Nine Mile Creek Watershed District
Water Management Plan

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1.0 Executive Summary

This Nine Mile Creek Watershed District (NMCWD) Watershed Management Plan (Plan) sets the vision, guidelines, and proposed tasks for managing surface water within the boundaries of the NMCWD. This Executive Summary summarizes highlights of the Plan, including introductory information, the NMCWD vision statement, goals, policies to achieve goals, and actions that will be implemented to achieve objectives.

1.1 Introductory Information

The NMCWD was established on September 30, 1959 in response to a citizen's petition to the State of Minnesota to address water resource management issues.

Like all watershed districts, the NMCWD is a special purpose unit of local government that manages water resources on a watershed basis (a watershed is an area of land that drains to a given lake, river, stream or wetland). Watershed district boundaries generally follow natural watershed divides, rather than political boundaries.

The NMCWD is located in the south-central region of Hennepin County, and covers approximately 50 square miles. Figure 1-1 shows the location of the NMCWD and the communities that lie within, or partially within the NMCWD. The following is a list of these communities:

- Bloomington
- Edina
- Eden Prairie
- Hopkins
- Minnetonka
- Richfield

Watershed districts are governed by a local Board of Managers who are appointed by the boards of the counties with the land in the watershed district. In the NMCWD, the Board of Managers has five members appointed by the Hennepin County Board. The appointments are for staggered three-year terms.

The regularly scheduled meetings of the NMCWD Board of Managers are held on the third Wednesday of each month. The meetings are open to the public and are held at the District Administrative Office located at 7710 Computer Drive, in Edina.

The NMCWD employs a full-time Administrator. Other services, including engineering, legal, accounting, and secretarial assistance are provided by part-time consultants. The NMCWD has a website (www.ninemilecreek.org), which includes NMCWD permitting information, manager and consultant information, agendas, and minutes from Managers' meetings, and other pertinent information.

Watershed districts within the Twin Cities metropolitan area come under the guidance of both the Watershed Act (Minnesota Statues 103D) and the Metropolitan Surface Water Management Act (Minnesota Statutes 103B). Minnesota Statutes 103B and 103D require watershed districts to prepare watershed management plans. In addition to the plan requirements given in statute, watershed districts in the Twin Cities metropolitan area must also follow the detailed plan requirements of Minnesota Rules 8410. This watershed management plan (Plan) is the fourth NMCWD Plan approved by the Minnesota Board of Water and Soil Resources (BWSR), or its predecessor. Previous plans were published in 1961, 1973, and 1996.

1.2 Watershed District Purposes

1.2.1 General Watershed District Purposes

The general purposes of a watershed district are to conserve natural resources through land use planning, flood control, and other conservation projects to protect the public health and welfare and for the wise use of the natural resources (Minnesota Statues 103D.201).

Watershed districts can be involved with a number of issues, including protection or enhancement of water quality, prevention and alleviation of flood damage, prevention and alleviation of soil erosion and sedimentation, regulation of streams, lakes and water courses for domestic, recreational and public use, and protection and regulation of groundwater uses.

In addition, the purposes of watershed management organization water management programs in the metropolitan area (quoted from Minnesota Statutes 103B.201) are as follows:

1. Protect, preserve, and use natural surface and groundwater storage and retention systems.
2. Minimize public capital expenditures needed to correct flooding and water quality problems.
3. Identify and plan for means to effectively protect and improve surface and groundwater quality.
4. Establish more uniform local policies and official controls for surface and groundwater management.
5. Prevent erosion of soil into surface water systems.
6. Promote groundwater recharge.
7. Protect and enhance fish and wildlife habitat and water recreational facilities.
8. Secure the other benefits associated with the proper management of surface and groundwater.

1.2.2 Historical NMCWD Purposes and Past Successes

For its first 15 to 20 years, the NMCWD Board of Managers focused primarily on how to solve the flooding problems in the watershed. This major effort resulted in the construction of six major flood prevention projects, including: Marsh Lake Dam, Normandale Lake Improvement, Bredesen Park flood storage area, Bush Lake Outlet, Smetana Lake Outlet, and Hopkins Culvert improvements.

Also, a major streambank stabilization project in the lower valley reach of Nine Mile Creek was completed to reduce erosion and sediment export to the Minnesota River.

The NMCWD rules and regulations have been an essential tool in preventing problems. In 1973, the District adopted rules and regulations and began reviewing proposed developments and other projects in the watershed through its permit program. The NMCWD rules and regulations have always addressed the water quantity impacts of stormwater (e.g. flooding, rate control). At first, the NMCWD rules only indirectly addressed the water quality impacts of stormwater, but since 1997 they have directly addressed water quality impacts (upon implementation of the 1996 NMCWD Plan).

The NMCWD has been concerned about water quality since its formation. Since 1968 the NMCWD and other authorities have been monitoring the water quality of streams in the watershed. Lakes have been monitored by the District since 1997.

Since 1997, the NMCWD has concentrated on solving remaining flooding problems and conducting water quality studies. Between 1997 and 2005 the NMCWD completed 12 diagnostic-feasibility studies (termed *Use Attainability Analyses,* or *UAAs*) for lakes within the NMCWD. Three additional lake UAAs are on-going, scheduled for 2006 completion.

Additionally, the NMCWD has implemented several programs and projects over the years to improve the quality of life in the watershed. Some of the more significant programs and projects include:

- Collecting monthly water levels on more than a dozen lakes.
- Collecting groundwater levels from nearly a dozen NMCWD groundwater observation wells.
- Collecting water quality data, cooperating with other organizations (e.g., Metropolitan Council (MC)) in collecting water quality data from almost every surface water body within the NMCWD.
- Completing water quality studies to determine if a water body's quality is achieving its goal and developing water management plans to improve or protect a water body's quality.
- Cooperating with constituent cities, other agencies and organizations in studies and capital projects to address water quality and flooding issues of mutual interest.
- Reviewing and/or permitting about 40 development proposals per year.

Since the adoption of the its Water Management Plan in 1996, the NMCWD has completed the Bush Lake Outlet, Smetana Lake Outlet and the Minnetonka Lakes Water Quality Improvement Basic Water Management projects. The Minnetonka Lakes Water Quality Improvement Project implemented the recommendations presented in the Glen Lake, Lone Lake, Minnetoga Lake and Shady Oak Lake Use Attainability Analyses. The District has received a petition from the City of Eden Prairie for the implementation of the recommendations presented in the Use Attainability Analyses completed for Anderson Lakes, Bryant Lake and Birch Island Lake. It is anticipated that the project will commence in 2007. The District has also received a petition from the City of Hopkins

for the stabilization of Nine Mile Creek from Excelsior Boulevard to T.H. 169. The stabilization recommendation was presented in the *Nine Mile Creek Use Attainability Analysis*, (Barr, March 2004).

As previously stated, the 1996 Water Management Plan concentrated on solving the remaining flooding problems within the District and began conducting water quality studies of 15 lakes within the District. This was an orderly transition between water quantity and water quality management that received the support of the municipalities within the District and the regulatory review agencies. The accomplishments of the 1996 Plan provided the foundation for the programs/objectives of the 2006 Water Management Plan. The Managers noted that this resulted in additional administrative activities for the District, thereby resulting in the hiring of an administrator to guide the activities of the District. To establish greater public involvement and interaction the Managers opened a District Office in 2005. A possible shortfall of the District's accomplishments over the past 10 years was that the Rules and Regulations of the District that have been in place since 1973 were not revised during this time period. The District has identified revision of the District's Rules and Regulations as a primary objective in 2007.

1.2.3 NMCWD Vision Statement

The NMCWD Managers adopted a vision statement to guide them through this planning process, and in its future day-to-day operations.

Nine Mile Creek Watershed District (NMCWD)
Vision Statement

It is the NMCWD Board of Managers' vision and intent to manage water resources within the District in a manner that will attain and preserve their highest and best intended beneficial uses. Intended use designations have been made in keeping with records of historical use, applicable state and federal water laws, and in consultation with the District's constituent cities, state and regional resource management agencies, and the general public.

The District seeks a proactive role in watershed runoff regulation that anticipates ultimate watershed land use development. The District also seeks to provide its residents with protection against both flood damage and water quality degradation by conducting diagnostic-feasibility studies of watershed runoff-related problems. Where these studies indicate the need for implementation of remedial measures to mitigate current or likely future problems that interfere with attainment of beneficial use goals, the District will sponsor reasonable cost cooperative projects in response to project petitions from its constituent cities.

Throughout all of its water management planning activities, the District will encourage increased stakeholder involvement in its decision-making, especially by public officials and concerned citizens.

1.3 NMCWD Plan Organization and Summary

This NMCWD Plan sets the course for future management of the water resources within the watershed. The NMCWD Plan provides data and other background information, outlines the applicable regulations, assesses specific and watershed-wide issues, sets goals and policies for the NMCWD and its resources, and lists planned actions to achieve the goals. The NMCWD Plan also discusses the financial considerations of implementing programs and actions, and funding sources that may be available to the District. The NMCWD Plan is organized into ten major sections, summarized as follows:

Section 1.0 Executive Summary—Summarizes the highlights of the NMCWD Plan, including introductory information, the District's Vision Statement, Goals, Policies, Objectives, and planned Actions.

Section 2.0 Land and Water Resource Inventory—Provides background information about the NMCWD and provides a brief history of the District. It also provides technical information describing the surface and subsurface conditions of the Watershed, including: precipitation, land cover, soils, topography, geology, groundwater, surface water resources, unique features and scenic areas, and pollutant sources. This section also includes a number of maps and summary tables, such as a map of major and minor sub watersheds and a table of drainage areas.

Section 3.0 Impact on Other Units of Government—The NMCWD has used various methods to involve and inform its constituent municipalities and the general public about preparation of this Plan. This has included numerous public meetings, meetings with municipal Engineering and Public Works Department staffs (the District's Technical Advisory Committee (TAC)) and use of the District's website (www.ninemilecreek.org), principal among other efforts. The NMCWD will continue expanding these involvement efforts to increase awareness of the NMCWD, coordinate and cooperate with other groups (including its Citizens Advisory Committee (CAC)) to educate the public, recruit (and recognize) volunteers for monitoring efforts and involvement in NMCWD programs, promote positive behaviors that have a positive impact on water resources, and to use its advisory committees in meaningful ways. Through these efforts, the District will increase the public's understanding of water resource management and issues in the watershed, and foster long-term public commitment to protecting these resources.

Section 4.0 Statement of Goals and Policies—Presents the issues, goals, and policies that pertain generally to the NMCWD. Section 4.0 contains an introductory preamble, plus nine subsections. These subsections, in tabular format, are organized around major topics, as follows:

4.1 Stormwater Management	4.6 Land Use Management
4.2 Surface Water Quality	4.7 Floodplain Management
4.3 Open Spaces and Recreational Uses	4.8 Education and Outreach
4.4 Wetlands Management	4.9 Administration
4.5 Groundwater Protection	

These nine subsections are all organized in the same manner, with a summary table that describes:

- The importance of the topic area
- General issues related to the topic area
- Management goals of the NMCWD
- Policies adopted and followed to achieve these goals
- Specific management objectives, including planned actions of the District.

Section 5.0 Assessment of Problems—Discusses identified water resource problems associated with lakes, streams, wetlands, drainage ditches, recreational use opportunities, and fish and wildlife resources.

Lake Water Quality Problems

Lake water quality problems have been diagnosed for major recreational lakes within the NMCWD through the UAA process, as outlined by the Water Environment Research Foundation (WERF). This process involves the following seven basic steps intended to achieve or maintain water quality conditions that support beneficial uses such as swimming, fishing, aesthetic viewing, and wildlife habitat:

1. Determine current and historic water quality conditions.
2. Set water quality goals that support intended uses.
3. Assess attainment or nonattainment of goals for current watershed land-use conditions.
4. Estimate annual runoff water and pollutant inputs to water bodies.
5. Calibrate a computer simulation model to predict observed lake- or stream-water quality conditions from annual runoff inputs.
6. Using the calibrated lake- or stream-model, assess water quality goal attainment for current and ultimate watershed land-use conditions and range of climatic conditions.
7. If necessary, recommend feasible alternative remedial measures (i.e., best management practices (BMPs)) to achieve desired water quality.

UAAs are intended to be "Total Maximum Daily Load (TMDL) Equivalent" studies and implementation of their recommendations should result in removal of the subject water bodies from the Minnesota Pollution Control Agency's (MPCA's) Sec. 303(d.) Impaired Waters list. The following tabulation (Table 1-1) summarizes the findings and conclusions of the lake UAAs completed to date. A wide variety of water quality problems typical of lakes within urban watersheds were identified. These include, generally, pollutant loads from both external and internal sources and various biological imbalances in plant and fish communities. UAA Project synopses are included in Section 5.1 of the Plan and discuss diagnosed problems and recommended remedial measures in greater detail.

Table 1-1 UAA-Identified Water Quality Problems in NMCWD Lakes

Lake	Water Quality Problems		
	Watershed Runoff Pollution	Internal P Recycle	Exotic Plant Species
Bush			✓ - CLP, EWM & PL
Bryant	✓	✓	✓ - CLP, EWM & PL
Smetana		✓	✓ - CLP & PL
Anderson	✓	✓	✓ - CLP & PL
Normandale	✓	✓	✓ - CLP & PL
Penn (Lower)			✓ - PL
Mirror	✓	✓	✓ - CLP & PL
Cornelia	UAAs In-Process		
Indianhead			
Arrowhead			
Birch Island	✓		✓ - PL
Glen	✓		✓ - PL
Minnetoga	✓		✓ - PL
Lone	✓		✓ - PL
Shady Oak	✓		✓ - EWM & PL

* CLP = Curlyleaf Pondweed, EWM = Eurasian Watermilfoil, and PL = Purple Loosestrife

Stream Water Quality Problems

Nine Mile Creek experiences many water quality problems characteristic to urban streams. These all relate to the increased quantity and degraded quality of watershed runoff reaching the creek. In diagnosing Nine Mile Creek water quality problems, the entire creek was surveyed and classified according to the Rosgen Physical Classification system, using stream measurements of

- Entrenchment ratio
- Flood-prone area
- Width/depth ratio
- Bankfull discharge capacity
- Sinuosity
- Channel materials
- Water surface slope

Stream reach segments were then rated as to their sensitivity to disturbance, recovery potential, and actual condition. In this process numerous problems were identified that will require remedial attention in the future.

Results of the Nine Mile Creek physical classification were subsequently used in combination with biological and water quality survey information to perform Ecological Use Classification (EUC) assessments of Nine Mile Creek stream reaches. These assessments identified the potential suitability of the stream for aquatic life, including benthic macroinvertebrates and fish. In general, these assessments indicated biological impairments were related to habitat destruction caused by the scouring effects of the increased frequency of bankfull or greater flows in the creek. Desirable remedial measures were identified along with the need for further detailed surveys in the future.

Other Assessed Problems

Urban stormwater runoff has the potential to cause numerous problems to other water resources and pursuits, including:

- County ditches
- Runoff rate control and flooding
- Recreational opportunities
- Fish and wildlife resources
- Soil erosion
- Land use practices
- Regulatory controls to mitigate adverse impacts on public waters and wetlands

These and other potential future problems are assessed in Section 5.0, along with the adequacy of current Capital Improvement Programs to deal with these problems.

Section 6.0 Implementation Program—Discusses responsibilities of the NMCWD, its constituent cities, and other state and regional governmental agencies for managing water resources within the District. Included are:

- **Regulatory Controls**
  - Wetlands Conservation Act
  - Erosion and sediment control
  - Shoreland and floodplain ordinances
  - Water quality nuisances
- **Stormwater and Drainage Design Performance Standards**
  - Target in-lake nutrient concentrations
  - Maximum permissible runoff rate and volume
  - Flooding impact standards
  - Stormwater outlet structure design criteria
  - Water quality basin design methodology
  - Pollutant load limitations
  - Variances
  - Information Program
- **Data Collection**
  - Lake monitoring
  - Stream monitoring
  - Assessment and reporting
- **Management Programs**
  - Municipal Comprehensive Stormwater Management Plans
- **Potential Structural Solutions to Problems**
  - Capital Improvement projects
  - Financing

All of the above programs involve some level of shared responsibility between the NMCWD and others, as is discussed in Section 6.0.

Section 7.0 Impact on Local Government—This section outlines how the NMCWD's implementation program will affect local government in terms of cost and administrative issues.

The NMCWD's intention is to work cooperatively with its municipalities and to limit additional requirements imposed upon local units of governments as much as possible while still accomplishing the NMCWD's purposes and implementing its Plan.

The District will work with its constituent cities on the initial stages of the permitting process to address District goals and objectives. The Cities may have to update and/or adopt ordinances or other regulatory controls to meet the goals and objectives of this Plan.

Section 8.0 Implementation Priorities—The NMCWD prefers to undertake Basic Water Management Projects on a cooperative basis in response to petitions from its constituent cities, but reserves the right to initiate projects itself. The District is now shifting its focus onto implementation of the recommended BMPs from the 15 lake/watershed UAAs completed during the past 10 years. No prioritization of projects has yet been made. The order in which projects are undertaken will depend, to some degree, on the receipt of petitions, but will likely concentrate on lakes, streams, and wetlands with the highest perceived public value (e.g. Level I swimming lakes) first. The District also reserves the right to initiate projects with a compelling need, even without a petition. Other flood control or water quality management projects not currently foreseen by this Plan may also be undertaken following the Plan Amendment process.

In addition to pending water quality improvement projects recommended by UAA reports, the District intends to be actively involved in TMDL studies and other programs that may lead to future capital improvement projects.

Section 9.0 Implementation Components—The NMCWD is ultimately responsible for implementation of all aspects of this Plan.

Each municipality within the NMCWD, in its local comprehensive stormwater management plan, must provide for the adoption of necessary regulatory controls, stormwater design standards, education programs, data collection programs, and maintenance programs that are identified in this Plan within 2 years from the adoption of the last Watershed District/Water Management Organization Water Management Plan. The District will work with the municipalities in achieving a coordinated effort between the requirements of the NPDES Permit/MS4 requirements and the statutory requirements of the Metropolitan Surface Water Management Act. As part of that plan, each municipality must develop a qualifying local wetlands management plan and assess the adequacy of specified management programs. Municipalities and other State Agencies designated as Local Government Unit (LGU) pursuant to the Wetlands Conservation Act (WCA) must also enforce that Act. Hennepin County is responsible for groundwater planning in accord with the BWSR-approved plan.

Where WCA duties have been assumed by municipalities, the responsibilities of the District are limited to providing technical assistance as requested by LGUs. For those municipalities that have chosen not to assume WCA responsibilities, the District has assumed those duties.

LGUs must adopt regulatory controls that, at a minimum, incorporate runoff BMPs and best available technologies as promulgated by the MPCA.

LGUs must adopt regulatory controls that address erosion and sedimentation for projects not subject to grading and land alteration requirements of the District. This requirement includes an obligation to consider single-family residential lot permitting.

LGUs will be responsible for enforcement of adopted floodplain and shoreland ordinances. The District will only undertake enforcement when the failure of the LGU to act leads to conditions that independently constitute a violation of the rules and regulations of the District or other governing law by which the District possesses a right of action.

The NMCWD has adopted a Capital Improvement Plan as part of their Water Management Plan (see Section 8.0)

Section 10.0 Amendment to the Plan—The NMCWD has established a procedure whereby this Plan may be amended.

Any amendment to this Plan must be made in accord with the procedure described in Section 10.0. This Plan extends for ten (10) years following the year in which it is approved and adopted as provided by law. This Plan shall remain in effect pending adoption and approval of any succeeding plan. Any person may propose to the Board of Managers, an amendment to the Plan. The Board of Managers may then initiate the amendment procedure.

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Water Management Plan

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2.0 Land and Water Resource Inventory

2.1 General Watershed Boundaries

The NMCWD consists of the land that drains into Nine Mile Creek. The District encompasses approximately 50 square miles in southern Hennepin County and it includes portions of the cities of Bloomington, Eden Prairie, Edina, Hopkins, Minnetonka, and Richfield (see Figure 2-1).

Nine Mile Creek flows approximately 15 miles from its headwater, where it crosses County Road No. 3 in Hopkins, to its mouth at the Minnesota River. The South Fork of Nine Mile Creek, joining the North Fork of the creek in Bloomington just south of Interstate Highway 494, is approximately 8.5 miles long. The Governmental Boundaries Map, Figure 2-2, shows the location and the legal boundary of the District. The legal boundaries of the District were modified in 1984 and again in 1994 to approximate more closely the natural topographic boundaries.

2.2 History

The NMCWD was established in 1959 by the Minnesota Water Resources Board acting under the authority of the Watershed Law. The authority granted to the District included authority to address flooding and water quality problems and was supplemented by planning authority delegated in the Metropolitan Surface Water Management Act. In 1961, the District established a floodplain management ordinance. This District effort complemented the authority and efforts of municipalities.

The Floodplain Management Act of 1969 encouraged municipalities to adopt, enforce and administer floodplain ordinances similar to those established by the District. Each of the District's municipalities adopted floodplain ordinances. This District and municipal regulation proved successful in that no significant flooding has occurred in the District even during the major flooding events that occurred in 1977, 1987, and 1993. The District's floodplain is based on ultimate development of the watershed tributary to the creek, according to municipal land use plans. The District flood elevations, because they were calculated based on total urbanization, are equal to or higher than the flood elevations shown in Flood Insurance Studies, which are based on development conditions when the Flood Insurance Study was undertaken.

Another reason that flooding problems do not occur within the NMCWD is because the District has completed several important basic water management projects in anticipation of ultimate watershed land use development. Completed flood control projects (see Figure 2-2) include the following:

- More than 30 years ago, the Board of Managers undertook wetland and habitat preservation by implementing the Marsh Lake Basic Water Management Project. Lying east of France Avenue in the vicinity of 94th Street in the City of Bloomington, the marsh was the last chance to detain and store floodwaters before they entered the steep channel now stabilized and restored by the Lower Minnesota Valley Restoration Project. This first major project

was completed in 1970. In addition to its function as a stormwater detention basin, the area was designated as a wildlife refuge to ensure that wildlife habitat was protected from development. Since its inception, the District supported, promoted, and adhered to a policy of multi use projects involving its water resources, wherever possible.

- The Mount Normandale Lake Basic Water Management Project created an artificial 135-acre lake in 1978. The Lake stores floodwater during high-intensity rainstorm events. This storage regulates the extreme fluctuations, or bounce in the flow regime of the creek, which can erode sediments. That fluctuation is recognized as an important factor in maintaining water quality. Two other basic water management projects serve this purpose, the Bredesen-Mud Lake Project, completed in 1985, and the Anderson and Bush Lakes Project, portions of which were completed in 1978 and 2000. In addition, all three projects also created and enhanced recreation, aesthetic nature uses, and wildlife habitat.
- One of the more recent basic water management projects, the Lower Minnesota Valley Restoration Project, finished in 1991, restored and stabilized the streambank through its final steep descent to the mouth of the creek at the Minnesota River. By stabilizing the streambank, erosion was significantly reduced. The nonpoint source pollution monitoring program for the creek documents this reduction. The benefits of this project directly address the problems identified by the Minnesota River Assessment Project (MRAP) and anticipate the planning of the Minnesota River Implementation Program (MRIP).
- Another recent project was the Hopkins Culvert Improvements Basic Water Management Project, completed in 1993. These improvements substantially improved the flow of the creek through the City of Hopkins. The changes significantly reduced local flooding of many properties and streets within the city. By lowering the flood elevation, previously flooded property became available for new and expanded commercial uses. That flooding had endangered both people and property during storm events.
- The District also completed the Smetana Lake Basic Water Management Project in 2002. That project created additional flood storage for the south fork of the creek. Besides this flood protection, the aesthetic and recreational uses of the lake were improved, as was creek water quality below Smetana Lake.

Currently, the District is completing yet another basic water management project, the Minnetonka Lakes Improvement Project, primarily designed to improve lake water quality conditions. This project is expected to be completed in 2006. As is discussed in later sections of this Plan (Chapter 5—Assessment of Problems, and Chapter 8—Implementation Priorities), numerous other lake and stream water quality improvement projects are planned for future years. Now that watershed land use development has largely reached its ultimate state, and potential flooding problems have been resolved, the primary focus of future District basic water management projects will be on the improvement of lake and stream water quality conditions.

2.3 Inventory of Water Resource and Physical Factors

Many local, regional, and state resource management documents were consulted during preparation of this section of the Plan. These publications are listed in the references section, at the end of this Plan.

2.4 Precipitation

The precipitation data normally used in the seven-county metropolitan area for hydrologic and hydraulic design are incorporated by reference in this Plan or may be included in the local plans of the municipalities within the District. These data are recorded and maintained by the United States Weather Service, located at the Minneapolis/St. Paul Metropolitan Airport, and are published in the following U.S. Weather Bureau technical papers and updates, which are used for hydrologic and hydraulic design:

Hershfield, D.M. 1961: Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. *Weather Bureau Technical Paper 40,* U.S. Weather Bureau. Washington, D.C., 115 pp.

Miller, J.F. 1964. Two- to ten-day precipitation for return periods of 2 to 100 years in the contiguous United States, *Technical Paper No. 49*, U.S. Weather Bureau and U.S. Department of Agriculture, 29 pp.

Following is a map (Figure 2-3) showing average annual precipitation totals for areas within the NMCWD. Rainfall in the lower portion of the watershed generally exceeds that of the upper portion.

In 2002, the NMCWD conducted a review of rainfall data they have collected since 1964 to determine local rainfall patterns within the watershed. Until now, only regional data have been available, which provide an average of rainfall patterns within a large regional area, not specific to the District. The results of the March 2002 rainfall study are very important because they can be used to predict more accurately expected rainfall amounts that are used to estimate the expected flows and flood levels. The District plans to use this information in designing flood control and water quality structures in the future.

2.5 General Geology and Topographic Data

Nine Mile Creek is a small stream tributary to the Minnesota River, and is located within the Lower Minnesota major watershed of the Minnesota River basin. The District is within the Big Woods portion of the Central Hardwood Forests Ecoregion as determined by the MDNR and Minnesota Pollution Control Agency (MPCA). According to the MRAP land use assessment, most of the District is assessed as having a low potential for nonpoint source pollution.

The topography of the District varies from relatively flat land in much of Bloomington and along the North Fork of the creek through Edina and Hopkins, to very hilly land along the west boundary of the District in Bloomington, the southwest corner of Edina, and most of Eden Prairie and Minnetonka. The remainder of the District is moderately rolling topography. There is an elevation difference of approximately 430 feet between the creek's outlet into the Minnesota River, at Elevation 700 feet

above mean sea level (MSL) and the highest point, located in the northwest corner of the District. Despite the extremes in elevation, about 90 percent of the land within the District ranges from 800 to 950 MSL.

The direction of stormwater flow and the location of watershed divides were determined through use of topographic maps with 2-foot contour intervals. Two-foot topographic mapping for the entire District is available from the municipalities. Figure 2-4, showing surface elevation contours and interior watershed divides follows. Additional information is available from the Geologic Atlas of the Minnesota Geological Survey, which is incorporated by reference. Also, the District will use Hennepin County's groundwater plan as a guide for making watershed management planning decisions that may have impacts on groundwater (see Section 2.7).

2.6 Surface Water Resource Data

2.6.1 Wetlands

1. The Minnesota Department of Natural Resources "Protected Waters Inventory Map" is incorporated by reference.

2. The "National Wetlands Inventory Map", produced by the United States Fish and Wildlife Service is incorporated by reference.

3. Most District cities have approved local wetland management plans by which they regulate development impacts on wetland resources. Pending completion of comprehensive wetland protection and management plans by the remaining cities, the District adopts as an interim regulation on a case-by-case process based upon the Minnesota Rapid Assessment Method. The nondegradation policy, Minn. Rules §7050.0185, and wetland mitigation principles, Minn. Rules §7050.0186, promulgated by the MPCA are also adopted.

   Each municipality must develop a local wetland management plan within 2 years of approval by the Board of Water and Soil Resources (BWSR) of the last watershed management organization plan that affects that municipality. The plan must (1) incorporate Minnesota Statutes Sections 103A.201, Subdivision 2, and 103G.222; (2) be adopted as part of an approved local water plan under Minnesota Statutes Section 103B.3355. The Plan must contain an executive summary, resource inventory, assessment of problems, goals and policies and implementation.

   The local unit of government must inventory the public value, location, size and type of wetlands under its jurisdiction. Wetland boundaries must be determined using the methodologies in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (January 1989). Wetland type must be identified according to Cowardin, et al., 1979, Classification of Wetlands and Deepwater Habitats of the United States and according to United States Fish and Wildlife Service Circular No. 39 (1971 edition) "Wetlands of the United States." Wetlands must be separately identified that are:

   A. Outstanding resource value waters[1]; including calcareous fens[2]

   [1]Minn. Rules §7050.0180 defines the term "Outstanding resource value waters". In pertinent part the term means "waters of the state with high water quality, wilderness characteristics, unique scientific or ecological significance, exceptional recreational value, or other special qualities which warrant stringent protection from pollution". Minn. Rules §7050.0180, Subp. 2A.

   [2]Minnesota Rules Sections 8420.1010 through 8420.1060 state standards and criteria for identification, protection, and management of calcareous fens

   B. Designated scientific and natural areas[3]

   [3]Minn. Stat. §86A.05 classifies and states the purposes for state scientific and natural areas:

   (a) A state scientific and natural area shall be established to protect and perpetuate in an undisturbed natural state those natural features which possess exceptional scientific or educational value.

(b) No unit shall be authorized as a scientific and natural area unless its proposed location substantially satisfies the following criteria:

(1) Embraces natural features of exceptional scientific and educational value, including but not limited to any of the following:

(I) natural formations or features which significantly illustrate geological processes;

(ii) significant fossil evidence of the development of life on earth;

(iii) an undisturbed plant community maintaining itself under prevailing natural conditions typical of Minnesota;

(iv) an ecological community significantly illustrating the process of succession and restoration to natural condition following disruptive change;

(v) a habitat supporting a vanishing, rare, endangered, or restricted species of plant or animal;

(vi) a relict flora or fauna persisting from an earlier period; or

(vii) a seasonal haven for concentrations of birds and animals, or a vantage point for observing concentrated populations, such as a constricted migration route; and

(2) Embraces an area large enough to permit effective research of educational functions and to preserve the inherent natural values of the area.

C. Habitat for species of wild animal or plant designated endangered, threatened or of special concern[4].

[4]Minn. Stat. §84.0895 provides protection of threatened and endangered species of wild animal or plant. The following designations apply:

(1) endangered, if the species is threatened with extinction throughout all or a significant portion of its range;

(2) threatened, if the species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range; or

(3) species of special concern, if although the species is not endangered or threatened, it is extremely uncommon in this state, or has unique or highly specific habitat requirements and deserves careful monitoring of its status. Species on the periphery of their range that are not listed as threatened may be included in this category along with those species that were once threatened or endangered but now have increasing or protected, stable populations.

D. State wildlife management areas[5].

[5]Minn. Stat. §86A.05, Subd. 8 provides in pertinent part:

A state wildlife management area shall be established to protect those lands and waters which have a high potential for wildlife production and to develop and manage these lands and waters for the production of wildlife, for public hunting, fishing, and trapping, and for other compatible outdoor recreational uses.

No unit shall be authorized as a state wildlife management area unless its proposed location substantially satisfies the following criteria:

(1) Includes appropriate wildlife lands and habitat, including but not limited to marsh or wetlands and the margins thereof, ponds, lakes, stream bottomlands, and uplands, which permit the propagation and management of a substantial population of the desired wildlife species; and

(2) Includes an area large enough to ensure adequate wildlife management and regulation of the permitted recreational uses.

E. Aquatic management areas[6].

[6]Minn. Stat. §86A.05, Subd. 14 classifies and states the purposes of aquatic management areas:

Aquatic management areas may be established to protect, develop, and manager lakes, rivers, streams, and adjacent wetlands and lands that are critical for fish and other aquatic life, for water quality, and for their intrinsic biological value, public fishing, or other compatible outdoor recreational uses.

F. Within any other unit which is part of the state outdoor recreation system[7].

[7]Minn. Stat. §86A.05 states the classifications and purposes for the state outdoor recreation system.

G. High priority areas for wetland preservation, enhancement, restoration, and establishment[8].

[8]Minnesota Rules §8420.0350, Subp. 2 states considerations relevant to identifying high priority.

Local wetland management plans must identify and assess the significance of runoff discharges into wetlands in accordance with standards for protection of quality and purity established by the MPCA. Point sources and nonpoint sources must be separately identified and their significance determined.

Existing beneficial uses must be identified in accord with the applicable water use classifications for waters of the state as stated in Minnesota Rules §7050.0200. The public value for wetlands must also be identified in accord with Minn. Stat. §103B.3355 and Minnesota Rules §8420.0110, Subp. 38. State of Minnesota Storm Water Advisory Group (1995) "Guidance for Evaluating Urban Storm Water and Snowmelt Runoff Impacts to Wetlands" shall be used in identifying beneficial uses and public values. These guidelines provide a process that enable municipalities to effectively manage storm water inputs to wetlands and to make responsible decisions on the designated uses of wetlands. The process primarily consists of the following steps:

- Inventory Wetlands
- Conduct hydrologic analyses
- Assess water quality impacts
- Determine wetland susceptibility
- Develop management strategy to avoid, minimize, and mitigate wetland impacts.

Flexibility is intended in implementing these guidelines. Municipalities must incorporate wetland mitigation policy and principles as established in Minnesota Rules 7050.0186. The wetland mitigative sequence incorporates impact avoidance, impact minimization and impact compensation. District-wide, wetland loss must be replaced at a 2:1 ratio, at a minimum, although municipalities and the District may require a higher mitigation ratio. Wetlands replacement or compensation shall occur within the watershed as feasible and practical.

Otherwise the mitigation of wetland loss must occur in as close proximity as possible, per Wetland Conservation Act (WCA) requirements.

Discharges and other activities that affect wetlands continue to be regulated in accordance with State and Federal wetland regulations. The District will continue to work with the appropriate regulatory agencies in the enforcement of these regulations. Stormwater discharges into wetlands must maintain existing beneficial uses and public values and may not degrade those uses or values. In situations where it is not feasible or practical to maintain all functions and values, the District will give priority to water quality and flood control while maintaining as many other functions and values as possible.

2.6.2 Hydrologic System Characteristics

1. Records of the Minnesota Department of Natural Resources (MDNR) with respect to the major hydrologic characteristics of public waters are incorporated by reference.

2. Maps showing the areas served by each existing stormwater system and identifying existing stormwater ponds and the location of all stormwater outfalls are incorporated by reference and can be obtained at each of the municipal offices. Stormwater plans shall be incorporated in local plans.

3. Information summarizing available data on the 100-year flood levels and peak discharges of existing and proposed stormwater ponds, as well as flood profile information that corresponds to the peak discharges of channelized flow passing through the watershed, is incorporated by reference. The information can be obtained at each of the municipal offices with respect to systems within each community and shall be incorporated in local plans.

   The flood profile information developed by the District is wholly consistent with flood profile information published in all Federal Emergency Management Agency (FEMA) flood insurance studies. In accordance with the U.S. Department of Housing and Urban Development's Flood Insurance Program, floodplain studies by other governmental agencies have been completed for portions of or all of the municipalities within the District. Each of these studies was based on existing development conditions. Because of the significant effect that urbanization will have on flood levels in the District, the District does not use existing conditions but rather future, ultimate development conditions based on the adopted comprehensive plans of municipalities within the District. According to the Metropolitan Council Water Resources Plan, all watershed plans must indicate how surface water management will be managed under existing conditions and expected for future development. The District's assumption avoids inadequate regulatory controls over developments in and near floodplain areas and fulfills the direction of the Metropolitan Council.

   Flood profile information encompasses all of the FEMA flood profile and additional areas necessary to manage the floodplain as future development progresses. The delineated floodplain is an envelope profile necessary to define the potential floodplain and establish guidelines for building elevations. This delineation is not a set of static elevations, but rather

a profile that can be adjusted as channel constrictions are removed or altered. This delineation allows as many land use alternatives as possible. Figure 2-5 shows the 100-year frequency floodplain limits along Nine Mile Creek and Figure 2-6 shows the floodplain profile.

4. The District does not have any known flood-prone areas outside of the established flood profile as part of their local water management planning. Municipalities are required though to assess and report whether local flood-prone areas exist. The Hopkins Culvert Improvements Basic Water Management Project rectified a widely known local problem.

5. In accordance with the U.S. Department of Housing and Urban Development's Flood Insurance Program, floodplain studies have been completed for portions or all of the municipalities within the District and may be viewed at the city hall of each respective municipality.

6. In 2005, the District completed an XP-SWMM, hydrologic and hydraulic model of the creek system and a P8 water quality model of the entire Nine Mile Creek Watershed District (NMCWD).

2.6.3 Lakes and Streams

There are numerous lakes and ponds, and many miles of streams within the NMCWD. All of these water bodies are viewed as valuable resources. Annually, the District conducts lake and stream water quality monitoring programs that gage the conditions of both. The locations of lake and stream water quality monitoring stations are shown on Figure 2-7. Hydrologic monitoring stations are also shown.

1. **Lakes.** Major lakes within the District are sampled on a rotating basis, once every four years. One-third of the lakes are sampled in each of three consecutive years. A summary report on the results of the preceding three years of lake monitoring is then written every fourth year.

   The lake water quality reports concentrate upon the three principal water quality indicators: total phosphorus, chlorophyll *a*, and Secchi disc transparency. Phosphorus is a biologically active element whose concentration often determines the productivity (i.e., algae and/or weed growth) of a lake. Chlorophyll *a* is the photosynthetic pigment of phytoplanktonic algae present in a lake, and an indicator of algal standing crop and photosynthetic rates. Secchi disc transparency is a measure of the depth to which one can see a standard 20-centimeter-diameter white (or black and white-patterned) disc lowered into the water. A detailed discussion of lake management strategies is included in Section 5.0, and the collected lake water quality data are summarized there, along with similar data from the MCES and the MDNR.

   Beginning in 1997, lakes within the NMCWD were monitored more intensively in support of Use Attainability Analyses (UAAs) that diagnose water quality problems and their causes and recommend feasible alternative remedial measures. Over the 10-year period from 1997 to 2006, 15 lakes and their watersheds were analyzed through the UAA process, beginning with headwaters lakes and proceeding downstream.

2. **Streams.** The District also monitors Nine Mile Creek water quality each year, in terms of both its chemical and biological conditions. Chemical parameters monitored have generally been restricted to those included in the MPCA Class 2.b. water quality standards, although total phosphorus and flow gaging has recently been added to the annual stream water quality monitoring program. Benthic macroinvertebrate and fish samples have also been collected from eight stream monitoring sites each year to assess stream water quality in terms of its biological diversity and health. The location of hydrologic and benthic monitoring stations are shown on Figure 2-8. The latter biological monitoring has been done to look for changes in stream water quality that may be caused by nonpoint source pollution. This has been done to complement the chemical water quality sampling that is largely based on fair-weather sampling, not during storm events when stream water quality would typically be degraded.

In addition to this District data collection, as part of MRAP, the Metropolitan Waste Control Commission (MWCC) studied the Creek from 1989–1992 and established a continuous monitoring station near the mouth of the Creek. Observations appear in the report of the MWCC to MRAP. These data include extensive flow gaging information. The MWCC's (i.e., now Metropolitan Council Environmental Services, MCES) creek monitoring station at 106th Street in Bloomington continues to operate now as part of the MCES Watershed Outlet Monitoring Program (WOMP), and the District has supplemented this monitoring effort by establishing three additional WOMP-type stations at upstream locations, including 98th Street (Main Stem, Bloomington) Metro Boulevard (North Fork, Edina), and West 77th Street (South Fork, Bloomington).

2.6.4 Shoreland Ordinances

The Minnesota Department of Natural Resources has approved the Shoreland Ordinance for the City of Eden Prairie and is continuing to work with the City of Minnetonka on their ordinance.

2.6.5 Surface Water Appropriations

Records of the MDNR with respect to permitted surface-water appropriations are incorporated by reference.

2.7 Groundwater Resource Data

The BWSR approved a groundwater plan for Hennepin County, though the County has yet to adopt this Plan. As approved by BWSR, the Hennepin County Groundwater Plan requires the District to coordinate preparation of standards and to implement programs that are uniform throughout each city, except where hydrologic conditions require variations. The District agrees to cooperate in fulfilling the following tasks:

- Within one year after adoption by Hennepin County, amend this Plan for consistency with requirements of the Adopted Groundwater Plan.
- Encourage cooperation by cities within the jurisdiction to fulfill the purposes of the Adopted Groundwater Plan.
- Forward copies of local water management plans or planned amendments to Hennepin County and Hennepin Conservation District for comment.
- Within two years after adoption by Hennepin County, attempt to identify District lands that do not meet the requirements of applicable state and federal standards intended to prevent groundwater contamination.

The District acknowledges that there is an interrelationship between surface water and groundwater resources and recognizes that surface water must be managed with a concern for proper management of groundwater resources.

The groundwater system in the District is comprised of the glacial drift water table and the underlying bedrock aquifers that are partially in an artesian condition, meaning that water in the bedrock is maintained under pressure by confining upper layers.

The general contours of the glacial drift groundwater are shown on Figure 2-8, which depicts location of hydrological gaging stations previously referenced. This map was developed using data from the District's groundwater monitoring program. The pressure levels in the Jordan Sandstone aquifer are also shown on this map. This information is taken from Technical Paper No. 2, published in 1961 by the Minnesota Department of Conservation. Since groundwater flows from a high-pressure area to a low-pressure area, the relative magnitude of the groundwater contour determines the direction of flow between the aquifers. This indicates that, in the absence of a confining layer, a groundwater flow from the glacial drift to the Jordan Sandstone exists.

The District must provide for the protection of groundwater and regulate its use to preserve it for beneficial purposes. This authority is presently exercised by comment upon groundwater appropriation permits issued by the MDNR. In commenting upon MDNR permits, even though the District does not possess permitting authority, the Board of Managers opposes groundwater appropriations for nonessential purposes. Upon petition, the District will consider as a basic water management project the identification and protection of groundwater sensitivity areas, recharge areas, and wellhead protection zones within the watershed.

2.8 Soil Data

The distribution of soil types in the District is the direct result of glaciations. The surficial soils of the area predominately consist of till and outwash deposits from Late Wisconsinan glaciations, as well as more recent postglacial organic, lacustrine, and alluvial deposits. The currently topography and surficial geology of the area are mostly due to the last of these glacial advances, which consisted of the Des Moines Lobe and Grantsburg Sublobe advances. The Grantsburg Sublobe of the Des Moines Lobe crossed through the area and reached its furthest extent in Grantsburg, WI approximately 16,000 years ago. Near surface till deposits of the Grantsburg Sublobe, and the Des Moines Lobe appear brown due to oxidation, however, in deeper reaches the till deposits have a distinctive grey coloring. The moraine areas are typified by hummocky topography, which consists of rolling hills and depressions usually filled with lakes and marches..

Underlying the Des Moines Lobe and Grantsburg Sublobe deposits are a series of deposits from older glaciations, including deposits from the Superior Lobe. Although the more recent Des Moines Lobe and Grantsburg Sublobe deposits account for the majority of the surficial soils in the area, there are a few outcrops of Superior Lobe deposits at the surface in the NMCWD. Till deposits from Superior Lobe are more reddish brown to brown in color, and have a different lithology than deposits from the Des Moines Lobe and Grantsburg Sublobe. During the advances of the Des Moines Lobe and Grantsburg Sublobe, some mixing of their till deposits with the underlying Superior Lobe deposits occurred to varying degrees.

During the periods when the glaciers receded, there were numerous areas where blocks of ice were left in place while adjacent ice melted or was carried away. Later, after the deposition of materials had ended, the ice blocks melted, leaving depressions in the landscape. Many of these depressions filled with water, resulting in the lakes and potholes that prevail throughout the District.

Soil boring information in the area indicates that the subsurface soils are intermixed and do not exhibit aerial continuity. Many soil borings indicate layers of sand embedded with till layers, which indicate that the area had been subjected to outwash or ice-contact depositional environments typical of stagnating or retreating glaciers.

Soils information for the District can be found on "Soil Survey of Hennepin County, Minnesota," United States Department of Agriculture (1974) by R.A. Lueth, and the distribution of hydrologic soil types within the District is shown on Figure 2-9. Surficial geology information can be found in the Minnesota Geological Survey's Geologic Atlas of Hennepin County (1989), edited by N.H. Balaban.

2.9 Land Use and Public Utility Services

The entire NMCWD is within the Metropolitan Urban Service Area (MUSA) and is completely urbanized. Each of the municipalities within the District maintains zoning ordinances, or other regulatory controls, and comprehensive plans that include general maps of existing land uses and anticipated land uses. City zoning maps and comprehensive planning maps are incorporated by reference and can be obtained through each municipality at the respective municipal offices.

2.10 Water-Based Recreation Areas and Land Ownership

Figure 2-10 shows the location and land ownership for publicly owned water-based recreation areas. Shady Oak Lake Park is a municipal beach operated by the cities of Hopkins and Minnetonka. Bryant Lake Regional Park is owned and operated by Three Rivers Park District as is Hyland Lake Regional Park. Hyland Regional Park extends into the Riley Purgatory Bluff Creek Watershed District. Bush Lake Park is owned and operated by the City of Bloomington.

2.11 Fish and Wildlife Habitat

The District's lake management classification tables (see Table 5-1, pages 5-28 through 5-33; and Table 5-2, page 5-35) list the ecological and management classifications for lakes of the District as designated by the MC, the MPCA, the MDNR, the municipalities of the District, and the District's Board of Managers. These designations include the available conclusions and recommendations from biological surveys or reconnaissance studies. The tables incorporates all state management plans for fish and wildlife. An extensive discussion of the purpose and uses of this table is presented as part of the Lake Management Strategy.

The MDNR has prepared the Minnesota Comprehensive Wildlife Strategy (CWCS) that is found in January, 2006 DNR publication entitled *Tomorrow's Habitat for the Wild and Rare: An Action Plan for Minnesota Wildlife*. As part of the development and implementation of District projects, the District will utilize this document in the improvement/restoration of fish and wildlife habitat.

2.12 Unique Features and Scenic Areas

The records of the MDNR that identify unique features and scenic-area information, including state-designated natural and scientific areas containing county, state, and federal rare and endangered species as well as other features such as waterfalls, springs, historic mills, and heritage elements identified by the MDNR Heritage Program, are incorporated by reference.

2.13 Pollutant Sources

The records of the MPCA that list known closed and open sanitary landfills, closed and operating dumps, and hazardous waste sites, as well as feedlots, abandoned wells, registered underground and above ground storage tank sites, and permitted wastewater discharges, are incorporated by reference. To the extent that any of this information may be included in a future county groundwater plan, that information is also incorporated by reference.

The District abides by a policy of requiring permit applicants and project petitioners to identify and abandon wells in accord with the rules of the MPCA and the Minnesota Department of Health (MDH).

Nine Mile Creek Watershed District
Water Management Plan

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3.0 Impact on Other Units of Government

3.1 Background

From its inception, the District has recognized its obligation to control flood waters. The District intends to continue to assure that its Plan implementation will control and alleviate damage to public and private properties and improvements from uncontrolled surface waters. A 100-year flood envelope was established assuming ultimate watershed land use development conditions, predicated upon the comprehensive plans and flood control planning of municipalities within the District. By assuming ultimate development conditions, the District avoided frequent recomputation of the flood envelope caused by changing land uses within the watershed. Regional runoff detention basins and floodways took into account the greater volumes and rates of runoff from impervious surfaces expected to be created by the future urbanization of the tributary watershed. Public and private capital expenditures were minimized by prohibiting development within flood prone areas and guiding development outside of the flood profile through floodplain zoning implemented through municipal adoption of District flood profiles. Structures outside the flood envelope were not subject to the cost of flood proofing and other inherent risks. This comprehensive approach is conservative and provides a higher degree of flood protection while also protecting wetland and open space areas of the floodway. The District has also promoted conservation of wetland areas outside the flood envelope as a means of reducing runoff rates, through detention, and for improving the quality of runoff discharging into lakes and streams.

The District intends to continue working with its constituent municipalities to protect public and private property through coordinated floodplain management. The District intends to utilize the authority granted by the Metropolitan Surface Water Management Act to review municipal Surface Water Management Plans and will continue to review local land use development proposals. By coordinating planning, municipalities and the District should be able to avoid excessive capital costs and fairly distribute the obligation of property owners to control flood waters. Construction of stormwater detention and retention (i.e., infiltration) basins will increase the need for regular maintenance. However, District experience has shown that stormwater management techniques, coupled with development controls, can protect water resources.

Use Attainability Analyses (UAAs) conducted for Nine Mile Creek and the District's 15 major recreational lakes have shown that water quality conditions commensurate with desired beneficial uses can reasonably be achieved and maintained assuming ultimate watershed development conditions and continued use of Minnesota Pollution Control Agency (MPCA)-recommended best management practices (BMPs). Results of these UAAs are presented and discussed, by water resource, in Section 5.0 Assessment of Problems of this Plan. Project recommendations from the UAAs form the basis for Section 4.0 General Statement of Goals and Policies and Section 8.0 Implementation Priorities, which factor into the District's capital improvement program.

3.2 Public Input to this Plan

Pursuant to Policy 61 of the Metropolitan Council Regional Plan for Surface Water Management and the rules of the Board of Water and Soil Resources (BWSR) concerning public input to the District's planning process, the District sought planning advice from its Technical Advisory Committee (TAC), composed of representatives from the Engineering or Public Works Departments of each municipality within the District. Committee representatives met to assess and discuss impacts of the District Plan on other units of government, and related planning issues. Following this initial coordination effort, formal letters were sent to local, regional, and state review agencies requesting them to identify topics that they would like to see addressed in the District's revised Plan (see Table 3-1). A series of public Water Forums was then hosted by the cities of the District. In addition to the general public, representatives from the local, regional, and state review authorities for the Plan were invited to attend. Table 3-2 identifies the water forum venues and dates, and major topics discussed. Comments received at the water forums focused on the need to solve lake and stream water quality problems, primarily. Increased public education and more frequent contact with municipal officials were also identified as desirable. A survey, prepared by the District, was randomly sent to 10,000 households within the District requesting the public's opinion regarding the state-of-the-waters within the District. The District received 444 survey responses that were considered in the preparation of this Plan.

Pursuant to the public water forum meetings held in each District municipality, separate meetings were scheduled with City staff to solicit their input to the planning process. Again, these staff were generally associated with the municipal Public Works or Engineering Departments. Table 3-3 lists the dates of these meetings, all held at the District's administrative offices. Similar meetings held with the District's TAC and Citizens Advisory Committee (CAC) are listed in Table 3-4.

Table 3-1 NMCWD Water Management Plan Input Request Tabulation

Request List	Request Date	Response/Participants
Hennepin County	October 27, 2005	
Hennepin Conservation District	October 27, 2005	
Bloomington	October 27, 2005	Participant in Forum
Eden Prairie	October 27, 2005	Participant in Forum
Edina	October 27, 2005	Participant in Forum
Hopkins	October 27, 2005	Participant in Forum
Minnetonka	October 27, 2005	Participant in Forum
Richfield	October 27, 2005	Participant in Forum
Metropolitan Council	October 27, 2005	November 23, 2005
Minnesota Department of Natural Resources	October 27, 2005	
Minnesota Department of Health	October 27, 2005	
Minnesota Pollution Control Agency	October 27, 2005	
Board of Water and Soil Resources	October 27, 2005	
Minnesota Department of Transportation	October 27, 2005	
Minnesota Department of Agriculture	October 27, 2005	

Table 3-2 Municipal Water Forum Meetings

Venue	Meeting	Major Issues Addressed
Bloomington City Hall	May 3, 2005	Normandale Lake water quality. Trails within the Nine Mile Creek corridor
Eden Prairie City Hall	May 5, 2005	Bryant Lake water quality Lake Smetana water quality Runoff detention pond maintenance
Edina City Hall	May 10, 2005	Lake Cornelia water quality Buckthorn Nine Mile Creek fisheries Shoreline erosion Health of wetlands Hybrid cattails
Minnetonka City Hall	May 17, 2005	Glen Lake water quality Bryant Lake water quality County Ditch 34 wetlands Mosquito control Exotic/invasive lake weeds Public education
Hopkins Center for the Arts	May 24, 2005	Culvert improvements Shady Oak Lake water quality Streambank erosion

Table 3-3 Water Management Plan Update Meetings with District Cities

Municipality	Date	Time
Hopkins	Friday, January 20, 2006	9:00 a.m.
Eden Prairie		10:30 a.m.
Bloomington	Monday, January 30, 2006	8:00 a.m.
Edina		10:30 a.m.
Richfield	Monday, February 6, 2006	9:00 a.m.
Minnetonka	Thursday, March 30, 2006	7:00 a.m.

Table 3-4 Water Management Plan Meetings with the Technical Advisory Committee and Citizens Advisory Committee

Municipality	Date	Time
Hopkins	Friday, January 20, 2006	9:00 a.m.
Eden Prairie		10:30 a.m.
Bloomington	Monday, January 30, 2006	8:00 a.m.
Edina		10:30 a.m.
Richfield	Monday, February 6, 2006	9:00 a.m.
Minnetonka	Thursday, March 30, 2006	7:00 a.m.

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4.0 General Statement of Goals and Policies

Nine Mile Creek Watershed District (NMCWD) Vision Statement

It is the NMCWD Board of Managers' vision and intent to manage water resources within the District in a manner that will attain and preserve their highest and best intended beneficial uses. Intended use designations have been made in keeping with records of historical use, applicable state and federal water laws, and in consultation with the District's constituent cities, state and regional resource management agencies, and the general public.

The District seeks a proactive role in watershed runoff regulation that anticipates ultimate watershed land use development. The District also seeks to provide its residents with protection against both flood damage and water quality degradation by conducting diagnostic-feasibility studies of watershed runoff-related problems. Where these studies indicate the need for implementation of remedial measures to mitigate current or likely future problems that interfere with attainment of beneficial use goals, the District will sponsor reasonable cost cooperative projects in response to project petitions from its constituent cities.

Throughout all of its water management planning activities, the District will encourage increased stakeholder involvement in its decision-making, especially by public officials and concerned citizens.

This section of the Plan presents the issues, goals, and policies that pertain to water resources within the NMCWD, organized in the following nine major topic areas:

In establishing its goals the District recognizes they are the end toward which its efforts and ambitions are directed. The goals are not rules but rather a statement of purposes. As with goals, the District's policies are its chosen courses of action selected from several alternatives, in light of given conditions, to guide present and future management decisions. The policies are not regulations or a program but instead are an effort to prudently manage the affairs of the District. The policies are not static or an end; they are the means to achieve the objectives articulated in the District's goals. This requires a partnership between Federal, State, local governments and citizens to be effective. The purpose of the Plan is to enable a cooperative effort to achieve common goals.

Each of the following subsections, 4.1 through 4.9, is organized in the same manner with a table that summarizes the following (in the order shown):

- Importance of NMCWD involvement in the topic area
- General issues associated with the topic area
- NMCWD goals that relate to the topic area
- NMCWD policies that will be implemented to accomplish its goals
- Legal authority to regulate

Detailed assessments of water resource problems within the District are presented in Section 5.0 of this Plan along with recommended remedial measures, by water body.

4.1 Stormwater Management

4.1.1 Importance	The quality and quantity of surface water is greatly influenced by stormwater runoff. To achieve the NMCWD goals for maintaining and improving water quality, and managing water quantity, stormwater runoff must be carefully and closely managed. The NMCWD manages stormwater runoff by carrying out its permit program, which includes preventative measures so that negative effects of stormwater runoff are addressed (and prevented) at the time of development, not afterwards.
4.1.2 General Issues	The quality and quantity of stormwater runoff, from rainfall and snowmelt, are dependent on the hydrology and the physical conditions of the watershed. Hydrology is dependent on weather, topography, soils, land use/land cover, and other factors. Changes to any of these factors will affect the quality and quantity of stormwater runoff. While some of the factors are difficult to control, changes to land use/land cover can be regulated and/or managed.
4.1.3 Goals	1. To understand each subwatershed and the uniqueness of its related water resources, and to manage each subwatershed to its realistic water quality, quantity, and ecological potential. 2. To utilize both structural and nonstructural measures to reduce runoff rates and non-point source pollutant loading. 3. To manage surface waters collaboratively with cities. 4. To manage both the rate and volume of runoff entering Nine Mile Creek and the lakes and wetlands within the watershed.
4.1.4 Policies to Achieve Goals	1. Stormwater runoff will be managed so that future peak rates of runoff are equal to or below existing rates. Management on a regional basis is recommended. 2. Stormwater volume control requirements will be developed during the rules revision process and adopted to achieve a net reduction. 3. Developers will be required to demonstrate that new and innovative stormwater management techniques have been considered. 4. The NMCWD will work with local government units to adopt/revise ordinances or other regulatory controls to allow for runoff pollution prevention methods through low-impact development. 5. Projects and developments plans will be reviewed to evaluate compliance with NMCWD standards. 6. Local watershed management plans will be reviewed for compliance with this Plan. 7. Presently, the District requires a stormwater management plan, through the grading and land alteration permitting process, for any development and/or redevelopment activities involving more than 100-cubic yards of land alternation.

4.1.4 Policies to Achieve Goals (continued)	8. Existing natural retention and detention areas will be used, when feasible, for stormwater management to maintain and improve existing water quality. 9. Stormwater will be managed to minimize erosion. 10. Redevelopment opportunities will be used to enhance existing stormwater management effectiveness. 11. The understanding of the hydrology of Nine Mile Creek and its watershed will be enhanced. 12. Impacts of runoff from development/redevelopment will be minimized by developing stormwater rate and volume control standards. 13. Known flooding/erosion problems will be addressed.
4.1.5 Objectives and Actions	**Objective 1**—Stormwater runoff will be managed in a manner that ensures that future runoff rates are less than or equal to current rates, and future runoff volumes are reduced. **Action 1**—The District will develop performance standards for land altering activities to achieve lower runoff rates and volumes following adoption of the plan. **Action 2**—The District will work with municipalities to adopt, revise, and implement ordinances or other regulatory controls that allow for and encourage innovative stormwater management techniques. **Objective 2**—Utilize structural and nonstructural approaches to reduce runoff rates and non-point source pollutant loadings. **Action 1**—The District will work with developers and municipalities to establish Low Impact Development (LID) demonstration development projects. **Action 2**—These sites will be used for public education purposes. **Objective 3**—Ensure stormwater management systems are maintained. **Action 1**—District will develop stormwater management maintenance standards in partnership with the cities of the District. **Objective 4**—Cooperatively manage surface waters with municipalities and other organizations and have uniformity among the District Plan and local surface water management plans. **Action 1**—Provide technical assistance to municipalities in updating their local surface water management plans so that they comply with and complement the District watershed Plan to achieve stormwater management goals.

4.1.5 Objectives and Actions (continued)	**Objective 5**—Existing stormwater management effectiveness will be enhanced through redevelopment opportunities **Action 1**—Work with developers and municipalities to include additional stormwater management techniques to redevelopment sites. **Action 2**—Identify demonstration sites with the assistance from municipalities and developers. **Action 3**—Educate developers and the general public about the importance of stormwater management at redeveloping sites.

4.2 Surface Water Quality

4.2.1 Importance	Water quality is commonly defined by its physical, chemical, biological and aesthetic (e.g., appearance and smell) characteristics. Good water quality is more than these few measurements, especially when considered as part of a healthy environment whose water quality supports a rich and varied community of aquatic organisms and protects public health. The lakes, ponds, streams and wetlands in the District are an important community asset. These resources supply recreational and aesthetic benefits, enhance property values, serve as sources for groundwater recharge, provide nutrient removal, wildlife habitat and fishery resources. The high quality of the watershed's natural resources makes it an attractive place for people to live. Preserving the high quality of the watershed's natural resources is critical to the existence of a high quality of life among the citizens residing in the watershed and in the larger metropolitan region. If water quality becomes degraded, a water resource will lose its value. If water quality is not maintained, it is not just the environment that will suffer, but the commercial and recreational value of our water resources will diminish and public health may be compromised.
4.2.2 General Issues	Water quality is closely linked to the surrounding environment and land use. The water quality of a lake, pond, wetland, or stream is dependent on the hydrology and the physical conditions of the resource. Hydrology is dependent on the weather, the topography of the landscape, the soils, the land cover, and other factors. Changes to any of these factors will influence the water quality of a water resource. While some of the factors are difficult to control, changes to land cover can be regulated and/or managed.
4.2.3 Goals	1. To manage and protect our water resources: lakes, ponds, creeks, streams, wetlands, drainages, and groundwater by improving and protecting the quality of water for all water bodies within the District. 2. To protect and enhance surface water quality of the lakes and streams of the District. 3. To maintain and enhance current range of uses for District water resources. 4. To strengthen construction-site permit compliance and reduce non-point source pollution from other land use activities. 5. To establish and maintain water quality monitoring program to systematically assess achievement of all District water quality goals for targeted lakes, streams, and wetlands. 6. To establish and support a citizen monitoring program. 7. Coordinate efforts with regulatory agencies on pollutant spills.

4.2 Surface Water Quality (Continued)

4.2.4 Policies to Achieve Goals

1. All major water bodies 2 acres or more in surface area will be classified for their intended beneficial uses.
2. All major water bodies will be managed for non-degradation of water quality, with allowance for natural variability. The major water bodies will be defined as the following lakes and ponds:

- N.W. Anderson
- S.W. Anderson
- S.W. Anderson
- Arrowhead
- Birch Island
- Bryant
- Bush
- Cornelia
- N. Garrison
- S. Garrison
- Glen
- Hawkes
- Indianhead
- Lake Edina
- Lone
- Minnetoga
- Mirror
- Oxboro
- Pond- 84th and Quinn
- Rose
- Shady Oak
- Skriebakken
- Smetana
- Upper and Lower Penn
- Valley View
- Wing

3. The water quality and habitat of all major water bodies will be monitored to detect changes or trends, and results will be reported.
4. Thresholds will be set to assist in determining appropriate water quality management/improvement actions.
5. Appropriate water quality management/improvement actions will be implemented.
6. Current and future NMCWD water quality improvement systems will be operated and maintained to ensure they provide the designed benefits.
7. The condition of water bodies in the NMCWD included on the Minnesota Pollution Control Agency's Sec. 303(d) Impaired Waters List must be improved so that they can be removed from that list.
8. Local governments and developers will be responsible for effectively managing stormwater in accordance with District runoff management criteria.
9. All stormwater runoff will be managed at the time of development through NMCWD's permitting program. Low impact development, infiltration, and other effective on-site treatment methods will be preferred, while stormwater management ponds will be promoted on a regional basis.
10. Naturally occurring retention and detention areas for stormwater management to maintain or improve existing water quality will be required where practical and feasible by the NMCWD throughout the watershed.

4.2.4 Policies to Achieve Goals (continued)	11. Work with the MPCA and other agencies to develop and implement Total Maximum Daily Load (TMDL) studies on all impaired water bodies, including but not limited to those included on the 303(d) 'Impaired Waters' list. When TMDLs are developed, the District will promote the collective consideration of State water quality standards, unless another mutually satisfactory approach is agreed upon. 12. Continue and improve the water quality monitoring program for Nine Mile Creek and its tributaries, and lakes in the Watershed. 13. Establish implementation programs on a subwatershed basis through establishing water quality goals and evaluating the effectiveness on management activities on affected water bodies. 14. Monitor and participate in the management of recreational lakes. 15. Minimize water quality impacts from new development, redevelopment, and land disturbing activities. 16. Ensure stormwater management systems are maintained.

4.2.5 Objectives and Actions	**Objective 1—**Work with the MPCA and other agencies to improve quality of the water bodies on the 303(d) list so that they can be removed from that list. **Action 1**—Actively participate in the TMDL/UAA process. **Action 2**—Determine appropriate responsibilities in implementing load reduction measures identified in the TMDL/UAA process. **Action 3**—Amend UAA studies to better reflect TMDL plans. **Objective 2—**Continue and improve the water quality monitoring program for Nine Mile Creek and the lakes of the District. **Action 1**—Expand and enhance water quality monitoring in the Watershed **Action 2**—Collect, interpret, and report water quality data **Action 3—**Establish and fund a citizen stream and lake monitoring program for the District. **Action 4—**Water quality and habitat of all major water bodies will be monitored to detect changes or trends. **Objective 3—**Minimize water quality impacts for new development/redevelopment and other land disturbing activities. **Action 1—**Review federal, state, and local agency programs related to water quality and identify where additions or changes are necessary. **Action 2—**Develop Watershed performance standards during the rules revision process. **Action 3—**Develop and adopt revised rules for the District. During the rule-revision process, the District will work with local units of government to incorporate District standards into their stormwater management plans, ordinances, and other regulatory controls. **Action 4—**Require cities to develop stormwater plans and ordinances or other regulatory controls that ensure that the costs for constructing, operating, and maintaining stormwater management systems for new developments and redevelopments are fairly allocated so as not to unduly burden local governments or the District. **Objective 4—**Advance the understanding of the hydrology and water quality of Nine Mile Creek and its watershed. **Action 1—**Provide educational workshops and information to general public about Nine Mile Creek and its watershed. **Action 2—**Implement the Project NEMO education program. Give presentation to planning commissions and city councils. **Action 3—**Continue to implement storm drain stenciling program **Action 4—**Host stream and community clean up events in partnership with cities and other organizations. **Action 5—**Monitoring data will be used to calibrate and refine hydrologic models.

4.3 Open Spaces and Recreational Uses

4.3.1 Importance	Improving and maintaining water quality in the Nine Mile Creek Watershed District (NMCWD) is the main concern and focus of the District. Improved water quality is essential to enhancing and increasing recreational uses, which are secondary benefits. Increased public access to Nine Mile Creek and the lakes of the NMCWD and providing places that offer a variety of water resource-related experiences can be the long-term results of improved water quality. Recreational and open space uses by the public can enhance people's understanding of the importance of protecting the natural resources in the NMCWD.
4.3.2 General Issues	Water quality is closely linked to the surrounding environment and land uses. Protecting and enhancing open spaces and natural areas near water resources can aid in improving the water quality of the lakes of the NMCWD and Nine Mile Creek. Providing open spaces and recreational uses of the NMCWD water resources for the public can enhance the public's understanding of the importance of our water and natural resources to our communities' vitality and health.
4.3.3 Goals	To maintain or expand current ranges of recreational uses for NMCWD water resources.
4.3.4 Policies to Achieve Goals	1. Develop or improve open space, recreational, and fish and wildlife habitat areas in conjunction with NMCWD water management projects. 2. Conserve natural and open spaces, and creek corridor to enhance access to the resource. 3. Incorporate open space and recreational use features into Basic Water Management Projects. The Natural Heritage database will be reviewed as part of each project undertaken by the District with items listed incorporated into the design of the project.
4.3.5 Objectives and Actions	**Objective 1—**Increase public awareness of Nine Mile Creek and the lakes in the watershed as a valued resource. **Action 1—**Implement an education program to educate the public about Nine Mile Creek and the lakes of the NMCWD. **Action 2—**Provide the public with information on the recreational opportunities throughout the Watershed through producing watershed maps, brochures, etc.

4.3 Open Spaces and Recreational Uses (Continued)

4.3.5 Objectives and Actions (continued)	**Objective 2—**Maintain natural stream corridor qualities for recreational users and general public. **Action 1—**Support non-profits and volunteer groups for stream cleanup activities **Action 2—**Evaluate Nine Mile Creek Corridor for opportunities to restore natural function and scenic values. **Action 3—**Partner with cities and private landowners to improve stream corridor through buffers, riparian plantings and restoration projects. **Objective 3—**Partner with others to pursue recreation and natural resource protection and enhancement opportunities. **Action 1—**Provide annual budget to leverage other funds and collaborate with other entities **Action 2—**Identify and implement appropriate partnership opportunities (Metropolitan Conservation Corridors)

4.4 Wetlands Management

4.4.1 Importance	Wetlands are an abundant resource within the NMCWD, providing value to the community. Wetlands come in many different shapes, sizes, and types and perform a variety of physical, chemical, and ecological functions. A healthy watershed is one in which wetlands are an integral part of the ecosystem. Wetlands are among the most productive ecosystems in the world. These resources can support an immense variety of species of microbes, plants, insects, amphibians, reptiles, birds, fish, and mammals. Wetlands supply recreational and aesthetic benefits, flood reduction benefits, biodiversity, low stream flow augmentation, enhance property values, serve as sources for groundwater recharge and discharge, provide nutrient cycling, provide wildlife habitat and provide fishery resources. Well-planned wetland protection and management efforts can have far-reaching benefits within the watershed and beyond. Active wetland management can improve water quality and wildlife habitat as well as providing recreational and educational opportunities for the public.
4.4.2 General Issues	Wetland quality is closely linked to the surrounding environment and land use. The quality of a wetland is dependent on the hydrology and the physical conditions of the resource and its watershed. Hydrology and ecology are dependent on the weather, the topography of the landscape, the soils, the land cover, and other factors. Changes to any of these factors will influence the quality of a wetland. Preservation of wetlands is controlled by various local, state, and federal laws. Effective wetland management depends on an accurate inventory and classification of wetland resources and a local wetland management plan developed with input from community residents and agencies.
4.4.3 Goals	Healthy and well-managed wetland resources will be maintained by pursuing the following NMCWD goals: 1. Maintaining and enhancing the functions and values of wetlands within the watershed. 2. Continuing to administer the Wetland Conservation Act (WCA) requirements as the responsible local government unit for wetlands within the cities of Eden Prairie, Edina, Hopkins, and Richfield. Also, provide technical assistance in wetland-related matters in Bloomington and Minnetonka; cities that administer the requirements of WCA. The Minnesota Department of Transportation (Mn/DOT) is the LGU for Mn/DOT transportation projects. 3. Managing wetlands to achieve no net loss of acreage, function, and value; and maintain the complex ecosystems that serve a variety of functions and values, including improving water quality and providing flood storage, wildlife habitat, open space, and aesthetics.

4.4.3 Goals (continued)	4. Practice responsible wetland stewardship by increasing city, government, and citizen knowledge and understanding of wetland ecology and management. 5. Protect all rare and high-quality wetland plant communities within the NMCWD. 6. Protect current populations and habitats of rare, endangered, and threatened plants and animals. 7 Protect and improve wetlands in identified open-space corridors. 8. Allow for multiple uses of protected wetlands, while ensuring that functions and values are maintained or enhanced. 9. Establish a wetland bank within the District for District-sponsored projects.
4.4.4 Policies to Achieve Goals	1. Wetland activities will be managed through NMCWD administration of the WCA and the NMCWD rules and regulations. 2. Require local governments to develop and implement local wetland management plans. 3. Work to achieve no net loss of wetlands in the NMCWD. 4. Wetland replacements will occur in the same subwatershed whenever possible. New wetlands will provide at a minimum equal or greater functions and values at a replacement ratio equal to, or great than that dictated by the WCA or the NMCWD rules, whichever is greatest. 5. Avoiding direct or indirect wetland disturbance will be encouraged for all developments and land disturbing activities. 6. Buffers, acting as filter strips, will be required around wetlands based on its management classification as indicated in each city's local wetland management plan. 7. High value wetlands should not be used for stormwater management where other alternatives exist. 8. Fragmenting natural areas and corridors will be avoided when feasible, and mitigated when unavoidable at equal value.

4.4.4 Policies to Achieve Goals (continued)	9. Impacts to locally and regionally significant natural areas will be avoided when feasible or mitigated when unavoidable at equal or greater value. 10. Cooperate with regulatory agencies to manage invasive species. 11. Require local governments to adopt land use and development ordinances or other regulatory controls to complement existing wetland protection regulations. 12. Identify and pursue wetland restoration opportunities within the watershed. 13. Protect existing fish and wildlife habitat areas and cooperatively promote the development of additional fish and wildlife habitat areas, following MDNR guidelines. 14. Protect sensitive habitats and communities, and rare species, following MDNR guidelines. 15. Assist in public education effort regarding wetlands and other fish and wildlife habitat of the NMCWD.
4.4.5 Objectives and Actions	**Objective 1—**Require local governments to develop and implement local wetland management plans that include a functions and values assessment. **Action 1—**Work with and assist local governments in the development and implementation of local wetland management plans. **Objective 2—**Work with local governments to adopt land use and development ordinances or other regulatory controls to complement existing wetland protection regulations and achieve no net loss of wetlands. Ordinances or other regulatory controls should include establishing standards for wetland buffers and preservation and protection of high-priority wetland areas. **Action 1—**Assist local governments in the development of the above ordinances or other regulatory controls. **Action 2—**Implement a public education program regarding the importance and value of wetlands and other fish and wildlife habitat in cooperation with local governments and other agencies. **Action 3—**Educate the public about the importance of buffer zones around wetlands. **Action 4—**Establish an Incentive Program for implementation of wetland buffer zones. **Objective 3—**Identify and implement wetland restoration opportunities within the District. **Action 1—**Work with natural resource agencies to manage invasive species. **Action 2—**Protect high-quality wetland areas, sensitive habitats and rare or endangered species.

4.5 Groundwater Protection

4.5.1 Importance	Most NMCWD residents obtain their drinking water from groundwater. This makes it especially important to ensure that these aquifers are uncontaminated, protected from future contamination and provide adequate supplies. NMCWD water bodies also are groundwater-dependent and need an adequate supply of clean groundwater.
4.5.2 General Issues	Groundwater quality and quantity are closely linked to the above ground environment. Groundwater quality and quantity are dependent on the infiltration of surface water/rainfall through the soil, which is dependent on soil type, land cover, weather, and other factors. Changes to any of these factors will influence groundwater. While some of the factors are difficult to control, some activities and changes to land cover can be regulated and/or managed. Groundwater is a finite resource with inputs and outputs. The input is generally rainwater and snowmelt that seeps into the ground. The outputs can be groundwater that is pumped out for human use and groundwater that naturally discharges to lakes, wetlands, and streams. Maintaining clean, safe groundwater supplies is critical to human and environmental health and to the economic and social vitality of our communities. Groundwater can be contaminated by commercial and industrial waste disposal, landfills, leaking petroleum tanks, septic systems, mining operations, feedlots and fertilizer/pesticide applications. Within the NMCWD, groundwater quality is good over the majority of the area; however, there are some locations where contaminants have been found. In these areas, there are added financial and social costs to manage the affected water supply.
4.5.3 Goals	1. To manage and protect our groundwater by understanding the effects of community growth and other activities on it, and focusing on groundwater-surface water interactions. 2. To protect groundwater quality and quantity to preserve it for appropriate and sustainable beneficial uses. 3. Protect groundwater recharge areas.
4.5.4 Policies to Achieve Goals	1. Groundwater level data will continue to be collected to assist in managing the water levels and floodplains of the NMCWD's water resources. 2. These data will be reported, annually, in the District Engineer's Report. 3. The NMCWD encourages the cities and other public water suppliers to adopt wellhead protection programs. These programs will include the identification and sealing of abandoned wells. The wellhead protection plans must be submitted to NMCWD for review.

4.5.4 Policies to Achieve Goals (continued)	4. The NMCWD will cooperate with the cities and other public water agencies to educate the general public concerning the use of best management practices (BMPs) to prevent contamination of groundwater supplies and the importance of these measures in protecting groundwater supplies. 5. Negative impacts (e.g., reduced flow to surface water bodies, lowering lake or wetland levels, well interference) to groundwater-dependent resources will be prevented through permit review, community plan review, and education efforts.
4.5.5 Objectives and Actions	**Objective 1—**Continue collecting groundwater level data and use to assist in managing the District. **Action 1—**Collect static groundwater levels from observation wells throughout the District and reported annually in the District Engineer's Report **Action 2—**Collaborate with other agencies to enhance groundwater monitoring efforts. **Objective 2—**Support the Minnesota Department of Health (MDH) and other state, regional, and local agencies in implementing wellhead protection programs and plans within District. **Action 1—**Provide technical assistance to cities that are working on developing or implementing Wellhead Protection Plans **Action 2—**Work with MDH to expedite the development of Wellhead Protection Plans in cities without such plans. **Action 3—**Review and comment on Wellhead Protection Plans as they are being completed. **Action 4—**Support the implementation of best management practices (BMPs) for wellhead protection areas. **Objective 3—**Distribute educational materials or programs that provide information on groundwater and how land use impacts our drinking water supply. **Action 1—**Coordinate efforts with cities and other public water agencies to educate the public on BMPs to prevent contamination of groundwater supplies **Action 2—**Collaborate with others to research infiltration impacts on groundwater and develop a consistent approach to protecting areas sensitive to groundwater contamination **Action 3—**Promote conservation of groundwater.

4.6 Land Use Management

4.6.1 Importance	Land use management plays a fundamental role in the management and protection of water resources. Municipalities in the NMCWD have the fundamental responsibility for comprehensive land use planning and zoning. These municipalities also have significant challenges in meeting state water quality standards for stormwater management. Cooperative land use and water resource management planning is critical to assuring the long term health of local communities and natural resources.
4.6.2 General Issues	1. Some of the pollutant loadings to resources identified in the District's Plan are best addressed through the guidance and regulation of future land use development and redevelopment, rather than through the construction of capital improvements. 2. The District values its strong working relationship with municipalities, and seeks to integrate its water resource protection goals with the land use plans of the municipalities.
4.6.3 Goals	1. To protect and conserve water resources by integrating water resources management with land use planning, and encouraging low impact development approaches that reduce non-point sources of pollution from urban land uses.
4.6.4 Policies to Achieve Goals	1. The District will work with municipalities to assure comprehensive land use plans that protect and preserve water resources within the watershed. 2. The District will work with municipalities to provide for the adoption of local controls, including Low Impact Development requirements, to define and abate any land uses that might adversely impact the achievement of water quality goals, and provide for the compliance with pollutant loading for specific subwatersheds consistent with local, regional, and state plans to achieve water quality standards. 3. The District will adopt rules revisions to implement this Plan and to further develop the District's program to regulate the use and development of land as it impacts water resources. These rules will regulate the use and development of land when the local government unit (municipality) does not have an approved, adopted, and implemented local water management plan, or enters into a cooperative agreement with the District concerning the District's ongoing regulatory program.

4.6.4 Policies to Achieve Goals (continued)	4. The District will work with municipalities to coordinate the District's regulatory program with local land use controls to promote the following policies: a. The presence of environmentally sensitive natural resource areas should guide land use management decisions. b. The impacts of development on water resources, including cumulative impacts, should be considered for each proposed development before development occurs. c. Stormwater BMPs must be identified as part of the development approval process. d. Development review by the District and municipalities should be coordinated and provide for effective technical input at the earliest possible point in the development process. e. Encourage low impact development techniques and approaches throughout the District. 5. The District will assist its constituent municipalities in complying with the requirements of their MS4-NPDES stormwater permits, particularly the Non-Degradation Plan elements of their Stormwater Pollution Prevention Plans (SWPPPs), which mandate that 1988-era runoff water and pollutant loads not be exceeded.
4.6.5 Objectives and Actions	**Objective 1—**Require developments within the Watershed to address impacts on water resources, including cumulative impacts. **Action 1—**Assist local governments within the District in developing criteria to consider potential off-site impacts (downstream impacts) **Action 2—**Encourage use of Low Impact Development (LID) techniques throughout the watershed **Action 3—**Development/permit review by the District and municipalities will be coordinated and provide for effective technical input at the earliest possible point in the development process (District involvement on the front end) **Action 4—**Through rules revision process, the District will develop rules to address rate and volume control. **Objective 2—**Coordinate the implementation of the Nine Mile Creek Watershed Management Plan with the implementation of local government's Comprehensive Plan updates. **Action 1—**Develop and adopt rate and volume control standards to reduce rates and volumes of runoff throughout the watershed.

4.6.5 Objectives and Actions (continued)	**Objective 3—**Coordinate the District's regulatory program with the local land use controls to minimize impact of developments/redevelopment on water resources. **Action 1—**Work with municipalities to identify stormwater BMPs as part of the development review and approval process. **Action 2—**Coordinate development review process with municipalities to provided effective technical input at the earliest possible point in the development process. **Action 3—**Encourage low impact development techniques and approaches throughout the District. **Action 4—**The District will assist in the funding of Low Impact Development demonstration projects. **Action 5—**Assist local governments with the development adoption of rate and volume control ordinances or other regulatory controls.

4.7 Floodplain Management

4.7.1 Importance	The protection of human life and flood-prone structures and improvements was the first priority of the District and continues to be a primary objective of the District.
4.7.2 General Issues	The District established a 100-year frequency flood envelope along the creek in 1961. The flood envelope was based on runoff from a totally urbanized watershed. The District has been managing/regulating development riparian to the creek based on the flood envelope since 1961.
4.7.3 Goals	1. To manage and protect the floodplains of the watershed from encroachment. 2. To protect human life and permanent improvements that could be damaged by flood events.
4.7.4 Policies to Achieve Goals	1. The natural function of the floodplain as a floodwater storage area will be protected from encroachment. 2. Maintain a no net loss of floodplain storage. 3. Floodplains will be managed to maintain critical 100-year flood storage volumes. 4. Local Water Plans will include provisions that restrict construction of new structures within the flood envelope, and other flood prone areas. 5. Upstream floodwater storage should be maximized. 6. Infiltration in appropriate floodplain areas should be increased through increased vegetated areas and reduced impervious surfaces. 7. Work with constituent cities to establish natural vegetated buffers on all publicly owned lands adjacent to Nine Mile Creek and stormwater detention areas. 8. Low floor elevation of all structures must be 2-feet above the 100-year flood elevation. 9. Place restrictive covenants on titles of properties, if necessary, to ensure floodplain protection. 10. Work with the cities in developing buffer ordinances or other regulatory controls.

4.7.5 Objectives and Actions	**Objective 1—**Require adoption of shoreland and floodplain ordinances that are in compliance with County and State ordinances. **Action 1—**Review the status of local floodplain and shoreland ordinances. **Action 2—**Assist municipalities with the development and adoption of floodplain ordinances to be compliant with District, County, and State requirements. **Objective 2—**Work with municipalities to identify and protect District floodplains. **Action 1—**Work with municipalities to establish natural vegetated buffers adjacent to Nine Mile Creek on all publicly owned lands. **Action 2—**Work with municipalities to develop and distribute educational materials on floodplain locations, protection, and floodplain land use restrictions. **Objective 3—**Prevent floodplain encroachment in order to maintain no net loss of floodplain storage, including the preservation, restoration, and management of floodplain wetlands. **Action 1—**Require local stormwater management plans to maintain critical 100-year flood storage volume. **Action 2—**Require local stormwater plans to include provisions that restrict construction of new structures within the flood envelope and other flood prone areas.

4.8 Education and Outreach

4.8.1 Importance	Public involvement and public information efforts are becoming increasingly important to the NMCWD. It is through these efforts that the District will increase the public's understanding of water resource management and issues in the watershed, and foster long-term public commitment to protecting these resources.
4.8.2 General Issues	NMCWD needs to educate and involve the public to meet the challenges of managing NMCWD's water resources. NMCWD needs public participation and support to balance interests and protect the watershed.
4.8.3 Goals	1. To manage and protect our water resources: lakes, ponds, creeks, streams, wetlands, drainage ditches, and groundwater by: a Promoting open communication with our constituents, both our citizen base and pertinent governmental units. b. Educating the general public and the local government units within the NMCWD on water quality and quantity issues, management and means of improvement. 2. To offer programs, educational opportunities, and information that facilitate an understanding of watershed principles.
4.8.4 Policies to Achieve Goals	1. Awareness of the District's presence and its role in managing water resources will be increased through expanded communications efforts. 2. Interest in and support of District will be increased through expanded cooperative education efforts, recruitment of volunteers, and public involvement in District projects and programs. 3. Awareness of the impacts that behaviors can have on the watershed's water resources will be raised through dissemination of education materials to targeted groups, including developers, and through other public information efforts. 4. Behaviors that have a positive impact on the water resources will be promoted through coordination/cooperation with other groups, and agencies. The District will investigate and develop a plan for an incentive program to encourage implementation of BMPs in the watershed. 5. Assist in distributing materials developed by other organizations and/or develop educational materials, where appropriate. 6. Incorporate water quality education/information regarding the NMCWD into all District activities. 7. Incorporate an educational component related to each goal area in the Plan.

4.8.4 Policies to Achieve Goals (continued)	8. Provide information to the public, and provide opportunities for public involvement and input on District policies and programs. 9. Coordinate efforts with other agencies and groups to develop and implement education programs related to responsible land use practices. Ensure that elected officials have access to this program. 10. Coordinate efforts with government, nonprofit, and other agencies to provide education programs on watershed issues. 11. The District's website (www.ninemilecreek.org) 12. Share data and studies with District cities 13. Prepare and provide maps to District cities
4.8.5 Objectives and Actions	**Objective 1—**Develop an education program related to each goal area in the Plan. **Action 1—**Incorporate water quality education/information regarding the NMCWD into all District activities. **Objective 2—**Provide information to the public and community groups, and provide opportunities for public involvement and input on District programs and activities. **Action 1—**Use District's website to provide information on NMCWD. • Post meeting dates, times, locations, on the web **Action 2—**Establish and support volunteer monitoring programs for Nine Mile Creek and lakes. **Action 3—**Support and maintain an active Citizens Advisory Committee (CAC). **Objective 3—**Work with other agencies and groups to develop and implement education programs related to sustainable land use practices. **Objective 4—**Coordinate efforts with government, nonprofit, and other agencies to provide education programs on watershed issues. **Action 1**—Conduct a survey of District citizen concerns, periodically.

4.9 Administration

4.9.1 Importance	Effective and efficient operation of the Watershed District's work is essential to ensure public support.
4.9.2 General Issues	1. Oversight of basic water management projects, long-range planning, and other special needs can overburden the engineering and legal resources of the District. In order to assure timely, effective oversight, a District Administrator has been hired to serve at the pleasure of the Board of Managers to perform such duties as may be delegated. 2. The administrative levy of the District will be in accordance with Minn. Stat. §103D.905, Subd. 3. An annual budget will be adopted following public hearing on the proposed budget. Minn. Stat. §103D.911. 3. The District is authorized to levy to pay the cost attributable to the basic water management features of projects initiated by petition of a municipality of the District. Minn. Stat. §103D.915. 4. When projects are properly initiated, the District will expend funds in accordance with priorities and available financial resources. First-priority is given to basic water management projects that are needed for proper and sufficient water quantity and quality management of streams and major lakes within the District. Second-priority is given to ancillary features of basic water management projects that will enhance waters and related land resources within the District. Third-priority is given to land acquisition for special purposes such as preservation of ecologically important or unique areas. 5. The District is a special taxing district governed by a citizen board appointed by county commissioners. Due to the significant costs associated with basic water management projects, the District believes that local elected officials should support implementation of basic water management projects so that District residents may influence elected officials. 6. The District is authorized to levy a tax to pay for the increased costs of preparing a water resources management plan or for projects identified in an approved or adopted plan.
4.9.3 Goals	The goal of the District is to manage its affairs in a fiscally responsible manner and to encourage citizen involvement in District activities.

4.9 Administration (Continued)

4.9.4 Policies to Achieve Goals	1. The District will annually budget its administrative fund in a manner that avoids shortfalls and excessive administrative levies. The District will levy according to its foreseeable needs, only. The 509 Fund, Metropolitan Surface Water Management Act, will be levied to fund the on-going studies and programs that were initiated/developed in the District's 1996 Plan and continued/implemented and expanded as part of this Plan. 2. The District will levy to fund *Repair & Maintenance* and *Survey & Data Acquisition* funds, and basic water management projects. Additional projects will be considered based on need and urgency. 3. Subject to available funds and levy authorities, the District will levy to raise funds to contribute directly for the payment of costs attributable to District projects upon the following percentage allocation guidelines: **First-Priority: (Basic Water Management Projects)** Up to 100% of authorized costs **Second-Priority**: **(Ancillary Features of Basic Water Management Projects)** Up to 50% of authorized costs **Third-Priority**: (**Land Acquisition for Special Purposes)** Up to 25% of authorized costs. 4. Currently subject to available funds, the District will review and administer its permitting programs without additional charge to applicants, using monies in the administrative fund. If necessary, a fee not to exceed actual costs will be implemented. 5. Enforcement of rules and regulations of the District will be by civil action; criminal conduct will be reported to municipal or county authorities for investigation and prosecution. 6. The District prefers to undertake basic water management projects in response to petitions from municipalities, but reserves the discretionary right to initiate projects itself. 7. To oversee the completion of a project, plan, budget, or other need, the District has hired an Administrator to facilitate and expedite projects.
4.9.5 Objectives and Actions	**Objective 1—**Support and oversee a Citizens Advisory Committee and Technical Advisory Committee.

Nine Mile Creek Watershed District
Water Management Plan

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5.0 Assessment of Problems

In its 1996 *Water Management Plan*, (1996 Plan) the Nine Mile Creek Watershed District (NMCWD) committed itself to assessing water resource problems, District-wide. Although the focus of that 1996 Plan was on water quality management, predominantly, flood control and other issues have also been assessed during its 10-year term. This section reports on the assessment process and the problems that were identified.

5.1 Lake Water Quality Problems

In 1991, the District inventoried and analyzed lake water quality data collected for its lakes from 1971 to 1991. In its report *Lake Water Quality Data Inventory and Historic Trend Analysis*, no statistically significant trends in lake water quality were detected over the 21-year time period. More recently collected data confirms that assessment, and the complete data set demonstrates that Watershed management efforts are generally maintaining lake water quality in accordance with Policy 55 of the *Management Guide* of the Metropolitan Council MC, which states:.

> *Water quality in the Metropolitan Area lakes and streams should be maintained at least at 1980-81 levels.*

However, this does not necessarily mean that current lake water quality conditions fully support intended beneficial uses of the lakes. For this reason, the District has, since 1996, completed Use Attainability Analyses (UAAs) for Nine Mile Creek and 15 recreational lakes and their watersheds. The UAAs all follow a step-wise, outcome-based evaluation and planning process. This process involves following the seven basic steps intended to achieve or maintain water quality conditions that support beneficial uses such as swimming, fishing, aesthetic viewing, and wildlife habitat:

1. Determine current and historic water quality conditions.
2. Set water quality goals that support intended uses.
3. Assess attainment or nonattainment of goals for current watershed land-use conditions.
4. Estimate annual runoff water and pollutant inputs to water bodies.
5. Calibrate a computer simulation model to predict observed lake- or stream-water quality conditions from annual runoff inputs.
6. Using the calibrated lake- or stream-model, assess water quality goal attainment for current and ultimate watershed land-use conditions and range of climatic conditions.
7. If necessary, recommend feasible alternative remedial measures (i.e., best management practices (BMPs)) to achieve desired water quality.

UAAs are intended to be "Total Maximum Daily Load (TMDL) Equivalent" studies, and implementation of their recommendations should result in removal of the subject water bodies from the Minnesota Pollution Control Agency's (MPCA's) *Sec. 303(d.) Impaired Waters* list.

As shown by the timeline depicted in Figure 5-1, the lake UAAs were completed over the past 10 years, generally two or three lakes per year, beginning with headwaters lakes and proceeding downstream. Results of the UAAs are summarized in the following project synopses (Figures 5-2 through 5-13), and in Table 5-1, in terms of water quality goal attainment (or non-attainment). Table 5-1 entries include summer-average epilimnetic concentrations of total phosphorus and chlorophyll *a*, and corresponding Secchi disc transparencies. These water quality variables were used to assess lake trophic status (i.e., fertility level) according to the Carlson Trophic State Index (TSI) value methodology. This index was developed from the interrelationships between summer Secchi transparency and epilimnetic concentrations of chlorophyll *a* and total phosphorus. The resulting index values generally range between 0 and 100, with increasing values being indicative of eutrophic (i.e., highly fertile) conditions, and lower values indicating relatively low fertility (i.e., oligotrophic). Most lakes within the District reside in an intermediate fertility category termed mesotrophic. Using TSI values calculated from Secchi disc transparencies for lakes across Minnesota and user perception survey data regarding lake suitability for swimming, the MPCA has developed ecoregion-specific thresholds that define swimmable use support. For the Central Hardwood Forest Ecoregion, which includes the NMCWD, the swimmable use support levels are as follows:

MPCA Swimmable Use Support Category	TSI_{SD}*
Fully Supporting	$\leq$ 53
Fully Supporting, but Threatened	54-56
Partially Supporting	57-63
Not Supporting	$\geq$ 64

*TSI_{SD} = Trophic State Index, Secchi disc basis

Besides the assessment of the MPCA , the Minnesota Department of Natural Resources (MDNR) has evaluated many of the District lakes for fisheries management purposes, and in 1992 developed an ecological classification of Minnesota lakes with associated fish communities. The purpose of the classification is to aid fishery managers to quickly separate likely problems from natural biological variation. The results of the classifications should allow fishery managers to make more realistic judgments of the status of fish communities from lake surveys. Limnological variables were used to classify the lakes into 44 types. Principal components analysis classified the variables into three types; variables associated with lake size, variables associated with lake depth, and variables associated with the chemical fertility of the lakes and length of growing season. These components were associated with the characteristic fish communities for each lake class. One parameter of the MDNR lake classification system is TSI score calculated by the same method utilized by the MPCA. Those statistics have been included in Table 5-1 to coordinate MDNR water quality goals with those of the MPCA and the District.

In 1996, the District adopted its own lake management category criteria, which are also defined on the basis of TSI (Secchi disc basis) values:

Nine Mile Creek Lake Management Category Criteria

Lake Category	District Water Quality Goal (TSI_{SD})
I. Whole body-contact recreational	$\leq$ 50
II. Partial body-contact recreational	51-60
III. Fishing and aesthetic viewing	61-70
IV. Runoff Management	$\geq$ 71

The District's goal for its Category I swimming Lakes is somewhat more restrictive than the MPCA's 'fully supporting' criterion ($TSI_{SD} \leq 53$), and the water quality criteria for the remaining categories reflect the judgment of the District about the levels of water quality required to support intended beneficial uses. These many classifications are summarized for easy reference in the Lake Management table (Table 5-1). The District now uses Table 5-1 to guide its lake water quality management activities. Lake level management information is shown on Table 5-2.

In carrying out its lake water quality management strategies, the District established three action steps: Protect, Assess, and Abate. Each action step is taken with reference to the District's adopted lake water quality goals and parameters of the Metropolitan Council (MC), the MPCA, the MDNR, the pertinent municipality, and the District. The definitions of Protect, Assess, and Abate are as follow:

Protect—means to avoid significant degradation from point and nonpoint sources and wetland alternations to maintain existing beneficial uses, aquatic and wetland habitats, and the level of water quality necessary to protect these uses in receiving waters. (Applicable to lakes that achieve their water quality goals).

Assess—means the diagnostic study of water pollution caused by nonpoint sources of water pollution or planning to implement BMPs. (All lakes within the District have now been assessed through the Use Attainability Analysis Process.)

Abate—means the implementation of feasible and practical BMPs by the District or a local unit of government to improve water quality conditions. (Applicable to lakes that currently fail to achieve their water quality goals, or are expected not to achieve goals under ultimate watershed land use conditions).

Each action defined above relates to achievement of goals listed in the District's lake management category criteria. Periodic trend analyses of data collected through the District monitoring program are used to identify significant degrading trends in water quality and a beneficial use may trigger an assessment or abatement action.

Table 5-2 Lake Level Management

Lake	Regional (100-Year) Flood Elevation (MSL)	Ordinary High Water Elevation*	Historical High Water Elevation		Historical Low Water Elevation	
			Elevation	Date	Elevation	Date
Anderson NW	841	839	841.8	07/24/87	834.7	06/25/77
SE	841	839	841.8	07/24/87	833.5	12/08/64
SW	841	839	841.8	07/24/87	835.1	12/08/64
Arrowhead	878.3	875.8	878.6	7/24/87	797.9	1/15/91
Birch Island	892	n/a	891.2	03/24/69	877.3	02/13/91
Bryant	854	852.6	854.8	07/24/87	849.3	01/14/77
Bush	835	833.2	836.9**	6/11/99**	826.0	08/08/64
Cornelia	964.2 (N) 862.6 (S)	859	864.1	7/24/87	858.1	10/27/03
Edina	824.3	822	825.4	7/24/87	817.8	2/09/82
Glen	906	904.1	905.0	08/06/65	898.6	01/29/90
Lone	900	n/a	901.1	04/04/66	895.4	01/29/90
Minnetoga	899	n/a	899.1	07/24/87	894.1	01/29/90
Mirror	906	904	912.1	07/24/87	901.8	01/14/77
Normandale	814	808	815.8	7/24/87	–	–
Oxboro	803	812	813.3	7/24/87	797.9	1/15/91
Penn	n/a	n/a	816.6	07/24/87	803.2	01/31/89
Rose	928.3	925.9	928.4	4/4/66	919.6	1/08/90
Shady Oak	905.2	903.4	904.4	04/04/66	897.8	01/29/90
Smetana	841	835.2	840.6	07/24/87	830.2	11/08/76
Wing	941.3	939.8	941.5	7/24/87	933.5	1/31/89

*Data from the Minnesota Department of Natural Resources

**Data from the city of Bloomington

5.2 Stream Water Quality Problems

Prior to completion of its second-generation *Water Management Plan* in 1996, the District conducted an annual stream water quality monitoring program with sampling station locations located at or near municipal boundaries. Unfortunately, however, much of that monitoring was conducted during fair weather when flows were relatively low, not during periods of elevated discharge when stream water quality is likely to be degraded by runoff-borne pollutants. Beginning in 1997, the District's stream water quality monitoring program was revised to collect data that are more diagnostic of stream health, including measurements of physical, chemical, and biological parameters. The District's stream monitoring program was further expanded in 2003 in response to Nine Mile Creek being listed on the MPCA's Section 303(d) Impaired Waters list because of excessive turbidity and chloride concentrations and biotic impairments, based on MC data collected downstream of 106th Street in Bloomington. These water quality and biotic impairments are now being addressed through a TMDL project in cooperation with the MPCA. The current NMCWD stream water quality monitoring program includes:

- Physical classification of the creek by stream reach, periodically, to detect changes in stream monitoring.
- Ecological use classification of stream reaches *vis-à-vis* the fish communities that can be supported.
- Benthic macroinvertebrate monitoring to determine 'biotic index' values.
- Runoff-related stream water quality monitoring, including operation of continuous flow gaging and storm runoff-activated automatic sampling stations on the North- and South-Forks and Main Stem of Nine Mile Creek.

Results of the monitoring programs during the past 10 years (see timeline, Figure 5-14) are discussed in the following paragraphs, and identified water quality problems are noted.

5.2.1 Physical Classification of Nine Mile Creek

5.2.1.1 Introduction

A physical classification of a stream classifies a stream into various types based on the relationship of its physical geometry and hydraulic characteristics. The purpose of a physical classification is to provide evidence of how the stream has been affected by changing land use, how the stream will behave under existing conditions, and to indicate how restoration may be approached if a portion of the stream becomes unstable. The physical classification is used in conjunction with the ecological classification to aid in the management of Nine Mile Creek.

Six reach segments of Nine Mile Creek (Figure 5-15) were classified in 1997 as part of the Nine Mile Creek UAA. The results of that study indicated that the creek is comprised of stream types that are sensitive to disturbance. Disturbance can be watershed-wide, such as urban development, or channel specific, such as introducing a road crossing. The NMCWD has been nearly fully developed for decades, and the creek has had time to adjust to the changes. Because the 1997 classification was the first time the creek had been classified, conclusions about the rate of change of the creek were not made. A second physical classification survey of Nine Mile Creek, the results of which are discussed here, was completed in 2003 to determine if changes in stream morphology were occurring.

5.2.1.1.1 Description of Nine Mile Creek

Nine Mile Creek has a total watershed area of approximately 50 square miles, 15 square miles of which are landlocked. The watershed ranges from relatively flat topography in the upper and middle portions of the watershed, to the steep lower valley which descends to the Minnesota River at the downstream portion of the watershed. Nine Mile Creek originates as two branches: a north branch (North Fork), and a south branch (South Fork).

The South Fork begins at Minnetoga Lake in Minnetonka, and then flows south to Bryant Lake and Smetana Lake before continuing east toward Normandale Lake. A secondary branch, County Ditch 34, originates at Birch Island Lake, combines with the Glen Lake outlet in the Eden Prairie Industrial Park area and flows into Bryant Lake on the West side of the Lake.

The North Fork begins in Hopkins near Excelsior Boulevard (County Road 3) and West of 11th Avenue. It flows southerly through Bredesen Park, continues south and joins with the south branch upstream of Normandale Lake.

From Normandale Lake the creek flows through Nord Myr Marsh and Marsh Lake. The outflow from Marsh Lake is controlled by the Marsh Lake dam. From here, the creek flows through a residential area, with yards abutting the creek for much of its length. After crossing Old Shakopee Road, the creek steepens as it descends into the lower valley. The land use in the lower valley is park/open space, owned by the City of Bloomington.

Historical aerial photos of the NMCWD were reviewed for years 1937 and 1940 to gain a better understanding of the history of the creek and associated watershed, particularly with regard to land use. The NMCWD was primarily agricultural until the 1950's, when urbanization rapidly occurred. The creek was straightened prior to 1935 to provide better drainage for farming in the area that is now Normandale Lake, Nord Myr Marsh, and Marsh Lake Park. This portion of the creek was County Ditch No. 1. Portions of the North Fork and South Fork were also straightened, particularly along the North Fork near T.H. 100 and in Bredesen Park area.

The change in land use from agricultural to residential has probably improved much of the riparian vegetation, as grazing and farming practices ceased with residential development, vegetated buffers have been established in many areas that were previously grazed. Also, grazing ceased on steep slope areas in the lower valley. Because vegetation is a very strong influence on stream stability, the overall condition of the streams may have improved as a result of the change in land use from farming to residential. The frequency and duration of flood flows has increased with urbanization, however, offsetting the benefits of improved vegetation.

5.2.1.1.2 Urbanization Influences on Nine Mile Creek Flood Frequency and Magnitude

The contributing watershed to Nine Mile Creek has changed over time from a natural condition to agricultural land use, and finally to urban land use. Under natural conditions the stream was in general equilibrium with the landscape and was able to convey storm runoff without significant change in its shape, pattern, or profile. Agricultural practices eventually began to dominate the land use of the watershed. When this occurred, the natural balance between watershed runoff and the stream shape, pattern, and profile was altered, and the stream began to show signs of degradation. When the watershed began to urbanize, more drastic changes were introduced to the relationship, and the stream shape, pattern and profile has been in a process of adjusting to these changes.

The most significant change associated with urbanization, as far as the stream is concerned, is an increase in runoff from the watershed. With urbanization, the rate and volume of runoff increases, as shown in Figure 5-16.

The shape, pattern, and profile of the stream channel are intimately related to the bankfull discharge. When the stream is in equilibrium with its environment, the shape, pattern, and profile are such that the stream can convey the bankfull discharge without significant change in those parameters. When urbanization occurs, the frequency of bankfull discharge increases depending on the amount of impervious area in the watershed. This concept is illustrated in Figure 5-17.

Because the bankfull flood is the dominant, channel forming flow, and because under natural conditions this flow only occurs on average once every 1.5 to 2 years, the stream must adjust to what is effectively a larger channel-forming discharge. The channel tends to widen and deepen its cross-section. As it does this, the sinuosity of the stream tends to decrease, with a resulting increase in the slope of the channel.

Detention ponds are often constructed to slow the rate of storm water flow to the stream, and thus attempt to maintain a more natural rate of flow to the stream. Figure 5-18 shows that with increasing storm water detention volume available it is possible to approach the pre-urbanized condition of bankfull flow frequency in the stream.

Infiltration of stormwater runoff is the most effective means of limiting the impacts of urbanization, as these methods not only reduce the magnitude of the flood discharge, but also reduce the total volume of storm runoff to the creek.

Because it is often impractical to store enough runoff to eliminate increases in the amount of runoff to the channel, the stream will respond to the flow increases. The natural stream channel tends to widen and deepen to convey the greater frequency and volume of discharge.

5.2.1.1.3 Sediment Transport

Sediment transport is an important function of the stream. It forms the shape of the channel, including the pools and riffles which are so important to aquatic life. Sediment transport consists of suspended sediment, which is distributed throughout the water column, and bed load sediment, which moves along the stream bed. Suspended sediment generally consists of finer particles, while bed load sediment consists of larger, heavier particles. With larger flows, bed load sediment particles may become suspended as the power of the stream increases. Bed load sediment occupies from 5 to 50 percent of the total sediment load of a stream; suspended sediment occupies the remaining larger fraction.

The progression of suspended sediment transport with a single storm is demonstrated in Figure 5-19. At low stream flows, the suspended sediment load is also low. As flow increases, the sediment load also increases, until the flow reaches a maximum. As the flood recedes, the sediment load is lower than for similar discharges on the rising limb of the hydrograph. The reason for this is that as the flood is building, all of the previously deposited sediment in the stream is being removed. The sediment deposits may be due to bank slumps, deposits from storm water inflow, or upland erosion. The stream is unable to move the deposited sediment until the flow is large enough to transport the sediment particles. When the flood recedes, there is less sediment available to move.

Although the sediment supply to a stream increases with urbanization, the increase in flood peak overcompensates for the increase in sediment yield (Leopold, 1978). That is, the sediment supply does not always keep up with the increase in flood flow in a mature urban watershed. This is another reason why detention storage is important, because it reduces the magnitude of large flows which have the capacity to remove sediment from the bed and banks of the channel.

5.2.1.2 Methods

5.2.1.2.1 Physical Classification System Description

The classification system used to classify Nine Mile Creek was developed by D.L. Rosgen in "A Classification of Natural Rivers" (Rosgen, 1994). Rosgen's classification system describes a stream on a reach by reach basis. A single stream can have several different stream types over its length. The system defines a stream type according to the shape, pattern, and profile of the reach. In particular, the following parameters are used to classify a stream type: the degree of entrenchment of the channel, the ratio of width to depth, degree of channel meandering or sinuosity, channel material, and the channel surface slope. Some of these parameters are illustrated on Figure 5-20.

The Rosgen classification system specifies seven basic stream types, ranging from A to G as shown on Figure 5-21. Each type has six subclasses corresponding to the predominant bed material present in the reach. These subclasses are numbered from 1 to 6: 1 is bedrock, 2 is boulder, 3 is cobble, 4 is gravel, 5 is sand, and 6 is silt. This allows for 42 combinations of stream type. A maximum of 15 of these types would likely be found on Nine Mile Creek. A description of the stream types is given in Table 5-3. This table gives a range of values of the criteria used for stream classification. These ranges are those most commonly observed; the actual observed values can lie outside of these ranges to a certain extent, recognizing that as the stream type changes, the criteria will adjust accordingly.

The ***entrenchment ratio*** is defined as the ratio of the width of the flood-prone area to the bankfull surface width of the channel. The ***flood-prone area*** is defined by Rosgen as the width measured at an elevation which is determined at twice the maximum bankfull depth. Field observation shows this elevation to be a frequent flood (50 year) or less, rather than a rare flood elevation. The entrenchment ratio describes the interrelationship of the river (stream) to its valley and landform features. This interrelationship determines whether the river (stream) is deeply incised or entrenched in the valley floor or deposit feature. The entrenchment ratio indicates whether the flat area adjacent to the channel is a frequent floodplain, a terrace (abandoned floodplain), or is outside the flood-prone area.

The ***width/depth ratio*** is the ratio of bankfull channel width to bankfull mean depth; it is used to describe the dimension and shape of the channel. ***Bankfull discharge*** occurs at approximately the 1.6-year recurrence interval and is referred to as the dominant discharge for the stream. Hydraulic geometry and sediment transport relations rely heavily on the frequency and magnitude of bankfull discharge.

Sinuosity is the ratio of stream length to valley length. It can also be described as the ratio of valley slope to channel slope. This value typically varies from 1.0 to 2.5, where a value of 1.0 corresponds to a straight channel. Sinuosity can often be determined from aerial photographs, and interpretations can then be made of slope, channel materials, and entrenchment. Values of sinuosity appear to be modified by bedrock control, roads, channel confinement, and vegetation types, among other factors. Generally, as gradient and particle size decrease, there is a corresponding increase in sinuosity. Meander geometry characteristics are directly related to sinuosity following minimum expenditure of energy concepts. Based on these relations and ease of determination, sinuosity is one of the delineative criteria for stream classification.

Channel materials refer to the bed and bank materials of the stream. Channel material is critical for sediment transport and hydraulic influences, and also modifies the form, plan, and profile of the stream. Interpretations of biological function and stability also require this information. The channel materials can often be predicted from soils maps and geologic information. They can also be determined in the field, and at the detailed level the materials are measured and the size plotted on percent distribution paper.

The ***water surface slope*** is of major importance to the morphological character of the channel and its sediment, hydraulic, and biological function. It is determined by measuring the difference in water surface elevation per unit stream length. It is typically measured through at least 20 channel widths or two meander wavelengths (Rosgen, 1996). In broad level delineations, slope can be estimated by measuring sinuosity from aerial photos and measuring valley slope from topographic maps.

5.2.1.2.2 Sensitivity to Disturbance by Stream Type

Different types of streams have differing sensitivities to disturbance and varying recovery potential. Sensitivity and recovery potential are interrelated to sediment supply in the stream, bank erosion potential, and the influence of vegetation on controlling bank erosion. These differences are itemized by stream type in Table 5-4.

The information in Table 5-4 is best applied when a stream's behavior can be predicted by appearance and by extrapolating information from similar stream types. Knowing the sensitivity of each stream type allows for better management of the stream systems, potential impact assessment, and risk analysis.

5.2.1.2.3 Data Collection

Six reference reaches of Nine Mile Creek were physically classified as shown on Figure 5-15 and are summarized in Table 5-5. At each reach, the profile and cross section of the channel were surveyed. Water surface elevations and bankfull elevation indicators were surveyed. At each cross section, permanent control monuments were installed to enable future monitoring of the sites. The sediment was characterized for each reach and the grain size distribution plotted.

5.2.1.2.4 Mapping

During the field survey, GPS coordinates were surveyed for each site to enable incorporation of the data into ArcView mapping of the Nine Mile Creek system. GPS coordinates were also read for each photograph, and will allow ground photographs to be incorporated into the ArcView mapping.

Table 5-4 Sensitivity of Stream Types (from Rosgen)

Stream Type[1]	Sensitivity to Disturbance[2]	Recovery Potential[3]	Sediment Supply[4]	Streambank Erosion Potential	Vegetation Controlling Influence[5]
B-4 (gravel)	moderate	excellent	moderate	low	moderate
B-5 (sand)	moderate	excellent	moderate	moderate	moderate
B-6 (silt)	moderate	excellent	moderate	low	moderate
C-4 (gravel)	**very high**	**good**	**high**	**very high**	**very high**
C-5 (sand)	very high	fair	very high	very high	very high
C-6 (silt)	very high	good	high	high	very high
E-4 (gravel)	very high	good	moderate	high	very high
E-5 (sand)	**very high**	**good**	**moderate**	**high**	**very high**
E-6 (silt)	**very high**	**good**	**low**	**moderate**	**very high**
F-4 (gravel)	extreme	poor	very high	very high	moderate
F-5 (sand)	very high	poor	very high	very high	moderate
F-6 (silt)	very high	fair	high	very high	moderate
G-4 (gravel)	extreme	very poor	very high	very high	high
G-5 (sand)	extreme	very poor	very high	very high	high
G-6 (silt)	very high	poor	high	high	high

[1] Stream types condensed to those evident on Nine Mile Creek; **prevalent types are in bold**.

[2] Includes increases in streamflow magnitude and timing and/or sediment increases.

[3] Assumes natural recovery once cause of instability is corrected.

[4] Includes suspended and bedload sediment from channel sources and from adjacent to stream.

[5] Vegetation that influences width/depth ratio stability.

5.2.1.3 Results

5.2.1.3.1 Physical Classification—Reference Reaches

Physical parameters used in the classification of the six reference reaches are summarized in presented in Table 5-6 and are described as follows:

Reference Reach PC2—Reach PC2 is located along the North Fork of the creek in Edina between 70th Street and CSAH 62, west of T.H. 100. Photos of this reach are shown in Figures 5-22 and 5-23. The riparian land is primarily city-owned (Heights Park), although it abuts residential property near CSAH 62. The stream is Type E through this reach, with a relatively narrow and deep channel. As is typical of this stream type, the floodplain is quite wide and marshy, with vegetation consisting primarily of grasses, willow, and dogwood.

This reach has degraded somewhat since the 1997 survey. There is little bank erosion evident where the banks are well vegetated with reed canary grass. Bank erosion is evident where the channel abuts residential properties with turf lawn adjacent to the stream. Here, the banks are prone to slumping into the creek.

Also, there is a large amount of debris that is clogging the channel at the downstream end of this reach.

Figure 5-22 Reach PC2 Reed Canary Grass

Figure 5-23 Reach PC2 Debris Jam

Reference Reach PC3A—Reach PC3A is located in the city of Minnetonka, east of Interstate 494 and north of CSAH 62. Photos of this reach are shown in Figures 5-24 and 5-25. This site is near the headwaters of the South Fork, and thus has the smallest length of the surveyed reaches. This reach is somewhat confined by its valley walls, and is directly upstream of a broad wet meadow. The reach has good quality vegetation, with grasses, willow, dogwood, and a variety of other tree and shrub species.

Although it is fairly steep, this reach is classified as Type E, owing to its narrow, deep cross-section and relatively wide floodplain. Since the 1997 survey, the reach has scoured and the profile is lowered. Portions of the reach have been lowered by approximately one foot, while the surveyed cross-section has been lowered by about six inches. Left unchecked, this erosion will migrate upstream and will likely become larger and more problematic. There are two old culverts in the downstream portion of this reach, which may provide some grade control in the downstream direction.

Figure 5-24 Reach PC3A Meadow

Figure 5-25 Reach PC3A Channel

Reference Reach PC5A—Reach PC5A is located along the South Fork of Nine Mile Creek, south of Interstate 494 and west of East Bush Lake Road. Photos of this reach are shown in Figures 5-26 and Figure 5-27. The land use surrounding this reach is undeveloped park land, consisting of a broad meadow with forested valley slopes. The creek flows through an open water area before crossing East Bush Lake Road. Review of the historical aerial photos reveals that this open water is larger in area now than in the 1930's, possibly due to road construction or beaver activity. It is also noted that the stream channel has cut off a significant portion of its historical alignment. It is not known if this is due to natural causes or man-made alteration.

Since the 1997 survey, a large storm sewer pipe has been constructed and outlets to the channel upstream of the surveyed reach. Also, construction on Interstate I-494 was ongoing in 2003, and could be a source of sediment to the creek upstream of the reach. These disturbances will tend to degrade what was the highest quality reach surveyed in 1997.

The surveyed reach has aggraded since the 1997 survey, indicating excessive sediment loading to the channel. This could be due to the new storm sewer that was installed upstream of this reach, or possibly due to culvert modifications at East Bush Lake Road. The channel cross-section is widening as a result. The channel in this reach remains classified as a Type E, which is characterized by a narrow, deep channel, and a broad floodplain. If the bed aggradation and channel widening continue, the stream type will probably revert to a Type C, which is a less desirable channel type from a hydraulic and ecological perspective. The floodplain consists almost entirely of grasses, with a few interspersed willow trees. The banks are quite stable, with only a few raw areas. The sinuosity of the channel is on the low end of that expected for an E channel, probably due to the channel cut-off.

Figure 5-26 Reach PC5A Looking Downstream

Figure 5-27 New Storm Sewer Inflow Upstream of Reach PC5A

Reference Reach PC7A—Reach PC7A is located downstream of Marsh Lake, south of West 98th Street and west of Penn Avenue. This reach is located just prior to where the creek descends into the lower valley. Photos of this reach are shown in Figures 5-28 and 5-29. The creek flows through a shallow wooded valley with residential land use on either side. The stream through this reach is highly meandering, and is a Type C channel. The floodplain of this channel is more confined than with an E stream type, and the channel dimensions are wider and shallower.

The stream banks continue to actively erode in this reach, especially where turf lawns abut the channel. Several factors contribute to the erosion: (1) lack of vegetative root mass due to turf lawn areas and shade from trees; (2) several large storm sewers discharge to the stream in this vicinity, increasing the frequency of bankfull flooding; and (3) the streamflow may be "sediment starved" as it leaves Marsh Lake, and thus have a greater tendency to erode its banks and bed.

Several homeowners have added rock riprap to the streambanks along their property, but this only accelerates erosion of the unprotected areas. This area is worthy of consideration for a coordinated effort to improve the stability and erosion-resistance of the channel. Such a project would consist of measures to reduce the flow velocity at susceptible banks, and improve the vegetation of the corridor by selective tree removal and introduction of native plants. Education of homeowners to encourage vegetative buffers between their lawns and the creek would also be beneficial.

Figure 5-28 Reach PC7A Bank Erosion

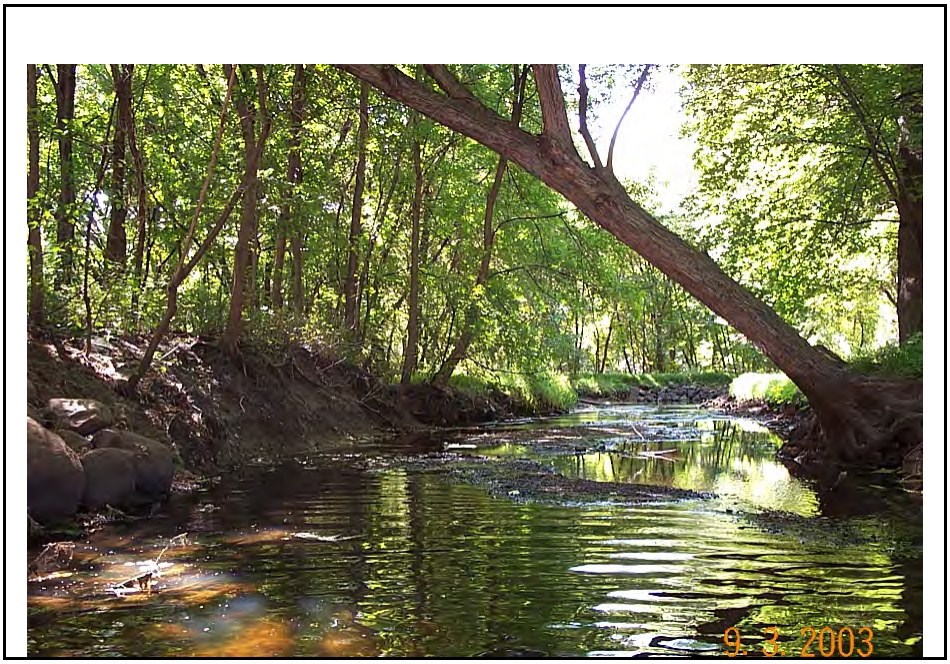


Figure 5-29 Reach PC7A

Reference Reach PC7B—Reach PC7B is located in Moir Park, south of Old Shakopee Road. Photos of this reach are shown in Figures 5-30 and 5-31. This reach is in the upper end of the "lower valley" of Nine Mile Creek, where the creek descends to the Minnesota River. This reach is a Type C channel, with its floodplain somewhat confined by the valley walls. The park bordering the stream is manicured on the south side of the creek, and undeveloped on the north side. The manicured (i.e., mowed) side of the stream receives heavy use from park visitors, and the use is evident in the increased erosion on this side of the stream. In the 1997 survey, it was noted that several portions of the reach had undergone major restoration. The restoration consisted of bank stabilization, using rock riprap toe protection, buried posts, concrete jacks, coconut bio-logs, and re-establishment of bank vegetation. Most of the measures that were implemented appear to be working well.

The current survey indicates that the reach is fairly stable, with little change in the bed profile or channel cross-section. This reach has deep pools and gravel bed material, both of which are conducive to fish. The bank protection measures appear to have helped to stabilize the area, but the existing bank vegetation is minimal. This reach would benefit from a wider buffer to allow further propagation of native plants and shrubs.

Figure 5-30 Reach PC7B Looking Downstream

Figure 5-31 Reach PC7B Bank Stabilization Site

Reference Reach PC7C—Reach PC7C is located downstream of 106th Street, where the creek is more confined by the valley walls. Photos of this reach are shown in Figures 5-32 and 5-33. This reach consists largely of riffles and runs, with the pools spaced relatively far apart. The sinuosity is also lower, again due to the confinement of the channel within the valley walls.

This reach is a Type C channel, although it is borderline B channel type. The overbanks for this reach are not mowed, and therefore the quality of vegetation is reasonably good. Since the 1997 survey, the channel has downcut an average of about six inches. The downcutting means that the channel is losing the little floodplain that it has, which will tend to aggravate bank erosion.

As with site PC7B, several portions of this reach have been stabilized in previous years, using similar measures. In general the measures remain very effective, although erosion problems have occurred at some unprotected sites. This reach, along with the entire lower valley, needs regular monitoring to ensure that the measures are stable and to detect new erosion problems before they become severe.

Figure 5-32 Reach PC7C Gravel Bar

Figure 5-33 Reach PC7C

5.2.1.3.2 Extrapolation of Physical Classification to Entire Stream

With the aid of aerial photos and topographic maps, the reference reach classifications were used to classify the remaining stream length. Figure 5-34 illustrates the stream types for the entire length of the stream. Overall, the stream types have not changed significantly from a similar survey completed in 1997.

Type E stream occurs in much of the middle and upper portion of the watershed, where the channel slope is mild and the valleys are broad and shallow. This stream type is defined by a deep, narrow channel with a low, wide floodplain. It is typical of marsh and meadow areas. Reach 2, 3A, and 5A are all Type E; they generally have well vegetated banks and floodplain and are highly meandering.

Type E stream probably existed in what are now Normandale Lake, Nord Myr Marsh, and Marsh Lake Park. The stream was straightened prior to 1935 in these areas resulting in the stream losing many of the natural characteristics it possessed prior to urban development in the 1950's.

Type C stream is predominant from Marsh Lake downstream to the Minnesota River, where the floodplain is more confined by the valley walls and the slope steepens.

5.2.1.4 Attainable Stream Conditions—Identified Water Quality Problems

Nine Mile Creek has retained much of its natural character with regard to aesthetics, ecological value, and flood control. The reaches that are monitored have desirable physical classifications that are appropriate to their location, topography, vegetation and flow conditions. However, since physical monitoring began in 1997, several of the reaches show signs of deterioration. Although they have not deteriorated to the point of changing physical classifications (to a less desirable classification), several reaches will do so if the deterioration continues. The history of erosion problems in the lower valley is testimony to the stress associated with the urban nature of the watershed.

The most commonly observed stream types on Nine Mile Creek were E5 and C4. Type E5 is commonly observed in the upper and middle reaches of the stream, and is typified by a narrow, deep, highly meandering channel with a well developed floodplain. Type C4 is typical of the lower valley of the creek, and is typified by a wider channel, is highly meandering, and has a narrower floodplain. These stream types are highly sensitive to disturbance; they have moderate (E5) to very high (C4) sediment supply, high (E5) to very high (C4) stream bank erosion potential, and very high vegetation controlling influence. Their natural recovery potential is fair (C4) to good (E5).

The lower valley, with primarily C stream type, is particularly vulnerable to bank erosion problems. This is especially true where the stream abuts the valley walls, which have had severe erosion problems in the past. Several large culverts drain surface runoff from I-35W and the surrounding neighborhoods to the lower valley. These culverts convey large volumes of surface runoff very efficiently, with no detention to slow the discharge. It may be beneficial to investigate options for creating detention ponds for some of the larger contributing subwatersheds.

The upper portions of the watershed are somewhat more resilient to stream bank erosion, with mainly E stream type. The typically wide floodplain associated with this stream type relieves the stress from the stream banks during larger than bankfull discharges. Many subwatersheds in this area also drain directly to the creek, however, with little or no detention. This contributes to the increase in flood frequency and discharge rate throughout the stream system. The significant deterioration of Reach 5A is alarming and indicative of what can happen when increases in flow and sediment occur to the stream.

As with the lower valley, if the vegetation is disturbed along the stream banks severe erosion can occur. This is evident in places where the stream abuts manicured yards. The lack of protective vegetation leads to greater bank erosion than in areas with natural Streambank vegetation.

The physical classification was performed on reaches that are in relatively good condition, as they serve as good indicators of the stream health. Numerous portions of Nine Mile Creek have already been impacted from weirs or other grade controls, and are essentially cattail marshes with a relatively straight flow channel. These areas offer significant potential for improvement to a system that has higher quality from a physical and ecological perspective, while retaining the flood control benefits

of the existing system. For example, the cattail marshes could be converted to a system of floodplain wetlands and the creek could be restored to a meandering shape.

5.2.2 Ecological Use Classification of Nine Mile Creek

5.2.2.1 Introduction

Nine Mile Creek was classified as to attainable ecological use to determine stream management goals and stream management practices. Ecological use includes the stream's fish and aquatic life uses.

The ecological use classification of Nine Mile Creek was based upon an evaluation of its ecosystem. The Nine Mile Creek ecosystem is comprised of habitat (watershed, banks, bed, water volume), flow, water quality, fish, and aquatic life communities (e.g., macroinvertebrates such as crayfish and aquatic insects). The fish and aquatic life communities found in the stream are dependent upon the overall quality of its ecosystem components. The poorest ecosystem component generally controls the type of fish community and other aquatic life that can live in the stream. An ecosystem evaluation identifies each ecosystem component and determines the poorest component. The types of fish and other aquatic life that can live in the stream are then determined from the poorest component. This evaluation is called ecological use classification.

5.2.2.2 Methodology

The classification of Nine Mile Creek as to ecological use was based upon the division of stream fish and aquatic life communities into five categories according to the Wisconsin Department of Natural Resources (WDNR) ecological use classification system (Ball, 1982), which is based upon flow, habitat, and water quality.

Cold water fishery (e.g., trout): Streams capable of supporting a cold water fishery, or serving as spawning area for salmonid species.

Warm water sport fishery (e.g., bass and sunfishes) Streams capable of supporting a warm water sport fishery or serving as a spawning area for warm water sport fish.

Intolerant forage fishery (e.g., species, such as rosyface shiner, that are intolerant of environmental degradation): Streams capable of supporting an abundant, and usually diverse, population of intolerant forage fish or intolerant macroinvertebrates. Intolerant species are those that are sensitive to many types of environmental stress and are absent in the presence of environmental degradation. These streams are generally too small to support cold or warm water sport fish, but have natural water quality and habitat sufficient to support forage fish or macroinvertebrates. Streams capable of supporting valuable populations of tolerant fish are included in Class C.

Tolerant forage fishery (e.g., species, such as creek chub, which can tolerate a wide range of environmental degradation): Streams capable of supporting only a small population of tolerant forage fish, very tolerant fish, or tolerant macroinvertebrates. Tolerant species are able to tolerate a wide range of environmental conditions and are often common in high degraded environments. The aquatic community in such a stream is usually limited due to naturally poor water quality or habitat deficiencies.

Very tolerant macroinvertebrates or no aquatic life: Streams capable at best of supporting very tolerant macroinvertebrates, or an occasional very tolerant fish. Such streams are small and severely limited by water quality or habitat.

The WDNR determined requisite criteria for the support of each class (see Table 5-7 and Table 5-8).

Nine Mile Creek was first classified as to attainable ecological use during 1997 as part of the Nine Mile Creek UAA. That initial classification was based on data collected up to 1997 (Barr, 1998a). Subsequently; annual flow, water quality, and biological data collected during 1998 through 2001 were evaluated annually to determine whether the stream consistently attained its attainable ecological use (Barr, 1999, 2000, 2001, and 2002), in light of new fisheries data collected by electro-shocking, and new physical classification data also collected in 2003. These latter analyses identified factors limiting stream ecological uses, and recommended ways the stream could be managed to improve its uses. In many cases, the damage done to benthic habitat by the increased frequency of bankfull or greater runoff events was the identified problem that could only be remedied by reduced runoff volumes. Resolution of this problem will require greater use of infiltration basins, rainwater gardens, and other innovative stormwater management techniques.

5.2.2.3 Results

The results of Attainable Ecological Use Classifications of Nine Mile Creek reaches are shown on Figure 5-35. These results have been extrapolated from the seven indicated survey sites to reaches with similar characteristics. A discussion of 2003 attainable use results follows, referencing creek branch:

5.2.2.3.1 North Fork

The potential, existing, and historical ecological uses were the same throughout the North Fork (Stations 1, 1A, 1B, 1C, 2, and 2A) and, hence, determined the attainable use. With the exception of two short reaches, the North Fork has an attainable use of Class D, tolerant forage fish. The headwaters reach of the North Fork, Stream Reach 1, has an attainable use of Class E, tolerant macroinvertebrates or no aquatic life. The use is constrained by habitat, including insufficient water to support fish. Stream Reach 1C (from Highway 62 to Valley View Road) has better habitat than the other reaches of the North Fork. Habitat improvements in this reach include reduced watershed erosion, reduced bank erosion failure, increased depth of pools, and an improved pool/riffle, run/bend ratio. The improved habitat in Reach 1C results in an attainable use of Class C, intolerant forage fish. Biological data have not been collected from Reach 1C. Hence, the actual biological community occurring in the reach has not been determined. Biological surveys are recommended to determine whether the improved habitat results in an improved biological community. If the reach is unable to support a Class C, intolerant fish community, because of water quality or flow characteristics that differ from the fish life requirements, the attainable use should be changed to the biological use of the reach.

Table 5-8 Stream System Habitat Rating Form

Stream _____ Reach Location _____ Reach Score/Rating _____

County _____ Date _____ Evaluator _____Classification _____

Rating Item	Category			
	Excellent	**Good**	**Fair**	**Poor**
Watershed Erosion	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any runoff. 16
Watershed Nonpoint Source	No evidence of significant source. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agriculture). 14	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 16
Bank Erosion, Failure	No evidence of significant erosion or bank failure. Little potential for future problem.	Infrequent, small areas, mostly healed over. Some potential in extreme floods. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20
Bank Vegetative Protection	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally health. 9	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18
Lower Bank Channel Capacity	Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 10	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 16
Lower Bank Deposition	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars.15	Heavy deposits of fine material, increased bar development. 18
Bottom Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20
Bottom Substrate/Available Cover	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable 17	Less than 10% rubble, gravel or other stable habitat. Lack of habitat is obvious. 22
Avg. Depth Riffles and Runs	Cold >1' 0 Warm >1.5' 0	6" to 1' 6 10" to 1.5' 6	3" to 6" 18 6" to 10" 18	<3" 24 <6" 24
Avg. Depth of Pools	Cold >4' 0 Warm >5' 0	3' to 4' 6 4' to 5' 6	2' to 3' 18 3' to 4' 18	<2' 24 <3' 24
Flow, at Rep. Low Flow	Cold >2 cfs 0 Warm >5 cfs 0	1-2 cfs 6 2-5 cfs 6	.5-1 cfs 18 1-2 cfs 18	<.5 c 24 <1 cfs 24
Pool/Riffle, Run/Bend Ratio (distance between riffles ÷ stream width)	5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 6	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20
Aesthetics	Wilderness characteristics, outstanding natural beauty. Usually wooded or unpastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. 14	Stream does not enhance aesthetics. Condition of stream is offensive.16
Column Totals:	_____	_____	_____	_____

Column ScoresE _____ +G _____ +F _____ +P _____ = _____ = Score

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor

5.2.2.3.2 South Fork

The headwaters reach of the South Fork, 3A, noted differences between the potential, existing, and historical ecological uses. The differences were due to the intermittent nature of the stream. During dry periods, a flow insufficient for the life requirements of fish occurs. The historical use of the headwaters reach is Class E, tolerant macroinvertebrates (no fish). 1997 through 2003 flow data indicate minimum flows were below the life requirements of fish during 4 of the 6 monitoring years. Favorable flow conditions during 2003 resulted in an existing use of Class C, intolerant forage fish. The potential use, Class D, reflects a long-term average minimum flow, which is between the favorable and unfavorable flows reflected by the existing and historical uses. Because flow is an uncontrollable parameter, the attainable use is a Class E, tolerant macroinvertebrates (no fish).

The remaining portion of the South Fork noted existing, historical, and potential ecological uses that were the same and hence, determined the attainable use. The South Fork from Bryant Lake to Normandale Lake has an attainable use of Class D, tolerant forage fish.

5.2.2.3.3 Main Stem

The biological community at stream Reaches 7A and 7C indicated the stream supported a higher use than was estimated from the stream's habitat, flow, and water quality. Hence, the attainable use of these stream reaches was based upon the historical ecological use. The potential use for all reaches on the Main Stem was a Class D, tolerant forage fish. The stream's existing use was a Class B, warmwater sport fish, at Reach 7A, and a Class C, intolerant forage fish, at Reach 7C. The stream reaches note a historical use and hence, an attainable use of Class C, intolerant forage fish.

The potential, existing, and historical ecological uses at stream Reach 7B are the same and, hence, determined the attainable use. The attainable use at stream Reach 7B is Class D, tolerant forage fish.

5.2.2.4 Ecological Use Limitation Factors

The attainable ecological use of Nine Mile Creek is generally limited by the following factors:

- Urbanized land use throughout its watershed
- Urban stormwater runoff impacts (i.e., flow and water quality conditions)
- Low base flow conditions
- Low dissolved oxygen conditions
- Degraded habitat (e.g., sediment filling of pools and riffles, absence of protective bank vegetation, etc.)

Although limiting factors may be changed by remedial measures, these measures do not ensure attainment of a higher ecological use class. The adverse temperature impacts of warm stormwater runoff and low base discharge in the creek will continue to reduce ecological use. Also, the erosive effects of frequent bankfull or greater discharges will continue to keep benthic habitat in a degraded

condition unless runoff volumes are reduced significantly. Nonetheless, management projects are recommended to preserve and/or improve existing habitat, flow, and water quality conditions.

District projects are recommended to reduce the widespread erosion in Nine Mile Creek, particularly in Reaches 2, 2A, 5A, 7B, and 7C. The 2003 survey of these reaches indicates erosion contributed to the habitat degradation observed during the 1997 through 2003 period. Continued erosion may prevent attainment of the stream's attainable ecological use. Erosion also results in degraded stream water quality. Recommended erosion control activities include:

- Improve the stream's channel stability, including channel and floodplain restoration techniques, such as improving stream bank protection, management of riparian vegetation, and restoring a stable channel shape, slope, and sinuosity.
- Reestablish vegetation in areas which lack sufficient vegetation to prevent erosion. Improving stream bank and riparian vegetation throughout the stream system will improve the resistance of the stream to erosion.
- Selective tree removal to provide more sunlight to areas that have a lack of ground vegetation.
- Establish a riparian buffer and improve channel stability to reduce streambank erosion.
- Develop and implement an education program to encourage riparian residents of Nine Mile Creek to assist with streambank stabilization by establishing a riparian buffer to replace shallow rooted turf grass lawns abutting the stream.
- Promote infiltration of stormwater throughout the watershed, soil conditions permitting, in order to reduce runoff volumes.

Activities associated with reducing the duration (volume) and rate of runoff will also reduce erosion. Recommended projects include:

- Continue to build storm water management basins to reduce discharge rates and volumes from the urbanized area.
- Introduce innovative stormwater management techniques to infiltrate runoff, thereby reducing the volume and rate of runoff to the creek.

Implementing these activities can reduce the frequency of bankfull flooding, and help maintain the stability of the stream.

All of the stream reach tributary drainage areas assessed in 2004 have impervious cover (IC) percentages above the 25 percent threshold that the Center for Watershed Protection (2003) predicts will cause stream degradation and non-supporting stream quality (Table 5-9). The reach of Nine Mile Creek that has the lowest IC, South Fork, is also the reach that historically has the lowest minimum discharges. The North Branch has the highest IC percentage. The Main Stem of Nine Mile Creek is intermediate between the upper two stream segments. The narrow range of IC values for the stream reaches and the fact that the entire stream reaches fall within the non-supporting category makes it difficult to discern any significant differences between the stream reaches.

The NMCWD IC is still within a range that allows for some ecological integrity to persist. Urban stormwater management is recommended to preserve and/or improve existing water quality and habitat conditions in Nine Mile Creek. As development/redevelopment occurs within the District, treatment of stormwater runoff should include practices that maintain a stable hydrology, reduce channel erosion, maintain stream temperatures, avoid acute toxicity problems, and allow for more on-site recharge (infiltration). Land use decisions that promote the retention of forest cover, re-establish riparian continuity and ensure overall watershed treatment of runoff will benefit the stream. A goal of 3 percent buffer area or 3 percent for flood control ponds (as a percent of contributing watershed area) can protect and improve stream conditions.

5.2.3 Benthic Macroinvertebrates as Stream Quality Indicators

Macroinvertebrate communities have their primary importance for the District's stream monitoring program as biotic indicators of water quality. Annual monitoring captures possible extreme conditions and, over time, will indicate long-term trends. As biological indicator organisms, the macroinvertebrates provide indirect evidence of changes in stream water quality related to stormwater runoff and physical changes within the watershed. The benthic community is exposed to temporal variations in stream water quality and "integrate" the quality of passing water. Benthic invertebrate data are being collected to validate Ecological Use Classification assessments, completed periodically on a stream reach basis.

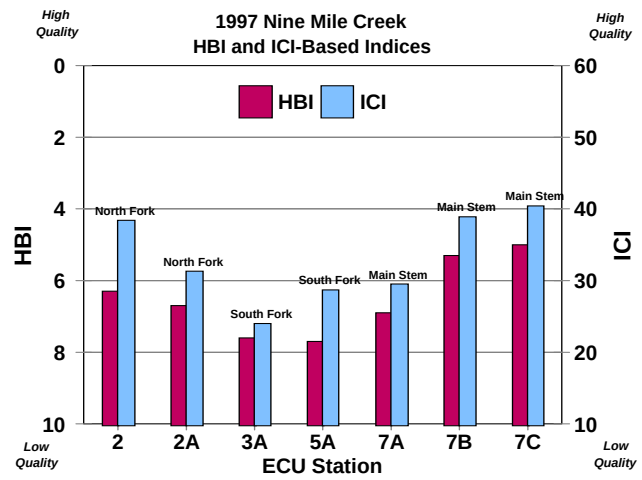
Beginning in 1997, benthic macroinvertebrates have been collected annually at the same seven monitoring sites established for periodic assessments for stream physical – and ecological- use classifications. Data collected in 2004, the most recent year of record, are presented in Table 5-10. These data have been analyzed according to two similar methods, the Hilsenhoff Biotic Index (HBI) and Invertebrate Community Index (ICI) methodologies, to yield relative water quality scores (low- to high-quality, see Figure 5-36. Both indices show that the upper North Fork (ECU-2) and lower Main Stem (ECU-7A, ECU-7B, and ECU-7C) have relatively better water quality than the lower North Fork and South Fork stations. Both indices further show that the South Fork (ECU-3A and ECU-5A) has a lower water quality than all other sample locations.

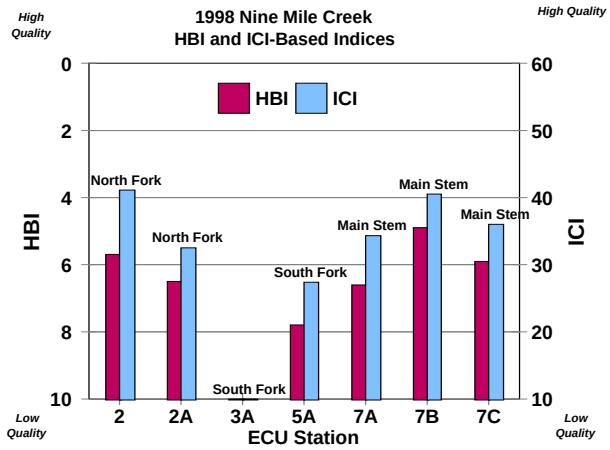
Table 5-10 Nine Mile Creek Watershed District Aquatic Macroinvertebrate Identifications Collected October 7, 2004

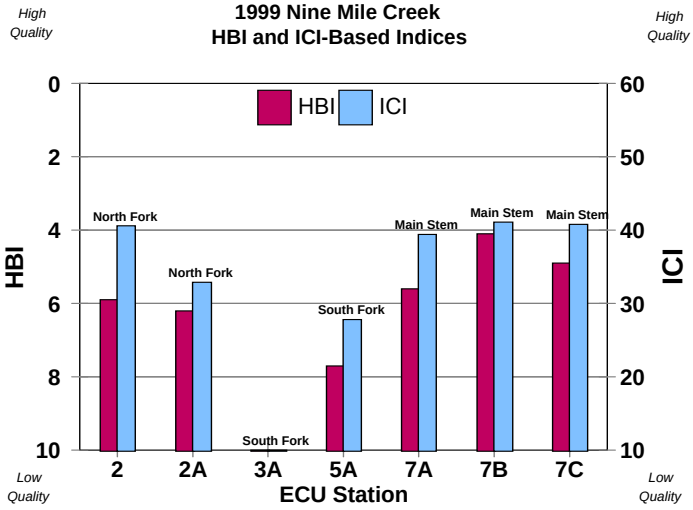
	Number of Specimens by Station						
TAXA	**ECU-2**	**ECU-2A**	**ECU-3A**	**ECU-5A**	**ECU-7A**	**ECU-7B**	**ECU-7C**
INSECTA							
Coleoptera (beetles)							
Dytiscidae							
Laccophilus (adult)	8						
Loidessus (adults)	4						8
Elmidae							
Dubiraphia (adults)	4						
Dubiraphia (larvae)	4	8		16			
Stenelmis (adults)	16	8			4	48	48
Stenelmis (larvae)	40	16			6		24
Haliplidae							
Peltodytes (adults)		16		16			
Hydrophilidae							
Tropisternus (adults)	*1*						
Diptera (true flies)							
Athericidae							
Atherix (larvae)		8			2		
Chironomidae							
Unidentified chironomidae	80	352	48	496	8		112
Chironomidae (pupa)		48					
Culicidae							
Undetermined Culicid pupa				16			
Simuliidae		16					
Simulium tuberosum	4						16
Simulium vittatum	4	168		32	6	32	48
Simuiidae pupae		8					
Stratiomyia							
Odontomyia			4				
Tipulidae							
Tipula							56
Unidentified Higher Diptera						3	
Ephemeroptera (mayflies)							
Baetidae							
Baetis brunneicolor (larvae)		8		12		288	704
Baetis flavistriga (larvae)	4	64		48	18	528	584
Unidentifiable Baetis	8			16			
Callibaetis				32			
Caenidae							
Caenis (larvae)	20			80			
Heptageniidae							
Stenacron spp.(larvae)	108	8		32	2	272	168
Hemiptera (true bugs)							
Belostomatidae							
Belostoma (adults)	13	16		12			
Corixidae (adults)							
Undetermined (immature)				16			
Trichorixa (adults)				32			
Hesperocorixa		4					
Sigara (adults)		16		32			
Gerridae (water striders)							
Aquarius (adults)			12				
Mesoveliidae							
Mesovelia (adults)				32			
Pleidae							
Neoplea (larvae)				480			
Rhagovelia (adults)	8						

	Number of Specimens by Station						
TAXA	**ECU-2**	**ECU-2A**	**ECU-3A**	**ECU-5A**	**ECU-7A**	**ECU-7B**	**ECU-7C**
Trichoptera (caddisflies)							
Hydropsyche betteni (larvae)	88	448	4	1312	80	504	824
Hydropsyche sparna (larvae)	36	16	4	240		144	1440
Cheumatopsyche (larvae)	276	128	12	272	106	568	32
Unidentifiable hydropsychidae					4		200
Leptoceridae							
Nectopsyche	4						
Oecetis				16			
Phryganeidae							
Ptilostomis			4				
Philopotamidae							
Chimarra obscura (larvae)						104	128
Odonata (dragonflies and damselflies)							
Aeshnidae							
Aeshna				5			
Calopterygidae							
Calopteryx (larvae)	16	16	24	4	4	1	
Coenagrionidae							
Enallagma	8	40	4		2		
Ischnura (larvae)	28	192	4	224			
Undetermined	8			16			
ANNELIDA							
Hirudinea							
Erpobdella punctata			4	4	6	8	8
Helobdella stagnalis			4	4			
Nephalopsis		16					
Undetermined leech			4				
Oligochaeta		40					
Undetermined aquatic earthworm	4	8		16			
BRYOZOA (fragments)		4					8
CRUSTACEA							
Malacostracha (crayfish)	3	5		4			1
Amphipoda							
Gammaridae							
Gammarus							24
Talitridae							
Hyalella	132	712	56	1648	10	8	16
Isopoda							
Asellus	4						
MOLLUSCA							
Gastropoda							
Gyraulus				16			
Helisoma			7	96			
Ancylidae							
Ferrisia	32	32		208			
Lymnaea spp.					2		
Physidae							
Physa		96	8	240			
Unidentified slug	1						
Pelecypoda							
Musculium			152	20			
Sphaerium spp.	113				4		**24**
Pisidium spp.	4	32	12	160	2		
TURBELLARIA (flatworms)							
Dugesia" type	36	56			2	32	144

*stream bed dry.







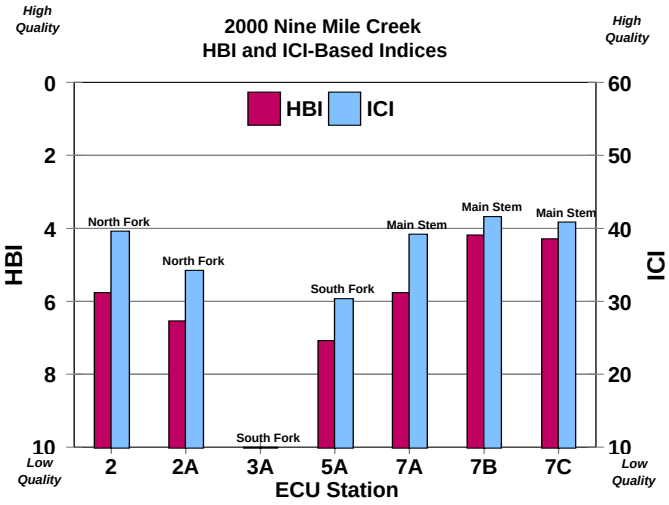
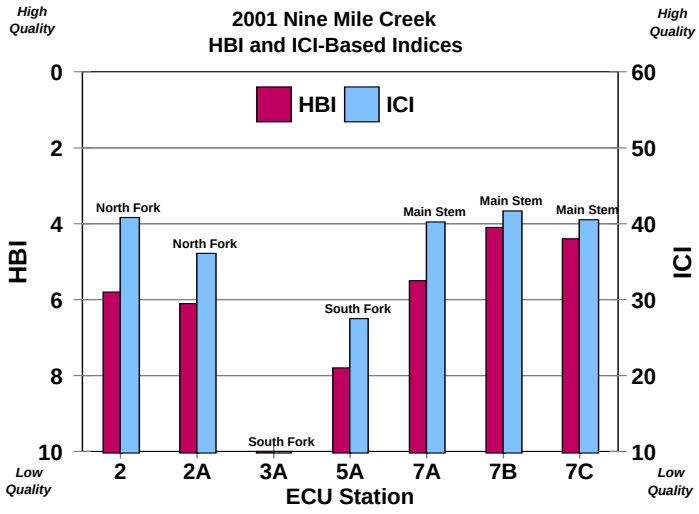
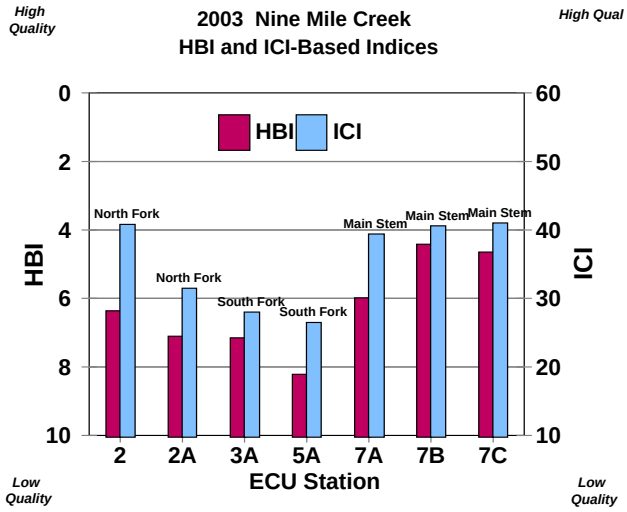
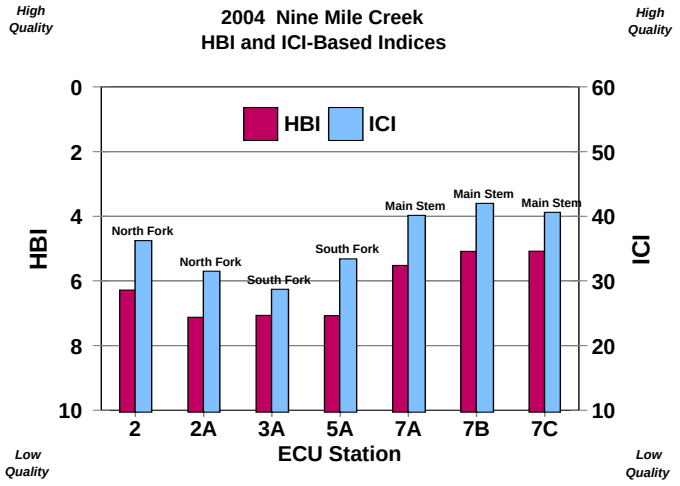


Figure 5-36 1997-2004 Nine Mile Creek HBI and ICI-Based Indices







****No monitoring conducted during 2002**

Figure 5-36 (continued)

5.2.4 Runoff-Related Water Quality Monitoring

In response to the MPCA's inclusion of Nine Mile Creek on its 2002 and 2004 Impaired Waters Lists [ref: 303(d.), Clean Water Act] because of fish community impairment, and elevated levels of turbidity and chloride, the District initiated a program of runoff-related water quality monitoring. Data evidencing these impairments were collected by the Metropolitan Council Environmental Services (MCES) between 1993 and 2003 at their Nine Mile Creek Watershed Outlet Monitoring Program (WOMP) station downstream of 106th Street in Bloomington, within the lower valley segment of creek. Although the primary source of the turbidity and fish community impairments were thought to be scarp erosion problems that have been remedied by the recently completed Lower Valley Stabilization and Restoration project the District agreed to cooperate with the MPCA by collecting additional water quality data in support of a TMDL study that would diagnose the causes of any continuing impairments. Elevated chloride concentrations are a seasonal phenomenon related to salt applications for roadway deicing.

In the autumn of 2003 the District constructed 'WOMP-type' continuous flow-gaging and storm runoff activated automatic sampling stations on the North and South Forks and Main Stem of Nine Mile Creek (see Figure 5-37). These stations now operate continuously during the ice-free months of the year to collect state-activated stream samples during runoff events. The runoff-related samples are supplemented by periodic base flow grab samples, year-round. Data collected from the four WOMP stations during 2004 are shown in the two figures (Figures 5-38 and 5-39) that follow. These data, and similar measurements from 2005, will be used to calibrate a runoff water quality computer simulation model in future phases of the TMDL study. Used in a predictive mode, this calibrated model will ultimately be used to investigate what watershed runoff BMPs are necessary to resolve remaining water quality impairments.

5.3 Condition of County Ditches

5.3.1 County Ditch 1

County Ditch 1 is the main stem of the Creek from Normandale Lake through Marsh Lake. Downstream of the Normandale Lake outlet structure, this is a well-defined channel that has required periodic maintenance. The maintenance has primarily been the removal of aquatic bog that has dislodged itself from the intensive wetland complex riparian to the creek channel.

5.3.2 County Ditch 41

County Ditch 41 was recently cleaned by the City of Hopkins (1995). Even though this section of the north fork of the creek is located in the City of Edina, the natural aggregation of sediment along the channel bottom resulted in a "pooling" of water under normal conditions within Hopkins upstream of T.H. 169. This clean-out of the channel has improved the conveyance of base stream flows.

5.3.3 County Ditch 34

County Ditch 34 provides the outlet conveyance from Birch Island Lake and handles the drainage from an area of primarily industrial and multi-residential land-use. This County Ditch is normally dry with flows typically only after intense rainstorm events. The District needs to work with the City of Eden Prairie to ensure that the required conveyance capacity of this ditch is maintained. Funding for this maintenance is available and eligible from the District's Maintenance and Repair fund.

5.4 Flooding and Stormwater Rate Control Issues

There are no significant flooding and stormwater rate control issues within the communities of the District. By assuming ultimate development conditions predicated upon comprehensive municipal planning, the calculated floodplain was established with sufficient capacity for storm events. Several major flood control projects were also completed over the past 45 years (see Figure 5-40) to detain flood flows within the floodplain and reduce its rate of passage. For the purposes of updating the Federal Emergency Management Agency (FEMA) Flood Insurance study of the Nine Mile Creek floodplain, the District recently prepared the revised map shown on Figure 2-5 (page 2-14) of this Plan, using the XP-SWMM hydrologic model.

5.5 Impacts of Water Quality and Quantity Management Practices on Recreation Opportunities

Management practices of the District improve recreation opportunities by maintaining and enhancing water quality and creating open-space areas appropriate for scenic and recreational uses. The Lower Minnesota Valley Restoration Project is one of the finest examples of the positive impacts of water management practices on recreation opportunities. For the first time members of the public can readily access the natural beauty of those reaches of the creek previously inaccessible.

5.6 Impacts of Stormwater Discharges on Water Quality and Fish and Wildlife Resources

Stormwater runoff, if not detained and treated to remove pollutants, may have several detrimental effects on aquatic organisms in streams and lakes. First, certain water pollutants may exert a toxic effect on aquatic biota. This toxic effect may be as a result of either chronic or acute exposures. Because of their flowing character, and the episodic nature of runoff-producing storm events, streams and their biota are most susceptible to acute toxicity problems associated with high concentrations of toxins, usually as a result of spills on the watershed. Lakes, on the other hand, become the repositories of all chemicals carried by streams. Lake-dwelling organisms are, therefore, more susceptible than their stream-dwelling counterparts to chronic toxicity problems associated with pollutants that are deposited in their sediments. (Chronic toxicity problems can also result in streams from pollutants that are deposited in the streambed sediments.) Acute toxicity problems are less common in lakes because of the buffering (i.e., dilution) capacity their vast volumes provide.

Second, sedimentation is a problem for both streams and lake. It is especially problematic in streams where eroded sediments from the watershed can bury the stream bottom and suffocate benthic organisms. Associated with this sediment is often a biochemical oxygen demand that reduces the dissolved oxygen content of stream and lake waters. In lakes, sedimentation problems usually manifest themselves in the form of sediment deltas at the mouths of inflowing streams. This deposition may destroy near-shore areas that are important fish spawning and rearing grounds.

Finally, the high concentrations of nutrients (primarily nitrogen and phosphorus) contained in urban stormwater runoff will have a fertilizing effect on the algae in streams and lakes. In streams, attached algae (called periphyton) may grow to extreme levels that can deplete the overlying water of its oxygen during night periods, thereby stressing fish and other stream biota. In lakes, however, the stimulating effects of added nutrients result in algal blooms, which, when they collapse, may deplete the dissolved oxygen contained in bottom waters of the lake. This oxygen depletion then renders the lower strata of the lakes unfit for habitation by coldwater fish species and other lake-dwelling organisms.

For all of the foregoing reasons, the District seeks to control urban stormwater runoff to the maximum extent practicable so adverse impacts are not experienced by lakes and streams within the District.

As evaluated by the Metropolitan Council Environmental Services (MCES), Nine Mile Creek has a higher lead concentration than other assessed streams, likely due to the historic deposition of automobile exhaust. It is unclear how long the effects of this deposition will persist. Nine Mile Creek does have lower total suspended solids than other streams, likely due in part to the completion of the Lower Minnesota Valley streambank stabilization and restoration project. Continued monitoring of the creek indicates that there is a significant and substantial water quality benefit from streambank stabilization.

5.7 Impact of Soil Erosion on Water Quality and Quantity

The major soil erosion problems occur during initial watershed development. This impact can be minimized through construction site inspection and installation and maintenance of erosion control measures. The District will continue to work with municipalities in developing more restrictive requirements for controlling soil and sediment erosion. Experience indicates that individual home construction is the greatest source of sediment leaving urbanizing areas.

5.8 General Impact of Land Use Practices on Water Quality and Water Quantity

The quality of stormwater runoff varies greatly in response to numerous factors, including (among others): geographic location, watershed land use, intensity of land use, degree of imperviousness, time since the last storm event, amount and duration of rainfall, type of runoff conveyance system present, and the degree to which good housekeeping activities (e.g., street sweeping) are practiced within the watershed. The wide range of runoff pollutant concentrations reported by various researchers is reported in Table 5-11, irrespective of predominant watershed land use.

The presence of pollutants in urban storm runoff is basically the result of "buildup-wash off" phenomena that occur between and during storm events, respectively. For a pollutant to be delivered to a surface water body via the storm runoff pathway, it must first be present (or available) on the watershed. Next, it must be detached (either physically or chemically) and become suspended or dissolved in the runoff flow. Finally, the pollutant must be transported with the runoff to a receiving water body. In urban areas that are highly impervious, a wide variety of substances build up on impervious surfaces between storm events, and are easily detached and readily transported to surface waters through an efficient network of storm sewer drainage pipes. Consequently, urban watersheds export relatively large amounts of pollutants to surface water bodies, as compared to undeveloped watersheds or to watersheds with less intensive land use activities predominating.

The effect of watershed land use activities on the chemical quality of stormwater runoff is demonstrated by the data presented in Table 5-12. Those data, collected as part of the U.S. EPA Nationwide Urban Runoff Program (NURP), are from widely disparate locations across the United States, and are only indicative of average runoff conditions. They suggest that generally higher levels of stormwater pollutants result from more highly impervious watersheds drained by storm sewers. Such data, derived from nationwide surveys, are less useful than locally collected data, however. Table 5-13 summarizes runoff water quality data from four (4) Twin Cities metropolitan area watersheds. The watersheds with more intensive land use activities (e.g., commercial and residential areas with storm sewers) generally yielded more stormwater pollutants than did the relatively open watershed. The averages and ranges of runoff pollutant concentration data reported for these four Twin Cities area watersheds are confirmed by other, more recent data collected for the Minneapolis Chain of Lakes watersheds (see Table 5-14).

The District expects that the storm runoff from the urbanized portions of the watershed will be of similar quality to that observed for the Minneapolis Chain of Lakes watersheds. By the time this runoff reaches the ultimate receiving waters, however, its pollutant concentrations will likely be much lower than the data for raw, untreated runoff, since most of it will have passed through stormwater detention basins or other BMPs implemented by the District cities to remove pollutants.

Table 5-11 Range of Pollutant Concentrations in Urban Stormwater [Wanielista 1978]†

Variable	Low	High
BOD_5	1	700 mg/L
TOC	1	150 mg/L
COD	5	3,100 mg/L
SS	2	11,300 mg/L
Total Solids	200	14,600 mg/L
Volatile Total Solids	12	1,600 mg/L
Settleable Solids	0.5	5,400 mg/L
Organic N	0.01	16 mg/L
TKN	0.01	4.5 mg/L
NH_3N	0.1	2.5 mg/L
NO_3N	0.01	1.5 mg/L
Soluble PO_4	2.1	10 mg/L
Total PO_4	0.1	125 mg/L
Chlorides	2	25,000 mg/L **
Oils	0	110 mg/L
Phenols	0	0.2 mg/L
Lead	0	1.9 mg/L *
Total Coliforms	200	150 x 10^6/100 ml
Fecal Coliforms	55	110 x 10^6/100 ml
Fecal Streptococci	200	1.2 10^6/100 ml

† Table quoted from Porcella and Sorenson (1980) Characteristics of Non-Point-Source Runoff and its Effects on Stream Ecosystems. EPA-600/3-80-032.

*(e.g.) indicates a concentration that exceeds either a MDH HRL or a U.S.-EPA MCL for drinking water.

** With highway deicing.

Table 5-12 Average Pollutant Concentrations (mg/L) in Urban Stormwater Runoff Samples from Nationwide Urban Runoff Program (NURP) Sites†

Pollutant*	Land Use			
	Residential	Mixed	Commercial	Open/ Non-Urban
COD	83	75	61	51
TSS	140	101	90	216
Pb	0.18**	0.19**	0.13**	0.054**
Zn	0.18	0.19	0.33	0.23
TKN	2.35	1.44	1.40	1.36
N/N	0.96	0.67	0.63	0.73
Total P	04.6	0.33	0.24	0.23
Soluble P	0.16	0.07	0.098	0.06

† Table quoted from MPCA (1989) Protecting Water Quality in Urban Areas -- Best Management Practices for Minnesota. MPCA-Division of Water Quality, St. Paul.

* Key:

COD = Chemical Oxygen Demand

TSS = Total Suspended Solids

TKN = Total Kjeldahl Nitrogen

N/N = Nitrate Nitrogen

**(e.g.) indicates a concentration that exceeds either a MDH HRL or a U.S.-EPA MCL for drinking water.

Table 5-13 Watershed Characteristics and Flow-Weighted Mean Pollutant Concentrations (mg/L) for Storm Runoff from Four Twin Cities-Area Watersheds†

Watershed Characteristics and Stormwater Pollutants*		Monitoring Site			
		Brooklyn Park Yates Avenue	**Cottage Grove Iverson Avenue**	**Golden Valley Sandburg Road**	**Maple Grove Elm Creek**
Major Land Use		Medium to high density residential	Residential area under construction	Light industrial	Relatively open, less than 25% farmed
Drainage Area (Square Miles)		0.35	0.15	0.12	14.3
Drainage System		Curb and gutter	Curb and gutter with some in-stream wetlands	Curb and gutter	Low gradient stream
Typical Soils		Flat sandy soils	Gently sloping loamy soils	Moderately sloped loamy soils	Loamy, well drained soils
Pollutant (mg/L)					
COD	(mean)	90	38	138	65
	(range)	24-879	1-597	10-850	45-157
TSS	(mean)	133	740	337	10
	(range)	2-758	17-26,610	7-4,388	2-374
Pb	(mean)	0.23**	0.02**	0.19**	0.005
	(range)	0.015-1.8**	0.008-0.31**	0.003-1.5**	0.001-0.012
Zn	(mean)	0.198	0.235	0.185	0.012
	(range)	.02-2.2	0.028-0.53	0.02-0.81	0.005-0.019
TKN	(mean)	3.6	1.2	2.5	2.1
	(range)	0.6-28.6	1.0-29.2	0.4-16.0	1.2-5.4
N/N	(mean)	0.79	0.07	0.42	0.27
	(range)	0.05-4.5	0.05-2.45	0.05-2.4	0.05-1.35
Total P	(mean)	0.63	0.62	0.63	0.35
	(range)	0.10-3.85	0.2-13.1	0.07-4.3	0.11-2.23

† Table adopted from MPCA (1989) Protecting Water Quality in Urban Areas—Best Management Practices for Minnesota. MPCA-Division of Water Quality, St. Paul.

* Key: COD = Chemical Oxygen Demand; TSS = Total Suspended Solids; Pb = Lead; TKN = Total Kjeldahl Nitrogen; N/N = Nitrate Nitrogen; Total P = Total Phosphorus

**(e.g.) Any highlighted number indicates a concentration that exceeds either a MDH HRL or a U.S. EPA MCL for drinking water.

Table 5-14 Minneapolis Chain of Lakes Storm-Runoff Water Quality Data Statistical Summary†

Parameter	Units	Sample Size	Average	Standard Deviation	Minimum	Maximum
Total Ortho Phosphate	(mg/ P/L)	127	0.25	0.26	0.00	1.40
Total Phosphorus	(mg/ P/L)	127	0.43	0.39	0.03	2.45
Total Nitrogen	(mg/ N/L)	127	2.64	1.82	0.05	7.90
Nitrate + Nitrite	(mg/ N/L)	119	0.44	0.34	0.01	1.95
Ammonia	(mg/ N/L)	127	0.67	0.60	0.02	2.00
Cadmium	(µg Cd/L)	127	1.01	1.10	0.01	5.92*
Magnesium	(mg Mg/L)	126	2.43	2.40	0.28	17.10
Silica	(mg Si/L)	121	3.01	1.99	0.48	13.00
Lead	(µg Pb/L)	127	4.78	5.39	0.18	29.12*
Potassium	(mg K/L)	126	8.80	9.06	0.30	46.85
Total Organic Copper	(mg C/L)	121	15.17	17.39	0.67	150.00
Copper	(µg Cu/L)	127	16.90	15.93	0.75	51.00
Calcium	(mg Ca/L)	126	17.36	12.88	3.10	63.00
Turbidity	(NTU)	112	22.79	13.92	1.60	91.00
Total Chromium	(µg Cr/L)	126	31,93	119.26	3.33	1114.00*
Zinc	(µg Zn/L)	127	67.23	53.40	9.00	392.00
Boron	(µg B/L)	126	68.46	85.77	5.33	642.00*
Nickel	(µg Ni/L)	126	88.58	587.02	3.33	6459.00*
Manganese	(µg Mn/L)	126	92.12	128.73	0.67	985.00*
Aluminum	(µg Al/L)	126	124.50	138.34	13.33	1121.00
Total Suspended Solids	(mg/L)	95	135.48	159.41	3.00	1055.00
Iron	(µg Fe/L)	126	219.83	685.95	4.00	6909.00
Sodium	(mg Na/L)	122	460.90	665.65	1.20	2500.00
Chloride	(mg Cl/L)	122	460.90	665.65	1.20	2500.00
Conductivity	(µmhos/cm@25°C)	126	1393.85	2144.74	12.00	9600.00

† Table quoted from Barr Engineering Company (1992) Minneapolis Chain of Lakes Clean Water Partnership Project – Stormwater Monitoring Study: Hydrologic/Nutrient Budgets for 1991. Report to the Minneapolis Park and Recreation Board.

* (e.g.) Any highlighted number indicates a concentration that exceeds either a MDH HRL or a U.S. EPA MCL for drinking water.

This Plan specifies the use of BMPs, including stormwater detention ponds constructed in accordance with MPCA design criteria, to remove stormwater pollutants. A public information program is a component of this Plan (See Section 4.6, Public Participation, Information and Education Goal, and Section 6.4, Information Program), included to heighten public awareness of the fact that all materials and substances placed or spilled on the land surface may ultimately be carried by storm runoff into surface water bodies or the groundwater. The District will continue to support public information seminars and participation at other local meetings and seminars. Coupled with good housekeeping BMPs like frequent street sweeping to remove debris from streets and gutters, these urban stormwater BMPs will likely produce reasonably good storm-runoff water quality.

The District cities employ an extensive list of BMPs to control erosion in developing areas. In addition, the District conducts detailed plan review of all proposed developments, and inspects all permitted construction activities and erosion control devices. Extensive requirements exist for silt control and revegetation of the site. All temporary on site sediment basins are required to be constructed prior to site grading and to remain in place until the development is essentially complete and revegetated.

There are many types of wetlands, just as there are a wide variety of types of lakes and rivers. Names associated with moving water include rivers, streams, creeks, brooks, and rills and those associated with standing water, include lakes, ponds, reservoirs, and pools. In the same way, there are numerous names associated with wetlands, including marshes, fens, swamps, bogs, sloughs, and mires. Each of the different water resources has its own set of values, functions, and uses but all have a place in the fabric of the environment. These resources are treated with equal protection under the state water quality standards.

Shallow seasonal wetlands are not more or less valuable in the landscape than deep open water wetlands, but their designated uses are as different as streams are different than rivers or lakes. It is recognized that damming a stream to form a ponded reservoir causes significant changes in the habitat, the hydrology and water quality downstream, and the plants and animals utilizing the resource.

In the same way, wetlands deserve careful consideration before they are converted to other types of wetlands or removed from the landscape altogether. Water resources are not isolated from each other or from the ecosystem. Wetland uses such as nutrient uptake, storm water storage, erosion control, low flow augmentation, wildlife habitat, and ground water recharge, are extremely valuable even in remote wetlands only distantly connected to the other resources in the watershed. And wetland removal will have reverberations throughout the fabric of the landscape. The poor water quality of the Minnesota River can be directly tied to the loss of small, seemingly insignificant, upland and riparian wetlands that cumulatively served the functions noted above.

Significant adverse impacts to wetlands result in degraded water quality, both in the wetland and downstream. These water quality impacts must be mitigated to prevent the loss of designated uses.

The U.S. Fish and Wildlife publication Circular 39 separates freshwater wetlands into eight types. These types range widely in characteristics. Some have saturated soils for only a few weeks a year while other are flooded all year. Some wetlands are treeless, containing only grasses and/or shrubs, while others are completely forested. Thus each wetland type provides its own individual set of characteristics, values, and uses, yet all wetlands, to some extent, provide the attributes described below.

Wetlands enhance water quality. Filtering of pollutants by wetlands is an important function and benefit of wetlands. These pollutants are often buried by new plant material, isolating them in the sediments. The trapping of nutrients by wetlands also helps reduce excess plant growth in lakes and rivers. The main nutrients of concern are phosphorus and nitrogen. Common sources of nutrients in runoff are urban storm water, cultivated fields, and feedlots. If a lake becomes polluted because of excess nutrients or sediments, lake restoration must be undertaken. Most lake restoration methods are very costly, and this cost is usually borne by the public. Thus the value of upland wetlands that capture nutrients can be significant.

Sediments are trapped in wetlands in several ways. When the narrow channel of a stream widens into a wetland, water velocity slows. This allows the sediments time to drop out and settle in the wetland. This also occurs along the riparian border of a stream, which capture erosional sediments before they can get to the stream. When wetlands decrease stream velocity, downstream bank scouring is also diminished. This further decreases the sediment in the stream and enhances the water quality. These downstream water quality enhancements are an important public benefit provided by wetlands.

5.9 Adequacy of Existing Regulatory Controls to Manage or Mitigate Adverse Impacts on Public Waters and Wetlands

The regulatory controls of the District and its communities are adequate. However, with recent promulgation of the wetland water quality rules and anticipated adoption of target pollution loads for the Minnesota River, as well as nonpoint source recommendations of the United States Environmental Protection Agency (U.S. EPA), those controls will likely need revision to incorporate expected changes.

A NMCWD permit program is in place. Within this program, land alteration, flood plain, work in water areas, appropriation and discharge of waters are regulated. The Alteration-of-Lands regulation affects any lands which may reasonably be expected to introduce sediment into public waters within the District. Through this regulation the District requires implementation of recommended BMPs. Alterations of less than 100 cubic yards of material are generally not expected to introduce sediment into public waters. Mass balance modeling and trend analysis of data collected through monitoring by the District indicated no significant degradation of water quality due to soil erosion through construction activities.

All portions of the District are covered by a local government unit responsible for implementing the 1991 Wetlands Conservation Act (WCA). That Act is adequate to maintain the tangible and intrinsic values of wetlands as natural storage and retention systems.

All natural storage and retention systems within the District are regulated. Protected waters are regulated through a permit program administered by the MDNR. The District comments upon Work in Protected Waters permits. Work in waters not protected by the state permit program is regulated by the District. Water areas include all lakes, ponds, streams, marshes, and other wetlands within the District.

The work in waters permit authorizes regulation of wetlands exempt from the WCA. More important, the work in waters permit effectively regulates work in all natural storage and retention systems. Regulation through the WCA and the District's Work In Waters permit is adequate to protect natural storage and detention systems.

Despite the adequacy of its regulatory programs, the District believes that its regulations should be revised expressly to adopt and fine-tune recently promulgated wetland water quality rules and other water quality requirements, such as the Nondegradation Requirement contained in municipal Phase 2 NPDES Stormwater Permits. These changes would provide an opportunity for the District to further refine its integrated resource management strategy by including wildlife, biological and forestry elements to the regulations. As part of the District's Rules revision in 2007, the District may be more restrictive on required setbacks from sensitive waterbodies.

5.10 Adequacy of Capital Improvement Programs

Underlying the enactment of environmental laws and the implementation of environmental programs is the implicit statement that the considerable costs of pollution control are outweighed by its benefits. The costs of nonpoint source pollution control have become a larger part of the overall picture in Minnesota in recent years, as nonpoint source problems have become more apparent and as control efforts have increased accordingly. The costs, however, are both more diffuse and more difficult to calculate than those for point source programs. Having concluded that the comprehensive costs of water pollution control efforts are not yet fully calculated, the benefits are even less precisely measured. Theoretical models for translating water quality improvement into economically measured benefits exist, but no attempts have been made to do this for the State as a whole, much less at the level of a watershed district. These costs and benefits are difficult to quantify, and evaluation must be made on a case-by-case basis using best professional judgment.

The nonpoint source pollution control program of the State is considerably younger than the corresponding point source program, and to some extent is still in the developmental stages. One of the challenges is to translate control activities into measurable benefits. If not in terms of dollars, results should be seen in terms of pollutant load reductions (e.g., lake water quality data indicate that there are quantifiable benefits to watershed runoff management BMPs). As these relationships

become better known, the District will amend its Plan to incorporate more detailed assessment of financial impacts, costs, and benefits.

Regardless of these cost:benefit analysis difficulties, the capital improvement authority of the District is adequate to correct problems relating to water quantity management. Designation of flood plain and its regulation assuming ultimate development conditions was appropriate and successful. Similarly, capital improvement authority of the District is adequate to correct water resource problems relating to fish and wildlife habitat. However, some fish and wildlife habitat problems may not be water-related such that the District cannot correct them. In such instances, the District role is to support the fish and wildlife management activities of the MDNR. With respect to public waters and wetland management, capital improvement authority of the District is adequate to correct problems relating to recreational-use criteria designated by the MPCA for activities such as swimming, fishing, wildlife habitat, and aesthetic viewing.

5.11 Future Potential Problems

A serious future problem is the continuing cost of implementing surface water and groundwater protection strategies during the land use redevelopment cycle. Many existing land uses will prove inconsistent with protection of sensitive groundwater recharge areas and wellhead protection zones. The Districts' proactive approach to managing this problem is outlined in Section 4.5.5 (Groundwater Protection—Objectives & Actions) of this Plan. Another potential problem is the growing transportation system within the watershed that will undoubtedly lead to alterations of the hydrologic system and require reassessment of the potential groundwater impacts.

Nine Mile Creek Watershed District
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6.0 Implementation Program

6.1 Implementation Program Responsibilities

The District is responsible for implementation of its programs. With respect to compliance with the Wetlands Conservation Act (WCA), the designated local government unit pursuant to the WCA shall be responsible for compliance and enforcement. Local units of government must develop and place in effect official controls required in this plan. Other than the wetland administration delegated to local government units, these controls must contain the minimum standards required by the plan. The District is responsible for information and data collection programs. Management programs are delegated to local government units while potential structural solutions are the responsibilities of the District. Counties are responsible for reviewing and approving the District's capital improvement program.

All referenced publications are available through the District engineer, District legal advisor, or District administrator.

6.2 Regulatory Controls

6.2.1 Wetlands Conservation Act

The District Work in Waters permit regulates wetlands independent of authority of the Wetlands Conservation Act (WCA). The District will continue this permit regulation under its watershed law, independent of regulation under WCA. Through the work in waters permit the District enforces the requirements of the WCA as minimum conditions for the permit. The District reserves the right to enforce those minimum conditions and to be more restrictive should a designated local government unit fail to enforce the Act. The purpose of this dual regulation is to assure achievement of District goals and policies and to protect and enhance water resources. With respect to enforcing the WCA, the District provides technical assistance to municipalities designated as the local government unit. The District enforces the Act for municipalities which do not obtain that designation. The cities of Bloomington and Minnetonka are administering the requirements of the 1991 WCA, while the District performs that function for the cities of Eden Prairie, Edina, Hopkins, and Richfield.

The District does not maintain oversight other than by providing technical assistance. Technical Evaluation Panels in all scenarios are composed of a technical professional employee of the board, a technical professional employee of the local Soil and Water Conservation District or districts, and a technical professional with expertise in water resources management appointed by the local government unit as provided by Minnesota Statutes Section 103G.2242 Subd. 2.

The District will continue to work with the municipalities in the protection and preservation of wetlands through the Local Wetland Management Plan that prioritizes and assess the functions and values of wetlands.

Pursuant to Minnesota Statutes Section 103G.2372, the Commissioner of Minnesota Department of Natural Resources (MDNR), Conservation Officers, and Peace Officers shall enforce laws preserving and protecting wetlands.

The Commissioner of MDNR, a Conservation Officer, or a Peace Officer may issue a cease and desist order to stop any illegal activity adversely affecting a wetland. In the order, or by separate order, the Commissioner, Conservation Officer, or Peace Officer may require restoration or replacement of the wetland, as determined by the local Soil and Water Conservation District.

The Commissioner of MDNR or assigned Conservation Officer will be notified when a public waters wetlands is at issue and voluntary compliance or compliance through a civil action are deemed inappropriate or ineffective by the District. Personnel of the District will cooperate with the Commissioner in monitoring and enforcing water permits and take all action to the extent of their authority, respectively, that may be necessary or proper for the enforcement of the provisions, rules, standards, orders, or permits specified in law.

For all other non-public waters wetlands that are illegally and adversely impacted, and where compliance with wetland law, either voluntarily or through a civil action, are deemed ineffective or inappropriate by the District, the County Sheriff and/or Municipal Police will be notified to enforce the law.

Pursuant to Minnesota Rules Section 8420.0290 Subp. 3, the enforcement authority shall issue a restoration order or replacement order when the drain or fill has already been completed when discovered, or after a cease and desist order has been issued and the landowner does not seek an exemption or no loss determination within 3 weeks, or the local government unit denies the application.

Promptly upon being informed by the enforcement authority of the need, the Soil and Water Conservation District staff person shall inspect the site and prepare a plan in consultation with the local government unit for restoring the site to its pre-altered condition, unless the Soil and Water Conservation District person concludes that restoration is impossible. The Soil and Water Conservation District shall incorporate its plan into a restoration and replacement order and send it to the enforcement authority for service in person or by certified mail to the landowner.

If the Soil and Water Conservation District determines that restoration will not restore all the loss caused by the drain or fill activity, the enforcement authority may order a combination of restoration and replacement, or may order replacement rather than restoration, as determined by the Soil and Water Conservation District.

The District reserves the right to cause enforcement of the WCA by all other lawful civil means.

The District accepts utilization of the state wetland bank. In the event that banking within the District is not feasible or practical then the District will allow utilization of banking credits outside the District.

The District may chose to adopt more restrictive wetland controls than provided by the WCA or controls required by other law such as Minnesota Rules Chapter 7050.

6.2.2 Erosion and Sedimentation Controls and Programs

The District believes that in order to reduce soil erosion and sedimentation, best management practices (BMPs) and best available technologies must be required and implemented. The District adopts and requires as minimum practices the BMPs and best available technologies promulgated by the Minnesota Pollution Control Agency (MPCA) including Minnesota Pollution Control Agency, 2005, Minnesota Stormwater Steering Committee: "*The Minnesota Stormwater Manual.*" When circumstances show that the recommended practice or technology is neither practical nor feasible, comparable erosion and sedimentation mitigation methods may be applied.

In addition, the District has established a grading and land alteration permitting program to reduce erosion and sedimentation of receiving waters. A grading and land alteration permit is required for the following:

a. Any project that proposes to alter or disturb more than 100 cubic yards of material.
b. Filling or encroachment within the 100-year frequency floodplain of the creek system or detention basins.
c. Filling with a nonexempt wetland area as defined by the WCA.
d. Any project that could reasonably be expected to introduce sediment into public waters within the District.

The issuance of a land alteration permit is contingent upon submittal of plans that are compliant with adopted standards. NMCWD Rules revision will be undertaken beginning in 2007.

Owners and operators of construction activity disturbing **one acre or more** of land need to obtain an NPDES/SDS permit from the MPCA. Site disturbances less than one acre within a larger common plan of development or sale that is more than one acre also need permit coverage.

Regulated parties must develop a Stormwater Pollution Prevention plan that should be submitted to MCPA and the District.

6.2.3 Local Erosion and Sedimentation Controls

The District requires, as part of the contents of local water management plans, that municipalities adopt controls for erosion and sedimentation controls similar in kind or character to those of the District, for the purpose of protecting soil from erosion during and after construction for projects or portions of projects that do not require a permit under the Grading and Land Alteration Permit

Program of the District. These requirements must be adopted so as to constitute enforceable provisions of any municipal permits.

6.2.4 Local Shoreland and Floodplain Ordinances

All municipalities which have been notified by MDNR have submitted shoreland and floodplain ordinances and are now enforcing them. There are no known significant flood prone areas in the District.

6.2.5 Water Quality Nuisances

The District has identified various water quality nuisances including noxious odors, goose feces on lakeside walkways, and fecal coliform bacteria in pubic beach areas, among others. While the District cannot solve all of these local water quality problems, it encourages municipalities to adopt effective controls that will reduce them (e.g., phosphorus fertilizer bans, prohibition of goose feeding, etc.).

6.3 Stormwater and Drainage Design Performance Standards

For purposes of stormwater and drainage design performance standards, the District incorporates by reference water and wetland quality standards promulgated by the MPCA and modified as needed to achieve management plans adopted by the MDNR or the Metropolitan Council (MC) as to target in lake nutrient concentrations and pollutant loadings for sediments and nutrients. The District acknowledges that these targets are subject to revision as degrading trends or other requirements indicate. The District anticipates amendment of these targets once the MC completes its loading budget for achievement of the interim strategy for the Minnesota River and nonpoint source guidelines are established by the United States Environmental Protection Agency (U.S. EPA).

Stormwater management is required by the District for any project that removes surface vegetation from any lands which may reasonably be expected to introduce sediment into public waters within the District. At present this standard is applied to any activity involving more than 100 cubic yards of material. This performance regulation applies for any development whether new or a redevelopment. A threshold acreage or other criteria is not applied. The permit threshold will be revised as part of the District's Rule revision in 2007.

In managing stormwater, the District requires no increased rate of runoff from a pre-development condition accomplished through either regional basins or on site detention for the critical 100-year frequency storm event. At a minimum, water quality treatment will be provided through either regional or on site facilities that meet design recommendations of the Minnesota Pollution Control Agency, 2005, Minnesota Stormwater Steering Committee: "*The Minnesota Stormwater Manual.*" Additional discharge requirements more restrictive than these minimum treatment requirements may be imposed by the District in order to achieve water quality standards as specified in Minnesota Rules Chapter 7050 and determined through analysis of attainable uses for a water resource.

6.3.1 Target In Lake Nutrient Concentrations

The MPCA has developed water quality standards relating to the suitability of lakes for swimming, by ecoregion. The District has adopted these standards for its swimming lakes.

The MDNR also recently investigated its lake ecological and management classifications and determined that changes would aid fishery managers in caring for aquatic communities. The District has adopted this method to facilitate lake management.

The methods of the District, the MPCA, and the MDNR are compatible. By cooperatively managing through these differing methods, the Managers believe that the water and related resources can be enhanced.

The Lake Management table (see Table 5-1, Section 5.0, page 5-28) summarizes the established management objectives for lakes within the Watershed, and NMCWD lake water quality goals are summarized below:

Lake	NMCWD Category	Total Phosphorus ([TP], µg/L)	Chlorophyll *a* ([Chl*a*], µg/L)	Secchi Disc Transparency ([S.D.] m)	Trophic State Index TSI_{SD}
NW Anderson	**III** Wildlife Habitat & Aesthetic Viewing	105 ≥ [TP] >75	60 ≥ [Chl *a*] >40	0.6 ≤ [S.D.] <1.0	70 ≥ TSI_{SD} >60
SE Anderson	**II** Partial Body Contact Recreational	75 ≥ [TP] >45	40 ≥ [Chl *a*] >20	1.0 ≤ [S.D.] <2.0	60 ≥ TSI_{SD} >50
SW Anderson	**II** Wildlife Habitat & Aesthetic Viewing	75 ≥ [TP] >45	40 ≥ [Chl *a*] >20	1.0 ≤ [S.D.] <2.0	60 ≥ TSI_{SD} >50
Arrowhead	Unspecified	--	--	--	--
Birch Island	**II** Partial Body Contact Recreational	75 ≥ [TP] >45	40 ≥ [Chl *a*] >20	1.0 ≤ [S.D.] <2.0	60 ≥ TSI_{SD} >50
Bryant	**I** Whole Body-Contact Recreational	[TP] ≤ 45	[Chl *a*] ≤ 20	[S.D.] ≥2.0	TSI_{SD} ≤ 50
Bush	**I** Whole Body-Contact Recreational	[TP] ≤ 45	[Chl *a*] ≤ 20	[S.D.] ≥2.0	TSI_{SD} ≤ 50
Cornelia—North Basin	Unspecified	--	--	--	--

Lake	NMCWD Category	Total Phosphorus ([TP], µg/L)	Chlorophyll *a* ([Chl*a*], µg/L)	Secchi Disc Transparency ([S.D.] m)	Trophic State Index TSI_{SD}
Cornelia—South Basin	Unspecified	--	--	--	--
Glen	**I** Whole Body-Contact Recreational	[TP] ≤ 45	[Chl *a*] ≤ 20	[S.D.] ≥2.0	$TSI_{SD} \leq 50$
Indianhead	Unspecified	--	--	--	--
Lone	**I** Whole Body-Contact Recreational	[TP] ≤ 31	[Chl *a*] ≤ 7.7	[S.D.] ≥1.8	$TSI_{SD} \leq 52$
Minnetoga	**I** Whole Body-Contact Recreational	[TP] ≤ 45	[Chl *a*] ≤ 20	[S.D.] ≥2.0	$TSI_{SD} \leq 50$
Mirror	**IV** Runoff Management	[TP] > 105	[Chl *a*] > 60	[S.D.] < 0.5	$TSI_{SD} > 70$
Normandale	**II** Partial Body Contact Recreational	75 ≥ [TP] >45	40 ≥ [Chl *a*] >20	1.0 ≤ [S.D.] < 2.0	$60 \geq TSI_{SD} > 50$
Lower Penn	**IV** Runoff Management	[TP] ≥105	[Chl *a*] >60	[S.D.] ≤ 0.5	$TSI_{SD} > 70$
Shady Oak	**I** Whole Body-Contact Recreational	[TP] ≤ 45	[Chl *a*] ≤ 20	[S.D.] ≥ 2.0	$TSI_{SD} \leq 50$
Smetana	**III** Fishing & aesthetic viewing	105≥ [TP] >75	60 ≥ [Chl *a*] > 50	0.6 ≤ [S.D.] <1.0	$70 \geq TSI_{SD} > 60$

6.3.2 Maximum Permissible Runoff Rate and Volume

The District requires that rates of runoff from developing or redeveloping sites be limited to existing rates, or less, through the use of either regional basins or on site detention for the critical 100-year frequency storm event.

6.3.3 Flooding Impact Standards

Natural resource impact standards are those established by law, including Minnesota Rules Chapter 7050 and set forth in state guidance: State of Minnesota Storm Water Advisory Group, May, 1995. "Guidance for Evaluating Urban Storm Water and Snowmelt Runoff Impacts to Wetlands." This regulation tends to reduce the flooding impacts to natural resources.

The District established a floodway encompassing the channels of watercourses, the beds of water basins, and those portions of the adjoining floodplains that are reasonably required to carry and discharge floodwater and provide water storage during a regional flood assuming ultimate development conditions. A "regional flood" means a flood that is representative of large floods known to have occurred generally in the state and reasonably characteristic of what can be expected to occur on an average frequency in the magnitude of a 100-year recurrence interval. Pursuant to the District flood plain permit the District requires flood mitigation. "Mitigation" means the act of alleviating the effects of floods and flooding by moderating or reducing the severe damages resulting from floods through structural and nonstructural flood management measures. Structural and nonstructural flood management measures are permit specific. Nonstructural flood management measures include, but are not limited to title certifications, a requirement that low floor elevations be a minimum elevations of 2 feet above the regional flood elevation, and restricted floodway encroachment that prevents unreasonable public hazard and ensures the capacity of the floodplain to carry and discharge a regional flood.

6.3.4 Design Criteria for Stormwater Outlet Structures

Although the District does not establish design criteria for stormwater conveyance systems, the District does require design criteria as established in the following guideline: Minnesota Pollution Control Agency, 2005, Minnesota Stormwater Steering Committee: "*The Minnesota Stormwater Manual*." In addition, systems must be in accord with municipal requirements for stormwater outlet structures.

These standards and criteria apply to any grading, filling or other land alteration which removes surface vegetation from any lands which may reasonably be expected to introduce sediment into public waters within the District. At present this standard is applied to any activity involving more than one hundred cubic yards of material. This performance regulation applies to any development whether new or a redevelopment. A threshold by acreage or other criteria is not applied.

The District does though require the location of manholes and sedimentation basins so that they may feasibly and practically be maintained and repaired. As an additional water quality requirement, in accord with current municipal practices, the District requires a minimum manhole dimension of 60 inches.

6.3.5 Water Quality Basin Design Methodology

Minimum water quality treatment will be provided through either regional or on site facilities that meet the minimum design requirements of the Minnesota Pollution Control Agency, 2005, