AN EVALUATION

# *Milwaukee Metropolitan Sewerage District*

*02-12*

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*02-12*

*July 2002*

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July 30, 2002

Senator Gary R. George and
Representative Joseph K. Leibham, Co-chairpersons
Joint Legislative Audit Committee
State Capitol
Madison, Wisconsin 53702

Dear Senator George and Representative Leibham:

At the request of the Joint Legislative Audit Committee, we have completed an evaluation of the Milwaukee Metropolitan Sewerage District. The District is a special-purpose municipal corporation that provides sewer services to the City of Milwaukee and most of Milwaukee County, as well as to all or parts of a number of municipalities in surrounding counties.

The District's $2.3 billion sewer improvement program, including the 19.4 mile Deep Tunnel and related improvements, has significantly reduced both the number and the volume of sewer overflows, and the District has not violated the combined sewer overflow provisions of its wastewater discharge permit since 1994. However, the program has not achieved the results anticipated when it was designed. Sanitary sewer overflows continue, and more than twice the predicted number of combined sewer overflows has occurred since the Deep Tunnel began operation. Since 1994, a total of 13.2 billion gallons of untreated wastewater has been discharged into Milwaukee-area waterways because of a combination of large storms, stormwater infiltration into sewers, capacity issues in the Deep Tunnel and the District's sewers and treatment facilities, and operational policies that have exacerbated overflows. For example, a total of 107 million gallons of untreated wastewater was discharged since June 1999 during six overflows that occurred because the District's contractor had temporarily turned off Deep Tunnel pumps while switching to a lower-cost source of electricity.

The District is in the process of implementing a $786.4 million building program that is intended to reduce sewer overflows by constructing additional wastewater capacity, increasing treatment plant capacity, and improving the performance of the sewer system. It also plans to spend $410.0 million on watercourse improvement projects. To date, completed projects have had significantly higher costs than the District anticipated.

We found that the District's sewer system and the Deep Tunnel have reduced the amount of pollutants entering waterways, and water quality has improved within the combined sewer area. However, water quality outside the combined sewer area has not improved since 1994 because of sewer overflows and nonpoint and other pollution sources. Neither Lake Michigan nor Milwaukee-area rivers currently meet designated water quality standards specified in federal and state law.

We appreciate the courtesy and cooperation extended to us by the District's staff during the course of our audit. The District's response is Appendix 5.

Respectfully submitted,

Janice Mueller

Janice Mueller
State Auditor

JM/PS/ss

# Summary

The Milwaukee Metropolitan Sewerage District is a special-purpose municipal corporation that provides sewer services to the City of Milwaukee and most of Milwaukee County, as well as all or parts of a number of municipalities within Waukesha, Ozaukee, Racine, and Washington counties. Each municipality served by the District owns and operates its own sewer system. Wastewater from the local sewer systems flows into the District's system of collector sewers, known as the metropolitan interceptor sewer system, before it is conveyed to one of two treatment plants or to 19.4 miles of temporary storage tunnels at depths of up to 325 feet, which are known as the Deep Tunnel. The District also maintains a total of 153 overflow points from which untreated wastewater may be discharged into local waterways during periods of heavy precipitation.

The interceptor system and the Deep Tunnel are part of the District's Water Pollution Abatement Program, a comprehensive, multi-year, $2.3 billion sewer improvement program that was begun in 1986 to comply with stricter federal water quality standards. Since 1994, when the $716.0 million Deep Tunnel was put into operation, concerns have been raised about both its performance and the continued discharge of untreated wastewater from the District's system into Lake Michigan and other Milwaukee-area waterways. Therefore, we evaluated sewer overflows, the District's efforts to reduce overflows, changes in water quality in Milwaukee-area waterways, and the District's compliance with a wastewater discharge permit issued by the Department of Natural Resources (DNR).

The Deep Tunnel has reduced both the number and the volume of sewer overflows in the Milwaukee area. Before 1994, the District had reported an average of 50 overflows annually. In the eight years since the Deep Tunnel began operating, there have been 39 sanitary sewer overflows and 24 combined sewer overflows. (Mechanical failures caused 11 of the sanitary sewer overflows, and inappropriate sewer connections caused 3 of the combined sewer overflows.) The District estimates that the Deep Tunnel has captured more than 40 billion gallons of wastewater and prevented 240 sewer overflows since 1994. The average annual volume of sewer overflows has been reduced by 7.2 billion gallons annually, or 81.3 percent from estimated pre-tunnel levels.

Nevertheless, at the time of construction, the Deep Tunnel was expected to virtually eliminate sanitary sewer overflows. It was also expected to significantly reduce combined sewer overflows by allowing an average of only 1.4 combined overflows per year. Contrary to these expectations, there has been an average of 4.9 sanitary sewer overflows and 3.0 combined sewer overflows annually since the Deep Tunnel went into operation. The combined sewer overflows, which were allowed under the terms of the District's permit, discharged 12.3 billion gallons of untreated wastewater into Milwaukee-area waterways since 1994. Sanitary sewer overflows discharged an additional 936.7 million gallons of untreated wastewater.

In total, the District has discharged 13.2 billion gallons of untreated wastewater since 1994. Of that amount, approximately 36 percent, or 4.8 billion gallons, was released because five large storms generated more wastewater than the Deep Tunnel's designed storage capacity of 405 million gallons. That capacity was based on the storm of record for the Milwaukee area, which occurred in June 1940 and generated approximately 6 inches of rain in a 48-hour period. The largest overflow occurred in June 1997, when 8.1 inches of rain fell over a 36-hour period in some areas served by the District.

More significantly, approximately 64 percent of the District's total discharge of untreated wastewater since 1994, or 8.4 billion gallons, occurred because the District's sewer system and the Deep Tunnel have proven to be insufficient to capture wastewater generated by smaller storms. For example, the water from a storm in April 1999 that generated a maximum of 3.3 inches of rain over a 36-hour period produced an overflow of 784.1 million gallons of untreated wastewater.

In addition to storm size, other factors contribute to continuing sewer overflows, including:

- water inflow and infiltration into municipalities' sewer systems, which has increased by 17.4 percent over 1980 levels;

- a capacity problem caused by siphons that limit the amount of wastewater conveyed to the District's Jones Island Wastewater Treatment Plant;

- sediment deposits in the Deep Tunnel, which have reduced its capacity by approximately 0.5 percent, or 2.1 million gallons; and

- policies and strategies adopted by the District and United Water Services Milwaukee LLC, which contracts to operate and maintain the District's two wastewater treatment plants and its sewage conveyance system.

Both the District and United Water Services have made efforts to eliminate sanitary sewer overflows, minimize combined sewer overflows, and avoid overfilling the Deep Tunnel. We found, however, that efforts to eliminate sanitary sewer overflows have resulted in larger combined sewer overflows than would have otherwise occurred. Furthermore, we estimate that 107 million gallons of untreated wastewater was discharged into waterways from June 1999 through June 2001 because United Water Services had temporarily turned off Deep Tunnel pumps while switching to a lower-cost source of electricity. The contractor saved approximately $515,000 by switching power sources during that period.

The District plans to address limitations of its sewer system by spending $786.4 million to increase capacity through projects that include:

- construction of 116.0 million gallons of additional storage capacity for sanitary sewage, which is an increase of 28.6 percent over the Deep Tunnel's current designed capacity of 405 million gallons;

- improvements to the District's conveyance system;

- the purchase of enhanced storm tracking and real-time flow monitoring equipment that should improve the District's ability to predict storage capacity needs; and

- increases in treatment plant capacity of 27.1 percent at the Jones Island treatment plant and 23.1 percent at the South Shore Wastewater Treatment Plant;

Furthermore, in part to reduce the amount of stormwater entering the District's sewer system, the Deep Tunnel, and treatment plants, the District has:

- adopted new inflow and infiltration limits and funded $2.1 million in local demonstration projects, in an effort to reduce inflow and infiltration by 5 percent district-wide through 2010;

- adopted rules that require municipalities to include runoff management systems as part of any development plans; and

- planned to spend $410.0 million for watercourse improvement projects that are intended not only to reduce flood damage to structures and to improve water quality, but also to reduce the inflow of stormwater into the sewer system.

More than three-quarters of expenditures for current and planned watercourse improvement projects are associated with watersheds of the Milwaukee and Menomonee rivers. We reviewed financial data for both completed watercourse improvement projects and those yet to be completed and found that actual costs have been significantly higher than was projected. For example, the nearly completed Lincoln Creek project, which was designed to protect approximately 2,000 homes and businesses in the City of Milwaukee and portions of the City of Glendale and the Village of Brown Deer, was projected to cost $70.4 million but has a current estimated cost of $115.4 million, which is a 63.9 percent increase.

Similarly, the District's cost projections for a watercourse improvement project to protect 425 properties and 315 structures on the Menomonee River from a 100-year flood have more than doubled since 2000, and much of the work associated with the project has yet to be completed. The District estimates that through 2020, a 100-year flood in the Menomonee River watershed would result in $13.2 million in damages to structures. Its August 2000 plan for the area had a projected cost of $83.1 million, and its most recent estimate of total project costs is $192.0 million, which is $108.9 million more than originally projected. Thus, in addition to raising concerns about the District's ability to accurately predict and limit total project costs, this project raises concerns about balancing the costs of watercourse improvement projects with anticipated savings from flood damage.

The District will soon begin work on its comprehensive 2020 Facility Plan, which will review a broad array of alternatives for reducing future sewer overflows, preventing flooding, protecting the environment, and improving water quality. The plan is expected to be completed in 2007. To accomplish its stated goals of protecting public health and the environment, preventing pollution, and enhancing the quality of area waterways, the District will need to evaluate its tax rate and capital spending levels, prioritize spending to balance the need for additional storage capacity with funding for watercourse improvement and other capital projects, consider the effects of planned capital projects on its costs, and continue to review staffing levels.

We reviewed changes in water quality in Milwaukee-area waterways to determine whether the decrease in the number and volume of sewer overflows has reduced the amount of pollution entering the water. Our review of water quality monitoring data suggests water quality has improved within the combined sewer area, but water quality outside of the combined sewer area has not improved substantially since 1994. Furthermore, despite improvements within the combined sewer area, a DNR report indicates neither Lake Michigan nor Milwaukee-area rivers currently meet designated water quality standards specified in federal and state law. Other sources of pollution, including nonpoint sources, continue to adversely affect water quality in the District's service area. Finally, the best available data indicate the Deep Tunnel may adversely affect groundwater quality in limited areas.

Wastewater discharge permits issued by DNR affect many aspects of the District's operations. The permit under which the District is currently operating includes effluent limits for its two wastewater treatment plants; requirements for sludge disposal and the production of Milorganite, a fertilizer made from sludge; guidelines for operating the Deep Tunnel; restrictions on combined and sanitary sewer overflows; and provisions for surface and groundwater monitoring.

Although both sanitary and combined sewer overflows have occurred since the Deep Tunnel went into operation in February 1994, the District has never violated the terms of its permit related to combined sewer overflows. The permit allows either up to six combined sewer overflows per year, or the capture and treatment of at least 85 percent of the total annual wet-weather wastewater collected in the combined sewer area. Although the District has had 24 combined sewer overflows since 1994, there have never been more than 6 in a year. As noted, the District has also had 39 sanitary sewer overflows since 1994. Its permit prohibits sanitary sewer overflows unless they result from equipment damage, temporary power interruption, or excessive storm runoff, or unless they are unavoidable and necessary to prevent loss of life or severe property damage.

DNR officials have alleged that at least 8 of the 39 sanitary sewer overflows, which resulted in 471 million gallons of untreated sanitary sewage being discharged into Milwaukee-area waterways, violated the District's permit. In March 2002, DNR and the Wisconsin Department of Justice filed a lawsuit against the District in Milwaukee County Circuit Court. The District maintains that all of these overflows were unavoidable and, therefore, allowed under the terms of its permit. DNR and the District have entered into a stipulated settlement of the lawsuit under which the District has agreed to implement a number of initiatives to reduce future overflows.

Our review of overflow data indicates that in four instances between 1994 and 2001, the District appears not to have submitted timely reports to DNR on sewer overflows that released approximately 90,000 gallons of untreated wastewater into Milwaukee-area waterways. The District ultimately reported these overflows in a quarterly report to DNR, which did not issue a notice of noncompliance.

Based on our review of available information, it appears that the District failed to meet other conditions of its permit on several occasions. For example, groundwater standards for coliform bacteria have been exceeded in at least 29 wells since 1995, and the Deep Tunnel was filled to a higher level than the permitted maximum five times since 1994. Isolated violations of permit conditions such as these do not automatically result in formal enforcement actions; historically, DNR has instead relied on informal administrative enforcement procedures, permit compliance schedules, and its authority to deny requested sewer extensions to achieve compliance with permit conditions.

Sewer overflows occur throughout Wisconsin. Between 1996 and 2001, 288 communities reported a total of 988 overflows, resulting in 564.1 million gallons of wastewater being discharged to Wisconsin waterways. DNR's strategy for bringing the large number of communities in Wisconsin with sanitary sewer overflows into compliance with federal and state requirements includes identifying and mapping every sewer overflow location in the state, working with communities to improve reporting of overflows, and addressing the problem of clean water inflow and infiltration into sanitary sewer systems. DNR also intends to take steps that will require communities that experience chronic sanitary sewer overflows to address their underlying causes.

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**The District provides sewer services to municipalities within and beyond its boundaries.**

The Milwaukee Metropolitan Sewerage District is responsible for providing sewer services to 18 municipalities within its boundaries and is authorized by statute to provide the same services to areas beyond its boundaries. Currently the District's boundaries include:

- all of Milwaukee County with the exception of the City of South Milwaukee and small areas of the cities of Franklin and Oak Creek;
- the portion of the Village of Bayside that is in Ozaukee County; and
- those portions of the City of Milwaukee that are in Waukesha and Washington counties.

In addition, the District provides sewer services by mutual agreement to all or parts of ten municipalities within Waukesha, Ozaukee, Racine, and Washington counties.

The District is a special-purpose municipal corporation defined in s. 200.23, Wis. Stats. Since 1982, it has been governed by the Milwaukee Metropolitan Sewerage Commission. Seven of the Commission's 11 members are appointed by the Mayor of the City of Milwaukee, including 3 who must be elected officials. The remaining four commissioners, including three who must be elected officials, are appointed by a committee of the chief elected officials of municipalities within the District other than the City of Milwaukee. The elected officials appointed by the Mayor of the City of Milwaukee serve one-year terms; all other commissioners serve three-year terms. The Commission appoints an executive director, who has responsibility for managing the District's 225.5 full-time equivalent (FTE) employees.

In response to stricter federal water quality standards, and as part of a comprehensive sewer improvement program known as the Water Pollution Abatement Program, the District began in 1986 to construct 19.4 miles of tunnels, at depths of up to 325 feet, for the temporary storage of stormwater and sanitary sewage. Construction of these tunnels, which are commonly referred to as the Deep Tunnel, was completed in 1993 at a cost of $716.0 million. Since 1994, when the Deep Tunnel was put into operation, concerns have been raised about its performance and the continued discharge of untreated or partially treated wastewater into Milwaukee-area waterways, including the Milwaukee, Kinnickinnic, and Menomonee rivers and their tributaries, as well as Lake Michigan.

Therefore, at the direction of the Joint Legislative Audit Committee, we analyzed:

- sewer overflows, including sanitary overflows that discharge both untreated waste from households and businesses, as well as combined sewer overflows that discharge stormwater and sanitary sewage;

- the District's policies, procedures, and processes for determining when untreated or partially treated wastewater may be released into Milwaukee-area waterways;

- the District's plans to reduce or prevent overflows and diversions of sewage in the future, including the estimated costs associated with these plans;

- changes in water quality in Milwaukee-area waterways, including which pollutants have adversely affected water quality;

- the adequacy of current and future efforts to evaluate the integrity and the condition of the Deep Tunnel; and

- the District's efforts to comply with its wastewater discharge permit and the regulatory and enforcement actions taken by the Department of Natural Resources (DNR).

In conducting our evaluation, we interviewed officials of the Milwaukee Metropolitan Sewerage District, DNR, the federal Environmental Protection Agency (EPA), the contractor operating the District's sewage treatment system, and other interested parties. We reviewed programmatic data related to the District, including operating and capital budgets, program expenditures, contracts, procedure manuals, plant operating records, and reports regarding operation of the District's wastewater treatment system prepared by consultants hired by the District. In addition, we analyzed water quality monitoring data collected by the District and other government agencies, and we reviewed reports from consultants and government agencies that have assessed water quality in Milwaukee-area waterways.

## Water Pollution Abatement Program

**The 1972 Clean Water Act required improvements to the District's sewage treatment system.**

The need for major improvements to the District's sewage treatment system originated in 1972, when amendments to the federal Clean Water Act required states to enforce stricter standards for sewage disposal. In Wisconsin, DNR is responsible for enforcing these federal standards.

To meet the requirements of the Clean Water Act, DNR promulgates administrative rules for municipal and industrial wastewater treatment systems, reviews and approves facilities plans for these systems, and issues permits that limit the amounts of various pollutants that may be present when treated wastewater is discharged into lakes and rivers. In 1976, after DNR ordered the District to reduce the amount of sewage discharged into Milwaukee-area waterways to meet the new, stricter discharge limits, the District sought court action to prevent the discharge limits from being enforced. In 1977, both parties agreed to a court order that required the District to prevent overflows from sanitary sewers and to greatly reduce overflows from combined sewers.

To meet these objectives, the District created its Water Pollution Abatement Program, a comprehensive, multi-year sewer improvement program that was designed to virtually eliminate sanitary sewer overflows and to greatly reduce combined sewers overflows. In 1981, DNR approved the District's master facilities plan to implement the program, which provided for:

- upgrading the District's sewage treatment plants;
- improving and replacing the existing sewage conveyance system; and
- selecting an alternative to discharging sewage overflows into Milwaukee-area waterways.

To accomplish the last provision, the District considered two approaches. One called for creating separate storm sewers and sanitary sewers, and treating the two waste systems separately. The other called for preserving the combined sewers and treating both sanitary sewage and stormwater. With the approval of DNR and the EPA, the District eventually chose the second approach, which officials at that time estimated would cost approximately $469.0 million less than sewer separation.

**The Water Pollution Abatement Program cost $2.3 billion to complete.**

The total cost of the Water Pollution Abatement Program, including construction of the Deep Tunnel and upgrades to two wastewater treatment plants and the District's sewer and conveyance system, was $2.3 billion. As shown in Table 1, local, state, and federal funds financed the District's sewer improvement program.

Table 1

**Water Pollution Abatement Program Expenditures**
(in millions)

| Funding Type | Expenditures* | Percentage of Total |
|---|---|---|
| Local | $ 958.3 | 42.3% |
| State: | | |
| Grants | 598.4 | 26.4 |
| Loans** | 218.2 | 9.7 |
| Total state funding | 816.6 | 36.1 |
| Federal*** | 489.5 | 21.6 |
| Total, all funding types | $2,264.4 | 100.0% |

* Does not include $603.8 million in interest costs incurred through capital cost financing.
** The District will eventually pay back all state loans with locally generated revenue.
*** Represents various EPA grants.

The District received $218.2 million (9.7 percent) of program funding as loans from the State's Clean Water Fund Program, which provides financial assistance to municipalities through loans and limited grants. Through December 2001, the Clean Water Fund Program had entered into financial assistance agreements with municipalities totaling $1.5 billion. The District is the largest recipient of Clean Water Fund loans and accounts for $384.7 million (25.3 percent) of the loan program's financial assistance through December 2001.

