Section 4
System Inventory and Related Activities

Overview

This section of the Minneapolis LSWMP focuses on the built system of stormwater drainage and sanitary sewers which have an impact on the water resources of Minneapolis. The City of Minneapolis has created a system of sanitary sewers and storm drains that are predominantly independent systems. Components of the stormwater management system include conveyance (gutters, catch basins, pipes, channels and county ditches), water quality/flood retention basins, and water quality treatment structures (grit chambers). Cross connections between the storm drainage and sanitary sewer systems still exist. This interconnection of the stormwater drainage and sanitary sewer collection systems is most evident during and immediately after large summer rainstorms. Excessive stormwater finds pathways to the sanitary sewers, and excessive sanitary flows find routes to surface waters. During extreme storm events, the overwhelmed sanitary sewers will overflow raw sewage to the Mississippi River at regulator sites, or will backflow raw sewage into basements. Therefore, this inventory of the systems that affect the water resources in Minneapolis includes the storm drainage system and cross connections with the sanitary sewer system.

Separate storm drains and a City-wide repaving program reduced strains on the wastewater treatment facilities.

Minneapolis' sewer system was established in 1870 with the construction of combined sewers that collected sanitary and stormwater flows and discharged directly to the Mississippi River. Starting in 1922, a dedicated stormwater system was constructed around the lakes and within areas of new development; however, the existing combined sewers were still used. After 1938, regulators were installed in combined sewers to direct average daily flows to interceptors and then to the newly-constructed wastewater treatment facility. Flows in excess of the interceptor capacity, as experienced during rain events, would overflow and then be discharged to the Mississippi River.

The combined sewer flows were a burden to the wastewater treatment facility and placed a capacity limitation on the sewer system and treatment facilities. What is now the Metropolitan Council Environmental Services (MCES) took responsibility for the interceptors and regulators in the mid-1960s. In 1960, the City banned rainwater drainage to the sanitary sewer (City Code 1960, As Amend., § 614.010); all sewers constructed after 1960 were dedicated to either sanitary or storm flows. Also in the 1960s, the City began to construct separate storm drains in conjunction with a city-wide street repaving program. Beginning in 1985, the City accelerated construction of separate storm drains to be in compliance with a schedule set in the City's NPDES CSO permit (Appendix K), which resulted in decreased occurrence of overflows to the Mississippi River.

Minneapolis currently operates two systems which are not fully separated. Both systems contain constructed pollution control devices in conjunction with institutional controls and best management practices (BMPs) to protect its water resources.

Infrastructure Inventory

The City of Minneapolis maintains a sewer system that is more than 130 years old. Sewers are constantly being improved to meet the development, quality of life and environmental stewardship goals set in The Minneapolis Plan as described in Section 1. This system inventory provides a summary of the sanitary and storm sewer systems in 2006. Inventory data was collected from recent reports and from the City's geographic information system (GIS) database.

Sanitary Sewer System

The City of Minneapolis owns and maintains a sanitary sewer collection system of shallow sewer and deep tunnels which is a total of 837.5 miles in length. These sewers drain into the regional MCES interceptors that convey the sewage to the Metropolitan Treatment Facility in St. Paul. Figure 4-1 shows both the Minneapolis and MCES sewer system. It also notes the location of the remaining regulators where excessive flows are directed to the Mississippi River during extreme storm events. Tables 4-1 and 4-2 provide summaries of the Minneapolis sanitary sewer system.

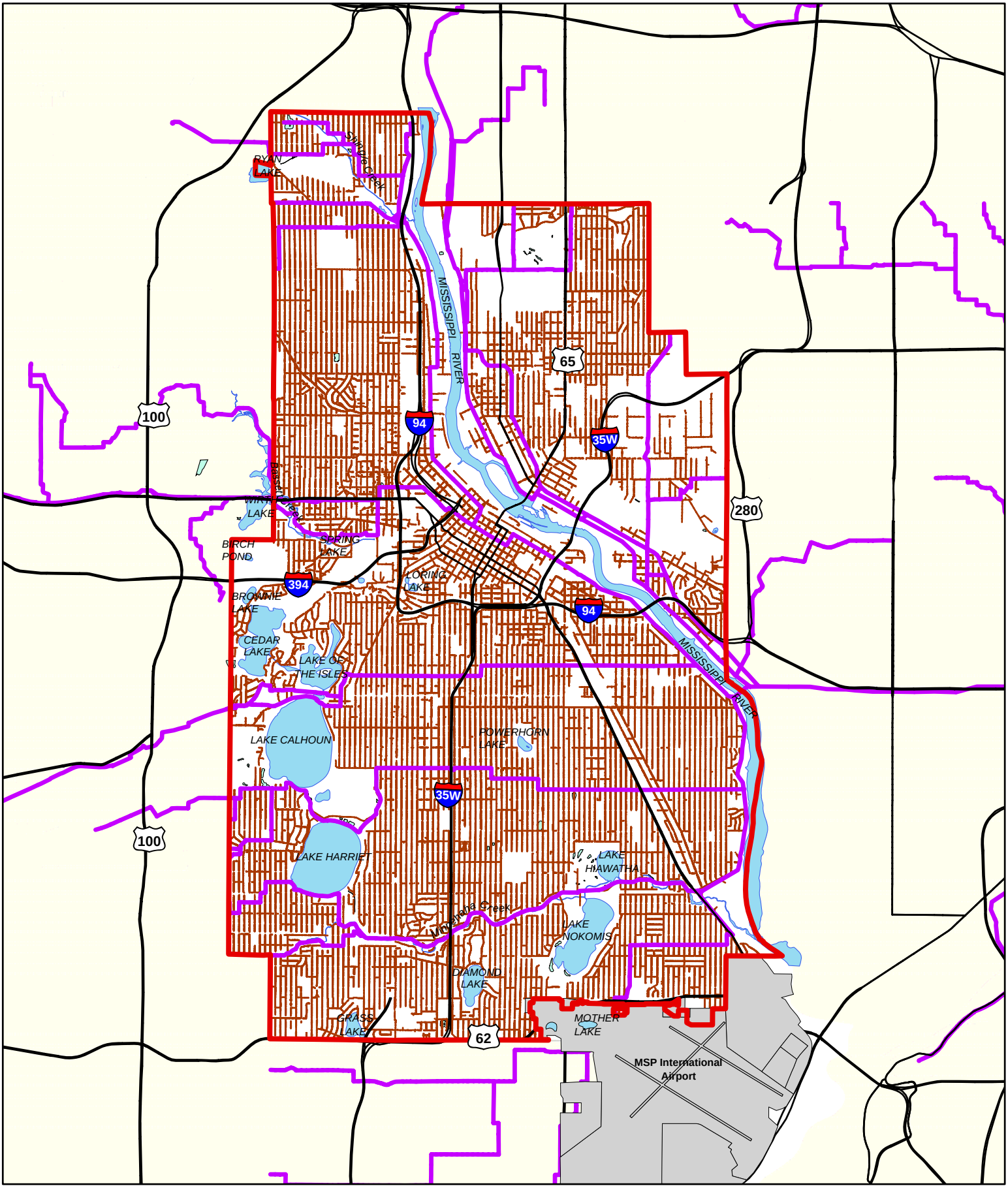
Table 4-1. Summary of Sanitary System

Material	Size	Year Constructed	% of System
Clay	8" - 36"	1888 to present	80
Brick	24" - 96"	1870 to 1930	10
Cement	12" - 24"	1882 to 1884	3
Concrete	12" - 102"	1927 to present	4
Other	6" -30"	1931 to present	3

Table 4-2. Sanitary Sewer System Infrastructure Inventory – City Owned

Component	Quantity
Pipes	
• Tunnels	5.5 Miles
• Trunk and Local Sewers	832 Miles
Manholes	29,000
Pump Stations	10
Regulators	8

Non-wastewater enters the sanitary sewers in the form of inflow or infiltration. This extraneous water can result in overflows at the seven remaining CSO locations. In addition, excessive inflow and infiltration (I/I) which does not overflow reaches MCES interceptors and is treated at the Metro Wastewater Treatment Plant. Excessive extraneous flows have caused MCES to create an incentive/penalty program to encourage municipalities to remove these non-wastewater flows. This I/I Surcharge Program will have a major impact on Minneapolis stormwater drainage systems, because much of the I/I flows will be redirected to the storm system.


RYAN LAKE
Bassett Creek
MISSISSIPPI RIVER
100
94
65
35W
280
Bassett Creek
WIRTH LAKE
BIRCH POND
SPRING LAKE
394
LORING LAKE
BROWNIE LAKE
CEDAR LAKE
LAKE OF THE ISLES
MISSISSIPPI RIVER
LAKE CALHOUN
POWDERHORN LAKE
35W
100
LAKE HARRIET
LAKE HIAWATHA
Minnehaha Creek
LAKE NOKOMIS
DIAMOND LAKE
MOTHER LAKE
GRASS LAKE
62
MSP International Airport
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City of Minneapolis
Sanitary Sewer System
Local Surface Water
Management Plan
Figure 4-1
City Sanitary Sewer
MCES Interceptors
Highways
Lakes

Since the mid-1980s, the focus of the City's CSO program was to expand the storm drainage system to locations where street and alley catch basins were connected to the sanitary sewer. It was estimated in 1986 that 4651.3 acres of runoff from street inflow connections were served by combined sewers. By 2000, 4582.5 acres of street drainage (98.52 percent) were separated, leaving 68.8 acres that are still served by combined sewers.

A major source of inflow in Minneapolis is rainwater from roof drains. Minneapolis ordinances require property owners to disconnect rainleaders and then enable City staff to inspect for compliance. A field survey in 1985 found that of the 99,900 buildings in the City, it was estimated that between 5,280 and 5,380 (5 percent) had rainleader connections. The City re-initiated its inspections of private properties in 2002, and has found 4,181 rain leader violations (see Combined Sewer Overflow – A Minneapolis Solution). Since the 2002 rain leader inspection program began, 760 properties (18 percent of violations) have disconnected rainleaders from the sanitary sewer. Inspection will continue in 2006. An additional 21,312 parcels are scheduled to be inspected in 2006.

