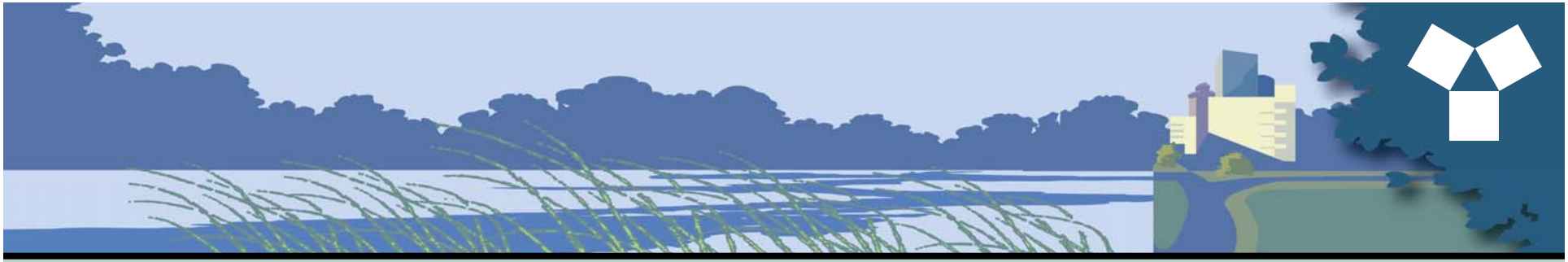


Village of Whitefish Bay's Sewer System Analysis

Presented to:

Village of Whitefish Bay

Environmental Advisory Committee

September 1, 2010

YAGGY COLBY ASSOCIATES

Introduction: Mark Mickelson, PE

- Mark Mickelson is a Principal of Yaggy Colby Associates, a multidisciplinary consulting firm located in Delafield, WI.
  - Yaggy Colby Associates provides Engineering, Surveying, Planning, Landscape Architecture, Geotechnical, and Environmental services to public and private clients throughout Southeastern Wisconsin.
- Mark has over 23 years of experience in the engineering field.
- He specializes in storm water analysis and storm water management, as well as floodplain analysis and mapping services.
- Registration/Licensure
  - Professional Engineer: Wisconsin and Indiana
- Education
  - Masters of Science, Engineering, University of Wisconsin – Madison
  - Bachelor of Science, Engineering, University of Wisconsin – Madison

Objectives

- Provide an informational/educational presentation on the Village's sewer system and their current and recent projects.
- Review includes all available information on the Village's sanitary sewer system and storm sewer system.
- The review will also include the history of flooding / basement backup events.

Synopsis

- Design of sanitary and storm sewer systems
- Overview of Village's sewer system
- History of flooding events
- Infiltration and Inflow (I/I)
- Previous Village studies
- Village of Whitefish Bay's Capital Improvement Program (CIP)
- CIP projects to date
- Summary of July, 2010 storm events, with flooding maps
- Presentation summary

Sanitary Sewer Design Basics

- Laterals to homes and businesses
- Only meant to handle waste stream, not storm or clear water
- Pipes increase in size as the system goes downstream
- Pipes are typically 10 to 15 feet deep in the center of the road
- Manholes are located every 200 to 300 feet, for cleaning and maintenance of the system
- Governed by WDNR codes and MMSD standards
- Village has a WPDES permit from WDNR for operation of its system
- Setback requirements from water main (8 feet from center to center)
- Some downspouts/sump pumps directly connected (illegal)
- Often space constraints with other utilities and right of way space limitations

Sanitary Sewer Bypasses / Overflows

The Village is obligated, per its Wisconsin DNR Wastewater Pollutant Discharge Elimination System (WPDES) permit, to limit sanitary sewer overflows (SSO's) and report the known extent of any SSO.

- **Bypasses can also be problematic, allowing surcharged storm sewer systems to backflow into the sanitary sewer system.**

2.3.2 Unscheduled Bypasses or Overflows

Any unscheduled bypass or overflow of wastewater at the treatment works or from the collection system is prohibited, and the Department may take enforcement action against a permittee for such occurrences under s. 283.89, Wis. Stats., unless:

- The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
- There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and
- The permittee notified the Department as required in this Section.