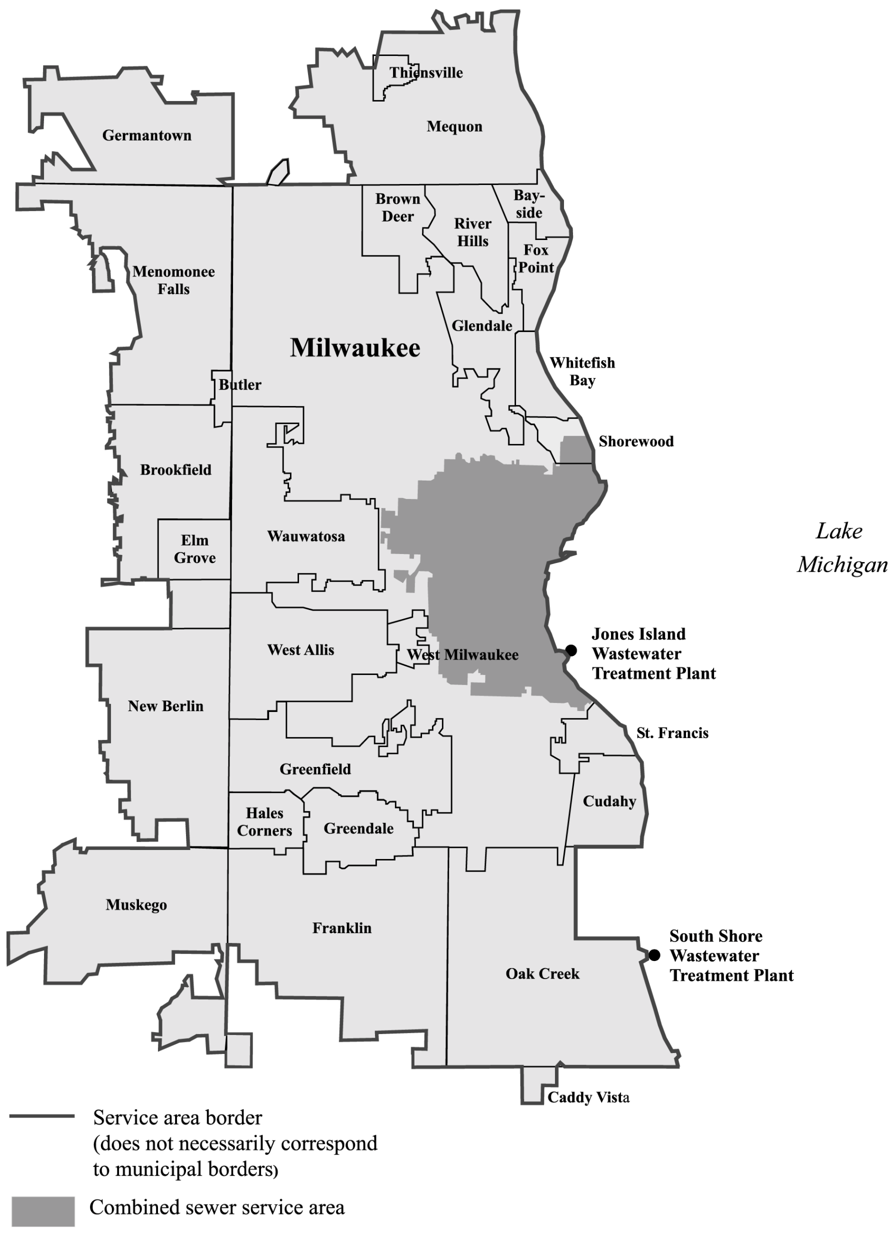
## District Operations

**Each municipality owns and operates sewers that flow into the District's collector sewers.**

Each municipality within the District owns and operates its own sewer system, which flows to a system of collector sewers that is owned and operated by the District. Portions of the systems owned by the Village of Shorewood and the City of Milwaukee are combined sewer systems that convey both sanitary sewage and stormwater. The remainder of the municipalities in the District's service area own and operate separate stormwater sewers. Figure 1 shows the area served by combined sewers, as well as all municipalities served by the District.

Figure 1

**Milwaukee Metropolitan Sewerage District Service Area**



The system of collector sewers owned and operated by the District is known as the metropolitan interceptor sewer system. From the metropolitan interceptor sewer system, wastewater is conveyed to one of the District's two wastewater treatment plants or, if capacity would otherwise be exceeded, diverted to the Deep Tunnel.

**The Deep Tunnel was designed to store up to 405 million gallons of wastewater.**

The District's Jones Island Wastewater Treatment Plant, located in the Milwaukee Harbor, has a designed peak capacity of 330 million gallons per day and an average daily wastewater inflow of 112 million gallons. The District's South Shore Wastewater Treatment Plant, located on Lake Michigan in the City of Oak Creek, has a designed peak capacity of 300 million gallons per day and an average daily wastewater inflow of 100 million gallons. The Deep Tunnel was designed to store up to 405 million gallons of wastewater that, as a result of rain or snowmelt, temporarily exceeds the capacity of the treatment plants or the metropolitan interceptor sewer system. From the Deep Tunnel, wastewater is pumped to both treatment plants over the course of several days, as plant capacity permits. Wastewater flowing within both the metropolitan interceptor sewer system and the local sewer systems is monitored by an automated central control system, which allows remote operation of the conveyance system, including control of the amount of wastewater diverted to the Deep Tunnel.

## District Revenues

**The District's revenues decreased from $139.0 million in 1997 to $123.2 million in 2001.**

The District's primary sources of revenue are taxes levied on property within the District, sewer user charges assessed against all municipalities served by the District, interest income, and capital charges on ten municipalities outside the District's service area that do not pay property taxes to the District. As shown in Table 2, the District's revenues have decreased from $139.0 million in 1997 to $123.2 million in 2001, or by 11.4 percent, largely as a result of decreased sewer user charges and capital charges to communities outside of the District.

Table 2

**District Revenues**
(in millions)

| | 1997 | 2001 | Percentage Change |
|---|---|---|---|
| Property tax levies | $ 52.9 | $ 62.1 | 17.4% |
| Sewer user charges | 53.9 | 43.4 | (19.5) |
| Interest income | 10.8 | 6.7 | (38.0) |
| Fertilizer sales | 6.3 | 5.8 | (7.9) |
| Capital charges* | 12.6 | 2.6 | (79.4) |
| Other** | 2.5 | 2.6 | 4.0 |
| Total | $139.0 | $123.2 | (11.4) |

* Represents capital charges to communities outside of the District.
** Includes insurance settlements, a payment from the Department of Transportation related to damage caused by the December 2000 failure of the Hoan Bridge, charges to United Water Services, and records request charges.

The District levies a property tax to fund capital improvement projects and debt service. The property tax was the District's largest source of revenue in 2001, representing 50.4 percent of total revenues. Sewer user charges, the District's second-largest revenue source, were 35.2 percent. Sewer user charges fund operating and maintenance expenses. The District assesses sewer user charges on each municipality within its service area based on the level of pollutants in the wastewater, the volume of wastewater the municipalities contribute to the District's system, and the number of sewer connections within each municipality. The municipalities, in turn, directly bill their residential, commercial, and industrial users. The District's sewer user charges decreased 19.5 percent from 1997 to 2001 for all municipalities using its treatment services. Changes in user charges for each of the municipalities served by the District are shown in Appendix 1.

## Operating Expenses

**The District contracts with a private vendor to operate and maintain its two wastewater treatment plants.**

As shown in Table 3, the District's operating expenses decreased from $116.9 million in 1997 to $114.5 million in 2001, or by 2.1 percent. A principal reason for the decrease is that the District entered into a ten-year contract with a private company—United Water Services Milwaukee LLC—beginning March 1, 1998, for the operation and maintenance of the District's two wastewater treatment plants, its conveyance system, and fertilizer production.

Table 3

**District Operating Expenses**
(in millions)

| | 1997 | 2001 | Percentage Change |
|---|---|---|---|
| Depreciation expense | $ 49.9 | $ 57.8 | 15.8% |
| Operations and maintenance | 45.3 | 37.7* | (16.8) |
| Administration | 15.3 | 13.7 | (10.5) |
| Other** | 6.4 | 5.3 | (17.2) |
| Total | $116.9 | $114.5 | (2.1) |

* Includes $31.9 million paid to United Water Services.
** Includes industrial waste and conveyance monitoring costs and laboratory and research services.

The District paid United Water Services $31.9 million in 2001 to perform these services. Under the terms of the contract, the District retains ownership of all facilities and assets and continues to operate its industrial waste pretreatment program and to be responsible for managing its capital projects; financial administration; water quality monitoring; laboratory and research services; sales and marketing of Milorganite and Agri-life, the organic fertilizers that are byproducts of the wastewater treatment process; administration of a minority business development and training program; and contract compliance.

Largely as a result of privatization, the District's staff has declined by 60.6 percent, from 572.0 FTE positions in 1997 to 225.5 FTE positions in 2002. As shown in Table 4, the largest division is operations, administration, and compliance, which includes contract compliance activities, laboratory services, industrial waste pretreatment, water quality monitoring, and conveyance monitoring. Since 1997, the District has made organizational changes to its operating structure each year. Appendix 2 shows its organizational chart and staffing levels for 2002, which were approved by the Commission in October 2001.

Table 4

**District FTE Positions**
2002

| Division | Number |
| --- | --- |
| Operations, administration, and compliance | 112.0 |
| Technical services | 56.0 |
| Information and community education | 32.5 |
| Executive director | 14.0 |
| Legal services | 9.0 |
| Commission services | 2.0 |
| Total | 225.5 |

In 1997, the District estimated its cost savings from privatization to be $145.8 million over the ten-year contract period. A consultant hired in 2001 to review contract performance estimated that the District had saved $36.5 million over the first three years of the contract, or $1.4 million more than projected. The increased cost savings resulted primarily from increased natural gas prices in 2000, which would have been the District's responsibility if it had not transferred this risk to its contractor.

**The District's lobbying expenditures totaled $253,093 in 2001.**

The District's spending in two areas has raised concerns. First, some have questioned the amount spent for contracts with private firms and in-house staff who lobby on an array of environmental and financial issues at both the federal and the state level. As shown in Table 5, the District's total lobbying expenditures ranged from a high of $253,093 in 2001 to a low of $159,715 in 1998 and have generally increased over time. Examples of 2001 lobbying expenditures include $25,000 related to a DNR fertilizer land spreading rule, $30,000 related to flood control issues, and $22,750 related to a bill that would have permitted the District to obtain selected construction contracts without the need to use a competitive bidding process in every instance.

Table 5

**District Lobbying Expenditures**

| | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|
| **Federal Government Issues** | | | | | |
| Contractors | $ 92,608 | $110,366 | $ 62,875 | $ 99,111 | $ 95,294 |
| District staff* | – | – | 2,532 | 3,328 | 6,129 |
| Subtotal | 92,608 | 110,366 | 65,407 | 102,439 | 101,423 |
| **State Government Issues** | | | | | |
| Contractors | 60,108 | 29,699 | 122,742 | 78,405 | 129,369 |
| District staff* | 36,615 | 19,650 | 28,817 | 18,483 | 22,301 |
| Subtotal | 96,723 | 49,349 | 151,559 | 96,888 | 151,670 |
| Total | $189,331 | $159,715 | $216,966 | $199,327 | $253,093 |

* Represents salaries, fringe benefits, and overhead for staff involved in lobbying. Data related to federal government issues were not available for 1997 and 1998.

Second, there has been interest in the amount the District spends on public relations. We reviewed this spending, which includes internal and external communications, such as newsletters and press releases; environmental education activities; community relations, such as meetings with local officials and interest groups; printing; and similar types of activities. In assessing public relations expenditures, we did not include public information efforts associated with the District's household hazardous waste program and marketing Milorganite.

**Public relations and related expenditures increased 30.8 percent from 1999 to 2001.**

As shown in Table 6, public relations and related expenditures have increased from $394,661 in 1999 to $516,168 in 2001, or by 30.8 percent. However, the area of community relations, which includes meetings with local officials, public education, and special events, reflected the largest increase in costs (320.9 percent) over this period. The second-largest increase, 45.5 percent, was in internal communications, such as a monthly newsletter to update the District's own employees on its activities and accomplishments.

Table 6

**District Public Relations and Related Expenditures**

| Category | 1999 | 2000 | 2001 | Percentage Change |
|---|---|---|---|---|
| External communications | $101,575 | $147,023 | $107,611 | 5.9% |
| Capital projects | 77,350 | 74,806 | 85,777 | 10.9 |
| Administration and management | 76,248 | 74,650 | 76,475 | 0.3 |
| Community relations | 15,880 | 36,057 | 66,836 | 320.9 |
| Internal communications | 42,772 | 46,563 | 62,223 | 45.5 |
| Graphics | 63,208 | 42,678 | 60,845 | (3.7) |
| Environmental education | 0 | 37,618 | 41,554 | n/a |
| Other activities | 17,628 | 10,518 | 14,847 | (15.8) |
| Total | $394,661 | $469,913 | $516,168 | 30.8 |

## Planned Capital Expenses

Although all components of the Water Pollution Abatement Program were completed in 1996, the District continues to incur substantial capital expenses for improvements to its existing systems, for watercourse improvement projects intended to prevent flooding, and for debt service on its capital projects. As shown in Table 7, the District has anticipated spending $1.3 billion for capital expenses through 2007, including $458.4 million for additional improvements to its sewage conveyance system, which will add additional conveyance and sewage storage capacity.

Table 7

**District Capital Plan, 2001-2007**
(in millions)

| Projects | Amount | Percentage of Total |
|---|---|---|
| Sewage conveyance system | $ 458.4 | 34.4% |
| Debt service | 442.7 | 33.3 |
| Watercourse improvements | 252.0 | 18.9 |
| Wastewater treatment plants | 123.2 | 9.3 |
| Other* | 54.4 | 4.1 |
| Total | $1,330.7 | 100.0% |

* Includes facilities planning, a minority business development and training program, environmental insurance, financial planning, and information technology.

The District expects to use a variety of sources to fund these planned projects. As shown in Table 8, $500.5 million (37.6 percent) will come from property tax levies from communities within the District. Municipalities served by but located outside of the District will provide $121.7 million through capital charges assessed by the District. Unlike sewer user charges, both capital charges and property tax levies are based on the total property tax value within each community, multiplied by $1.70 per $1,000 of equalized property value. The $1.70 rate has been in effect since 1997 and is projected to remain at this level through 2007. From 1987 through 1994, when the majority of work related to completion of the Water Pollution Abatement program was done, the rate was approximately $3.00. It should be noted that during the past several years, capital charges have been reduced by credits for watercourse improvement projects.

The District's second-largest source of capital funding is the Clean Water Fund, which is expected to provide $352.4 million in loans through 2007 to help the District fund capital costs. The District will eventually pay these loans back with property tax revenue.

Table 8

**Capital Project Funding Sources, 2001-2007**
(in millions)

| Source | Amount | Percentage of Total |
|---|---|---|
| Property tax levies | $ 500.5 | 37.6% |
| Clean Water Fund loans | 352.4 | 26.5 |
| General obligation bonds | 256.9 | 19.3 |
| Capital charges | 121.7 | 9.1 |
| Fund balance | 47.3 | 3.6 |
| Interest income | 26.3 | 2.0 |
| Grants* | 25.6 | 1.9 |
| Total | $1,330.7 | 100.0% |

* Represents various EPA grants.

****

Although the Deep Tunnel has significantly reduced both the number and the volume of overflows, it has not achieved the results anticipated when the District's Water Pollution Abatement Program was planned. Sanitary sewer overflows continue to occur, and more than twice as many combined sewer overflows as predicted have occurred since the Deep Tunnel began operation. Several factors contribute to this problem, including large storms in recent years, capacity issues in the Deep Tunnel and the District's sewers and treatment facilities, and operational policies that have exacerbated overflows.

## Quantifying Sewer Overflows

**The District estimates the Deep Tunnel has prevented 240 sewer overflows since 1994.**

Before the Deep Tunnel was completed, the District reported an average of 50 sewer overflows annually. Since the first year of the tunnel's operation in 1994, the District estimates that the Deep Tunnel has captured more than 40 billion gallons of wastewater and prevented 240 sewer overflows into area waterways. Nevertheless, when wastewater flows exceed either the capacity of the Deep Tunnel or the ability of the sewer system to convey wastewater to the tunnel or treatment plants, overflows occur. The District maintains a total of 153 overflow points from which untreated wastewater may be discharged into local waterways: 121 at combined sewer locations, and 32 at sanitary sewer locations. As noted, sanitary sewer overflows discharge untreated waste from households and businesses; combined sewer overflows discharge a combination of stormwater and sanitary sewage.

Although the Deep Tunnel and related projects were designed to virtually eliminate sanitary sewer overflows and all but an average of 1.4 combined sewer overflows each year, both types of overflows have occurred in each year since the Deep Tunnel became operational. As shown in Table 9, there have been 39 sanitary sewer overflows since 1994, or an average of 4.9 annually, and 24 combined sewer overflows, or an average of 3.0 annually. Nevertheless, the District has not violated the provision of its wastewater discharge permit with DNR that allows up to six combined sewer overflows annually. The extent to which it may have violated its permit related to sanitary sewer overflows has never been resolved.

The District believes that when the capacity of its sewer system is exceeded, sewer overflows are preferable and a lesser public health threat than the alternative, which is sewage backing up into the basements of homes and businesses. In addition, these overflows prevent damage to the District's two treatment plants, the Deep Tunnel, and sewer systems.

Table 9

**Number of Sewer Overflows***

| Year | Sanitary Sewer Overflows | Combined Sewer Overflows | Total |
|---|---|---|---|
| 1994 | 1 | 1 | 2 |
| 1995 | 5 | 1 | 6 |
| 1996 | 3 | 4 | 7 |
| 1997 | 5 | 2 | 7 |
| 1998 | 4 | 2 | 6 |
| 1999 | 8 | 6 | 14 |
| 2000 | 5 | 5 | 10 |
| 2001 | 8 | 3 | 11 |
| Total** | 39 | 24 | 63 |

* During 19 storms, there was both a sanitary sewer overflow and a combined sewer overflow.

** Mechanical failures caused 11 sanitary sewer overflows, and inappropriate sewer connections caused 3 combined sewer overflows.

**Since construction of the Deep Tunnel, the District has discharged 13.2 billion gallons of untreated wastewater.**

As shown in Table 10, since it began to operate the Deep Tunnel, the District has discharged 13.2 billion gallons of untreated wastewater into area waterways, including 12.3 billion gallons from combined sewers and 936.7 million gallons from sanitary sewers. 1999 and 2000 were years of exceptionally large overflows, primarily as a result of the unusually high rain and snowmelt levels in those years.

Table 10

**Total Volume of Wastewater Discharged in Sewer Overflows**
(millions of gallons)

| Year | Sanitary Sewer Overflows | Combined Sewer Overflows | Total |
|---|---|---|---|
| 1994 | 2.3 | 171.2 | 173.5 |
| 1995 | 73.2 | 773.3 | 846.5 |
| 1996 | 67.7 | 674.9 | 742.6 |
| 1997 | 248.6 | 1,991.5 | 2,240.1 |
| 1998 | 79.6 | 629.3 | 708.9 |
| 1999 | 271.7 | 4,105.4 | 4,377.1 |
| 2000 | 137.5 | 3,489.7 | 3,627.2 |
| 2001 | 56.1 | 464.6 | 520.7 |
| Total | 936.7 | 12,299.9 | 13,236.6 |

**The Deep Tunnel has reduced the average annual volume of combined sewer overflows by 78.3 percent.**

Despite the continuing overflows, the Deep Tunnel has substantially reduced both the frequency and the volume of sewer overflows. As shown in Table 11, after its completion, the average annual volume of combined sewer overflows was reduced by 5.5 billion gallons per year, or 78.3 percent. Similarly, the average annual volume of sanitary sewer overflows was reduced by 1.7 billion gallons per year, or 93.4 percent.

Table 11

**Average Annual Overflow Volumes**
(millions of gallons)

| | Estimated Pre-Tunnel* | Actual Post-Tunnel | Percentage Reduction |
|---|---|---|---|
| Combined sewer overflows | 7,077 | 1,537 | 78.3% |
| Sanitary sewer overflows | 1,769 | 117 | 93.4 |
| Total | 8,846 | 1,654 | 81.3 |

* The estimated average annual volume of wastewater discharged through sewer overflows before the Deep Tunnel began operation was determined by a consultant retained by the District.

## Factors Contributing to Overflows

Many factors contribute to sewer overflows, including mechanical failures, such as stray voltage and computer malfunctions that can cause gates to open and discharge sewage into waterways, and faulty sewer system connections. Mechanical failures caused 11 sanitary sewer overflows since 1994, but these resulted in the discharge of only 2.7 million gallons, or 0.3 percent of all sanitary sewer overflows that occurred. In addition, in two instances, inappropriate sewer connections resulted in the discharge of 74,000 gallons of untreated wastewater from combined sewers. This represents less than .01 percent of the total combined sewer overflows.

The remainder of the sewer overflows occurred during wet weather and were caused by:

- the magnitude of storms in recent years;
- the capacity of both the Deep Tunnel and the District's sewer system; and
- operational policies of the District and its contractor.