The success of City programs and policy aimed at eliminating combined sewers connections and inflow can be seen by observing the change in total overflow volumes at the remaining CSO locations (see 2004 CSO Annual Report). Figure 4-2 shows total annual overflow volumes since 1984. Total annual overflow volume was reduced by 99% from 1984 to 2001.

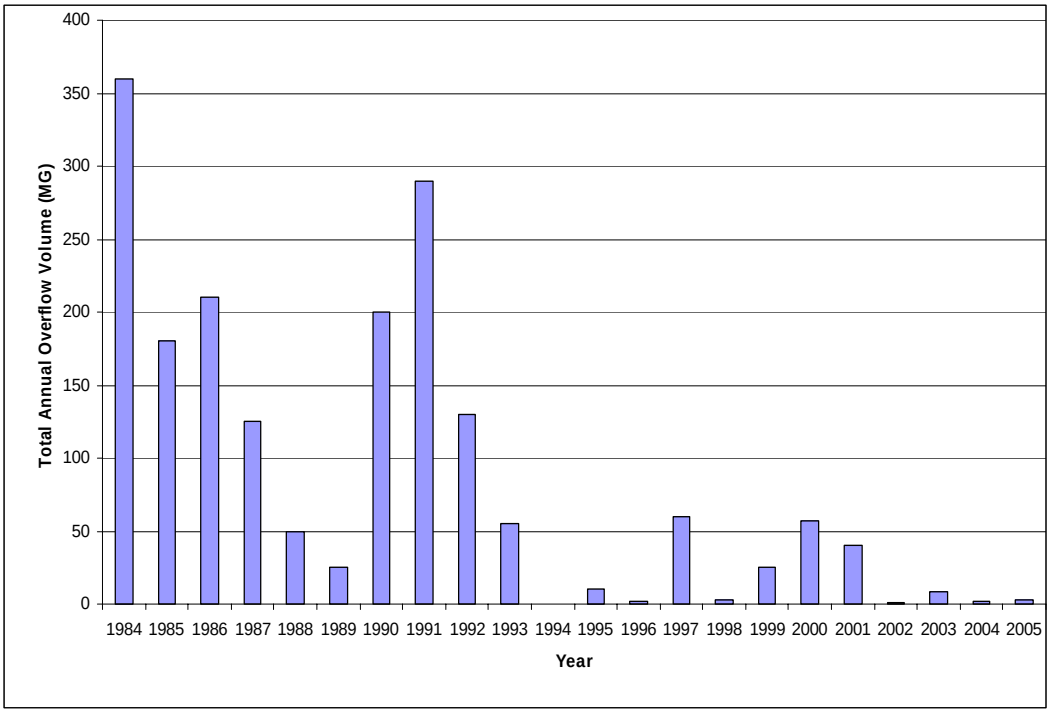


Figure 4-2. Annual Overflow Volume at CSO Locations

Minneapolis Storm Drainage System

The storm drainage system of Minneapolis is newer than the sanitary sewer system.

Table 4-3 provides a quick look at its history. In the period between 1938 and 1960, storm drains were constructed in developing areas of the city, but the older combined sewers still conveyed both sanitary and storm flows. Since the 1960s, the city has dramatically increased the mileage of storm drains either as part of road reconstruction projects or in efforts to separate the combined sewers. Currently, the Minneapolis stormwater system handles approximately 50 square miles, with the following major City owned components:

Table 4-3. Storm Drainage

Year Built	% of Storm Sewer System by Length
Pre-1900	0.1%
1901 – 1910	0.3%
1911 – 1920	0.5%
1921 – 1930	2.7%
1931 – 1940	27.0%
1941 – 1950	7.5%
1951 – 1960	8.8%
1961 - 1970	16.8%
1971 – 1980	17.1%
1981 – 1990	14.3%
1991 – 2000	4.7%
2001 - 2006	0.1%

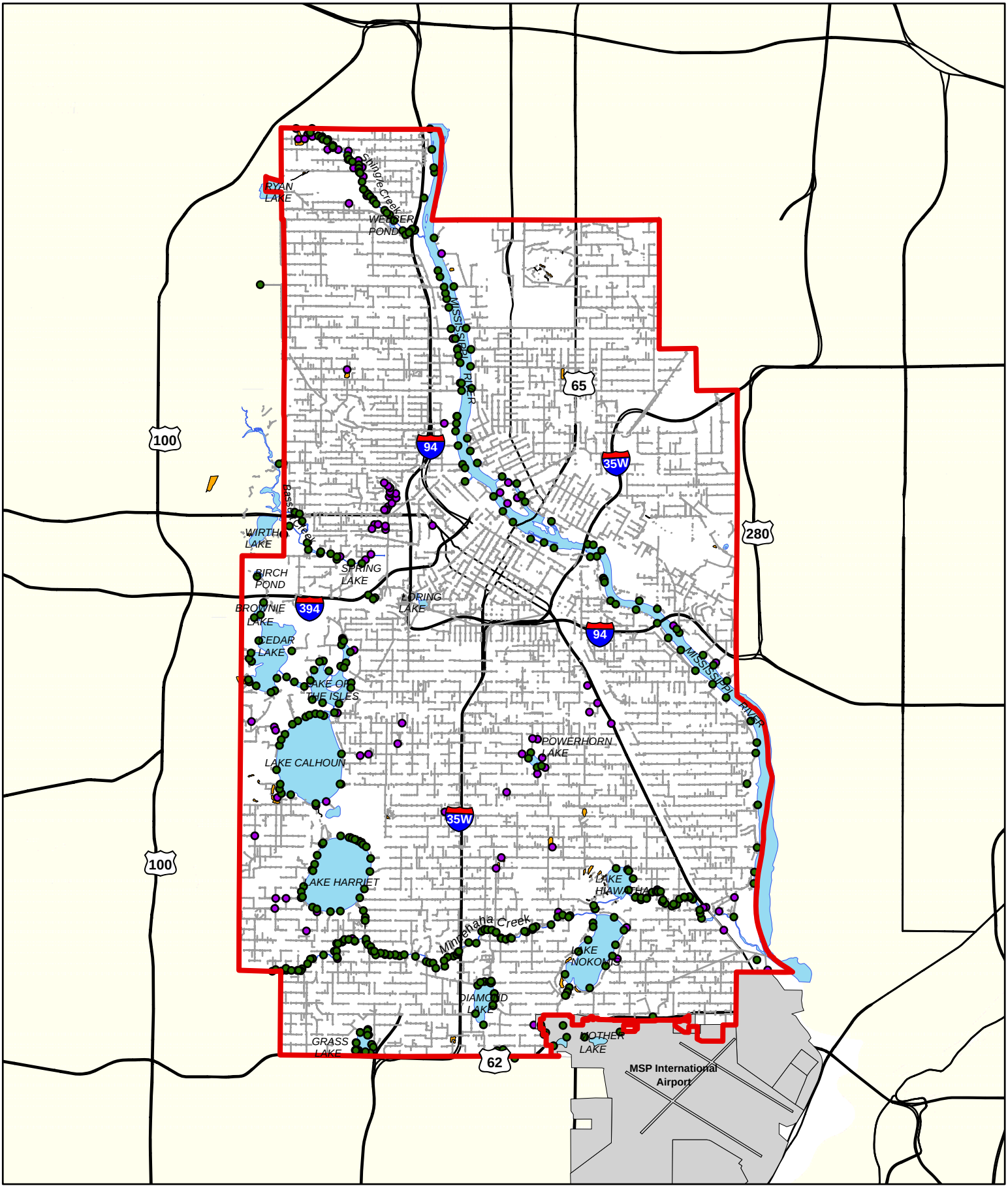
- Water quantity detention facilities to control localized flooding.
- Water quality treatment facilities including stormwater ponds and grit chambers.
- Drainage system, including surface water, drainage ways and storm drains; and,
- Deep tunnels which convey stormwater to the Mississippi River.

Table 4-4 and Figure 4-3 summarize the storm drainage system owned and operated by the City of Minneapolis. This inventory includes the storm drainage system that was transferred to the City of Minneapolis from the Minneapolis Park and Recreation Board in 2000.

Table 4-4 Storm Drainage System Infrastructure Inventory

Component	Quantity	
Pipes	556	Miles
Storm tunnels	16.7	Miles
Manholes	18,200 +	
Catch Basins / Inlets	25,000 +	
Detention Facilities (Public)	16	Ponds
Grit Chambers / Quality Controls	127	
Pump stations	25	
Outfalls	387	

Figure 4-4 illustrates the individual catchment areas served by the Minneapolis drainage system. This figure also shows how the jurisdictional boundaries of the watershed district/organizations overlay onto the catchment areas.



