Detroit Water and Sewerage Department

Wastewater Master Plan
Volume 4

Capital Improvement Program

CDM Camp Dresser & McKee



Draft — June 25 . 2003

Detroit Water and Sewerage Department

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Appendix

Technical Memoranda*

The Following Technical Memoranda were used in the preparation of *Capital Improvement Program*, Volume 4 of the Detroit Water and Sewerage Department's Wastewater Master Plan.

- *Capital Improvement Program*
- *Flow Needs for DWSD Customers through 2050*
- *Basis of Cost Estimates*
- *Diurnal Flow Analysis of Wastewater Treatment Plant Influent*
- *Conceptual Design for a Future Wastewater Treatment Plant*
- *Conceptual Plan for Oakwood Northwest Interceptor*
- *Capital Improvement Program in Macomb County*
- *Evaluation of Clintondale Pump Station*
- *Long Term Solids Disposal Alternatives for Detroit Wastewater Treatment Plant*
- *Identification of Regulatory and Permitting Requirements*
- *Summary of "1978 Segmented Facilities Plan with Environmental Assessment" and "1981 Detroit Facilities Plan - Alternative Facilities Interim Report"*

*Technical Memoranda are available on the CD that accompanies this report

1. DWSD Current Capital Improvement Program

1.1 The City of Detroit Budgeting Process

The Detroit Water and Sewerage Department (DWSD) is an independent department and enterprise fund of the City of Detroit, with its own process for developing a capital improvement program. The Department's budget and financing are included, however, in the overall city budget. Therefore, a description of the DWSD CIP and budget development process should begin with a brief overview of the Detroit budgeting process.

Detroit is a home-rule city with governance divided into two branches: the executive branch, headed by the mayor, and the legislative branch, composed of the City Council and its agencies. The Mayor, as chief executive, appoints most department directors and deputy directors (including the Director of the Detroit Water & Sewerage Department). The City Council is composed of nine members elected at-large to four-year terms. The City Council has the authority to override the mayor's veto on all matters, including the city budget, with a two-thirds majority of its members.

The financial operations of the City are carried out through the appointed positions of the Finance Director (the Chief Financial Officer of the City overseeing most financial functions) and the Budget Director. The Budget Director assists the mayor in the preparation of the city's annual budget and long-term capital agenda. The City Charter provides for appointment of an Auditor General charged with analysis of the budget and the power to investigate the operation and administration of any city department. Independent accounting firms are hired to audit the financial transactions of city agencies.

The budget development process is described in the City Charter. The total proposed expenditures cannot exceed the total estimated revenues, so the budget as submitted is balanced. The adoption of the budget results in the appropriation of funds for programs, levy of property taxes, and provision for issuance of the bonds specified in the capital program.

The city's fiscal year is July 1 through June 30. For example, the FY 2002-03 budget was adopted on July 1, 2002. The schedule for the development of the budget (dates are for fiscal year 2002-2003) is shown in Table 1.1, along with the schedule for the development of rates at DWSD.

The Detroit Water and Sewerage Department, as a separately funded enterprise, has its own process for budget and rates development, including separate hearings. However, the department budget is included in the overall city budget and therefore follows the same general schedule.

All City departments, including DWSD, utilize a computer-based central accounting and reporting system referred to as DRMS (Detroit Resource Management System). This system allows budget information to be provided to each department and agency to allocate financial resources and control actual expenditures, and provides historical information for development of the annual financial report and next year's budget.

The accounting and financial reporting policies of the city conform to the generally accepted accounting principals (GAAP) and reporting standards of the Governmental Accounting Standards Board (GASB). Government Accounting Standards Board Statement #34 (GASB-34), issued in 1999, establishes new requirements for the annual financial reports of local governments, and the city has stated in the official budget that it has a plan of work for achieving the goals in this statement. One of the goals of the new accounting standard is to show the true cost of consuming

Table 1.1: Yearly Schedule for Development of Detroit City Budget and DWSD Rates

Month	City Budget	DWSD Rate Setting Process
August:		Preliminary review of prior actual revenues and expenditures.
September:		Flow analysis and projections completed.
October/ November:	Public budget meetings held to discuss department proposals before November 1.	Preliminary operating and capital budget and financing plans completed. Cost of service allocations and rate design completed.
December:	City agencies submit estimated requirements to the Budget Department by December 8. Five-year capital agenda (CIP) is submitted by December 1 of each even-numbered year.	Finalize proposed rates. Director approves preliminary rates by early December. Prepare Board of Water Commissioner (BOWC) information package by mid-December.
January:		BOWC workshop held in early January. Public hearings held before the BOWC in mid-January.
February:	Budget hearings held and proposed budget is presented to mayor by February 22.	Public hearing held before City Council in mid-February.
March:	Mayor reviews budget through a series of hearings with departments and may revise or alter it, returning it to the Budget Director by March 29. Five-year capital agenda is approved by March 1.	Rates approved by March 3.
April:	Mayor presents Executive Budget to City Council by April 12.	
May:	City Council reviews budget through a series of hearings with departments. Budget is returned to mayor for approval or rejection before May 17. Mayor approves or disapproves of budget in whole or part by May 30.	
June:	City Council acts on any items disapproved by mayor by June 3. Finance Director completes statement of taxation and bond requirements by June 10.	
July:	City operations start under new budget July 1.	Customers notified of new rates by July 1.
August:		Effective date of new rates is August 1.

Sources: City of Detroit 2002-2003 Executive Summary (City Budget), pp. A6-A8. City of Detroit Budget Department, "Budget Development Process for Fiscal Year 2000-2001" from City of Detroit website, 11/27/02. Presentation: "DWSD Sewer Rate Methodology" by B. Foster, Black & Veatch, to Rates Workgroup, 10/24/02.

capital resources used to provide services, including infrastructure such as sewer systems, wastewater plants, roads, and other assets owned by a community.

With the full accrual accounting required by GASB-34, the utility must report the historical cost of the sewer system and its components. Revenues include all earnings of the system, even those that will be collected in cash in future years. Expenses of the system are also reported, and include an annual depreciation or a modified approach option. The first approach, depreciation of infrastructure assets, is required to show the "usage" or decline in value of the system over its life. Under the second, modified approach, maintenance and preservation costs are expensed and only additions and improvements to the system are capitalized. This approach recognizes the cost of maintaining the infrastructure asset rather than just the depreciation of an asset's value. Each governmental entity must decide which approach to take for financial reporting.

For government entities with total revenues over $100 million, GASB-34 compliant financial statements are required for the fiscal year ending after June 15, 2002. The DWSD Sewage Disposal Fund Financial Statement for Years Ended June 30, 2001 and 2000 (dated 1/ 18/ 02) states that implementation of GASB-34 for DWSD was required for the fiscal year ending June 30, 2002.

More information on GASB-34 and financial and asset management approaches are presented in the description of the Human Resources and Technology program, to be covered in Volume 5 of the Master Plan, *Customer Service Program*.

1.2 DWSD Budget Development

The Detroit Water and Sewerage Department is operated as a separate enterprise fund in the city budget. These entities are operated in a manner similar to commercial enterprises, where the intent is to recover, through user charges, the cost or expenses (including depreciation) of providing goods or services to the general public. Enterprise funds are budgeted on an accrual basis rather than on the modified accrual basis used for other city departments.

According to the 2002-2003 Executive Summary for the City of Detroit Budget, one of the guiding principals for overall city budget development is that all enterprise funds must be self-sufficient. Four of nine enterprise funds are currently self-supporting, while the remainder requires some general fund support. The self-supporting funds include Water, Sewage Disposal, Housing and Parking. The general fund has no liability for funding any DWSD expense not covered by self-generating revenue, and subsidy payments to the system have never been made from the general fund. Temporary advances have been made, however, from the general fund to cover financing of capital projects until proceeds are obtained from revenue bond issues.

DWSD personnel are city employees, however, and estimates of personnel needed each year are included in the overall city budget. The fiscal 2002/ 2003 budget included funding for 1,477 positions.

DWSD is managed by a director appointed by the mayor. The policies of the department are set by a seven-member Board of Commissioners, also appointed by the mayor. Four members of the board represent Detroit and there is one member each on the Board from western Wayne, Oakland, and Macomb counties.

The DWSD budget has two components, water supply and sewerage, funded by two separate funds. Budget appropriations in the 2002-2003 for each sector is:

- Sewerage - $878,315,962
- Water Supply - $636,314,098

Table 1.2: Proposed Sewerage Expenditures, 2002-03

Major Category of Expenditure	Amount	%
Salary and Wages	$85,133,229	9.7
Employee Benefits	$22,740,345	2.6
Professional & Contractual Services	$21,311,672	2.4
Operating Supplies	$15,549,720	1.8
Operating Services	$40,982,603	4.7
Capital Equipment, Outlay, Major Repairs	$9,252,000	1.1
Fixed Charges	$101,766,400	11.6
Other Expenses	$581,579,993	66.2
Total	**$878,315,962**	**100.0**

Source: 2002-03 Mayor's Budget Recommendation, City of Detroit 2002-2003 Executive Summary, page C-158.

The 2002-2003 Mayor's Proposed Expenditures for the sewerage portion of the DWSD budget are distributed as shown in Table 1.2.

The category "Fixed Charges" includes debt service on outstanding bonds. The category "Other Expenses" includes bond sales.

Table 1.3: Major Category Appropriations for Sewerage 2002-2003

Major Appropriation Category	Amount	%
Administration	$24,763,325	2.8
Financial Services Group	$10,491,760	1.2
Facilities Management	$19,013,006	2.2
Wastewater Plant Operations	$144,282,352	16.4
Interest & Bond Redemption	$101,766,400	11.6
Sewerage System Improvements & Purchases	$35,082,840	4.0
Extraordinary Repairs & Replacements	$3,323,600	0.4
Sewerage Reserve Deposit	$2,634,600	0.3
Engineering Services	$3,387,079	0.4
Sewerage Bond Series	$533,571,000	60.7
Total	**$878,315,962**	**100.0**

Source: City of Detroit Fiscal 2002/2003 Budget, Agency 42 Sewerage Department, pp. 165-168.

Table 1.4: Revenue Expected from Sewerage 2002-03

Major Revenue Category	Amount	%
Revenues from Use of Assets	$21,037,500	2.4
Sales and Charges for Services	$317,229,878	36.1
Miscellaneous	$540,048,584	61.5
Total	**$878,315,962**	**100.0**

Source: 2002-03 Mayor's Budget Recommendation, City of Detroit 2002-2003 Executive Summary, page C-158.

Major appropriations in the DWSD fiscal budget for the fiscal year 2002-2003 are shown in Table 1.3.

Revenues for enterprise funds like DWSD must balance appropriations. Expected revenue totals in 2002-2003 for the Sewerage Fund are shown in Table 1.4.

The category "Sales and Charges for Services" is revenue derived from sewer rates, and "Miscellaneous" includes sewer bond sale proceeds.

1.3 Sewer Rates Development and the CIP

The schedule for development of the rates each year follows the same general schedule as the city budget development, as shown in Table 1.1. The overall methodology for determining sewer rates was initiated in 1980. The original methodology has been altered somewhat over time as the result of disputes with wholesale customers, and the resulting rate settlement agreements of 1978, 1980, 1982, 1995, and 1999. The latest rate settlement agreement in 1999 made significant changes to the rate model methodology — for example, charges for combined sewer overflow facilities had to be accounted for.

Unlike the water rates, which are designed on the more standard "utility" basis for determining revenue requirements as required by state law, the sewer rates are determined using a "cash" basis methodology. Differentiation between owner and

non-owners of the sewer system, and capital cost allocations can be more complicated with this method of determining revenue requirements.

Measurement or estimation of wastewater flows from each wholesale customer using a five-year averaging technique is required to determine the rates for each community. This can require extensive calculations, particularly where there are no meters installed to measure flows.

The major steps in rate development are as follows:

- Determine revenue requirements: O&M, capital improvements financed from revenue, debt service on revenue bonds, actual cash needs, debt service coverage, reserve deposits.
- Establish customer classes: retail, wholesale, industrial, owner, non-owner, following the principles of "proportional use" and "growth pays for growth."
- Allocate costs to functional components: treatment, collection system, CSO costs, customer service, etc.
- Measure units of service: sanitary, dry, wet weather flows, CSO cost.
- Develop the cost of service for units of service.
- Distribute costs to customer communities through unit charges, i.e., allocation of commodity charge (sanitary and dry weather I/ I) and monthly charge (wet weather flow and CSO projects).
- Compare results with revenues derived from existing rates.
- Revise rates to recover cost of service.
- Calculate final rates for each community.

Further detailed discussion of the development of the sewer rates is beyond the scope of this report, and are covered more extensively in the discussion of rate modeling in Volume 5 of the Wastewater Master Plan, *Customer Service Program.* The importance of the CIP in rate modeling is clear in the first step -- i.e., the determination of revenue requirements. Revenue requirements are determined for the following categories:

Operations and Maintenance Requirements:

Sewage Treatment Plant

Industrial Waste Control

Sewer Pump Stations

Sewer Maintenance

Interceptor Maintenance

Commercial

Meter Operations

Engineering

Administrative and General

Capital Requirements:

Debt Service (bond repayment)

Revenue Financed Capital

Renewals and Replacements

Extraordinary Repair and Replacement

Working Capital Requirement

The sewer system CIP has a major impact on total city indebtedness. Funding for the Sewerage Disposal System is maintained as a separate fund in the Detroit accounting system. As of 2002-2003, the total sewage disposal bond debt is $1,647,698,286. This is a large proportion (about 36 percent) of the city's total gross direct debt. (The other large portion is the water bond debt, at 29 percent of gross direct debt). In 2002, the Sewage Disposal Revenue Bonds were rated A1 to AAA.

For fiscal year 2002-2003, a sewerage rate increase of 16.4 percent on average was approved for Detroit customers, and an increase of 11.7 percent for

wholesale customers. On January 22, 2003, the Board of Water Commissioners approved proposed rate increases for fiscal year 2003-2004 for water and sewerage averaging around 9 percent.

1.4 DWSD CIP Development Process

For general capital improvements in the city budget, the city's CIP (also called the Capital Agenda) covering the next five fiscal years is submitted to City Council by December 1 of each even numbered year and is approved by City Council by March 1 of the following year. The Capital Agenda summarizes all expenditures in the five-year period, including all physical improvements, related studies and surveys, permanent property and equipment for any improvement. The estimated annual cost of operating the facilities to be constructed or acquired is also submitted with the Capital Agenda.

The Capital Agenda is published and hearings are held on it before the March 1 deadline for presentation to City Council. The City Council may delete items from the Agenda, but other modifications can be made only after recommendations from the Planning Director.

DWSD's Capital Improvement Program is developed separately from the Capital Agenda for the remainder of the city's budget because DWSD is a self-sufficient enterprise fund. However, the same schedule for development of the CIP is followed and the results incorporated into the final DWSD budget and rates development.

The Detroit Water and Sewerage Department uses maximum debt financing to pay for the capital programs to minimize the impact on sewage rates. Programs are paid for primarily through the sale of revenue bonds, with only a small amount of capital financing derived from annual revenues. Like many other large utilities, DWSD uses the cash flow method of project financing, rather than funding projects entirely in the year the project is started.

Internally, the DWSD CIP is developed by the Rates and Capital Improvement Section, part of the Financial Planning Division, Financial Services Group. The following procedure for development of the CIP was provided by this section.

Proposals for projects are developed by engineering project managers and division managers in DWSD working on the planning and construction of improvements to the system. Assistant directors must approve them. Project proposals must include the following documentation:

- Problem statement
- Potential alternative solutions
- Operational benefits of the proposed project
- Financial benefits of the proposed project using net present value method (cost vs. potential savings)
- Preliminary scope of work
- Identification of related projects underway or planned
- Time requirements
- Preliminary cost estimate
- Identification of in-house responsibility
- Reference materials
- Funding source must be identified (bond funds, extraordinary repair and replacement funds, improvement and extension funds, operation and maintenance funds)

The Engineering Division's input is required for several of the project proposal steps. Engineering cost estimates are developed for all projects.

Proposals are forwarded to the Financial Planning Division for consideration. The official DWSD procedure is to form a Joint Capital Committee to

rank and prioritize projects before they are placed on the final CIP list. (In recent years, this Committee has not been formed.) Criteria used to prioritize projects include the demonstrated need to:

- Repair and replace critical components
- Meet mandated regulatory requirements
- Fulfill contracts with wholesale or retail customers
- Maintain system reliability or capacity
- Improve system reliability
- Utilize technological advances
- Expand the service area

Once the project approvals are obtained, an organization number is assigned. The project budget is prepared by a financial manager from the engineer's estimate. The project is then entered on the CIP list. The official CIP is subject to the approval of the director of DWSD.

Once approved for funding, the project must be authorized by an Accounting Division manager, and receive an official project number. The budget is then entered into the financial system.

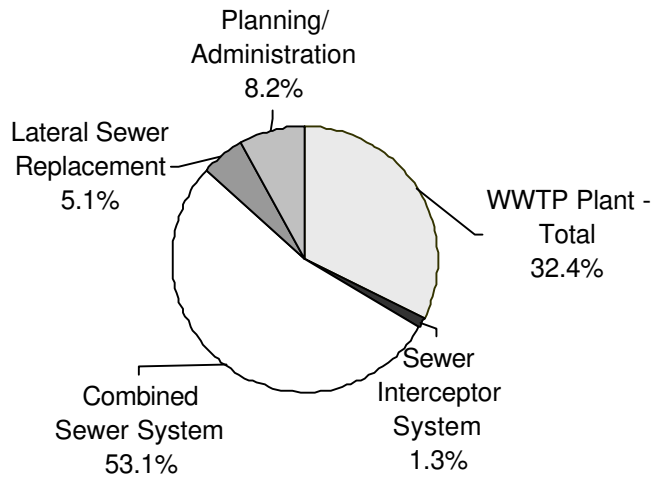
1.5 Recent DWSD Capital Expenditures

Typical capital projects proceed in three phases: study, design, and construction. In some cases, phases are combined, such as study/ design and design/ construction (this can also be a design-build project). For funding purposes, each phase is considered a separate project. As described earlier, funding is allocated yearly and not for the entire project. Projects identified as "ongoing" have been authorized to start by the director, whereas projects identified as "new" have not yet started.

Projects in the CIP are categorized as follows:

- Wastewater Treatment Plant
- Primary Treatment

Figure 1.1: DWSD 5-Year Proposed Capital Expenditures



2002-2007 CIP Total Expenditures

- Secondary Treatment
- Solids Handling
- Disinfection Facilities
- General Purpose
- Sewer Interceptor System
- Combined Sewer System
- Lateral Sewer Replacement
- Planning/ Administration

Figure 1.1 shows the percentage breakdown of the total expenditures in the current CIP (the discussion of the current 2002/ 2003-2006/ 2007 CIP for DWSD refers to the final draft issued on November 21, 2002. After extensive review by the DWSD director, the Mayor, and City Council, the final version will be approved by July 1, 2003).

As shown in Figure 1.1, the largest percentage expenditures are for work at the Wastewater Treatment Plant and the combined sewer system, both programs mandated by regulatory requirements. The Wastewater Treatment Plant expenditures are largely due to judicial mandates. Early in 2000, United States District Court of Appeals Judge

John Feikens appointed the mayor of Detroit a Special Administrator of the Wastewater Treatment Plant to prevent recurrent environmental noncompliance. To date, this oversight function has been left in place indefinitely.

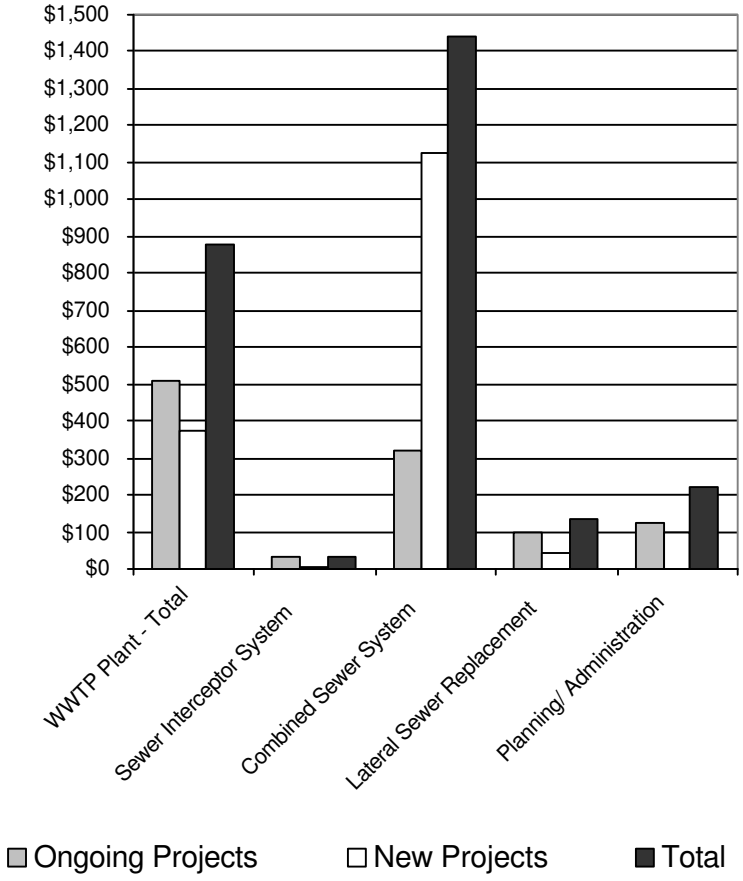
The expenditures for the combined sewer system are required by Michigan Department of Environmental Quality permit provisions mandating elimination or treatment of combined sewer overflows. The total of these two expenditures are 85.5 percent of the current CIP.

An indication of the direction of future expenditures can be obtained by looking at a breakdown of the ongoing versus new projects in the current CIP. The capital improvement programs proposed by DWSD are divided into "ongoing" and "new" projects. Ongoing projects are those with authorized funding that have generally started. New projects are those that have not yet been officially started but have been identified as needing to start during the five-year time period of the CIP. Not all of the funding for these projects is necessarily available or authorized during the time period of the CIP. The remaining funds required to complete the project are included in the total but may be required beyond the five-year period of the CIP.

The breakdown shown in Figure 1.2 indicates that expenditures will be shifting over the next five years from work on the Wastewater Treatment Plant to work on combined sewer discharge reduction or treatment. So far, a lower number of new projects related to the sewer interceptor system, lateral sewer replacement, and planning and administration have been identified.

Over the last five years, five-year CIP expenditure projections have increased for all categories except the sewer interceptor system. Figure 1.3 on the following page shows the total CIP proposed expenditures per category for some of the CIPs available — fiscal years 1998, 2000, 2002, and the proposed 2003 CIP.

Figure 1.2: New and Ongoing CIP Expenditures Based on Proposed 5-Year CIP (millions of dollars)



On a yearly basis, the total CIP expenditures have been increasing steadily since 1997-98, with 2000-2001 expenditures at 374 percent over the level just three years earlier. Despite this, the rate of expenditure has lagged somewhat behind the goals set out in the CIP for the same time period, as shown in Figure 1.4 on the following page.

Figure 1.3: Proposed Expenditures by Category for Four DWSD 5-Year CIPs (millions of dollars)

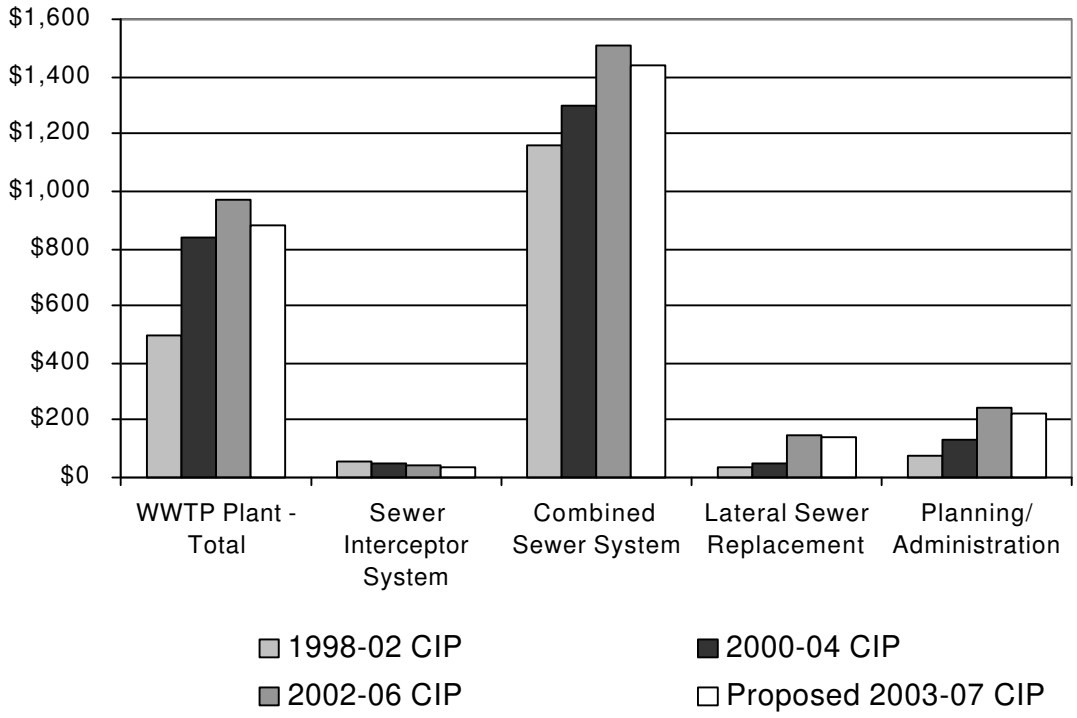
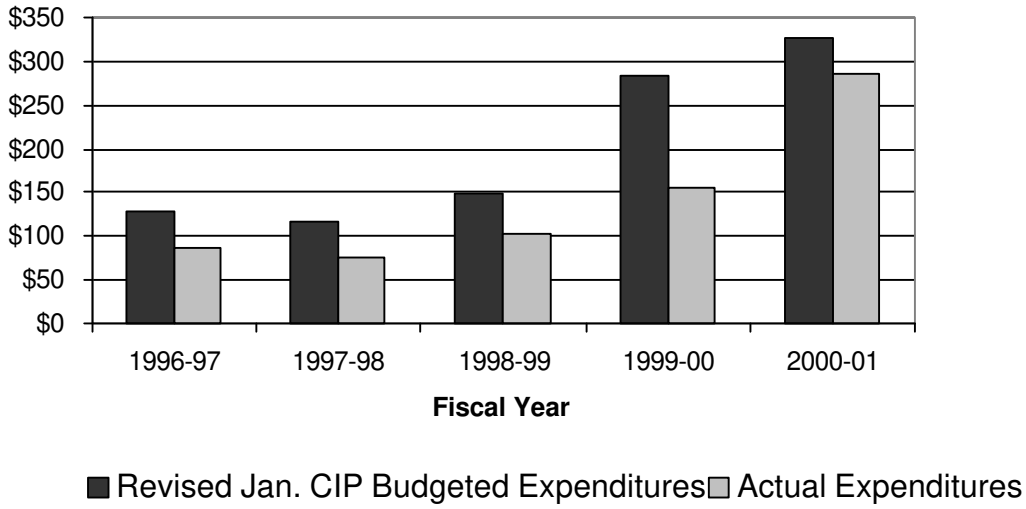


Figure 1.4: CIP Mid-Year Budget versus Actual Expenditures for Five Years (millions of dollars)



2. Preliminary Findings

The following section is based on a summary of the major findings of the Wastewater Master Plan, as presented to the Southeast Michigan Water Quality Consortium on January 17, 2003.

The Detroit Water and Sewerage Department has completed extensive investigations of its wastewater system as part of the master planning effort. Throughout 2003, DWSD will be presenting its Master Plan for comment and discussion. This section describes the major lessons learned from the master planning investigations to date. These lessons are organized into four major areas:

- The DWSD Wastewater System
- Flows Today
- Planning for Growth
- Flow Management

2.1 The DWSD Wastewater System

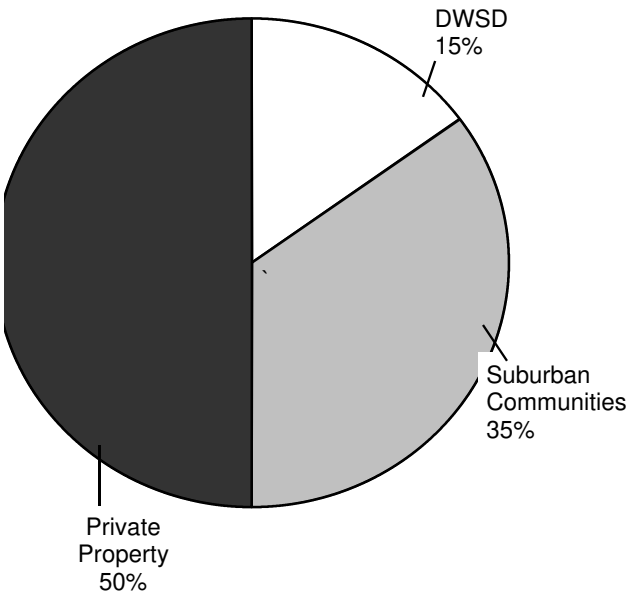
The DWSD wastewater planning area developed for the Master Plan includes 124 communities in the SEMCOG area.

The current DWSD regional wastewater system serves Detroit and 76 suburbs encompassing 75 percent of the population of Wayne, Macomb and Oakland counties, which comprise one third of Michigan's population. It also serves the manufacturing and commercial operations in the service area.

There are 36 other wastewater treatment plants in the area, including 22 major treatment plants.

The DWSD system includes two major components: the largest wastewater treatment plant in the world, plus enough pipe to circle the world at the equator (about 28,500 miles including Detroit and suburban sewers). In addition to the public sewers, there are also the house connections pipelines.