### Storm Size

**An increase in the number of large storms has contributed to sewer overflows.**

A major factor contributing to overflows in recent years is the increase in the number of large storms that produce wastewater flows exceeding the capacity of the Deep Tunnel and the District's sewage conveyance system. During planning for the Water Pollution Abatement program, the District estimated the storage capacity requirement for the Deep Tunnel and related projects based on the largest storm previously recorded in the Milwaukee area, which occurred in June 1940. This storm of record generated approximately 6 inches of rain during a 48-hour period. On that basis, the District concluded that the Deep Tunnel's storage capacity of 405 million gallons would be sufficient to prevent virtually all sanitary sewer overflows and all but an average of 1.4 combined sewer overflows per year.

Since the Deep Tunnel's first year of operation in 1994, five storms have been larger than the June 1940 storm of record. In total, these five storms resulted in the discharge of 4.8 billion gallons of untreated wastewater from sanitary and combined sewers, or 36.4 percent of the District's overflow volume since completion of the Deep Tunnel. As shown in Table 12, the largest overflow occurred during a June 1997 storm that produced 8.1 inches of rain over a 36-hour period at some locations in the District's service area. This storm filled the Deep Tunnel and resulted in 203.0 million gallons of untreated sanitary sewage and 1.6 billion gallons of untreated combined wastewater being discharged into area waterways.

Table 12

**Storms Larger than the June 1940 Storm of Record**
(millions of gallons)

| Date of Overflow | Maximum Rainfall (inches) | Duration (hours) | Sanitary Sewer Overflow Volume | Combined Sewer Overflow Volume | Total Overflow Volume |
|---|---|---|---|---|---|
| June 21-23, 1997 | 8.1 | 36 | 203.0 | 1,607.8 | 1,810.8 |
| July 2-4, 1997 | 2.3 | 1 | 45.3 | 383.6 | 428.9 |
| August 5-8, 1998 | 8.9 | 48 | 79.5 | 475.3 | 554.8 |
| July 21-24, 1999 | 3.9 | 12 | 62.2 | 1,126.2 | 1,188.4 |
| July 2-3, 2000 | 4.7 | 12 | 4.7 | 791.7 | 796.4 |
| Total | | | 394.7 | 4,384.6 | 4,779.3 |

**The Deep Tunnel has not captured all wastewater generated by storms of a size it was designed to handle.**

However, the District's sewer system and the Deep Tunnel have proven to be insufficient to capture wastewater generated by storms smaller than the 1940 storm. As shown in Table 13, precipitation from 16 storms smaller than the storm of record has resulted in the discharge of 8.4 billion gallons of untreated wastewater into area waterways. For example, wastewater generated by the second of two storms in April 1999, which produced a maximum of 3.3 inches of rain over a 36-hour period, filled the Deep Tunnel and resulted in an overflow of 784.1 million gallons of untreated wastewater. The District could not capture the wastewater generated by these smaller storms because of both limited storage capacity and two operational policies of the District and its contractor.

Table 13

**Overflows Resulting from Storms Smaller than the 1940 Storm**
(thousands of gallons)

| Date of Overflow | Sanitary Sewer Overflow Volume | Combined Sewer Overflow Volume | Total |
|---|---|---|---|
| February 19, 1994 | 2,310* | 171,200 | 173,510 |
| August 27-31, 1995 | 62,324 | 773,280 | 835,604 |
| June 17-20, 1996 | 67,640 | 674,825 | 742,465 |
| November 10-11, 1998 | 32* | 154,000 | 154,032 |
| January 23-24, 1999 | 15* | 214,800 | 214,815 |
| April 9-10, 1999 | 48,680 | 644,900 | 693,580 |
| April 23-24, 1999 | 74,501 | 709,600 | 784,101 |
| June 13-14, 1999 | 83,885 | 911,200 | 995,085 |
| September 28-29, 1999 | 72* | 498,711 | 498,783 |
| May 17-20, 2000 | 109,650 | 1,539,100 | 1,648,750 |
| June 1-2, 2000 | 29* | 194,200 | 194,229 |
| August 5-6, 2000 | 1,990 | 127,200 | 129,190 |
| September 11-14, 2000 | 21,130 | 837,500 | 858,630 |
| February 9-10, 2001 | 55,840 | 261,900 | 317,740 |
| June 12-13, 2001 | 0 | 99,400 | 99,400 |
| August 25, 2001 | 0 | 103,300 | 103,300 |
| Total | 528,098 | 7,915,116 | 8,443,214 |

* These five sanitary sewer overflows were caused by equipment malfunction or insufficient conveyance capacity in the District's sewer system and were unrelated to the Deep Tunnel's capacity.

## Sewer System Capacity

**Inflow and infiltration, a siphon problem, and sediment deposits limit capacity.**

The ability of the District's sewer system to convey wastewater and to store excess amounts in the Deep Tunnel until they can be treated is limited by surface water that flows directly into sanitary sewers through roof drains, sump pumps, leaky manhole covers in local sewers, and improper storm sewer connections, as well as by groundwater that infiltrates the system through defective sewers and manholes. A capacity problem also limits the District's ability to capture and store wastewater, and the amount of space available for wastewater in the Deep Tunnel has been reduced by groundwater infiltration and sediment deposits in the Deep Tunnel.

Water Inflow and Infiltration - Sanitary sewers are designed to carry only household and industrial waste and to exclude stormwater; however, all sanitary sewer systems experience inflow and infiltration to some extent, particularly as sewers age. Excessive, unintended water entering the sewer system as inflow and by infiltration presents a problem for both the District and the municipalities it serves.

**The most current information suggests that inflow and infiltration have increased by 17.4 percent over 1980 levels.**

In planning the Deep Tunnel's capacity, engineers assumed inflow and infiltration would be reduced by 12.5 percent through projects undertaken as part of the Water Pollution Abatement Program. However, the most current information available suggests that inflow and infiltration have actually increased by 17.4 percent over 1980 levels. According to the District, the increase in inflow and infiltration suggests progressive deterioration of the sewer systems over time, because higher rates of infiltration are expected in aging sewer systems. The District also believes that faulty construction techniques and illegal connections of sump pumps by homeowners in some developments have contributed to the problem.

The amount of inflow and infiltration entering sanitary sewers varies among municipalities within the District's service area. The District has established a standard under which a peak wastewater flow equal to or less than six times dry-weather flow is acceptable, but a peak wastewater flow that exceeds six times dry-weather flow is excessive. As shown in Table 14, the increase in peak wastewater flow ranges from a low of 2.8 times the dry-weather flow for Germantown, which is 1 of 7 municipalities that meet the District's standard, to a high of 16.4 times the dry-weather flow for Elm Grove and Fox Point, which are 2 of 21 municipalities that do not. It should be noted that the District does not measure inflow and infiltration in its own sewer system; therefore, no data are available to measure whether the District meets its own standard. District officials indicate that they believe the amount of inflow and infiltration contributed by the District's sewer system is small.

Table 14

**Dry-Weather and Peak Flow for Sanitary Sewers in 28 Municipalities**
(thousands of gallons per day)

| Municipality | Dry-Weather Flow | Peak Flow | Ratio of Peak Flow to Dry-Weather Flow |
|---|---|---|---|
| **Meets District Standard** | | | |
| Germantown | 2,446 | 6,830 | 2.8 |
| Oak Creek | 5,575 | 29,143 | 5.2 |
| Muskego | 1,412 | 7,681 | 5.4 |
| West Milwaukee | 2,096 | 11,497 | 5.5 |
| New Berlin | 3,646 | 20,201 | 5.5 |
| Thiensville | 521 | 2,971 | 5.7 |
| Brown Deer | 2,769 | 15,763 | 5.7 |
| **Does Not Meet District Standard** | | | |
| Cudahy | 4,892 | 30,980 | 6.3 |
| Caddy Vista | 35 | 222 | 6.3 |
| Mequon | 2,269 | 15,834 | 7.0 |
| Greendale | 2,283 | 16,131 | 7.1 |
| Wauwatosa | 8,819 | 63,772 | 7.2 |
| Menomonee Falls | 2,630 | 19,976 | 7.6 |
| Brookfield | 2,901 | 22,785 | 7.9 |
| Milwaukee* | 44,531 | 385,875 | 8.7 |
| Franklin | 1,854 | 16,591 | 8.9 |
| Hales Corners | 964 | 8,955 | 9.3 |
| Whitefish Bay | 1,730 | 17,286 | 10.0 |
| Glendale | 2,152 | 21,836 | 10.1 |
| West Allis | 8,236 | 86,292 | 10.5 |
| St. Francis | 1,336 | 14,375 | 10.8 |
| Greenfield | 3,587 | 42,904 | 12.0 |
| Butler | 451 | 5,883 | 13.0 |
| River Hills | 511 | 6,963 | 13.6 |
| Bayside | 846 | 11,706 | 13.8 |
| Shorewood* | 327 | 4,883 | 14.9 |
| Fox Point | 920 | 15,042 | 16.4 |
| Elm Grove | 1,042 | 17,042 | 16.4 |

* Includes only the areas of Milwaukee and Shorewood served by their own sanitary sewers, not these municipalities' combined sewers.

**The District's ability to capture and store wastewater is limited by a capacity problem with its siphons.**

Sewer Capacity Limitations Caused by Siphons - The existing sewer system restricts the amount of wastewater that can pass from the District's interceptor sewers through siphons that carry it under the Milwaukee River to the Jones Island Wastewater Treatment Plant. The Jones Island treatment plant was designed to treat a peak flow of 330 million gallons of wastewater per day; however, a consulting firm hired by the District reported in August 2001 that the siphons can deliver no more than 260 million gallons per day, which is 21.2 percent less than the plant's peak capacity. As a result, during periods of heavy precipitation, a significant amount of wastewater is diverted into the Deep Tunnel rather than treated immediately by the Jones Island treatment plant.

Although the siphons were updated in the mid-1980s as part of the Water Pollution Abatement Program, the problem was only recently identified. District officials have indicated they can partially compensate for this problem by pumping additional wastewater directly from the Deep Tunnel.

**Inadequate siphon capacity contributes to overflows because wastewater is diverted to the Deep Tunnel rather than conveyed for treatment.**

The siphon problem contributes to overflows because it results in the annual diversion of an estimated 1.0 to 2.0 billion gallons of wastewater to the Deep Tunnel. If the siphons operated as originally planned, this diverted wastewater would be conveyed to the Jones Island plant for treatment rather than to the Deep Tunnel, where it occupies available storage capacity and contributes to larger overflows. The extent to which overflow volume has increased because of inadequate siphon capacity cannot be calculated from available data.

Inflow, Infiltration, and Sediments in the Deep Tunnel - When the Deep Tunnel was constructed out of the natural bedrock, approximately 45 percent of its length was lined with concrete, and cracks in the walls of the remainder of the tunnel were grouted to control groundwater infiltration. Although the District's operating and maintenance manual recommends an inspection of the Deep Tunnel after the first year of operation and at five-year intervals thereafter, the District did not inspect the tunnel until early 2002. At that time, a consultant estimated that 2.8 million gallons of groundwater enter the tunnel each day. That amount is 1.9 million gallons per day less than original estimates. District officials speculate that minerals contained in groundwater have, over time, sealed or reduced the size of cracks in the Deep Tunnel's walls.

The consulting firm concluded that the Deep Tunnel was generally in good condition and operating as expected, and it recommended the Deep Tunnel be inspected at ten-year intervals. However, the 2002 inspection did show that at least 2.5 million gallons of wastewater and 521,000 gallons of groundwater were inadvertently reaching the Deep Tunnel daily from leaky sewers. For example, the consulting firm found that a City of Milwaukee sewer was plugged with sand and gravel, causing a diversion of wastewater into the Deep Tunnel, and two of the District's sewers were plugged with debris that was causing wastewater to enter the Deep Tunnel. It is not known how long these diversions occurred, but the obstructions have been removed.

A buildup of sediments consisting of rocks, sand, and silt was found in portions of the Deep Tunnel, along with other materials, such as sports balls and plastic bottles. It is estimated that sediments and other materials have reduced the capacity of the Deep Tunnel by approximately 0.5 percent, or 2.1 million gallons. In April 2002, the consulting firm that performed the inspection recommended removal of the sediments and other material and estimated the costs for removal and disposal at between $2.2 million and $2.5 million. However, in a May 2002 letter to the District, the firm modified its recommendation to indicate that the removal of sediments did not require immediate action. At this time, it is not known whether the District will proceed with removal of sediments and other material from the Deep Tunnel. However, the District is unlikely to undertake additional grouting, because its consulting firm determined that additional grouting would eliminate less than half of the present infiltration and would be more than three times as costly as continuing to pump and treat the water entering through infiltration.

## Operational Policies

The District and United Water Services have established procedures that are intended to meet the requirements of the District's wastewater discharge permit with DNR, including eliminating sanitary sewer overflows, minimizing combined sewer overflows, and avoiding overfilling the Deep Tunnel. While the District has generally met these requirements of its permit, we found that its procedures for eliminating sanitary sewer overflows have led to larger combined sewer overflows than would have otherwise been the case. In addition, we found that United Water Services has shut off Deep Tunnel pumps during periods of peak electricity rates in order to save money, despite larger overflows caused by this practice.

Deep Tunnel Sanitary Sewage Reserve Capacity - Combined sewer overflows generally contain lower levels of pollution than sanitary sewer overflows because combined sewage is diluted by rain and snowmelt. As a result, the District's wastewater discharge permit issued by DNR generally prohibits sanitary sewer overflows but allows up to six combined sewer overflows each year.

**Combined sewer overflows may occur even when the Deep Tunnel is not full.**

Because of the location of the Deep Tunnel and the configuration of the sewer system, wastewater from combined sewers reaches the tunnel first during a storm. In an attempt to eliminate sanitary sewer overflows, as required by its permit, the District reserves a portion of the Deep Tunnel's capacity to capture the sanitary sewage. One consequence of this policy is that the District allows combined sewer overflows to occur even though the Deep Tunnel is not full.

The volume reserved in the Deep Tunnel for sanitary sewage has changed over the years. Following a July 1999 storm in which 62.2 million gallons of sanitary sewage were discharged into area waterways, the District increased the amount of the Deep Tunnel's capacity reserved for sanitary sewage from 40 million gallons to 200 million gallons. By reserving additional capacity for sanitary sewage, the District minimizes the likelihood of a sanitary sewer overflow. It should be noted that the 200 million gallon reserve capacity is intended as a general guideline, and the District expects United Water Services to modify the reserve capacity during a storm based on predicted wastewater flows and precipitation intensity in various areas of the District.

**A policy change has reduced the volume of sanitary sewage overflows but increased the volume of combined overflows.**

The new reserve policy has reduced the volume of sanitary sewage overflows, but it has also resulted in combined sewer overflows that could have been avoided or reduced if the Deep Tunnel had been filled to capacity. For example, in a July 2000 storm, an estimated 70 million gallons of additional sanitary sewage that would have been discharged into area waterways under the 40 million gallon reserve policy was captured under the new policy. However, during the same storm, 93.5 million gallons of storage capacity, or nearly a quarter of the Deep Tunnel's capacity, remained unused while 791.7 million gallons of untreated combined wastewater was discharged into area waterways.

Overall, during six of the nine combined sewer overflows that have occurred since the new reserve policy was adopted, a significant amount of the Deep Tunnel's capacity went unused. As shown in Table 15, over 100 million gallons of unused storage capacity remained in the Deep Tunnel during three different overflows since the new policy was enacted. If the Deep Tunnel's storage capacity would have been completely utilized during these storms, combined sewer overflows would have been reduced by 656 million gallons, or 14.1 percent. Moreover, during the August 2001 overflow, enough storage capacity remained in the Deep Tunnel to capture all of the combined sewage that was released into Milwaukee-area waterways.

Table 15

**Available Deep Tunnel Storage Capacity During Overflows Since September 1999**
(thousands of gallons)

| Overflow Dates | Combined Sewer Overflow Volume | Sanitary Sewer Overflow Volume | Unused Deep Tunnel Storage Capacity |
|---|---|---|---|
| September 28-29, 1999 | 498,711 | 72* | 149,170 |
| May 17-20, 2000 | 1,539,100 | 109,650 | 2,500 |
| June 1-2, 2000 | 194,200 | 29* | 109,640 |
| July 2-3, 2000 | 791,700 | 4,736 | 93,520 |
| August 5-6, 2000 | 127,200 | 1,990 | 46,670 |
| September 11-14, 2000 | 837,500 | 21,130 | 2,680 |
| February 9-10, 2001 | 261,900 | 55,840 | 4,940 |
| June 12-13, 2001 | 99,400 | 0 | 67,770 |
| August 25, 2001 | 103,300 | 0 | 179,080 |
| Total | 4,453,011 | 193,447 | 655,970 |

* These sanitary sewer overflows resulted from insufficient conveyance capacity and were unrelated to the Deep Tunnel's capacity.

District officials have indicated that reserving adequate storage capacity for sanitary sewage depends on accurately predicting weather patterns and storm intensity, which affect the volume of wastewater entering the District's sewer system from each municipality's sanitary sewers. However, limited data are currently available to allow the District to determine how much capacity must be reserved during a storm to capture sanitary sewage. As noted, unlike wastewater flows from the combined sewers, which can reach the Deep Tunnel in a matter of minutes after the start of a storm, it may take several hours for the flows from sanitary sewers to reach the Deep Tunnel. The automated system the District currently uses to monitor wastewater volume throughout its service area does not permit precise predictions of the volume of sanitary sewage that will enter the Deep Tunnel, and weather predications are frequently inaccurate. Therefore, United Water Services must make decisions that affect the amount of wastewater that may be discharged into local waterways without complete information.

Turning Off Deep Tunnel Pumps - In an effort to reduce costs, United Water Services uses two different sources of electrical power for pumps that remove wastewater from the Deep Tunnel. United Water Services purchases electric power from the local electric utility from 10:00 p.m. to 9:59 a.m. weekdays and on weekends and holidays, when the rates are lower (off-peak). United Water Services generates its own electrical power with turbines at the Jones Island Wastewater Treatment Plant during other peak times, when purchasing electricity from the utility is more expensive.

**A money-saving strategy resulted in the discharge of an additional 107.0 million gallons of wastewater.**

When United Water Services changes the source of power supplied to the pumps, the pumps must be shut off for at least one hour to cool before they can be restarted. Turning the pumps off reduces the amount of wastewater that is pumped from the Deep Tunnel, thereby decreasing the available storage space and influencing decisions on when gates are closed or reopened to allow wastewater into the tunnel. Based on our review of detailed overflow data from June 1999 through December 2001, we estimate that an additional 107.0 million gallons of untreated wastewater was discharged into area waterways during six overflows as a result of turning pumps off to switch power sources. Available data did not permit us to estimate the volume of additional sewer overflow that resulted from this policy before June 1999. District officials indicated that this procedure has been a standard practice since early 1996, and therefore precedes the contract with United Water Services, which began in March 1998.

Although we estimate that United Water Services saved approximately $515,000 by switching power sources during these overflows, turning off the pumps in order to save money appears to violate the terms of its contract with the District. District officials indicated they have been working with United Water Services for the past three years to resolve the problem and that in September 1999, they issued a notice of contract noncompliance to United Water Services that was related to this issue. However, the notice did not specifically address the issue of turning off the pumps during overflows as a cost-saving measure. In addition, the District did not issue additional notices of noncompliance even though United Water Services turned pumps off during sewer overflows on four occasions subsequent to September 1999.

After we raised this issue with the District during the course of our audit, the District specifically directed United Water Services in March 2002 to continuously operate the Deep Tunnel pumps, regardless of energy costs, whenever the Deep Tunnel is being used to capture and store wastewater. District records indicate that during an April 2002 sewer overflow, the pumps were operated continuously as required. It should be noted that the contract between the District and United Water Services does not give the District authority to impose any financial penalty against United Water Services for its apparent breach of the contract.

District officials indicated that they plan to upgrade electrical equipment in order to allow operators to switch power sources without having to turn off the pumps. A contract for preliminary engineering of this work was approved in January 2001, and construction is to be completed in spring 2003. The District estimates this upgrade will cost between $50,000 and $100,000.

## Sewer Overflows in Wisconsin

**Excluding the District, there were 988 reported sewer overflows in Wisconsin from 1996 through 2001.**

The District is not the only operator in Wisconsin to experience sewer overflows. As shown in Table 16, there were 988 reported sewer overflows, excluding the District, from 1996 through 2001, which resulted in the discharge of 564.1 million gallons of untreated wastewater to Wisconsin waterways. These overflows, in 288 different sewer systems, were caused by rain, snowmelt, equipment failure, power outages, plugged sewers, and flooding.