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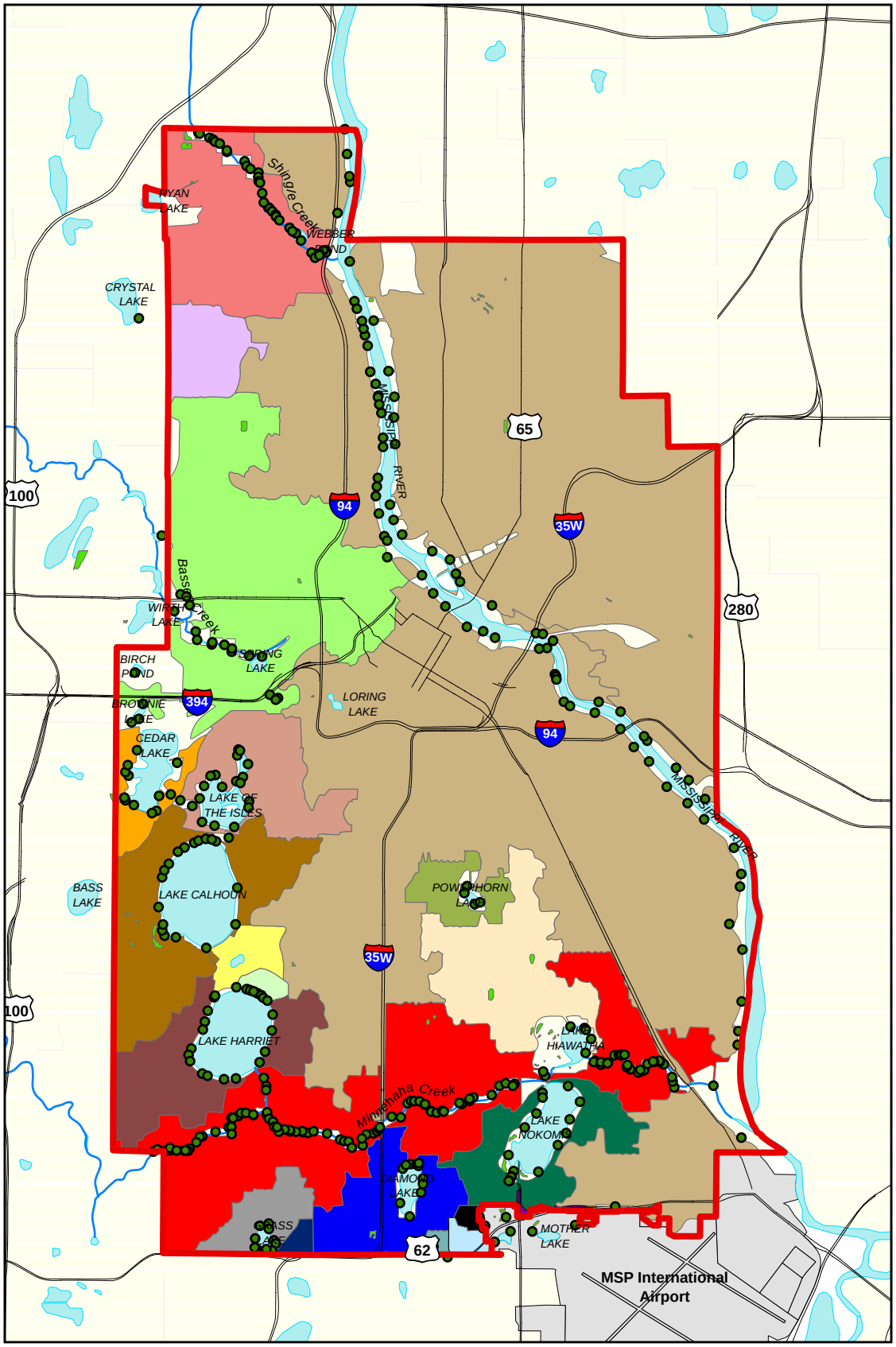
City of Minneapolis

Stormwater Drainage System

Local Surface Water Management Plan

Figure 4-3

- City Storm Sewer
- Highways
- Grit Chambers
- Outfalls
- Stormwater Basins



- City Boundary
- Outfall
- Water Body
- Bassett Creek
- Cedar Lake
- Cemetary Lake
- Crystal Lake
- Diamond Lake
- Grass Lake
- Lake Calhoun
- Lake Harriet
- Lake Hiawatha
- Lake Nokomis
- Lake of the Isles
- Legion Lake
- Minnehaha Creek
- Mississippi River
- Mother Lake
- Powderhorn Lake
- Richfield Lake
- Sanctuary Pond
- Shingle Creek
- Taft Lake
- Unnamed Wetland W of Mother Lake

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City of Minneapolis

Stormwater Drainage Areas

Local Surface Water Management Plan

Figure 4-4

Non-Minneapolis Storm Drainage System

Interconnected with the Minneapolis storm drainage system are networks owned and operated by other public agencies. Cooperative agreements that govern the construction, operation and maintenance are contained in Section 1, Introduction. Non-Minneapolis storm drainage systems are described below, and are not included in the inventories of this LSWMP:

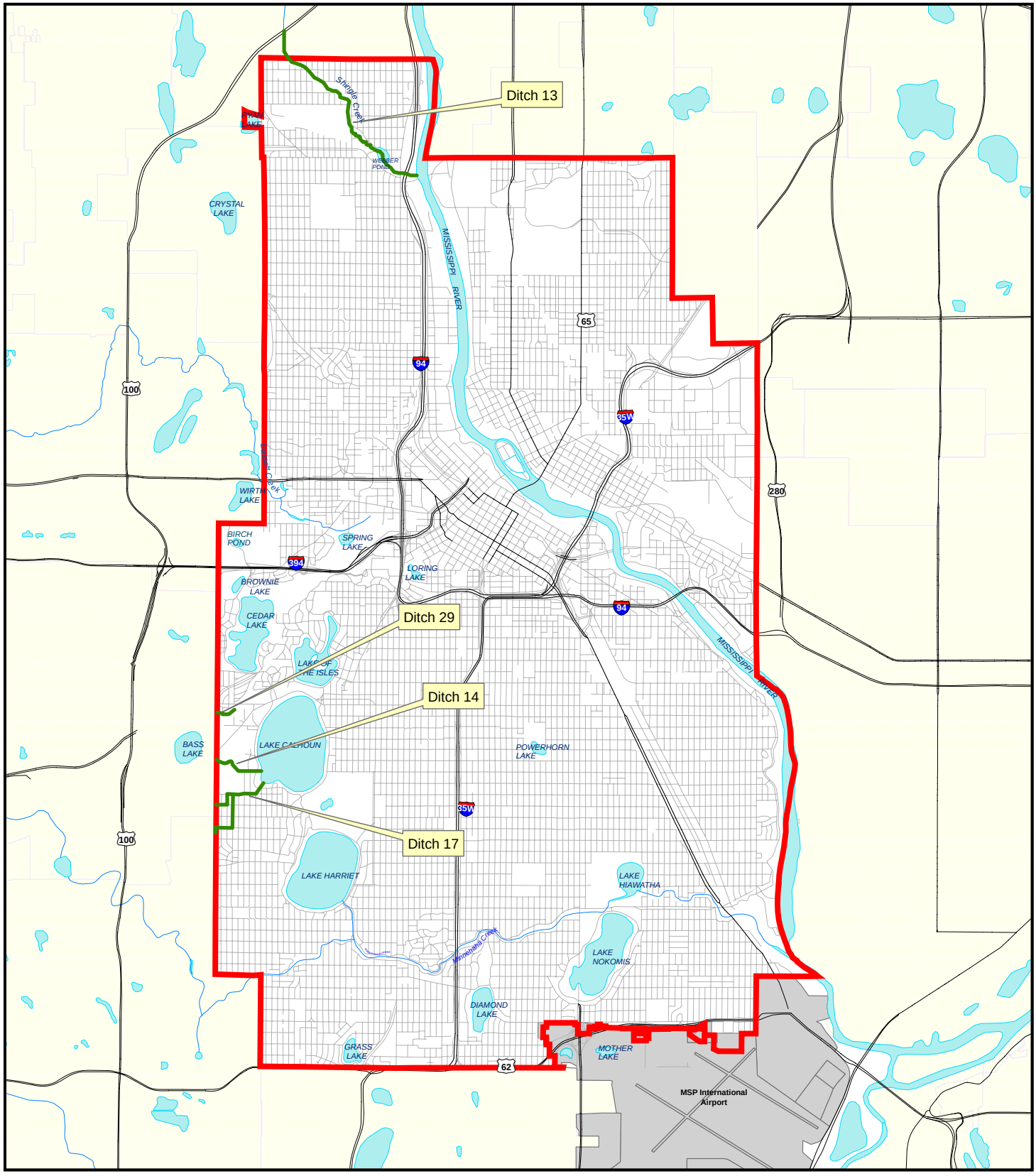
- **University of Minnesota** owns a surface drainage and deep tunnel storm drainage network that discharges directly to the Mississippi River. This system serves the original campus area of the University, primarily southeasterly of University Avenue and 15th Street SE. The newer campus areas drain to the Minneapolis system. As owner of a storm drainage system, the University of Minnesota is subject to MS4 permitting requirements of the USEPA stormwater regulations.

- **Minnesota Department of Transportation** owns surface drains and deep tunnels that serve the interstate highway system. Areas of the Minneapolis system drain into this MN/DOT system. The reverse is generally true for the Trunk Highway system, where the MN/DOT system drains into the Minneapolis system. This is a general description of the ownership for MN/DOT; exceptions should be researched on a case-by-case basis.

- **Hennepin County** is responsible for County Ditch 13 – which is also known as Shingle Creek. The section of Shingle Creek from the city border with Brooklyn Center to approximately Humboldt Ave N is designated as this county ditch (Figure 4-5). For purposes of water quality improvements considered in this LSWMP, this section is considered a public water. However, the Minnesota Department of Natural Resources does not have any jurisdiction to issue permits or otherwise approve any improvements. Permission to connect to or construct improvements along this ditch must be obtained from the County. As owner of the ditch, Hennepin County is subject to MS4 permitting requirements of the USEPA stormwater regulations.

- **Minnehaha Creek Watershed District** serves as the ditch authority for all county or judicial ditches that exist within the area of their jurisdiction. Ditches number 29, 14, and 17 all drain from the west into Lake Calhoun (Figure 4-5). Each of these has been constructed as an underground storm drain, and is interconnected with the Minneapolis system. As owner of these ditches, the MCWD is subject to MS4 permitting requirements of the USEPA stormwater regulations.

