Milwaukee Metropolitan Sewerage District

2010-2020 Private Property Inflow and Infiltration Reduction Program

Legislative Findings

February 2011

The Milwaukee Metropolitan Sewerage District (the "District") is embarking on a ten year program to fund repairs to private property sources of infiltration and inflow ("I/I"). This document is for the purpose of stating the District's legislative findings in support of this program.

Finding #1: Basement backups are a significant public health and safety issue.

Water and sewage backing up into basements is a very significant public health and safety issue.

The most immediate danger to residents is from the risk of electrocution and gas leaks when appliances and electronics are affected by the flood waters. *See* http://city.milwaukee.gov/FloodCleanup.

A hazard exists to public health in the presence of sewage through exposure via inhalation, contact, and ingestion. The sewage contains a variety of harmful pathogens, including bacteria, fungi, viruses and parasites. *See* Suggested Guidelines for Remediation of Damage from Sewage Backflow into Buildings, Berry M. and Bishop J., Journal of Environmental Health, 1994 Oct; Vol. 57(3):9. While acute exposure to pathogens routinely found in untreated sewage such as enteroviruses, rotaviruses, hepatitis A, Escherichia coli, salmonella, giardia, roundworms, hookworms, and tapeworms (*Id.* at table 1) is apparent at the time of a backup event, the hazard persists through chronic exposure to biological and chemical contaminants from the onset of the event through the completion of cleanup and restoration. (Human Health Concerns Related to Chronic Exposure to Raw Sewage Resulting from a Malfunctioning Sanitary Sewer Line, Better Brite III Investigation, Center for Disease Control(CDC), Agency for Toxic Substances & Disease Registry, August 2002)

The opportunity for exposure continues as basement backups provide an environment for mold growth inside the home, contributing to allergies and the potential for health problems long after the flood event has subsided. *Id.* *See also* Long Term Monitoring of Mold Contamination in Flooded Homes, Pearce McGregor, et al., Journal of Environmental Health. 1995 Oct., Vol. 58(3).

<u>Finding #2</u>: Under many circumstances, removing I/I from private property is the most direct means to reduce the risk of basement backups because it removes excess flow at the source.

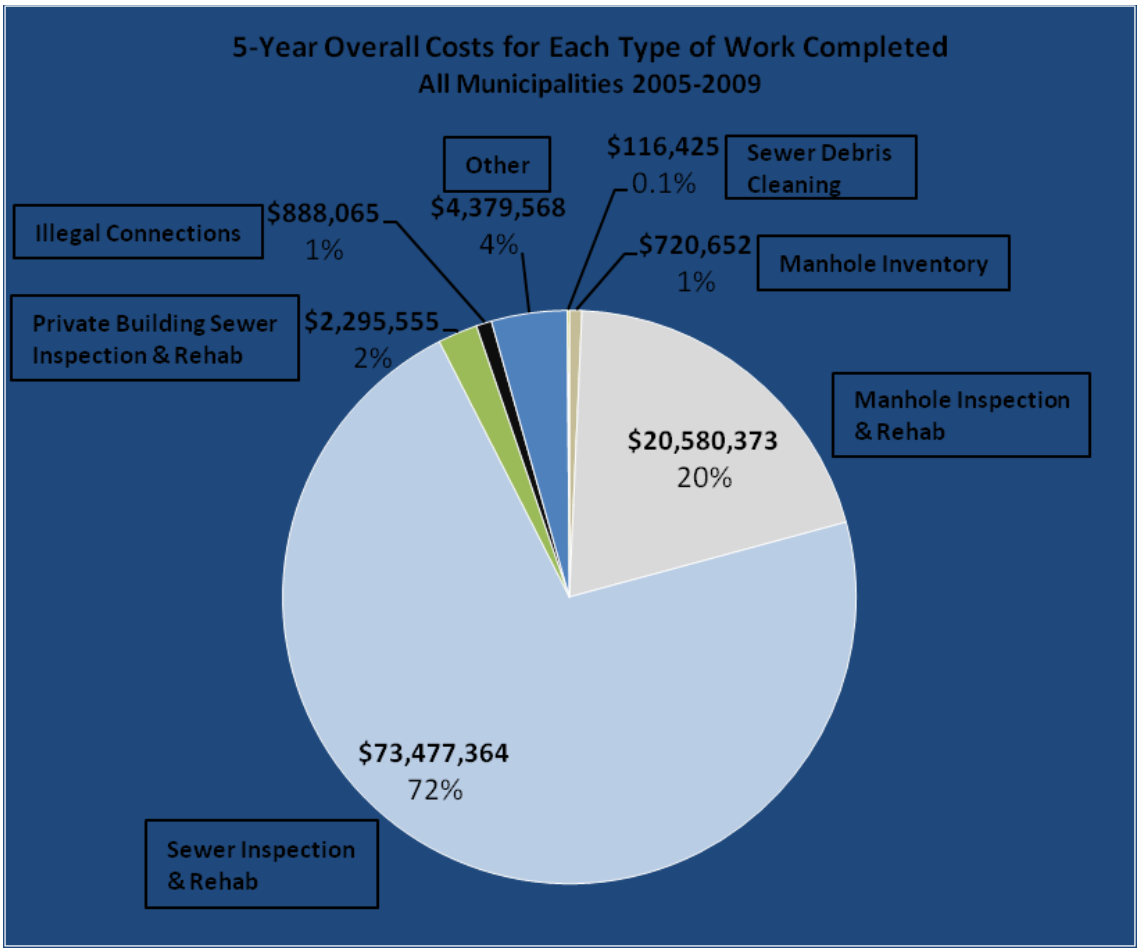
Basement backups during wet weather events typically occur due to sewage flow exceeding the capacity of the collection and conveyance system. In the MMSD service area, pipes are generally adequately sized to accommodate typical I/I rates that would be anticipated during dry weather and statistically "normal" wet weather events.