Table 16

**Statewide Sewer Overflows, Excluding the District**

| Year | Number | Estimated Volume (millions of gallons) |
|---|---|---|
| 1996 | 173 | 115.3 |
| 1997 | 124 | 81.2 |
| 1998 | 177 | 113.2 |
| 1999 | 148 | 77.2 |
| 2000 | 194 | 77.6 |
| 2001 | 172 | 99.6 |
| Total | 988 | 564.1 |

Sewer overflows occur in the District's sewer system as well as in sewer systems owned and operated by the municipalities it serves. As shown in Table 17, 19 of the 28 municipalities served by the District reported a total of 189 sewer overflows from 1996 through 2001, resulting in the discharge of 146.1 million gallons of untreated wastewater to Milwaukee-area waterways. Approximately 86.0 percent of these overflows were caused by rain, snowmelt, or flooding.

Table 17

**Sewer Overflows in Municipalities Served by the District***
1996 through 2001

| Municipality | Number | Estimated Volume (millions of gallons) |
|---|---|---|
| West Allis | 22 | 3.4 |
| Brookfield | 20 | 40.9 |
| Wauwatosa | 20 | 11.6 |
| Milwaukee | 14 | 33.8 |
| Whitefish Bay | 13 | 11.3 |
| Bayside | 12 | 2.1 |
| Menomonee Falls | 12 | 6.5 |
| Elm Grove | 11 | 3.6 |
| Cudahy | 10 | 0.7 |
| Mequon | 10 | 17.2 |
| River Hills | 8 | 1.3 |
| Brown Deer | 7 | 1.0 |
| Hales Corners | 7 | 0.4 |
| New Berlin | 7 | 4.4 |
| Fox Point | 5 | 1.4 |
| Germantown | 5 | 2.3 |
| Shorewood | 3 | <0.1 |
| Muskego | 2 | 1.2 |
| Thiensville | 1 | 3.0 |
| Total | 189 | 146.1 |

* The cities of Franklin, Glendale, Greenfield, Oak Creek, and St. Francis; the villages of Butler, Greendale, and West Milwaukee; and the Caddy Vista Sewer District reported no sanitary sewer overflows from 1996 through 2001.

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Through 2010, the District plans to spend $786.4 million on capital projects to increase capacity and reduce the amount of stormwater entering sanitary sewers. These projects include building additional wastewater storage, making improvements to the sewer system, implementing a new wastewater flow control system, and increasing treatment plant capacity. In addition, the District is undertaking watercourse improvement projects in an effort to reduce flooding and improve water quality. The District is also preparing to begin work on its comprehensive 2020 Facility Plan, which will review a broad array of alternatives for reducing future overflows, preventing flooding, protecting the environment, and improving water quality. That plan is expected to be completed in 2007.

## Efforts to Increase Capacity

To increase the capacity of its system, the District plans to:

- add additional wastewater storage capacity;
- improve and rehabilitate the Jones Island siphons, the collector sewers, and other aspects of its sewer system;
- update its control system to evaluate changes in storage capacity over time; and
- increase the wastewater processing capacity of its treatment plants.

### Additional Storage Capacity

**Three new sewers are expected to provide 116.0 million gallons of additional storage capacity.**

By December 2009, the District plans to construct three wastewater storage sewers that are expected to provide 116.0 million gallons of additional storage capacity for sanitary sewage. As shown in Table 18, the District plans to spend $175.5 million to construct this additional storage capacity.

Table 18

**Planned Wastewater Storage Sewers**

| Project | Estimated Cost (millions) | Additional Storage Capacity (millions of gallons) | Scheduled Completion |
|---|---|---|---|
| Northwest side relief sewer | $131.7 | 89.0 | December 2006 |
| Wisconsin Avenue sewer | 25.3 | 24.8 | December 2009 |
| Port Washington Road sewer | 18.5 | 2.2 | December 2009 |
| Total | $175.5 | 116.0 | |

The Northwest side relief sewer project will consist of a 7.4 mile, 20-foot diameter tunnel that will hold approximately 89.0 million gallons of sanitary sewage. A construction contract was awarded in December 2001, and the project is expected to be completed in December 2006. The Wisconsin Avenue sewer project, scheduled for completion in December 2009, will consist of a 2-mile, 20-foot diameter tunnel that will provide an additional 24.8 million gallons of storage for sanitary sewage. Finally, the Port Washington Road sewer project, scheduled for completion in December 2009, currently is expected to consist of a 2-mile, 6-foot diameter sewer that will provide approximately 2.2 million gallons of storage for sanitary sewage. District officials indicate that this project is still being reviewed and may be increased to provide additional storage capacity.

**Additional storage capacity is expected to reduce sanitary sewer overflows.**

The three wastewater storage sewer projects are expected to reduce sanitary sewer overflows caused by a lack of storage and conveyance capacity. The addition of more storage capacity may also allow the District to reduce its Deep Tunnel sanitary sewage reserve. Therefore, the District will need to closely review its sanitary sewage reserve capacity to ensure that future combined sewer overflows are reduced as much as possible.

## Improvements in the District's Sewer System

To correct the problem that prevents siphons from delivering sufficient wastewater to the Jones Island Wastewater Treatment Plant, the District has budgeted $96.2 million for their redesign and reconstruction. This project is expected to be completed by 2007. District officials expect the redesigned siphons to deliver wastewater at a rate of 390 million gallons per day to the Jones Island plant.

The District has also budgeted $77.7 million through 2010 to maintain and increase the wastewater transportation capacity of its sewer system. Planned projects include construction of additional sewers that will provide additional capacity during times of high wastewater flow, rehabilitation of existing sections of interceptor sewers, and increased capacity at four sewage pump stations.

## Improvements in the Control System

In order to reserve the appropriate storage capacity for sanitary sewage in the Deep Tunnel, the District must be able to accurately predict wastewater flows from each municipality. As noted, this task is complicated by the lag between the onset of precipitation and the time required for flows from the outlying municipalities to reach the Deep Tunnel. The current control system, which was installed in 1986 as part of the Water Pollution Abatement Program improvements, does not provide adequate information to predict wastewater flow.

**A new $16.5 million control system is scheduled to be operational by December 2004.**

The District has included $16.5 million in its capital budget for planning and construction of a new "real-time" control system, which is scheduled to be operational by December 2004. The proposed system incorporates technological improvements that have occurred since 1986, and it is expected to allow the District to better predict storage capacity needs by, for example, updating precipitation data every 15 minutes rather than every 24 hours, as the current system does. In addition, the new system is expected to integrate data collection systems that are now separate, including rain gauges and flow monitors, and to automatically adjust the sanitary sewage reserve capacity every 10 minutes based on these data. While the new system will improve the District's operations, officials indicate that it will not completely eliminate the need to establish tunnel reserve capacity, because its ability to accurately predict the amount, time, and location of precipitation that will fall in the District's service area will still have limits.

### Increasing Treatment Plant Capacity

**The District's two treatment plants cannot reach their designed capacities.**

Maximizing the available capacity of sewage treatment plants can reduce the size and frequency of overflows. Although District documents state that the Jones Island Wastewater Treatment Plant has a peak capacity of 330 million gallons per day, and the South Shore plant has a peak capacity of 300 million gallons per day, a consultant hired by the District determined that actual maximum capacities are 295 million gallons per day at the Jones Island plant, and 260 million gallons per day at the South Shore plant.

The consultant recommended improvements that would increase the Jones Island plant's capacity by 80 million gallons per day, or 27.1 percent over current actual capacity, and the South Shore plant's capacity by 60 million gallons per day, or 23.1 percent over current actual capacity. The District has budgeted $5.8 million for these capacity improvements, which it has estimated may be completed by September 2004 at Jones Island, and by March 2003 at South Shore.

## Efforts to Reduce Stormwater Entering Sanitary Sewers

Because the amount of stormwater that is captured and treated can have a substantial effect on the number and volume of sewer overflows, the District has undertaken several initiatives to reduce the amount of stormwater entering its own sewer system, the Deep Tunnel, and the treatment plants, including:

- inflow and infiltration reduction projects;
- watercourse improvement projects; and
- stormwater rule changes.

## Inflow and Infiltration Reduction Projects

**The District hopes to reduce inflow and infiltration by 5 percent district-wide.**

As noted, inflow and infiltration reduce the system's available capacity for conveying wastewater and contribute to overflows. Eliminating sources of inflow and infiltration is complicated by the fact that many sources—including illegal non-sanitary connections and leaky sewers that convey wastewater from households and businesses to the municipal sewers—occur on private property. The District's 2010 Facility Plan established a goal of reducing inflow and infiltration by 5 percent district-wide through 2010. To reach this goal, the District is undertaking several projects in the municipalities it serves.

In September 1998, the District adopted new rules directing municipalities served by the District to minimize infiltration and inflow to the "maximum extent economically achievable." To assist the municipalities in implementing the rules, the District budgeted $8.6 million to provide funding for municipalities to evaluate their sewer systems. The amounts budgeted for this purpose, which are listed in Appendix 3, range from $2.5 million for the City of Milwaukee to $10,013 for the Caddy Vista Sanitary District.

Through 2001, the District has provided $5.7 million to municipalities for sewer system evaluations. District officials indicate that available funds were allocated based on the size of the communities' sewer systems, using factors such as total system length and number of manholes, which are one of the primary pathways for inflow.

**The District will spend $2.1 million for demonstration projects in eight communities.**

The District has also entered into agreements totaling $2.1 million for demonstration projects awarded on a competitive basis to eight communities. The projects are intended to identify economically feasible approaches for addressing inflow and infiltration problems. For example, Caddy Vista is investigating whether it is more cost-effective to eliminate sources of inflow and infiltration in the public right-of-way or on private property. Brown Deer is inspecting and repairing sewers on private property using a new technology that lines the sewer from the public street. As shown in Table 19, project funding ranges from $521,000 in Wauwatosa to $100,000 in the City of Milwaukee.

Table 19

**Inflow and Infiltration Reduction Demonstration Projects**
As of July 2002

| Municipality | Amount Approved | Payments through 2001 |
|---|---|---|
| Bayside | $ 230,000 | $ 45,968 |
| Brown Deer | 200,000 | 0 |
| Caddy Vista | 146,525 | 42,450 |
| Elm Grove | 312,000 | 66,815 |
| Milwaukee | 100,000 | 0 |
| Oak Creek | 291,800 | 0 |
| Wauwatosa | 521,000 | 38,698 |
| Whitefish Bay | 249,500 | 0 |
| Total | $2,050,825 | $193,931 |

Information gained from the demonstration projects will be shared with other municipalities the District serves. These projects are expected to be completed by December 2002, although monitoring of inflow and infiltration will continue into the future in order to assess the success of the reduction efforts. Furthermore, a recent agreement between the District and DNR requires the District to spend $2.9 million over the next six years on inflow and infiltration reduction on private property and to adopt rules on private property inflow and infiltration by December 2007. Finally, to address inflow and infiltration problems within its own sewer system, the District budgeted $945,000 in 2002 for projects that include identifying sources of inflow and infiltration, sealing manhole covers, and installing liners inside manhole shafts.

### Watercourse Improvement Projects

Watercourse improvement projects may include:

- construction of levees and flood walls;
- construction of underground stormwater storage basins and above-ground detention ponds;
- rehabilitation of streambeds to improve flow and reduce erosion and sedimentation;
- rehabilitation and restoration of natural floodplains;
- land acquisition for conservation purposes;
- stormwater management to improve water quality; and
- purchase and demolition of homes and commercial buildings that cannot be protected from flooding through other means.

While the primary benefits of these projects are reducing the damage to structures caused by flooding and improving water quality, the projects also serve to reduce inflow into the sewer systems, which contributes to sewer overflows.

**Through 2010, the District plans to spend $410.0 million for watercourse improvement projects.**

As shown in Table 20, through 2010, the District plans to spend $410.0 million from its capital budget for watercourse improvement projects, including $133.8 million that was spent through 2001. Watershed projects for the Milwaukee and Menomonee rivers and their tributaries account for 78.9 percent of all current and planned expenditures. It should be noted that a September 1996 ruling by the Public Service Commission restricts the District to allocating capital costs associated with watercourse improvements to those communities that “are clearly tributary to the watercourse being improved.” Therefore, the District reduces capital charges for communities outside of its service area in order to offset costs associated with watercourse improvement work that does not directly benefit them. From 1997 through 2001, ten communities received reductions in their capital charges totaling $36.1 million.

Table 20

**Anticipated Costs for Watercourse Improvements**
(in millions)

| Watershed | Expenditures through 2001 | Anticipated Costs 2002-2010 | Total |
|---|---|---|---|
| Milwaukee River | $97.1 | $ 34.2 | $131.3 |
| Menomonee River | 24.3 | 167.7 | 192.0 |
| Miscellaneous projects* | 6.6 | 40.0 | 46.6 |
| Root River | 4.1 | 12.4 | 16.5 |
| Kinnickinnic River | 0.6 | 15.8 | 16.4 |
| Oak Creek | 1.1 | 4.4 | 5.5 |
| Lake Michigan drainage | 0.0 | 1.7 | 1.7 |
| Total | $133.8 | $276.2 | $410.0 |

* Includes studies on sedimentation, water quality, and stormwater best management practices, a long-term watercourse maintenance plan, conservation and greenway plans, and allowances for cost overruns and project close-out issues.

We reviewed financial data for the watercourse projects undertaken to date and found that costs for the Lincoln Creek project (which is part of the Milwaukee River watershed) have been significantly higher than originally projected. In addition, increases in projected costs during planning for the Menomonee River watershed watercourse improvement project raise concerns about the potential for similar cost increases.

Lincoln Creek drains a 21-square-mile urban watershed that includes parts of the north side of the City of Milwaukee, the City of Glendale, and the Village of Brown Deer. The Lincoln Creek watershed has a history of flooding, which caused significant property damage in June 1997 and August 1998. The Lincoln Creek project was designed to protect approximately 2,000 homes and businesses in the 100-year floodplain by widening and deepening the creek's channel, constructing floodwater detention basins to hold 80 million gallons of floodwater, and flattening and widening the natural floodplain. Construction on the Lincoln Creek project was substantially completed in early 2002.

**The cost of the Lincoln Creek project increased 63.9 percent from original estimates.**

Lincoln Creek project costs were projected at $70.4 million when construction began in 1999. As shown in Table 21, however, the most recent projected cost estimate was $115.4 million, an increase of 63.9 percent. Design, construction, and other costs, which include real estate acquisition, insurance, and legal and other professional services costs, all increased by more than 50 percent.

Table 21

**Lincoln Creek Flood Control Project**

| Budget Item | Original Cost Projection | Current Estimate (March 2002) | Difference | Percentage Increase |
|---|---|---|---|---|
| Design | $ 4,070,000 | $ 7,693,729 | $ 3,623,729 | 89.0% |
| Construction | 61,100,000 | 94,689,380 | 33,589,380 | 55.0 |
| Other | 5,230,000 | 13,013,380 | 7,783,380 | 148.8 |
| Total | $70,400,000 | $115,396,489 | $44,996,489 | 63.9 |

The $33.6 million increase in estimated construction costs occurred because construction bids exceeded the District's projection by $12.9 million, because the District chose to accelerate completion of the project by two years after the floods in 1997 and 1998, and because the District made numerous changes to its original project plans and underestimated the amount of erosion control work that would be required by DNR before the start of construction.

District officials give several reasons for the increased cost of the watercourse improvement projects. For example, they believe project bids exceeded the District's original projections because a number of contractors had already reached the maximum amount of work they were able to be bonded for and, therefore, fewer contractors bid on the work. District officials also indicated that the amount of work required to relocate utilities and construct additional bridges was greater than had been anticipated and that substantial additional costs were incurred because the District was unable to ascertain the extent of soil contamination from incinerator ash and other toxic pollutants on a number of sites related to the project. Although environmental concerns had been noted during preliminary engineering investigations, the extent of the contamination could not be determined, in part, because property owners would not allow environmental consultants hired by the District on their property before the District negotiated for ownership or easement access. We found that the District spent an additional $6.1 million to remove and dispose of 256,774 cubic yards of contaminated soil in a permitted landfill.

Finally, the District contends that new DNR regulations also caused costs to increase. In 2001, construction contractors on the Lincoln Creek project billed the District for $1.0 million above projected amounts for additional erosion control measures required by DNR. Officials indicated that as the extent of DNR's erosion control requirements became clearer, the District incorporated them into subsequent construction contracts.

**Menomonee River watershed project costs are currently $108.9 million higher than originally projected.**

Similarly, the District's cost projection for the Menomonee River watershed has more than doubled since 2000, and most of the work associated with the project has yet to be completed. The Menomonee River watershed is larger than Lincoln Creek, draining 137 square miles in portions of 18 communities. The District's initial plan of August 2000 called for completion of $83.1 million in projects to protect 425 properties and 315 structures from a 100-year flood. However, the District's most recent estimate of total project costs is $192.0 million, which is $108.9 million (131.0 percent) more than originally projected. District officials note that the initial cost projection was made early in project planning, and it is not unusual or unexpected for costs to increase as additional information about the properties and structures within the project area become available.

The District attributes projected increases for the Menomonee River watershed plan to higher-than-expected costs for acquiring and relocating businesses and homes, the identification of additional structures requiring protection, the need for additional environmental clean-up work, the modification of initial projects because of site constraints, and the addition of projects not included in the original plan. For example, the District initially projected that constructing floodwater detention basins on the Milwaukee County Grounds would cost $36.4 million. During later stages of project planning, the District discovered that design constraints on the site would require the addition of a 3,000-foot stormwater tunnel at an additional cost of $22.8 million. The tunnel and other modifications resulted in a revised cost estimate of $69.3 million for the project.

One completed Menomonee River watershed project that experienced cost overruns was the removal of a dam and a concrete lining in the channel of a portion of the lower Menomonee River, which was initially projected to cost $2.3 million. The District subsequently added $811,000 to the project's budget to address sediment contamination that had not been previously identified, along with additional costs related to staffing, design work, environmental investigations, and the demolition of a structure in the floodplain. As a result, the final project costs totaled $4.7 million, or 104.3 percent more than the District's initial projection.

Similarly, the District initially projected construction costs at $14.0 million, with an additional $11.0 million for property acquisition of 34 structures along the Menomonee River in Wauwatosa. District officials now believe that 56 structures are in the floodplain and that property acquisition costs will total $21.0 million. To date, the District has spent $8.5 million on property acquisition for this project.

Finally, the District's 2002 capital budget includes approximately $25.1 million for the construction of a levee, removal of contaminated soils, and acquisition of properties in western Milwaukee. These costs were not included in the initial August 2000 Menomonee River watershed plan approved by the District.

**Substantial cost increases raise concerns about project selection and the District's ability to predict total watercourse project costs.**

Substantial actual and projected cost increases for watershed improvement projects raise concerns regarding not only the District's ability to accurately predict and limit total project costs, but also its criteria for selecting projects. District officials have indicated they use what is known as a "cost-effective approach" in selecting certain projects from among a range of possible alternatives that meet the objectives and expectations of interested parties. However, they do not use cost-benefit analyses to evaluate proposed projects.

District officials believe a cost-benefit approach is inappropriate for watercourse management projects because they believe this type of approach does not necessarily lead to the most acceptable solution to flooding problems. They have also indicated that it is difficult to assign dollar values to secondary benefits that are required in cost-benefit analyses, such as improved water quality, fish and wildlife habitat, public health, recreational opportunities, and aesthetic improvements.

**Watershed improvement costs greatly exceed potential property damage costs from flooding.**

Regardless of whether a cost-benefit approach is used, we believe more could be done to enhance the District's current approach. For example, the District does not currently consider less-costly alternatives that would protect some or most—but not all—structures within the 100-year floodplains. Further, its current approach does not appear to balance the cost of a watercourse improvement project with anticipated savings from flood damage: the District estimates that through 2020, a 100-year flood in the Menomonee River watershed would result in $13.2 million in damages to structures, but it has proposed a $192.0 million dollar watershed management plan to address this concern. Total costs associated with property damage from a series of smaller floods would also be substantially less than the amount the District will spend on watercourse improvements.

**The extent and frequency with which projects exceeded their projected costs may warrant closer attention.**

Although it is not unusual for construction projects to exceed their budgets, the extent and frequency with which the District's watercourse improvement projects have exceeded projected costs warrants closer attention and consideration, including justification for cost increases. We believe a clearer understanding of costs and benefits is needed for the District to make informed decisions on these projects. While the District does not have control over all factors contributing to cost increases, it does have control over a number of them, including the scope of the projects it chooses to undertake. However, cost-control efforts are made more difficult because of the District's budgeting practices. Commissioners are currently provided with only annual budgets for all of the capital projects the District is proposing, including watercourse improvement projects. The annual budgets include estimates for future years, but experience has shown that the information provided to the Commission does not provide for an accurate determination of total project costs.