Figure 2.1: Sewer System Ownership



For every 1,000 feet of public sewers there are typically 1,200 feet of service connections, mostly on private property.

DWSD owns and operates the wastewater treatment plant and about 15 percent of the pipes (3,383 miles). The suburban communities own and operate about 35 percent of the pipes. The remaining 50 percent of the pipes are on private property.

There are a variety of reasons that quality operation of the system is crucial. Chief among them is protecting the drinking water supply for half the population of Michigan.

Overall implications from the review are:

- Everyone has a stake in the system. The region, the City, the suburbs, property owners, and our economic infrastructure cannot survive or thrive without quality wastewater service.
- A quality wastewater system cannot be achieved by simply focusing on the 12 percent of

the system owned by DWSD. Cooperation and integrated planning with customer communities are a prerequisite to both a quality system and operating efficiency.

2.2 Flows Today

Current residential flow data developed as part of the Master Plan can be summarized as follows:

- Each person generates about 77 gallons per day of wastewater.
- The typical household generates 193 gallons per day of wastewater.
- There are 1.24 million households in the planning area.
- Total population in the planning area is 3.8 million people.
- The total estimated residential flow to the DWSD system is 232 million gallons per day.

Generally, conveying and treating residential flow is not a problem today, and it is not expected to be a problem in the future.

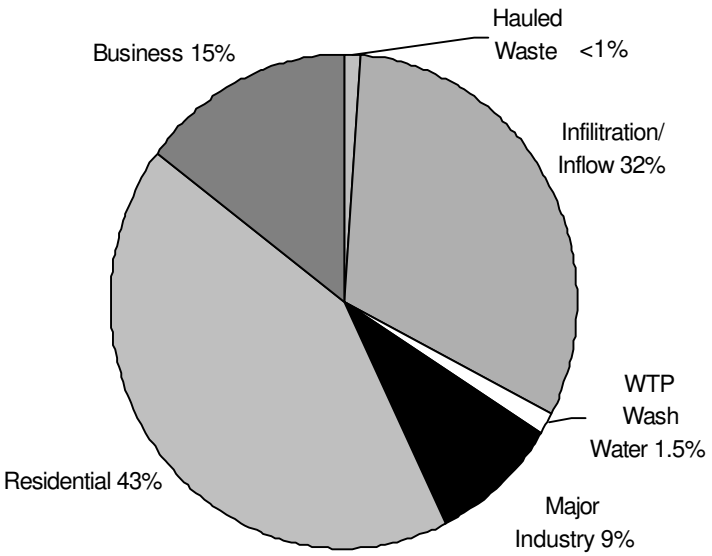
There are five major components of dry weather wastewater flows:

- Residential
- Business
- Major industry
- Infiltration/ inflow
- Wash water from water treatment plants
- Hauled wastes – including septage, RVs, boats, and portable toilets (less than 1 percent)

Infiltration/ inflow was about 40 percent of the average daily flow in dry weather — about 242 million gallons per day in 2001. This varies from year to year, based on weather factors. The current infiltration/ inflow is normal for systems with DWSD's size and age.

However, some of the infiltration/ inflow in the DWSD system is excessive. Infiltration/ inflow is excessive when it is less expensive to remove it than to build new facilities to transport and treat it. Estimates prepared for this Master Plan show that at least 50 mgd of the infiltration/ inflow is excessive. By comparison, this is more than the capacity provided by several other major service providers in the region. Put another way, 50 mgd could serve approximately 500,000 people. The Master Plan includes programs directed at eliminating excessive infiltration/ inflow so that new customers can be added to the system without adding to the capacity of the treatment plant.

Figure 2.2: Major Components of Wastewater Flow



Wet weather flow is the main Wastewater Treatment Plant capacity problem today. During wet weather, the system carries storm water from combined sewers serving Detroit and a dozen suburbs. Also, separated sewer areas have wet weather flows from footing drains, illegally connected sump pumps, and leakage into the sewers. When there is a day with one inch of rain, wet weather flows can exceed dry weather flows by a factor of 10.

There are three components to the evolving strategy for addressing wet weather flows:

- New contract limits to promote reductions in peak flow.
- DWSD will provide some, but not all capacity for SSO control.
- Development of a regional operations plan to handle high wet weather flows.

In addition, DWSD is working to provide its suburban customer communities with a series of recommended minimum practices for sewer system maintenance to cover the approximately 8,770 miles of sewer owned by the suburban customers.

Review of projected flows in the system leads to the following conclusions:

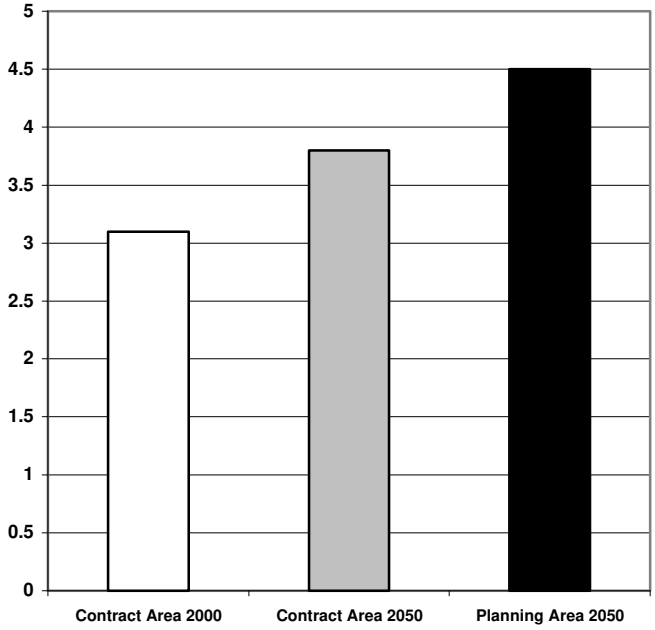
- Reducing I/ I by 50 MGD amounts to creating enough capacity to service the growth expected in the planning area. Put another way, growth is not expected to exceed the capacity of the system.
- Much of the "efficient" reduction in infiltration/ inflow must come from parts of the system not owned by DWSD—including private property. This private property work would include enforcing existing ordinances, time of sale inspection of service connections, and financial assistance with footing drain disconnections.
- Wet weather flow control must be shared by the communities and DWSD. Communities must cooperate for flow management to succeed.

2.3 Planning for Growth

Growth within the existing service area of the DWSD customer communities should be distinguished from growth outside of that area.

Today, DWSD provides service to slightly more than 3 million people. DWSD has contracts with suburban communities to serve areas that in 50 years could total 3.4 million people. For comparison, the population in and around the DWSD service area is expected to be about 4.3 million in 50 years.

Figure 2.3: Estimated Population Projections



The Master Plan addressed the question: How many of the 4.3 million persons will be DWSD customers in 50 years?

This question was addressed by taking a watershed management approach to delineating the planning area. The growing importance of watershed-based decision-making to guide water quality protection is recognized in the Master Plan. For example, SEMCOG's regional water quality plan for Southeast Michigan emphasizes watershed management.

The emerging Wastewater Master Plan is based on the following premises:

- DWSD is not planning to provide sewer service to all of the planning area. The planning area already includes customers of more than 22 other major wastewater treatment providers, numerous smaller decentralized treatment systems, and about 133,600 homes with on-site sewage disposal systems.

- DWSD, through the Master Plan, is defining its role as the major regional service provider in the watershed. DWSD will work in cooperation with other providers to protect water quality in the three watersheds.
- Following the watershed management approach, it is important to recognize that a healthy watershed has a combination of sewered areas, decentralized treatment, and on-site sewage disposal systems.

The issues of growth and changing land use are of critical importance to this region. There are wide ranging perspectives and expectations about what DWSD's role was and should be in responding to expected growth in the region. DWSD's service priorities can be summarized as follows:

- DWSD should serve existing customers first. The first priority of DWSD under this Master Plan is to make cost-effective improvements and I/ I reduction geared toward meeting the current and future needs of existing customers.
- If circumstances merit, and based on cooperation with other service providers, new customer communities will be able to join the regional system.
- The second priority of DWSD under this Master Plan will be to continue to reduce excessive infiltration and inflow in the system to provide capacity for new customer flows. DWSD plans to create 50 mgd of new capacity by reducing excessive infiltration/ inflow.

Regarding new flows in the regional system, DWSD should not take any role in deciding whether or not growth should occur in a certain community or how land should be used. These are decisions best left to local governments. However, DWSD's role is to work with customers and community groups to define the conditions under which it will provide service, and to develop expectations of customer communities that are consistent with good management practices.

Using SEMCOG's regional 208 plan as a starting point, community practices can be discussed. One example: Has the community adequately identified its sewer-related needs and are those needs consistent with its master plan and zoning? Customer communities that are able to answer this question with a "yes" are helping assure that the regional components of the system are efficiently designed, maintained, and financed.

DWSD intends to work in cooperation with local governments, assuring that zoning and master planning are consistent, and that they match the level of service needed from DWSD.

Community input from the Water Quality Consortium and other groups is needed to:

- Identify and discuss the types of good management practices DWSD might ask of its customer communities.
- Build and maintain support for coordinating and integrating plans with other service providers in the region.

2.4 Flow Management

Historically, fixes to infrastructure, be it roads or sewers, often took the form of enlarging the system—simply making it bigger. However, experience with flow management programs has shown that by managing the flow in the system, the desired level of service can be achieved at less cost than building new facilities. Flow management includes the effort to keep water out of the pipes in the first place, but also includes a number of other techniques for managing the way water moves through those pipes from the various parts of the system, all the way to the treatment plant on Jefferson.

In investigating flow management opportunities, a four-prong strategy should be adopted:

- DWSD should set out its expectations of customer communities, such as not building new sewers unless the community can pay for and

maintain them (from SEMCOG's 208 Plan).

- DWSD should revise its contracts to improve equity in contract limits and enforce limits where some communities are now exceeding their contract capacities.
- DWSD should rehabilitate its own sewers to reduce excessive dry weather flows.
- DWSD should provide technical assistance to customer communities to help them reduce SSOs through such techniques as removing footing drains, performing infiltration/ inflow studies, and developing ordinances for inspection and rehabilitation of service connections.

The goal of these strategies is to reduce excessive infiltration/ inflow by 50 mgd within the next 20 years.

An analysis of records and new inspections has shown that most of the 3,383 miles of DWSD-owned pipeline are in good to excellent condition. However, over 88 percent of Detroit's pipelines are more than 50 years old. As part of preparing for the future, the aging pipeline networks need to receive a systematic inspection, condition assessment, and rehabilitation program. The DWSD pipeline rehabilitation program, in place since 1981, should be expanded.

The 30-year cost for wastewater infrastructure in the region has been estimated by SEMCOG to range from $14-26 billion. The SEMCOG Infrastructure Report recommends that costs be reduced and revenue increased. Flow management is key to keeping costs down, but to be successful, the cooperation of customer communities and property owners is required.

DWSD cannot prepare and implement its Master Plan in a vacuum. The plan will be implemented efficiently with the cooperation and active participation of the customer communities.

A major tool in implementing the Master Plan will be the adoption of revised sewage disposal agreements by the beginning of 2004. (This is being done through DWSD's Contracts Work Group.) These new agreements will improve equity in contract flow limits based on detailed evaluations of community needs.

A second major tool in implementing the Master Plan will be through coordination with the areawide 208 plan.

Customer community input is critical. Therefore, a third major tool in implementing the Master Plan will be through the continued participation of customer communities in technical working groups and a steering committee. Customer working groups have been extremely effective in developing plans for SSO control, the regional operations plan, new contracts, and for communicating information on rates.

Regional cooperation is the key to meeting the Master Plan and policy goals outlined in this summary.

The theme of this Master Plan is to manage flows, improve efficiency, and rehabilitate existing infrastructure, rather than add major new facilities. Future growth can be accommodated with a flow management strategy and enhanced efficiency. The following sections of the report present the implementation plan to achieve the goals of flow management, infrastructure renewal, and enhanced customer service and efficiency.

3. Proposed Programs and Methodology

3.1 Wastewater Master Plan Program Definition

The recommended programs to carry out the findings of the Wastewater Master Plan, as described in Chapter 2, are listed in Table 3.1 on the following page. The proposed programs are divided into two categories, described as follows:

- Capital Improvement Programs: These are recommended programs for infrastructure work traditionally included in a capital improvement program, covering all components of the existing wastewater plant and collection system. These program descriptions first summarize the current plans for infrastructure improvements, and then identify additional improvements that need to be made to the system as a result of the Master Plan analysis of the system operation. Most of these programs will be covered under DWSD's Capital Improvement Program. Some work may be considered operations and maintenance work and may be moved to that category, at the discretion of DWSD.
- Management Programs: This category includes: 1) new programs proposed to implement the recommendations of the Wastewater Master Plan, and 2) improvements and additions to existing programs already underway. The existing programs are currently included mainly in DWSD's operating budget, with some special projects included in the Capital Improvement Program.

The proposed Master Plan programs outlined in Table 3-1 differ from the five current categories in the DWSD Capital Improvement Program. The current CIP categories are as follows:

- Wastewater Treatment Plant
- Sewer Interceptor System
- Combined Sewer System (including all programs in the Long Term CSO Control Plan, which covers pump stations, regulators, collection system work, etc.)
- Lateral Sewer Replacement
- Planning/ Administration

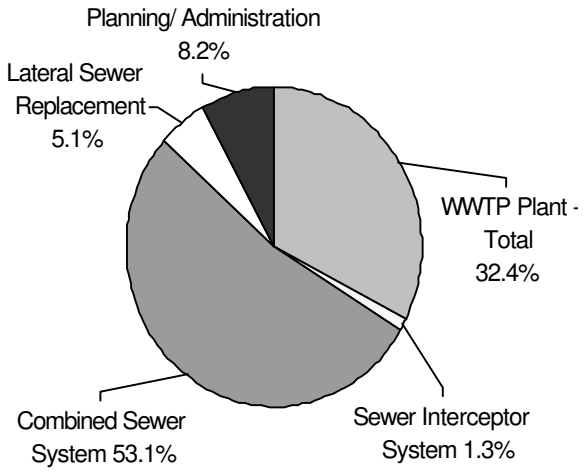
A different organization has been developed because of the wide variety of efforts needed to effectively achieve the master planning goals of flow management, enhanced customer service, and improved efficiency.

The goals of each program, the recommended schedule, and plan for implementation are described Chapters 4 through 9 of this Volume.

3.2 Current and Proposed CIP Expenditures

The proposed five-year FY 2002-03 through fiscal year 2006-07 CIP (based on the draft issued 11/ 21/ 02) totals $2.713 billion and is distributed according to the standard CIP categories as shown

Figure 3.1: DWSD 5-Year Proposed Capital Expenditures



2002-2007 CIP Total Expenditures

Table 1: Wastewater Master Plan Capital Improvement and Management Programs

Capital Improvement Programs:

SEWER INFRASTRUCTURE PROGRAM

- Lateral and Connector Sewer Cleaning, Sediment Disposal, and Condition Assessment
- Interceptor and Trunk Sewer Cleaning, Sediment Disposal, and Condition Assesssment
- Lateral and Connector Sewer Improvements
- Interceptor and Trunk Sewer Improvements
- Manhole and Catch Basin Improvements
- Regulators, Outfalls, Backwater Gates, and In-System Storage
- Pump Stations
- Meters and Billing

CSO and SSO PROGRAM

- CSO Control
- SSO Control

WASTEWATER TREATMENT PLANT AND OTHER FACILITIES

- Liquid Train Facilities
- Biosolids Train Facilities
- Regional Operations Plan and SCADA
- Buildings and Grounds

Management Programs:

ENVIRONMENTAL PROTECTION PROGRAM

- Regulatory Compliance and Monitoring
- Industrial Pretreatment Program and Septage Management
- Flow and Watershed Management
- Facilities on Private Property

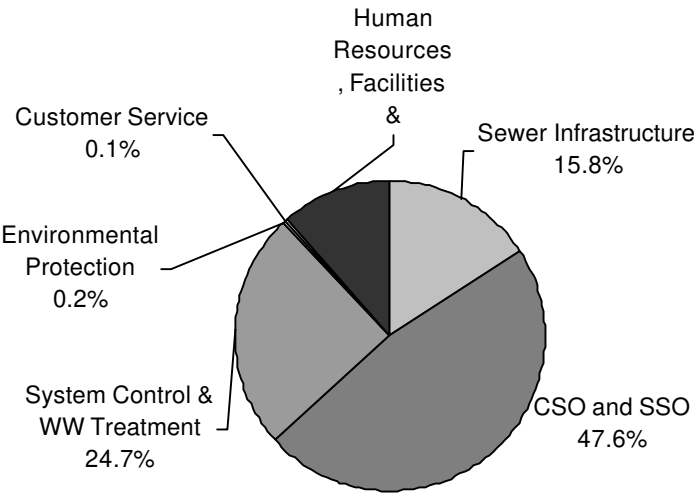
CUSTOMER SERVICE PROGRAM

- Steering Committee and Work Groups
- Customer Liaison
- Compliance and Enforcement
- Facilities and Service Area Expansion
- Public Outreach and Information

HUMAN RESOURCES & TECHNOLOGY PROGRAM

- GIS and Computer Systems
- Asset and Financial Management
- Energy Management
- Emergency Preparedness
- Performance Management and HRIS (Human Resources Information Systems)
- Staff Development and Recruiting
- Labor Relations

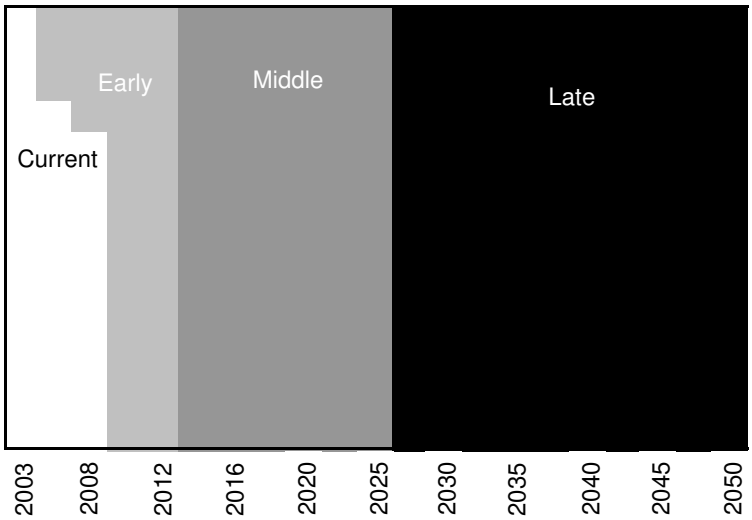
Figure 3.2: Current DWSD CIP Expenditures by Proposed Master Plan Categories



in Figure 3.1.

The proposed expenditures in the current 2002-07 CIP were redistributed to the Wastewater Master Plan proposed programs to give a complete picture of current DWSD expenditures in each area. Figure 3.2 shows the total current distribution of proposed expenditures. Complete lists of current CIP projects, allocated as described to the proposed Master Plan programs, are compiled in Appendix A on the CD that accompanies this report.

Figure 3.3: Theoretical DWSD Program Expenditures over the 50-Year Master Planning Period



The relationship between the current CIP and the programs described in the Wastewater Master Plan is conceptually shown in Figure 3.3. The current 2002-07 CIP projects are integrated into the Master Plan 50-Year CIP in the early years of the program.

3.3 Capital Improvement and Management Program Development Assumptions

The general approach to developing costs for the infrastructure programs is as follows:

1. Estimated costs for each project were determined using the cost information sources described in section 3.3.1. All costs are stated in 2003 dollars, based on a Construction Cost Index of 6698. Costs from reports done in the past have been adjusted to 2003 dollars. Projected cost escalation factors for future years are presented in section 3.3.2 for calculation of theoretical future costs but are not used in presentation of program costs or rate modeling. (Rate projections are based on a 3 percent assumed inflation factor.)

2. The schedule for each project was determined based on the general program goals, as described in this report. A key factor in determining the schedule was the infrastructure inspection, rehabilitation, and replacement intervals described in section 3.3.3.

3. As these are planning level estimates, the total cost is always rounded to the nearest $1,000. This level of rounding is standard for DWSD five-year CIP development. For program costs without precise unit quantities and costs, the level of rounding will be higher — generally to the nearest $10,000 to $100,000.

4. Projects costs are summed for each year from 2003 to 2050.

5. For rate modeling, projects will be categorized

by beneficiary, by year, as follows:

Projects "common to all," i.e. charged to all customers

- City of Detroit only projects
- Oakland County only projects
- Macomb County only projects
- Wayne County only projects
- CSO projects (cost is split 83 percent Detroit, 17 percent suburban)
- Other first-tier customers project (special projects for individual customers)

3.3.1 Cost Information and Unit Prices

The following sources of information were used to develop the unit prices and cost estimates in the CIP:

1. Unit costs for new sewer construction, sewer rehabilitation, cleaning and new manhole construction were obtained from the Wastewater Master Plan technical memorandum *Basis of Cost Estimates.* The costs in this technical memorandum were derived from a review of historical construction costs from several engineering studies done in the Detroit metro area.

2. Cost estimates from major existing programs were used where relevant. Examples of these reports include:

Needs Assessment Study, Revision 3, November 15, 2002, developed for PC-744 (Wastewater Treatment Plant Upgrade)

Asset Audit, December 2001, developed for PC-744 (Wastewater Treatment Plant Upgrade)

Long Term CSO Control Plan, CS-1281, 1996

Update to the Long Term CSO Control Plan, November 2001

DWSD Proposed 2003-2007 CIP, version dated 11/ 21/ 02

3. Additional cost information was obtained from other sources, such as articles and reports on wastewater programs in other cities. The sources of these costs are shown on the project worksheets in Appendix A of the *Capital Improvement Program* technical memorandum. The multipliers associated with 1) contractor overhead and profit, 2) contingency, and 3) engineering, legal, administrative and management costs are described in the technical memorandum *Basis of Cost Estimates*.

3.3.2 Cost Escalation

Historical construction costs were adjusted to 2003 costs as described in the technical memorandum *Basis of Cost Estimates*. An inflation factor of 3 percent is assumed for rate modeling.

3.3.3 Infrastructure Inspection, Rehabilitation, Replacement Intervals

There are three categories of expenditures to be considered in a master plan:

- New projects proposed to improve the system or to address increases in service area or projected flows.
- Rehabilitation and replacement of existing system components.
- Annual O&M costs for labor, energy, chemicals, supplies, and outside services to operate and maintain the system.

A key assumption in determining costs for the second category is the interval assumed for inspection, rehabilitation, and replacement. In the development of the CIP, assumptions on how many components will require rehabilitation and replacement during specific time periods have to be made to calculate an overall cost. The details of these assumptions can be found in the technical memorandum *Capital Improvement Program*.

Before developing the CIP, a number or sources, which included recommended inspection, rehabilitation and replacement intervals, were investi-

gated. Table 3.2 shows the recommended intervals based on these sources. These estimates were derived from review of a number of sources:

- Depreciation schedules for wastewater system by asset class used for rate analysis, Black and Veatch, 2002
- Property, plant and equipment depreciation schedules, *City of Detroit Sewage Disposal Fund Financial Statement*, June 30, 2001, and 2002.
- EPA Report: *Clean Water and Drinking Water Infrastructure Gap Analysis*, EPA Office of Water, September 2002
- Wastewater Master Plan technical memorandum *Review of Collection System Regulators and Outfalls*
- Information from the Government Accounting Standards Board on depreciation standards used by state and local governments now adopting the GASB-34 accounting standard.

The information obtained from these sources is listed under *Resource Information for Useful Life Estimates* in Appendix A on the CD, which accompanies this report.

The system component or asset life is considered in the Capital Improvement and Management Program development for three reasons:

- It provides a rational basis for master planning decisions on future projects that must be completed to keep the system operating, even when expansion of the system is not contemplated.
- Maintenance, rehabilitation, and scheduled replacement have been shown through many utility management studies to be more fiscally sound than waiting until more costly emergency repairs are required.
- The new requirements of the GASB-34 accounting standard will require estimating the depreciation of the system or a modified approach requiring a full asset management program (see Section 1.1 for a description of GASB-34, and the Asset/ Financial Management Program Description). In either case, the new standard's goal is to make more transparent the level of "consumption" of infrastructure assets.

Actual application and implementation of the recommended intervals, particularly for rehabilitation and replacement, will vary with the actual condition of the infrastructure component inspected. In the development of the CIP, assumptions on how many components will require rehabilitation and replacement have to be made to calculate an overall cost.

Table 3.2: Inspection, Rehabilitation, and Replacement Intervals Compiled From Various Sources (years*)

Asset Type	Inspect	Rehab	Replace
Buildings	10	20	60
Process Units	1	5	20
Mechanical	1	5	20
Pumps	1	3	15
Meters	1	5	20
Flow Regulators	5	15	30
Outfalls	5	50	150
Backwater Gates	1	10	50
Outfall Diversion Dams	1	10	50
In-System Storage Devices & In-System Gates	1	10	30
Interceptors**	20	50	150
Trunk**	20	50	150
Connectors**	20	50	150
Laterals**	20	50	150
Manholes**	20	50	150
Catch Basins**	3	20	150
Useful Life of rehabbed Pipe			50

*Intervals used for cost estimates for this Master Plan. Actual inspection/ rehab results may yield longer or shorter intervals for particular facilities

** Life of these items are 150 years unless inspection information shows urgent need.

3.4 O&M Cost Development Assumptions

The audited O&M expenses for the past three years have been reported as shown in Table 3.3.

The operation and maintenance costs for the DWSD system are estimated each year based on past expenditures and the projected budget. The expenditures for O&M have been estimated and are shown in Table 3.4 for the development of the fiscal year 2003-04 rates.

Using the projected 2003-24 estimate, and the 2001 average wastewater flow of 724 MGD, the average O&M cost is about $818 per million gallons of wastewater treated.

Table 3.4 Major Category of O&M for Rates Determination (fiscal year 2003-04)

	Amount	%
Sewage Treatment Plant	$111,488,713	58.8
Sewer System Maintenance	$10,590,087	5.6
Pump Stations	$4,483,294	2.4
Interceptors	$793,618	0.4
New Wet Weather Facilities	$610,460	0.3
Commercial & Meter Operations	$10,696,354	5.6
Industrial Waste Control	$13,104,332	6.9
Administrative & General	$34,892,402	18.4
Engineering	$3,066,827	1.6
Total	$189,726,087	100.0

3.5 Management Program Development Assumptions

Program 4 (Environmental Protection Program) is described in detail in this report. Much of this program is already included in the DWSD operations and maintenance budget. There are some new programs described in this report that will require additional funds, estimated at $9 million per year.

Programs 5 (Customer Service) and Program 6 (Human Resources and Technology Program) are addressed further in Volume 5 of this Master Plan, *Customer Service Program.*

Table 3.3: DWSD O&M Expenses from Audited Financial Reports (2000 through 2002)

	2000	2001	2002	Average	%
Sewage Treatment Plant	$98,660,787	$110,205,698	$105,202,432	$104,689,639	61.30
Sewer Maintenance and Engineering	$22,950,022	$19,185,922	$17,933,381	$20,023,108	11.73
Pump Stations	$4,983,751	$2,871,539	$3,099,200	$3,651,497	2.14
Interceptors and Regulators	$26,814	$35,019	$157,951	$73,261	0.04
CSO Control Basins	$58,773	$597,063	$350,640	$335,492	0.20
Commercial	$4,453,169	$4,487,359	$5,071,329	$4,670,619	2.73
Administrative & General	$29,715,325	$34,900,655	$47,369,937	$37,328,639	21.86
Total	$160,848,641	$172,283,255	$179,184,870	$170,772,255	100.00

4. Sewer Infrastructure

4.1 Lateral & Connector Sewer Cleaning, Sediment Disposal & Condition Assessment

4.1.1 Condition Assessment

Needs

To gauge the extent of sewer rehabilitation required for a particular segment of sewer, a condition assessment, or an inspection is necessary. Regular inspection of sewers, particularly in problem areas, is an essential part of an ongoing collection system maintenance program.

New standards such as the CSO (combined sewer overflow) minimum controls, proposed CMOM (capacity, management, operations, and maintenance) regulations and the new GASB-34 accounting standard recommend compiling an inventory of all capital assets and their condition, including sewer systems. The city should therefore inspect and assess all sewer lines, not just for rehabilitation scheduling, but also for asset estimation. The sewer condition assessment program can help in drawing up an inventory of all sewer lines and other facilities.

For contracted work, the cost of TV inspections could be unnecessarily high if the scope of the work is unknown. With little or no knowledge of existing conditions, contractors may increase the cost of inspection. Specifications for TV inspection should be based on time and materials, rather than lump sum. The city should appoint an inspector to ensure the city's best interests are complied with.

All the information gathered during the condition assessment program is compiled to set priorities for the maintenance and rehabilitation activities.

Scope/Magnitude in 2002/3 and Projections to 2050

Detroit sewers total approximately 3,383 miles, and are comprised of seven different materials. About 2,950 miles is over 50 years old, and of this, five miles may have been inspected in the last year. Based on the pilot lateral sewer TV inspection report conducted for the Wastewater Master Plan, approximately 80 percent of the 23,500 feet of pipe inspected contained significant sediment deposits, debris buildup, root infestation and deterioration of pipe integrity. According to DWSD records, about 70 miles of sewer per year are inspected by walk-through, and about 60 miles per year are cleaned and televised. DWSD has 31 Vactor trucks manned by crews of three people to clean and televise existing sewers.

Technologies Available

To accurately assess a sewer pipe, the sewer line must be clean enough to allow passage of a mobile camera. When sediment buildup is to the point where the camera cannot pass, sewer jetting with Vactor or bucket for removal of debris should be used to clear it out.

A closed circuit TV (CCTV) attached to a mobile camera is the most widely used technology to perform sewer inspections. Lateral and connector sewers are inspected by running a TV camera down the sewer to check for pipe conditions, sediment volume and other anomalies that could affect sewer rehabilitation.