- **Bassett Creek Watershed Management Organization** shares the responsibility for the operation, maintenance and repair of the Bassett Creek tunnel system with the City and MN/DOT. Although Minneapolis owns both the old and new sections of the tunnel, Section 5.2.2.1 of the BCWMC 2004 Watershed Management Plan notes that BCWMC accepts responsibility for inspection, maintenance and repair of the new tunnel. This plan also requires that cities obtain approval from the BCWMC prior to altering the physical structure or altering the hydrology of the area tributary to the new tunnel.



City of Minneapolis

Ditches in Minneapolis

Local Surface Water Management Plan

Figure 4-5

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- Major Freeways/Highways
- River/Stream
- General City Boundary
- Drainage Ditch
- Lake

System Operation and Maintenance Activities

System Maintenance

Public Works Field Services Division, Sewer Maintenance Section routinely inspects and maintains the sanitary sewer and storm drainage systems as needed to ensure the system properly functions. Frequency of inspections and maintenance are often event-driven and based on experience and inspection results history. Sewer maintenance staff have developed a formal inspection, cleaning and repair schedule in response to NPDES Phase I requirements. The following periodic inspection and maintenance procedures are followed:

- Street maintenance staff annually inspect and clean basin grates on street sweeping routes during the summer.
- Catch basin and manhole castings are inspected, cleaned and replaced as necessary.
- Catch basin and manhole rings are inspected and replaced and/or regrouted as necessary.
- Catch basin and manhole structures are inspected and are repaired or replaced as needed. Pipe inverts, benches, steps (verifying integrity for safety), and walls are checked. Cracked, deteriorated, and spalled areas are grouted, patched, or replaced.
- Storm sewer piping is inspected either manually or by television to assess pipe condition. Items looked for include root damage, deteriorated joints, leaky joints, excessive spalling, and sediment buildup. The piping system is programmed for cleaning, repair, or replacement as needed to ensure the integrity of the system.

During summer street sweeping, City staff typically inspect and clean basin grates

Specific information on the annual maintenance activities for the stormwater drainage system is detailed in the City's NPDES Annual Report.

In 2000, the City and the MPRB created an inventory of the entire public infrastructure owned and managed by each. During subsequent negotiations, the City and the MPRB assumed either maintenance or ownership certain components of each others infrastructure. As part of this agreement, the MPRB transferred ownership of their entire stormwater drainage system to the City. Since that time, Public Works has increased inspection of these storm drains in order to create a current inventory, determine the condition, and determine the need for additional maintenance.

Storm Drain Catch Basins

The City maintains a storm drains spatial database to assist with planning.

To fully utilize storm sewer capacity, catch basins (also called inlet structures) are kept operational to allow runoff to easily flow into the underground storm drains. All efforts are made to keep catch basins and other inlets free of debris and sediments so as not to restrict flow and cause localized flood damage. Leaf and lawn litter are the most frequent cause of inlet obstructions. On a routine basis, City staff visually inspect catch basins to ensure they are operational.

Piping System

The City spends approximately $1 million each year rehabilitating and repairing sanitary sewers. CCTV inspections are used to select specific areas in need of lining. Rehabilitation is recommended where sewers are either structurally failing, have excessive infiltration of groundwater, or have excessive root intrusion. Inspections, rehab or repair of the storm drains are conducted on an as-needed basis.

Over the past several years the City has made an extensive effort to update its storm drains spatial database. Almost all of the storm drain system has been digitized with attribute information attached. Most recently the storm drain network newly transferred from the MPRB was incorporated into the database. This information will be used for lifecycle modeling and budget projections.

Open Channels and County Ditches

Open ditches and vegetated channels are a minor part of the Minneapolis stormwater drainage system. Vegetated channels are periodically inspected and maintained, as high flows can create erosion within the channels.

Pump Stations

Pump stations are periodically inspected and monitored based on performance factors and specified pump maintenance schedules. An annual check-up is conducted for each pump station.

Grit Chambers, Sump Manholes and Sump Catch Basins

Grit chambers, sump manholes and sump catch basins are included in storm drainage systems to collect sediments before they are transported to downstream water bodies. Once sediments are transported to a lake or pond, they become much more expensive to remove. Sediments originate primarily from road sanding operations, construction activity and soil erosion.

As of 2005, there are 127 grit chambers distributed across the City, with more being planned. These structures are designed to collect these sediments and are inspected at least once a year, and cleaned as necessary, to provide capacity for future sedimentation. Suction vacuum equipment is typically used to clean these grit chambers. Sediment quantity removed, floatable amounts, presence of oil, and date

cleaned are recorded and maintained in a database. Removed substances are screened for visual or olfactory indications of contamination. If contamination is suspected, the material is sent for analysis and subsequently disposed of appropriately.

Stormwater Basins

Stormwater flood control and water quality basins represent a sizable investment in City's drainage system. General maintenance of these facilities helps ensure proper performance and reduces the need for major repairs. Periodic inspections are performed to identify possible problems in and around the basin. Inspection and maintenance is conducted for basin outlets, basin inlets, side slopes and sediment buildup.

Basin Outlets

The City maintains stormwater basins by conducting the following activities:

- The area around outlets is kept free and clear of debris, litter, and heavy vegetation.
- Trash guards are installed and maintained over all outlets to prevent clogging of the downstream storm sewer. Trash guards are inspected at least once a year, typically in the spring, to remove debris that may clog the outlet. Problem areas are addressed more frequently, as required.
- Emergency overflow outlets are provided for all ponds when possible. These are kept clear of debris and other materials and properly protected against erosion.

Basin Inlets

Inspection and maintenance of basin inlets address the following:

- Inlets are inspected for erosion. Where erosion occurs near an inlet, energy dissipaters or riprap is installed.
- Inlets are inspected for sediment deposits, which can form at the inlets due to upstream erosion. Sediment deposits are removed to ensure that design capacities of storm drains entering the basin are maintained.

Vegetation keeps side slopes from eroding or depositing sedimentation into basins.

Side Slopes

Inspection and maintenance of basin side slopes address the following:

- Side slopes are kept well-vegetated to prevent erosion and sediment deposition into the basin. Severe erosion along side slopes can reduce the quality of water discharging from the basin and require dredging of sediments from the basin.
- Noxious weeds are periodically removed from around basins.

- Some basins in highly developed areas require mowing. If mowing is performed, a buffer strip of 20 feet or more adjacent to the normal water level is typically maintained. This provides filtration of runoff and provides wildlife habitat.

Sediment Buildup

Inspection and maintenance of sediment buildup in basins address the following:

- Basins are inspected to determine if sediment buildup is causing significant loss of storage capacity. Excessive sediment buildup significantly reduces the stormwater treatment efficiency of water quality ponds. Inspections occur after significant rainfalls.

- Sediment removal is performed where excessive sediment buildup has occurred. As a general guideline, ponds require dredging every 15 to 20 years.

Road Maintenance

According to regulations enacted by the USEPA, the gutters of urban streets are also considered part of the storm drainage system. Therefore, maintenance activities conducted for the roadways are integral to maintenance of the storm drainage and surface water systems.

Winter Street Management Practices

Minnesota receives an average of 40 inches of snow during a typical year. This requires a large amount of deicing chemicals (primarily salt) to be applied to roads and sidewalks each winter. Studies indicate that an estimated 80 percent of the environmental damage caused from de-icing chemicals is a result of improper storage and handling of the material (MPCA 1989). Improper storage and overuse of salt increases the risk of high chloride concentrations in runoff and groundwater. High chloride concentrations can be toxic to fish, wildlife, and vegetation.

The City owns a number of storage facilities designed according to MNDOT specifications for runoff control. All salt stockpiles are stored under cover at these locations, to minimize potential for groundwater contamination and runoff. Plans are underway to build a larger facility with better runoff collection systems in place.

The City will continue to use and improve the procedures it has established for efficient application of de-icing materials to reduce cost and minimize environmental damage. Good accounting of materials applied during a season is in place. Street conditions are assessed for each individual event and ice control material application is adjusted accordingly. Equipment is maintained in good working condition and is properly calibrated to prevent excessive application. Maintenance supervisors receive training at the Local Road Research Board.

The Shingle Creek Chloride TMDL study found that the primary source of chloride in the stream was from the use of deicing chemicals on impervious surfaces. The analysis in this study concluded that a 71 percent reduction in chloride use would be

necessary to reduce the chloride levels in Shingle Creek to water quality standards. The Shingle Creek Chloride TMDL Implementation Plan contains recommendations for member cities to implement:

- Incorporate chloride management BMPs into NPDES Stormwater Pollution Prevention Plans (SWPPP)
- Develop and maintain a salt management plan
- Create chloride reduction requirements for individual commercial properties seeking site plan approval
- Improve application equipment and decisions:
    - Calibrate spreaders annually
    - Use MN/DOT Road Weather Information System to improve application decisions
    - Evaluate new technologies such as pre-wetting and anti-icing on annual basis
    - Investigate and adopt new products where feasible and cost effective
- Maintain good housekeeping practices at storage sites
- Conduct annual training for supervisors and operators
- Stockpile snow away from sensitive areas
- Sweep streets as soon as possible in later winter
- Integrate chloride management BMPs into NPDES permit and annual report

The primary mission still remains to provide the best snow and ice control with the resources available. In response to the recommendations contained in the Shingle Creek Chloride TMDL Implementation Plan, the City of Minneapolis has started the process to change the equipment used in the Shingle Creek Watershed area of Minneapolis. Changes being considered are to transition from manually controlled sanding equipment to fully automated sanding equipment. This will give the City the ability to improve tracking of material use. It is believed that the use of the pre-wet system and ground speed control, will achieve a reduction of up to 30% of the materials used with little change in the level of service. With electronic tracking/data storage, the ability to most closely tailor response to the storm event will be possible as data is acquired and results of our efforts are analyzed. They have added anti-icing activities as a method to get ahead of the storm event and reduce the amount of material that may be needed to de-ice after the event.