### Stormwater Rules

**Since 2001, the District has required municipalities to include a runoff management system in all development plans.**

To limit additional stormwater runoff that contributes to flooding and the inflow of stormwater into sanitary sewer systems, the District adopted rules in 2001 requiring municipalities to include a runoff management system as part of any development plan. The stormwater management requirements will apply to any new development that results in the construction of impervious surfaces of one-half acre or more, such as parking lots. It excludes impervious surfaces already in existence and exempts any project approved before January 1, 2002.

By January 1, 2003, local communities are required to adopt their own stormwater management rules to:

- preserve natural features having stormwater storage and drainage characteristics;
- minimize the construction of surfaces that create runoff; and
- limit runoff with stormwater detention structures.

Municipalities must submit their stormwater management plans to the District for approval before beginning any new development. The District may withhold approval of stormwater management plans if a municipality has not complied with its stormwater management rules or rules related to the construction of sewers and inflow and infiltration control.

## In-Plant Diversions

**In-plant diversions increase the volume of wastewater that receives some treatment during wet weather.**

An in-plant diversion is another strategy for reducing the volume of overflows by maximizing the flow of wastewater through a treatment plant. Under extreme wet-weather conditions, DNR regulations allow wastewater treatment facilities to divert and partially treat a portion of the wastewater they process in order to protect the biological treatment components of a treatment plant from excessive flows and to prevent damage to private property caused by sewer backups. During an in-plant diversion, wastewater that is diverted receives partial treatment before being combined with fully treated wastewater and discharged. Such discharges must still meet limits on contaminants specified by the facility's wastewater discharge permit; therefore, DNR and the District indicate that the use of in-plant diversions is preferable to allowing untreated wastewater to be discharged through sewer overflows. Nevertheless, the District does not fully use its in-plant diversion capabilities.

The Jones Island treatment plant was designed to use in-plant diversions during peak flows. According to the District's standard operating procedures for the plant, if flows reach the plant's stated peak capacity (330 million gallons per day), up to an additional 60 million gallons per day may be diverted to a later stage of the treatment process. Total flow will then equal 390 million gallons per day, which is the maximum that can be disinfected through a treatment process that includes application of chlorine to kill harmful organisms.

**The District did not employ in-plant diversions on at least six occasions that resulted in overflows.**

We found that the District did not employ in-plant diversions on at least six occasions that resulted in overflows. Moreover, during ten overflows when in-plant diversions were used, the District did not fully use its ability to perform in-plant diversions. For example, during a storm that occurred in July 2000, the District partially treated only 7.0 million gallons of wastewater but discharged 796.4 million gallons of untreated wastewater into local waterways.

District officials indicated that they consider a number of factors before initiating an in-plant diversion, including whether the plant can continue to meet effluent limits during higher than normal flows and whether additional flows would compromise the plant's long-term treatment capability. In addition, they stated that the use of this practice has been limited in the past to avoid criticism by the media and legislators and to avoid possible enforcement actions by the EPA. It should be noted that while this practice is accepted by DNR, the EPA has not issued clear guidance regarding the use of in-plant diversions as a means to limit the volume of sewer overflows.

Two other factors may also provide incentives for both United Water Services and the District to limit in-plant diversions. First, the District pays a fee to DNR based on the level of contaminants in its effluent, and the fee would likely increase if greater amounts of pollutants were contained in its effluent as a result of only partially treating wastewater during in-plant diversions. Second, the District's contract with United Water Services provides financial incentives to the contractor if effluent standards specified in the contract are achieved. Neither DNR's measure of the District's effluent quality nor United Water Services' bonus is affected when an overflow—rather than an in-plant diversion—occurs. Furthermore, the District's wastewater discharge permit limits only the number of overflows each year, not their volume.

**The District's use of in-plant diversions is likely to be clarified in its next permit.**

The limited use of in-plant diversions during periods of heavy flow may be less harmful to human health and the environment than discharging untreated sewage into local waterways. DNR and EPA officials indicate that the District's use of in-plant diversions is likely to be clarified in its next wastewater discharge permit, to be issued later this year.

## Future Considerations

The District expects its comprehensive 2020 Facility Plan to be completed in 2007, and all work included in the plan to be completed by the end of 2020. To accomplish its stated goals of protecting public health and the environment, preventing pollution, and enhancing the quality of area waterways, the District will need to establish clear priorities and to consider a number of cost-effective alternatives before determining how it will proceed.

### Establishing District Priorities

**Statutes provide the District with broad authority.**

The duties and powers of all metropolitan sewerage districts are established by ch. 200, Wis. Stats., which authorizes the District to:

- plan, design, construct, maintain, and operate a system for the collection, transmission, treatment, and disposal of all sewage;
- collect, transmit, and dispose of stormwater and groundwater;
- excavate in or alter any state, county, or municipal street, road, alley, or public highway in the District for the purpose of constructing, maintaining, and operating its sewer system;
- improve any river or stream within the District by widening, deepening, or otherwise changing it in order to carry surface or drainage water;

- make improvements outside of the District to any river or stream that flows from within the District to a point outside of the District;

- divert stormwater, groundwater, and water from lakes, rivers, or streams into drains, conduits, or storm sewers;

- adopt rules, issue special orders, and award permits related to carrying out its responsibilities;

- levy a tax on property and assess user charges for sewer operation; and

- issue bonds, notes, or certificates to fund capital expenditures.

Statues do not, however, establish priorities for the District's use of these powers in accomplishing its objectives. That is the responsibility of the 11-member Commission, which will need to establish priorities for allocating the funds the District expects to have available for its 2020 Facility Plan. To fund capital projects, the District expects to continue to levy a tax of $1.70 per $1,000 of assessed property value through at least 2007.

**The District will need to evaluate its tax rate and capital spending levels.**

In planning for future capital projects, a number of issues will need to be considered:

- First, the District will need to assess the level of capital spending it expects to fund with taxes. For example, it could restrict capital spending to levels that could be funded at its current tax rate, increase taxes to fund additional projects that will present significant benefits, or reduce the tax rate and undertake only those projects needed to maintain its current system and meet its legal obligations under terms of an agreement with DNR.

- Second, the District will need to assess the level of resources it can devote to various goals. For example, while the collection, treatment, and disposal of sewage is a critical responsibility, some question funds spent for restoring animal and plant habitat, which is not expressly part of its statutory mission. In addition, while the District's watercourse improvement projects have both protected a number of structures located in floodplains and enhanced the environment, they have less-directly affected sewer overflows. The District will therefore need to determine whether its goals are better served by directing resources toward these projects or others, such as those that would reduce the number and volume of future overflows by, for example, constructing additional wastewater storage.

- Third, the District will need to define and evaluate the potential effects of planned capital projects on future operating costs. For example, planning, construction, and eventual maintenance work associated with the District's comprehensive 2020 Facility Plan may affect the District's staffing needs.

- Finally, the District will need to continue reviewing staffing levels to ensure that the savings it achieved through significant staff reductions during the past several years continue to limit its costs.

**Separation of Combined Sewers**

**Separating Milwaukee's combined sewers may be costly.**

One longstanding proposal for limiting future overflows has been to separate combined sewers in the City of Milwaukee and the Village of Shorewood into sanitary and stormwater sewers, so that only sanitary sewage would be treated. Officials from the District, DNR, and the EPA have periodically evaluated this option and believe that it would be prohibitively costly, disruptive to residents and businesses because work would be required on most streets, and potentially degrade water quality because additional untreated stormwater would enter local waterways. Currently, stormwater—potentially containing road salt, heavy metals, oil, bacteria, viruses, and nutrients—is captured by the combined sewers and treated at the Jones Island treatment plant.

The cost of sewer separation compared to other overflow abatement measures is an important consideration. Section 200.33 (2)(b), Wis. Stats., directs sewerage districts to choose the most cost-effective method of combined sewer overflow abatement. If two or more methods are equally cost-effective, the method that separates the fewest feet of combined sewers must be chosen. When the District evaluated the cost of separating the combined sewer systems in the late 1970s, while developing its Water Pollution Abatement Program, it determined that the cost would be approximately $469.0 million more than building a tunnel to capture and store stormwater and sanitary sewage.

More recently, a consultant hired by the District estimated it would cost $2.1 billion to completely separate the combined sewers in Milwaukee and Shorewood. The District has no plans to separate the combined sewers at this time, although it plans to revisit this issue as it completes its 2020 Facility Plan.

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Several water quality indicators suggest that the District's Water Pollution Abatement Program has decreased the amount of pollutants entering Milwaukee-area waterways by reducing the number and volume of sewer overflows. Our review of water quality monitoring data suggests that water quality has improved within the combined sewer area since the Deep Tunnel began operation, but that water quality outside of the combined sewer area has not substantially improved since 1994. Furthermore, despite improvements within the combined sewer area, a 1998 report by DNR indicates that neither Lake Michigan nor Milwaukee-area rivers currently meet designated water quality standards specified in federal and state law. Other sources of pollution, including nonpoint sources, continue to adversely affect water quality in the District's service area. In addition, the best available data indicate the Deep Tunnel has adversely affected groundwater quality in limited areas.

## Effects of Sewer Overflows on Water Quality

Water quality within and outside the combined sewer area is degraded by sewer overflows from the District and surrounding communities, as well as by other urban and rural point and nonpoint sources. Point sources are fixed and identifiable. They include industrial waste discharge points and farm animal feeding operations. Nonpoint sources are more diffuse and numerous and include both urban and rural runoff and airborne pollutants. Appendix 4 describes various pollutants and defines a number of water quality indicators.

**The primary human health concern of all sewer overflows is exposure to disease-causing organisms.**

The primary human health concern of both combined and sanitary sewer overflows is exposure to disease-causing bacteria and viruses, including cryptosporidium, which cause gastrointestinal illnesses. In addition to human health problems, sewer overflows degrade the aesthetic aspects of rivers and lakes and can release excessive nutrients and toxic chemicals that may harm or kill aquatic plants and wildlife. There is also growing evidence that urban stormwater runoff is a major source of bacteria and other microorganisms generated by domestic pets and urban wildlife.

In downtown Milwaukee, some of the negative effects of urban runoff are mitigated by the combined sewer system and the Deep Tunnel. However, upstream sources of nonpoint source pollution, including stormwater runoff outside of the District's combined sewer area and rural nonpoint pollution, adversely affect water quality throughout the watershed, including within the combined sewer area.

**Sanitary sewer overflows contain higher concentrations of raw sewage than combined sewer overflows.**

The amount of pollutants found in point and nonpoint sources of pollution can vary widely depending on their source. For example, combined sewer overflows contain untreated sewage that is substantially diluted by stormwater, but stormwater can contain pollutants such as road salt, sand, gravel, heavy metals, bacteria, viruses, oil, and grease washed from city streets and parking lots. Sanitary sewer overflows typically contain higher concentrations of raw sewage but less of these other types of pollutants. Sanitary sewer overflows are also a significant source of phosphorous, a nutrient that can degrade water quality at excessive levels. The major pollutants in rural nonpoint source pollution are nutrients from fertilizers, bacteria from animal waste, and suspended solids from sediment and soil erosion. These contaminants are also present in urban nonpoint source pollution, but urban runoff may also contain more chloride from road salt and toxic pollutants such as gasoline, oil, lead, zinc, and particles from vehicle exhaust.

As shown in Table 22, DNR estimates that rural runoff contains more than twice the level of suspended solids as sanitary or combined sewer overflows. On the other hand, sanitary sewer overflows typically contain significantly higher concentrations of pollutants such as phosphorus and bacteria. Nevertheless, combined sewer overflows have been the primary focus of concern in the Milwaukee area. The more limited attention focused on sanitary sewer overflows may stem from the fact that combined sewer overflows are typically much larger and may contribute more pollution due to their larger volume.

Table 22

**Estimated Pollution in One Million Gallons of Wastewater**
(in pounds)

| Source of Pollution | Biochemical Oxygen Demand | Phosphorus | Suspended Solids | Fecal Coliform Bacteria* |
|---|---|---|---|---|
| Sanitary sewer overflow | 833 | 16.7 | 1,000 | 19 million |
| Combined sewer overflow | 333 | 5.8 | 667 | 9 million |
| Urban stormwater | 250 | 2.5 | 1,000 | 4 million |
| Rural runoff | 125 | 6.7 | 2,500 | no data |

* Fecal coliform bacteria values show the number of bacteria in one gallon of water and provide an indicator of more harmful bacteria that may be present but are more difficult to identify and measure.

Source: Department of Natural Resources

**The Deep Tunnel has reduced the amount of phosphorous entering the Milwaukee River.**

DNR estimates that as a result of the Deep Tunnel, the amount of phosphorus entering the Milwaukee River from all sources within the District's service area has been reduced by approximately 59 percent, from 170 tons per year before 1994 to approximately 70 tons afterwards. As shown in Table 23, following construction of the Deep Tunnel, overflows from combined and sanitary sewers dropped from first to last as a source of phosphorus in the Milwaukee River. Currently DNR estimates that stormwater runoff and upstream point sources are the most significant sources of phosphorous in the river.

Table 23

**Phosphorus Entering the Milwaukee River**
(pre-tunnel and post-tunnel percentages)

| | Percentage of Total | |
|---|---|---|
| Source of Phosphorus | Pre-Tunnel | Post-Tunnel |
| Sewer overflows | 56% | 6% |
| Stormwater runoff | 25 | 54 |
| Upstream point sources | 14 | 27 |
| Other sources | 5 | 13 |
| Total | 100% | 100% |

Source: Department of Natural Resources

**Beach Closures**

**There were 105 beach closures in Milwaukee County in 2000.**

Concerns over the frequency of beach closures in the Milwaukee area have drawn attention to sewer overflows as a potential source of bacteria. The City of Milwaukee Health Department regularly monitors Milwaukee-area beaches and issues advisories to responsible local officials when bacteria counts are high. Many Milwaukee-area beaches are also closed as a precautionary measure after significant rainfall, in response to concerns over bacteria in urban stormwater. There were 105 beach closures in Milwaukee County in 2000, including 79 at Milwaukee's South Shore, the most frequently closed beach. South Shore was also closed for a total of 43 days in 1999 and 28 days in 2001.

**The number of beach closures cannot be explained solely by bacteria from sewer overflows.**

DNR, the United States Geological Survey, the University of Wisconsin-Milwaukee Great Lakes Water Institute, and others, working together as the Southeast Wisconsin Beach Task Force, are studying the relationship between sewer overflows and beach closures. To date, their research has concluded that beach closures in Milwaukee occur more frequently than sewer overflows, and that while sewer overflows are one source of harmful microorganisms, the number of beach closures cannot be explained solely by bacteria from sewer overflows. Researchers believe that nonpoint source pollution also contributes significant levels of bacteria to waters near area beaches, and that bacteria levels are affected by water temperature, wind direction, lake currents, and rainfall. Preliminary research suggests that closures at South Shore Beach are the result of multiple local sources of bacteria, including waterfowl, poor water circulation because of the configuration of the breakwater, and stormwater runoff from a nearby parking lot. Researchers indicate that these beach closures at South Shore do not appear to be directly related to bacteria levels in the Milwaukee River caused by sewer overflows.

In addition, Milwaukee Health Department officials suggested that one reason for the increase in beach closures in recent years may be that more effort has been placed on monitoring beach water quality. Researchers continue to study the factors leading to high bacterial counts at Milwaukee-area beaches, and a final report is expected in fall of 2002.

## Assessing Changes in Surface Water Quality

**The District conducts extensive monitoring of surface water in the Milwaukee area.**

As noted, the Deep Tunnel was designed to capture nearly all sanitary sewer overflows, which contain high levels of fecal coliform bacteria and other pollutants and are a source of phosphorus and other excessive nutrients. The District conducts extensive monitoring of surface water in the Milwaukee-area and maintains a database of water quality tests dating back to 1975. The monitoring sites include more than 70 locations on Lake Michigan and Milwaukee-area rivers, including sites outside of the District’s service area.

In order to assess the effect of the Deep Tunnel on water quality, we analyzed the District’s surface water monitoring data using two methods. First, we analyzed significant changes in average concentrations of 13 water quality indicators at 10 monitoring sites on the Menomonee, Milwaukee, and Kinnickinnic rivers. Second, we analyzed data from 29 monitoring sites on the 3 rivers and Lincoln Creek that were located both within the combined sewer area and outside the combined sewer area, to determine whether established standards for water quality have been met. We combined the findings from both analyses to make an overall determination of water quality changes since completion of the Deep Tunnel.

Water quality is a relative description of the condition of a river or lake with respect to its physical, chemical, and biological components and cannot be measured by a single test. Moreover, water quality fluctuates on a day-to-day basis as a result of varying environmental conditions and changing sources of pollution. Because it is difficult to summarize water quality in absolute terms, we selected 13 water quality indicators that are influenced by sewer overflows.

**Changes in Concentration of Indicators**

One way to measure water quality is to examine the extent to which average concentrations of the 13 water quality indicators changed over time. We calculated multiple year averages at ten representative sampling sites over two time periods, 1987 through 1993 (pre-tunnel), and 1994 through 2000 (post-tunnel). Five of the sites are within the combined sewer area, and five are in areas of the watershed not affected by combined sewer overflows. We used statistical procedures to assess whether the changes in average concentrations were significant for each of the water quality indicators. If no significant changes indicating either improvement or degradation in water quality were found at a particular site, that site was considered to have no change in the average concentration of a pollutant or water quality indicator.

**Changes in average concentrations of water quality indicators suggest general improvement within the combined sewer area.**

As shown in Table 24, within the combined sewer area, changes in the average concentrations of seven water quality indictors suggest improvement in water quality since the Deep Tunnel began to operate. However, changes in the average concentrations of four indicators suggest degradation in water quality within the same area. The average concentrations of two water quality indicators showed no change.

Table 24

**Changes in Average Concentrations Within the Combined Sewer Area**
(sites showing significant change from pre-tunnel levels)

| | Number of Sites | | |
|---|---|---|---|
| Water Quality Indicator | Increase | Decrease | No Change |
| **Improvement** | | | |
| Ammonia | 1 | 3 | 1 |
| Biochemical oxygen demand | 0 | 3 | 2 |
| Chlorophyll | 0 | 3 | 2 |
| Dissolved oxygen* | 2 | 0 | 3 |
| Fecal coliform bacteria | 0 | 3 | 2 |
| Lead | 0 | 2 | 3 |
| Nitrogen | 1 | 3 | 1 |
| **Deterioration** | | | |
| Chloride | 5 | 0 | 0 |
| Phosphorus | 2 | 0 | 3 |
| Suspended solids | 4 | 0 | 1 |
| Turbidity | 4 | 0 | 1 |
| **No Change** | | | |
| Copper | 0 | 0 | 5 |
| Zinc | 0 | 0 | 5 |

* Increased concentrations of dissolved oxygen represent an improvement in water quality.

**Changes in average concentrations of water quality indicators suggest water quality has not improved outside the combined sewer area.**

As shown in Table 25, outside the combined sewer area, changes in the average concentrations of only two indicators suggest improvements in water quality since the Deep Tunnel began to operate. In contrast, changes in the average concentrations of six other indicators suggest that water quality has deteriorated outside the combined sewer area. The average concentrations of five indicators showed no significant changes outside of the combined sewer area after the Deep Tunnel began to operate.

Table 25

**Changes in Average Concentrations Outside the Combined Sewer Area**
(sites showing significant change from pre-tunnel levels)

| | Number of Sites | | |
|---|---|---|---|
| Water Quality Indicator | Increase | Decrease | No Change |
| **Improvement** | | | |
| Biochemical oxygen demand | 0 | 3 | 2 |
| Lead | 0 | 2 | 3 |
| **Deterioration** | | | |
| Ammonia | 2 | 0 | 3 |
| Chloride | 4 | 0 | 1 |
| Nitrogen | 2 | 0 | 3 |
| Phosphorus | 2 | 0 | 3 |
| Suspended solids | 3 | 0 | 2 |
| Turbidity | 3 | 0 | 2 |
| **No Change** | | | |
| Chlorophyll | 0 | 0 | 5 |
| Copper | 0 | 0 | 5 |
| Dissolved oxygen | 0 | 0 | 5 |
| Fecal coliform bacteria | 0 | 0 | 5 |
| Zinc | 0 | 0 | 5 |

## Meeting Water Quality Standards

Although average concentrations are useful for measuring changes in water quality, water quality standards provide another measure. Under the Clean Water Act, DNR establishes water quality standards for Wisconsin waters according to the highest potential uses each water body in the state is capable of supporting. These uses include supporting fish and other aquatic life, supporting wildlife, use for human recreation, and use for drinking water. The water quality standards set maximum limits for pollutants, including nutrients, bacteria, and toxic chemicals, and establish acceptable ranges for water quality indicators such as temperature and dissolved oxygen, which are important in sustaining the beneficial uses of a water body.

Evaluating changes in the percentage of samples meeting water quality standards before and after the Deep Tunnel provides a useful way to summarize the monitoring data collected by the District and to evaluate progress in meeting water quality goals. We calculated the percentage of sample results that met recommended or established water quality standards for 11 water quality indicators over two time periods: 1987 through 1993 (pre-tunnel), and 1994 through 2000 (post-tunnel). Our analysis included 29 monitoring sites on the Menomonee, Kinnickinnic, and Milwaukee rivers and Lincoln Creek, including 15 sites within the combined sewer area and 14 sites outside of the combined sewer area. In performing this analysis, we used DNR's established water quality standards for "warm water sport fish and aquatic life" to evaluate chloride, copper, dissolved oxygen, lead, and zinc, and the "full human contact recreational use" standard for fecal coliform bacteria. In addition, we used EPA-recommended reference values to evaluate ammonia, chlorophyll, nitrogen, phosphorus, and turbidity, because neither the EPA nor DNR has promulgated water quality standards for these indicators. Because no standards or reference values have been established for biochemical oxygen demand and suspended solids, we did not include them in this analysis.

**As measured by water quality standards, water within the combined sewer area showed both improvement and deterioration.**

In this analysis, an increase in the percentage of samples meeting the water quality standard indicates improvement in water quality, while a decrease in the percentage of samples meeting the standard suggests deterioration in water quality. As shown in Table 26, within the combined sewer area, four water quality indicators improved, five indicators deteriorated, and two did not change.

Table 26

**Percentage of Samples Within the Combined Sewer Area Meeting Water Quality Standards**

| Indicator | Pre-Tunnel | Post-Tunnel | Percentage Point Difference |
|---|---|---|---|
| **Improvement** | | | |
| Chlorophyll | 19.3% | 32.9% | 13.6% |
| Dissolved oxygen | 75.2 | 79.2 | 4.0 |
| Fecal coliform | 18.4 | 41.5 | 23.1 |
| Lead | 98.1 | 98.2 | 0.1 |
| **Deterioration** | | | |
| Chloride | 100.0 | 99.7 | (0.3) |
| Copper | 89.7 | 87.9 | (1.8) |
| Nitrogen | 14.7 | 11.7 | (3.0) |
| Phosphorus | 6.2 | 4.2 | (2.0) |
| Zinc | 99.7 | 99.5 | (0.2) |
| **No Change** | | | |
| Ammonia | 99.6 | 99.6 | 0.0 |
| Turbidity | 0.6 | 0.6 | 0.0 |

**As measured by water quality standards, water outside the combined sewer area has deteriorated.**

As shown in Table 27, outside of the combined sewer area, the percentage of samples meeting the water quality standards decreased for all 11 water quality indicators.

Table 27

**Percentage of Samples Outside the Combined Sewer Area Meeting Water Quality Standards**

| Indicator | Pre-Tunnel | Post-Tunnel | Percentage Point Difference |
|---|---|---|---|
| **Improvement** | | | |
| None | – | – | – |
| **Deterioration** | | | |
| Ammonia | 98.9% | 98.7% | (0.2)% |
| Chloride | 100.0 | 98.1 | (1.9) |
| Chlorophyll | 24.1 | 21.6 | (2.5) |
| Copper | 92.9 | 92.1 | (0.8) |
| Dissolved oxygen | 97.6 | 96.9 | (0.7) |
| Fecal coliform | 29.3 | 24.9 | (4.4) |
| Lead | 99.4 | 99.2 | (0.2) |
| Nitrogen | 17.6 | 14.6 | (3.0) |
| Phosphorus | 10.8 | 5.4 | (5.4) |
| Turbidity | 3.0 | 2.4 | (0.6) |
| Zinc | 100.0 | 99.7 | (0.3) |
| **No Change** | | | |
| None | – | – | – |

It should also be noted that the degree to which the various water quality standards were met ranged from less than 1 percent to 100 percent. For example, both within and outside the combined sewer area, over 98 percent of all samples met water quality standards for ammonia and chloride, while nearly every sample measured for turbidity and phosphorus failed to meet the standards.

### Overall Changes in Surface Water Quality

**We combined data from both measures of water quality to produce a single measure.**

In order to create a single measure of change in water quality, we combined the findings from our previous two analyses to assess overall changes in various water quality indicators both within and outside of the combined sewer area. In general, for an indicator to be considered "improved," average concentrations had to show improvement and the percentage of samples meeting water quality standards had to increase or remain unchanged. Conversely, for an indicator to be considered "deteriorated," average concentrations had to show deterioration and the percentage of samples meeting water quality standards had to decrease or remain unchanged. Because there were no water quality standards for biochemical oxygen demand and suspended solids, our assessment is based solely on changes in their concentrations.

**Overall, water quality within the combined sewer area has improved for more indicators.**

As shown in Table 28, overall water quality within the combined sewer area has improved with respect to five indicators (ammonia, biochemical oxygen demand, chlorophyll, dissolved oxygen, and fecal coliform) and deteriorated with respect to five indicators (chloride, nitrogen, phosphorus, suspended solids, and turbidity). In contrast, overall water quality outside of the combined sewer area improved for only one indicator (biochemical oxygen demand), while it deteriorated for six indicators (ammonia, chloride, nitrogen, phosphorus, suspended solids, and turbidity). In no instances did a water quality indicator improve outside of the combined sewer area but deteriorate inside of the combined sewer area.

Table 28

**Summary of Water Quality Changes After Construction of the Deep Tunnel**

| Indicator | Within Combined Sewer Area | Outside Combined Sewer Area |
|---|---|---|
| Ammonia | Improved | Deteriorated |
| Biochemical oxygen demand | Improved | Improved |
| Chloride | Deteriorated | Deteriorated |
| Chlorophyll | Improved | No change |
| Copper | No change | No change |
| Dissolved oxygen | Improved | No change |
| Fecal coliform | Improved | No change |
| Lead | No change | No change |
| Nitrogen | Deteriorated* | Deteriorated |
| Phosphorus | Deteriorated | Deteriorated |
| Suspended solids | Deteriorated | Deteriorated |
| Turbidity | Deteriorated | Deteriorated |
| Zinc | No change | No change |

* Although nitrogen concentrations within the combined sewer area decreased at three of the five monitoring sites, the percentage of samples meeting water quality standards decreased by such a large extent that a general decline in water quality is indicated.

The changes in water quality noted within the combined sewer area suggest that the Deep Tunnel has played a role in reducing the amount of pollution entering the waterways as the result of combined sewer overflows. However, because of the diversity of pollution sources that affect Milwaukee-area waterways, changes in water quality cannot be attributed to a single factor.

In addition, monitoring sites outside of the combined sewer area are not affected by combined sewer overflows, and the Deep Tunnel would be expected to have a smaller effect on water quality at these sites. Our findings suggest that while some water quality indicators improved within the combined sewer area after construction of the Deep Tunnel, upstream pollution sources—including nonpoint source pollution and sanitary sewer overflows—continue to impair water quality within and outside of the combined sewer area. These conclusions are generally consistent with a number of water quality assessments we reviewed that were completed by the District, the Southeast Wisconsin Regional Planning Commission, DNR, and others. Differences among the studies' conclusions are the result of slightly differing methodologies, including whether data are reported separately for each monitoring site or aggregated to provide a broader picture of overall changes in water quality. For example, some studies have reported slight improvements in water quality when selected monitoring sites outside of the combined sewer area are analyzed individually.

## Effects of the Deep Tunnel on Groundwater

**17.2 percent of samples taken near the Deep Tunnel exceeded the groundwater standard for coliform bacteria.**

Concerns have also been raised about the effects the Deep Tunnel may have on groundwater quality in the Milwaukee area. DNR requires the District to monitor 32 groundwater wells located near the Deep Tunnel for nutrients, toxic chemicals, and bacteria to ensure that wastewater is not escaping from the Deep Tunnel and that groundwater meets established standards. Between 1995 and 2001, the District reported that 17.2 percent of the groundwater samples taken at the wells exceeded the groundwater standard for total coliform bacteria, which includes both fecal coliform and other species of coliform bacteria. While coliform bacteria have never been detected in 3 wells, the remaining 29 wells demonstrate a range of coliform contamination. As shown in Table 29, the percentage of samples from all wells that failed to meet the groundwater standard for total coliform bacteria ranged from 11.1 to 21.1 percent annually.

Table 29

**Number of Samples Exceeding Groundwater Standards for Total Coliform**

| Year | Number of Samples | Number of Exceedances | Percentage |
|---|---|---|---|
| 1995 | 319 | 53 | 16.6% |
| 1996 | 596 | 120 | 20.1 |
| 1997 | 744 | 157 | 21.1 |
| 1998 | 631 | 90 | 14.3 |
| 1999 | 709 | 132 | 18.6 |
| 2000 | 482 | 74 | 15.4 |
| 2001 | 469 | 52 | 11.1 |
| Total | 3,950 | 678 | 17.2 |

In order to address concerns regarding potential long-term groundwater contamination, DNR included a groundwater monitoring compliance schedule requirement in the District's 1997 wastewater discharge permit. As a result of the compliance schedule, the District hired an outside consultant to evaluate the potential long-term effects of the Deep Tunnel on groundwater. After reviewing the groundwater monitoring data, the consultant confirmed elevated levels of certain wastewater pollutants, including fecal coliform bacteria, in some wells after the Deep Tunnel was filled. The consultant also found that coliform bacteria were more likely to be present in the wells when the Deep Tunnel was filled to a level higher than the maximum operating level established by DNR in the District's permit. The District has filled the Deep Tunnel above that level on five occasions but has not done so since 1999.

The consultant concluded that although wastewater escaping from the Deep Tunnel has the potential to pollute groundwater, the effects are localized and short in duration. The consultant also concluded that some wells were more likely to be contaminated than others, because of both their proximity to the Deep Tunnel and localized geologic conditions such as fractures in the rock and groundwater flow patterns. The consultant estimated that the maximum distance of travel for wastewater escaping from the Deep Tunnel is between 150 and 400 feet, assuming that the Deep Tunnel is not filled above the maximum operating level established in the permit. Overall, the District and its consultant believe that the majority of pollutants are flushed back into the Deep Tunnel within days after the Deep Tunnel has been pumped out to a treatment plant and normal inward groundwater flow is reestablished.

The District maintains that because of the short duration of wastewater surges out of the Deep Tunnel and the limited distance wastewater travels in groundwater, and because few industries or residences within the District's service area obtain their water supply from wells, wastewater escaping from the Deep Tunnel is unlikely to affect other groundwater users. Nearly all residential and industrial users within the District's service area receive their water supply from Lake Michigan, and DNR estimates there are fewer than 25 active high-capacity wells in the entire Milwaukee River Basin. Both DNR and the District's consultant believe that most of these wells are located far enough away from the Deep Tunnel to be unaffected by wastewater escaping from the Deep Tunnel.

DNR and the District both agree that filling the Deep Tunnel to a level greater than the maximum operating level allowed in the permit increases the chance of wastewater contaminating the groundwater. Therefore, the District has agreed to abide by this operating restriction. The District and DNR continue to monitor groundwater quality around the tunnel, and DNR has indicated that additional groundwater monitoring and reporting requirements may be included in future permits.

****

The District generally complies with the requirements of its wastewater discharge permit, but it appears to have failed to meet certain conditions related to groundwater standards, sanitary sewer overflows, and the Deep Tunnel's operating requirements. Since 1994, DNR has taken two enforcement actions against the District for alleged permit violations related to sewer overflows, including a civil complaint filed with the Milwaukee County Circuit Court in March 2002. The complaint has been resolved with a stipulated agreement between DNR and the District issued in May 2002.

## Wastewater Discharge Permit Compliance

**DNR issues wastewater discharge permits that regulate the District's operations.**

Wastewater discharge permits are the primary mechanism used to implement the point source pollution control requirements of the Clean Water Act and ch. 283, Wis. Stats. The EPA retains an oversight role in Wisconsin's permitting program, but DNR issues the wastewater discharge permit that regulates many aspects of the District's operations. Although the District's most recent five-year permit expired on March 31, 2002, its provisions will remain in effect until DNR issues a new permit, which is expected to occur later in 2002. They include:

- effluent limits that restrict the amount of pollutants that may be legally discharged from the two wastewater treatment plants;
- restrictions on combined and sanitary sewer overflows; and
- other compliance requirements, such as requirements for sludge disposal and Milorganite production, guidelines for operating the Deep Tunnel, and provisions for surface and groundwater monitoring.

**Permit violations may be self-reported or identified by DNR.**

Like other regulated facilities, the District is required to self-report any violations of permit terms and conditions. DNR may also identify permit noncompliance during on-site inspections or through reviews of the monthly discharge monitoring reports that regulated facilities must submit. These reports contain the results of effluent water testing and are used to verify compliance with permitted limits.

The range of potential violations depends on the specific requirements included in a facility's permit, but it may include sewer overflows, failure to meet effluent limits, failure to submit required monitoring information, or failure to adhere to permit-required deadlines. All violations of permit conditions are subject to enforcement, although isolated violations do not automatically result in formal enforcement actions. DNR officials indicate that the appropriate enforcement response is based on the type, severity, and frequency of the violation, as well as the compliance history of a particular facility and the potential harm to public health and the environment.

DNR follows a stepped enforcement process, which begins with less-formal enforcement actions, such as meeting with the permittee to discuss corrective actions or issuing warning letters known as notices of noncompliance. If the conditions leading to the violation cannot be resolved in this manner, DNR can issue a more formal notice of violation; schedule an enforcement conference with the permittee; establish a compliance schedule in future permits; or in the case of sewer overflows and effluent limit violations, enact a moratorium on new sewer system extensions in the community. If the permittee still fails to undertake the appropriate corrective actions, DNR may request that the Department of Justice initiate a formal action leading to court-ordered fines, judgements, stipulations, or consent orders.

### Effluent Limit Compliance

**The District has consistently met effluent limitations established in its permit.**

To determine the District's compliance with effluent limits, we reviewed the monthly discharge monitoring reports it submitted to DNR from 1998 through 2001. We found that the District has consistently met effluent limitations established in its permit at both the Jones Island and South Shore treatment plants. In only one instance—during the Hoan Bridge failure of December 2000, which forced the closure of a large portion of the Jones Island plant—did the District fail to meet its weekly limit for biochemical oxygen demand. DNR and the EPA agreed not to pursue enforcement actions for this effluent violation because the cause of the disruption was beyond the District's control.

### Sewer Overflow Compliance

**Since completion of the Deep Tunnel, the District has never violated combined sewer overflow requirements.**

Since the completion of the Deep Tunnel, the District has never violated the terms of its permit as a result of combined sewer overflows. The permit, issued in June 1997, allows either up to six combined sewer overflows per year or the capture and treatment of at least 85 percent of the total annual wet-weather wastewater collected in the combined sewer area. The District has had six or fewer combined sewer overflows each year since 1994.

**Eight sanitary sewer overflows resulted in the discharge of 471 million gallons of untreated sewage.**

However, the District has had 39 sanitary sewer overflows since 1994. DNR officials allege that at least eight of these sanitary sewer overflows, which resulted in 471 million gallons of untreated sanitary sewage being discharged to Milwaukee-area waterways, violated the permit. With the Wisconsin Department of Justice, DNR filed a complaint in Milwaukee County Circuit Court against the District in March 2002. DNR officials also identified an additional nine sanitary sewer overflows between 1994 and 2000 that they believe may have been violations of the District's permit.

The District maintains that all of these overflows were unavoidable and, therefore, allowed under the terms of its permit, which include exemptions for overflows that result from equipment damage or temporary power interruption, are unavoidable and necessary to prevent loss of life or severe property damage, or are the result of excessive storm runoff. DNR and the District entered into a stipulated settlement in May 2002 under which the District has agreed to:

- complete all projects identified in the District's 2010 Facility Plan by December 31, 2010;
- enlarge planned sewer upgrade projects to add an additional 116.0 million gallons of storage;
- develop a 2020 Facility Plan that will identify future wastewater treatment, storage, and conveyance needs;
- undertake inflow and infiltration reduction efforts with the assistance of the municipalities served by the District, with a goal of a 5 percent reduction in inflow and infiltration system-wide;
- implement operational measures to minimize wet-weather combined and sanitary sewer overflows, including maximizing wastewater flow to the treatment plants during wet weather and maximizing plant capacity through the use of in-plant diversions;
- install additional rain gauges and flow meters in the conveyance system to improve decision-making on Deep Tunnel filling rates and on how much capacity to reserve in the tunnel for wastewater from outside the combined sewer area;
- develop and implement a capacity, management, and operations and maintenance plan to meet the goal of eliminating all non-permitted sewer overflows; and

- prepare a long-term combined sewer overflow control plan as required under federal law as part of its 2020 Facility Plan.

**The District has agreed to develop a long-term control plan for combined sewer overflows no later than December 31, 2007.**

Under the stipulated agreement with DNR, the District has also agreed to develop a long-term sewer overflow control plan no later than December 31, 2007. Changes to federal law enacted in 2001 require the development of such plans as soon as practicable, and generally within two years. Officials of the EPA acknowledged that the District had already completed many elements of the plan as a result of the efforts leading to construction of the Deep Tunnel; however, they stated that several additional areas need to be addressed, including identification of the effects of sewer overflows on sensitive areas such as beaches, an assessment of combined sewer overflows' effect on water quality, and development and evaluation of combined sewer overflow alternatives.

It should be noted that in July 2001, before the DNR lawsuit was filed, two environmental organizations notified DNR and the District that they intended to file a lawsuit for alleged permit violations related to sewer overflows. District and DNR officials stated that they were unable to reach agreement with these groups, and the groups subsequently filed a separate lawsuit in federal District Court in March 2002. The environmental groups' complaint alleges that at least 28 of the 39 sanitary sewer overflows since 1994 violated the District's permit, and it seeks abatement of future sewer overflows, penalties for past overflows of up to $25,000 per violation per day, and reimbursement for court costs and attorney's fees. This case is currently pending.

### Other Compliance Issues

In October 2001, DNR issued a notice of noncompliance to the District for failure to report two dry-weather sanitary sewer overflows within 24 hours, as required by the District's permit. These overflows, which occurred on September 18 and September 24, 2001, during days with no precipitation, resulted from malfunctioning overflow control gates. Each lasted approximately 20 minutes; together, they released a combined total of approximately 10,000 gallons of untreated wastewater to the Menomonee River. The District issued a notice of contract noncompliance to United Water Services for its failure to properly maintain this overflow point and related equipment. In addition, DNR and the District resolved the notice of noncompliance by agreeing to permanently abandon these overflow gates so that sewage could not be inadvertently released in the future.

**In four instances, the District appears not to have submitted a sewer overflow report by the required time.**

We reviewed quarterly overflow reports submitted to DNR by the District and identified four other instances between 1994 and 2001 in which it appears that the District failed to report sanitary sewer overflows within the required 24 hours. The overflows occurred at different locations and released a total of approximately 90,000 gallons of untreated wastewater. The District ultimately reported these overflows in a quarterly report to DNR, but DNR did not issue a notice of noncompliance for failing to report these events within the requisite time frame. District officials note that these overflows required field verification and contend that they could not, therefore, be reported within 24 hours as required. These overflows were all attributed to precipitation, and they included:

- a July 23, 2001 overflow lasting 20 minutes that released 50,000 gallons of untreated wastewater;

- a June 1, 2000 overflow lasting approximately one hour that released 29,000 gallons of wastewater;

- an overflow occurring between July 21 and 22, 1999, during which an unknown volume of wastewater was discharged for an unknown duration from two manholes that are not monitored by the District; and

- a November 10, 1998 overflow lasting less than 5 minutes that released 10,000 gallons.