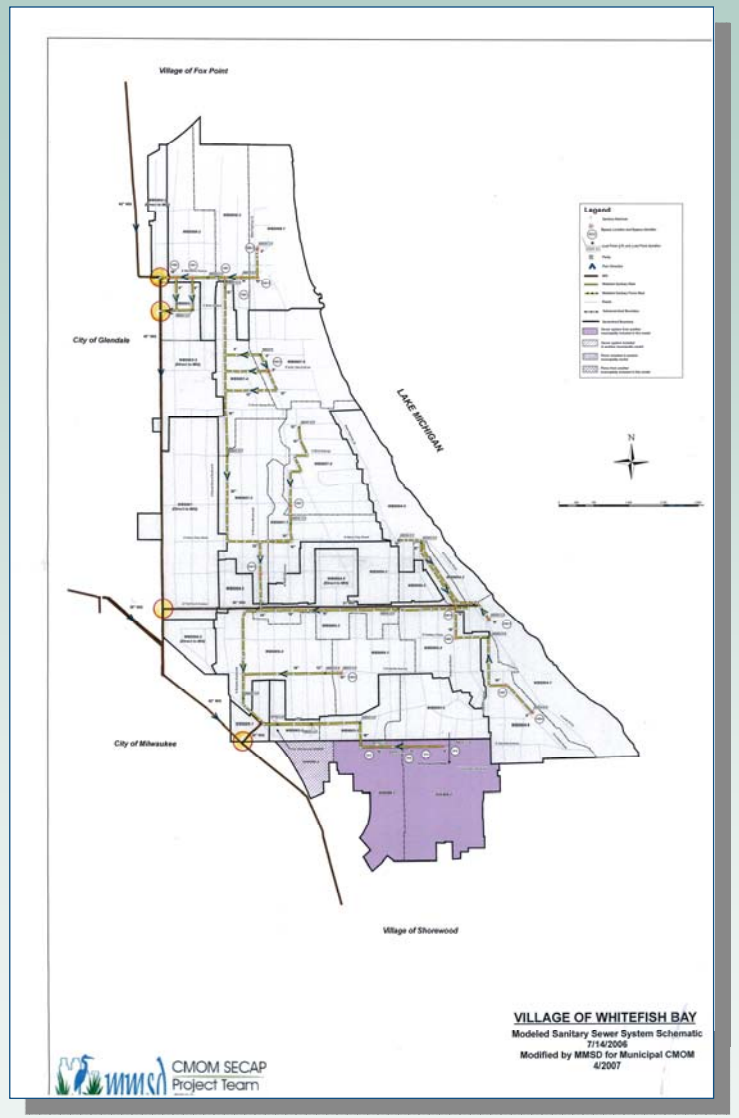
(*Note: Refer to Standard Requirement 4.8.2 for a description of scheduled bypassing that may be allowed pursuant to s. NR 205.07(v), Wis. Adm. Code.*)

Storm Sewer Design Basics

- Typically designed to accommodate a 10-year/ 24-hour storm event
- Catch basins along curb collect and transmit to a sewer main in street
- Pipes increase in size as the system moves downstream
- Pipes are typically 3 to 8 feet deep
- Village has a WPDES permit from WDNR for operation
- Setback requirements from water main horizontally and vertically at crossing
- Often space constraints with other utilities and right of way space limitations

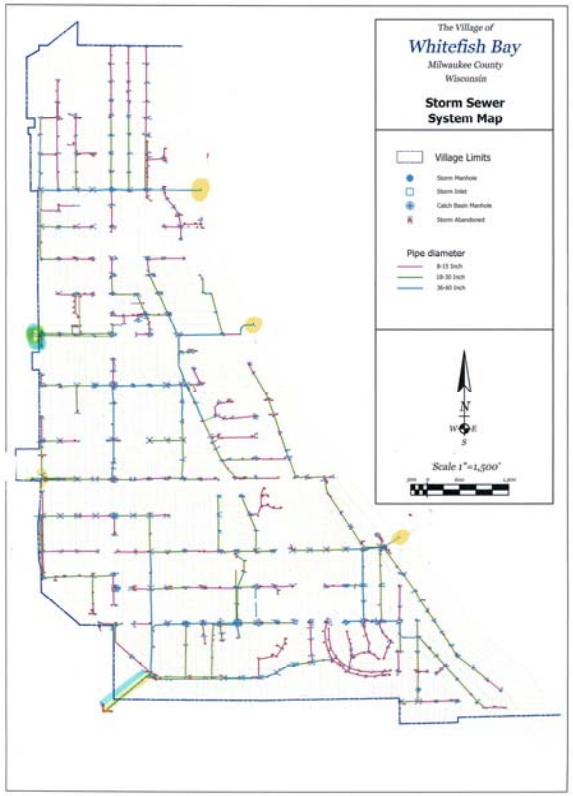
Village of Whitefish Bay's Sanitary Sewer System