Street sweeping reduces the volume of sediment that enters the drainage system and water bodies. Source: City of Minneapolis

Street Sweeping

Street sweeping is an integral part of the City's surface water management system. It greatly reduces the volume of sediment that has to be cleaned out of sump structures and downstream water bodies. The City will continue to practice a minimum of two sweeping operations a year, in spring and fall. All City streets are swept, aided by enforcement of temporary parking bans. Special methods are employed to address seasonal conditions and to optimize cleaning. Pressurized water is applied to push sediment and leaves to the gutters. Street sweepers follow and clean the gutters. Tandem sweeping takes place with air regenerative sweepers following mechanical sweepers. High traffic commercial areas and priority areas are swept more frequently.

In the fall, leaves are bunched into piles and picked up and sent to a composting facility for disposal. This greatly reduces inlet blockages and protects the water quality of downstream water bodies. Street sweeping and leaf litter pickup minimizes impacts to City surface waters from leaf litter, sand, salt and other debris.

Capital Improvement Activities

Design: Assessments and Standards

Water Quantity Assessment Standards

The City has initiated a practice of modeling the storm drainage system in coordination with developing a solution to a problem, such as street flooding. Often this modeling will lead to development of a capital improvement project. To ensure consistency of modeling efforts, the City created modeling guidance, which can be found in Appendix M.

Water Quantity and Water Quality Design Standards

The City of Minneapolis has developed standards for design, performance and management of its stormwater systems. The City intends this guidance to ensure that all hydrologic, hydraulic and water quality analyses will be prepared in a manner consistent with City requirements. Water quantity standards are intended to ensure the system is adequately sized for future flows, to prevent flooding and to ensure all design allows for economical maintenance. Hydrologic and hydraulic design standards are contained in the City's modeling guidance (Appendix M). In 2000, the City formally adopted the MPCA Manual Protecting Water Quality in Urban Areas, Best Management Practices for Minnesota, October, 1989, as design standards for stormwater best management practices. The recently released Minnesota Stormwater

Manual is being reviewed by Public Works staff for use as guidance on structural BMP design and maintenance procedures, including stormwater infiltration systems.

Capital Improvement Program (CIP)

Minneapolis invests in water resources management within the framework of its current capital and operating budgets of the City. Both are approved on an annual basis. Future CIP projects are listed, but are subject to considerable change. In any given year City departments may need to use water resources management funds to match a MNDOT project or to solve a new flooding problem or to implement a recommendation of a TMDL study. The City's annual CIP budget is developed in a very open process that starts with City department proposals which are reviewed in detail by a citizen's committee (CLIC – Capital Long Range Improvement Committee) and the Mayor. Finally, the City Council holds public hearings before final budget adoption. Creation of a more specific capital improvement budget is not feasible; it would not allow adjustments for new priorities, nor would it be able to adapt to citizen based priorities. Funding established in the City's 2006 Capital Improvement Program identifies all the water resources related projects anticipated by the City in 2006. Specific projects designated in the current 2006 – 2011 CIP are described in Section 5. The following pages detail the funding programs that have been established by the City.

The City has established funding for storm and tunnel reconstruction and rehabilitation, such as this project at Bassett Creek. (Source BCWMC).

Storm and Sanitary Tunnel and Sewer Rehabilitation

These funds are used to rehabilitate and repair storm drain tunnels, sanitary sewer tunnels, and sanitary sewers. The program establishes annual funding to permit repair and rehabilitation activities to be completed as needed to the storm drain and sanitary sewer system as prioritized by the Minneapolis Public Works Field Services Division.

The Public Works Department recently completed a comprehensive condition rating report (Tunnel Management Plan), which outlines identified deficiencies and repair priorities. Based on assessment completed to date on the storm drain tunnels, typical problems include voids above or below the tunnel structure, cracking due to pressurization, erosion of the tunnel floor, and infiltration of ground water. Currently the Public Works Department is conducting repairs on those most in danger of collapse or those for which failure has been identified such as the 2nd Avenue Storm

Tunnel and the Hennepin Avenue Storm Tunnel, (4th Street North Drift). The cost to repair these tunnels varies with the magnitude of the problems.

Miscellaneous Storm Drains

This program provides for infrastructure repairs or improvements to solve small drainage and flooding issues. Funds are utilized to create minor improvement to the storm drainage system, especially those improvements where it is unfeasible to wait for available capital improvement funding. Typical projects include minor improvements necessary to accommodate a redevelopment project, or minor repairs that need immediate attention.

Implementation of US EPA Stormwater Regulations

Funds from this program are used to implement structural BMPs. The programs are a combination of capital improvement projects, maintenance activities, ordinances, stormwater monitoring and public education which, in total, will improve the runoff being discharged to the lakes, and streams in the City of Minneapolis. The net benefit of the overall program is improved water quality in our receiving waters and compliance with US EPA regulations.

Combined Sewer Overflow Improvements

The primary focus of this program is to remove City-owned inflow of stormwater from the sanitary sewer system, and redirect this flow to the storm drain system. Originally established in the mid-1980s, these funds have been used to relocate street and alley drains from the sanitary sewers to the storm drainage system. To date over 99% of the projects have been completed. Project areas designated for future funding in this program are shown on Figure 4-6. In 2006, the City added City-owned buildings with roof drain inflow connections to the list of projects funded by this program.

Elimination of overflow events is mandated by a NPDES permit issued jointly to the City of Minneapolis and MCES. The current NPDES permit (expired in 2001) required elimination of CSOs within that permit's timeframe. The MPCA has communicated to staff at the City and MCES that a plan for elimination of CSOs must be submitted before a new permit can be issued. The City is currently following recommendations from a CSO study jointly conducted by the City and MCES, completed in April 2002. MCES approved the Minneapolis Tier II Comprehensive Sewer Plan on Jan. 29, 2003, which documents the City's implementation plan for CSO improvements based on this joint study. If the City fails to complete this commitment, the Met Council could withhold development funding to the City. In addition, failure to meet permit mandates could be subject the City to Clear Water Act, such as citizens' lawsuits with fines up to $25,000 per violation per day.

According to the 2002 joint study, this CSO program requires all components to be implemented to meet the goal of effectively eliminating Combined Sewer Overflows, except under extreme conditions. This includes the removal of both public and private stormwater inflows to the sanitary sewer system. In addition, the effectiveness

FA#	LOCATION	OUTFALL	STATUS
PS09	Excelsior Blvd & Lake Calhoun	54-170	Project Complete
PS10	Lyndale Ave S Storm Drain	10-720A	Project Complete
1	42nd Ave N & Russell Av N	20-210B	Under Construction
2	51st Ave N & Vincent Ave N	20-010	Project Complete
3	37th Ave N & Humboldt Ave N	10-110	Project Complete
4	33rd Ave NE and Benjamin St NE	10-100	Project Complete
5	Crystal Lake	63-010	Engineers Report Complete
6	33rd Ave N Storm Drain	10-120	Complete(Needs Analysis)
7	35th Ave NE and Polk St NE	10-100	Project Complete
8	3rd St N at 23rd Ave N	10-230	Engineers Report Complete
9	Holland Neighborhood Flood Basin	10-180	Project Complete
10	18th Ave NE & Quincy St NE	10-320	Project Complete
11	Talmage St & Hoover St NE	10-460G	Project Complete
12	37th & 39th St E & Columbus Av S	76-010	Project Complete
13	Clinton Ave S - 45th to 46 St E	70-330	Engineers Report Complete
14	Clinton Av S & 39th St E	10-430R	Engineers Report Complete
15	22nd St W & Garfield Av S	10-430J	Engineers Report Complete
16	Jefferson Elementary School	53-150	Project Complete
17	43rd St W & Wentworth Ave S	10-430J	Engineers Report Complete
18	50th St W & Wenthworth Ave S	10-430U	Engineers Report Complete
19	Aldrich Ave S & 44th St W	57-020	Under Construction
20	Minnehaha Creek - Humboldt to Newton Ave S	70-110,120,130,145	Project Complete
21	Hiawatha Golf Course Flood Pond	76-010	Engineers Report Complete
22	Sibley Field	76-010	Engineers Report Complete
23	43rd St W & Abbott Ave S	54-080A/B/C	Project Complete
24	45th St W & Lyndale Ave S	10-430U	Design Complete
25	45th St W - Nicollet to 1st Ave S	10-430U	Engineers Report Complete
26	43rd St E & Park Av S	70-350	Under Construction
27	44th St E to 29th Ave S	70-475	Under Construction
28	40th St E and Snelling Ave S	57-100A/B	Project Complete
29	50th to 51st St W & York to Zenith Ave S	57-100	Engineers Report Complete
30	51st St W & Abbott Ave S	57-100	Engineers Report Complete
31	Sheridan Ave S - 50th to 51st St W	57-070	Project Complete
32	49th St E & Stevens Ave S	70-330	Engineers Report Complete
33	Minnehaha Creek - 34th to 38th Ave S	70-535,545,555	Project Complete
34	60th St W - Nicollet to Stevens Ave S	71-070	Project Complete
35	54th St E & 28th Ave S	10-720F	Project Complete
36	Victory Mem Pkwy & Xerxes Ave N	63-010	Problem Identified
37	29th & Logan Ave N	40-010	Project Complete
38	Dean Parkway	54-150	Preliminary H & H Analysis
39	46th Ave S - 36th to 37th St E	10-670	Engineers Report Complete
40	39th St W & Kings Highway	10-430T	Preliminary H & H Analysis
41	27th Ave NE & Stinson Blvd NE	10-440E	Preliminary H & H Analysis
42	Abbott Hospital - E 28th St & 10th Ave S	10-630Y	Preliminary H & H Analysis
44	29th Ave NE & Tyler St NE	0-100	Preliminary H & H Analysis
45	33rd St W & Girard Ave S	54-040	Problem Identified
47	22nd St W & Emerson Ave S	53-120	Preliminary H & H Analysis
48	Lowry Ave NE & 2nd St NE	10-150	Preliminary H & H Analysis
49	32nd Ave NE & Garfield Ave NE	0-100	Preliminary H & H Analysis
50	Polk St NE & Tyler St NE (Alley)	0-100	Preliminary H & H Analysis
51	34th Ave NE & Central Ave NE	0-100	Preliminary H & H Analysis
52	5th St NE & 35th St NE	10-100	Preliminary H & H Analysis
53	Randolph St NE & 29th Ave NE	10-100	Preliminary H & H Analysis
54	St. Anthony Pkwy. W of Central Ave	0-100	Preliminary H & H Analysis
55	Lyn Park Av & Lyn Park Lane N	10-400C	Problem Identified
56	Xerxes Av S & 57th St W	70-055	Problem Identified
57	Chowen Av S & 45th St W	54-080	Problem Identified
58	Summer St NE & Mckinley Pl S	10-450L	Problem Identified
59	Lyndale Ave S - 26th to 27th St W	10-430J	Problem Identified
60	2129 Emerson Ave S	53-120	Problem Identified
61	40th St E - Van Nest Ave to I-35W	10-430U	Engineers Report Complete
62	6th Ave SE & 7th St SE	10-450A	Problem Identified
63	28th St W & Humboldt Ave S	53-160	Problem Identified
64	Upton Ave N & 29th Ave N	40-101	Problem Identified