While I/I cannot reasonably be completely eliminated, consecutive wet weather events that generate "abnormal" precipitation rates based on statistical and historic evidence aggravated by saturated soil conditions create excessive I/I rates. The excessive I/I rates are a result of multiple factors including: 1) increased hydraulic pressure exerted on I/I pathways that are active daily during dry weather; 2) overwhelmed surface water drainage seeking pathways of inflow that are not active during dry weather conditions; and 3) elevated groundwater levels submerging the higher elevation lateral defects.

Pipe surcharging can allow more flow to be conveyed than what a pipe was designed for, but often this available additional capacity is not significant in areas with little topographical relief (i.e. flat slopes). This type of topography describes much of the MMSD service area, particularly in areas near stream and river corridors. As a result, pipe surcharging can result in basement backups when flows exceed pipe capacity by as little as 50 percent. Sizing all pipes to adequately convey flows during any conceivable extreme flow condition will result in an oversized and poorly functioning conveyance system through most of the service life under normal flow conditions. Such a scenario leads to solids and debris settling out to the invert of pipe reducing the diameter and creating obstruction thereby resulting in more frequent dry weather sewer backups and overflows. The accumulation of solids in the pipe can also lead to anaerobic conditions that increase odors and formation of corrosive agents thereby shortening pipe life. The practice of oversizing pipe is, therefore, not a practice endorsed by industry standards. *Process Design Manual for Sulfide Control in Sanitary Sewerage Systems, U.S. EPA, Oct 1974.*

Therefore, addressing I/I is critical both to reducing basement backups and to having an optimally functioning conveyance system.

It is important to address I/I from both public sources and private sources. In the past 10-15 years, the municipalities serviced by the District have done significant work on I/I control from public sources. Following is a graph detailing the public expenditures on public property I/I.



(Source: MMSD, based on Municipal I/I Annual Reports). As shown, very little work has been done to control I/I from private property sources. However, projects from around the county demonstrate that private property I/I removal is very effective in reducing flows and reducing the risk of basement backups.