- Constructed primarily between 1910 to 1950
- 204,000 lineal feet of pipe (38.6 miles)
- 942 manholes
- 8-inch to 36-inch pipe sizes
- Primarily vitrified clay pipe with 2- to 3-foot joint spacing
- No lift stations within the Village
- Originally a combined system; was separated in the 1920's after installation of MMSD interceptor along Lydell Avenue
- Four discharge locations to MMSD interceptor
- 16 currently known bypasses
- Approximately 75% of homes have foundation drains connected to the sanitary sewer system



Village of Whitefish Bay's Storm Sewer System

- Five discharge locations
- Previous study shows it can primarily handle a 10-year storm event
- There are virtually no detention basins within the Village to mitigate peak flows
- Outdated catch basin design



Infiltration/Inflow

Preserving The Environment • Improving Water Quality

The Issue
Infiltration & Inflow

Clear water has become a clear problem for local sewer systems and the Milwaukee Metropolitan Sewerage District's conveyance system

How I/I enters the system:

- Leaky manhole covers or deteriorated manholes
- Illegally connected downspouts, yard drains and sump pumps connected to the sanitary sewer system
- Collapsed, broken or leaky sewer pipes

Problems it creates:

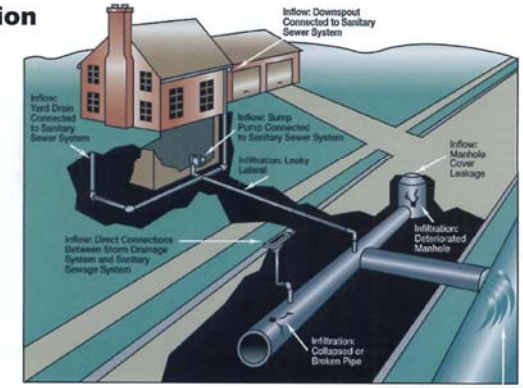
- Takes up capacity meant for wastewater
- When clear water exceeds capacity of conveyance system, sewer overflows may occur

What Is Infiltration And Inflow (I/I)?

Clear Water: Water that does not need to be treated at a wastewater treatment plant that enters the sewer system.

Infiltration: Groundwater that leaks into the sewer system underground.

Inflow: Rainwater that enters the sewer system above ground.



One of the main components of the District's long-range plan is to address the amount of clear water entering local sewer systems and the District's wastewater conveyance, treatment and storage facilities. The District is undertaking demonstration projects in eight of the communities it serves to show a variety of innovative methods to reduce the amount of clear water entering the sewer system.

What's being done to address the I/I problem:

- Manhole inspections and rehabilitation
- Smoke testing and building inspections to detect illicit connections to sanitary sewer system
- Lateral and sewer inspections
- Demonstration projects on private property to evaluate I/I reduction methods

Milwaukee Metropolitan Sewerage District
260 W. Seeboth Street, Milwaukee, WI 53204-1446
414-225-2138
www.mmsd.com

02-078 03/01/02

Infiltration/Inflow

Two sources of potential infiltration:

- Municipal
  - Leaking manholes
  - Cracked/broken pipes
  - Catch basins to sanitary sewer
- Private
  - Leaking laterals
  - Downspout connections to sanitary sewer
  - Private drains connected to sanitary sewer
  - Foundation drains connected to sanitary sewer

Photo taken 9/1/10 of manhole 203A in Cumberland Avenue. After 0.5 inch rainfall event, shows clear water in the sanitary sewer system.

