# Mayor's Independent MMSD Audit Committee

## Final Report

Presented to Mayor Tom Barrett

October 1st, 2004

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The Honorable Tom Barrett
Mayor of the City of Milwaukee
City Hall, Room 201
200 East Wells Street
Milwaukee, WI 53202

Regarding: Final Recommendations and Performance Review of the Milwaukee Metropolitan Sewerage District (MMSD) Conducted by the Mayor's MMSD Audit Committee

Dear Mayor Barrett:

On behalf of the Mayor's MMSD Audit Committee, we are proud to present to you the following *Final Recommendations and Performance Review of MMSD*. While running for Mayor of Milwaukee, you announced as part of The Barrett First 100 Days Action Plan that you would initiate an independent audit of MMSD.

At your directive, the Committee has conducted all of its proceedings in public and has heard extensive testimony from a variety of outstanding individuals and organizations. The Committee would like to thank the many scientists, local public officials, environmentalists, fishing organizations, national wastewater treatment experts, and staff members from the Wisconsin Department of Natural Resources (DNR) and the Southeastern Regional Planning Commission (SEWRPC) who appeared before the Committee. Their expertise, base of knowledge, commitment to clean water and unique perspectives were invaluable in producing this audit of MMSD's practices and performance.

This review has been conducted over the past three months with the assistance of nationally respected leaders in the wastewater industry including Dick Sandaas, a consultant with extensive history in the wastewater treatment industry, and Andy Lukas and staff from Brown and Caldwell. The *Final Recommendations and Performance Review of MMSD* contains new scientific information developed specifically for purposes of this audit. The review also consisted of document reviews as well as extensive discussions and testimony from MMSD executives and staff. United Water Services staff also provided input.

Clean water is a regional challenge that will take a coordinated regional response. The Committee hopes that its audit will benefit MMSD, the 28 municipalities it serves, and all those dedicated to improving water quality and moving the region forward.

On behalf of the entire Committee, we would like to thank you for the honor and privilege of serving on the Mayor's MMSD Audit Committee.

Sincerely,

Mayor's MMSD Audit Committee

Don Theiler, Committee Chair
Division Director
King County Wastewater Treatment Division

Ashanti Hamilton
Milwaukee Alderman

Tony Earl
Former Governor of Wisconsin

Wally Morics
City of Milwaukee Comptroller

Theresa M. Estness
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Citizen

Nancy Frank
UW-Milwaukee, School of Architecture & Urban Planning

# 1. Executive Summary

In June of 2004, Mayor Tom Barrett of the City of Milwaukee formed the MMSD Audit Committee to explore the causes of the large volume of sewer overflows in May 2004. The review was to evaluate the adequacy of the sewer system and its management during this period as well as other periods of wet weather. In addition, the Mayor requested that the Audit Committee answer several questions in this regard and make recommendations for improvements. The Audit Committee conducted five day-long meetings, during which it accumulated extensive information leading to its recommendations. The Audit Committee received input from expert panels, MMSD staff presentations, and consultant presentations. This provided a wide spectrum of information covering policy, environmental, regulatory, technical, and operational matters.

The issues reviewed by the Audit Committee were complex. However, certain facts are clear to the committee as a result of its deliberations. First and foremost, there is too much storm water getting into the system during major storm events. This excess water is overwhelming the MMSD sewer system and causing an unacceptable level of overflows.

Two of the Committee's recommendations address excessive wet-weather flows into the MMSD system. The first calls for MMSD and the 28 contributing communities to reduce excessive infiltration and inflow in the separate sewer area. This could be accomplished by eliminating illegal connections, developing a cost effective infiltration and inflow (I/I) reduction program, and establishing maximum I/I levels. The second calls for development of a program to reduce excess flows into the combined sewered area, which would include partial sewer separation.

The Committee recommends that MMSD follow through on overflow reduction project implementation, minimize blending, and build treatment systems at combined sewer overflow points to minimize environmental damage. The Committee also recommends that the municipalities in the MMSD service area create a system to share the cost of I/I reduction as well the cost of treating storm water and non-point source pollution.

Complete separation of the existing combined system is not recommended at this time for a combination of reasons: the cost is prohibitive; the disruption of the downtown area would be enormous; and the impact on water quality would be negative because of the loss of the stormwater treatment, which currently occurs.