Table 4.1 lists the common technologies for performing a condition assessment on small sewers.

Criteria for Implementation

According to the Optimization of Collection System Maintenance Frequencies and System Performance report (ASCE, Feb. 1999) other large utilities in the U.S. typically inspect 2-6 percent of their sewer per year. Currently, DWSD inspects an average of 70 miles per year and 60 miles per year through contracting.

Condition assessment of sewers should be schedule in a specific area, such as a neighborhood or

Table 4.1: Common Technologies for Condition Assessment of Sewers

Method	Application
Smoke Testing	Most common source detection method to identify I/I. Source detection after previous lining or replacement.
Dye Testing	Used after smoke testing to confirm suspected storm drainage connections.
Building Plumbing Inspection	As-needed after smoke testing to confirm suspected inflow sources such as roof leaders and foundation drains
Manhole Inspection	Primary source detection to evaluate I/I sources and structural conditions. Investigation performed along with other investigation procedures.
Flow Isolation	Follow-up source detection after sealing; used where flow monitoring indicates high infiltration in large areas.
TV Inspection	Primary internal inspection technique for sewer system evaluation, used to verify smoke testing, flow isolation or when temporary flow monitoring indicates excessive I/I. Used after grouting and sealing techniques.

sewer district, to minimize travel time and cost. The program must be conducted in conjunction with cleaning of the sewers.

Operational & Financial Benefits

Methodical documentation of current status of pipes provides critical information in developing a program for orderly repair, rehabilitation and replacement of sewers. The cost of preventive maintenance is significantly less than repairs made during emergency conditions. Because the collection system condition has not been documented on a regular basis, DWSD has no program for maintenance and is solely addressing emergency customer complaints. These circumstances may have been prevented if the sewers been assessed and maintained. The longer the system is neglected, the faster the pipes will deteriorate. Also, the number of complaint calls because of blocked sewers and basement flooding will continue to increase.

Current Expenditures

There are currently two projects under way: CS-1325, Inspection and Rehabilitation of Existing Circular Sewers at a cost of $4,111,000 and CS-1368, Inspection and Rehabilitation of Existing Circular Sewers and Non-Circular Sewers at a cost of $55,342,000 until 2005. There are no new projects scheduled to begin within the next five years.

General Recommendations

Sewer pipes should be proactively inspected every 20 years as preventive maintenance. Current TV inspections are based on the number of complaints received at DWSD. These complaints should be logged in a map-based GIS system so that problem areas in the city can be readily identified. Potential problem areas could also be identified by collecting data on the sewer inspected, such as the type of pipe, size, bedding material, and date of installation. From this data, certain areas of the city and types of pipe can be identified as likely candidates for inspection.

Computer Maintenance and Management System (CMMS) programs are also available specifically for collection systems, for scheduling and tracking inspections and improvements. There are further details on this in Volume 5 of this Master Plan, *Customer Service Program*.

4.1.2 Sewer Cleaning

Needs

Continuous uninterrupted sewer service must be provided to the customers in the service area. A strong program for collection system maintenance and rehabilitation must be in place. The system must perform adequately to accomplish these goals. System performance is difficult to quantify

because there are so many variables in the collection system. Proper maintenance can support an acceptable level of system performance. Based upon records investigated and results from the current TV pilot inspection program, "cleaning/ jetting" and root cutting are the two most important maintenance issues.

Thorough cleaning is required before sewers can be assessed. Therefore, a cleaning program is always part of the TV inspection program. Cleaning can also be conducted as a separate maintenance program. Lateral and connector sewers are relatively small and require a separate cleaning and condition assessment method.

Scope/Magnitude in 2002-03 and Projections to 2050

Based on previous sewer inspections and the current pilot TV inspection program, many of the lateral sewers are filled with solids and debris. The most significant obstruction to completing TV inspection was the presence of moderate to heavy root infestation. Tree roots grow into the sewer seeking moisture. Their growth is accelerated by the nutrients found in the wastewater. The roots enter the sewer through cracks, separations at pipe joints, and defective service connections.

The DWSD sewer system has 2,258 miles of lateral sewers and 559 miles of connector sewers, most of which are over 50 years old. Almost all of these pipes will have to be inspected, rehabilitated or replaced by 2050.

The following steps are required for cleaning:

- Clean all sewer lines by appropriate means and with proper equipment immediately prior to internal inspection or velocity measurement.
- Determine, if possible, all obstructions or other physical alignment, joint or connection conditions, which could interfere with or prevent the insertion, movement and detection range of inspection equipment.

Technologies Available

Sewer pipes can be cleaned and restored to 99 percent of their original capacity. Sewer cleaning usually consists of flushing the sewer with high velocity water and vacuum-pumping the sediment to a truck.

- **Step Jetting:** This cleaning method is currently being used by DWSD. This process requires taking short sewer lengths and repeatedly cleaning and vacuuming small portions at a time. With repeated jetting and vacuuming, this will allow stubborn sediment to break up.
- **High Pressure Jetting:** A high-pressured hose fitted with a steel jet nozzle is introduced into the sewer and water pressure of up to 2,000 psi is injected to drive the hose up the sewer against the flow. The center hole in the nozzle breaks up accumulation in front of the hose to allow for easy passage. When the hose is withdrawn, water jets flush the sewer clean. Light materials are flushed down the line and heavy materials are deposited in the manhole for removal with a Vactor truck.
- **Jigawon Cleaning:** Presented at the WEFTEC 2001 Collection System conference, this method uses a flow-restricting device and the existing sewer flow to create turbulence within the pipe, moving the sediment downstream to where it can be removed.
- **Root Removal:** When roots have penetrated the pipeline, they are generally removed by mechanical or chemical means. Typically a sewer rod or an auger tool may remove the roots by sawing them out. This is an immediate corrective method, but it does not address the long-term issues, as the roots will grow back. Herbicide or chemical treatments are generally applied by flood treatment (soaking), spraying, or foaming. Foam herbicides and chemical grouts are increasingly popular methods for root control, as they are relatively easy to apply and ef-

fective in root intrusion.

- **Flushing:** The concept is to induce an unsteady wave by either rapidly adding external water or creating a "dam break" effect by quick opening a restraining gate. The aim is to re-suspend, scour and transport sediments to the sewage treatment plant during dry weather and/ or displace sediments in the upper reaches of the collection systems closer to the system outlet. Manual flushing methods usually involve discharge from a quick-opening valve to introduce a heavy flow of water into the line at the manhole. Flushing removes floatable solids and some sand and grit, but is not effective for removing heavy solids.

Criteria for Implementation

Target cleaning goals are shown in Table 4.2. Data was obtained from *Optimization of Collection System Maintenance Frequencies and System Performance* (ASCE, Feb 1999). Cleaning is necessary to the extent that a mounted TV camera can pass through with ease and can inspect the pipe walls for cracks, infiltration and other defects.

Table 4.2: Target Goals on 5-year Average (1992-96)

Type	Size of System	Criteria
Cleaning	Central	0.22 mile/miles system- yr = 638 miles/yr
	Large Systems	0.27 miles/miles system-yr = 738 miles/yr
	Overall	0.3 miles/miles system-yr = 870 miles/yr
Root Removal	Central	0.02 miles/mile system-yr = 58 miles/yr
	Large Systems	0.04 mile/mile system-yr = 116 miles/yr
	Overall	0.04 mile/mile system-yr = 116 miles/yr
TV Inspection	20-yr Average	2% per year = 58 miles/yr
	5-yr Average	6% per year = 174 miles/yr

Operational & Financial Benefits

Without proper cleaning, costs of repair and emergency repairs will increase. Regular cleaning and preventive maintenance costs are significantly less expensive than those made during emergency conditions. Because the collection system has not been cleaned on a regular basis, the sediments in the pipes hardened and this neglect promoted heavy root infestation. These circumstances may have been prevented had regular cleaning been maintained. The longer the system is neglected, the faster the pipes will deteriorate and the number of complaint calls for blocked sewers and basement flooding will continue to increase.

Current Expenditures

There are currently two projects under way: CS-1325, Inspection & In-place Rehabilitation of Existing Circular Sewers and CS-1368, Inspection & In-place Rehabilitation of Existing Circular and Non-Circular Sewers. The amount being spent for both projects is $59,453,000. This cost includes cleaning of sewers prior to lining. See Appendix A on the CD that accompanies this report.

General Recommendations

A cleaning program should be based on the number of complaints reported for each area of the city, and concentrate first on areas of the city with known problems. A cleaning program should be implemented in conjunction with the condition-assessment program. To reduce travel time, the sewer districts with the greatest need for sewer cleaning should be targeted first, and cleaning activities concentrated in one area.

Each cleaned sewer and its inspected condition should be logged in a database and mapping system. Following the preliminary cleaning program, a maintenance program should be developed where sewers will be inspected/ cleaned regularly based on selected criteria, such as the type of

sewer, age, bedding soils, etc. The cleaning interval should be based on the sediment buildup i.e., sewers with high sedimentation should be cleaned more frequently. (However, sewers with high sedimentation rates should also be examined for other problems, such as cracks, settling, poor slope, etc., that may indicate if replacement is needed.) In general, lateral and connector sewers should be inspected at a minimum of 10-15 year intervals.

Cleaning performed by DWSD maintenance crews is dependent on the availability of cleaning equipments and crews. Notification of area residents is often required.

An effective root control method is to first mechanically cut the roots and then apply a foaming method to kill the roots. It is also necessary to prohibit planting trees and plants near sewer pipe right-of-ways and minimize root infestation.

4.1.3 Sediment Disposal

Needs

Sediment buildup in the DWSD sewer system is attributed to: flat sewers; dips in the sewer pipe failing to maintain a grade line; open storm covers on manholes and catch basins bringing in surface sediment; solid obstructions like debris and roots creating natural dams; and presence of light loam and sandy soil offering sediment infiltration and developing voids in the pipe network.

Sewer cleaning will result in a significant annual volume of sediment needing disposal. Some sediment may have trace residues of mercury and polychlorinated biphenyls (PCB) that are classified as hazardous waste as shown in the report *PCB/Mercury Minimization Program*. Proper disposal of this sediment must be carefully planned to avoid:

- Overloading the wastewater treatment plant or local sewers;
- Permit violations at the wastewater treatment plant due to residues of contaminants in the sediment;
- Penalties to the City for improper disposal of hazardous materials;
- Inefficiencies in handling, trucking and disposal costs.

Inappropriate disposal of sediments, especially hazardous wastes, may result in environmental fines. Further investigation is necessary to understand the proper procedure, permits required, and locations for sediment/ sludge disposal. Current sewer cleaning and televising costs may be reduced, or at least accurately estimated, if a designated disposal site is available for contractors.

Scope/Magnitude in 2002/3 and Projections to 2050

CDM inspected 23,500 feet of lateral sewers as part of a pilot TV inspection program. The inspection showed that almost 11,000 feet contained sediments and required heavy cleaning with over 30 cubic yards of solids removed by vacuum pumping. Based on this sample, the solids buildup in the lateral and connector sewers could be as much as 15,000 to 20,000 cubic yards.

The impact on WWTP discharges needs to be considered also. Even low concentrations of mercury and PCBs could result in discharge violations if the timing and volume of the sediment disposal is not considered. Also, successful flushing of sediment into the sewer system or disposal directly at the WWTP could significantly increase total solids load at the plant. Currently, the sediment is being disposed of at the Huber Central Facility.

Technologies Available

Disposal of the sediment will depend on whether the sediment is hazardous or non-hazardous. An estimated 50-55 cubic yards of sediment per mile of pipe is present. Hazardous presence can only be determined by collecting the sediment from cleaning and retaining it in a holding tank where

batch samples can be collected. A facility could be built at the Central/ Huber Facility consisting of several concrete holding cells. Sediment could be deposited from each location into a cell. Laboratory tests done on the samples could check for total suspended solids (TSS), volatile suspended solids (VSS), and for contaminants at hazardous levels, such as PCBs and mercury. Once the holding tank sediment is classified, it can be disposed of by one of the following methods:

- Non-hazardous disposal in the collection system: To avoid trucking/ hauling sediment, segments of sewer could be flushed sequentially to direct the sediment to the wastewater treatment plant. This is the least costly option. However, the impact on the wastewater treatment plant operations and discharge limits would have to be considered. Also, if sediment is disposed of in upstream interceptors, potential buildup of sediment in those locations needs to be considered.
- Non-hazardous landfilling: Trucking of the sediment to a landfill would require that the sediment pass the paint filter test and toxicity characteristic leaching procedure (TCLP). No free liquids are allowed to be landfilled. The sediment may have to be dewatered or stabilized before landfilling.
- Hazardous waste disposal: Sediment that has high contaminant levels will need to be disposed of at a certified hazardous waste landfill. The Environmental Quality in Wayne County is one such landfill.

Criteria for Implementation

A disposal program is necessary because the sewer cleaning will continue and expand. This program is therefore tied directly to the cleaning program. Sampling and analysis of the sediments/ sludges are required to determine the nature of the material that is collecting in the sewer system. Information on the nature of this material is not currently available. The sediment will be classified as non-hazardous waste and fall under RCRA regulations if levels of PCBs are below 50 ppm. If above 50 ppm, then it would be regulated as hazardous waste under TSCA.

Operational & Financial Benefits

A *PCB/Hg Remedial Design Report* was submitted to DEQ in 1995. The report concludes that there are no disposal practices being followed. If the wastewater treatment plant discharges exceed the NPDES limits, the plant might face serious violation fees and penalties.

Current Expenditures

Current disposal costs are included in the current cleaning/ televising contracts, based on disposal in the sewer system (deposited at Huber Facility).

General Recommendations

The current practice of disposing sediments is on a case-by-case basis and should not be continued because of the potential liability involved and unknown impact on the wastewater treatment plant and collection system. It may also be indirectly increasing the contract costs for cleaning, inspecting, and lining sewers, as contractors have to arrange for disposal. DWSD needs to negotiate a disposal contract with landfills.

DWSD should undertake a program to determine the nature of the sludge/ sediment in the system by conducting a pilot sampling program. This could be done by DWSD staff utilizing the WWTP laboratory to analyze the sediment samples, or could be done by a separate consulting contract using an outside laboratory. Several locations should be selected for sampling and the results compiled in a report.

After the study is completed, the final method of disposal should be selected based on the results. If the sediments are found to be non-hazardous and can be disposed of in the sewer system or WWTP, then appropriate locations for disposal should be determined.

4.2 Interceptor & Trunk Sewer Cleaning, Sediment Disposal & Condition Assessment

4.2.1 Condition Assessment

Needs

Assessment of the sewer conditions consists of inspections to determine the infiltration/ inflow condition. Structural conditions are investigated through internal inspections. Internal inspections are commonly performed through four methods, physical inspection, photographic inspection, closed circuit TV inspection (CCTV) and geotechnical inspection.

CSO (combined sewer overflow) minimum controls, proposed CMOM (capacity, management, operations, and maintenance) regulations and the new GASB-34 accounting standard recommend inspection and maintenance of all capital assets including interceptors and trunk sewers. The city should therefore inspect and assess all sewer lines, not just for rehabilitation scheduling, but also for asset estimation. The condition assessment program can help in drawing up an inventory of all sewer lines and other facilities.

Due to the age of the major interceptors and trunk sewers, many are in need of geotechnical investigation. Sewers with cracks and misaligned joints are exposed to the ground through which groundwater can infiltrate into the sewer system and erode the surrounding soil. This can leave voids and unstabilized soil that can jeopardize soil foundations and deteriorate the sewers rapidly, causing sinkholes and depressions on the surface.

Scope/Magnitude in 2002/3 and Projections to 2050

There are 83 miles of interceptors and 483 miles of trunk sewers in the DWSD collection system. Very few have been assessed except for the four miles that were prepared for lining in the Romeo, 15-Mile Road and Edison Corridor interceptors. The age of the interceptors and trunk sewers is summarized in Table 4.3.

Table 4.3: Age of Sewer Pipes in the DWSD System

	>100 yrs	50-99 yrs	0-50 yrs
Interceptor	0	28 miles	55 miles
Trunk	82	364 miles	37 miles

Technologies Available

Two methods, non-destructive testing (NDT) and ground disturbing methods are used to perform a geotechnical inspection of soil conditions around a sewer pipe. Ground based radar (GBR) or Ground Penetrating Radar (GPR), sonic/ ultrasonic testing are the NDT methods. Soil boring, geo-probing and soil probing are some of the ground disturbing methods.

Interceptor and trunk sewer pipe inspections can be performed with the following methods:

- Physical Inspections: Interceptors and trunk sewers over four feet in diameter are inspected by partial draining and a walk-through inspection. Physical inspection involves directly entering large sewers not in service. Partial draining and a walk-through inspection are necessary to inspect large sewers. In some cases, installation of gates or inflatable dams may be required to divert the flows so that inspections can be performed. Inspection of the 15-Mile Romeo Interceptor required the installation of gates.
- Closed Circuit Television: Photographic inspection utilizes a camera to take a series of color photographs along the inside of sewer lines. CCTV is performed by a camera mounted in a casing and pulled through the sewer with cables. A light source is provided and the camera can record the location of the mounting vehicle inside the sewer as well as document sewer conditions onto videotape.
- Ground Penetrating Radar: GPR systems emit a frequency and reflections from different soil

properties are recorded. The system can be used in the middle of a street, as long as there are no large metal bodies that may cause anomalies and underlying utilities are mapped out. Detroit clay with a thickness greater than two feet will not register. However, the GPR systems can accurately register areas of voids and low-density cavities as small as 1 to 2 feet in size. The system can read as deep as 10 to 15 feet depending on the soil.

- Infrared Thermography: Infrared thermography systems use the transfer of energy (heat) to determine subsurface conditions. This is useful in determining backfill conditions surrounding a pipe that has the least resistance to conduction of energy and has negligible convection effect, as opposed to empty air pockets.

The advantages and obstacles of the above technologies as well as two additional technologies are summarized in Table 4.4.

Table 4.4: Condition Assessment Technologies

Techniques	Advantages	Obstacles for Implementation
Walk-Through	• Capability of thoroughly inspecting and easily classifying sewer defects • Minor repairs can be attended to on the spot • Assessment is more accurate • Cost estimates can be achieved accurately	• Requires taking sewer out of service, which may disrupt service. • Requires Confined Space Entry permits • Requires trained personnel to assess sewers • Assessment may be subjective and vary based on inspectors' experience and training.
CCTV	• Very commonly used, well-known technology • New developments include production of higher quality images, and portable inspection system	• Dependant on skill and experience of technicians • Dependant on the quality of TV picture • Difficult to estimate field production • Does not provide backfill condition information • Inaccuracy in detection of certain pipe defects
Infrared Thermography System	• Large area of inspection • Allows night-time inspection • Detects pipe wall defects and provides backfill information • High field production	• Does not provide information on depth of cracks • Image interpretation depends on environment • Relies on single-sensor data collection
Sonic Distance Measurement Method	• Describes cross-section of pipes • Measures pipe wall deflection, corrosion loss, volume of debris • High field production	• Does not simultaneously records parts of the pipe that are below and above water • Relies on single-sensor data collection
Ground Penetrating Radar	• Provides continuous cross-section profile of pipe walls • Identifies depth of cracks • High field production	• Data interpretation is very difficult; requires experienced technicians
Advanced Systems (KARO, PIRAT, SSET)	• Multi-sensory system provides more reliable data • Provides continuous profile of pipe walls • Robot module • Higher benefit/cost ratio is anticipated	• In the prototypical or testing stage • High initial cost

Criteria for Implementation

All trunk sewers and interceptors should be inspected in the next 10 years to ensure continued functioning of these essential system components. The interceptors and trunk sewers with known structural problems should be inspected first. The Northwest Interceptor and the Detroit River Interceptor are the interceptors that are recommended first for inspection. Known problems with trunk sewers should be listed by DWSD field staff in order to determine which of the trunk sewers should be inspected first.

Operational & Financial Benefits

Methodical documentation of the current status of pipes provides critical information in developing a program to repair, rehabilitate and replace sewers in an orderly fashion. The costs of preventive maintenance are significantly less than those made during emergency conditions. Because the collection system condition has been irregular, DWSD is mainly addressing emergency customer complaints.

As an example, a segment of the Southfield sewer collapsed suddenly. No recent inspections and assessments had been performed. The neglected pipe deteriorated quickly. The cost of replacing this sewer was high and service disruptions in the area were considerable.

Current Expenditures

There are currently no expenditures for assessing interceptors and trunk sewers for the next five years in the capital improvement program. Some interceptor inspection may be funded through operations and maintenance funds.

General Recommendations

It is recommended that all trunk sewers and interceptors be inspected and assessed by 2010. During this inspection, structural problems should be identified and repaired. After 2010, all interceptors and trunk sewers should be inspected on a 20-year cycle. During that time DWSD should inspect and assess 5 percent of the interceptors and trunk sewers per year. It is recommended that the Northwest Interceptor and Detroit River Interceptor be inspected first.

Performance of a more extensive geotechnical condition assessment on a particular segment of sewer should be based upon initial inspection results for the segment. For large sewers, knowing the conditions of the surrounding backfill is important. Therefore Ground Penetrating Radar or Infrared Thermography is recommended.

4.2.2 Interceptor and Trunk Sewer Cleaning

Needs

Preparatory cleaning for large trunk sewers and interceptors is different from the methods used for lateral and connector sewers. Pre-cleaning existing sewers promotes bonding between the lining material and sewer during rehabilitation. Sediment and debris in the invert of the sewer can harm some lining materials, leading to early failure. Cleaning is also required prior to inspection of the interceptors and trunk sewers.

Scope/Magnitude in 2002/3 and Projections to 2050

There are 83 miles of interceptors and 483 miles of trunk sewers in the DWSD collection system. With the exception of about four miles that were prepared for lining the Romeo, 15-Mile Road and Edison Corridor interceptors, the remaining system requires cleaning.

Technologies Available

Interceptors and trunk sewers convey large amounts of flow, which need to be diverted in order to undertake cleaning. This requires a complete understanding of the system through which flow can be diverted or minimized. Using the 15-Mile Road repair as an example, a series of back-

water gates, in-system storage and inflatable dams were used to divert sewer flow.

Interceptors and trunk sewers are large enough for equipment to be brought inside for cleaning. Maintenance personnel can enter the sewer and manually clean the inner walls of the interceptors with pressure jets. Drag-buckets and Vactor trucks can be used in removing sediments.

Criteria for Implementation

In other major metropolitan cities, the target cleaning goals are set between 2 and 12 percent of the total length of sewer (ASCE, 1999). Cleaning is necessary to the extent that a mounted TV camera can pass through with ease and inspect the pipe walls for cracks, infiltration and other defects.

Operational & Financial Benefits

Without proper cleaning, costs of repair and emergency repairs will increase. Regular cleaning and preventive maintenance costs are significantly less expensive than those incurred during emergency conditions.

These large sewers are the only routes that bring wastewater to the treatment plant. If capacity is reduced, the system will backup and overflow through combined sewer outfalls or CSO facilities. In some locations, particularly for trunk sewers, basement flooding may be the result of reduced capacity.

Current Expenditures

There are currently no projects in the fiscal year 2002-2003 CIP for cleaning interceptors and trunk sewers.

General Recommendations

Cleaning of the interceptors and trunk sewers is required before inspection can occur. As condition assessments should be performed on all trunk sewers and interceptors in the next 10 years, cleaning should also be completed in the same time period. After that, cleaning should be performed at periodic intervals (no less than every 10-20 years) based on the accumulation of sediment.

4.2.3 Sediment Disposal

Needs

The need for sediment disposal from interceptor and trunk sewers is similar to that for lateral and connector sewers, as described in Section 4.1.3.

Scope/Magnitude in 2002-03 and Projections to 2050

Sediment or sludge deposition has been found in large sewers. Based on DWSD sewer interceptor and trunk sewer profiles, an estimated 75,000 feet of interceptor and trunk sewer have the possibility of sludge present with almost 22,000 cubic yards of sludge confirmed.

Table 4.5 lists the trunk sewers and interceptors that were estimated to have sludge. This list was compiled from DWSD records of inspection until 2001. The volume of sludge present is an estimate based on these records.

The impact on WWTP discharges needs to be considered in disposing of the solids. Even low concentrations of mercury and PCBs could result in discharge violations if the timing and volume of the sediment disposal is not considered. Also, successful flushing of sediment into the sewer system or disposal directly at the WWTP could significantly increase the total solids load at the plant.

Technologies Available

Disposal of the sediment will be similar to disposal techniques described in Section 4.1.2.

Criteria for Implementation

The criteria for implementation of sediment disposal from interceptor and trunk sewers is similar to that for lateral and connector sewers, as described in Section 4.1.3.

Operational & Financial Benefits

Current disposal practices may bring liability because a PCB/ Hg Remedial Design Report was submitted to DEQ and there are no indications that these practices are being followed. If wastewater treatment plant discharges exceed the NPDES limits, the plant might face serious violation fees and penalties.

Current Revenue/Expenditures

Current disposal costs are included in the cleaning/ televising contracts, based on disposal in the sewer system (deposited at Huber Facility).

General Recommendations, Future Expenditures and Schedule

The current practice of disposing of sediments on a case-by-case basis should not be continued because of the potential liability involved and unknown impact on the treatment plant and collection system. It may also be indirectly increasing the contract costs for cleaning, inspecting, and lining sewers, as contractors have to arrange for disposal.

DWSD should undertake a program to determine the nature of the sludge/ sediment in the system by conducting a pilot sampling program. This

Table 4-.5: List of Trunk Sewers and Interceptors with Sludge Deposition

Sewer Line	Limits	Diameter (ft)	Length (ft)	Buildup (in)	Estimated Volume (cyd)
Detroit River Interceptor	Randolph to Beaubien	14	700	24	350
Detroit River Interceptor	Marquette to Parkview	9	700	24	
Detroit River Interceptor	Marquette to Parkview	7	600	12	
Oakwood Northwest Interceptor	Fort St & Rouge River Siphon	5	?	12	
Mack Ave. Relief Sewer	3-mile Rd	12	700	24	
Fox Creek Enclosure	Bedford to Devonshire	15	750	12	
Ashland Relief Sewer	Harper to Chalmer	14	1,500	36	
Ashland Relief Sewer	Jefferson & DRI	10	2,500	24	
East Jefferson Relief Sewer	Jefferson & St. Clair	4	200	12	
East Jefferson Relief Sewer	Jefferson & Harding	14	300	48	
Conner Creek Closure	E. Forest to Kercheval	17.5	23,800	6 to 24	6,056
Conner Creek Closure	South of 6-mile Rd	17.5	1,200	48	
Conant-Mt. Elliot Sewer	7-mile Rd	13.7	3,900	7	305
First-Hamilton Sewer	Larned to Vernor	14	3,500	12	
Baby Creek Enclosure	Downstream of Vernor	17.5"	4,100	51	9,358
Hubbell Sewer	North of 7-mile Rd	8	800	18	
Hubbell Sewer	North of Grand River	12	1,100	18	
Hubbell Sewer	Plymouth Road	12	1,100	18	
Southfield Sewer	7-mile Rd to Pembroke	10	2,600	24	1,802
Southfield Sewer	North of 6-mile Rd	10	3,450	24	
Southfield Sewer	South of Fenkell	10	200	36	
Southfield Sewer	North of Schoolcraft	10	2,600	24	
Southfield Sewer	Ford Rd	8	800	8	
Hubbell Southfield Sewer	South of Michigan to CSO	12	2,200	24	
W. McNichols Relief Sewer	Southfield Fwy to Greenview	14	1,000	36	
Schoolcraft Relief	West of Southfield Fwy	12	700	12	
Lakeshore Interceptor	Before Henry B. Joy	12	1,000	14	
Romeo Interceptor	Terre Belle to Heather	10	1,555	6 to 14	272
Romeo Interceptor	Clinton River to 15-mile	10	9,931	8 to 26	3,773
Edison Corridor	South of 15-mile Rd	12	500	12	
Edison Corridor	North of Fvazho Rd.	12	1,000	12	
TOTAL			**74,986**		**21,916**

could be done by DWSD staff utilizing the WWTP laboratory to analyze the sediment samples, or could be done by a separate consulting contract using an outside laboratory. Several locations should be selected for sampling and the results compiled in a report.

After the study is completed, the final method of disposal should be selected based on the results. If the sediments are found to be non-hazardous and can be disposed of in the sewer system or WWTP, then appropriate locations for disposal should be determined.

4.3 Lateral & Connector Sewer Improvements

Needs

The DWSD sewer system has approximately 2,817 miles of lateral and connector sewers, about 88 percent of which are more than 50 years old. All pipe materials have a finite expected life. These sewers need to be rehabilitated. Failure to correct major lateral sewer problems results in excessive infiltration and inflow into the wastewater plant and complaints from neighborhoods served by the laterals. General lateral sewer problems are listed in Table 4.6.

Table 4.6: Typical Sewer Pipe Problems in Detroit

Problem	Causes
Root Growth	Roots penetrating through pipe joints and broken pipe sections.
Off-Set Joints	Ground movement and pipe joints cause debris buildup.
Sedimentation	Broken pipe allows soil to be washed into pipe.
Corrosion	Corrosion or breakdown erode of pipe structure. “Bottomless” Pipe.
Obsolete Material	Orangeberg Pipe is a discontinued product due to poor performances and design life. Pipe crumbles during normal cleaning.
Infiltration	Groundwater penetrates pipe joints and cracks.
Exfiltration	Effluent escapes pipe to contaminate surrounding soil.
Structural Cracks	Material fatigue, changes in support of the backfill around pipe.
Undersized Sewers	Sewers inadequately sized to carry current flows.
Grease	Grease build-up on sewer walls attaches itself to other debris causing blockage.
Odor	Sewer gases.
Adverse Soil Conditions	Improper or disturbed pipe bedding creates excessive soil pressure, causing infiltration of fine soils. Pipe can also bend or collapse due to inadequate bedding support.
Utility Interference	Installation of utilities can disturb existing sewers. For example, directional drilling errors can damage sewers.