History of Village Flooding Events

Village of Whitefish Bay Flooding Events

June, 1997	5.9 inches rain in 2 days
August 1998	3.8 inches rain in 2 days
2004	(reported event, do not have details)
June, 2008	6.2 inches of rain in 2 days
July 15, 2010	5.6 inches of rain in 12 hours
July 22, 2010	7.5 inches of rain in 4 hours; over 9 inches of rain in 2 days

Per SEWRPC

50% recurrence interval (2-year storm)	2.57 in 24 hours; 3.04 in 48 hours
10% recurrence interval (10-year storm)	3.62 in 24 hours; 4.20 in 48 hours
1% recurrence interval (100-year storm)	5.88 in 24 hours; 6.13 in 48 hours

Summary of Previous Village Studies

- 1981 MMSD Sanitary System Evaluation Survey (SSES)
- 1999 Earth Tech SSES*
  - In response to 1997/1998 basement flooding events
- 2000 – 2002 Rust/Harza
  - MMSD Metropolitan Interceptor Sewer (MIS) studies
- 2002 Bonestroo Facilities Plan (follow-up to 1999 Earth Tech report)*
- 2006 Brown and Caldwell MIS Studies
- 2008 Superior Engineering "Capacity Assurance, Management, Operations, and Maintenance Program" (CMOM)

**Summarized on following pages*

1999 Earth Tech
Sanitary System Evaluation Survey

- August, 1999
- In response to June, 1997 (5.9 inches / 2 days) and August, 1998 (3.8 inches / 2 days) flooding events
- Resulted in a joint project with the Village of Shorewood for a relief sewer and bypass
- This project was not approved by the Wisconsin DNR
- Village then opted for Infiltration & Inflow Study

1999 Earth Tech
Sanitary System Evaluation Survey

- Scope
  - Flow monitoring
  - Postcard survey
  - Manhole inspections
  - Capacity analysis
  - Metropolitan Interceptor Sewer (MIS)
  - Smoke testing
  - Dye testing
  - Televising/cleaning
  - Alternate rehabilitation evaluation
  - Storm sewer evaluation

1999 Earth Tech
Sanitary System Evaluation Survey

- Conclusions
  - Manhole defects: 5% of total inflow
  - Private drains, connected downspouts, and catch basins: 15% of inflow
  - Foundation drains: 75% of inflow
  - 73% of homes in Village had foundation drains connected to sanitary sewer

1999 Earth Tech
Sanitary System Evaluation Survey

- Recommendations
  - Manhole rehabilitation
  - Repair inflow defects from smoke testing
    - Driveway drains, catch basins, downspouts
  - Capacity analysis
    - In-line storage options
    - Upsizing of Fairmount Avenue/Courtland Place sewer
    - Foundation drain disconnection
    - Downspout extensions/ordinance

2002 Bonestroo
Facilities Plan

- September, 2002
- Built on 1999 Earth Tech report, with additional insight on Inflow and Infiltration (I/I)
- Objective was to minimize basement backups / wet weather overflows through rehabilitation of existing system. (The fact that basement backups primarily occurred during rain events indicated that "wet weather inflow" was major contributor to problems.)

2002 Bonestroo Facilities Plan

- Scope
  - Evaluated public and private sources
  - Reviewed previous studies (1981 SSES and 1999 SSES)
  - Dye tested sewer
  - Televised sewer
  - Hydraulic modeling

2002 Bonestroo Facilities Plan

- Eliminated options
  - Storage option: due to costs, lack of free outlet, and lack of protection from MIS surging
  - Upsizing pipe: due to costs and fact that volume and rate increases are limited by MMSD
  - Wet weather relief sewers: did not address I/I problem and wasn't likely to be approved (similar to joint project with Shorewood)
  - Foundation drain disconnection: due to costs and unpredictable benefits

2002 Bonestroo Facilities Plan

- Recommendations
  - Reduce wet weather inflow by 40%, so that future 100-year performance would be equivalent to existing 10-year performance
  - Manhole to be rehabilitated (720); recommended to reduce I/I by 5%
  - Smoke testing of sanitary sewer system flaws to identify structural defects for repair and rehabilitation; recommended to reduce I/I by 5%
  - Replace structural defects in sanitary sewer, including sags, broken pipes, holes in pipes, and missing pipes
  - Sanitary sewer lining of cracked pipes; recommended to reduce I/I by 10 – 20%
  - Sanitary lateral repair and rehabilitation; recommended for a 10 – 20% reduction in I/I (noting that storm sewer leaking to defective laterals is a major component of inflow)

2002 Bonestroo Facilities Plan

- Recommendations, continued
  - Eliminate sanitary sewer bypasses; proposed closing 6 bypasses to reduce risk of flow from storm sewer to sanitary sewer
  - Storm sewer and drainage improvements
    - Generally, the storm sewer system had proper capacity to handle a 10-year rain event, but pipe segments were found without the required capacity.
    - A table recommending 35 upgrades was provided, with mostly a 1 – 2 pipe size increase.