Finally, the Committee sensed a willingness on the part of regional leaders to work together on the solutions to this problem. The successful implementation of these recommendations is reliant upon regional leadership and cooperation. Assigning MMSD with sole responsibility for solutions to regional issues will not work. The committee is encouraged by the efforts of the MMSD Executive Director, Kevin Shafer, who is working regionally to improve communications and understanding of the issues. Local

suburban officials who appeared before the Audit Committee testified that Mr. Shafer has been "extremely good" at sharing information and involving communities in developing regional solutions. The regional summit hosted by MMSD on September 23 of this year is an example of these efforts.

# 2. Recommendations

Wastewater collection systems in the Milwaukee area and the Milwaukee Metropolitan Sewer District (MMSD) have recently been overwhelmed – notably in May 2004 - by the amount of stormwater entering the system. Stormwater enters the system from both the combined sewer area and the separate sewer area. The result has been overflows and backups of untreated sewage into the area rivers, lakes, streams, and basements. MMSD has clear and specific responsibilities in this regard, including: 1) Elimination of sewer backups into homes caused by the public sewer system, 2), Elimination of Sanitary Sewer Overflows (SSOs) from the separate sewer system, and 3) Minimization and reduction of Combined Sewer Overflow (CSO) impacts. The Audit Committee recommendations are directed primarily at addressing these three areas of concern.

## *2.1. Reduce wet weather flow into the sewer system.*

Activities must address infiltration and inflow (I/I) reduction in the separate sewer service area, and combined sewer runoff reduction in the combined sewer service area. Wet weather flows into the system have reached a level which is causing separate system overflows which must be eliminated. Flow reductions cannot occur unless both the combined sewer area and the separated sewer area undertake programs to reduce flows to an acceptable level.

a. All MMSD communities have ordinances making stormwater connections to the separate sewer illegal. MMSD must ensure that all communities enforce these ordinances.
b. MMSD should develop a continual I/I management program that provides for the cost effective reduction of I/I in existing service areas and significantly limits I/I from future development. The program must be:
    - enforceable,
    - rapidly implementable,
    - measurable,
    - fundable, and
    - supported by the communities.

    The program must include comprehensive and consistent I/I investigations in all communities to identify sources of the I/I, and the costs and benefits of controlling these sources. The program should identify I/I sources and implement activities designed to reduce I/I from identified illegal connections and from other sources which would be cost effective to control.

    The program should include a set of actions to insure that future I/I

does not increase above an accepted rate. Examples are:

- Requiring the identification of possible I/I from residences and commercial establishments at time of sale;
- Developing ongoing programs to replace or repair defective or failing sanitary and storm sewers when streets, alleys, and highways are repaired;
- Providing backflow preventors in areas experiencing basement backups; and
- Testing laterals for soundness following the reconstruction of buildings.

c. MMSD should undertake a program with Milwaukee County and the cities of Milwaukee and Shorewood to analyze runoff reduction opportunities in the combined sewer area including downspout disconnection, rain barrels, rain gardens, rooftop storage and flow restrictors, catch basin storage and other techniques. These techniques should be implemented where it is determined to be reasonable and will not create other problems, such as localized flooding and building foundation problems.
d. MMSD should establish maximum acceptable I/I levels from future development.

## *2.2. Additional actions to reduce the impact of or eliminate overflows*

a. MMSD should follow through on project commitments made in the Stipulation Agreement with WDNR.
b. MMSD should prioritize projects that will accelerate reduction of existing overflows and eliminate sewer backups into homes. MMSD should also look for opportunities to accelerate these projects. Among them, Port Washington Road and Wisconsin Avenue Relief Sewer projects provide overflow reduction and both might be accelerated, with a change in contracting policy. MMSD must, at the same time, be mindful of other organizational constraints that may limit the ability to deliver projects at an accelerated rate.
c. Using the results of the high rate treatment pilot project, MMSD should implement this type of treatment technology at appropriate CSO points to reduce impacts of untreated overflows in the combined system.
d. MMSD must make every attempt to reduce the need for blending by reducing system wet weather flows or adding treatment capacity. As a part of the blending reduction effort, MMSD should also explore the

feasibility and desirability of fast flow treatment of the flows diverted around the secondary treatment process.

e. MMSD, the cities of Milwaukee and Shorewood, and Milwaukee County should look at opportunities to reduce flows to the combined sewer area by partially separating portions of the combined sewer where the first flush pollutants could still be captured in the MMSD system. Examples of where this approach is already being pursued are the Marquette Interchange and Canal Street Reconstruction Projects. Complete separation of the existing combined system is not recommended at this time for a combination of reasons: the cost is prohibitive; the disruption of the downtown area would be enormous; and the impact on water quality would be negative because of the loss of the stormwater treatment, which currently occurs.