Scope/Magnitude in 2002/3 and Projections to 2050

With 88 percent of the lateral and connector sewer system currently older than 50 years old, rehabilitation of an estimated 2,480 miles of lateral and connector sewers may be required. The current lateral and connector sewer replacement program repairs or replaces approximately 20 miles of sewer pipe per year.

Technologies Available

The following are methods of rehabilitating existing sewers (without increasing diameter and possibly reducing diameter):

- Cured-in-place lining (CIPP): This is the method currently used by DWSD. Chemical products are mixed in the field to form a lining system that is distributed along the pipeline wall using an inflatable and removable liner. The common feature of CIPP is the use of polyester or epoxy resin impregnated fabric tube. The tube is inserted into the existing host pipe and inflated against the wall of the host using a hydrostatic head or air pressure. A remote robotic cutter reopens the lateral and other sewer connections. The chief advantage is that it minimizes the reduction of cross sectional area. The main disad-

vantage is the need to take the host pipe out of service during the installation and curing process. Diversion and bypass adds to the installation cost.

- Slip-lining: A flexible pipe such as polyethylene is introduced to line existing sewers. There are two main types: continuous and segmental. The basic methodology consists of a new pipe of smaller diameter being inserted by pulling or pushing into the deteriorated host pipe. This method has the merit of simplicity and is relatively inexpensive. However, drawbacks include reduced cross-section and reconnecting laterals. Also, service lines usually necessitate excavation.
- Rigid lining: This is similar to slip-lining, except it involves installation of PVC or other rigid piping.

Sewer replacement alternatives to entirely replace sewers, with a possible increase in diameter, include:

- Open cut construction: This traditional method used to replace pipe requires digging up each sewer section and replacing it.
- Microtunneling or augering: Use of small boring machines to install sewers in congested areas with many utilities.
- Pipe bursting: A bursting machine is used to break up existing pipe, while pulling in replacement pipe behind. Pipe bursting typically utilizes a percussive tool, static expansion cone, or a hydraulic expander to break out the existing pipe, while a new pipe is pulled in place. The bursting head breaks the existing pipe into fragments that are pushed into the surrounding soil. The new pipe is usually pre-welded polyethylene pipe of the required length.

Sewer repair methods (usually considered routine maintenance) include:

- Point repair: Repair of a single-point failure, such as a cracked line.
- Segment repair or replacement: Removal of a longer section of pipe between joints.

Criteria for Implementation

All sewers should be able to handle their design peak flows, without sewage backups into basements or manholes. Infiltration and inflow into lateral sewers should not be excessive. Sewer rehabilitation efforts should provide a system that operates in conformance with local and state regulations that meet minimum standards. This is a two-part process. The first part involves inspection and condition assessment and was addressed previously. The second part involves evaluating the risk of flows that exceed system capacity. Wet weather performance criteria are often a good indication of what system expectations should be.

For peak flow rate conditions, the sanitary system must be designed to handle flow generated by a 10-year 1-hour storm event.

Sewers identified with these problems, either through inspection or complaints, should be placed on a replacement or rehabilitation list. The mean rehabilitation/ replacement rate for sewers was estimated in one utility survey at 39 percent of the system over 25 years, or approximately 1.6 percent of the system per year (ASCE, 1999). However, the range in this study was very wide - 0.1 to 100 percent of the system rehabilitated in 25 years. To stay within the average range for rehabilitation, DWSD should be lining or replacing a minimum of 45 miles of the system per year (based on 2,817 total miles of lateral and connector sewers).

Operational & Financial Benefits

- Reduction in complaints from customers: Proactive maintenance of laterals should reduce the number of complaint calls and the emergency repairs that result.
- Reduction in flows to the treatment plant: Improvements in maintenance and repair of lateral

sewers should result in reduced flow. This directly reduces the cost of treatment (chemicals, testing, etc.) as well as the long-term costs of constructing new treatment facilities.

- Future Permit Requirements - CSO Minimum Controls and CMOM Requirements: Proposed regulations on combined sewer and sanitary sewer overflows will require permittees to implement an ongoing program to identify and prioritize structural deficiencies and implement a program to address deficiencies in the sewer system.

Current Expenditures

Over $100 million has been allocated for sewer improvements in the current capital improvement plan (2003-07), as shown in Table 4.7. The exact amount is difficult to determine because some projects include both water and sewer line replacement. The currently planned expenditures include both general lining and rehabilitation programs and replacement programs in specific areas of the city.

Table 4.7: Lateral Sewer Projects from DWSD's 2002-2007 CIP

Project	Contract No.	Expenditure Period	Amount (million
Lateral Sewer Replacement - Various Streets	CS-1361	2002-2006	$11.9
Sewer Improvements - Acid Damage	PCS-68	2002-2003	$5.0
Water System Replacement & Lateral Sewer Replacements	WS-613	2002-2004	$1.9
Inspection and In-Place Rehabilitation of Circular Sewers	CS-1325	2002-2003	$4.1
Emergency Sewer Repairs on an As-needed Basis	CS-1361	2002-2006	$11.9
Inspection & In-place Rehab of Circular and Non-circular Sewers	CS-1368	2002-2005	$55.3
Lateral Sewer and Water Main Replacement - Palmer Woods	WS-635	2002-2004	$2.4
Misc. Underground Utilities	N/A (new)	2002-2006	$7.1
Lateral Sewer Replacement Allowance	N/A (new)	2003-2007	$32.1
Lateral Sewer Replacement - Oakwood	N/A (new)	2004-2006	$10.0
TOTAL			**$141.626**

General Recommendations

An improvements program for lateral and connector sewers should be developed in phases in conjunction with the condition assessment program outlined in Program 1.A. This improvement program would address repair, rehabilitation and replacement of lateral and connector sewers. Possible approaches are:

- Prioritize by level of complaints. This is the current system used. After identifying problem areas in the city, concentrate efforts on correcting problems in those neighborhoods.
- Replacement/ rehabilitation program following inspection: Areas of the city could be scheduled for inspection. Following inspection, the proposed improvements program could be developed for each area and contracted out as a package. Cost savings could be realized by identifying of the most cost-effective approach for that area and by reducing contractor mobilization costs.

The above programs should take into account the results of I/ I studies. The ultimate goals should be to reduce customer complaints and reduce infiltration and inflow into the system.

Lateral and connector sewers should be inspected every 20 years with rehabilitation planned 50 years and complete replacement every 150 years.

4.4 Interceptor & Trunk Sewer Improvements

Most of the interceptors and trunks sewers in the Detroit system are adequate to take current and future flows, and require mainly repair and rehabilitation. This is addressed in Section 4.4.1. There are some trunk sewers that may have inadequate flow capacity. The current results of analyses of these sewers are described in Section 4.4.2.

4.4.1 Interceptor and Trunk Sewer Repair and Rehabilitation

Needs

Pipes and structures that are large enough to allow a person to enter to inspect and repair are defined as large sewers. Since interceptors fit this category, their rehabilitation and repair methods vary slightly from laterals. Today these large sewers are considered confined space and all of OSHA regulations associated with confined space entry requirement.

Voids and loose/ unstabilized soil can lead to sinkholes and depressions on the surface. Unstabilized soil can also induce strain on a poorly supported pipe causing it to fracture or collapse.

Presence of sludge deposits, large debris, spalling concrete cut, hairline cracks on walls, joint leaks and pipe failure are all indicators that a sewer needs to be rehabilitated. Solids can build up in the pipe due to structural defects like sags in the line, cracks, holes, protruding laterals, misaligned pipe and offset joints. Interceptor failure will lead to a poor collection system and will render the wastewater treatment plants inefficient. Sewer backlogs may occur causing costly repairs.

Causes of sewer failure are essentially the same as lateral sewers:

- Sewer construction
- Soils
- Pipe material
- Age
- Crown corrosion

Scope/Magnitude in 2002-03 and Projections to 2050

There are 83 miles of interceptors owned by the DWSD. These were built from 1920 to 1985. New interceptors have been built by customers (financed by DWSD) since 1985. In addition, there are 88 trunk sewers ranging in size from 4-10 feet. These 88 trunk sewers include 483 miles of sewers owned by the DWSD, of which 446 miles are more than 50 years old.

Interceptors and trunk sewers are reported to be in better shape than lateral sewers, but still accumulate a substantial amount of sediment. DWSD staff addresses large break repairs. There are a number of ways to rehabilitate large sewers. Most of these rehabilitation systems use a pressure-applied coating and are performed by personnel inside the sewer. All OSHA regulations regarding confined space entry, proper ventilation and breathing apparatus need to be observed.

Technologies Available

Point repair, segment repair or replacement are three of the alternatives suitable for sewer rehabilitation. Depending on the size of pipe and existing condition, cured-in-place lining, slip-lining or rigid lining is feasible.

- CIPP – A flexible tube is impregnated (or wetted out) with a two part epoxy resin system, then installed within the host pipe by water, air, or winch, then cured using heat to form a pipe within the host pipe.
- Pre-formed liners – Pre-formed liners can be made in many shapes and out of just as many materials. Personnel enter the existing pipe, and

physically aid in the installation of the preformed sections. After the installation of the liner sections the annular space between the liner and the host pipe is pressure grouted with a cement material. The liner with grout gives a smooth and structurally sound rehabilitated pipe. Some types of preformed liners are: glass-fiber-reinforced plastic, glass-fiber-reinforced cement and steel-reinforced cement.

- Spiral wound liners – These are spiral wound plastic materials that are snapped together manually and wedged in place while the annular space is pressure grouted with a cement material. This process also gives a smooth structurally sound rehabilitation.
- Sprayed-on liners – These liners can be sprayed on epoxy coating, or sprayed on cement applied over steel or other types of reinforcement to provide a smooth structurally sound pipe.

For interceptors and trunk sewers, especially above four feet in diameter, some lining methods may not be applicable. Long-term durability may not be as good, because of the high flows in some of these sewers and corrosion of the underlying concrete sewer. Spalling or separation of the lining from the concrete wall of the sewer has been found in some large sewers in Macomb County.

Sewer replacement alternatives to entirely replace sewers or new construction, with a possible increase in diameter, include:

- Open cut construction: The traditional method used to replace pipe, requires digging up each sewer section and replacing it.
- Microtunneling or augering: Use of small boring machines to install sewers in congested areas with many utilities.
- Conventional tunneling: Use of larger boring machines or boring and jacking to install larger sewer segments without digging up streets.

Sewer repair methods (usually considered maintenance) include:

- Point repair
- Segment repair or replacement

Criteria for Implementation

Interceptors and trunk sewers must be able to carry dry and wet weather flows from a large area. Infiltration and inflow into trunk and connector sewers should not be excessive, and structural defects should be corrected before they become larger problems. Sedimentation in the trunk sewer should not be excessive. Sewers identified with these problems, either through inspection or complaints, should be placed on a replacement or rehabilitation list.

Interceptors and trunk sewers in some areas of the city may be undersized or become undersized within the 50-year planning period. Undersizing is usually evident in the field from surcharging of manholes during wet weather events. All major interceptors and some trunk sewers are included in the current sewer system model (WWMP Model based on GDRSS) and this model can be used to determine which sewers are undersized or likely to become undersized. As they reach their maximum design capacities, these sewers should be replaced by larger diameter sewers rather than rehabilitated or lined.

For peak flow rate conditions, the sanitary system must be designed to handle flow generated by a 10-year 1-hour storm event. Sewers identified with potential problems, either through inspection or complaints, should be placed on a replacement or rehabilitation list. The mean rehabilitation/ replacement rate for sewers was estimated in one utility survey at 39 percent of the system over 25 years, or approximately 1.6 percent of the system per year. However, the range in this study was very wide - 0.1 to 100 percent of the system rehabilitated in 25 years (ASCE, 1999).

Operational & Financial Benefits

Large interceptor and trunk sewers are the merging points for all wastewater, be it industrial, residential or commercial. These interceptors and trunk sewers are the main arteries leading to the wastewater treatment plant. Capacity is important, as any wet weather flows will flood the system and it is important that these interceptors and trunk sewers are kept at optimum conditions to handle such flows and not be under-designed. Keeping these sewers at optimum operating conditions will be key to keeping costs down and allaying future costs to build additional interceptors for additional flows.

Current Expenditures

There is currently only one rehabilitation project at the Romeo Arm Interceptor at Garfield Road. This is slated to finish in 2004 at a cost of $5,808,000 for design and construction

General Recommendations

Interceptors and trunk sewers should be inspected prior to determining a rehabilitation method. Interceptors should be inspected every 20 years as part of the maintenance program. A repair/ rehabilitation/ replacement program for interceptors and trunk sewers should be developed in phases, in conjunction with the inspection and cleaning program outlined in Section 4.2. Possible approaches are as follows:

- Do field verification during wet weather events of interceptor and trunk sewer performance (i.e. monitor manholes).
- Perform TV or walk-through inspections of large sewers. The oldest sewers and sewers that have not been inspected in many years should be inspected first. Interceptors and trunk sewers should be inspected every 20 years as part of the maintenance program.
- Develop a ranking of interceptors and trunk sewers for rehabilitation or replacement based upon their location in the system and general condition. Prioritize by level of complaints. This is the current system used. After identifying problem areas in the city, concentrate efforts on correcting problems in those neighborhoods.
- Following inspection, the proposed rehabilitation/ replacement program could be developed for each area of the city and contracted out as a package. Cost savings could be realized by identification of the most cost-effective approach for that area, and by reducing contractor mobilization costs.

The above programs should take into account the results of I/ I studies. The ultimate goals should be to reduce customer complaints and reduce infiltration and inflow into the system.

The mean rehabilitation/ replacement rate for sewers was estimated in one utility survey at 39 percent of the system over 25 years, or approximately 1.6 percent of the system per year (ASCE, 1999). However, the range in this study was very wide - 0.1 to 100 percent of the system rehabilitated in 25 years. To stay within the average range for rehabilitation, DWSD should be lining or replacing about 9 miles of the system per year (based on 566 total miles of interceptor and trunk sewers).

All sewers should be able to handle their design peak flows, without sewage backups into basements or manholes. Infiltration and inflow into lateral sewers should not be excessive. Sewer rehabilitation efforts should provide a system that operates in conformance with local and state regulations that meet minimum standards. This is a two-part process. The first part involves inspection and condition assessment was addressed previously. The second part is to evaluate the risk of flows that exceed system capacity. Wet weather performance criteria are often a good indication of what the system expectations should be. For peak flow rate conditions, the sanitary system must be designed to handle flow generated by a 10-year, 1-hour storm event.

In general, interceptors should be inspected every 20 years, necessary rehabilitation performed every 50 years and total replacement performed every 150 years.

4.4.2 Relief Sewers

Needs

The *Status Report on Storm Relief Sewer Program*, issued in July 1975 (re-issued July 1978) by the City of Detroit Water and Sewerage Department, determined the relief sewers necessary in order to protect all basements from flooding from rainstorms up to 1.9-inches per hour. The relief sewers required are shown in Figure 4.1.

As part of the Master Plan, the need for these relief sewers was investigated using the WWMP Model. The relief sewers recommended consisted of major relief sewers, intermediate relief sewers to connect various neighborhoods to the large relief sewers, and lateral relief sewers within neighborhoods. The model was used to investigate the need for the major relief sewers under projected future conditions using a 10-year, 1-hour design storm event, which is 1.8-inches in depth. Through this analysis, it was determined that relief sewers were needed to prevent excessive surcharging along Seven-Mile, Fenkell, Schoolcraft, Hubbell, Joy, and Clark sewers. The recommended length, diameter, and depth of the relief sewers are shown in Table 4.8.

Figure 4.2 highlights the relief sewers recommended as a result of the WWMP Model analysis of the 10-year, 1-hour design storm. It is important to note that not all of the proposed relief sewers from Figure 4.1 are currently in the GDRSS Model. Further studies are being conducted on these sewers and additional recommendations may be made at a later time.

Trunk sewer capacities were also evaluated in the *Segmented Facilities Plan* and several relief sewers were recommended. A level-of-service review of trunk sewers was also completed for the Long Term CSO Control Plan. A reevaluation of trunk (and possibly connector) sewer capacity should be undertaken using projected flows to verify that the level of service is adequate.

Technologies Available

Relief sewers can be constructed parallel to existing sewers to take additional flows. Connections to existing sewers must be designed as well as the relief sewer, to ensure an even distribution of flow in the two parallel sewers.

Alternatively, sewers can be replaced entirely. Technologies to replace sewers include:

- Open cut construction: The traditional method used to replace pipe requires digging up each sewer section and replacing it.
- Microtunneling or augering: Use of small boring machines to install sewers in congested areas with many utilities.
- Conventional tunneling: Use of larger boring machines or boring and jacking to install larger sewer segments without digging up streets.

Operational & Financial Benefits

Adequate trunk sewer capacity ensures that all wastewater generated in a particular section of the city will make its way to the treatment plant without overflows through basements or manholes.

Recent Michigan court decisions have upheld the right of property owners to sue municipalities for damage due to basement flooding. The potential cost to the city is high if it can be shown that adequate capacity was not maintained.

Current Expenditures

No relief sewers are currently included in the capital improvement program.

General Recommendations

The five trunks sewers evaluated above (Seven-Mile, Schoolcraft, Fenkell, Hubbell, and Joy/ Clark) should be considered for upgrades. These

Figure 4.1: Relief Sewer Needs Identified in 1978 DWSD Relief Sewer Study

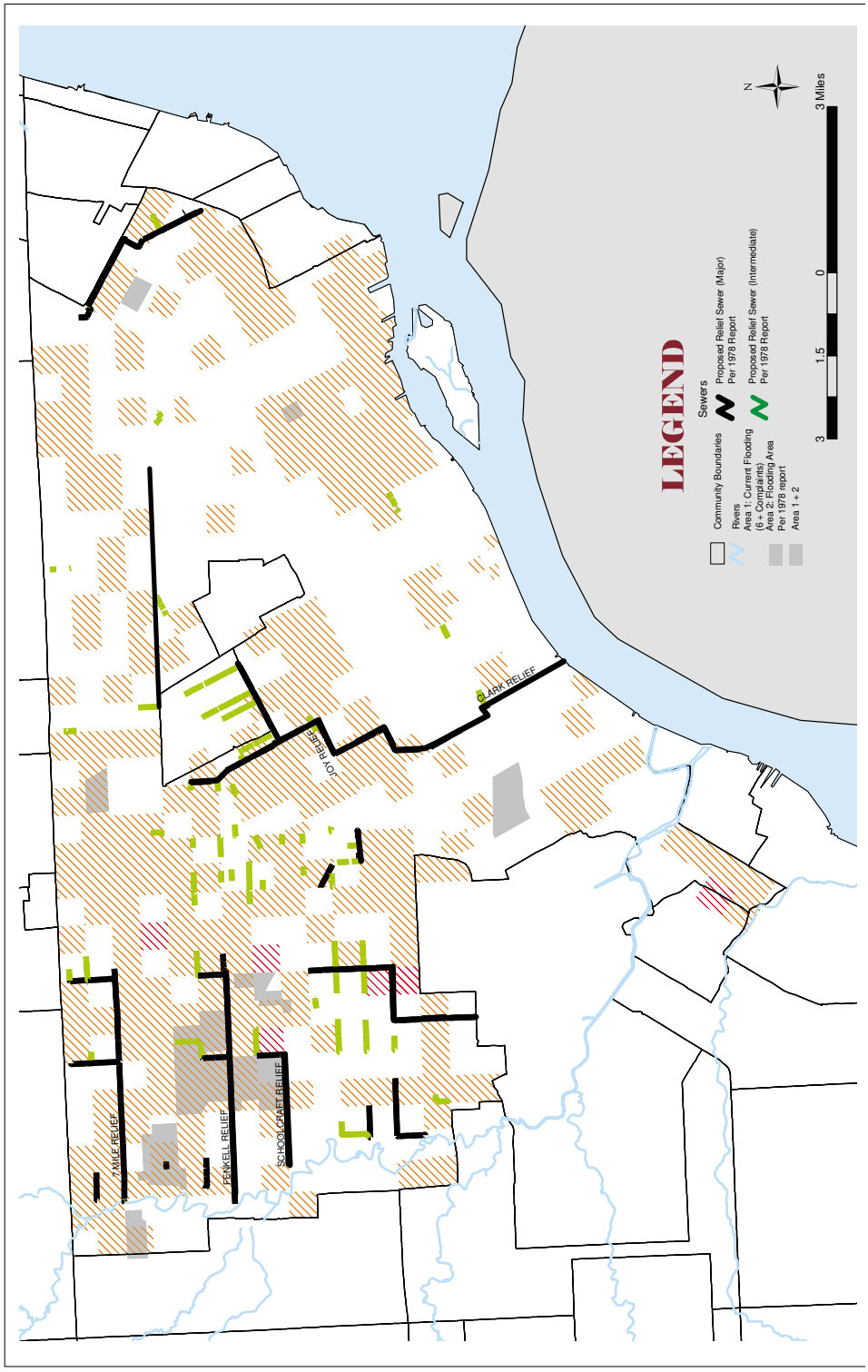


Figure 4.2: Relief Sewers Recommended as Result of Analysis of 10-year, 1-hour Design Storm

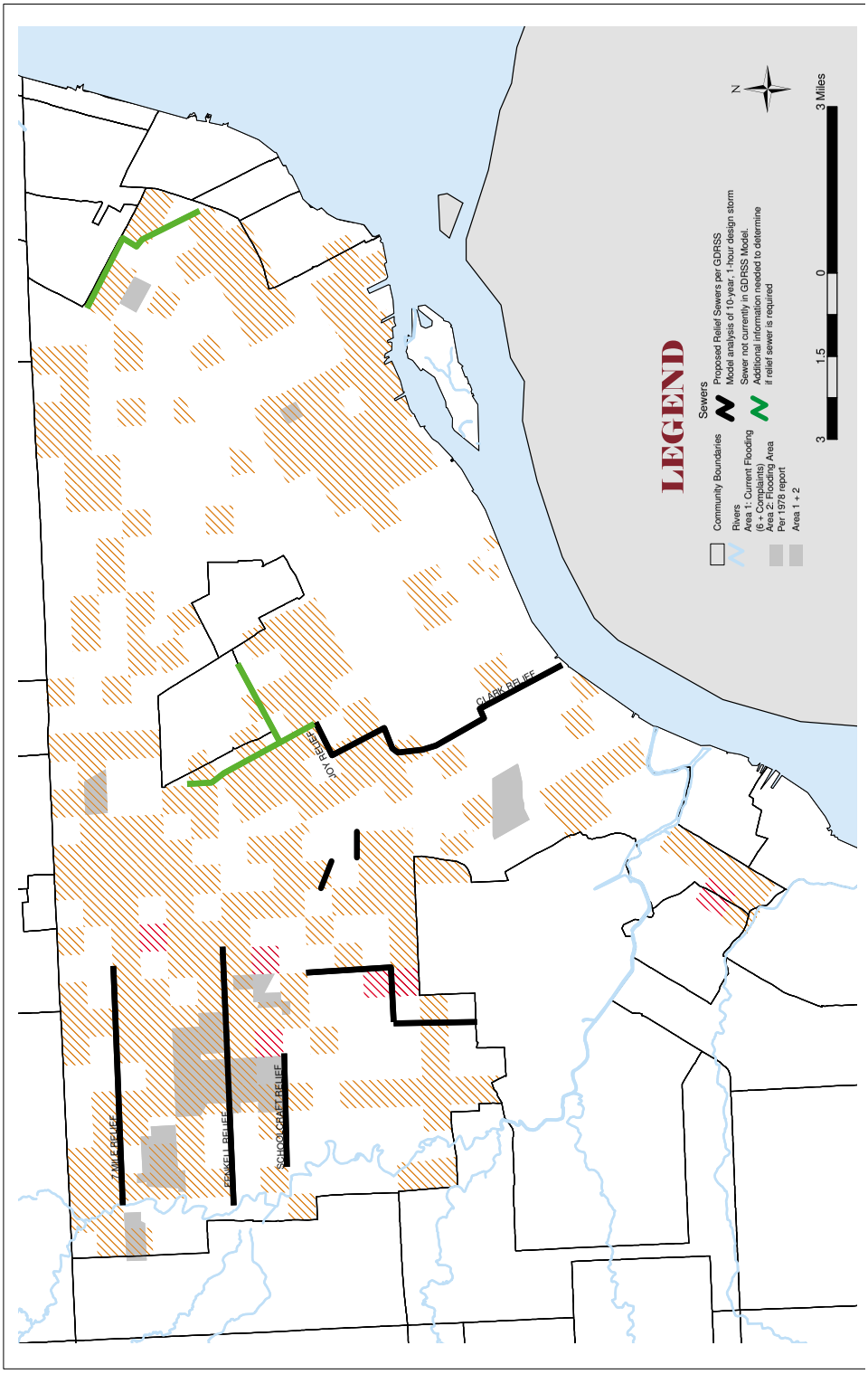


Table 4.8 Recommended Relief Sewers

Name/Description	Length (ft.)	Diameter (ft.)	Depth (ft.)
7-Mile Relief			
Hubbell to Southfield	7,920	10	30
Southfield to Rouge River	13,200	10	20-30
Fenkell Relief			
Hubbell to Southfield	7,920	13	20-30
Southfield to Rouge River	13,200	16	5-10
Schoolcraft Relief			
Southfield to Rouge River	10,560	16	15
Hubbell Relief			
Hubbell (From Plymouth to Joy)	5,280	12	5-10
Joy (From Hubbell to St. Mary's)	5,280	12	5-15
St. Mary's (From Joy to Paul)	7,920	12	15-20
Joy/Clark Relief			
Joy Sewer	6,833	16	20-30
Clark Sewer	27,216	16	10-20
Clark Connection to NIEA	169	10	10

five sewers should be placed high on the list of trunk sewers to be inspected. Depending on the condition of these sewers, availability of right-of-way, and feasibility of construction, the sewers should be replaced with a larger diameter trunk sewer, or a parallel relief sewer should be constructed.

As mentioned above, all trunks sewers have not yet been evaluated for adequate capacity assuming a 10-year, 1-hour storm. Further evaluations are required to determine the adequacy of the trunk sewers in the city. Trunk sewers that are now not part of the Wastewater Master Plan GDRSS model may need special evaluation.

4.5 Manhole & Catch Basin Improvements

4.5.1 Manhole Cover & Rims

Needs

Manholes provide access to the sewer system, and must be maintained free of debris, be structurally sound to access the sewers, and have safe conditions for workers entering the system. Manholes can be a leading source of infiltration and inflow into the sewer system, usually due to leakage around the manhole covers and through the connection between the sewer lines and the manhole structure.

If a manhole cover is located on a road with heavy traffic, the dynamic loads from vehicles can cause structural damage to the opening. Tree roots can grow through cracks, and with time, cause major infiltration problems. Metal rungs in the manholes corrode over time and can therefore be dangerous to workers who need to enter the manholes for inspection and repair.

Scope/Magnitude in 2002-03 and Projections to 2050

There are an estimated 57,700 manholes in the DWSD system. Most of the manholes are more than 90 years old and constructed of brick. Manholes constructed of brick have a higher probability of developing cracks due to loss of mortar. Settlement of the manholes over time results in misalignment of the manhole structure and sewer pipes. Settlement of the manholes over time results in misalignment of the manhole structure and sewer pipes. Existing manhole covers that do not lock allow infiltration into the system through the cover vents. In a recent inspection of lateral sewers, several manholes were blocked with large amounts of debris, including residential solid waste and yard wastes. Further investigation is necessary to understand the extent of these block-

ages. The debris caused sediment backup in the manhole and connecting sewer lines. Currently, only spot repairs are done on manholes. No other lining, repair, or replacement programs have been undertaken.

Manhole inspections should be performed in conjunction with sewer inspections to find evidence of surcharge or infiltration, missing structural material, and broken rims and covers. Bedding material in the manhole indicates a break or collapse in an upstream line. Deteriorated steps may indicate the presence of corrosive gases.

Manhole rehabilitation could consist of one or more of the following: Replacing lid/ cover, sealing cover-frame fit, replacing manhole frame/ cover, installing insert below cover, sealing frame-to-chimney joint, realigning frame, cementitious coating, pressure grouting, epoxy wall coating and PVC lining. This list is not exhaustive, but gives an example of manhole rehabilitation.

Technologies Available

New manholes are seldom constructed of brick, because of the cost effectiveness of pre-cast concrete. Concrete manholes can be constructed of four-foot pre-cast sections assembled on a concrete cast-in-place base or a single casted manhole with the walls poured in one section. Connection of the sewer line to the manhole must be designed to reduce formation of cracks and infiltration into the system. Flexible connectors are now available, which reduce infiltration into the system.

Rehabilitation includes rebuilding the manhole walls, spot repairs on cracks, and lining the inner walls of the manhole with a concrete mortar or synthetic lining to achieve zero infiltration. This may prolong the life of a manhole for another 10-15 years, after which replacement is recommended.

The decision to replace or rehabilitate a manhole should be based on inspection. Replacement of manholes is most feasible when the sewer pipe is being replaced.

One three-day procedure of rehabilitating a manhole begins with a visual inspection to determine the extent of repair required, and the access to the manholes. Once a plan is developed, a schedule for high-pressure cleaning is initiated. The high pressure cleaning is accomplished by utilizing a 6,000-psi pressure washer with an oscillating 3-D high pressure cleaning head. This cleaning head is able to completely clean a 4- to 5- foot section of a 48-inch diameter manhole in approximately five minutes. Assuming that most manholes are 8-10 feet deep, a complete manhole can be cleaned in 10-15 minutes. This substrate preparation is to remove all loose or bad concrete or brick and to achieve a clean profile onto which the sealing material can adhere.

The following day, a visual internal inspection is performed to check for any large leaks or abnormal conditions. Usually a cementitious quick plug water-stop is installed. Following this, the crew would begin spraying a substrate to provide a strong base coat for the final coat to adhere properly to. This process is accomplished by using a no-entry spray system, which uses a progressive cavity pump to deliver material via a hose to a rotary air spray nozzle. The rotary nozzle casts the sealing material out in a 360-degree radius in four-inch bands. Provided the downstream manhole is ventilated using an air suction hose to keep fresh air in and to help in curing the sealant, entry into the manhole is not required during this process.