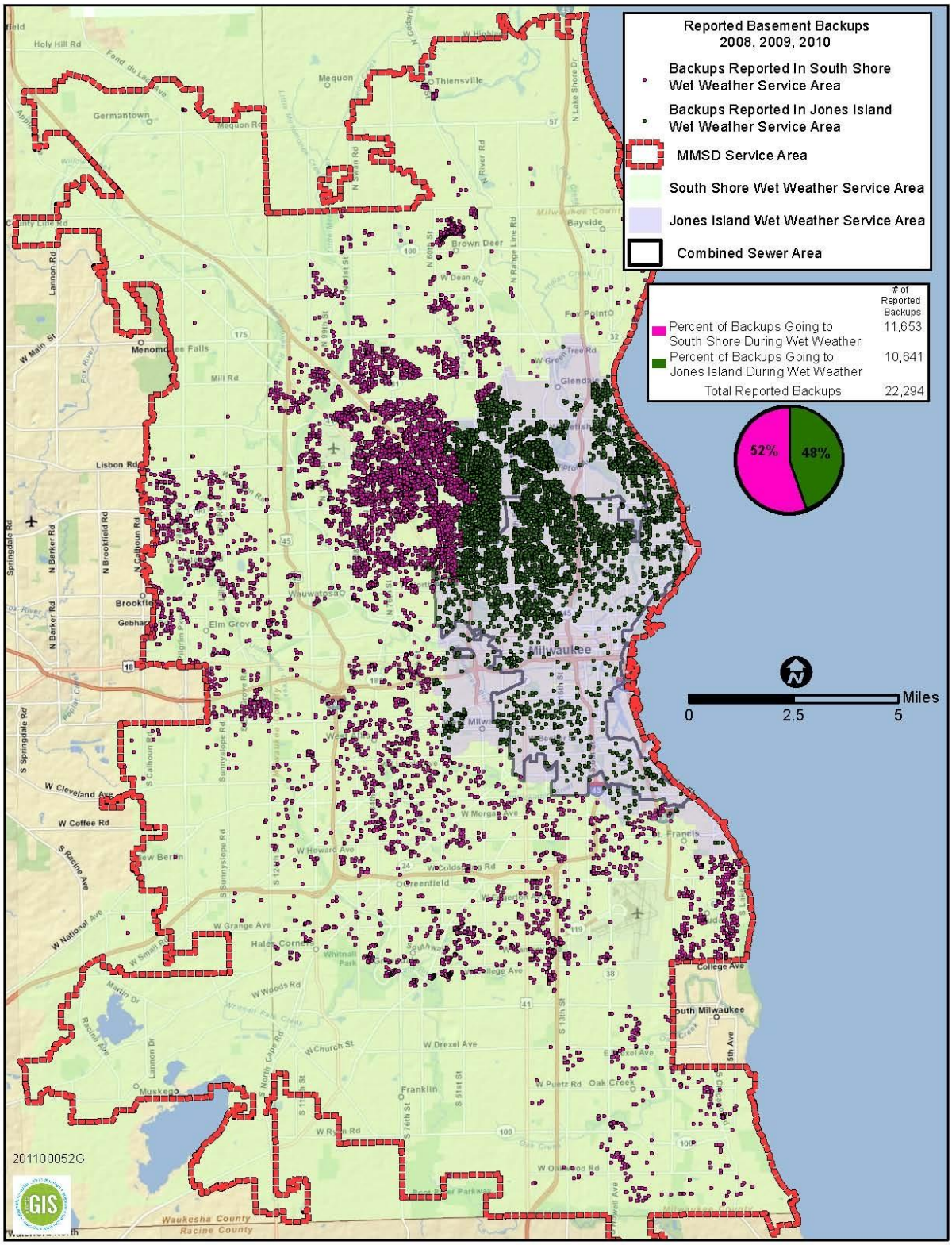
In particular, the 2004 WERF Research Report found, in an exhaustive comparison of I/I reduction projects, that significant peak flow reductions coincided with significant private lateral rehabilitation. *See* 99-WWF-8: Reducing Peak Rainfall-Derived Infiltration/Inflow Rates – Case Studies and Protocol (WERF ISBN 1-893664-76-7), Brown and Caldwell, 2003. A pilot I/I reduction program in King County, WA, came to a very similar conclusion. *See* I/I Reduction Pilot Project Report, King County Washington.

<u>Finding #3</u>: In most circumstances, basement backups are caused by sewer surcharging that is very close to the affected property. Therefore, a) I/I reduction work in the combined sewer area will help reduce the risk of basement backups in the combined sewer area; and b) separating combined sewers is likely to have a minimal effect, if any, on basement backups in the separated sewer area. Most basement backups in 2008-2010 occurred in separated sewer areas.

The District's data collection, flow monitoring and modeling work indicates that in most circumstances basement backups are caused by sewer surcharging that is very close to the affected property. In other words, basement backups in the combined sewer area are caused by combined sewers that have reached capacity, while basement backups in the separated sewer sewer area are caused by sanitary sewers that have reached capacity. I/I reduction work in the combined area will help reduce the risk of basement backups in the combined area, and therefore the District is not limiting Program funding to I/I work in the separate sewer area. U.S. EPA routinely urges (or requires) I/I reduction work in combined sewer areas in response to basement backups and combined sewer overflows ("CSO").