## *2.3. Financing*

a. If determined to be cost-effective, MMSD should provide funding or incentives for private property owners who rehabilitate their private laterals.

b. MMSD should establish a program which creates financial incentives to control and reduce excess flows within each community's sewer system. This program could involve a surcharge for excess flows above a predetermined base flow within each community's system. The charge should reflect the cost of transporting and treating excess flows from that community including the maintenance of the overall system. Such a rate program should be designed to reward communities which control and reduce excess flows in their systems. Consideration should be given to putting at least a portion of the rates from such a charge into a fund to assist communities to control and reduce excess flows into the MMSD and local sewer systems.

## *2.4. Enforcement*

a. Enact programs that ensure illegal contributions to sanitary system are eliminated.

b. WDNR should be aggressive and equitable in SSO enforcement actions throughout the state. Communities in Wisconsin which have experienced SSOs should be required to eliminate them.

## *2.5. Non-Point Source and Stormwater Pollution/ Beach Closures*

Water quality problems, such as beach closures, are not caused by MMSD overflows alone. Eliminating all MMSD overflows would not prevent most beach closings. Pollution from non-point sources and pollution from municipal and county stormwater collection systems must be addressed in order to achieve the water quality levels desired by the public. There is a vacuum in assigned responsibility for and leadership in addressing non-point source and stormwater pollution.

a. MMSD should aggressively continue its efforts to assist the region in dealing with these issues.
b. All communities contribute to the water quality impacts because they generate non-point source and stormwater pollution. The Intergovernmental Cooperation Council (ICC) and MMSD contract communities should take the lead in developing a system of cost sharing for treating stormwater in the region. By virtue of the deep tunnel, all MMSD customers currently pay for treating a substantial volume of stormwater generated in the combined sewer areas of Milwaukee and Shorewood. The cost-sharing system would need to recognize this reality and include equitable ways to fund stormwater treatment in the separate sewer areas.
c. MMSD should contribute, within the limits of their authority and responsibility, to solutions that reduce non-point source and stormwater pollution to tributary lakes and rivers, for example, improving stormwater management on parking lots that discharge without treatment into receiving waters near beaches.
d. Other entities such as Milwaukee County should take actions that would have an immediate, cost-effective benefit on water quality near beaches. Such actions would include beach raking and local stormwater control on and near the beaches.

## *2.6. Public Communications*

Public communication is needed to clarify the causes and potential solutions for regional water quality problems. It is important for everyone to understand that there is no single villain causing our water quality problems, just as there is no single cure.

a. Other organizations, working with MMSD, should communicate with the public on the respective roles and responsibilities of MMSD and

other governmental entities in protecting and improving regional water quality.

b. Research public expectations on water quality and sewer overflows to assist in establishing specific water quality goals for the region taking into account public willingness to pay for the solutions.
c. Communicate with public on five key things:
    i. Nature of the regional water quality problem.
    ii. SSO and CSO goals and their impacts on water quality.
    iii. Nature of I/I and strategies for controlling I/I.
    iv. Nature of non-point source and stormwater pollution and strategies for achieving control goals.
    v. Respective responsibilities for achieving water quality goals.

## *2.7. United Water Services (UWS) Oversight*

The Audit Committee focused its attention on the May 2004 overflows and did not identify UWS as a significant contributor to them. However, the Audit Committee has identified a number of concerns going forward.

a. To ensure that an adequate number of skilled technical staff will be available in the future to operate this highly complex system, MMSD should require any subsequent contractor to provide a Succession Plan for key human resources.
b. MMSD should follow-up on 2003 UWS Performance Evaluation recommendations related to maintenance schedules on non-critical assets.
c. On future operating contracts, MMSD should include contract incentives pertaining to overflow prevention that were recommended in the 2003 Performance Evaluation.
d. MMSD should ensure the Technical Environment Committee is fulfilling its charge of overseeing the performance of UWS in meeting its responsibilities. This should include active participation of its members, regular meetings and, at a minimum, quarterly reports to the MMSD Commission.

## *2.8. Regional Watershed Approach to Solutions*

a. Develop and implement a mechanism for meaningful and effective suburban input to implement the recommendations in this report in an atmosphere of cooperation so that all members of the sewered community feel included in decision-making.
b. The region must develop and implement mechanisms to address all sources of pollution and also determine what the specific water quality goals are for the area. Without this information the communities

responsible for the sewer system cannot determine how to design and maintain their individual systems.

c. The WDNR should become more active in fulfilling its responsibilities and be provided with the resources to assist the region in establishing specific goals and implementation solutions.

# 3. Discussion of Panel Questions Regarding May 2004 Performance

Mayor Barrett commissioned the Audit Committee to answer several pressing questions regarding the environmental situation and causes surrounding the overflows in May 2004. The Mayor and his cabinet created seven categories of questions for the Audit Committee to focus on, and they are discussed as follows.

## *3.1. Relating to United Water Service (UWS) Performance*

*What impact has privatization of Milwaukee Metropolitan Sewerage District's (MMSD's) operations had on overflows?*

There is no clearly identifiable impact of privatization on the major overflows which occurred in May 2004. The tunnel operating decisions are made jointly between UWS and MMSD during larger storm events. Otherwise, UWS has full authority to make operational decisions. Some isolated overflows events appear to be due to operational errors during the period UWS has been operating the system.

Weather information used by UWS and MMSD management during the May storm events for making decisions on tunnel operation, included radar and satellite imaging; current storm intensity, duration, and probability; recorded rainfall amounts for preceding events; and forecasted rainfall amounts. Resources include National Oceanic and Atmospheric Administration (NOAA) forecasts, weather-related internet websites, the Great Lakes Weather Service, and MMSD rain gages. The historic reliability of weather forecasting resources is not known at this time.

The 2003 UWS Performance Evaluation reviewed whether UWS cost-savings measures could be contributing to overflows. That review did not find that this was the case. Further, tunnel operating data would indicate that the tunnel was performing in a similar manner while MMSD was solely responsible. The review did express some concerns for reduced staffing levels, including experienced staff, and the potential for performance impacts in the future.

*How has UWS performed against their contract?*

UWS's performance has generally been satisfactory.

There are no contract incentives/disincentives linked to overflow prevention, as contrasted with the treatment plant operations which have incentives/disincentives. UWS has responded in a positive fashion to the incentives for treatment in their current contract. UWS follows standard operating procedures and collaborates with MMSD management while operating the system.

*Is UWS making errors that are causing or contributing to the overflows?*
A limited number of minor overflows might have been prevented if UWS had better technology provided to experienced operators. Also, during the first May 2004 storm, basement backups occurred, and a review is underway regarding UWS operation of overflow gates during that period.

*Is UWS trying to save money at the expense of our environment?*
Nothing is currently evident to suggest that UWS is making decisions that harm the environment. However, issues identified in the 2003 Performance Evaluation, such as staffing levels (reduced by one-third and lack of succession planning), and deferred maintenance of non-critical equipment, will have an impact on system performance if not addressed. The effects of cost pressures on UWS from sky-rocketing utility costs should be monitored for any future impact on their performance.

The 2003 Performance Evaluation showed the system performance since the tunnel has gone "on line" is not significantly different since UWS came under contract. Some operational protocols for the tunnel have changed as operating experience has been built, but these changes had the input of both MMSD and UWS staff and management.

The effluent quality at treatment plants has historically exceeded contract requirements, which are significantly lower than the WPDES permit for effluent. For this, UWS has received performance bonuses as provided in their contract. The following outlines the bonus, penalty, contract and permit limits for wastewater effluent.

**Table 1. UWS Contract Incentives for Treatment Plant Effluent**

| Constituent | Bonus Limit (Less than) | Penalty Threshold (Greater than) | Contract Limit (Greater than) | Permit Limit (Greater than) |
|---|---|---|---|---|
| BOD | 9 mg/L[2] | 13 mg/L[2] | 15 mg/L[1] | 30 mg/L[1] |
| TSS | 8 mg/L[2] | 13 mg/L[2] | 15 mg/L[1] | 30 mg/L[1] |
| Total phosphorus | None | None | 1 mg/L at South Shore<br>0.5 mg/L at Jones Island[1] | 1.0 mg/L[1] |
| Fecal Coliform | None | None | 100 units/100 mL[2] | 400 units/100 ml[3] |

[1]Monthly average
[2]Annual average
[3]Monthly geometric mean

There are no incentives/penalties in the contract for CSO's, SSO's, or other operational performance.

## 3.2. Relating to Deep Tunnel

*What exactly was the deep tunnel supposed to accomplish for us?*
The deep tunnel was initially designed to capture all overflows from the separate system for the largest storm of concern that was analyzed for the Water Pollution Abatement Program (WPAP). The period of record analyzed was from 1940 to 1978. Engineers

then determined that a storm in June 1940 produced the largest amount of separate sewer flow that would require storage. Subsequently this storm was termed "the Storm of Record." The tunnel sizing was based on the estimated flows from the June 1940 Storm of Record assuming 12.8 percent reduction in local sewer system I/I.

Since this type of storm is rare (once in 40 years), engineers also determined that smaller storms occurring much more frequently would not use much of the tunnel volume. MMSD determined that using the excess tunnel capacity in smaller events to capture potential CSO would allow it to meet its water pollution abatement goals at significant cost savings over other alternatives. The result was a dual purpose tunnel: preventing SSOs and reducing the number of CSOs. When the decision was made to use the tunnel for dual purposes, the overall volume of the tunnel was increased to the present size. MMSD's challenge is to operate the tunnel in a manner that maximizes CSO controls while at the same time not jeopardizing its ability to prevent SSOs. The Appendix provides further information regarding tunnel design and performance history.

Unfortunately, as MMSD communicated the plans and expected performance for the tunnel, the public came away with a perception that no overflows of any kind would occur after the tunnel was operational. However, newspaper accounts from the Milwaukee Sentinel in September 1993, shortly after the tunnel became operational, clearly make a distinction between expected control performance for CSO (1.4 per year after the tunnel is operational) and SSO (elimination).

### *What are the standards the deep tunnel is required to meet?*

The design standards for the deep tunnel are no separate sewer overflows (SSOs) and an annual average of 1.4 combined sewer overflows (CSOs). The permit standards for the MMSD wastewater system are zero SSOs and up to 6 CSOs annually. An explanation of tunnel permit and design standards is provided in Appendix B. It is important to note that during the original planning (WPAP), engineers recognized that there would be events of significant CSO volumes. Public attention from the May 2004 events has been focused on the magnitude of the overflow volume; however, it would be more appropriate to consider the significance of the SSO events which are not allowed by permit.

### *Is the deep tunnel meeting these expectations and standards?*

The deep tunnel falls short of public expectations for a very expensive project. It does, however, appear to be performing close to the technical objectives established during the design. To answer this question properly, it must be broken into two categories: CSO and SSO. The ability to meet CSO control objectives is largely determined by the weather, and more specifically how many large storm events occur during a given year. MMSD records indicate that the annual average for the 10 year operational history of the tunnel (1994 through 2003) is approximately 2.4 CSOs per year, which is higher than the estimated 1.4 per year. This includes a yearly high of 6 and a low of zero (shown in Figure 1). From this perspective, the tunnel has allowed MMSD to meet the permit conditions for CSO and control overflows to close to the design expectations. It is

important to note that the tunnel was not sized to contain total CSO volumes during heavy rains. In fact, during the original planning (WPAP), engineers estimated that there would be events of significant CSO volume (greater than 1 billion gallons).

As for SSO events, there are two primary causes: 1) tunnel-related, and 2) pipeline bottlenecks in the system. This discussion deals with tunnel-related SSOs. Even with the changes in tunnel operation protocols that improved the capture of SSOs after 1999, SSOs have occurred. This means the zero SSO permit requirement has not been met. The remaining question is whether this is because the tunnel was originally sized with insufficient capacity or if flows from the separate sewer area are greater than what was anticipated at the time of the WPAP. Further discussion of this question is provided below.

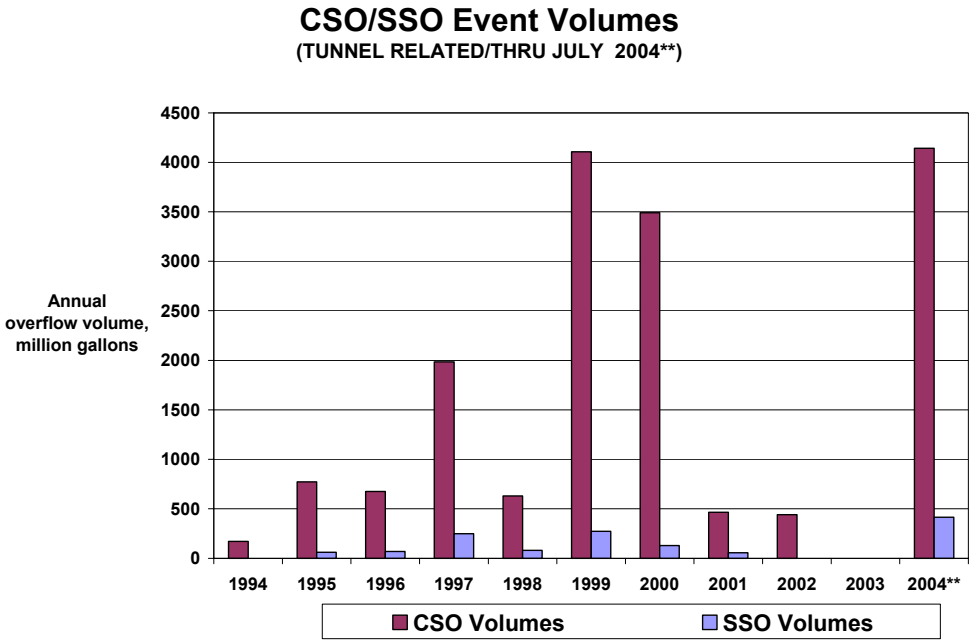


*Figure 1. Tunnel-Related CSO and SSO Volumes Reported by MMSD Since 1994*

### *If not, what are the reasons?*

Excess I/I appears to be a key factor. MMSD has the authority to order I/I remediation in local systems but has not exercised it. Their current approach is to use 2020 Facility planning for dealing with I/I. The DNR is seeking legal remedies against 28 communities for excessive flows.

During the May 2004 storms, about 13 percent (equal to 7.6 billion gallons) of the rain that fell on the MMSD separate sewer service area flowed into the sewer system. This is a significant amount. Even so, it is within the range experienced in the past five years (1999 through 2003). Over that five-year period, the amount of rain flowing into the

separate sewer system ranged from 7 percent to 15 percent, with an average of 9 percent. This shows the May 2004 storms were not exceptional in terms of the percentage of stormwater entering the MMSD separate sewer system; however, the volumes were extraordinary. Appendix D provides further information on these calculations.

A comparison of these I/I percentages to the Seattle, Washington area separate system shows that the MMSD system has much more I/I. An analysis of a portion of the Seattle system showed the following:

- 1 to 2 percent I/I rate for a 1 year storm event.
- 2 to 4 percent for a 20 year storm event

A broader estimate for the entire separate system in Seattle indicated the I/I is in the range of 6 to 7 percent for the 20 year storm. All of these amounts characterizing the Seattle system show significantly less I/I than in the MMSD system.

What is just as telling is the comparison of separate sewer flow to combined sewer flow that enters the MMSD system. Over the past 5 years, the separate sewer system generated, on average, 64 percent of the wet weather flow. For comparison, during May 2004 storms, 66 percent of the wet weather flow originated in the separate sewer area. This means that the majority of total sewer flow during storm events originates in the separate sewer system.

Another reason is the difficulty in predicting the amount of tunnel volume to reserve for flow from the separate sewer area. This is particularly challenging in extended rainy periods such as May 2004. A post-event analysis performed for this audit indicated that if the entire tunnel had been reserved for SSO capture, the tunnel would not have filled completely. This action would have increased CSO volumes by approximately 800 million gallons. MMSD has several projects addressing this operating constraint, including contracting with a provider of long-range precipitation forecasts.

A Monday Morning Quarterback could criticize the MMSD for not reserving all of the capacity for the separate sewer flows; however, if this had occurred, as pointed out above the increase in overflow volume would have been approximately 400 million gallons. Also, if the rainfall had ended earlier, the tunnel would not have been fully utilized. In that event, the MMSD would have certainly been rebuked for not using the tunnel to reduce combined sewer overflows.

## *3.3. Relating to Other Communities with Combined Sewers*

*How does Milwaukee's situation compare to other similar sized communities with similar climate? What efforts have these communities made to reduce CSO's?*

The communities of Minneapolis, as well as St. Paul and South St. Paul, Minnesota, separated their combined sewers in the 1970s through the 1990s. Despite sewer separation, Minneapolis still experiences overflows in larger storm events, with the most active overflows spilling four times per year or more. A primary cause of this continued overflow activity is incomplete separation on private property that was deemed too expensive to tackle at the time. Minneapolis has recently initiated a downspout disconnection program that will require all homeowners to eventually disconnect from the system.

Chicago's system, operated by MWRDGC, includes approximately 400 square miles of combined sewer area. Chicago's most recent permit authorizes CSOs, but requires the system be able to convey and treat up to 10 times dry weather flows without a CSO occurring. This is consistent with Illinois state standards for CSO, which also requires CSOs to be treated in order to prevent sludge deposits, floating debris, and solids, and to prevent depression of dissolved oxygen levels below the applicable water quality standard. MWRDGC has no direct overflows to Lake Michigan, but in large flood events CSOs to the Chicago Sanitary and Ship Canal can discharge to the lake. The last such event was in 2002. The MMSD system performs at a higher standard than the 10 times dry weather flow standard, but would not meet the CSO treatment standard. Appendix F provides further discussion of the differing regulatory approaches to CSO and SSO discharges in the Great Lakes states.

The City of Detroit has a combined sewer area of 500 to 550 square miles, roughly 20 times the size of Milwaukee's. Detroit has implemented a $1 Billion program for downspout disconnection to reduce combined sewer flows, CSO treatment to reduce overflow impacts, and containment of stormwater in the combined sewer area to reduce the need to overflow. A sewer separation study indicated that separation was not a viable option due to the cost and the negative impact of polluted stormwater runoff on water quality if it were removed from the sewer system. Detroit plans on constructing a deep tunnel which would be designed for 1 overflow per year and 200 MG of storage for the CSO. They are also investigating I/I concurrently to quantify if it is a cost effective solution.

*What has been their operational experience under similar rainfall conditions?*
The City of Detroit generally experiences the same weather patterns as Milwaukee, and has historically experienced up to 50 overflows per year for the combined sewer area. Based on our understanding of the Detroit system plan, overflows will occur more frequently in Detroit than Milwaukee, but most of these overflows will receive treatment.

The State of Michigan requires treatment to consist of screening and disinfection at a minimum.

Chicago continues to implement its Tunnel and Reservoir Plan (TARP); however, overflows still occur. Records obtained from MWRDGC indicate that CSOs occurred at major discharge locations on 20 dates in 2004 thus far. MWRDGC has 145 permitted CSO discharge points. For comparison, MMSD has 117 permitted CSO outfalls.

## *3.4. Relating to Existing Plans at MMSD*

*What projects are currently developed and can/should they be accelerated?*

There are a number of projects currently being undertaken by MMSD and included in the Stipulation Agreement with the Wisconsin Department of Natural Resources. Current projects that will provide additional storage are:

- Northwest Side Relief Sewer (88 MG – complete in 2005);
- Port Washington Road Relief Sewer (up to 30 MG – complete in 2008);
- West Wisconsin Avenue Relief Sewer (25 MG – complete in 2009).

The Harbor Siphons project will also add capacity from the combined sewer system into the Jones Island Wastewater Treatment Plant. This capacity will allow MMSD to delay the discharge of combined sewer flows into the deep tunnel, thus preserving storage for separate sewer flows.

Acceleration opportunities are being sought by MMSD staff for Port Washington Road and West Wisconsin Avenue. It should be noted that MMSD organizational constraints can impede these project acceleration efforts. For example, MMSD's $1.2 Billion Capital Improvement Program over the next six years exceeds the MMSD's capacity to do the work. A recent American Society of Civil Engineers (ASCE) peer review confirmed these project delivery constraints.

Current MMSD Commission policy requires a second Request for Proposals process to obtain final design services for both Port Washington Road and West Wisconsin Avenue projects. Changing this policy to allow amending the current preliminary engineering contracts to provide for final design services could save approximately six months for each project.

*How would these projects have affected the May storm events if they had been in place at that time?*

Based on an analysis of system operating data, it appears that these planned projects would have allowed MMSD and UWS to prevent tunnel-related SSOs during the May storm.

During the May storm period, MMSD was only able to use two of the three deep tunnel pumps due to an emergency construction project. The project was initiated to avoid a

catastrophic failure of the pumping system. If full pump capacity had been available during that event, one of the tunnel-related SSOs would have been avoided. The SSOs on May 23-24 would still have occurred, but would have been substantially less. There would have been virtually no reduction in the CSO volume reported, which at a reported 4.1 billion gallons is the largest portion of the May overflows.

*What additional projects would have had a substantial positive effect on the May 2004 overflows?*

Based on the analysis for this Audit, it appears that additional pumping out of the tunnel, beyond what is currently designed into the system, would have allowed MMSD to greatly reduce SSOs in May. This additional pumping would take advantage of treatment plant capacity that was available at certain times during the May storms. Some SSOs would still have occurred with this additional pumping, but CSO volumes would not have been reduced. Had additional storage and pumping both been implemented before the May 2004 events, tunnel-full SSOs could have been avoided, but CSO volumes probably would have been reduced only slightly.