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CSO_ID	LOCATION	OUTFALL
1	4 CBs E of 2nd St N on 22nd Av N	10-220
4	2 CBs on Elwood Av & James Av N	40-240
6	CB N of 4th St SE btw Central Av & E Hennepin	10-350
7	CBs in 2 alley near Sheridan Av N & 29th Av N	40-010
10	CB in alley S of 43rd St btw Harriet & Garfield Av S	10-430U
13	CB in alley btw 22nd & Standish Av S; 38th to 39th St E	76-010
16	CB in alley near Sheridan Av N & 24th Av N	40-010
17	CB in alley N of E 45th St, btw Cedar & 18th Av S	76-010
20	2 CBs on Oakland Av, N of Lake St E	10-630U
21	2 alley drains N of Lake St E, E & W of Columbus Av S	10-630U
24	CB at Penn Av N & 17th Av N	40-010
25	CB in alley btw Lyndale & Garfield Av S; 46th to 47th St W	10-430U
26	15 CBs at 45th St W & Lyndale, also E to Garfield Av S	10-430U
30	2 CBs at Queen Av S & Wm Berry Pkwy	54-060
32	CB in alley btw 16th & 17th Av S; 44th to E 45th St	76-010
36	CB at E Hennepin Av & Central Av NE	10-450A
37	CB in alley btw 19th & 20 Av S, S of E 32nd St	76-010
38	CB in alley S of 44th St E, btw 2nd & 3rd Av S	70-330
42	3 CBs & SD @ E Lake St & Stevens Av S	10-430M
43	2 CBs at Blaisdell Av & W Lake St	10-430M
46	CB in alley N of 34th St E, btw 20th & 21st Av	10-680
47	CB in alley N of 29th St E btw 33rd to 34th Av S	10-630C
50	2 CBs at Marshall St NE & 29th Av NE	10-100
52	2 alley CBs & 4 CBs - 36th to 37th St W; Bryant to Dupont Av S	10-430V
53	CB in alley near 49th St W btw Pleasant & Rustic Lodge Av	70-330
54	2 alley CBs, 4 CBs W of 18th to Cedar Av S, 37th to 38th St E	76-010
55	CB in alley N of E Minnehaha Pkwy btw 18th & Cedar Av S	72-130
56	4 CBs & SD on 24th Av SE, S of Elm St SE	10-460Q
57	CB on University Av NE btw 1st Av NE & Hennepin Av E	40-350
58	CB at 2nd St N & 29th Av N	10-130
59	2 CBs S of E Lake St, on 15th Av S	10-630Z
60	CB on 12th St S @ Nicollet Mall	10-410E
65	CB on Vincent Av S & Brookwood Terrace	70-050
66	2 CBs on Lyndale Av S, N of Crosstown Hwy 62	71-070
69	CB in alley N of 43rd St W, btw Pillsbury & Pleasant Av S	10-430U
71	2 CBs at Linden Av & 16th St N, also CB in pkg lot	41-020
75	2 CBs on Grand St NE, 26th to 27th Av NE	10-030
77	CBs on 6th Av N, btw 4th St N & Washington Av N	40-340
79	2 CBs at 27th Av S & E 27th St	10-630L
80	CB on 9th Av N, Washington Av N to 3rd St N	40-360
84	2 pairs of CBs on 7th Av N, Washington Av N to 4th St N	40-340
85	2 CBs on 8th Av N, Washington Av N to 3rd St N	40-360
86	CB in alley N of 42nd St W, btw Grand & Pleasant Av S	10-430T
87	Sewer trunk line near Morgan Av S & Laurel Av W	40-140
88	CB in alley S of 46th St W, btw Garfield to Harriet Av S	10-430U
89	CB in alley N of 46th St W, btw Lyndale & Garfield Av S	10-430U
95	CB in alley N of 33rd Av NE, btw Tyler & Polk St NE	10-100
97	CB on Lowry St NE, btw Jackson and Central Av NE	10-450I
100	4 CBs at 37th Av NE & Van Buren St NE	10-100
102	CB in alley N of 5th Av N, btw Newton & Morgan Av N	40-220
103	CB at Upton Av S & W 52nd St	57-010
106	2 CBs at Humboldt Av N & 45th Av N	20-210A
108	Emergency overflow at 36th Av NE & Polk St NE	10-100
109	CB in alley S of 43rd St W, btw Pillsbury & Wentworth Av	10-430U
110	CB in alley N of Pleasant Av, btw 59th & 59+1/2 St W	71-070
111	CB on S side of 10th Av N, 3rd to 4th St N	40-330
114	CB in alley N of 41st St E, btw 13th & 14th Av S	76-010
115	CB in alley N of 38th St E, btw 15th & Bloomington Av S	76-010
116	Temporary connections at E 47th St & Stevens Ave S	70-330
117	5 CBs on E side of 2nd St N & 23rd Av N	10-230

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Legend

Flood Area Status

- Problem Identified
- Preliminary H&H Analysis
- Engineers Report Complete
- Design Complete
- Under Construction
- Project Complete
- Complete (Needs Analysis)*
- 000 Flood Area Label

CSO Area Status

- Incomplete Cso Area
- 000 Cso Area Label

* = Project complete, but flooding problems still exist.

City of Minneapolis

Flood Areas and Future CSO Projects

Local Surface Water Management Plan

Figure 4-6

MINNEAPOLIS DEPARTMENT OF PUBLIC WORKS

MINNESOTA CSO PROGRAM

of ongoing property inspections to identify and remove illegal connections to sanitary sewers will be reduced if supporting capital improvement projects are not funded. CIP projects will be needed to provide additional storm drains for redirected stormwater connections, or add capacity to prevent flooding.

Flood Mitigation and Alternative Stormwater Management Strategies

The City established the Flood Mitigation Program in response to severe building flooding that occurred in the summer of 1997. In a report titled *Flood '97*, the Department of Public Works identified 39 areas of flooding that could be mitigated through improvements to the storm drainage system. Five areas were identified with the worst recurring flooding and immediate funding was established to purchase the houses and relocate the residents, in preparation for construction of stormwater holding basins or ponds. The logic of starting the program with property acquisition was based on the principle of removing residents from the harm of future flooding, if a severe storm occurred before the future basins were in-place.

The program included construction of six stormwater retention basins (or ponds) plus 20 major storm drain construction projects. Originally the scope of the program was to spend $63 million over nine years (1998 through 2006). The City has taken specific steps to incorporate flood mitigation in the annual capital improvement program. Several flood mitigation projects were proposed in 2004 to the Capital Long-Range Improvement Committee (CLIC). CLIC is a committee comprised of citizens and business people that consider the projects proposed for the City's Five Year Capital Improvement Program. In reviewing the flood mitigation program proposals for the 2005-2009 in July, 2004, the committee noted that the mitigation program "represent a large capital expenditure for perhaps a relatively small number of homes" and made the recommendation that the "City take a "big picture" look at gradually returning many of these (flooded) home sites to their earlier nature, as wetlands, natural holding ponds and parklands." As a result of that direction, no other flood area mitigation projects have been submitted. Flood control measures are now programmed under a new activity, Alternative Storm Water Management Strategies.

Regulatory Activities

CSO Program

The NPDES CSO permit (Appendix K) mandates that Minneapolis and MCES submit an annual report to the MPCA on the City's CSO program. The program's current goal is to eliminate CSOs at the eight remaining regulator sites in the city or at a minimum to meet or exceed the EPA's current sewer overflow policy. The annual report summarizes yearly rainleader disconnection activities and sewer separation work. The report also details maintenance activities; sewer cleaning, storm drain inspections, and grit chamber inspections.

As part of The Minneapolis Plan approved by the MCES, the City entered into a Memorandum of Understanding that included both parties funding a CSO evaluation study. Accordingly, the City and the Met Council jointly hired a consultant to study the sanitary sewer system in order to determine the source of clean water draining into the system. This extraneous water is the cause of ongoing overflows of untreated sewage mixed with stormwater to the Mississippi River during severe rainstorms called "Combined Sewer Overflows." The study concluded that multiple actions are necessary to further reduce the occurrence of CSOs. Even with 100% removal of inflow sources, CSOs would still occur. Recommendations include a combination of inflow reduction, regulator modifications, and in-line storage.