For example, the 2004 U.S. EPA Report to Congress on the Impacts and Control of CSOs and SSOs includes summaries of various inflow reduction programs around the country. The City of South Portland, Maine developed a program in 1986 to reduce wet weather inflow into their combined sewer system (CSS). Between 1986 and 1995, the City invested $2.5 million dollars in the program. Of the 6,000 residential buildings surveyed, 380 roof leaders and 300 sump pumps were identified as connected to the CSS. The City offered monetary incentives for the home owners to disconnect the inflow sources and by the program's completion in 1995, 64.5% of all known inflow sources had been redirected. This resulted in a reduction of CSO volume of 58 MG per year, a three percent reduction in annual flow to the local wastewater treatment plant, and fewer reported residential backups. Additionally, the inflow reduction program removed more than 420 gallons per year of storm water from the CSS for every dollar spent. The total cost of the rebate program was $128,000.

At the same time, actions to separate combined sewers would have a minimal (if any) effect on basement backups in the separate sewer area – where most of the District's basement backups are occurring. An analysis of reported wet weather backups by MMSD municipalities from 2008 through 2010 showed that 52 percent of the backups were reported in the South Shore WRF service area, which operates completely independently of flows in the combined sewer service area. Further analysis shows that only 17 percent of the reports were from properties served by a local combined sewer.


Reported Basement Backups
2008, 2009, 2010
Backups Reported In South Shore Wet Weather Service Area
Backups Reported In Jones Island Wet Weather Service Area
MMSD Service Area
South Shore Wet Weather Service Area
Jones Island Wet Weather Service Area
Combined Sewer Area
# of Reported Backups
Percent of Backups Going to South Shore During Wet Weather 11,653
Percent of Backups Going to Jones Island During Wet Weather 10,641
Total Reported Backups 22,294
52%
48%
Miles
0
2.5
5
201100052G
Waukesha County
Racine County

<u>Finding #4</u>: Private property I/I work can result in lower capital and operating costs to the District and the 28 municipalities it serves, along with lower insurance premiums, lower disaster recovery costs, and preventing the devaluation of properties for property owners in the District's service area.

The money spent to reduce private property I/I will generate benefits beyond reducing the risk of basement backups. The I/I that is eliminated from the system with these repairs or disconnections will also reduce flows during normal, dry weather periods and during smaller rain events that do not result in basement backups.

For example, the City of Duluth, Minnesota has witnessed a reduction in dry weather flow by 8 MGD since the inception of the I/I elimination programs in 1995. The City realized immediate results with notable reduced SSO events and basement backups in the initial targeted pilot program with the long term benefit of tangible reduced dry weather flow as determined through flow monitoring. This flow reduction can translate into cost-savings in terms of reduced capital costs for increased conveyance and treatment capacity, storage structures, and reduced operating costs.

As another example, extensive cost analysis reports compiled by King County, Washington comparing I/I reduction projects versus capital improvement projects necessary to manage larger flows have concluded that I/I reduction projects on private property analyzed on a basin by basin basis are cost effective. The 2005 Benefit/Cost Analysis Report prepared by Earth Tech for King County identified 9 projects affecting 7,000 properties with a benefit to cost ratio in a range of 1.1 to 3.3 with a total expenditure of $73,000,000 and total estimated flow reduction of 22 MGD.

The Miami-Dade County Water and Sewer Department Comprehensive Lateral Investigation Program (CLIP) Report, February 2007, surmised that the Lateral Repair Program while four times more costly on a per foot basis than reduction efforts in mainline projects, the cost in dollars/gallon of flow removed was one sixth the cost of the mainline programs. The CLIP program (mainline+lateral program) was found to be one eighth the cost of pumping, transmitting, and treating the flow had it not been removed from the system.

Reducing the risk of basement backups has other benefits as well. The District has anecdotal reports of residents who have had the sewer backup rider to their homeowner's insurance policy cancelled because of backups at their home or in their neighborhood. In addition, the Federal Emergency Management Agency (FEMA) provided aid totaling $45.2 million to homeowners and businesses damaged by the 2010 extreme wet weather events. We do not know how much of this damage was caused by basement backups versus surface flooding, but believe that the amount of money was significant. Finally, it is common sense that homes with repeat basement backup problems will not sell as readily and will drive down property values (and associated tax revenue) in the community.