The third and final day would be dedicated to spraying the topcoat, either a cementitious material for light I/ I or an epoxy material forming a corrosive barrier to protect against H_2S attack. The health and safety issues for this process are very advantageous because it minimizes actual confined entry for the crew. Usually a three-year inspection period is suggested for checking on signs of visible infiltration or corrosion.

Manholes can also be lined with fiberglass or

cured in place for rehabilitation

Criteria for Implementation

All manholes should be safely accessible with a low rate of infiltration. The highest priority should be the manholes with severe structural problems.

Other large utilities typically rehabilitate 100 manholes per summer season per year. This results in the ability to rehabilitate 3 manholes in an eight-hour day for a cost under $1,000 per manhole, assuming the manhole is 8 to 10 feet deep.

New manhole construction requirements include a leakage test.

Operational & Financial Benefits

Preliminary inspection and scheduling are the key issues to a cost-effective program. Inspection establishes a good estimate of the cost of rehabilitating or replacing a manhole. It also helps in scheduling manhole rehabilitation with a planned sewer replacement program in that area.

Once the present condition of a manhole is established, scheduling of finances and operating costs can be made with the manholes in poor condition being scheduled for earlier rehabilitation.

Tying manhole rehabilitation with the sewer replacement program is beneficial because the time for personnel and crew can be minimized. The cost of digging can be cut because the location does not need to be dug twice (once for the sewer and once for the manhole).

According to the McCandless Township Sanitary Authority of Pittsburgh, PA, their system included 10,000 manholes. Aggressive manhole rehabilitation was necessary to reduce the 10- to 20-gallons per minute I/ I flow per manhole. With a cost of only $800 per manhole, the Authority was able to initiate a manhole program with 100 manholes rehabilitated within the first summer.

Current Expenditures

Currently there are no existing manhole rehabilitation programs in place. The DWSD manholes over 90 years old have not been replaced and the amount of I/ I flow via this channel is unknown. With over 57,700 manholes under the DWSD jurisdiction, most of which are over 50 years old, a rehabilitation program is necessary. According to the field engineering crew of DWSD, none of the manholes have been lined to date, and an unknown percentage of manholes have pre-cast barrels.

General Recommendations

General recommendations are as follows:

- A numbering system should be adopted to identify each manhole in the DWSD system. This numbering system should be tied to a database and mapping system where information on each manhole can be recorded.
- Manholes should be included in the current inspection programs for sewers. Manhole inspection should be scheduled every 20 years, rehabilitation scheduled every 50 years and replacement every 150 years. Inspection data should be entered into the database mentioned above.
- Manhole cover and rims should be part of the inspection criteria and should be repaired or replaced to reduce infiltration.
- Manhole repairs and lining should be scheduled by area to reduce total costs.
- Replacement of manholes should be included in contracts to replace sewers in areas of the city requiring major rehabilitation. It is far easier and cheaper to include manhole replacement as part of an overall sewer replacement program than to dig up manholes separately.

4.5.2 Catch Basins & Inlets

Needs

Inlets with catch basins are designed to transport stormwater to the combined sewer system while retaining debris and sediment in the basin. Clean-

ing of catch basins should be undertaken to: 1) reduce pollutants and sediments being discharged from the combined sewer system into local rivers; 2) reduce the need to clean connecting sewers; and 3) combat current outbreaks of West Nile Virus by allowing better treatment of standing water in catch basins with insecticides that reduce mosquito populations. This treatment will be more effective if the catch basins are clean. At the same time, catch basins should be inspected for substantial defects and identified for repairs.

Scope/Magnitude in 2002-03 and Projections to 2050

There are an unknown number of catch basins in the city, but assuming they are approximately every 200 feet, an estimate of 200,000 basins can be made. It can also be assumed that all of these catch basins require cleaning. All catch basins need to be inspected and inventoried to determine the present conditions, including whether to schedule them for immediate rehabilitation/ replacement or future inspection

Technologies Available

Catch basins can be cleaned by bucket and hoist, or by using a vacuum or wash water system. Catch basin cleaning techniques involve simply using a Vactor truck to vacuum the clogged basin from sediment, debris, leaves etc.

Catch basin rehabilitation methods are similar to manhole rehabilitation. They are:

- Replace lid/ cover,
- Seal cover-frame fit,
- Replace catch basin frame/ cover,
- Install insert below cover,
- Seal frame-to-basin box joint,
- Frame realignment,
- Cementitious coating,
- Pressure grouting,
- Epoxy wall coating,
- PVC liners.

Criteria for Implementation

Catch basins have not been routinely inspected, so there is little information available on them. A catch basin maintenance program would involve inspection of catch basins every three years, rehabilitation every 20 years and replacement every 150 years.

A catch basin should be cleaned if the depth of deposits is greater than or equal to one-third the depth from the basin to the invert of the lowest pipe or opening out of the basin. If a catch basin significantly exceeds the one-third depth standard during inspection, it should be cleaned more frequently. If woody debris or trash accumulates in a catch basin, it should be cleaned on at least a weekly basis (EPA, 1999).

The performance of a catch basin is related to the volume in the sump (i.e. the storage in the catch basin below the outlet). Lager et al. (1997) described an optimal catch basin sizing criterion, which relates all catch basin dimensions to the diameter of the outlet pipe (D). The diameter of the catch basin should be equal to 4D. The sump depth should be at least 4D. This depth should be increased if the cleaning is infrequent or if the area draining to the catch basin has high sediment loads. The top of the outlet pipe should be 1.5D from the bottom of the inlet to the catch basin.

Operational & Financial Benefits

Preliminary inspection and scheduling are the key issues to a cost-effective program. Inspection establishes a good estimate to the cost of rehabilitating or replacing a catch basin. It also helps in scheduling catch basin rehabilitation with a planned sewer replacement program in that area.

Once the present condition of a catch basin is established, scheduling the finances and operating costs can be made with the catch basins in poor

condition being scheduled for earlier rehabilitation than those that can wait for a later fix.

Tying catch basin rehabilitation to a sewer replacement program is beneficial in that the time for personnel and crew can be minimized. The cost of digging can be cut because the location does not need to be dug twice.

Current Expenditures

There is no program in place to rehabilitate catch basins. Depending on customer complaints or scheduled rehabilitation work at a particular location, catch basins may be cleared of debris for better access.

General Recommendations

- The city should undertake a pilot inspection program to estimate the number of catch basins needing cleaning and repair. A pilot cleaning program and repair program should be established to try out different methods of cleaning and repairing the basins. Based on the pilot program results, the best methods of cleaning and repairing should be selected and implemented. The priorities for catch basin work should be in the areas connected to permit CSO discharges.
- A numbering system should be adopted to identify each catch basin in the DWSD system. This numbering system should be tied to a database and mapping system where information on each catch basin can be recorded.
- Catch basins should be included in the current inspection programs. A catch basin maintenance program would involve inspection of catch basins every three years, rehabilitation every 20 years and replacement every 150 years. Inspection data should be entered into the database mentioned above.
- Catch basin repairs and lining should be scheduled by area to reduce total costs.
- Replacement of catch basins should be included in sewer improvement contracts in areas of the city requiring major rehabilitation. It is easier and more cost-effective to include catch basin improvement as part of an overall sewer replacement program than to dig up catch basins separately.

4.6 Regulators, Outfalls, Backwater Gates and In-System Storage

4.6.1 Regulators

Needs

Flow regulators are flow control devices that control flow from trunk sewers into interceptors based on wastewater levels in the interceptor. These regulating structures were designed to divert sanitary flow during dry weather conditions and combined sanitary and storm flow during storm weather conditions. Most of these regulators have been replaced with hydraulic slide gates.

Scope/Magnitude in 2002-033 and Projections to 2050

There are 41 flow regulators, 37 of which were rehabilitated under PC-695 in 1998. These regulators were inspected and reports were written under CS-1158 in 1992 and 1993. Based on current available data, outfall regulator B-1 located at Ashland and Jefferson is in need of an inspection in the immediate future. At present, 40 of the outfalls are between 50 and 75 years old.

Technologies Available

Defects in any of the following could result in regulator deficiencies:

- Frame and cover
- Manhole cone
- Manhole steps
- Grating
- Brickwork under manhole frame

- Outlet structure
- Regulating chamber
- Diversion dam
- Diversion chamber
- Sludge buildup
- BWG chamber
- Flashboards

Criteria for Implementation

All mechanical systems should be inspected regularly, preferably annually, but at a minimum of every five years. Non-functioning mechanisms should be replaced as soon as possible. Regular structural inspections should also be done at least every 15 years, and rehabilitation and replacement scheduled to eliminate structural deficiencies.

Operational & Financial Benefits

Outfall flow regulators are maintained as part of the long-term CSO plan.

Current Expenditures

According to the DWSD CIP published in 2002, there is currently one project (PC-695) in 2002-03 to rehabilitate flow regulators and diversion dams in the amount of $558,000.

General Recommendations

Regulator outfall number B-1 needs to be inspected. It is located at Ashland and Jefferson. The recommended inspection and re-inspection rate for flow regulators is every 5 years, the rehabilitation rate is 15 years and replacement interval is 30 years. Within 50 years, all of the outfall regulators need to be replaced twice to keep the system in optimum condition.

Based on previous inspections done in the 1990s, there are three flow regulators at outfalls B-8, B-11 and B-13 that are in need of rehabilitation. Regulator B-8 is in need of manhole steps, grating, a regulating chamber and sludge removal. Regulator B-11 needs all of the aforementioned rehabilitation as well as brickwork under a manhole frame, a diversion dam and a diversion chamber. Regulator B-13 only needs manhole steps, grating, brickwork under the manhole frame, a regulating chamber and sludge removal. Table 4.9 lists the recommendations.

Table 4.9: Flow Regulator Inspection Recommendations

District	No.	Rehabilitation/ Replacement Short-term
Central	40	3
East Jefferson	1	
TOTAL	41	

4.6.2 Outfalls

Needs

Outfall sewers lead from flow regulators and/ or dams to the Detroit or Rouge rivers. Outfall sewers carry combined sewer overflows during certain wet weather periods and discharge into the Detroit and Rouge rivers.

Scope/Magnitude in 2002-033 and Projections to 2050

There are 81 outfalls currently owned and maintained by DWSD. There were inspection deficiencies in 42 of them under CS-1158. Of those 42, 31 are still in need of rehabilitation.

Technologies Available

Mechanical gates and other mechanical structures need regular repairs and replacement. Structural repairs can be done to concrete outfall structures to prolong their lives. However, all concrete structures have a finite life and should be replaced when extensive repairs are required.

Criteria for Implementation

Outfalls should be inspected regularly to prioritize repairs and rehabilitation work needed.

Operational & Financial Benefits

Outfalls are critical to the operation of the combined sewer system and need to function properly to regulate discharges from the system.

Current Expenditures

There are three ongoing outfall construction projects, a rehabilitation project and two inspection projects lined up for the next five years. There are also new projects lined up for outfall improvements in the next five years and repair of one outfall beyond 2007. The total for on-going projects is $50,670,000 and the total for new projects is $14,150,000. A new Detroit River outfall is currently under construction and is scheduled to be completed in April 2003.

General Recommendations

Outfalls have a longer life span than regulators. Thus, the recommended interval is five years for inspection, 50 years for rehabilitation and 150 years for replacement. Based on these recommendations, 42 outfalls were deficient based upon previous inspections. Of these 42, 30 are still in need of rehabilitation. Table 4.10 lists the recommendations.

Table 4.10: Outfall Recommendations

District	No.	Rehabilitation/Replacement		
		Long-term	Mid-term	Short-term
Rouge River	22	4	2	2
Dearborn	1	1		
Oakwood	4	1	1	
Central	50	15	1	4
Jefferson	4	1		1
TOTAL	**81**			

4.6.3 Backwater Gates

Needs

Backwater gates are devices installed in the CSO outfalls along the Detroit and Rouge Rivers. The purpose of the gates is to prevent water from the Detroit and Rouge rivers from entering the DWSD collection system. The backwater gates are installed at the overflow side of the regulators (usually two sets of gates: a sewer gate and a river gate) and act as check valves when the river levels are higher than the invert elevations of the outfalls.

Scope/Magnitude in 2002-03 and Projections to 2050

There are 54 backwater gates in the system. Of these, 26 are listed as having deficiencies. These gates were inspected in 1992 and 1995 under CS-1158. DWSD has been doing repairs, but the extent and location of these repairs is unavailable.

Operational & Financial Benefits

Backwater gates are maintained as part of the Long Term CSO plan.

Current Expenditures

There are no projects in the existing CIP for backwater gates for the next five years.

General Recommendations

Based on the technical memorandum *Review of Collection System Regulators and Outfalls*, eight backwater gates have not been inspected since 1992. There are 26 gates listed to have deficiencies based on previous inspections. Of these 26, 12 are still in need of rehabilitation. These gates will also have to undergo a regular preventive maintenance plan. The recommended inspection rate is every year; rehabilitation rate: every 10 years; complete replacement: every 50 years. Table 4.11 lists the recommendations.

Table 4.11: Backwater Gates Recommendations

District	No.	Rehabilitation/Replacement Long-term	Mid-term	Short-term
Rouge River	25		4	
Dearborn	1			
Oakwood	3			
Central	23		8	
Jefferson	2			
TOTAL	**54**			

4.6.4 In-System Storage and Diversion Dams

Needs

The in-system storage devices are inflatable dams and slide gates that maximize storage within the collection system during wet weather operation.

Scope/Magnitude in 2002-033 and Projections to 2050

There are 40 existing in-system storage devices, 13 of which are currently being installed.

Operational & Financial Benefits

In-system storage devices are maintained as part of the long-term CSO plan.

Current Expenditures

The inflatable fabridam at Livernois and Ranspatch was inspected in 1992 and was non-functional at the time. The CSO team inspected the Hubbell-Southfield inflatable fabridams in 1994 and found that the dams were generally in good condition. Little or no maintenance has been done in the last five years.

This CS-1329 project consists of the installation of 13 collection system in-system storage facilities. The construction of this project is to be completed under Contract PC-747 by December 2004.

General Recommendations

The recommended inspection rate for in-system storage devices is one year. The rehabilitation rate is every 10 years. The replacement interval should be 30 years. Table 4.12 lists the recommendations.

4.7 Pump Stations

Needs

The DWSD sewer system currently operates 14 major pump stations. This number will decreased when the Garfield Pump Station in Mount Clemens closed. In addition to the 14 major pump stations, there are seven package stations on Belle Isle.

All pump stations, with the exception of 3 locations; have pumps that are more than 20 years old. Old electrical, mechanical and structural parts can greatly reduce pump efficiency. If some of the pumps have are not functioning or have not been checked, inspected, rehabilitated or maintained, it is possible that some pump stations will be inadequate to handle flows.

Table 4.12: In-System Storage Devices and System Gates Recommendations

District	No.	Rehabilitation/Replacement Long-term	Mid-term	Short-term
Rouge River	9	1		
Dearborn	1			
Oakwood	2			
Central	21		1	2
Jefferson	1			
Baby Creek	6			
TOTAL	**40**			

Scope/Magnitude in 2002-03 and Projections to 2050

Most of the pump stations have mechanical, electrical and structural parts that are all more than 20 years old. The Belle Isle package pump stations with a total of 18 pumps are in immediate need of major mechanical and structural rehabilitation. The Fairview pump station needs major long-term mechanical, electrical and structural rehabilitation. The Conner Creek, Freud, Northeast and Woodmere pump stations also have components in need of immediate and long-term rehabilitation. The PC-744 project (Wastewater Plant Rehabilitation Project) has published an Asset Audit report where rehabilitation recommendations specific to each pump station are detailed.

Technologies Available

Assessing the useful life of the pump station by inspection can determine whether a station needs to be rehabilitated or replaced. The following components could need rehabilitation, repair and replacement in the future:

- Mechanical – Pumps, compressors, diminutors, boilers, furnaces & water heaters
- Electrical – Pump motors, generators, transformers and electrical panels
- Structural/ Building – Structural repairs on building and wet well, and mechanical fixed building items such as HVAC components, cranes, etc.

Criteria for Implementation

The criterion for performing a condition assessment on the pump station and facilities is based upon asset audits that are currently being done on a yearly basis. This assessment identifies maintenance, repairs, replacement, and upgrade needs for all pump stations. Soon DWSD staff will be trained to do the audit in-house, allowing for continued yearly inspections.

Operational & Financial Benefits

Maintenance and replacement of pump station components are essential for maintaining sewer service. The DWSD system has several critical pump stations that lift flows into the system. Routine maintenance and scheduled replacement should reduce expensive emergency repairs.

Current Expenditures

There are currently 11 projects totaling $53,221,000 for design and construction from 2002 to 2007. The majority of these projects focus on pump station rehabilitation, security upgrades and electrical power distribution equipment. See Table 4.13.

General Recommendations

All pump station with components older than 20 years should be inspected prior to determining feasible rehabilitation methods. Afterwards, stations need to be inspected at least every two years as part of the maintenance program. Pump stations should be inspected annually with necessary rehabilitation scheduled every three years. While most electrical and mechanical components will have a recommended maximum life of 15 years, building components often typically last longer and may be replaced at longer intervals. A summary of pump station asset audit results is shown in Table 4.14.

4.8 Meters

Needs

DWSD maintains 67 major meters in its service area. Of these, 56 are important billing meters or flow-monitoring meters, 7 are at the Wastewater Treatment Plant measure incoming flow, and 2 are measuring effluent flow at the Plant.

Scope/Magnitude in 2002-03 and Projections to 2050

There are currently seven flow meter technologies in use:

Table 4.13: Pumping Station Projects from DWSD's 2002-2007 CIP

Project	Contract No.	Expenditure Period	Amount ($1,000)
DN/BLD/Maintain Contract for Emergency Generators	DWS-828/ CS-1241/ LS-1366	2002-2003	$5
Switchgear Replacement at Bluehill & Freud Pump Stations	DWS-837	2002-2005	$16,752
Conner Creek & Fox Creek Stations Rehab	CS-1331/ PC-674	2002-2006	$25,814
Modifications of Oakwood Sewage Pumping Station	CS-1291-2	2002-2003	$559
Fairview Station Rehabilitation	PC-684	2002-2003	$5
Rebuild Major Electrical Power Distribution Eqpt	PO 2500547	2002-2003	$200
Belle Isle Station & Collection Improvements	PC-682/ CS-1076	2002-2003	$5
Additional Pump at Northeast Sewage Pumping Station	CS-1279-17 & 17A/ PC-736	2002-2005	$3,135
Belle Isle Pump Station (Outfall 083) Improvements and CSO Control	CS-1363	2002-2005	$2,439
Security System Upgrade for Various Booster Stations	CS-1346/ DWS-844	2002-2006	$3,199
Overhaul of Major Electrical Power Distribution Equipment	N/A (new)	2002-2005	$1,108
TOTAL			**$53,221**

- Electromagnetic induction meters (magmeters);
- Full-conduit, multiple-path, transit-time meters;
- Full-conduit, single-path, transit-time meters;
- Open-channel, multiple-path, transit-time meters;
- Open-channel, ultrasonic meters;
- Flume meters;
- Weir meters

Each type of meter has its own rehabilitation and repair technology.

Technologies Available

The repair technologies could be structural, mechanical or electrical.

Criteria for Implementation

Meters should be able to provide information on rainfall, infiltration/ inflow and provide the level of accuracy necessary for thorough flow evaluations during dry and wet weather conditions.

Operational & Financial Benefits

Meters are essential for billing customers accurately for their sewer usage. They also help determine the flows in the system and to help estimate future flows and volumes necessary for growth and future planning. These meters must be kept

Table 4.14: Summary of Pump Station Asset Audit

Analysis	Category	Percent of Total
Size/Complexity of Repair	Light	37
	Medium	22
	Major	41
Time Frame	Immediate	41
	Short Term	33
	Long Term	27
Type of Repair	Mechanical	42
	Electrical	37
	Structural/Building	21

Table 4.15: Meter Projects from DWSD's 2002-2007 CIP

Project	Contract No.	Expenditure Period	Amount ($1000)
Sewage Metering - Primary Measuring Device Improvements - Group 2	PC-718/ CS-1225	2002-3	$44
Primary Measuring Device Improvements Group 3	PC-721	2002-7	$10,000,
Suburban Sewage Primary Measuring Devices Improvements Group 1	CS-1225	2002-7	$1,181
Flow Verification Services Metering Device Calibration	CS-1282	2002-6	$7,000
Master Sewer Meters - Clinton Twp	CS-1111-7	2002-7+	$23
Detroit Water Meter Replacement & Auto Reading Equipment Installation	CM-2007	2002-6	$70,000
Flow Control and Wastewater Sampling	None	2003-4	$3,000
Clinton Twp and Fraser Control Facilities	PC-687	Beyond 2007	$2,000
TOTAL			**$93,248**

operational at all times.

Current Expenditures

Table 4.15 shows current expenditures as per the fiscal year 2002-03 DWSD CIP.

General Recommendations

The condition of the meters has never been systematically evaluated. Many of the meters have structural components. Approximately 30 report no significant issues with operation. The rest require minor adjustments or are being repaired and replaced under CS-1249.

For flume meters, if flow measurements are off, flume construction was defective causing mechanical problems. Inspection for routine maintenance should be performed every year, scheduling. Inspection for rehabilitation should be performed every five years. Complete replacement intervals should be every 20 years.

4.9 Operations & Maintenance

Needs

Unlike the previous sections, this operations and maintenance section does not describe a separate program, but rather this section describes the operations and maintenance aspect of the previously described programs. Operations and maintenance must be considered once the capital improvement plans have been implemented. The operations and maintenance activities are an essential part to keeping wastewater systems in good working condition throughout the life of their operation. The following focuses on the collection system but applies also to other components of the system.

Scope/Magnitude in 2002-03 and Projections to 2050

There are four basic types of operations and maintenance for a collection system.

- Inspection - Field inspections are important to identify sources of infiltration and defects. All information gathered from the inspection crew should be utilized to set priorities for preventive maintenance and rehabilitation.
- Regular Preventive Maintenance – This involves cleaning lines, removing obstructions, noting needed repairs, performing minor repairs and performing special programs such as root control or chemical dosing for odor control. The goal of the preventive maintenance is to prevent infiltration into and exfiltration in the collection system, and to protect the system from unnecessary damage and decay.
- Emergency Maintenance – This involves responding to customer complaints and other emergency situations.
- Repairs – It is often cost effective to contract out some repair work. It is important to focus efforts in critical areas — those that have high cost of failure and would affect the environment nega-

tively — first.

Technologies Available

There are various technologies available to help in operations and maintenance. The type of equipment is dependant on the collection system component being operated on.

- Inspection – Inspection of existing pipeline may include surface inspection by walking the line, flow measurement, dye tests, smoke tests and video inspections. Manhole inspections are often conducted along with sewer line inspections to check for surcharge, infiltration, missing structural material and broken rims and covers
- Regular Preventive Maintenance – Effective record keeping, scheduling, cleaning sewer lines, corrosion, odor, root and grease control measures are the various components comprising preventive maintenance.
- Emergency Repair – The most important characteristic of an emergency crew is the ability to project a positive image of the public utility to the customer. Emergency calls are the basis of dispatching these crews. Reducing the number of emergency calls is a factor in reducing costs. Educating the consumer through the media, public meetings and mailings can be helpful. Operators must determine if a response to a particular call is necessary and communicate the short-term and long- term responsibilities to minimize the problem. Crews should tell the homeowner what caused the problem, how it was resolved and how it can be prevented in the future.
- Repair – This part of the program is somewhat reflective of the previous rehabilitation and replacement programs that detail the necessary steps for each component of the collection system. Repairs are prioritized and scheduled based on whether the condition is critical or not.

Criteria for Implementation

The goal of the operations and maintenance program is to reduce the cost of replacement and extending the life of a collection system component by maintaining it regularly.

- Inspection – Identify sources of infiltration and defects and log them. Perform system surveillance and simple grouting and sealing or other repair work.
- Regular Preventive Maintenance – An efficient preventive maintenance program requires good record-keeping, planning, a competent well-trained workforce, and the right equipment. A preventive maintenance program should be cost-effective in eliminating chronic problems and reduce customer complaints. Annual reporting of blockages, failures, overflows, and I/ I allow evaluation of the effectiveness of the program.
- Emergency Repairs – Reducing the number of emergency calls is a criterion for success. This is because the cost of performing a repair on an emergency basis is significantly more than the same repair performed during regular preventive maintenance.
- Repairs – When scheduling repair or rehabilitation, the following characteristics should play a role: age greater than 50 year, deeper or larger than average, brick or masonry or unlined or unreinforced concrete material, location under busy streets or near entrances to emergency facilities and sensitive environments, difficult access, frequency of maintenance and inspection, and the presence of excessive infiltration and inflow.

Operational & Financial Benefits

The four basic operation and maintenance activities are in all respects cost-effective and beneficial for the system. Without proper maintenance, costs of repair and emergency repairs will increase. Regular preventive maintenance costs are significantly less expensive than those made during

emergency conditions. "Experiences in both the public and private sector have shown that as more resources are dedicated to preventive maintenance, fewer are needed for corrective and emergency maintenance and the total maintenance costs begin to decline." (WEF, 1992)

Current Expenditures

There are currently no proactive operations and maintenance programs scheduled in the five-year capital improvements plan. Most projects are started in response to critical sewer system conditions. There is no program to install grease traps. Grease problems are addressed only when a customer complains. Most grease problems exist near industrial sites and are handled by the industrial pretreatment group. Although grease problems also exist in residential areas, there are no programs in place to address these issues.

General Recommendations

- Inspection – Perform field inspections by surface inspections, walking the line, flow measurement, dye tests, smoke tests and video inspections. Large diameter lines are inspected by manned entry.
- Regular Preventive Maintenance - Prevent infiltration and exfiltration. Protect the system from unnecessary damage or decay. Record and report components critical to budget costs. Schedule repairs and monitor daily operations. Clean sewer lines by mechanical, hydraulic or chemical means to maintain a clean and fully open sewer. If no database exists as to how often the lines were cleaned a rule of thumb is to clean sewer lines every five years (Maring, 1995).
- Emergency Repairs – Reducing the number of emergency calls should reduce costs. Educating the customer through the media, public meetings or mailings can be helpful. Priority must be placed on calls. The repair crew needs to tell homeowners the cause of the problem, how it was resolved and how it can be prevented in the future.
- Repairs - Rehabilitation dollars should be spent on the most critical areas. Sometimes it is cost-effective to contract out repair work to other departments or outside subcontractors or borrow and share equipment.

5. CSO and SSO Control Program

5.1 CSO Program

5.1.1 Introduction

The Detroit Water and Sewer Department (DWSD) maintains Detroit's combined storm and sanitary sewer system. Both sanitary and storm flows are ordinarily diverted to the treatment plant. The collection systems cannot handle the flows generated by significant storm events. When this happens, the system becomes surcharged; and both sewer and storm flows are diverted to local waterways. This is commonly referred to as a Combined Sewer Overflow (CSO). Construction of combined sewer systems was the standard practice for many years until the Clean Water Act was adopted, requiring all cities to meet specific water quality standards.

Current regulations require specific measures to reduce combined sewer overflows. In response, Detroit developed the Long Term Combined Sewer Overflow (LTCSO) program, as required by the National Pollution Discharge Elimination System (NPDES) permit issued by the Michigan Department of Environmental Quality (MDEQ) in 1989 and modified in 1992.

5.1.2 Background

The following time line describes the major events in the LTCSO program:

Time Line

October 1989 – New NPDES Permit Requirements

December 1992 – Revisions to NDPES Permit

July 1996 – Submitted approvable Wastewater Treatment Capacity Analysis Report

July 1996 – Submitted approvable Long Term Combined Sewer Overflow Control Program for the Detroit River Outfalls

July 1996 - Submitted approvable Combined Sewer Overflow Control Program for the Rouge River Outfalls

October 1997 - New NPDES permit took effect

December 31, 2001 - Update of Long Term CSO Control Plan

December 1, 2008 – Amendment of Long Term CSO Control Plan

DWSD's discharges from its wastewater collection system at the Wastewater Treatment Plant (WWTP), or as CSOs through its outfalls on the Detroit and Rouge rivers, are allowed through the NPDES permit issued by MDEQ under authority of the USEPA. In 1989, the MDEQ issued a new NPDES Discharge Permit that required the elimination or "adequate treatment" of combined sewer overflows. DWSD formally contested the proposed permit provisions due to the costs associated with the permit. This led to a series of settlement negotiations. These negotiations concluded in an agreement to develop a Long Term Combined Sewer Overflow (LTCSO) program. This led to the design and construction of several short-term CSO facilities as part of a Rouge River Basin Demonstration Program. This program required DWSD to design, build, and monitor for two years the performance and effect of the pilot projects on Rouge River water quality.

As part of the settlement agreement, additional items were added in 1992 to the list of required projects, including:

- Design and construction of a third CSO detention basin
- Evaluation of the hydraulic capacity of the WWTP
- Evaluation of the collection system transport capacity

- Utilization of in-system storage at selected locations
- Development of a Collection System Operational Plan
- Preparation of a Rehabilitation Plan

Currently, design and construction have been started for the CSO controls for the Rouge River outfalls above Michigan Avenue, along with the controls for the Baby Creek outfall, the Source Control Project, in-system storage, and real time control.

The Source Control Project will be developed based on the results of the pilot program and will be instituted citywide in residential areas. Currently, data is still being collected and interpreted. Other areas of focus in the future are the marinas along the rivers.