2002 Bonestroo Facilities Plan

- Implementation
  - Addressed options for recommended upgrades
  - Two options with costs and reductions were analyzed
  - Option 1 ($11.8 million) was recommended, with 45 – 70% reduction in Infiltration and Inflow
  - A 5-year implementation was proposed

Village Sanitary Sewer Improvements

- From 2006 - 2010, over $32 million has been spent on capital improvement projects in the Village of Whitefish Bay.
  - Over $9 million for sanitary sewer upgrades
  - Over $3.5 million for storm sewer upgrades

Village of Whitefish Bay
Capital Improvement Programs

- Maintenance / upgrades
  - Sidewalks
  - Streets / curb and gutter
  - Water main / hydrants
  - Storm sewer / catch basins
  - Sanitary sewer

Village of Whitefish Bay
Capital Improvement Programs

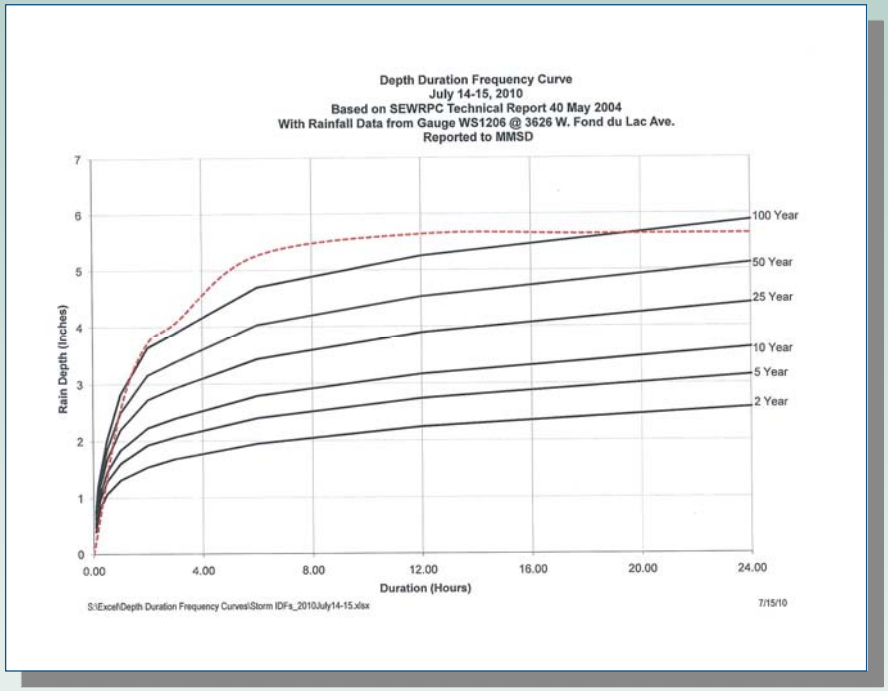
- Village Engineer and Village Manager work together to list and prioritize each year's work plan
- Currently have a 5-year plan, which is adjusted on an annual basis
- When dealing with older infrastructure, must balance priorities with budgets
- Of the $32 million spent since 2006, $12.5 million has been spent on sewer upgrades ($9 million on sanitary sewer; $3.5 million on storm sewer)