Finding #5: Disconnecting foundation drains is a very effective strategy for reducing inflow. Rehabilitation or replacement of laterals (including flood grouting) is also one of the most effective strategies for reducing infiltration, especially in older communities where deteriorated laterals can contribute very large quantities of clear water to the sanitary sewer system.

Communities around the country have had success with foundation drain disconnection programs. The City of Duluth, MN, has tremendous experience with foundation drain disconnection, having made this approach the cornerstone of its I/I reduction efforts which began in 1995 in response to a mandate by the Minnesota Pollution Control Agency. The City's initial program focused on foundation drains. One of the first indications of success was less frequent basement backup realized within the first year of the initial program. Analysis of flow reduction by Brown and Caldwell showed a substantial reduction in wet weather peak flows, wet weather volumes, and SSO frequencies from a basin that implemented comprehensive foundation drain disconnections. Foundation drain disconnection has been found to be significantly less expensive than building storage for controlling the once-in-20 year SSO event. (*See* Was It Worth the Price? I/I Reduction Effectiveness of a Foundation Drain Disconnection Program in Duluth, Minnesota; S. Lipinski and A. Lukas; Presented at Water Environment Federation Collection Systems Conference, 2003.) To further reduce I/I and SSOs to a once in 20-year frequency, the City has progressed with lateral rehabilitation, scheduling 650 lateral inspections for 2011 supplemented with 16 MG of storage construction. The experience of the Duluth staff has been that 50% of laterals inspected will need rehabilitation. (Interview with City of Duluth staff, February 3, 2011.)

As another example, the U.S. EPA website reports on the success of a program in Johnson County, Kansas. The older sections of the County had repeated problems with sanitary sewer overflows and building backups. The county began an extensive program to identify and remove private property I/I, focusing on foundation drain disconnection. The program resulted in a 40 % reduction in total I/I, or 110 million gallons per day during a 10 year storm event. Customer complaints regarding sewer problems were also significantly reduced. http://www.epa.gov/npdes/sso/kansas/index.htm.

The City of Columbus, Ohio, conducted a pilot study of 216 properties which included water testing to identify target sources through simulated heavy rainfall. Foundations were the most common improper connection. Private source I/I was determined to be contributing approximately 55% of the total I/I through the study. (*See* Sanitation District No. 1 of Northern Kentucky Inflow and Infiltration from Private Property, Strand, 2006.)

Many other communities have had successful lateral rehabilitation programs. The 2004 Water Environment Research Foundation (WERF) Survey of Public Works Utilities concludes that on the average 40% of all I/I is sourced from private laterals. According to data compiled by the survey, on the average, there are 82 laterals for every mile of public mainline sewer.

For a local example, through an MMSD BMP program, the City of Mequon performed comprehensive infiltration reduction on sewer mains, manholes, and private laterals up to the house foundation. Previously, sewer mains and manholes were inspected and deemed to be contributing very little to the I/I conditions observed by downstream flow meters. A flood grouting approach was used to simultaneously seal off infiltration-causing defects in the system, a process that resulted in over 85% reduction in peak wet weather flows and volumes. I/I Reduction Demonstration Project - Sanipor Flood Grouting in River Road Service Area, Brown and Caldwell, October 2009.)

Similarly, Sarasota, Florida rehabilitated 297 private laterals in 2001-2002, utilizing primarily pipe bursting at an average cost of $2450/lateral for a reduction in pumped volume from one lift station in the basin of 30% and reduction in pumped volume from a second lift station in the basin of 78%. Lafayette, Louisiana utilized flood grouting to rehabilitate 26 laterals including associated mains and manholes for a cost of $580/lateral and a reduction in tested exfiltration of 90% after 21 weeks in service. (*See* Methods for Cost-Effective Rehabilitation of Private Lateral Sewers, WERF, 2006.) Prichard, Alabama has rehabilitated and replaced 1000 laterals since 2004, eliminated 5 of their 8 SSO sites, and reduced I/I by 33% as determined by flow monitoring. (*See* Sanitation District No. 1 of Northern Kentucky, Inflow and Infiltration from Private Property, Strand, 2006.)

Finding #6: Private property I/I work reduces the risks of combined and sanitary sewer overflows to surface water during wet weather by increasing the percentage of total flow that can be conveyed, stored and treated.

Private property I/I work will address some of the largest sources of clearwater and storm water flow into the combined and sanitary sewer systems. Reducing the clear water flow into sanitary and combined sewer systems reduces the total flow that must be conveyed, stored and treated. This, in turn, decreases the amount that must exit the system as combined sewer overflow ("CSO") or sanitary sewer overflow ("SSO") and is equivalent to an increase in the percentage of total flow that can be conveyed, stored and treated.

In 2004, the United States Environmental Protection Agency made a report to Congress on CSOs and SSOs. This report can be accessed at http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm. The report details many of the human health and environmental impacts of CSOs and SSOs. The pollutants in CSOs and SSOs contribute biological oxygen demand, total suspended solids, toxics, nutrients and floatables that impact aquatic life, drinking water, fish consumption and recreation. *Id*. at 5-3. U.S. EPA limits CSOs and SSOs through the Clean Water Act permitting

process and has taken numerous enforcement actions against non-compliance communities. For 2010 alone, the U.S. EPA website lists consent decrees entered into with seven communities relating to sewer overflows.

Chapter 8 of the 2004 EPA Report to Congress: Impacts and Control of CSOs and SSOs discusses inflow reduction and sewer lateral rehabilitation as important means of reducing the amount of storm water entering the combined and sanitary sewer systems and preventing CSOs and SSOs. U.S. EPA notes that "recent studies indicate that a significant component of the infiltration in any sewer system is the result of service lateral defects that contribute varying quantities of I/I." Reducing infiltration will reduce the number and quantity of overflows, avoid the harmful environmental and public health impacts of overflows and avoid potential prosecution by U.S. EPA.

Finding #7: Deteriorated laterals are also a source of pollution to area surface and ground waters and pose public health issues other than basement backups.

In an urban setting such as the District, deteriorated laterals allow untreated sewage to contaminate the surrounding environment. Other communities have already developed programs to identify and repair broken laterals and protect their local surface water resources.

The City of Lakeport, California has developed a private sewer lateral certification program that tests and inspects both residential and commercial sewer laterals in order to identify those laterals needing repair or replacement. It defines laterals that are broken, cracked or damaged in some way as those that may allow effluent sewage to leak out into the surrounding soil or allow influent water to enter the system. Effluent sewage leaking out may impact the water quality of Clear Lake, the lake that is a central feature to the City. Additionally, influent water into the system increases the flow in the sewer system while at the same time decreases the system capacity, which in turn may cause sewer backups and overflows. See http://www.cityoflakeport.com/departments/page.aspx?deptID-48&id=115.

Similarly, the City of Santa Barbara, California has developed a Sewer Lateral Inspection Program (SLIP). Cracked, broken, or clogged sewer laterals can cause sewage backups and overflows. These sewage spills can endanger public health and cause contamination of creeks and the ocean. In order to prevent spills from broken sewer laterals, the City has passed a law that requires homeowners to inspect their lateral if they are doing significant remodeling to their home or if the Public Works department has observed cracks and/or roots in the lateral during routine inspection of the City system. If the subsequent inspection shows that no repairs are necessary, the homeowner receives a certificate of compliance that is valid for three years. However, if the lateral is broken or clogged, the homeowner is instructed to make the necessary repairs. Sewer laterals that have been installed within the last twenty (20) years are exempt from this program. See http://www.santabarbaraca.gov/Resident/Licenses_Permits/SLIP/.

Additionally, there have been a number of studies completed in Wisconsin regarding various water sources contaminated by wastewater discharges. A 2007 study indicated with an analysis of aquifers used for drinking water supply in the Madison, Wisconsin, area found bacteria and human viruses present in confined bedrock aquifers. *See* Human Enteric Viruses in Groundwater from a Confined Bedrock Aquifer by Borchart et al. Similarly, a study of Greater Milwaukee Watersheds completed by the Great Lakes WATER Institute tested 62 municipal stormwater discharges in the Menomonee River and 3 discharge locations along Lake Michigan. The analysis found that the Lake Michigan outfalls had positive results in over 70% of samples and the Menomonee River outfalls had positive results in over 73% of samples. Additionally, analysis of stormwater outfalls along the Kinnickinnic River and Lincoln Creek were found to have human markers in 60% and 65% of the samples, respectively. Analysis of Honey Creek, Underwood Creek, Oak Creek, and the Milwaukee River also found evidence of sanitary sewage contamination of stormwater. Greater Milwaukee Watersheds Pathogen Source Identification, Great Lakes WATER Institute, S. McLellan and E. Sauer, March 1, 2006 to July 28, 2009.