Evaluation of the Rouge River Demonstration Plan will start in 2005 and continue for two years. Modifications as needed will then be made to the Rouge River Long Term CSO portion of the plan, allowing for design starting in 2008 through 2010. Construction will begin in 2011 to be completed in 2014. Evaluation of the Detroit River CSO facilities will begin in 2016, and continue until 2018. This will allow for the initiation of design for any facilities to be completed during the 2019-2035 time period. Need for the projects will be determined based on the extent and significance of public health problems attributed to CSO discharges.

5.1.3 Long Term Plan

DWSD has been mandated by MDEQ to provide "adequate treatment" for its combined sewer overflows as part of the NPDES permit issued in 1989 and revised in 1992. As a result of the agreement with MDEQ, several demonstration/ pilot projects were initiated under the Preferred Plan. The active CSO projects are the In-System Storage Project, Screening and Disinfection Pilot Projects (Leib and St. Aubin), Baby Creek CSO Facility, Connor Creek CSO Basin and several Wastewater Treatment Plant upgrade projects.

Several pilot studies have been initiated. Conner Creek, Leib, and St. Aubin have all been designed and are under construction or completed. Monitoring of these facilities will begin in the next few years. Two years of monitoring these facilities will provide enough data to determine the success in reducing and treating CSOs with these facilities. The results of this data and consideration of the USEPA Combined Sewer Overflow Policy and NPDES Permit issued by MDEQ will lead to a new course of action to improve the receiving waters.

In the near future, a deep rock tunnel will also be started. The results of these projects will be reported to MDEQ and an amendment to the LTCSO plan will be developed to address remaining issues.

Tunnel

Within the LTCSO plan, several alternatives were investigated to reduce the CSOs entering the Upper Rouge River. These alternatives were analyzed to determine the most cost-effective and efficient way to address the CSO problem. As a result, the LTCSO report recommends a deep rock "treatment" tunnel as the most cost effective CSO control plan for the upper Rouge River outfalls. This facility would screen, disinfect, and provide contact time for the 10-year, 1-hour flow and reduce the expected discharge occurrences to once a year. DWSD has confirmed it will move ahead with the design and implementation of this tunnel.

Seven alternatives were investigated to determine the most cost-effective and efficient way to address the CSO problem in the Upper Rouge River:

- Soft Ground Tunnel – Original Tunnel Route
- Soft Ground Tunnel - Dual Route

- Flow-through Rock Tunnel
- Conventional Rock Tunnel
- Conventional Rock Tunnel with Basins
- Soft Ground Tunnel with Basins
- 13 CSO Basins

These alternatives were analyzed based on their ability to reduce nutrients and solids entering the waterway, disinfect the combined flows, and remove floatables. The most cost effective alternative was to be evaluated. As a result, the deep rock "treatment" tunnel was recommended.

The planning level criteria for design were recommended. The tunnel will be 150 feet deep and run over 40,500 linear feet. In total, the tunnel will provide 120 million gallons of storage capacity. The proposed diameter is 22.5 feet. Additional features include 10-drop shafts, a dewatering pump station capable of dewatering the system in 24 hours, and two surge tanks.

New Developments

New developments have occurred involving the joining of the Upper Rouge River tunnel with Dearborn's proposed deep tunnel. Dearborn is also proposing a CSO tunnel running along the Lower Rouge River. The Dearborn tunnel is proposed to be 5.7 miles and hold 55 million gallons. The joint tunnel would have had a single dewatering pump station. The Dearborn tunnel will also have surge control facilities at its beginning and end. A connector tunnel would have been required, which would have increased the volume of the joint tunnel. In early 2001, preliminary cost estimates for the joint tunnel were presented to both municipalities. Both chose to move forward with the engineering feasibility study concentrating on the geotechnical and hydraulic aspects of the joint tunnel. A decision has been made to pursue separate tunnels.

Table 5.1 of Appendix A shows all projects required in the LTCSO plan agreed to by MDEQ in 1992 and described in the 1996 LTCSO report. The only change to this list in the update is the reduction of in-system storage devices from 33 to 13. Several of these projects are already underway or listed in the current 2002-2007 CIP. These projects and their costs are also listed in Table 5.1 of Appendix A.

Some of the projects will extend beyond DWSD's current 2002-07 CIP, or will begin after 2008. Table 5.2 in Appendix A lists the estimated costs for these projects, as discussed in a meeting on January 14, 2003 with consultants and DWSD staff working on the Long Term CSO Control Program. The costs of these projects are included in the Wastewater Master Plan CIP.

5.2 SSO Control

Needs

The DWSD regional sewer system consists of both a combined sewer service area and a separated sanitary sewer service area. Detroit's sewer system is almost all combined. As a result, the city does not have any sanitary sewer overflows (SSOs). However, several of the city's wholesale customers do have separate sanitary sewer systems that experience SSOs. These SSOs can be caused by a number of factors, including high wet weather flows due to infiltration and inflow, physical capacity constraints, constraints in achieving contract flow capacities to the DWSD system, and temporary operation and maintenance problems.

SSOs are releases of untreated sewage into the environment. Such discharges are illegal in Michigan. SSOs can be related to basement flooding, which has the potential to cause property damage and may present public health concerns. The Michigan Department of Environmental Quality (MDEQ) policy is to identify separate sanitary sewer overflows and take appropriate regulatory action to eliminate them.

In the spring of 2001, the DWSD joined with its wholesale customers in a collaborative process to examine solutions to eliminating the public health and water quality impacts of SSOs in the DWSD service area. This effort began after the DWSD had been approached by several customers seeking additional contract capacity as a potential approach to eliminating SSOs in their collection systems.

There are a variety of problems that may cause chronic SSOs. These problems include:

- Inflow
- Infiltration
- Undersized Systems (sewers and pumps too small to carry all of the sewage or peak wet weather-induced flows in the system)
- Pipe Failures (blocked, broken, or cracked pipes, sediment buildup, pipe settling, pipe shifting, etc.)
- Equipment Failures (pump failures, power failures)
- Sewer Service Connections (discharges occurring at faulty sewer service connections to buildings)
- Deteriorating Sewer System (improper installation, improper maintenance)

Scope/Magnitude in 2002-03 and Projections to 2050

Overall, 17 DWSD customers reported 41 million gallons of SSOs to MDEQ in the period (July 2000 to July 2002). In the first year, 26 MG was reported; in the second year, 15 MG was reported. By comparison, over 33 billion gallons of combined sewer overflows (CSO) were reported during the same period. A complete summary of the frequency, volumes, and causes of SSOs in the DWSD service area is given in Volume 6 of the Wastewater Master Plan, *Evaluation of Regional SSO Controls*.

Causes were identified in a survey of the DWSD customers. Based on the regional modeling analysis, it appears excessive flows over the original design capacity is the primary cause. Furthermore, the survey results and field data collection indicate that footing drains connected to the sanitary sewer system appear to be the primary reason for the excessive flows. All customers reporting SSOs have a portion of their system that has residential footing drains connected to the sanitary sewer system.

Technologies Available

Both local and regional SSO control alternatives are available.

Short-Term Control Measures: Short-term control measures are viewed as temporary/ interim solutions to the sanitary sewer overflow problem. On October 23, 2001, the Michigan Department of Environmental Quality Surface Water Quality Division sent a letter to all municipalities with sanitary sewers. Attached to the letter was a list of 13 short-term SSO control measures that can and should be implemented in approximately 36 months to minimize and partially control sanitary sewer overflows associated with capacity deficiencies or excessive wet weather flows. The 13 short-term SSO control measures, which include inflow and infiltration reductions, sewer use ordinances, and leak detection, are defined in Chapter 13 of Volume 6 of the Wastewater Master Plan, *Evaluation of Regional SSO Controls*.

- **Local Storage:** The local storage alternative consists of placing storage basins in the system to temporarily store sewage during heavy rainfall events. This would enable peak flows to be reduced downstream of the basins by storing them until the rainfall intensity has decreased.
- **Source Reduction:** Source reduction is any means used to prevent or reduce stormwater

from entering the sanitary sewer system. The source reduction alternative primarily considered was footing drain disconnection. For this type of source reduction, a sump pump would be installed in each home that has the footing drain disconnected. The sump pump would direct all stormwater into the backyard or storm sewer system. Reducing the volume of water that enters the sanitary sewer system reduces the peak flows during a storm and therefore reduces surcharging. Other types of source reduction include downspout disconnection/ enforcement and structural rehabilitation to prevent infiltration through cracks and joints.

- **Treatment:** Like the local storage alternative, the treatment alternative consists of placing storage basins in the system to temporarily store sewage during heavy rainfall events. Unlike the local storage alternative, the treatment alternative does not allow for the complete storage of the SSO and/ or contract exceedance volume. Rather, this alternative would allow for a minimum amount of contact time in order to treat the sewage before it is discharged.

Under the treatment alternative, sanitary sewer overflows would not necessarily be prevented. However, the sanitary sewage would first be treated before it is released and potentially overflowed. This could range from screening and disinfection techniques to more advanced techniques such as ballasted flocculation and the use of other physical and chemical treatment options to meet secondary treatment standards. Current regulations require full secondary treatment for any sanitary flow. In order for these alternatives to be possible, some leeway would need to be given for achieving 85 percent removal for sanitary flows that have been diluted with rainfall.

- **Transport Capacity:** The transport capacity alternative can either consist of building relief sewers or pipe bursting. Relief sewer construction consists of placing a parallel pipe next to a pipe with insufficient capacity that is already in the ground. This will enable the flow that is currently in one pipe to be divided between two pipes.

- **Regional Transmission/Acceptance:** Regional solutions for SSO control involve conveying excess wet weather volumes to the DWSD interceptor system in order for them to be treated at the WWTP. This alternative must consider potential downstream flooding impacts, as well as displacement of CSOs. Pipe bursting involves a machine that would replace the original pipe with a large pipe. The larger pipe would increase system capacity.

Details on these alternatives, including the costs and benefits for each one, can be found in Volume 6, *Evaluation of Regional SSO Controls*.

Criteria for Implementation

Based on the recommendations from the SSO control study, Detroit should be able to accept flows into the regional system up to an "allowable 10-year, 1-hour flow" for each customer. The "allowable 10-year, 1-hour flow" is the flow generated from a local collection system during the 10-year 1-hour design storm that conforms to criteria for peak hour flow to average daily flow for growth (summer) antecedent conditions and "best practices for system maintenance" developed by the Wastewater Master Plan and endorsed by the Contracts Work Group.

Ultimately, it is expected that following the "best practices for system maintenance" will lead to reducing flows to within a maximum peak flow allowed for the 10-year, 1-hour event. The primary factor in determining this "allowable 10-year, 1-hour flow" for each community is the percentage of homes with connected footing drains.

Local SSO solutions such as storage and footing

drain disconnection will be needed for flows over the allowable 10-year, 1-hour flow up to the level of control the MDEQ establishes (most likely the 25-year, 24-hour growth event). Communities not reporting SSOs but which are over this contract amount will also need to reduce wet weather flows to meet the "allowable 10-year, 1-hour flow."

Details of how this will be implemented and enforced will be determined by the DWSD contract work groups. However, DWSD will need to identify with each customer what their "allowable 10-year, 1-hour flow" is and what capital improvements need to be made by DWSD.

Operational and Financial Benefits

Performing this work will help provide a high level of customer service by:

- Providing cost-effective solutions to eliminate SSOs from the DWSD service area.
- Establishing a uniform policy that deals with all customers equitably.
- Managing the regional system optimally and responsibly.

Current Expenditures:

Currently, the only expenditures on this work are through the SSO task of the Wastewater Master Plan.

General Recommendations:

The following steps should be followed by DWSD to identify and implement the necessary improvements of the proposed SSO control plan:

- The SSO work group should continue to meet and be hosted by the DWSD in order to collect and share program information. This will include monitoring the progress and implementation plans. Furthermore, DWSD should continue to provide technical assistance through the SSO work group and GDRSS (CS-1249).
- Contract revisions and renegotiations should be done with each customer based on the "allowable 10-year, 1-hour growth event" and direction from the contracts work group. This should include identifying any capital improvements DWSD is responsible for.
- DWSD through the Wastewater Master Plan should finalize the list of "Best Practices for System Maintenance"
- Through the SSO work group, DWSD should continue its role to help customers in interactions with MDEQ regarding SSO guidance/ regulations and compliance.

6. Wastewater Treatment Plant & Other Facilities

Needs

The Detroit Water and Sewer Department (DWSD) owns and operates Detroit Wastewater Treatment Plant (WWTP). These facilities were built in the 1940s, with substantial renovations in the 1970s and currently with the PC-744 project (Wastewater Treatment Plant Upgrade Project). Many of the units in the facility have reached the end of their life expectancy or will in the next 50 years. For this reason, an estimate of the rate of rehab/ replacement is required to determine what the needs for funding will be in the next fifty years. Additional consideration should to be given to addressing new regulatory requirements.

As summarized in Section 2 of this report, the Wastewater Treatment Plant will not need to be expanded for several decades. The need for additional capacity will need to be periodically re-evaluated based on the results of other important programs such as the Long Term CSO Control Plan. Even if the plant does not need to be expanded, it is likely that another major rebuilding of the plant on its current site will be required in the next 50 years.

Control of the collection system operation is essential to ensure that the wastewater treatment processes at the plant are used to their optimum capacity before expansion of the plant is required. Adequate control technologies should also result in easier operation and fewer personnel to operate the plant and collection system.

Scope/Magnitude in 2002-03 and Projections to 2050

The Wastewater Treatment Plant currently treated approximately 724 mgd of wastewater a day in 2001, plus 50 to 70 mgd of recycled flows on average. The peak permitted primary treatment capacity for wet weather flows is 1,520 mgd. DWSD will increase the permitted treatment capacity 1,700 mgd upon completion of contract PC-744. The permitted secondary treatment capacity is 930 mgd.

Originally, the plant was put into operation in 1940 with a 50-70 percent pollutant removal rate, based on a population of 2 million people. Since that time, the treatment plant has been upgraded to remove 85 percent of the pollutants and serve a population of over 3 million. Due to stringent permit requirements, DWSD has been required to continually upgrade and rehab the plant.

In addition, many of the capital facilities and some of the infrastructure that were originally installed are nearing the end of their useful lives and need replacing. It is also critical that the Wastewater Treatment Plant be put in a condition of sustained, long-term compliance with DWSD's NPDES permit and other regulatory requirements, as well as compliance with MDEQ, OSHA/ MIOSHA, and Clean Air/ Clean Water Acts.

A rehabilitation and replacement schedule for Wastewater Treatment Plant facilities is included in Table 6.1 of Appendix A. The estimates costs related to this schedule are shown in Table 6.2 of Appendix A.

Technologies Available

DWSD commissioned a *Needs Assessment Study*, as part of the PC-744 project, to quantify the amount of rehab/ replacement needed immediately and in the future at the WWTP. The Needs Assessment was developed to assist in properly identifying areas of improvements for upgrading the WWTP over the next five years and beyond. Annually, reports have been submitted detailing the ongoing and proposed capital improvement projects.

The report focused on four areas of improvement: the liquid stream treatment process, the solids stream treatment process, utilities, and miscellane-

ous support facilities.

Within the liquid stream treatment process, there are four facilities that require major upgrades to meet future permit requirements. These are rehabilitation and installation of pumps in the raw wastewater pump stations, installing two new circular primary clarifiers, rehabilitation of the rest of the circular clarifiers, upgrading the Intermediate Lift Stations (ILS), and upgrading the aeration decks.

Within the solids stream treatment process there are also several facilities that need to be upgraded: the gravity thickeners, the dewatering facilities and conveyance belts, incineration facilities, and lime mixing facility.

The entire plant is connected with underground and aboveground utilities. Most of the current infrastructure (process lines, water, gas, communication, electrical, air, and steam) need to be rehabbed or replaced. There are several ongoing and future projects to address current deficiencies.

Support facilities are non-process facilities within the WWTP. The main buildings are the administration building, the maintenance building, the operations building, plant parking facility, and plant electrical building. Substantial renovations are needed in the old administration building and in the existing parking structure. Asbestos and concrete repairs are required throughout the facilities.

Each of these areas was investigated to determine which units in the facility needed renovation, replacement, or maintenance. Significant portions of the recommended projects have been started, with a target completion date of 2005.

During the current renovations and upgrades, there are many types of new technologies that are being used in the investigation and design of the unit processes of the WWTP. Due to space limitations at the current WWTP, new technologies that are more space-efficient may be needed in the long run. This would include fluidized bed clarifiers and high rate filters.

Criteria for Implementation

The *Needs Assessment Study* identified critical components of the plant that needed upgrading to meet current regulatory standards. There are two more needs assessments updates scheduled under PC-744, to be completed in 2003 and 2004. The 2004 revision will identify projects that may be needed but may not be completed under the current contract ending in 2005. These projects should receive priority for completion.

An ongoing needs assessment program will be recommended by the team implementing the PC-744 project, the Detroit Wastewater Partners. If continued, the needs assessment process will determine the priority for replacement and rehabilitation of plant components.

Using current life expectancy data as described in Section 3 of this report, the anticipated needs for rehabilitation and replacement can be estimated. These estimates are shown in Table 6.2 of Appendix A, based on information currently available in the *Needs Assessment Study*. Final prioritization should be set using a variety of factors including safety, process, and overall need.

Operational and Financial Benefits

The benefits of a long-term program to maintain and upgrade the plant include:

- Facilitate timely and less expensive replacement of plant components before they fail.
- Improve operational efficiency by freeing up plant staff to attend to other necessary tasks.
- Improve the work environment at the plant.
- Avoid permit problems and fines.

Current and Estimated Future Expenditures

A complete summary of all of the Wastewater Treatment Plant projects currently underway and planned, according to the 2002-07 CIP, can be found in the CIP summaries for Program 3 found in Appendix A on the CD that accompanies this report. This summary includes projects required for system control, as well as work on the Wastewater Treatment Plant.

Table 6.3 at the end of this section compares current Wastewater Treatment Plant project costs as listed in the *Needs Assessment Study - Revision 3* and the proposed 2002-07 CIP. Projects currently on hold and not included in the current CIP are identified in this table.

Detroit Wastewater Partners (Malcolm Pirnie), the program managers for the PC-744 wastewater plant upgrade, reviewed this information in a meeting on January 31, 2003. They reported that a more complete assessment of future work on the plant is anticipated by the end of 2004, when the next Needs Assessment is completed.

In the meantime, an overall assessment of funding needed for the Wastewater Treatment Plant Program was developed for planning purposes from a summary of the current funding for wastewater treatment plant programs. The data on these expenditures can be found in more detail in Appendix A and is summarized in Table 6.3.

Table 6.3: Summary of CIP Proposed Expenditures on the WWTP and System Control

CIP	Proposed CIP Expenditures (over 5 years)	Yearly Average (over 5 years)
2002/3 to 2006/7	$878M	$175M
2002/3 to 2006/7 (deleting non-WWTP projects)	$670M	$134M
2001/2 to 2005/6	$973M	$194M
1997/8 to 2001/2	$493M	$99M

**See Appendix B, Program 3 for a detailed list of projects from the current CIP

Source: Sewage Disposal System Capital Improvement Program,

The totals for the Wastewater Treatment Plant projects in the CIP documents usually include some projects in other parts of the collection system, such as pump station projects. These were deleted from the totals detailed in Appendix A and result in the lower estimate of $670 million rather than $878 million for Wastewater Treatment Plant and system control expenditures.

From this summary, the planning level estimates for expenditures on the plant are as follows:

- Total Wastewater Treatment Plant yearly estimated CIP funding needs: $150 million
- Yearly needs assessment and inspection: $100-200,000 per year. If not done yearly, the cost would be higher.

Detroit Wastewater Partners (Malcolm Pirnie) also reported that expenditures on renewal and replacement of wastewater treatment plant components are typically 3 percent of the value of the wastewater plant per year for large plants. An estimated value for the Detroit Wastewater Treatment Plant is about $5 billion. Expenditures of 3 percent of the plant value result in an estimate of $150 million per year as a reasonable target to maintain a functioning plant.

General Recommendations

Recommendations on future work on the Wastewater Treatment Plant can be summarized as follows:

- Complete projects recommended by PC-744 that may fall outside of the current contract expiring in 2005.
- Conduct a yearly needs assessments to determine the need for new equipment.

- Conduct needs assessments evaluating processes and plant capacity every three years.
- Evaluations should consider the ultimate life of wastewater treatment plant components, including structural elements.
- If the Wastewater Treatment Plant is maintained as is, the annual CIP funding needs will be about $150 million. Space-saving and improved treatment technologies could be implemented in the future. The use of these technologies would affect the yearly estimated funding needs for the WWTP.

7. Environmental Protection Program

7.1 Regulatory Compliance and Monitoring

Needs

Complying with federal requirements will avoid penalties and extended legal issues. The extent and complexity of the regulatory oversight of the DWSD operation makes compliance a challenge. By participating in the development of laws, rules and regulations, DWSD can help regulators understand the effect and cost of new requirements on DWSD customers, influence the decisions and help to anticipate capital improvement needs.

It is difficult and cumbersome to secure timely adoption of updated sewer use ordinances from each suburban municipality when changes need to be made to comply with the federal regulations or changes in the National Pollution Discharge Elimination System (NPDES) permit issued to DWSD. The NPDES permit applies to Detroit and the 76 suburban customers.

The emerging issues most likely to impact DWSD sewerage operations are the development of total maximum daily loads by MDEQ, new regulations on sanitary sewer overflows and MDEQ clarifying CSO requirements. The new NPDES permit for the DWSD wastewater discharge will impact the DWSD sewerage system and its customers.

Further study is needed to understand the impact of atmospheric deposition of mercury and PCBs on the DWSD sewerage system.

Scope/Magnitude in 2002-03 and Projections to 2050

There are numerous federal and state laws and regulations, as well as the Detroit City Charter, that directly and indirectly impact the DWSD sewerage system. Reporting is required to EPA and MDEQ for regulatory compliance for the PCB/ Mercury Minimization Program, SARA Title III, Clean Air Act, 503 Sludge Regulations and the Underground Storage Tank Act. Five technical memoranda have been written as part of the master planning process to describe regulatory impacts. These are identified in the reference section.

- The DWSD sewerage system is subject to extensive regulation under the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 and the Water Quality Act of 1987 (the "Clean Water Act") and other federal and state laws, regulations and guidance documents. The key document that details compliance requirements for DWSD is the NPDES permit, MI0022802 issued July 1, 1997 and expired on Oct. 1, 2002. A new NPDES permit is expected in 2003.
- Incinerator emissions are regulated under the Federal Clean Air Act and the permit issued by the State of Michigan.
- Inert ash from the incinerator is disposed of in a landfill regulated by the Solid Waste Management section of the Michigan Environmental Code (part 115).
- The U.S. Federal District Court has placed requirements on DWSD to comply with federal laws under the jurisdiction of the court.
- DWSD provides wastewater service to 76 suburban customer communities, and administers the Industrial Pretreatment Program in the service area pursuant to delegation agreements, that have been approved by each suburban customer. Each customer is required to adopt a local sewer use ordinance that is consistent with and at least as restrictive as, Detroit Ordinance 34-96. Ordinance 34-96 is the basis for the industrial pretreatment program. Required changes in Detroit Ordinance 34-96 occur when a new NPDES

permit is issued by MDEQ and when federal regulations change. Additional discussion of Ordinance 34-96 appears in the section on Industrial Pretreatment Program.

- In addition there are emerging regulatory issues that could increase the cost of operation of the DWSD sewerage system. EPA's Total Maximum Daily Load (TMDL) regulation and new state regulations on CSOs and SSOs could result in additional requirements.

Further description of the various Detroit, federal and state laws and regulations directly and indirectly impacting the DWSD sewerage system is provided in the DWSD technical memorandum, *Review of Federal, State and Local Regulations* on the CD that accompanies this report.

The technical memorandum, *Review of Emerging Regulatory Issues,* describes emerging regulatory issues that could impact DWSD and could affect development. These include: total maximum daily loads; water quality trading; watershed planning and watershed management districts; sanitary sewer overflow controls; treatment of combined sewer overflows; wet weather flow blending; wet weather water quality standards; nutrient limits; chlorine use restrictions; industrial pretreatment requirements; land use controls to regulate growth and sprawl; and storm water permits.

The paper presented at WEFTEC in 1998 summarized the findings of a major study to assess the impact of atmospheric deposition of mercury, PCBs and cadmium to storm water runoff. One conclusion is: "The median concentrations of mercury and PCBs in precipitation, storm water runoff exceed water quality based effluent limits by 2 to 3 orders of magnitude." Mercury and PCBs in rainwater will impact sediments in the sewers, biosolids, incineration and the effluent discharge from the wastewater plant.

Technologies Available

The following alternatives for regulatory compliance are identified in the technical memorandum, *Review of Source Water Protection and Related Watershed Management Regulations and Programs,* that is on the CD that accompanies this report.

- Habitat Equivalency Analysis — relates ecosystem information to water quality credits.
- Water Quality Trading — allows trading of discharges that exceed water quality standards for discharges that are less than water quality standards.
- Net Environmental Benefit Analysis — a technique to quantify and compare the benefits of alternative actions that affect the environment.
- BMP initiatives — applying BMPs to non-point sources such as mercury, could meet future NPDES requirements.
- Future watershed-wide permit concept — focuses on water quality goals, multiple sources of pollutants, and non-point source controls. A watershed approach provides an alternative for compliance with future regulations on discharges from the wastewater treatment plant. The watershed approach includes prioritizing sources of pollutants in the entire watershed and developing a plan to address them.
- TMDL impacts on WWTP discharge to receiving streams — TMDLs are established when water quality does not meet standards. A TMDL on the Detroit River would require addressing the pollutant of concern.
- Further reduction and control of point sources such as CSO, SSO and WWTP wet weather treatment capacity.

Criteria for Implementation

The DWSD sewerage system could be self-sustaining, operate without federal assistance and in compliance with federal regulations. In the Response of the City of Detroit to the Report of the

Committee of Investigation: Detroit Water & Sewerage Department-Violations January 12, 2000, the city stated,

"It is the mission of the City of Detroit to operate and maintain its wastewater treatment plant in compliance with all applicable state and federal laws including the Amended Consent Judgment and its NPDES permits for the benefit of the public in general and specifically for the benefit of the customers which it serves, both inside and outside of the City of Detroit."

The operation of the DWSD sewerage system must be in compliance with the NPDES permit and state and federal laws. Compliance will involve the DWSD employees and customers in a system-wide effort to know the requirements and operate and maintain the system within the parameters called for.

Operational & Financial Benefits

- Compliance with the laws that apply to the DWSD sewerage system will avoid fines and the cost of court appearances.
- DWSD will be able to plan improvements based on need and benefit.
- DWSD will be seen as a leader in protecting the environment and improving the quality of life for people in Southeast Michigan.
- Compliance alternatives could reduce the cost of operation and could avoid future capital expenditures.

Current Revenue/Expenditures

Regulatory compliance expenditures planned for 2002 to 2004 include several contracts and line items. These include: CIP implementation assistance and related services; assistance to the Mayor as Special Administrator for the Sewage Treatment Plant, Legal Services, Wastewater Master Plan, legal services for audits and grants, and assistance with regulatory agencies and strategic planning and capital improvement. The budgets for these items total approximately $6.8 million.

General Recommendations, Future Expenditures and Schedule

DWSD should:

- Provide coordination and leadership to suburban customer communities to assist them in achieving compliance with new federal regulations which will require permits for tributary sanitary sewer systems and the development of Capacity, Management, Operation and Maintenance (CMOM) programs.
- Provide support as needed or requested by suburban customer communities who pursue watershed plans in response to EPA's Phase II storm water permit requirements.
- Actively participate with state and federal regulatory agencies as they analyze and develop new rules and policies relating to wastewater treatment and/ or water quality. This should include involvement in various organizations such as the Michigan Municipal League, SEMCOG, the Water Environment Federation, the Association of Metropolitan Sewerage Agencies, etc.
- Advocate and support expanded funding for wastewater infrastructure projects through grants and loans at both the state and federal level.
- Support state and/ or federal legislation that would regulate the content of hazardous materials such as mercury in commercial or household products, where the pollutants could ultimately wind up in the waste stream.
- Participate in efforts to establish "Smart Growth" initiatives to optimize the utilization of existing infrastructure and reduce the need for expansion of costly services to undeveloped areas.
- Continue to work with the International Joint

Commission on activities to address that agency's long-term water quality goals for the Great Lakes and connecting channels including remediation of the "Areas Of Concern" and reduction of pollutants such as nutrients and bio-accumulative toxic chemicals.

- Continue to compile water quality and sediment quality data on the Detroit River for future use in the development of Waste Load Allocations and/ or the establishment of allowable TMDLs.
- Pursue termination of the Federal Consent Decree and removal of the Federal Court's oversight of the system administration by completing all required activities as set forth in the Amended Consent Judgment.
- Review the use of hazardous chemicals and the status of spill prevention and response plans, and make appropriate modifications as necessary to ensure full compliance with state and federal regulations for the handling, use, storage, and disposal of these materials. Consideration should be given to pursuing Environmental Management System (EMS) or ISO certification as a mechanism to address this issue.
- Evaluate the adequacy of current laws and regulations to oversee and regulate the privately owned sewer infrastructure (i.e. house leads and footing drains) to insure that they are properly maintained and do not contribute excessive dry and wet weather infiltration and inflow to the system. Consideration should be given to the adoption of a "time of sale" inspection requirement for residential property.
- Establish mechanisms to minimize the potential for illegal dumping of septage and/ or industrial wastes into the sewer system.
- Develop a compliance program to monitor the condition of residential downspouts and insure that these I/ I sources are not connected to the sewer system throughout the service area.
- Review and revise as necessary the Sewer Use Ordinance and Industrial Pretreatment Program to incorporate modifications to local limits based on updates to the headworks loading analysis, and to implement a streamlined enforcement process for industrial discharge violations. Consideration should be given to a mechanism which would streamline the adoption of these requirements by suburban customer communities including contract provisions to be set forth in the new Service Agreements. The Industrial Waste Control Division Ordinance 34-96 should be reviewed when the new NPDES permit is issued by MDEQ. Possible discrepancies between Ordinance 34-96 and the code of federal regulations were identified in the technical memorandum, *Industrial Waste Control Division, Ordinance 34-96*. The Findings and Conclusions section in that technical memorandum should be reviewed when the ordinance is updated.
- Consider watershed alternatives for complying with future regulations.