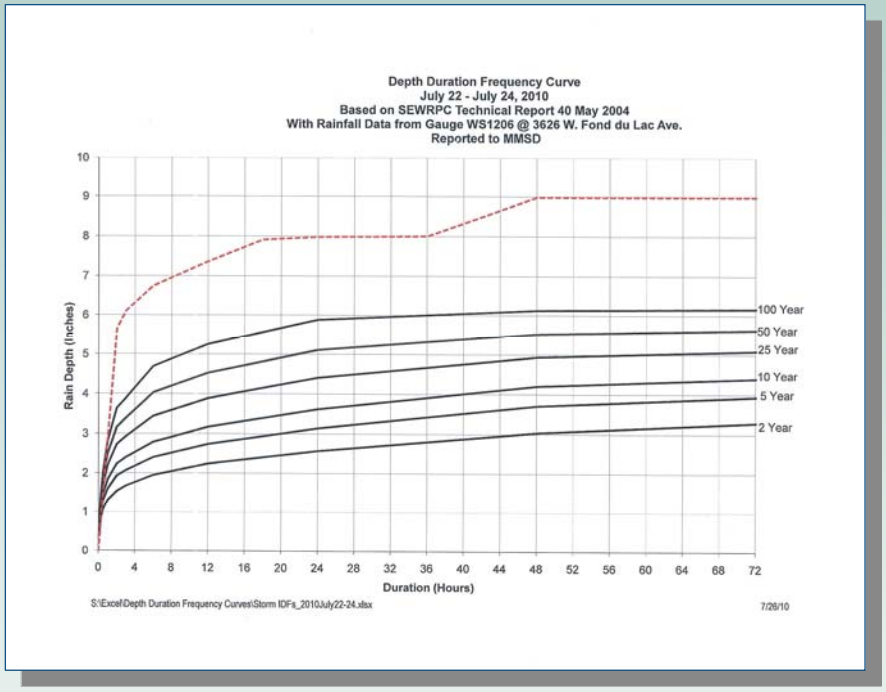
Design Constraints

- Sanitary sewer
  - Rate and volume controlled by MMSD and downstream interceptors
  - Aging sewers
- Storm sewer
  - Downstream discharge locations
  - Numerous sag points in Village streets
  - Very flat roads
  - Storm sewer often opposite direction of sanitary flow
  - Outdated catch basin design limits ability to get water into the system
  - Limited space in roadway with sanitary, water main, and storm sewer plus required setbacks from water main