The City instituted a program to reduce stormwater inflow through redirection of rooftop rainleaders to side yards and storm drains.

The City has responded to these recommendations with a program to remove both public and private sources of stormwater inflow to the sanitary sewer system. A new ordinance was approved effective Aug, 1, 2003: Chapter 56, Prohibited Discharges to Sanitary Sewer System. It requires property owners to redirect rooftop rainleaders and private surface area drainage either to side yards or to the public storm drain system. Property inspections are being conducted to identify illegal connections to sanitary sewers, and then notifications are sent of the work needed to comply with the new ordinance. This CIP program funds the addition of storm drains where not available for storm connections, and separation of current storm connections from the sanitary sewer.

Stormwater Management Program

The NPDES Stormwater Permit (Appendix L) mandates that the City submit an annual stormwater management program report by June 1 of each year. The Minneapolis Stormwater Management Program and Report summarizes system maintenance during the previous year, identifies areas for program improvement, defines responsibilities of various City departments, and defines a work plan through the next year.

Standards for Stormwater Management for New Construction

The City of Minneapolis and the Minneapolis Park and Recreation Board have adopted ordinances that influence stormwater management for new construction projects (see Sect ion 1, Introduction). Specific ordinances and the departments responsible for oversight are listed in Section 1 of this LSWMP. New construction projects that propose to alter wetlands must comply with provisions of the Minnesota Wetland Conservation Act. The City of Minneapolis, Department of Public Works, is designated as the Local Government Unit by the Minnesota Board of Soil and Water Resources. As LGU the City is responsible for ensuring the provisions of the WCA are implemented in Minneapolis.

Stormwater management requirements established by Minneapolis overlap with the standards established by the watershed district/organizations with jurisdiction in the

City. These also overlap with stormwater management requirements set by the Minnesota Pollution Control Agency in their General Permit for Construction Activities. Table 4-5 cross-references the minimum sized site that is required to meet specific activities (erosion control, rate control, stormwater infiltration, floodplain management, water quality management, buffer strips and wetland conservation) for each of these organizations. Areas in the table that are highlighted note the most restrictive requirement for each activity. In most circumstances, the Minneapolis requirements apply to the smallest sites and therefore are the most comprehensive.

Illicit Dumping and Illegal Discharges into the Storm Sewer System

The Regulatory Services Environmental Management Division of the City provides education and regulation for unauthorized and non-stormwater discharges in the storm drains. The current system is complaint-based inspection and investigation.

The City's NPDES Stormwater Permit requires that 20% of the City's outfalls are inspected annually on a rotating basis. The locations of all existing major outfalls are identified in the field and indicated on the City's storm drain base map. If dry weather flows are detected and illicit connections could be the source of the flow, a grab sample is collected for analysis to determine if pollutants are present. Inspectors work with Public Works Field Services to discover the source of the illicit flows.

The Mississippi Watershed Management Organization (MWMO) and the City of Minneapolis Environmental Services are developing a cohesive water monitoring program that will identify a series of baseline chemical, physical and biological parameters discharging from a watershed-wide storm drainage system (primarily through outfall monitoring) that is also designed to detect illicit discharges entering into water bodies in the City. The sample results will track the water quality changes at the outfalls identifying points of potential illegal discharges, sewer cross connections, an assessment of outfalls and their drainage areas for non-point source pollutants.

Typically, storm water flows to area catch basins which are typically located on city streets. From the catch basins the storm water flows through underground pipes and discharges through outfalls to the lakes, streams or the Mississippi River in Minneapolis. There are over 105 storm drain outfalls on the Mississippi River within the City limits alone. The sampling and monitoring effort is currently focusing on those outfalls and drainage areas to the Mississippi River.

Illicit discharges include both intentional dumping of wastes and accidental spills of chemicals/liquids in the City's storm drain system. Intentional discharges would include dumping of oil/paint or other regulated wastes into catch basins. Motor vehicle collisions and electrical transformer overloads are examples of accidental releases that enter area storm drains. The result is untreated waste and hazardous materials that contribute to high levels of pollutants, including heavy metals, toxics and solvents. Environmental Services is responsible for illicit discharge detection and

Table 4-5. Comparison of Minimum Size Sites	Minneapolis	BCWMC	MCWD	MWMO	SCWMC	MPCA
Erosion Control						
Minimum site area	5000 sf	10000 sf	5000 sf	adopts requirements of member cities	15 ac[a]	1 ac
Minimum volume of stockpile or grading	500 cy	200 cy	50 cy		5ac[b]	
Other triggers for water management requirements					▪ within floodplain ▪ adj to waterbody	
Rate Control						
Minimum site area: single family subdivision - new	1 acre	required for all sites tributary to culvert or tunnel - no minimum site area	8 acres	adopts requirements of member cities	required for all projects requiring project review	required for all projects which create 1 acre of new impervious surface
Minimum site area: multi family subdivision	1 acre		5 acres			
Minimum site area: commercial/industrial/institutional	1acre		0.5 acre			
Minimum site area: roads/streets/highways w/o added imp. surface	exempt		none			
Minimum site area: roads/streets/highways w/ 1 ac. added imp. surface	all projects		all projects			
Stormwater Infiltration						
Minimum site area: single family subdivision - new					required for all projects requiring project review	
Minimum site area: multi family subdivision						
Minimum site area: commercial/industrial/institutional						
Minimum site area: roads/streets/highways w/o added imp. surface						
Minimum site area: roads/streets/highways w/ 1 ac. added imp. surface						
Floodplain alteration						
Floodway alteration	prohibited			adopts requirements of member cities		
Floodfringe alteration - permit required for fill	25 cy					
Floodfringe alteration - other	permit required					
Floodplain alteration	n.a.	permit required	permit required		permit required	
Water Quality						
Minimum site area: single family subdivision	1 acre	2 acres[c]	20 acres	adopts requirements of member cities	required for all projects requiring project review	required for all projects which create 1 acre of new impervious surface
Minimum site area: multi family subdivision	1 acre	2 acres[c]	8 acres			
Minimum site area - residential redevelopment	1 acre	10 acres[cd]				
Minimum site area: commercial/industrial/institutional	1 acre	0.5 acre	8 acres			
Minimum site area - commercial/industrial/institutional redevelopment	1 acre	5 acres[d]				
Minimum site area: roads/streets/highways w/o added imp. surface	exempt	1 acre	none			
Minimum site area: roads/streets/highways w/ 1 ac. added imp. surface	1 acre	1 acre	5 acres			
Buffer strips						
Buffer required for sites adjacent to wetlands and water bodies			required		required	
Wetland						
Minimum site area for wetland alteration	no minimum	not LGU	not LGU	not LGU	not LGU	

[a] single family residential

[b] all other land uses

[c] and must contain 4 or more proposed units

[d] all redevelopment projects in BCWMC must meet non-degradation requirement (no increase in phosphorus load) for all projects that increase impervious surface

highlight represents most restrictive requirement

elimination by City Ordinance. Activities include development of baseline information, identification of problem areas, investigation and determination of sources, documentation and requiring corrective action.

Additional efforts to eliminate illicit discharges to the sanitary sewers include public education, and direct response to notifications received from the community, other city departments and government agencies. At the present time Environmental Services addresses complaints of materials being discharged to the Minneapolis storm drainage system whether they are permitted discharges or not. Environmental Services also reviews compliance with NPDES, SDS, and general storm water permit requirements for businesses as needed. Staffing and priorities are being reviewed as part of the Regulatory Services Business Plan and the Minneapolis Sustainability Plan for conducting regular facility inspections which can include site inspection, review and compliance with MPCA and MCES permits (air, NPDES, and industrial permit), TRI efforts, and the businesses spill response and prevention plan and mechanical integrity plan.

Emergency Preparedness

Spill Response

The City of Minneapolis has a written statement of policies and procedures to be followed in the event of a spill. Both the MPCA Duty Officer and the Minnesota Department of Public Safety are informed of the spill if it exceeds a specified volumetric threshold. First responders to emergency spills are typically environmental management and/or fire department personnel. Measures are taken for spill containment, source elimination and recovery. After the event, the sewers are completely serviced; street maintenance and/or environmental management staff coordinate the final clean up and disposal. Environmental and others continue to be involved in site monitoring. The event is concluded with a follow-up as to how the event occurred and what measures need to be taken to prevent future incidences.

Flood Response

In the event of a flood, the City is prepared to follow the City's Emergency Plan.

Rainleader Inspections

Minneapolis is in the process of separating sanitary sewers from storm drains. This separation effort works to reduce the number of combined sewer overflows. It has been determined that a major source of clear water in the sewer system comes from rainleaders, which are connected to the sewers. The added flow from rooftop connections can significantly contribute to the occurrence of overflows of the sewer system.

The City has passed an ordinance (Title 3, Chapter 56), which requires property owners to disconnect rainleaders connected to the sanitary sewer system. The rainleader ordinance gives the City authority to identify sources of prohibited stormwater discharge to the sanitary system by performing property inspections.

If a prohibited stormwater discharge is identified, property owners will receive a disconnection notice. The notice will give the property owner a deadline to complete the disconnection work. Property owners can request a time extension to the deadline by filing a request form and paying a processing fee. If the prohibited stormwater discharge is not disconnected by the deadline, the property owner must pay a fine up to $700, face imprisonment, and/or have any City licenses revoked.

Education

Education plays an important role in any effort to implement a stormwater management program. The objectives of an education effort differ based on the target audience. In general, the target audiences include policy makers, City staff, residents, businesses and the development community.

Policy Makers

Ultimately, the important stormwater management decisions are made by the City's policy makers like the City Council and Park and Recreation Board. The sheer volume of decisions the Council and Board make means that stormwater information must be presented clearly and consistently.