MMSD has provided WDNR with a list of the SSO locations during the May storms and projects that will provide local relief for SSOs. Of the sixteen reported SSO locations, five are associated with either the Port Washington or Wisconsin Avenue Relief Sewer projects. Another three would be addressed by other projects already underway. Three more locations overflowed due to the tunnel being full and could potentially be addressed with more storage. There are no planned projects for the five remaining SSO locations, and further analysis will be required to address them.

## 3.5. Relating to Sewer Separation

*Is sewer separation a viable option?*

Full separation is not a viable option for the following reasons:

- Untreated discharge of the stormwater resulting from separation would increase the level of pollution currently being experienced
- Disruption to the combined sewer area would be extensive during the extended construction period required for full separation.
- Cost of separation would be very great and not cost-effective when compared to the benefits.

Partial separation projects should be pursued where feasible when considering cost, disruption, and environmental impacts. Wherever partial separation is pursued, the first flush of stormwater pollutants should be delivered to a treatment system. The Appendix provides further details concerning the potential impacts of sewer separation.

*What would full separation cost?*
Estimates for full separation range from $2.1 – $2.7 billion (not including private property costs) in studies conducted for MMSD in 2000 and 2002. These costs did not include separation costs for private property owners' sewer improvements. In some instances these costs could be substantial and should not be overlooked when considering the full cost of sewer separation. The 2020 Facilities Plan team is performing a very thorough evaluation of separation costs and effectiveness that will include input from local construction experts.

*What would be the impact on water quality and flooding?*
Without proper stormwater treatment, sewer separation will cause a net increase in pollutants to area rivers and the lake. Untreated stormwater discharges would have a negative impact on water quality. The flooding impact of separation is unknown, but any further evaluations of separation should include the costs required to provide the same or better level of flood protection residents currently experience.

*How does sewer separation compare to other options?*
Sewer separation has not been shown as a cost effective option in many studies, especially when the cost of stormwater treatment is taken into account. Partial separation and CSO treatment should be pursued instead of full separation where shown to be viable and where it would provide significant environmental benefit.

## 3.6. Relating to Eliminating Overflows

*Is achieving zero overflows from the entire collection system a realistic and desirable goal?*
It is a realistic and necessary goal for SSOs. A reasonable goal for CSOs is to reduce them and limit their impact. Tactics could include reducing runoff to combined sewers and treating CSOs. During this Audit, the Committee received considerable scientific input indicating that CSOs are not the major contributors to beach closures and other water quality problems. If proven to be correct with further study, it would be difficult to justify the cost to achieve zero CSOs. It is quite likely that significant water quality problems will remain even if overflows were eliminated.

## 3.7. Relating to MMSD Management of System

*How did MMSD management perform during these wet weather events?*
The joint decision making process between MMSD and UWS during tunnel events seems appropriate and effective. There is a strong commitment within MMSD to achieve optimum system operation. Since the tunnel became operational in 1994, MMSD and UWS have learned how to better operate the system to reduce and in some cases avoid overflows. The key decision in this operation relates to interpreting weather forecasts to anticipate when to close off combined sewer flows to the tunnel. While this decision is hampered by the availability of reliable long term rainfall forecasts, decision-makers appear to be doing a reasonable job of managing the system.

*Were there actions which MMSD should have taken which could have improved the outcome of the wet weather events and reduced overflows?*

For this Audit, an analysis of system operational data was performed for the May 2004 events to determine the significance of those storms and the impact of reduced tunnel pumping on overflows. This analysis, based on recent 2020 Facilities Planning modeling, concluded that May 2004 was approximately a 10-year event from the perspective of tunnel volume required to control SSOs. MMSD has performed a separate analysis of rainfall data across the service area and determined that this 19-day window of storms had a 32-year return period.

As for the impact of reduced tunnel pumping, it was determined that the first tunnel-full SSO could have been avoided and the second greatly reduced if the full pumping capacity had been available. Pump availability would have had virtually no impact on CSO volumes, which is the largest portion of the reported overflow volume.

The Committee learned about an overflow incident at Marshall Street at the Milwaukee River on August 3, 2004. This facility, along with a number of others, has instrumentation and configuration characteristics which need remediation. There has been a lack of urgency within the MMSD organization to resolve such issues.

Strong long-term action to limit new I/I and reduce historical I/I in the separate sewer system should have been taken by MMSD in the past. If such strong action had been taken, the separate sewer overflows would have been reduced and perhaps eliminated altogether.