Results from a study done on Honey Creek in 2006 indicate that storm sewer inputs of fecal coliform and E. coli bacteria are significant to Honey Creek and that there is evidence of sanitary sewage present in both the tested storm sewer system and in Honey Creek, even though there were no reported sanitary sewer overflows or bypasses during the monitoring period. Honey Creek Bacteria Investigation Survey, MMSD Engineering & Planning Department and Water Quality Research Department, July-August 2006.

In addition to this study on Honey Creek, the City of Wauwatosa performed dye testing in Honey Creek Parkway tributary areas. The results from the dye water flooding showed that up to 55 gpm of storm water was being transferred into the sanitary sewer system at an individual lateral connection. *See* City of Wauwatosa, Sanitary Sewer Dye Testing, Honey Creek Parkway Tributary Area, September 16, 2010 TAT Presentation.

The Great Lakes WATER Institute also completed a study in January 2010 called Ecological Study and Management Plan for Atwater Park Beach. This study was sponsored by the Village of Shorewood. The final report of the study presents information regarding the identification of sewage contamination sources, as well as suggestions on how to mitigate the impacts of this contamination. Outfall 1 has intermittent human sewage inputs and subsequent smoke testing found that there are complicated problems in the area, such as leaking laterals and open joints. Outfall 2 has a consistent sewage signal during both rain and baseflow conditions. The report states that the "persistent inputs of sewage contamination at Outfall 2 and the unpredictable discharges at Outfall 1 may pose a serious human health risk." The report also suggests that the Village of Shorewood implement a lateral inspection and lining program because the lack of identifiable sewage sources from a single location in the stormwater system may be due to cracked or broken home laterals. *See* Ecological Study and Management Plan for Atwater Park Beach Final Report, Great Lakes WATER Institute, Prof. Hector Bravo, Dr. Sandra McLellan, Beth Sauer, Dr. Harvey Bootsma, Jaren Hiller, and William Weaver, January 2010.

Finally, the MMSD 2020 Facilities Plan, completed in June 2007, presents existing pollutant loading data which defines fecal coliform loadings in each of the six watersheds in the region (Kinnickinnic River, Menomonee River, Milwaukee River, Oak Creek, Root River, and Lake Michigan Drainage). These are broken out by point sources (Industrial, Sanitary Sewer Overflows, and Combined Sewer Overflows) and nonpoint sources (Urban and Rural). The Plan also states that a likely major contributor to the unidentified urban nonpoint sources is the flows that come from broken or cracked laterals which then become tributary to the storm sewers and waterways. In addition to this, the April 2010 Watershed Restoration Plans for the Kinnickinnic and Menomonee Rivers also state that the "unknown sources" of fecal coliform identified in the 2020 Facilities Plan cannot be attributed to the assumed fecal coliform loads from land uses in the streams, but rather that these sources may be caused by illicit connections.

<u>Finding #8</u>: Although privately owned, lateral sewers are a necessary part of the collection system. Although lateral replacement or rehabilitation may be a benefit to the private property owner, that benefit is incidental to the public benefits and public purpose described above.

The Legislative Findings set forth above illustrate the public purpose in repairing private property sources of I/I. Although homeowners may benefit from installation of a sump pump or a repaired lateral sewer, the greater benefit comes to the community at large.

The public health impacts of basement backups, deteriorated laterals and sewer overflows reach beyond individual residents, as do the increased operation, maintenance and capital construction costs imposed by infiltration and inflow. As the Appeals Court of Massachusetts recently noted:

> [E]very inhabitant of the town (as well as those living in downstream communities bordering the Saugus River and beyond) benefited from I/I repairs to the dilapidated sewer system. Not only was sewage overflow onto streets and into residences averted, but with each repair, sewage discharge in to the environmentally sensitive river and nearby ocean became less likely, with resulting environmental and health benefits extending to all inhabitants of the town.

Denver Street LLC v. Town of Saugus, 78 Mass. App. Ct. 526 (Jan. 6, 2011).