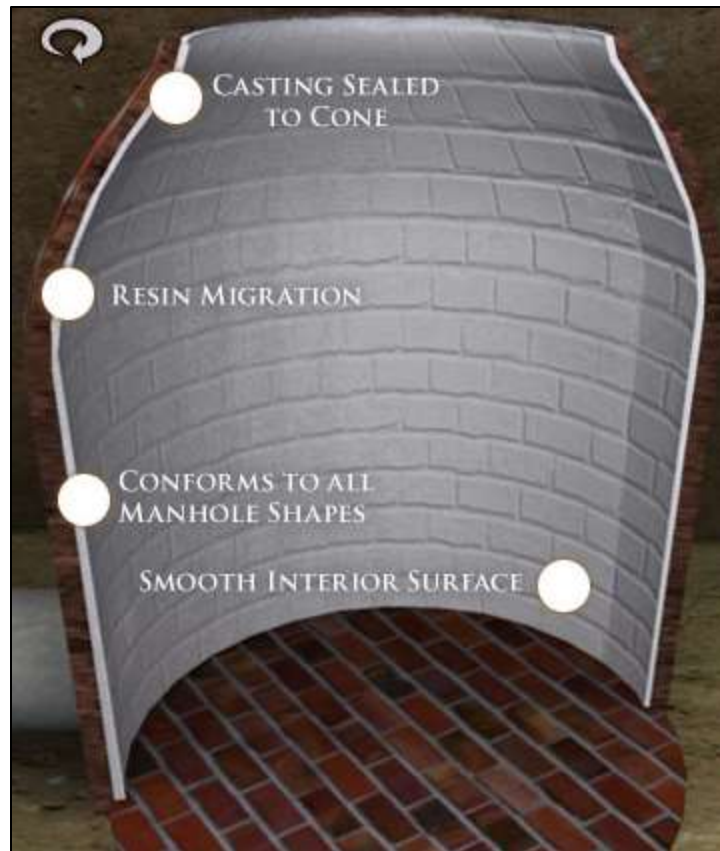
PVC and HDPE Liners



Credit: Predl Systems

- Rehabilitation or new construction
- Custom fit

Full Depth CIP Lining



Credit: LMK Technologies

- Custom fit liner
- Corrosion protection
- Structural



Credit: LMK Technologies

Channel Lining Systems