Based on our review of available information, it also appears that the District failed to meet certain conditions of its permit on several other occasions. As noted previously, the District has reported that levels of coliform bacteria exceeded the groundwater standard in at least 29 wells since 1995. According to the terms of the District's permit and Wisconsin Administrative Code, the District is required to meet all groundwater standards in the aquifer surrounding the Deep Tunnel. Moreover, the District filled the Deep Tunnel to a level higher than the maximum allowable level established in the permit five times since 1994. When the Deep Tunnel was initially constructed, neither DNR nor the District anticipated that wastewater would escape from the tunnel if the District adhered to the maximum allowable fill level established in the permit. The District's experience in operating the tunnel between 1994 and 1997 showed that wastewater could escape from the tunnel even if the tunnel was filled to a level lower than the maximum limit provided by the permit. The District contested this provision of its permit in 1997, pending the outcome of additional groundwater studies required by DNR through a compliance schedule included in the 1997 permit. As noted, based on the results of these studies, the District agreed to abide by the maximum fill level to minimize the risk of wastewater escaping from the tunnel, and the tunnel has not been over-filled since 1999.

### Statewide Wastewater Permit-Related Enforcement Actions

**Historically, DNR has rarely initiated enforcement actions against communities for sewer overflows.**

Historically, DNR has rarely initiated enforcement actions against communities for sewer overflows, but has instead relied on informal administrative enforcement procedures, permit compliance schedules, and its authority to deny requested sewer extensions to achieve compliance with permit conditions. However, between January 1, 1995 and December 31, 2001, DNR initiated a total of 350 formal enforcement actions against municipal, industrial, and agricultural facilities statewide for wastewater permit or other wastewater-related violations. These actions included 286 notices of violation and 64 cases that were referred to the Department of Justice, including the previously noted case involving the District.

Table 30 summarizes the types of violations cited in 286 notices of violation issued from 1995 through 2001. In total, 752 instances of noncompliance were cited in the notices, most of which covered more than a single violation. As shown in the table, effluent limit exceedances and failure to submit discharge monitoring reports were the two most common reasons for notifications and together accounted for 30.3 percent of the instances of noncompliance cited.

Sewer overflows accounted for only 1.1 percent of the incidents in which noncompliance was cited. As was shown in Table 16, 288 municipalities—excluding the District—reported a total of 988 sewer overflows from 1996 through 2001 that discharged 564.1 million gallons of untreated wastewater to Wisconsin waters. Many of these communities are regulated under a single general permit for wastewater discharges that, like the District's, prohibits sanitary sewer overflows except in limited circumstances. DNR allows facilities or industries with similar types of wastewater discharges to be regulated under a general, statewide permit, including communities that own or maintain a sanitary sewer collection system but do not operate their own treatment facility.

Table 30

**Instances of Noncompliance with Wastewater Rules and Regulations**
(notices of violation from 1995 through 2001)

| Description | Number | Percentage |
|---|---|---|
| Effluent limit exceedance | 117 | 15.5% |
| Failure to submit discharge monitoring report | 111 | 14.8 |
| Miscellaneous* | 90 | 12.0 |
| Discharging in violation of permit | 83 | 11.0 |
| Sludge and landspreading related | 70 | 9.3 |
| Discharging without permit | 63 | 8.4 |
| Reporting-related | 53 | 7.0 |
| Laboratory and sampling related | 48 | 6.4 |
| Inadequate/improper equipment maintenance | 38 | 5.0 |
| Operator improperly certified | 27 | 3.6 |
| Industrial pretreatment related | 27 | 3.6 |
| Agriculture and animal waste related | 9 | 1.2 |
| Overflow violations | 8 | 1.1 |
| Stormwater-related | 8 | 1.1 |
| Total | 752 | 100.0% |

* Miscellaneous violations include failure to submit plans, failure to meet compliance schedules or other permit deadlines, nonpoint source pollution violations, construction without approval, air emissions violations, and improper operator training, among others.

The difference between the number of overflow-related enforcement actions shown in Table 30 and the number of actual overflows indicates that while sewer overflows continue to occur throughout the state, few communities are subject to formal enforcement action by DNR for these overflows. Instead, DNR officials indicate they address sewer overflow problems by working with communities to reduce inflow and infiltration into the sewer system and to ensure plant capacities are adequate. In some circumstances, DNR has enacted sewer extension moratoriums. Since 1995, it has issued sewer extension bans for 35 municipalities, including 1 within the District's service area (Whitefish Bay). As of April 2002, five sewer extension bans were in effect, but none were within the District's service area.

Informal enforcement actions and notices of noncompliance may occur more frequently than formal enforcement actions. It is difficult to determine how many informal actions DNR has taken against regulated facilities because records of such actions are kept in DNR regional offices. DNR's Southeast Region, which includes the area served by the District, reported issuing seven notices of noncompliance to municipalities for permit violations in 2001, including the previously noted notice of noncompliance issued to the District. These actions resulted from a variety of permit violations, including laboratory certification violations, failure to report sewer overflows, exceedance of effluent limits, noncompliance with pretreatment program requirements, and incomplete or late submittal of discharge monitoring reports.

## Future Considerations

EPA has agreed with the stipulated agreement between DNR and the District and acknowledges that the District has made progress toward reducing the number and volume of combined sewer overflows with the completion of the Deep Tunnel. However, as noted, recent amendments to the Clean Water Act mandate that all new wastewater permits issued to facilities with combined sewers require each facility to develop a long-term plan to limit combined sewer overflows. As part of the May 2002 settlement, the EPA has required the District to immediately begin developing critical elements of its plan to meet federal combined sewer overflow requirements. In addition, the EPA has announced its intention to develop a national strategy for addressing sanitary sewer overflows, which may include provisions that would require additional efforts by the District in the future.

Because of the large number of communities in Wisconsin with sanitary sewer overflows, DNR recognized a need for increased statewide efforts to control sanitary sewer overflows in a report to the Natural Resources Board in March 2001. DNR's strategy for bringing these facilities into compliance with federal and state requirements regarding sanitary sewer overflows includes:

- identifying and mapping every sewer overflow location in the state;
- working with communities to improve reporting of overflows; and
- addressing the problem of clean water inflow and infiltration into sanitary sewer systems.

**DNR recently revised permit language to specify when sewer overflows are allowed.**

In response to EPA concerns that Wisconsin permits were less stringent than federal requirements pertaining to sanitary sewer overflows, DNR recently submitted revised permit language defining the conditions under which sanitary sewer overflows would be allowed. The EPA concluded that this revised language is sufficient to meet existing federal requirements prohibiting sanitary sewer overflows. DNR also intends to work with communities covered by the general permit that experience chronic sanitary sewer overflows, and in some cases it may issue individual permits that establish compliance schedules for correcting the problems leading to overflows. Wisconsin is one of only a few states that issue a general permit to communities that do not operate their own treatment plants. While the general permit requires communities to report sanitary sewer overflows, it does not provide a mechanism for requiring communities to address the underlying causes of the overflows. Currently, more than 220 sewer systems that operate a wastewater conveyance system without a treatment plant are regulated by the general wastewater permit, including all 28 communities served by the District.

DNR officials indicate they are considering developing a set of factors for determining which communities will be targeted for individual permits. These factors are likely to include the number and volume of sewer overflows, the number of locations at which overflows occur, and the local water quality standards. Because some communities served by the District have had sanitary sewer overflow problems, they may be subject to these new permit requirements in the future.

****

Appendix 1

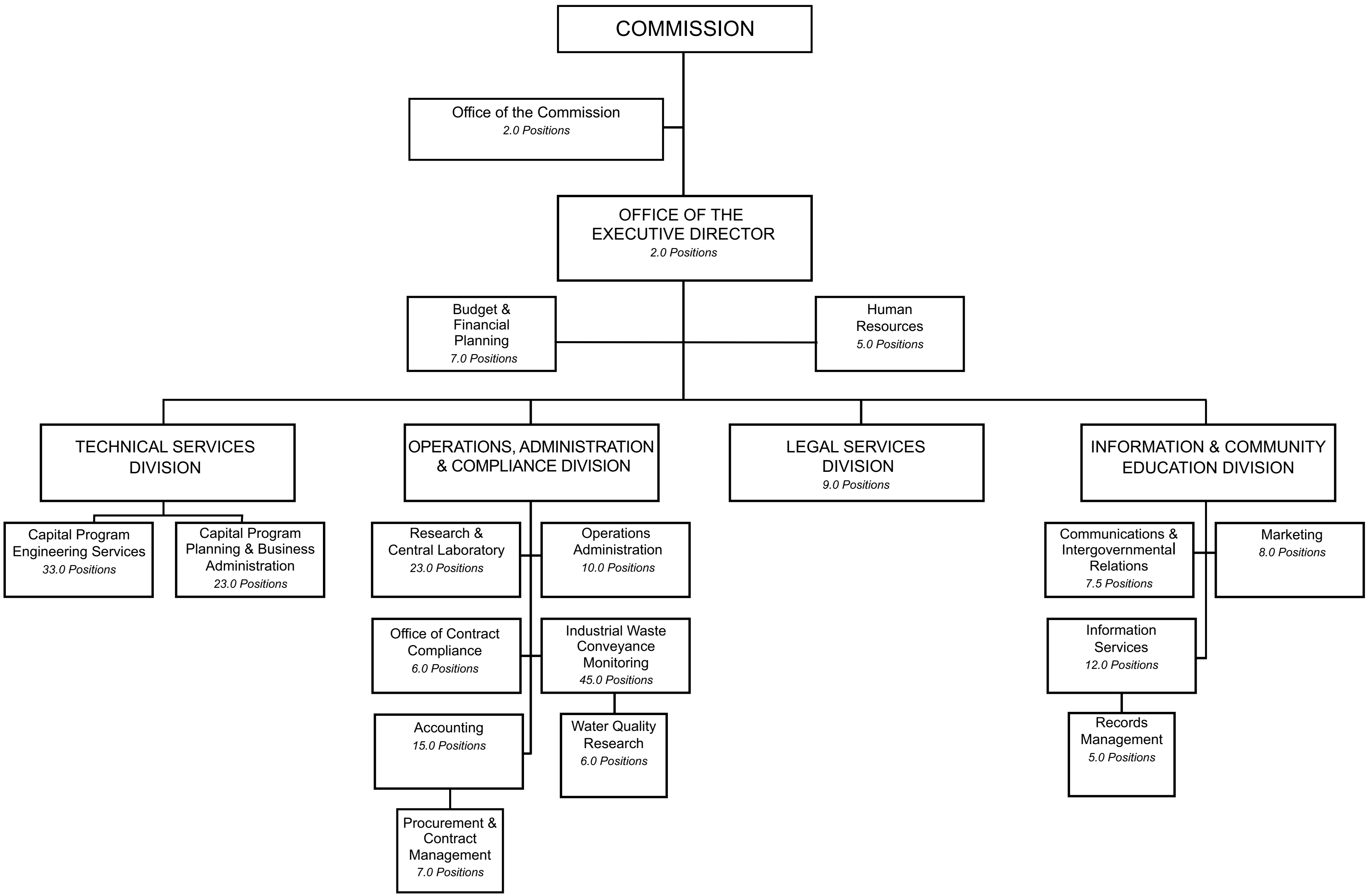
**Sewer User Charges to Municipalities**

| Municipality | 1997 | 2001 | Percentage Change |
|---|---|---|---|
| Bayside | $ 165,750 | $ 145,147 | (12.4)% |
| Brookfield | 631,330 | 537,128 | (14.9) |
| Brown Deer | 549,176 | 448,277 | (18.4) |
| Butler | 145,770 | 109,815 | (24.7) |
| Caddy Vista Sanitary District | 24,370 | 20,747 | (14.9) |
| Cudahy | 1,215,986 | 1,042,008 | (14.3) |
| Elm Grove | 208,237 | 194,612 | (6.5) |
| Fox Point | 251,500 | 218,593 | (13.1) |
| Franklin | 859,868 | 893,759 | 3.9 |
| Germantown | 686,708 | 584,571 | (14.9) |
| Glendale | 681,639 | 591,838 | (13.2) |
| Greendale | 519,832 | 434,347 | (16.4) |
| Greenfield | 1,258,364 | 1,174,868 | (6.6) |
| Hales Corners | 297,669 | 262,380 | (11.9) |
| Menomonee Falls | 1,136,164 | 991,901 | (12.7) |
| Mequon | 648,351 | 582,216 | (10.2) |
| Milwaukee | 33,028,525 | 26,357,142 | (20.2) |
| Muskego | 600,690 | 537,029 | (10.6) |
| New Berlin | 1,157,831 | 1,064,800 | (8.0) |
| Oak Creek | 1,122,180 | 1,029,039 | (8.3) |
| River Hills | 59,135 | 55,842 | (5.6) |
| Shorewood | 464,217 | 413,552 | (10.9) |
| South Milwaukee* | 11,106 | 18,842 | 69.7 |
| St. Francis | 347,124 | 324,910 | (6.4) |
| Thiensville | 112,630 | 96,147 | (14.6) |
| Wauwatosa | 2,369,281 | 1,995,544 | (15.8) |
| West Allis | 2,622,885 | 2,197,358 | (16.2) |
| West Milwaukee | 2,225,077 | 624,949 | (71.9) |
| Whitefish Bay | 479,468 | 422,774 | (11.8) |
| Total | $53,880,863 | $43,370,135 | (19.5) |

* South Milwaukee receives hazardous waste disposal services only, because it operates its own wastewater treatment plant.

Appendix 2

**Milwaukee Metropolitan Sewerage District 2002 Organization Chart**
Including FTE positions in each area



Appendix 3

**District Funding of Municipal Sewer System Evaluations**

| Municipality | Budget | Expenses through 2001 |
|---|---|---|
| Bayside | $ 81,445 | $ 53,671 |
| Brookfield | 287,263 | 153,312 |
| Brown Deer | 157,240 | 0 |
| Butler | 49,932 | 0 |
| Caddy Vista | 10,013 | 9,519 |
| Cudahy | 190,552 | 38,170 |
| Elm Grove | 128,325 | 96,218 |
| Fox Point | 109,205 | 111,287 |
| Franklin | 377,828 | 373,776 |
| Germantown | 191,205 | 27,885 |
| Glendale | 209,208 | 74,800 |
| Greendale | 229,718 | 113,891 |
| Greenfield | 430,405 | 168,080 |
| Hales Corners | 115,010 | 114,932 |
| Menomonee Falls | 488,278 | 379,632 |
| Mequon | 352,128 | 295,963 |
| Milwaukee | 2,535,026 | 2,069,807 |
| Muskego | 203,339 | 247,428 |
| New Berlin | 497,426 | 322,450 |
| Oak Creek | 428,096 | 203,910 |
| River Hills | 76,582 | 64,130 |
| St. Francis | 97,584 | 76,493 |
| Shorewood | 47,100 | 46,923 |
| Thiensville | 45,513 | 38,169 |
| Wauwatosa | 510,423 | 213,290 |
| West Allis | 528,851 | 300,784 |
| West Milwaukee | 68,819 | 25,583 |
| Whitefish Bay | 121,289 | 120,443 |
| Total | $8,567,803 | $5,740,546 |

Appendix 4

## Water Quality Pollutants and Indicators

**Ammonia –** Ammonia is a component of nitrogen fertilizers, domestic and industrial wastewater, and animal waste. High concentrations of ammonia are toxic to fish and other aquatic life. The toxicity of ammonia depends on water temperature and pH, and it becomes more toxic to fish and aquatic life during the warm summer months.

**Biochemical Oxygen Demand –** Biochemical oxygen demand is a measurement of the amount of dissolved oxygen consumed through the decomposition of organic material over a specified time period (usually 5 days) in a water sample. Although biochemical oxygen demand is not a specific pollutant, it is used as a measure of the readily decomposable organic content of water and wastewater.

**Chloride –** Chloride is present naturally in the environment, but high concentrations of chloride in waterways are caused primarily by road salt runoff, sewage from overflows, faulty septic systems, agricultural irrigation, and municipal and industrial discharges. High concentrations of chloride are toxic to freshwater fish and other aquatic life.

**Chlorophyll –** Chlorophyll is not a pollutant, but rather is a measure of aquatic plant and algae growth in rivers and lakes. As aquatic plants and algae die, they release chlorophyll—the substance used to convert sunlight, water, and air into food for plants—into the water. High levels of chlorophyll usually indicate the presence of noxious weeds and algae caused by excessive amounts of nutrients in the waterway. These weeds and algae cause aesthetic impairments, reduce the recreational value of the river or lake, and can displace more desirable native plants.

**Copper, Lead, and Zinc –** Trace levels of naturally occurring metals such as copper, lead, and zinc are found naturally in the environment. Many of these elements are necessary for aquatic life in minute amounts but are toxic to fish, aquatic life, and humans at higher doses. Toxic heavy metals are found as pollutants in many water bodies as a result of urban runoff that contains paint chips, residue from automobile tires and brakes, and corroded metal parts. Other sources of trace metals include municipal and industrial wastewater discharges and contaminated sediments from past industrial activity.

**Dissolved Oxygen –** Dissolved oxygen is not a pollutant, but instead is an important indicator of water quality. Without sufficient dissolved oxygen, fish and other aquatic life suffocate and toxic chemicals such as mercury may be released from bottom sediments. Dissolved oxygen is affected by temperature and the presence of oxygen-consuming material in the water, such as sewage, decaying plant matter, and other biochemical processes that consume oxygen.

**Fecal Coliform Bacteria –** Fecal coliform bacteria are naturally present in the environment in excrement from all warm-blooded organisms, including humans. Although fecal coliform bacteria do not pose a health threat to humans, they are relatively easy to measure and are indicative of conditions in which fecal contamination containing more serious pathogens is likely to be present.

**Phosphorus and Nitrogen –** Nutrients such as phosphorus and nitrogen are essential in limited quantities for aquatic plant growth, but excessive nutrients lead to degradation of water quality through excessive weed and algae growth, increased turbidity, and low dissolved oxygen as plant matter decays. Common sources of nutrients include municipal and industrial discharges, failing septic systems, sewer overflows, fertilizer, livestock, domestic pet waste, wildlife, and airborne sources.

**Suspended Solids –** Suspended solids are the particulate matter present in water or wastewater and include sand, gravel, soil, and other solid materials. High levels of suspended solids harm fish and aquatic life by clogging gills, reducing the amount of light that can penetrate the water, and causing silt and sand to cover spawning areas. Suspended solids typically enter waterways as the result of runoff from fields, roads, and construction sites or from eroding stream banks.

**Turbidity –** Turbidity is a measure of the amount of light transmitted through a water sample and is closely related to suspended solids, but measures both particulate and dissolved pollutants in the water. High levels of turbidity usually indicate polluted waters and affect the amount of light available for desirable plant growth.

Preserving The Environment •
Improving Water Quality

Kevin L. Shafer, P.E.
Executive Director

July 24, 2002

Ms. Janice Mueller
State Auditor
State of Wisconsin
Legislative Audit Bureau
22 E. Mifflin St., Suite 500
Madison, WI 53703

Dear Ms. Mueller:

I am pleased to provide a written response to the Legislative Audit Bureau's (LAB) evaluation of the Milwaukee Metropolitan Sewerage District's successful effort to reduce the number of sewer overflows into Milwaukee-area waterways.

First, I would like to thank you and your staff for your review over the past 10 months. Your efforts have resulted in a report that highlights the many positive results for the Milwaukee area as a result of the Deep Tunnel System, including the fact that the Deep Tunnel has substantially reduced the amount of pollutants entering Milwaukee-area waterways, and water quality has improved within the combined sewer area of the District, which was the main goal of the Water Pollution Abatement Program. Your report also notes that other pollution sources, including polluted runoff and sanitary sewer overflows, continue to impair water quality within and outside of the combined sewer area.

**We are proud to say that in all of the instances where the Audit Bureau has raised issues, MMSD already had projects started to improve those specific operations prior to the initiation of the audit.**

We are proud to say that in all of the instances where the LAB has raised issues, MMSD already had projects started to improve those specific operations prior to the initiation of the audit. For example, the District began in 2001 the $96.5 million design and reconstruction of two siphons in downtown Milwaukee that transport wastewater under the Milwaukee River to the Jones Island Wastewater Treatment Plant to improve their efficiency and increase their capacity. The Audit Bureau has confirmed the issues that the District is already working to improve and found no new issues.

In addition to my comments on the specifics of your report, it is necessary to highlight several important items included in your evaluation:

•**The Deep Tunnel System has substantially reduced the frequency and volume of both combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs).** The number of annual overflows has been reduced from 50 a year to about 2.6 a year. In addition, after completion of the Deep Tunnel System, the average annual volume of SSOs was reduced by 1.7 billion gallons per year, or 93.4 percent, while the average annual volume of CSOs was reduced by 5.5 billion gallons per year, or 78.3 percent.