City Staff

City and Minneapolis Park and Recreation Board staff have a wide range of responsibilities in the implementation of the LSWMP are trained to have a basic understanding of water resources management, including:

- A description of the major stormwater management issues (including known stormwater management problem areas, stormwater management expectations for new and redevelopment projects, incorporation of stormwater mitigation into capital improvement projects, and regulatory jurisdiction).
- The objectives of the LSWMP, and the general approach outlined in the LSWMP for resolution of outstanding issues.
- The responsibilities of the different work units in implementing the LSWMP.

Public

Successful management of the City's surface waters requires positive support and action from the public. In order to engage City residents and gain their active support and participation it is vital to inform City residents about basic stormwater management issues, flood mitigation and water quality concepts, and policies and recommendations in the LSWMP.

The City of Minneapolis keeps its residents informed through its web page. Information is provided on specific projects, and periodic updates on the progress of the listed projects are made available. Press releases to local papers and journals are

also good methods by which this information is disseminated. Public meetings are held to invite public input on certain issues.

Starting in 2006, the Department of Public Works will begin an education program that focuses on partnering with the Minneapolis Blooms Program, the Committee on Urban Environment (CUE), Friends of the Mississippi River, the Green Institute, and the Minneapolis Park and Recreation Board (MPRB) for its Stormwater Education and Outreach Program. The following is a summary of those partnering efforts:

- The Minneapolis Park and Recreation Board: MPRB naturalist staff provides stormwater information at neighborhood events, park events, local festivals and parades, and outdoor concerts.

- Minneapolis Blooms Program: Rain Garden Workshops, including workshop facilitation, rainwater garden design, program funding, facilities for the rainwater garden events, and providing stormwater education. The MWMO has provided funding for this program since 2003.

- Friends of the Mississippi River coordinate the City's Catch Basin Stenciling Program. Volunteers stencil storm drains, distribute education door hangers to residences and business in the stenciled neighborhoods, provide classroom visits, and reach out to non-English speaking communities with multilingual materials. Water quality education programs and materials would target non-English speaking households. MWMO contributes funding.

- The city-wide storm drain stenciling program was implemented by the City of Minneapolis in 1995. At that time, volunteer activities were coordinated by the League of Women Voters through an annual contract with the City. Later, the City contracted the volunteer coordination to the Friends of the Mississippi River. Volunteers stencil storm drains and distribute door hangers to residences and businesses in the stenciled neighborhoods. In 2004, the MWMO provided partial funding for activities in the MWMO jurisdictional area.

- The City of Minneapolis and the MWMO jointly fund a program to increase water awareness and education in multicultural communities. The program is coordinated by the City's Office of Multicultural Affairs. In 2006 the program initiated an assessment and planning for education in the Hmong community.

- The "Water down the Drain Interactive Multimedia Kiosk" was initiated by the MCWD in partnership with the City, MPRB, MWMO, and Hamline University College for Global Education. The kiosk is a stand-alone, self-directed education tool with modules in English, Spanish, or Hmong that helps users understand the urban water cycle.

- The Green Institute coordinates Stormwater Education pilot projects that would target both business and neighborhood organizations.

Public Engagement

When implementing a new activity or developing a capital improvement project the City of Minneapolis actively seeks to engage the public in the process of decision making. The City of Minneapolis is committed to incorporating community engagement activities into decision making for all activities undertaken by City departments. To standardize the process and to manage the expectations of citizens, The City of Minneapolis Communications Department prepared a guidebook for use by all departments.

Coordination with Other Government Agencies

The City of Minneapolis goals and policies outlined in this LSWMP are consistent with those of the City's four watershed district/organizations.

At present, the City of Minneapolis is not proposing any change in the current system of approvals and permits necessary for land disturbing activities in the City. Table 2.2 in Section 2 (Goals and Policies) outlines the regulatory responsibilities of the City, four watersheds, and the MPRB. This Plan's impact on other units of government will be to foster more collaborative efforts—where each entity does what it does best without another entity duplicating those efforts. In this vein, the City will assume the lead in infrastructure management and construction; MPRB the lead in water quality monitoring, and management of park lands; and the watersheds the lead in water quality implementation and assessment.

The City takes the lead in infrastructure management and construction.

The LSWMP envisions the City of Minneapolis and its watershed management organizations continuing to:

- Perform a joint review of construction projects before permits are issued
- Review and approve any new outfalls (where stormwater is emptied into surface water)
- Cooperate to enforce regulations and ordinances, including erosion control, stormwater management and floodplain alteration
- Share the costs for constructing regional water quality controls that use Best Management Practices (BMPs)

Watershed management district/ organizations help coordinate the efforts of multiple agencies.

Hennepin County has jurisdiction over 83.5 miles of roads within Minneapolis. In the past, the City and County have worked together to identify retrofitting opportunities on County road projects. Lake Street is a recent example of this cooperation, where the project will include installation of water quality devices.

The Minnesota Department of Transportation (MNDOT), with jurisdiction over 46.3 miles of the roadway within the City, is frequently involved in cooperative agreements with Minneapolis for construction of new stormwater facilities—particularly new storm drains. While MNDOT and the City maintain separate storm drain systems, runoff water from each travels into the other's system—necessitating a high level of coordination.

Drainage does not conform to municipal boundaries, which is the primary reason watershed districts were created. The City of Minneapolis cooperates with and coordinates efforts with neighboring cities when managing common drainage areas. Most coordination is accomplished through the structure of the watershed management organizations, though some cooperative projects have been accomplished outside of this structure, including:

- Establishing responsibilities for mutually agreed upon BMPs protecting common surface waters by adopting cooperative agreements
- Monitoring water quality for common receiving waters
- Working together to fund and complete water quality projects

The City of Minneapolis and MCES cooperate on the CSO program, controlling private discharges to the storm and sanitary systems and billing for sewer service. These cooperative efforts will continue.

Existing Assessment Studies

Condition and Capacity Assessments

Deep Tunnel System

In early 2004, the City completed its Storm Tunnel System Management Plan. Creation of the Management Plan involved the inspection of approximately 14.7 miles of City-owned deep storm tunnels to determine their structural condition. Each tunnel's structural condition is the primary factor used to determine whether a tunnel can continue to function as originally intended. This survey did not include the non-City owned tunnels nor the Basset Creek Tunnel, which is inspected as a culvert by bridge inspectors.

In addition to conducting the inspections and evaluating tunnel condition, hydrologic and hydraulic modeling was performed to determine the hydraulic loading to each tunnel system. The modeling used a simulated 100-year, 24-hour, 6-inch rainfall event over the area tributary to each tunnel system. The results were evaluated and correlated to structural conditions encountered in the inspections.

The hydraulic analysis showed that the majority of tunnels operate under surcharge. Based on this hydrologic and hydraulic analysis, it was determined that only four of the tunnel systems operate with no surcharge for the 100-year event. These four

tunnel systems operate without surcharge because they are relatively short, have large cross sections, and serve small drainage areas. The rest of the tunnel systems pressurize for the 100-year event. The effect this has on individual tunnels varies and depends on the tunnel's structural condition.

By linking hydraulic results with structural conditions and action levels, the overall condition of each of the tunnel systems is determined. The tunnel systems that need the most maintenance and rehabilitation are the 10th Avenue Southeast, St. Mary's, and East 38th Street tunnel systems.

Stormwater Monitoring and Calibration Project

In 2003, the City hired Bonestroo, Rosene, Anderlik & Associates to install flow monitors in three areas of the City to collect volume and water quality during peak flows. The monitored areas had already been modeled by the City for flood mitigation projects, therefore modeled results and monitored data could be compared. The purpose of making these comparisons is to determine standard hydraulic and hydrologic modeling parameters for use in future citywide modeling efforts.

Monitoring was performed to assist in calibration of stormwater models. (Source MPRB)

The calibration report concluded that additional flow monitoring is needed before modeling parameters can be determined. General recommendations included:

1. Use subcatchment width and slope to obtain the desired time of concentration and thus peak flow off the drainage area. Given that the citywide modeling will consistently use drainage areas as small as two to five acres, reasonable variations in width and slope will not have a dramatic effect on the timing and magnitude of drainage area flow peaks.

2. Runoff volume should be calibrated using impervious percentage first, then other parameters later. In all cases, a review of aerial photographs is required to determine the total percent impervious. From this, the connected portion can be calculated from some assumptions outlined in the calibration report.

3. Green-Ampt equations are the recommended method for calibrating infiltration on the pervious portion of the drainage. The calibration report is based on monitoring data from 2003. The scarcity of large events that season meant limited occasions where runoff was actually generated off the pervious surface. For this reason it was not possible to calibrate Green-Ampt parameters to the actual data.

In lieu of a calibration, a sensitivity analysis was prepared to illustrate the relative impact of each of the three Green-Ampt parameters.

4. Depression storage and catch basin inlet capacity are two parameters that also affect flow and volume. Depression storage, both off the pervious and impervious surfaces, helps determine how much runoff is intercepted before it can become runoff. In this way it affects volume calculations. It also affects peak flow calculations to a lesser degree. Catch basin inlet capacity can affect both volume and peak. If the inlet capacity causes bypass of the catch basin and flow into another drainage area then the inlet capacity will affect flow volume. If the inlet capacity does not cause discharge into another drainage area, the limit on the amount of water that can enter the pipe system will strongly affect the peak flow in that system.

SWMM Calibration and Standards Study

In August through October, 2004, SRF Engineering monitored pipe flow and water quality data and rainfall in an area of south Minneapolis as part of a modeling calibration study conducted for the City. Information was used to study the I-35W tunnel, calibrate hydrologic and hydraulic parameters, and calibrate water quality parameters. One goal is to establish standards for future modeling efforts in the City such that all models can eventually be integrated together. This will result in a higher level of model accuracy and greater confidence in the results. One product of this effort was a *Development Manual for SWMM Users* that is contained in Appendix M.