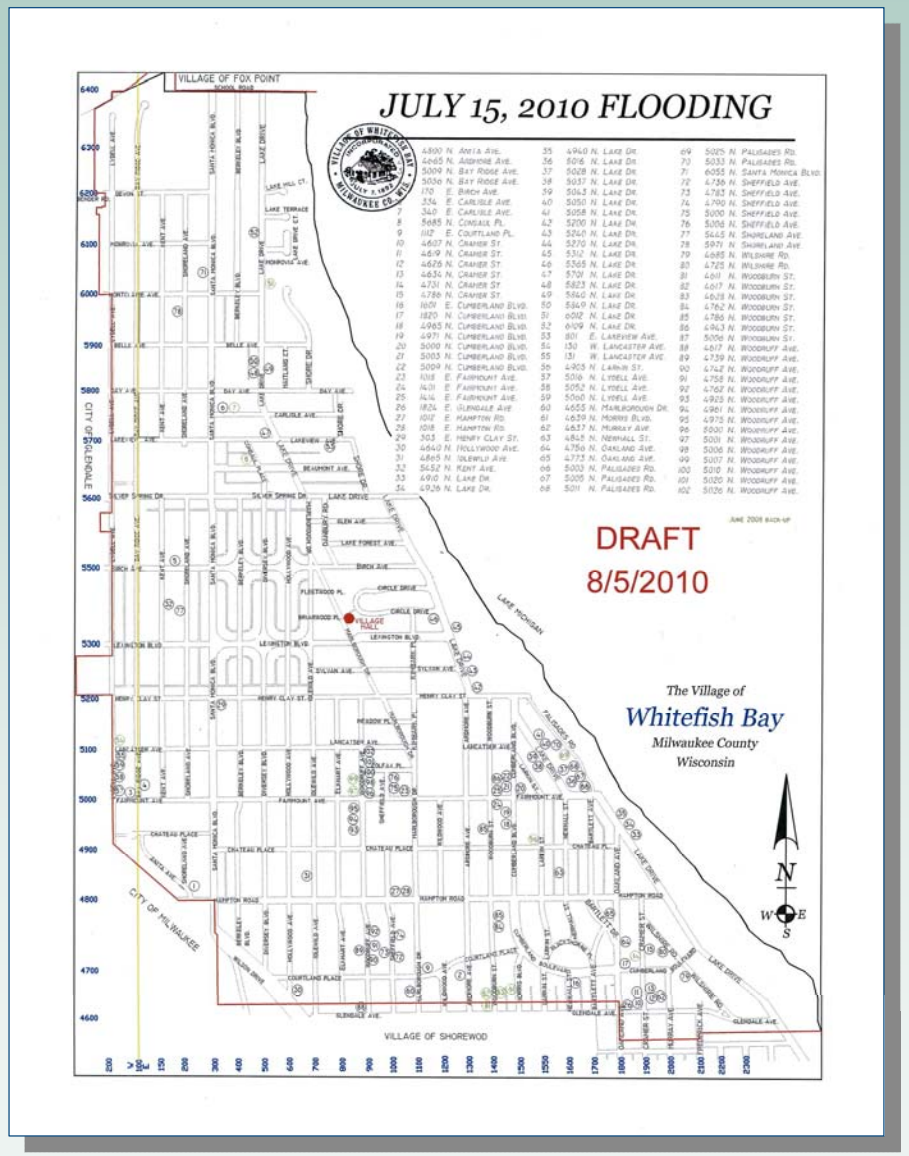
Design Constraints

July, 2010 Storm Events





July 15, 2010 Storm Event Summary

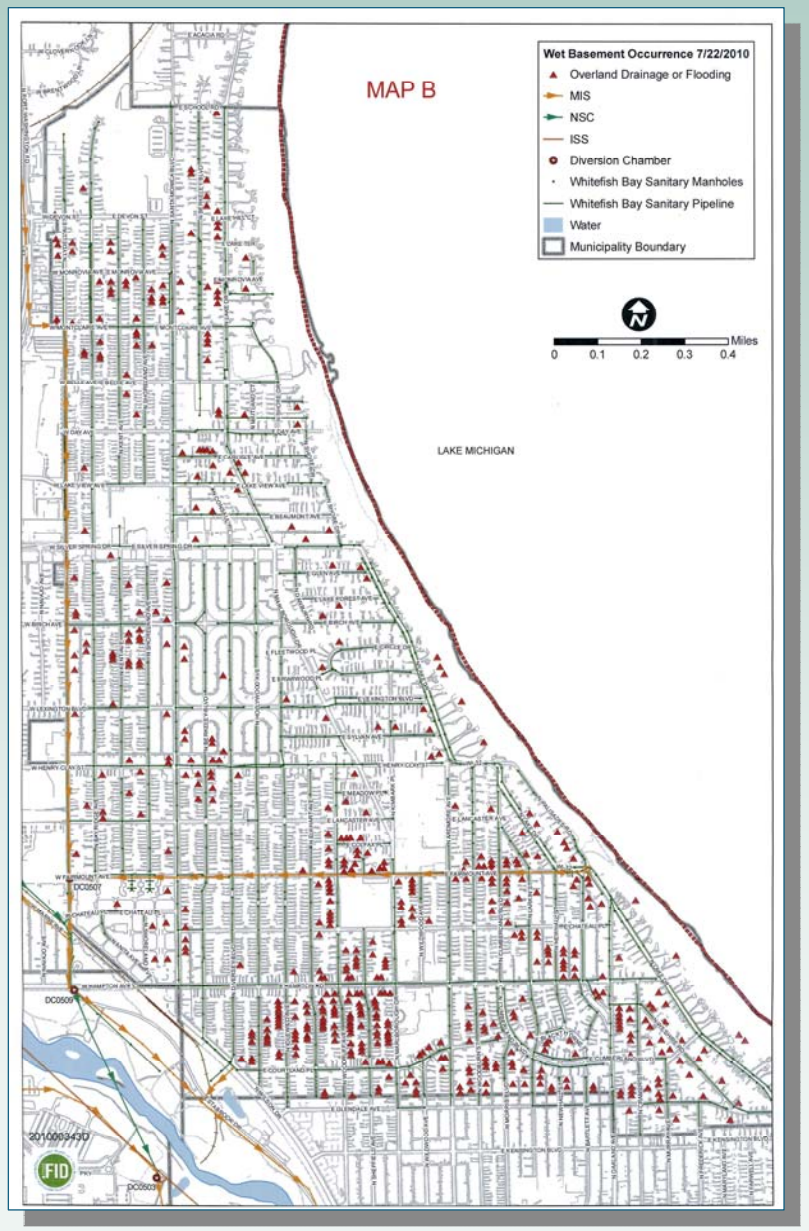


July 22, 2010 Flooding Map

Reported sanitary sewer backups

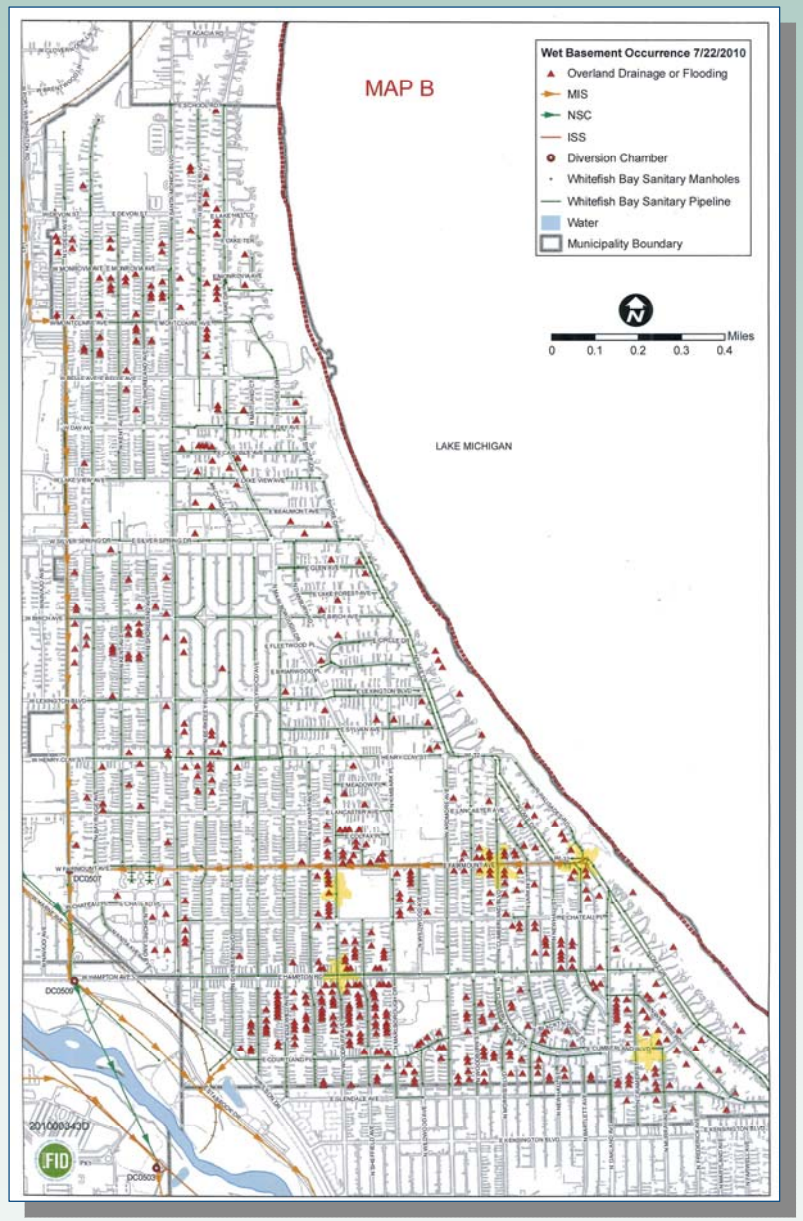
July 22, 2010 Flooding Map

Reported clear water backups, or flooding



2010 Study Areas

Proposed Engineering Study for 5 neighborhoods severely affected during 2010 storms



Summary

- The July, 2010 storms were historically extraordinary events that taxed the infrastructure of the North Shore area.
- Whitefish Bay has implemented and maintained an aggressive sewer rehabilitation program since 2005, and will continue to do so through updated CIP's.
- The Village has addressed the sanitary sewer replacement upgrades noted in the 2002 Bonestroo Facilities Plan.
- Whitefish Bay will continue to study, evaluate, and recommend improvements based on a proposed Engineering Study that will utilize all historical documentation, including the July, 2010 flooding data.