**The District has never violated its Wisconsin Department of Natural Resources- and Federal Environmental Protection Agency-approved combined sewer overflow permit.**

milwaukee metropolitan sewerage district
260 W. Seeboth Street, Milwaukee, WI 53204-1446
414-225-2088 • email: KShafer@mmsd.com • www.mmsd.com

**•Polluted runoff, or nonpoint pollution, is now the major source of pollutant loadings to Milwaukee-area waterways.** According to a recent report, polluted runoff accounts for more than 88 percent of the biochemical oxygen demand entering Milwaukee-area waterways.

**The Deep Tunnel System has substantially reduced the frequency and volume of both combined sewer overflows and sanitary sewer overflows.**

**•The District has never violated its Wisconsin Department of Natural Resources- (DNR) and Federal Environmental Protection Agency-approved (EPA) combined sewer overflow permit.**

**•A major contributing factor to sewer overflows in recent years is the increase in the number of large storms that produced wastewater flows that exceeded the capacity of the Deep Tunnel System.**

**•The single most important cause of the overflows is the amount of rainwater leaking into private laterals and local sewers.** This flow has increased by 17.4 percent since 1980 rather than being reduced by 12 percent as had been planned as part of the Water Pollution Abatement Program in the 1980s. The DNR agrees that rainwater leaking into local sewers is the major cause of recent sewer overflows. When these excessive flows overwhelm the District's system, overflows are necessary rather than letting untreated wastewater backup into homes and businesses.

**•The District has saved $36.5 million over the first three years of its 10-year contract, started in March 1998.** The savings are about $1.4 million more than projected after three years. In all, the District expects to save more than $140 million over the term of the contract with United Water Services to operate its treatment plants and conveyance system.

**•As the report accurately reflects, the District plans to spend about $1 billion over the next several years to rehabilitate, replace and build new interceptor sewers, which will provide additional capacity and further reduce the risk of overflows.** The plan, which has been approved by a Milwaukee County Circuit Court judge, is the result of an agreement with DNR and is intended to assure that MMSD will meet its discharge permit requirements for SSOs. The federal EPA is fully supportive of this stipulation.

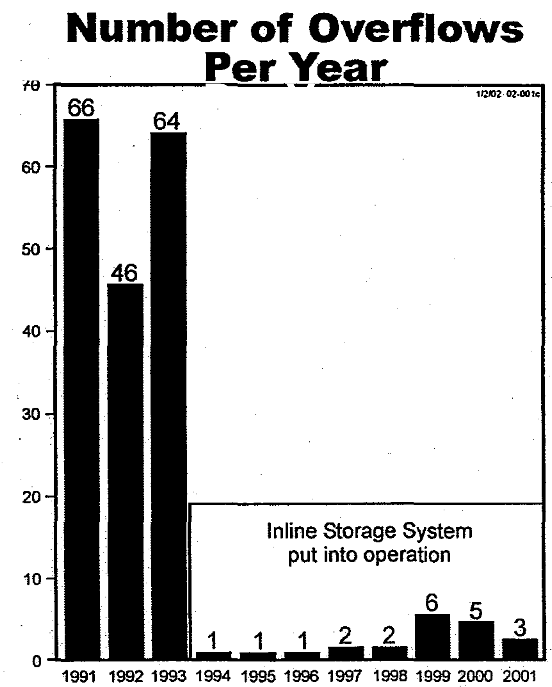
There are a few significant areas in the report where we have differing viewpoints or there is a need for further elaboration. They are:

**Frequency of overflows should be evaluated by specific cause**

The report overstates the average number of combined and sanitary sewer overflows that have occurred as a result of the Deep Tunnel System. Rather than counting sewer overflows that were Deep Tunnel related, the report cites all overflows, even if they were caused by a mechanical failure or an unrelated problem in the conveyance system, resulting in an inflated annual average. Those overflows were unrelated to the Deep Tunnel and, in fact, these type of events occur in all communities throughout Wisconsin and the United States.

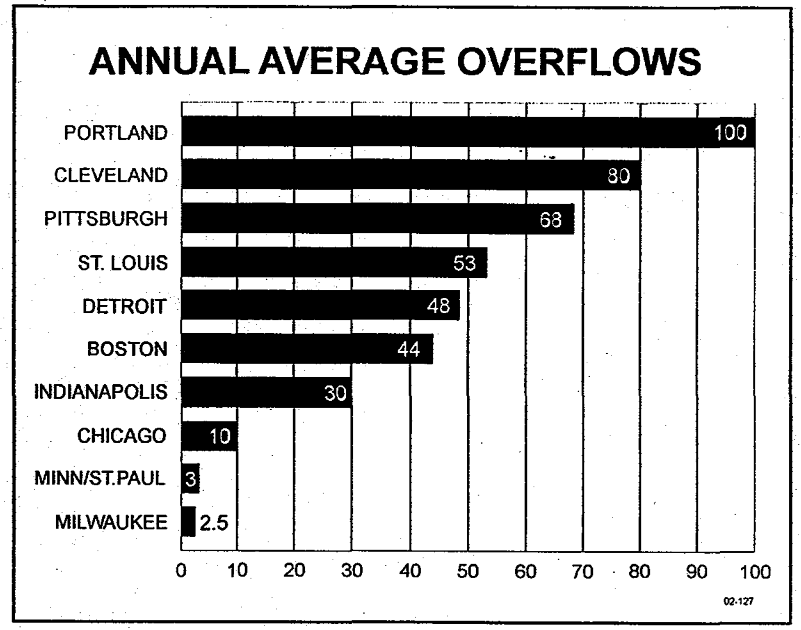
In the first eight years of operation of the Deep Tunnel, there have been 21 CSOs, or an annual average of 2.6, and 18 SSOs, or an annual average of 2.3, that occurred as a result of the closing of the Deep Tunnel gates.

The report cites the planning goal average number of overflows that was expected at 1.4 per year during the design and planning for the Deep Tunnel System in the early 1980s. But the report fails to state that the figure was an estimate over a 40-year weather record. It is unfair to state that after just eight years, the tunnel has not achieved the results it was designed for. It is too early to make that conclusion. If the LAB had looked at the number of overflows from the Deep Tunnel after three years, it would have only been an average of 1.0 CSO a year. The point is that due to fluctuations in weather patterns, one needs to look at a longer period of time to judge the results.



**MMSD is recognized as the national leader in reducing sewer overflows**

We are concerned that the report does not include information on the level and volume of overflows for comparable cities across the United States. The information would have shown that Milwaukee is significantly ahead of any major city in the United States in reducing the number and volume of CSOs and SSOs.




In some cities, there are still sewer overflows any time it rains more than .25 inches. For example, in 2001, the City of St. Louis, which serves a population of 1.4 million, had about 53 sewer overflows, discharging about 26 billion gallons of untreated wastewater to the Mississippi River. The Allegheny County Sanitary Authority, which serves 850,000 residents including the City of Pittsburgh, had about 68 sewer overflows in 2001, discharging 12 billion gallons of untreated wastewater.

Other cities that have wastewater storage systems similar to Milwaukee, such as Chicago, still experience sewer overflows. In fact, in August 2002, after a very large rainstorm hit downtown Chicago, the sewerage agency was forced to overflow about 2 billion gallons of untreated wastewater into the Chicago River and 1 billion gallons into Lake Michigan as reported by The Chicago Tribune.

Sewer overflows are a national issue that many communities across the country are just starting to address. Cities such as Pittsburgh and Atlanta are facing potential huge fines from the EPA if they don't implement plans to significantly reduce sewer overflows to levels that Milwaukee is already achieving. Many cities, such as Atlanta, Cincinnati, Portland and Washington, D.C. are just now embarking on building wastewater storage systems similar to the Deep Tunnel. Officials from some of these cities have visited Milwaukee to look at our successful approach to this problem.

**Cities such as Pittsburgh and Atlanta are facing potential huge fines from EPA if they don't implement plans to significantly reduce sewer overflows to levels that Milwaukee is already achieving.**

Indianapolis plans to spend more than $1 billion over the next 20 years in an effort to reduce its sewer overflows about 80 percent, to an average of four a year, by expanding its sewer plants and likely building huge underground storage tanks to capture most of its overflows for later treatment. The average sewer rate for the city's 870,000 taxpayers is expected to climb 40 percent by 2020 to help pay for it.

**The establishment of the 200-million-gallon reserve policy for separate sewer flows optimizes the District's chances of achieving all of the objectives of the Deep Tunnel System**

The original purpose of the Deep Tunnel System was the elimination of SSOs, the control of CSOs and improvement in water quality. The reserve policy also helps reduce the risk of overfill of the storage system, which could cause exfiltration from the Deep Tunnel. Since this reserve policy has been established, there have been no tunnel overfills.

Since the policy was put in place three years ago, about 190 million gallons of untreated sanitary sewage has been overflowed as a result of the Deep Tunnel gates being closed, or an average of 63 million gallons a year, compared to about 733 million gallons in the five years prior to that policy, or an average of 147 million gallons a year. This is a 57 percent reduction.

**The reserve policy is flexible, allowing our contract operators to adjust it as they monitor approaching rain, to ensure the capture of the maximum amount of untreated wastewater**

As the LAB report points out, the reserve policy is flexible, allowing our contract operators to adjust it as they monitor approaching rain, to ensure the capture of the maximum amount of untreated wastewater. For example, in early June 2002, the Milwaukee area was hit with up to 4.5 inches of rain over two days. The Deep Tunnel was able to capture more than 300 million gallons of untreated wastewater as operators adjusted the reserve that prior to its operation would have been discharged into area rivers and Lake Michigan. There were no separate or combined sewer overflows or bypasses from the Deep Tunnel during this event.

While the report makes mention as to the conveyance system's and operators' required reliance on weather predictions in order to make complex decisions, we wish to emphasize that predictions are often not accurate because of the imprecision of weather forecasting. It is not uncommon for approaching storms that are monitored on digitalized real-time weather maps by the District's contract operator to show that one to three inches of rain will hit the District's service area in the next several hours. Based on that information, the contract operator will not normally adjust the reserve believing it will be needed to capture the expected flows. Weather patterns often change radically, either shifting north or south and missing the service area. These unpredictable weather conditions have necessarily resulted in unused capacity in the Deep Tunnel. The DNR permit requires that the District and its contract operator must first make sure that there are no SSOs and that the Deep Tunnel does not overfill.

**Weather patterns often change radically, either shifting north or south and missing the service area. These unpredictable weather conditions have necessarily resulted in unused capacity in the Deep Tunnel.**

As the report noted, the District is installing a $3.3 million Real Time Control System that will provide updated information on system performance every 15 minutes or less. The information will help the District maximize existing system capacity during heavy rainstorms. The District currently has extensive monitoring devices in its conveyance system, but the new technology will give control operators more information faster and allow them to adjust system operations to changes in weather throughout MMSD's service area.

### Blending

As stated in the report, blending, or inplant diversion, is an EPA- and DNR-approved standard operating procedure for a wastewater treatment plant trying to maximize the amount of wastewater treated. The total flow receives extensive treatment, including disinfection and dechlorination, and meets all permit requirements. In fact, a court-ordered agreement between DNR and MMSD requires that the District begin blending during rainstorms as soon as the treatment plants reach full capacity to ensure the treatment of as much wastewater as possible.

The District's contract operator uses this procedure when it is warranted, but the comments in the report do not take into account the fact that weather events can be intense, but brief, and may not warrant blending for a full 24 hours. The blending capacity at Jones Island cannot be met if the storm flow intensity is for only a portion of the day.

**Blending is an EPA- and DNR-approved standard operating procedure for a wastewater treatment plant trying to maximize the amount of wastewater treated. The total flow receives extensive treatment and meets all permit requirements.**

### The District has objected to United Water Services' policy of turning off pumps to switch power sources during storm events

The District agrees that this practice should not occur, and, in fact, issued a notice of noncompliance to United Water Services in September 1999 after it was done during July 1999. The notice states that United Water Services "breached the terms of the agreement" when it failed to maximize pumpout capacity on July 21 and 22, 1999. It should be noted that the District's contract with United Water Services allows for an "event of default" if the company receives notices of "persistent and repeated failures."

United Water Services disputed the notice of noncompliance and also disputes some of the LAB's findings. None of United Water Services' actions prompted either a combined or separated sewer overflow. Their actions may have slightly increased the volume of the overflows. The District has ordered the company to continuously run the pumps during tunnel events. MMSD also began a project in 2001 that will allow the power switchover without having to turn off the pumps. It is expected to be completed in 2003.

**The District agrees that this practice should not occur, and in fact, issued a notice of noncompliance to United Water Services in September 1999 after it was done during July 1999.**

### Siphon capacity project already underway

Because construction of the downtown siphons, which transport wastewater under the Milwaukee River to the Jones Island plant, was started before other elements of the Water Pollution Abatement Program were finalized, their design was based on factors that later changed. However, as documents provided to the LAB showed, the plan all along was that any shortfall in hydraulic delivery through the siphons to Jones Island would be accommodated by diverting flow to the Inline Storage System and then pumped out to the Jones Island or South Shore plant for treatment.

As stated earlier in this response, the District began a project in 2001 to redesign and reconstruct the siphons as part of the Central Metropolitan Interceptor Sewer improvement project that will increase their efficiency and capacity. We expect this project will be completed in 2007.

### Concerns raised about watercourse project cost increases do not consider the cost changes inherent in watercourse project planning

The report's analysis of a small number of watercourse projects illustrates the well-understood principle that there will usually be a reasonable difference between preliminary cost estimates and final construction costs. This is because preliminary estimates are developed without the benefit of public participation, site location, geotechnical investigations or even preliminary design. This principle is reflected in the Association for the Advancement of Cost Engineering's guideline that preliminary costs generally vary between -30 percent and +50 percent of final construction costs.

**The report's analysis of a small number of watercourse projects illustrates the well-understood principle that there will usually be a reasonable difference between preliminary cost estimates and final construction costs.**

Despite those facts, the report uses a preliminary and outdated cost estimate for the Lincoln Creek Environmental Restoration and Flood Control Project to make its assertion that the projects exceeded budgeted amounts. In fact, the $70.4 million figure used in the report was a preliminary estimate that was not necessary to update after final design was completed because the project was on a fast-track schedule to be completed because of heavy flooding along the creek corridor in 1997 and 1998.

It was completed two years ahead of schedule, bringing flood relief to more than 2,000 homes and businesses, which had been ravaged by flooding for decades. In fact, between 1960 and 1997, more than 4,000 separate flooding problems were reported along Lincoln Creek.

The main reasons for the increase in the Lincoln Creek cost preliminary estimate were:

•DNR permit requirements that exceeded expectations based on past practices of the state agency and the fact that the District had to receive a Chapter 30 permit from the DNR for each of the 10 reaches of the creek, rather than one permit for the entire project.
•$12.8 million in design costs were not included in the preliminary estimate as it was only a construction estimate for the project.
•Contaminated soils encountered were not identified during initial investigations because they were on private property where owners did not allow access for soil borings. This cost the District about $6.1 million.
•The preliminary estimate was developed in 1996 and inflation added about $13.7 million to the project.
•An endangered snake habitat that DNR was not aware of, along with other real estate, insurance and professional services that added $7.8 million.
•Bypass culvert projects that were not included in the original estimate that added $7.2 million to the cost of the project.

**The $70.4 million figure used in the report was a preliminary estimate that was not necessary to update after final design was completed because the project was on a fast-track schedule to be completed because of heavy flooding along the Lincoln Creek corridor in 1997 and 1998.**

Substantial changes were made along Lincoln Creek as concrete was removed and detention ponds added. It is now more of a meandering waterway, aimed at keeping the water within its banks during heavy rainstorms. Over two miles of concrete were removed as part of the project and the floodplain was shrunk, thereby removing the need for the residents to carry expensive flood insurance. The project is being viewed nationally as a model of how to implement a flood control project in an urban area.

Lastly, the number of contracts sampled was too few from which to draw any conclusion. For example, a review of the Water Pollution Abatement Program projects would have provided a representative number of contracts. It would have been relevant because most of the inspectors, project managers and senior staff now employed by the District were present during the original program from the mid 1980s to the present time. Such a study would have shown minimal cost increases generally in the area of 7 percent, which were extraordinarily low for a $2.3 billion program.

**A strict cost-benefit approach to flood management work does not yield the most acceptable solution to urban flooding problems**

The District's current approach on flood management projects, to implement an alternative that is preferred by a consensus of watershed stakeholders, was a decision by the MMSD Commission, based on the recommendations of a special policy group that included the executive director of Southeastern Wisconsin Regional Planning Commission, along with five locally elected officials.

Taxpayers have found the alternative of allowing homes to flood with sewage after extensive overland flooding to be unacceptable. This alternative is potentially dangerous, can cause significant property damage and is a risk to public health and safety.

**Taxpayers have found the alternative of allowing homes to flood with sewage after extensive overland flooding to be unacceptable. This alternative is potentially dangerous, can cause significant property damage and is a risk to public health and safety.**

The report also states that the District should consider whether to do a project based on the amount of flood damages. This is a flawed approach. The costs from a single 100-year event cannot be used as a comparison to project costs because in all of the areas MMSD is undertaking flood management work, the flooding has occurred numerous times. For example, the area of downtown Wauwatosa near the Menomonee River was extensively flooded in both June 1997 and August 1998. In the Congress Street area near Lincoln Creek, it has been reported that flooding occurred on a yearly basis prior to the implementation of the flood management project.

The report's comments on the benefits and costs of watercourse projects ignore three important considerations:

•The tangible benefits from these projects are not limited to preventing damages to homes and businesses. Several watercourse projects are multi-purpose in nature and provide water quality treatment, recreational opportunities and natural resources protection.

•The District made an explicit commitment to minimize the use of conveyance-oriented solutions because they were destructive to the environment and would not receive approval from the DNR. The District's and stakeholders' choice of other solutions have added to total project costs, but will preserve and enhance the resource value of area waterways and neighborhoods for future generations.

•Flood management plays an important role in the protection and efficient operation of the local and regional sewer systems during heavy storms. This function is not captured in the cost-benefit analysis of the monetary property damages avoided as a result of District flood management projects.

**The report's suggestion that the District look at implementing projects that would provide protection for some, but not all residents impacted by flooding in a watershed is ill-advised and would not be supported by elected officials in communities served by MMSD or their residents.**

Moreover, the report's suggestion that the District look at implementing projects that would provide protection for some, but not all residents impacted by flooding in a watershed is ill-advised and would not be supported by elected officials in communities served by MMSD or their residents. We should not be expected to go to West Allis, for example, and say the District will implement a project that will reduce the risk of flooding to residents who live near the Root River north of Oklahoma Avenue but not to others who just happen to live south of Oklahoma Avenue. That is unfair treatment to residents who are District taxpayers and who have made a commitment to their neighborhoods.

**Increase in lobbying expenses does not include millions of dollars captured by the District as a result of lobbying efforts**

As a result of this increased effort to secure federal funds, the District has received $11 million from Congress since 1998 for the Central Metropolitan Interceptor Sewer System Improvement Project. This has resulted in a net savings of over $17.2 million to taxpayers because of the additional interest costs if the District had to borrow that amount. A request for an additional $12 million has been made by the Milwaukee Congressional delegation in 2002. The District also received $2 million from Congress in 1997 for the District's Lincoln Creek Environmental Restoration and Flood Control Project.

**This has resulted in a net savings of over $17.2 million to taxpayers because of the additional interest costs if the District had to borrow that amount.**

On the state level, MMSD helped establish the statewide flood control grant program as part of the 1999 state budget. This fund, originally budgeted at $17 million, provides grants to communities statewide working on flood control projects. The District has already received $185,000 for the home acquisitions as part of the Hart Park flood management project and $600,000 for the Root River flood management project. In addition, several communities served by the District have received flood control grants, including Brookfield, Elm Grove, Mequon and Fox Point.

In closing, I would like to express once again our appreciation for your analysis. We look forward to reviewing the analysis in more detail to determine if there are changes that can be made to improve the quality and cost effectiveness of the District's service to its customers and to continue to improve the Milwaukee-area environment. I also hope your report prompts discussions among the policy-makers at the state level as to what can be done to reduce the amount of polluted runoff entering Milwaukee-area waterways, which the LAB identified as the major priority in the efforts to continue to improve water quality.

Sincerely,

Kevin L. Shafer

Kevin L. Shafer, P. E.
Executive Director