7.2 Industrial Pretreatment and Septage Management Program

7.2.1 Industrial Pretreatment Needs

Harmful pollutants entering the DWSD sewerage system can upset the treatment process, harm employees and contaminate sludge making it difficult to dispose of. PCBs, mercury and fats, oils and grease have been problems in the past. The Industrial Waste Control Division monitors and regulates sources of wastewater discharges that could be harmful.

As changes are made to the federal pretreatment regulations, changes are required to Ordinance 34-96. A review of Ordinance 34-96 was completed in the technical memorandum, *Industrial Waste Con-*

trol Division, Ordinance 34-96. Three discrepancies were identified in the technical memorandum between the federal regulations and Ordinance 34-96. Additional requirements are expected on metal products manufacturing processing that could expand the number of significant industrial users.

Scope/Magnitude in 2002-03 and Projections to 2050

The Industrial Waste Control Division (IWC) is responsible for implementation and enforcement of Ordinance 34-96 and the federal pretreatment regulations, 40 CFR 403. The purposes of the ordinance are to protect the environment, public health and safety and pollution prevention.

There were 403 standard industrial users (SIUs) in 2001, with an estimated discharge of 45 mgd. There were 12,042 non-SIU dischargers in 2001 with an estimated discharge of 50 mgd. The SIUs make up about half of the industrial flow, and 7.5 percent of the dry weather flow (605 mgd in 2001) to the sewage plant. Regular inspections, monitoring and sampling of wastewater help determine that wastewater is safe for the sewerage system and workers. In 2001, 685 facilities were inspected, 13,138 samples were collected and $453,867.51 was collected in fines, fees and penalties.

I.W.C. has established a Pollution Prevention group to develop information summaries about chemicals and materials for industrial, commercial, and residential customers, and brochures about silver and grease traps.

The PCB/ mercury program has resulted in non-detectable levels of PCBs and mercury in the waste stream. This program could serve as a model for other constituents that may have to be addressed.

Flow from SIUs is projected to decrease from 45 mgd in 2000 to about 35 mgd in 2050. Detroit will have the largest flow reduction going from 23.6 mgd in 2000 to 17 mgd in 2050. When the Western Wayne communities transfer their sewage to the Ypsilanti Community Utilities Authority (YCUA), there will be further reductions in the industrial flows and the pollutant loadings to the Detroit wastewater plant from SIUs.

IWC receives complaints regarding backups of sewage and obstructions in the sewers. Similar complaints are received at the Health Department and the Building and Safety Engineering Division of DWSD.

Technologies Available

The pretreatment information management system database under development (PIMS) will retrieve and process monitoring data by SIU and enable access to the complete monitoring database. Detroit's system will be modeled after similar ones in Chicago and Kansas City. The Massachusetts Water Resource Authority also has an information system that integrates field inspections with laboratory data.

The WOTS is in operation within DWSD and could be used by IWC to report and track complaints.

Criteria for Implementation

Revisions to Ordinance 34-96 should be undertaken when there are revisions to the federal pretreatment regulations. A process for revising community sewer regulations, which is required when Ordinance 34-96 is revised, could be addressed in contract negotiations with each community.

Operational and Financial Benefits

- By simplifying the process to revise community regulations it will reduce DWSD staff time verifying that communities have adopted the latest ordinance revision.
- Identification of data by SIU would allow a comparison of quality of wastewater north and south of Eight Mile Road.

- Monitoring pollutants and flows will identify trends in the quality and quantity of wastewater from SIUs.
- Tracking complaints and coordinating complaint response with others that respond would reduce duplication of effort to correct problems and could assure better compliance.

Current Revenue/Expenditures

IWC collected $454,000 in 2001 for fees, fines, fees and penalties. The budget for operation of the IWC Division includes $736,906 for administration, $7,3216,720 for Field Monitoring and $2,725,500 for Program Operations. The budget for the Pre-treatment Program Database Management is $1,897,000 for 2002 to 2004.

General Recommendations, Future Expenditures and Schedule

The industrial pretreatment program provides adequate monitoring, testing and data management of industrial discharges to prevent the introduction of harmful pollutants into the wastewater system. The DWSD system is one of the largest in the world. What has been learned and the solutions that have been implemented would benefit other sewer providers. One recommendation is that IWC present papers at national conferences to share information and report on work being undertaken to meet regulations and to improve the operation (i.e. PIMS). Other recommendations:

- The data collected on Significant Industrial Users (SIUs) by the IWC and by each SIU should be organized by SIU. This data would be available as part of the implementation of the PIMS.
- When Ordinance 34-96 is revised, the discrepancies identified in the technical memorandum *Industrial Waste Control Division, Ordinance 34-96* should be reviewed and addressed in the revisions.
- A change to Ordinance 34-96 requires the current 76 suburban community customers to adopt a local sewer ordinance that is at least as restrictive as Ordinance 34-96. Consideration should be given to establish a process to simplify ordinance revisions so suburban communities ordinances are compatible with DWSD. A work group consisting of IWC and community representatives might be helpful in developing a way to more efficiently meet the federal requirements for ordinance amendments.
- Evaluate the adequacy of the IPP charges to administer regulatory activities and operate the system.
- The Work Order Tracking System should be used for logging and tracking complaints received by IWC.
- A new laboratory should be constructed that allows for testing of lower levels of mercury and PCBs.

7.2.2 Septage Management

Needs

The DWSD Sewer Service Study Area includes areas that will be served by onsite sewage disposal systems (OSDS) through 2050. OSDS generate septage that must be disposed of according to state and federal law. The quantity of septage that is discharged to the DWSD sewerage system is expected to increase from 15 million gallons in 2000 to between 17 and 32 million gallons in 2050.

The range of 17-32 million gallons per year reflects the differences in future management practices from current practices and regulatory changes that could significantly increase septage quantities. Regulatory changes include changes in the laws that govern transportation and disposal of septage and increased enforcement compared to 2002. A discussion of septage projections and the influencing factors can be found in technical memorandum *Septage Transport and Disposal to the Detroit Wastewater System* on the CD that accom-

panies this report.

A lack of enforcement of land disposal of septage allows for dumping of septage in unauthorized locations, which threatens the quality of surface water and groundwater. When enforcement does occur, it is expected that the land disposal sites will be closed and most waste will go to septage receiving stations.

When OSDS are not maintained, they fail and the public health threats and environmental pollution puts pressure on sewer extensions to eliminate the problem OSDS. The location of a septage receiving station near OSDS provides a convenient and reliable method of septage disposal.

Specific observations from the technical memorandum are:

- The 15 mg of septage being discharged to the DWSD system in 2000 is likely underestimated. At least one hauler dumped more loads than tokens purchased and there was possible unauthorized use of the septage receiving station on Eight Mile Road. In addition, bogus tokens are still being found in the Oakland County token box, which allow disposal without paying the required fee. Lack of video surveillance and unattended stations allow for disposal of septage without paying the appropriate fees.
- At the Eight Mile Road and DWSD septage receiving stations, there is no water for cleanup of spills or washing of hoses. This makes it difficult to maintain sanitary conditions at the disposal sites.
- DWSD collects samples from septage hauling trucks to verify the quality of the septage and its acceptance to the sewerage system. When one septage hauler saw the DWSD sampling van, he left the area and the truck was not sampled. This raises questions about what was in the truck.
- As urban development expands, the existing septage disposal locations are getting farther from the locations where septic tanks are used for waste disposal. This increases costs to the haulers for labor and fuel and increases traffic and chances of accidents. Septage haulers are concerned about septage freezing in trucks in the winter when there is a long travel time to a disposal facility. The addition of a few new sites near the rural areas will provide better service to the septage customers and reduce fuel use, labor costs and traffic. The closing of the Stephens Highway septage receiving facility in Oakland County will increase the hauling distance for septage haulers and recreational vehicles to travel to dispose of waste.
- Solids were reported to accumulate in the sewer at the Southeastern Oakland County septage receiving station. This resulted in odors and occasionally the need to remove the sludge.

Scope/Magnitude in 2002-03 and Projections to 2050

The Detroit sewerage system provides a regional disposal service for septage haulers, portable toilet companies, private recreational vehicle waste, and solids from small wastewater plants. This service provides an environmentally responsible and legally acceptable method of septage disposal. DWSD has issued permits to 34 septage haulers to dispose of septage in the DWSD sewerage system.

The projected sewage quantities from the unsewered areas in the DWSD planning area are 26 mgd by 2050. If these systems are not properly maintained, there will be pressures for sewers to be extended to service the areas. Provision of septage disposal facilities is a very important part of the maintenance of OSDS and decentralized wastewater systems.

In 2000, 15 million gallons of septage was discharged into the DWSD sewerage system. This is projected to increase to 17-32 million gallons per year by 2050.

Approximately 133,600 OSDS were in use in the DWSD sewer service area in 2000, and 103,000 OSDS are expected to be in use in 2050. While the numbers of OSDS are expected to decrease, the closing of the land disposal sites due to regulatory enforcement issues will increase the demand for septage disposal receiving stations. In addition, Washtenaw, Wayne, Macomb and Oakland counties are implementing OSDS inspection programs at the time of sale of a property. These programs are increasing the frequency of pumping septic tanks, which will increase the volume of septage requiring disposal.

Four septage receiving stations that discharge to the DWSD sewerage system are shown in Table 7.1.

Additional septage disposal stations are needed to meet the demand for septage disposal and customer needs. Figure 7.1 is a map showing locations suggested by septage haulers and Macomb and St. Clair counties.

Technologies Available

Septage can be disposed of by:

- Mixing it with community wastewater in a trunk sewer and treating it along with the other sewage at a treatment plant. This is the method used by the septage receiving stations on the DWSD system.
- Introducing it directly to sludge digesters at a wastewater treatment plant.
- Applying septage to the land. The use of land disposal sites is limited due to seasonal conditions such as saturated and frozen soil.
- Treating septage disposal using a filter press that extracts liquid from the septage and discharges the liquid to a sanitary sewer. The filter cake is disposed of at a sanitary landfill. Two haulers in Michigan are reported to be using filter presses.
- Septage transfer stations that could serve several septage haulers. A holding tank is provided for haulers to dump into. The holding tank waste is pumped into a truck similar to ones used for land application of biosolids from wastewater treatment plants. The truck can land apply the septage or take it to a septage receiving station or wastewater treatment plant. This solution may require a change to the state law regulating septage haulers so that more than one hauler can use the holding tank.

Table 7.1: Septage Receiving Stations in the DWSD Service Area

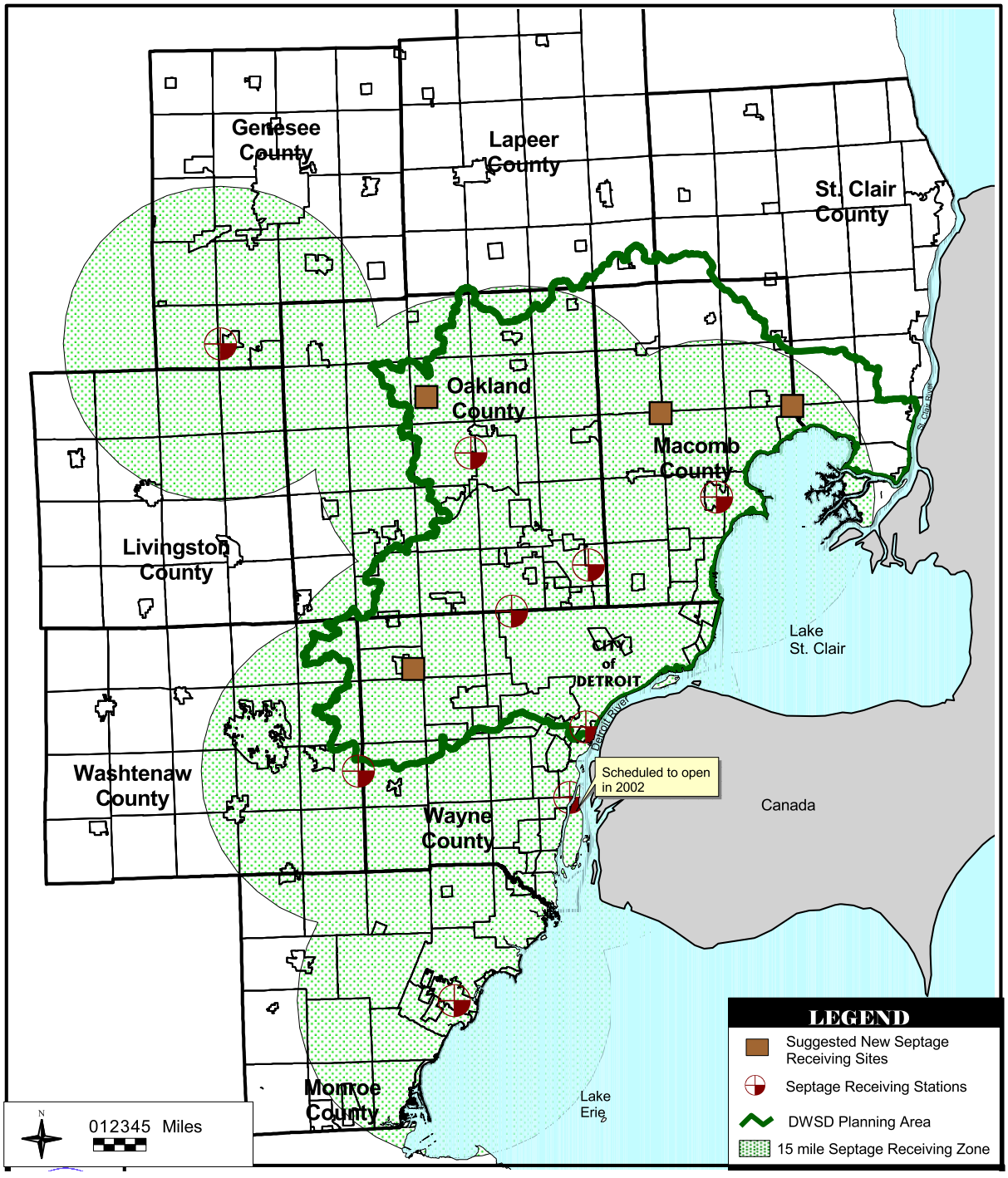
Plant	Hours	Fees
Detroit Wastewater Treatment Plant 9300 W. Jefferson, Detroit	24 hours/day, all year	$.02/gal
Oakland County 22440 Eight Mile Road, Southfield	8 a.m.-4 p.m., Mon.-Fri., Sat. 9- 4 p.m.	$.028-$.048/ gal
Oakland County 1155 Cesar Chavez, Pontiac	24 hours/day, all year.	$.028-$.048/ gal
S.E. Oakland County 29132 Stephenson, Madison Heights	7:30 a.m.- 3:30 p.m. Mon.-Fri.	$.028-$.048/ gal

The new septage disposal station in Pontiac includes several features that improve the efficiency and use of the facility. The station included 24-hour access, electronic surveillance, electronic payment and ease of disposal. Remodeling existing septage disposal stations should use the Pontiac station as a model and adapt the ideas to the existing site where practical.

Criteria for Implementation

The new Oakland County septage unloading facility is fully automated, incorporates many labor-saving ideas in its construction and should be reviewed when new stations are considered. It can accommodate up to four haulers at a time. This station is the newest septage disposal facility in

Figure 7.1 : Suggested Septage Receiving Stations in Southeast Michigan



the DWSD Service Area and is the most used. Cost of construction of the new Oakland County septage unloading station completed in 2002, was $1 million. This station includes a large area for dewatering catch basin cleanings so the cost of a station for septage disposal only would be less.

Also the Water and Environment Federation, October 2002 issue includes an article describing a new septage receiving station in Springfield Ohio. This station has some good features that may also be helpful in designing a new septage disposal facility. The cost of the septage receiving station in Springfield was $120,000.

Financing of a new septage receiving facility could be done by the local municipality, county or possibly through DWSD with costs recovered in the rates charged to a community. Financing could be assisted by the Strategic Water Quality Initiatives Fund (SWQIF), through the Clean Michigan Initiative or grant money (319d) for watershed-related projects. Low interest loans are available to municipalities for projects that include construction of septage acceptance/ treatment facilities.

A new septage disposal facility should be located near areas that will continue to be using OSDS. Constructing a septage receiving station is usually done by the county or the wastewater authority. Obtaining approval for a site for septage disposal is a local issue and can involve sensitive negotiations. Since DWSD contracts with counties for wastewater disposal, the county should be part of early discussions for consideration of a site. A new septage disposal receiving station would require approval of the county or the DWSD contracting agency. In addition, septage receiving stations would be part of the contracting agency's industrial pretreatment program; and haulers using the septage receiving station would be monitored by the DWSD Industrial Pretreatment Program. Capacity in the sewer to transport the septage could impact contracted capacity by communities and require community approval.

Odors, good housekeeping, truck traffic, access and year round availability are important considerations in locating a facility.

Septage haulers have requested additional septage receiving stations that would be nearer the communities that rely on onsite sewage disposal systems. The Macomb County Blue Ribbon Commission of Lake St. Clair recommended improved septage disposal practices and convenient disposal facilities. The *Septage Production, Transport and Disposal* report by Macomb County and the *Macomb County Office of Public Works Preliminary Feasibility Report on a Septage Disposal Facility* provide suggestions for possible locations of septage disposal facilities.

Given the information reviewed for the DWSD Wastewater Master Plan, three areas are recommended for consideration for new septage receiving stations.

- Near the Macomb County/ St. Clair County line, which would discharge to a pump station or main trunk sewer;
- The northern part of Oakland County where a interceptor sewer is available;
- The Plymouth/ Northville area in Wayne County where a large sewer would be available.

In summary, to develop a new septage receiving station, a site would have to be identified, the community and the county would need to agree on the location and sewer capacity issues, DWSD Industrial Pretreatment program should be consulted and financing would have to be secured. Since there are many local issues related to locating a septage facility, the county and local municipality should take the lead in developing a new site. The counties should work closely with DWSD staff in planning for a new facility. Items to consider in locating a site are: working with local communities to host a facility, meeting local requirements, securing financing, assuring flow ca-

pacity in the sewer and requirements for maintenance of OSDS.

Operational and Financial Benefits

- Improving methods of revenue collection and review of charges for septage disposal will assure that revenue covers the cost of transportation, treatment and disposal and that septage haulers are paying their fair share of the costs to dispose of septage.
- Cooperating with counties on improved septage disposal stations and new septage disposal stations will meet customer and community needs in an environmentally responsible way.
- Maintenance of OSDS, of which septage removal is an important part, will help reduce sprawl associated with sewer extensions to rural areas. It will also reduce potential increases in wastewater flow to the Detroit WWTP and delay the need for more treatment capacity.

Current Revenue/Expenditures

DWSD received $290,556 in revenue from the sale of tokens and tickets for septage disposal in 2000. The rate charged by DWSD is 2 cents per gallon for septage disposal. Oakland County pays DWSD for the disposal of septage at the three septage disposal stations in Oakland County. The range of charges for other treatment plants in Michigan is from 2.8 to 6.74 cents per gallon. Oakland County also pays DWSD for disposal of sludge from 15 wastewater treatment plants. The fees charged are in effect until Oct. 6, 2003 and range from $23.17 to $37.30 per 1,000 gallons. Expenditure for DWSD is the regular testing of septage hauling trucks. The revenue to support the sampling program and the Industrial Pretreatment Program comes from the meter charges. There were approximately 34 haulers licensed in 2000. Each hauler is required to submit a report every six months and include results of a sample of septage tested by an independent laboratory.

The current expenditures for the operation of the septage disposal facilities, monitoring and administration could not be determined. These costs should be compiled and compared to the existing and proposed charges to assure that charges for disposal cover the cost of the services provided.

General Recommendations

DWSD should request updates from the Macomb/ St. Clair County septage study committee on progress toward developing new septage receiving stations and cooperate with SEMCOG's efforts to find a location for a septage facility in St. Clair or Macomb county. Financing of a new station could be assisted by DWSD providing a loan to build the station that could be recovered through sewer rates or disposal charges. If DWSD assists in financing, DWSD should insist that there be in place a required maintenance program for OSDS and decentralized wastewater systems in that county or community.

Recommendations to upgrade existing septage receiving stations

- Video cameras at the disposal stations need to be kept in working order and the tapes should be reviewed on a regular basis to check on unauthorized dumping. Entrance and exit gates need to be kept in working order. Manholes used for dumping should be locked when there is no attendant available.
- The entrance driveway at the Eight Mile Road site should be changed so a hauler can drive directly to the manhole. Currently, a truck must pull in, back up on the grass, and then pull forward to reach to gate.
- Water should be provided at sites that do not have it to assist in washing equipment and the site.
- The septage stations should be upgraded to accept debit cards. This should save labor, prevent

the dumping of more loads than tokens purchased and eliminate use of counterfeit tokens.

- DWSD should upgrade the septage disposal manhole at the sewage plant by providing a concrete apron that slopes to the manhole, installing a water line, moving the manhole location or moving the road so trucks do not block the road, and providing a sign to identify the site.
- Conferences or disciplinary action should be considered for septage haulers that fail to have trucks tested when DWSD is taking samples.
- To maintain consistency in charges for wastewater disposal, the cost for transporting and treating septage should be based on the schedule of surcharge rates developed by DWSD. Currently the rate charged to septage haulers is 2 cents per gallon. Calculating the rates for treating septage based on the 2000-2001 Schedule of Surcharge Rates for sewage and using the average strength of septage based on sample results from 1997 provides a rate cost of 3.2 cents per gallon. The data and calculations on Septage costs are shown in Table 7.2. For comparison purposes, the average components of septage compiled by EPA are shown. The average strength of DWSD tested septage is below the EPA averages. It is recommended that the rates be raised to 3 cents per gallon and that a regular review of septage testing results and rates charged be done every two years. The range of charges for other treatment plants in Michigan is from 2.8 to 6.74 cents per gallon.
- A similar review should be made of the costs for solids received from wastewater treatment plants. The current agreement is in effect until October 6, 2003. New rates should be ready to take effect at that time.
- In exchange for raising the disposal fees, DWSD could consider eliminating the requirement for haulers to have their septage tested by an independent laboratory. Haulers report that this costs them about $800 per sample. Verification of the quality of the septage for each hauler could rely on the results of unannounced samples collected by DWSD.
- The septage receiving station at the Detroit WWTP should be improved. Plans have been included in PC-744 for a new receiving station at the Detroit WWTP, but the work has been put on hold.

Table 7.2: Septage Costs

Pollutant	Rates (1)	Average Concentrations (mg/l)	Average Concentrations (mg/l)	Treatment Cost (5000 gal)
BOD	$0.203/lb. over 275 mg/l	4249	6,500	$33.63
Suspended Solids	$0.227/lb. over 350 mg/	10,235	12,900	$93.54
Phosphorus	$2.299/lb. over 12 mg/	208	210	$18.78
Fats, Oils, Grease	$0.099/lb. Over 100 mg/	2,966	5,600	$11.83
TOTAL				**$157.78 ($0.032/ gallon)**

1. Summary of Operating Statistics for Fiscal Year Ending June 20, 2001, p. 20
2. Average concentration of parameter from U.S. EPA 1984 and 1994, Septage Handling, Manual of Practice No. 24, Water Environment Federation, 1997, p. 12.
3. Average of each parameter for 109 samples from septic tank trucks for year 1997, DWSD Dump Site Data E file.

7.3 Water Quality, Air and Hazardous Waste Monitoring

Needs

Water Quality Monitoring: Monitoring will increase due to additional CSO basins under construction and changes in monitoring to comply with the new DWSD NPDES permit. Special studies may also require new testing methods as con-

cerns have been expressed about hormone mimickers and pharmaceutical drugs in wastewater discharges. Additional monitoring may involve organic compounds, sediments and macroinvertebrates. These tests may have to be contracted initially, but in- house testing may be better in the long term. The new tests and increased numbers of tests will put increasing demands on the DWSD laboratories.

Hazardous Waste Monitoring: The NPDES permit requires a PCB/ mercury minimization program. As the laboratory detection limit for PCBs and mercury is lowered, the test results may require a more aggressive program to exclude PCBs and mercury from the sewerage system.

DWSD uses and stores hazardous materials. Regular review of storage practices, need for the various hazardous materials, spill prevention control plans and disposal of hazardous waste are necessary to prevent environmental contamination and to comply with hazardous materials regulations.

Sediments removed from sewers that are to go to landfills, land application or incineration need to be tested to determine if they contain hazardous materials.

Air Monitoring: Air is monitored for the required submittal of emission inventory reports for the emergency generator sites at DWSD facilities. Dust is monitored during some construction projects. In addition monitoring is done to comply with the air pollution controls required by MDEQ. A separate air discharge permit is in place for the incinerator. This permit also requires monitoring.

Scope/Magnitude in 2002-03 and Projections to 2050

Water Quality Monitoring: Water quality monitoring is required to comply with the National Pollutant Discharge Elimination System (NPDES) permit MI0022802 issued to Detroit Water and Sewerage Department October 1, 1997. The permit expired October 1, 2002 but will continue in effect until a new permit is issued. Due to violations of the NPDES permit, DWSD is subject to additional oversight by the U.S. District Court in Case No. 77-7110. A master schedule has been developed as part of this case. It includes performance monitoring and a PCB and Mercury Pollutant Minimization Program.

Permit MI0022802 requires monitoring of CSO discharges from outfalls 049F, 050A and 084A for 20 parameters whenever there is a discharge from them. Outfall 049B must be monitored for seven parameters. When outfall 49F is out of service, 84A must be tested for 15 parameters. Outfalls 84A and 49 discharge to the Detroit River and Outfall 50 discharges to the Rouge River. Outfalls 49 and 50 are shown on Figure 7.2.

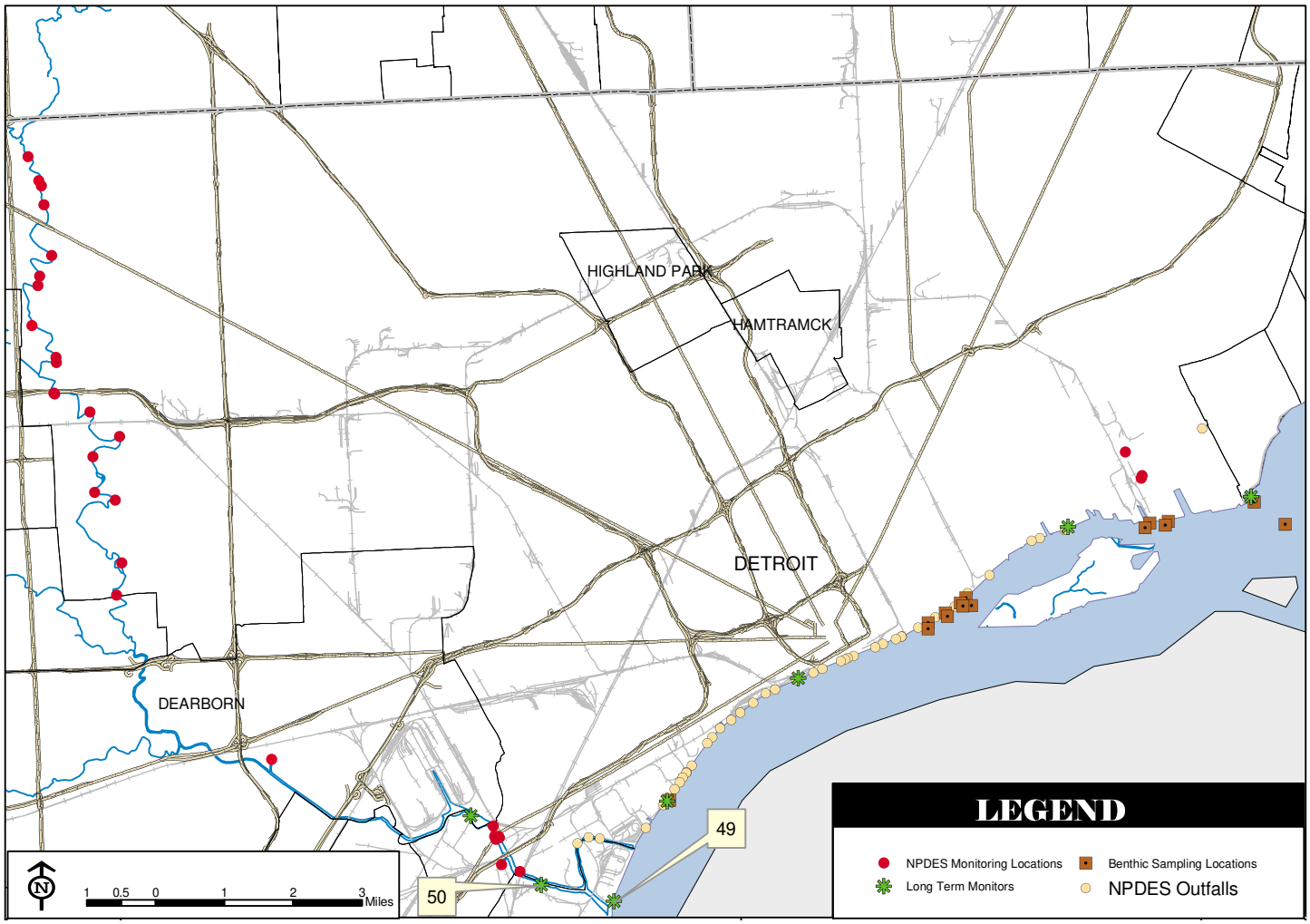
The NPDES permit also refers to monitoring that is part of the Industrial Pretreatment Program. The monitoring includes analyses of the treatment plant influent, effluent and sludge. No testing parameters are given.

Long-term monitoring sites, CSO outfall locations and benthic macroinvertebrate sampling sites are shown on Figure 7.2. Benthic sampling is being performed to monitor the biological community and investigate ecological effects of untreated and treated CSO discharges along the Detroit River as part of the Water Quality Work Group under the long-term CSO plan.

In 2000-2001, 20,659 tests were performed on 6,313 samples taken from wastewater treatment unit processes. Residuals were sampled 73 times and 3,536 tests were performed. The Industrial Waste Surveillance Program averaged 1,146 samples per month and made 144,647 determinations. (*Summary of Operating Statistics for Fiscal Year Ending June 30, 2001*, pages 250, 251.)

Testing was also performed by the DWSD labora-

Figure 7.2: Outfalls 49 and 50, CSO Outfall Locations, Benthic Macroinvertebrate and Long Term Monitoring Sites



tory for:

- CSO basins — 1,934 samples, 1,934 determinations
- Pickle Liquor Monitoring — 51 samples, 663 determinations
- Part 503/ monthly sludge — 66 samples, 1,056 determinations
- Miscellaneous Analyses — 100 samples, 5,794 determinations
- Quality Assurance - 3,977 samples, 5,604 determinations

In addition to DWSD testing, there are other laboratories conducting tests to evaluate the wastewater system.

Hazardous Waste Monitoring: Reporting to MDEQ regarding the PCB/ mercury minimization program is expected to continue. As the laboratory detection limit for mercury is lowered, the test results may require a more aggressive program to exclude mercury from the sewerage system.

DWSD has established a PCB/ Mercury Minimization Task Force to identify and reduce all point and non-point sources of PCBs and mercury entering the sewerage system.

To comply with other state laws, DWSD has programs to monitor underground storage tanks, and Spill Prevention Control & Countermeasure and Pollution Prevention Plans.

DWSD responds to requests for emergency waste cleanups, mercury spills and oil releases to clean up spills.

The Industrial Waste Control Division of DWSD (IWC) has established a Pollution Prevention group to develop and encourage pollution prevention. Pollution fact sheets are being developed by this group. The group is also supporting operators of restaurants to encourage proper grease disposal. Silver pollution prevention methods are also being reviewed to reduce silver discharges.

A TV inspection pilot project was undertaken in 2002 to inspect lateral and connector sewers in Detroit. In one subset of the project, 41 of 48 sewer segments inspected, sediment had to be removed before the inspection could be performed. A system-wide inspection program is proposed under the CIP program. Sewer inspection will result in the disposal of a significant amount of sediment. This will require more testing of the sediment to assure that transportation and final disposal comply with applicable regulations.

Technologies Available

Automatic sampling of several of the parameters that are monitored is possible and could reduce the cost per sample. Some DWSD sites have automatic sampling (Leib and St. Aubin). The experience with automatic sampling and collecting samples on a regular basis at Leib and St. Aubin could be helpful in determining applications in other locations. The conflicting needs of calibrating equipment and running equipment continuously presents challenges at sites that do not have continuous discharges.

There may be opportunities for improving data management and reporting to MDEQ.

Constructing sediment dewatering basins for sediments removed from sewers and catch basin cleanings will reduce costs for transportation and disposal of sediments.

Criteria for Implementation

New sampling or testing procedures must comply with accepted testing procedures as recognized by U.S. EPA and the MDEQ. When new sites and outfalls are added to the DWSD system MDEQ will require a new field-sampling plan.

Operational and Financial Benefits

Each automatic sampling application would have

to be evaluated separately to determine cost of installation and benefits.

Current Expenditures

Revenue is generated from the schedule of surcharge rates. When wastewater exceeds the schedule for BOD_5, total suspended solids, phosphorous and fats, oils and grease, an additional charge for disposal is required. In fiscal year 2001, $2.3 million was collected by DWSD for the surcharges. The 2002/ 2003 DWSD sewerage budget includes:

- Analytical Laboratory - $2,538,000
- Operations Laboratory - $7,179,508
- Industrial Waste Control (IWC) Division Administration - $736,906
- IWC Field Monitoring - $7,316,720
- IWC Program Operations - $2,725,500

A special study is underway that monitors air quality at the Detroit WWTP. The budget for this is $150,000 for 2002-2003.

Recommendations, Future Expenditures and Schedule

Sampling methods and experience with sampling should be reviewed annually to identify methods that would reduce costs for testing and sampling. Conferences, workshops, and discussions with manufacturers of laboratory testing equipment would provide an opportunity to evaluate new equipment that could reduce the costs for collecting and testing.

An evaluation of testing now performed by private laboratories should be compared to the cost of DWSD tests, taking into consideration the additional space, human resources and equipment that would be needed.

7.4 Flow and Watershed Management

Needs

Projected growth in the DWSD service area will result in additional wastewater that must be transported and treated in compliance with state and federal requirements. Either the transportation and treatment facilities will have to be expanded or "clean" water will have to be excluded from the system in sufficient quantities to offset the additional flows.

There are communities that exceed their contract capacity with DWSD and are also implementing corrective action plans to address sanitary sewer overflows (SSO). If changes are not implemented, the communities will be subject to fines and penalties.

The existing Detroit Wastewater Treatment Plant has the capacity to handle all of the dry weather flow from the projected growth in the existing service area and in much of the planning area over the next 50 years, if infiltration/ inflow (I/ I) is managed and reduced.

Scope/Magnitude in 2002-03 and Projections to 2050

Over the next 50 years DWSD wastewater flows are expected to increase from 724 mgd in 2000 to 756 mgd in 2050 with maximum dry weather daily flows increasing from 757 mgd in 2000 to 789 mgd in 2050. These increases in flow are due to an increase in the service area, increased residential and employment populations, changes in water usage, and addition of CSO dewatering flows. Reduction in flows via flow management could reduce the dry weather flow by 35-50 mgd and offset the expected flow increases.

Of the total dry weather I/ I of 242 mgd in 2001, 78 percent was from Detroit. There are 10 metered districts in Detroit that exceed 1,000 gallons per

day per acre of dry weather I/ I.

Flows from Significant Industrial Users (SIUs) are expected to be reduced from 45 mgd to 35 mgd by 2050 due to reductions in water use and reduction in manufacturing facilities in the service area.

Three water treatment plants discharge an average of 9 mgd of backwash water and sludge to the sewerage system. Water reuse is expected to reduce this daily flow.

Septage is disposed of into the sewerage system at the rate of 15 million gallons per year. This flow could increase to as much as 32 mg per year by 2050.

CSO facilities that will be constructed in the future will have storage capacities that will allow them to be emptied to the sewerage system during dry weather conditions. This will increase the amount of wastewater to be treated at the sewage plant.

There are over 300,000 households in Detroit that, for the most part, have clay pipe connections to the combined sewers serving these properties. Leaks in these service leads have been identified as one of the sources of inflow and infiltration into the sewerage system. Replacing these sewer leads over the next 50 years will reduce inflow into the system. Section 7.6 has more detail related to facilities on private property. The direct connection of downspouts and footing drains from households are additional sources of dry and wet weather flows that could be reduced.

Technologies Available

The Long Term CSO Control Plan, Detroit and Rouge rivers states, "It has been determined that up to 40 percent of the dry weather flow within the City of Detroit may be due to dry weather inflow and infiltration." Reducing I/ I could provide extra capacity in the collection system and increase dry weather treatment capacity at the sewage plant. This in turn would reduce collection and treatment costs. The use of incentives, best management practices (BMPs) and watershed management provide for methods that can reduce infiltration and inflow into the sewers. Reduction of infiltration and inflow could avoid an expansion of the existing wastewater treatment plant or the construction of an additional wastewater treatment plant.

There are 76 communities that are discharging wastewater to the DWSD system. A variety of problems and solutions are available to assist them in reducing the quantity of wastewater that is discharged to the DWSD sewerage system. DWSD has begun to address this problem through the Long Term CSO Control Program.

Incentives to reduce infiltration and inflow into sewerage systems have been used by other cities to encourage reduction of extraneous flows. Grants have been used by the Massachusetts Water Resources Authority for pipeline replacement, public/ private inflow removal, I/ I reduction planning and sewer rehabilitation. Milwaukee has developed a $1.2 million grant program for rainwater reduction, which can be used to replace sewer laterals and downspouts.

Watershed/Community BMPs: Communities in the Rouge River watershed have proposed a variety of projects to reduce sewage flows to the DWSD system. The projects under consideration and a brief description follow.

- Commingling SSO for Treatment at Bloomfield Village CSO RTB. This project will redirect storm water in the RTB facilities to Rouge River. This removal will offset wet weather sanitary flow to the RTB.
- Footing Drain Removal Demonstration Project. This will quantify the effectiveness, cost and I/ I reduction success of removing footing drains on private property in Auburn Hills. Another community in Oakland County will be considered for a footing drain removal demonstration pro-

ject.

- Sump Pump Disconnection Demonstration Project. This will quantify the effectiveness, cost and I/ I reduction success from removing sump pump discharges from sanitary sewers (Village of Beverly Hills, City of Farmington).
- Flood Prone Manhole Evaluation. This will evaluate manhole reconstruction materials and techniques in flood prone areas that would reduce I/ I in the Evergreen-Farmington area.
- Reduction of Excess Peak Flows Through Evaluation and Modification of In-line Storage. This project includes sewer separation in two small areas of Inkster (about 15 acres).
- Reduction of Excess Peak Flows Through Evaluation and Modification of In-line Storage in Garden City. Using modeling, a set of recommendations will be made to remove or modify ten existing weir/ vortex valve structures and possibly modify the regulating structures.
- City of Melvindale Footing Disconnection Pilot Program. This pilot program will reimburse part of the cost for footing drain disconnection.
- City of Dearborn CSO Control Program. This includes the separation of a 42-inch storm sewer from the combined sewer system, separation and diversion of storm flow from outfall 14, and construction of a storm sewer, manholes and catch basins in the South Highland/ Trenton Terrace area.
- City of Allen Park Pilot Footing Drain Removal Project. A 12-block area of Allen Park will be targeted for voluntary removal of footing drains from the sanitary sewer.
- City of Dearborn Downspout Disconnection Program. This project aids and encourages residents to disconnect roof downspouts from the combined sewers.
- City of Westland Manhole Rehabilitation Program. This program identifies manholes that need repair to reduce or eliminate inflow and infiltration of storm water into the sanitary sewer system.

Decentralized Wastewater Systems: Communities in the DWSD study area have indicated that they will continue to rely on onsite sewage disposal systems (OSDS). In areas of low density, one dwelling unit or less per acre, OSDS is appropriate if the soil and groundwater are suitable for installation of an OSDS. Some communities that are continuing to rely on OSDS do not have sufficient area of suitable soils for a typical OSDS. In these areas decentralized wastewater systems are an option for wastewater disposal. Decentralized wastewater systems are generally thought of as systems that service more than one dwelling unit or have more advanced treatment of the wastewater than a gravity septic tank disposal system.

The use of decentralized wastewater systems is a new approach to onsite sewage disposal. The National Onsite Wastewater Recycling Association has developed a model framework for unsewered wastewater infrastructure (decentralized wastewater systems). The model framework focuses on performance and sustainability. A brief look at this and how it might relate to DWSD Master Plan follows.

The model consists of seven elements:

- Performance Requirements are set to protect the public health and environment. They must be measurable and should be established based on risk management.
- System Management - perpetual management is required in order to meet the performance requirements.
- Compliance Monitoring - regular testing of the system to assure compliance.
- Technical Guidelines for evaluation, design, construction and operation to achieve the per-

formance required.

- Education and Training ensure consistency of staff to meet the standards of practice they are engaged in.
- Licensing/ Certification to maintain high standards for competence and conduct of staff, continuing education key.
- Program Review to see that the operation is grounded in good science and engineering, meets regulatory authorities' expectations, and follows sound management practices.

Following this model will assure long-term functioning of onsite and decentralized wastewater systems. In most cases, new regulations will be necessary if communities are going to rely on decentralized wastewater systems.

Communities that will continue to rely on onsite sewage disposal and decentralized wastewater systems need to be aware that sewer capacity and sewer extensions are not being planned to serve their areas. Communities will need to assure proper operation and maintenance of onsite systems so there is not pressure to extend sewers due to failure of onsite systems. The implication in the Master Plan is that sewer and sewage plant capacity is not being reserved for these areas.

Urban Stream Restoration: The Rocky Mountain Institute has been studying the advantages and disadvantages of restoring enclosed streams in urban areas to open river channels. This is also known as "daylighting." The technical memorandum, *Urban Stream Restoration, City of Detroit* that accompanies this report describes daylighting that has occurred in two communities, one in Michigan and one in Pittsburgh, and how this concept might be used for a subdivision in Detroit.

Advantages to daylighting are described in that technical memorandum. Of particular interest to the planning process is the potential of daylighting to divert urban runoff from combined sewer systems before it mixes with sewage, reducing combined sewer overflows and burdens on treatment plants. Daylighting projects in other communities have been important in the redevelopment of neighborhoods and downtown areas.

An estimate was made of the impact of removing stormwater from combined sewers in the Greydale area of Detroit. Approximately 65 acres is tributary to the enclosed stream in this area. Diverting stormwater from the combined sewers to the enclosed stream under Greydale would remove 10-11 million gallons per year of water now being transported and treated in the sewerage system.

Wastewater Reduction Devices: The International Plumbing Code, in effect in Michigan, requires water-saving devices to be installed in new construction. Areas where there are severe water shortages or where the cost of water is high, have tried a variety of measures to reduce water use that goes beyond the minimum requirements of the plumbing code. Some of these could be considered for use by DWSD and its customers.

- Graywater Recycling: The use of graywater, that is wastewater from sinks, laundry, and showers, is an acceptable practice in Arizona. It is also being incorporated into reconstruction of a convent in Monroe County. The Servants of the Immaculate Heart of Mary are constructing facilities to divert approximately 7,000 gallons per day graywater to wetlands. The water from the wetlands will be used for flushing toilets. Graywater recycling would reduce the amount of wastewater that would have to be treated by DWSD.
- Low Flow Devices: The plumbing code specifies toilets that use 1.5 gallons or less per flush. There is a wide range of toilets that use less than 1.5 gallons per flush. These include air pressure devices, vacuum systems, composting toilets, and incinerator toilets. The toilet is the largest user of water in a residence. Reducing wastewater from toilets would reduce sewage flows. In addition to toilets, there are washing machines, and showerheads that use much less water than the

standard devices.

- Leak Detection Devices: Detecting water leaks will not only save water but will also reduce water and sewer bills and reduce the flow of sewerage in the DWSD sewerage system. Simple steps like placing food coloring in toilet tanks to detect leaks, fixing leaking faucets, and monitoring water bills can identify wasted water and help property owners and the sewerage system.
- Facilities on Private Property: There are over 300,000 households in Detroit that for the most part have clay pipe connections to the combined sewers serving these properties. Leaks in these service leads have been identified as one of the sources of inflow and infiltration into the sewerage system. Replacing these sewer leads over the next 50 years will reduce inflow into the system. More detail related to facilities on private property can be found later in this chapter.

Criteria for Implementation

There are many opportunities for reducing flows to the sewerage system and avoiding the large expense of expanding the existing wastewater plant or building a new plant. The cost and benefit of each possibility is one criterion for implementation. Other criteria, such as environmental benefits, redevelopment of housing, and aesthetic improvements, may also influence implementation of steps to reduce flows to the sewerage system. Another consideration is who will pay the cost: DWSD, the customer or the community.

Operational and Financial Benefits

Reducing dry and wet weather flows to the sewerage system will avoid the need to expand the wastewater plant, reduce SSOs and CSOs, protect the environment and reduce health hazards, reduce pumping and other operational costs at the wastewater plant.

General Recommendations and Schedule

Extraneous flow of water to the sewerage system during dry and wet weather should be eliminated as much as is reasonably possible.

Several communities are implementing programs to reduce dry weather and wet weather flow to the sewerage system. To continue these efforts and to encourage additional communities to also implement programs to reduce flows, incentives should be offered for projects that would reduce dry or wet weather flows. Incentives could be a sliding scale of rates for those that exceed their contract capacity, i.e. as the flows get closer to the contract amount the rate goes down. Another incentive would be grants to communities to help them perform the design or field work to develop the elements of a program or plans.

When areas in Detroit are under consideration for redevelopment, the potential of daylighting urban streams and of removing stormwater from the combined or sanitary sewers should be considered. The Greydale area and Bloody Run Creek are examples of buried streams that could be daylighted to the benefit of the community.

7.5 Facilities on Private Property

This section addresses two important issues identified in the Wastewater Master Plan: extraneous flows to the sewer system from private houses and onsite sewage systems in Detroit.

7.5.1 Water/Wastewater Flows from Private Houses

Needs

The Long Term CSO Control Plan identifies residential areas as sources of rainwater entering the sewerage system. It states that, "A fundamental CSO Control plan element is the reduction of rain water entering the sewer system from residential areas." Private residences serve as a conduit for rainwater and groundwater to enter the DWSD sewers where downspouts are directly connected

to the house plumbing and where there are leaking house leads. This extraneous water increases the peak flow and volume of water in the sewer during wet weather and adds to Infiltration/ Inflow (I/ I) during dry weather. When sewer capacity is exceeded, the result can be flooded basements or sewer overflows.

Public Act 4, 1998 and Act 451, Section 31, 312.b require that downspouts be disconnected as part of CSO permits. As new permits are issued to communities that have CSOs, downspout disconnection will be included in the permit. The requirement for a plan to disconnect downspouts will be in Detroit's NPDES permit.

Many of the complaints that come to the DWSD emergency complaint line are related to problems with residential service leads.

Other sources of extraneous flow from private property into the sewer system include rainwater, leaking water fixtures and surface water that drain into abandoned houses and into the sewer system.

Scope/Magnitude in 2002-03 and Projections to 2050

The Long Term CSO Control Plan, Detroit and Rouge Rivers states, "It has been determined that up to 40 percent of the dry weather flow within the City of Detroit may be due to dry weather inflow and infiltration." Reducing I/ I will provide extra capacity in the collection system and increase dry weather treatment capacity at the sewage plant. This in turn would reduce collection and treatment costs. Leaks in house service connections have been identified as one of the sources of I/ I into the sewerage system.

There were approximately 336,428 households in Detroit according to the 2000 Census. It is likely that most of these have clay pipe house sewer leads. Specifications for house service leads identify clay pipe as the standard for use. Clay pipe requires more joints than plastic drain waste and vent piping. The clay pipe joints often leak or collapse and allow groundwater to enter the system.

Televising of the sewers in Detroit has identified water entering the sewer pipes from the top of the service connection when no wastewater was flowing from the service connection. Proper sealing of the connection of the sewer service lead to the sewer will reduce ground and surface water infiltration into the sewer system.

Failing house leads are reported to the Detroit City Health Department. The Health Department verifies the complaint and the complaint is forwarded to the Building and Safety Department for follow-up and issuance of a plumbing permit if necessary. If the owner does not proceed with a permit, the departments do not know if the problem was corrected.

The connection of downspouts and footing drains is contributing to the peak flows and volume of water in sewers during dry and wet weather.

Technologies Available

The inspection of house service connections could be done at the time of property transfer of a house. The Building and Safety Department currently inspects houses that are sold. An inspection of the house for the condition of the sewer lead, downspout discharge locations and footing drain discharges could be done at that time.

Improved materials for house leads are available. Several types of plastic pipe have been approved under the Building Officials Conference of America (BOCA). Plastic pipes allow for longer lengths of pipe and thus fewer joints. Glued joints provide a good seal to keep groundwater and roots out of the pipe.

The tracking of complaints about house leads could be done through the DWSD Work Order Tracking System (WOTS). This could identify ar-

eas that have clusters of complaints and might justify a more vigorous program to replace sewer leads.

Detroit has an ordinance that prohibits sump pump installation in buildings. A similar requirement that would prohibit direct connection of downspouts to sewers would reduce the peak flows in sewers during rain events.

Sarasota, Florida is replacing all lateral service lines as a capacity management issue. In high groundwater areas it found the laterals were constantly flowing when the water meter was not showing water use. Sarasota is using PVC pipe for the sewer leads and paying costs from sewer rates.

Milwaukee has budgeted $1.2 million to reduce rainwater coming into the sewers and to replace leaking private laterals. Birmingham, Michigan has found that a majority of sewer laterals are failing and is working on a bid to have the laterals replaced. The homeowner would pay for the replacement of the lateral and the work would be done by a pre-approved contractors. It is expected this will reduce the cost to the homeowners.

Criteria for Implementation

A new specification should be developed and implemented for sewer leads from private houses to the DWSD sewer system. This specification should meet the state plumbing code, be adopted as part of the Detroit Plumbing Code and be adopted by DWSD as the standard for private house sewer lead construction. It is important that DWSD and Building and Safety use the same specification for private service connections.

An inspection program of existing sewer leads from private houses should be considered. This would require a new ordinance to include this inspection with other inspections at the time of property ownership transfer. This inspection could determine where the sewage discharges for parcels that are not paying for sewer service, would identify property that has an OSDS and could report information about the condition of the sewer lead.

Assuring correction of sewer blockages in service leads will involve coordination of complaints between the Health Department, Building and Safety and DWSD. The DWSD complaint-tracking system should be reviewed to determine if it can be used by other departments to report sewer problems. Having one place to track sewer complaints will help in tracking corrections and resolving complaints.

Incentives and ordinance support could be used to disconnect downspouts and footing drains from direct connection to the combined or separated sewers.

The Long Term CSO Control Plan has made recommendations regarding private property. The study, which was done to evaluate rainwater control, should be followed when implementing recommendations.

Operational and Financial Benefits

- Reducing inflow of extraneous water from downspouts, footing drains, abandoned houses, and leaking private sewer service leads will reduce collection and treatment costs by reducing flow. Wet weather flow reduction will reduce the frequency of sewer overflows.
- Improving coordination in construction and replacement of sewer leads will provide a uniform construction standard, save time and resources and reduce groundwater infiltration into the sewers.
- Having a central place for complaints related to sewer leads should improve follow-up and correction of problems with leads.

General Recommendations

- When city workers visit vacant or abandoned buildings, they should observe and report to

DWSD buildings that are allowing extraneous water to discharge to the sewers. Information should be provided to the various departments that visit vacant properties about looking for water leaks and rainwater discharges to the sewers.

- A new specification should be developed for construction and materials for sewer leads on private property. The specification should be adopted by the Building and Safety Department and DWSD to assure uniform application and inspection.
- Complaints received by the Health Department, DWSD and Building and Safety Department on sewer leads should be coordinated by the complaint-tracking system currently used by DWSD.
- Downspouts and footing drains should be disconnected from sewers.
- A review of the drainage at abandoned houses should be conducted to prevent rainwater, surface water and groundwater from entering the sewer system. A similar review should be made for drinking water supply leaks that could be discharged into the sewer system. The various departments that work with abandoned properties and demolishing properties should be provided with an educational brochure of how extraneous flows impact the sewerage systems, what to look for and who to report findings to.

7.5.2 Onsite Sewage Disposal Systems in Detroit

Needs

In an urban area like Detroit, the continued use of onsite sewage disposal systems (OSDS) is a risk to public health and a threat to ground and surface water. OSDS in the city should be eliminated as soon as possible. In reviewing properties for OSDS, 331 properties have been identified that pay for water service but do not pay for sewerage service. This number includes a number of households that receive sewer service from other communities. The number of onsite sewage disposal systems (OSDS) in Detroit is estimated between 27 and 101 based on a review of City Health Department records and DWSD customers in Detroit that are paying for water only. As OSDS repair permits are requested from the Health Department, the property is reviewed to determine if sewers are available.

In addition to customers who are not paying for sewer use, there are residents that are paying for sewer use and are not connected to the sewer available to them. In reviewing properties for OSDS, the Health Department found 18 properties that were connected to the sewer but were paying for water only. The technical memorandum, *Onsite Sewage Disposal Systems in the City of Detroit*, provides details on addresses and sewer availability to properties that are paying for water only.

The properties that have an OSDS and do not have sewers available are mostly located in the northwest part of the city near Eliza Howell Park. This area is lower than the sewers, so pumping of sewage would be needed to reach the sewers.

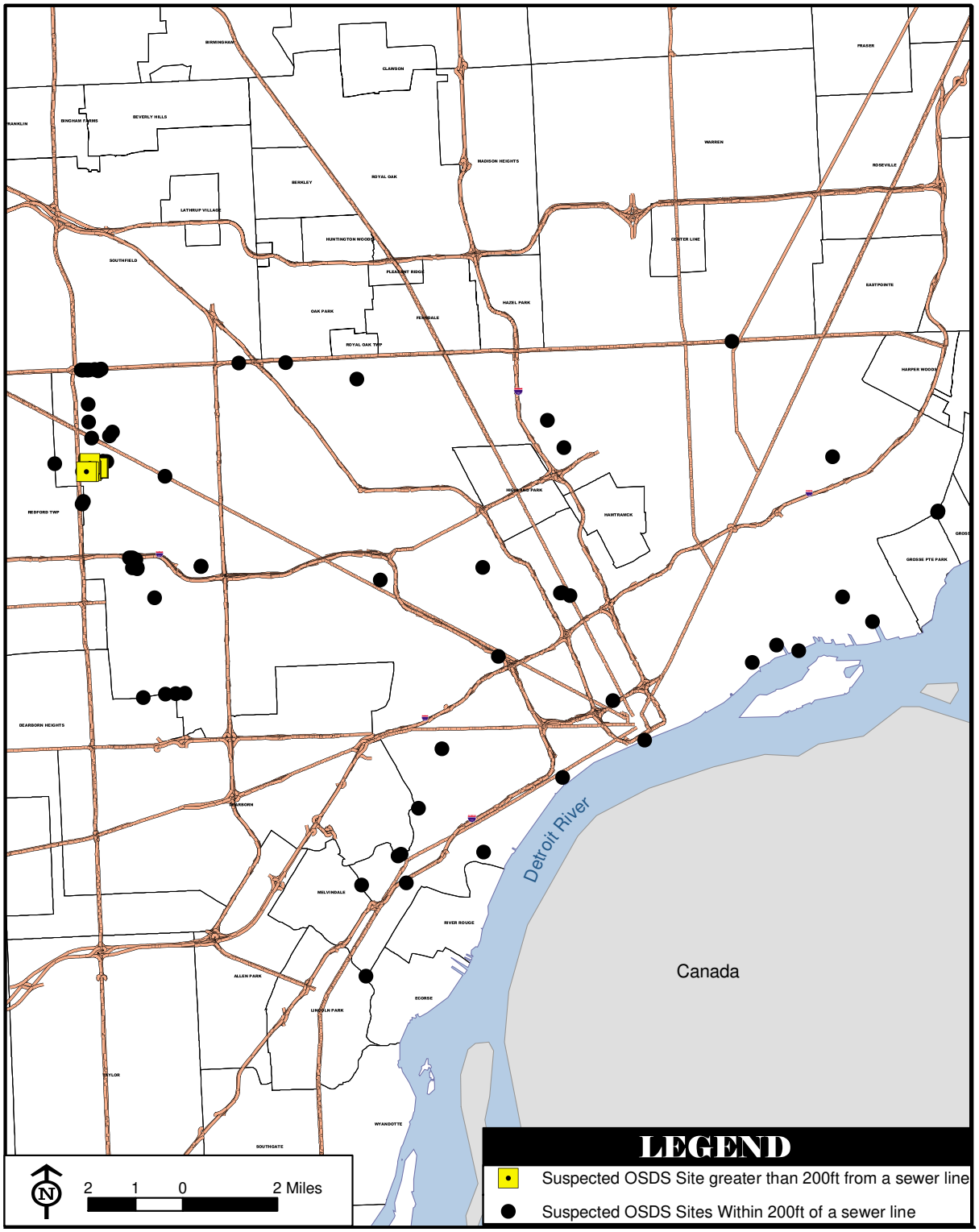
Scope/Magnitude in 2002-03 and Projections to 2050

The households in Detroit that receive sewer service without paying are a source of lost revenue for DWSD. In addition, the continued use of OSDS in Detroit is a source of pollution to surface water and groundwater and is a threat to the public's health. Figure 7.3 shows the locations of the properties that could have OSDS.

Technologies Available

To manage onsite sewage systems, counties have established inspections at the time of sale of a building that has an OSDS. Wayne, Washtenaw and Macomb counties have adopted ordinances requiring inspections at the time of sale. Oakland County has proposed an ordinance and it is under review. These inspections assure the purchaser

Figure 7.3: Possible OSDS Locations in Detroit



that the OSDS is not failing and is designed to properly dispose of wastewater from the structure.

Criteria for Implementation

An inspection program for properties in Detroit that are paying for water only, at the time of transfer of ownership, could determine where sewage from these properties is being discharged. This information should then be entered in the DWSD billing accounts systems to track that information. If the property is connected to DWSD sewers, appropriate steps should be taken to correct the billing records and DWSD field records of sewer connections. If a property is not connected to a sewer, engineering should review the property to see how to sewer it and to include sewer construction in future capital improvement projects.

Operational and Financial Benefits

- Connecting OSDS in Detroit to the sewerage system will eliminate OSDS as sources of groundwater and surface water pollution. Additional customers will be added to the system.
- The cost of sewering areas not served by a public sewer in Detroit will be more expensive than gravity sewers, since many properties will need a pump.
- Determining the method of wastewater disposal for the 331 properties paying for water only could increase the number of customers paying for sewage disposal.
- Connecting OSDS in Detroit to the sewerage system will eliminate OSDS as sources of groundwater and surface water pollution and add additional customers to the system.

General Recommendations

- OSDS should be eliminated in the City of Detroit.
- An inspection program should be implemented to determine where the discharge of sewage is going from the 331 addresses that are paying for water only. This could be done at the time of sale or as a special program.
- The houses that have OSDS near Eliza Howell Park should be reviewed by engineering and scheduled for sewer extension to eliminate these OSDS.
- A program for inspection of house leads and downspout disconnection at the time of property transfer of a house should be developed.

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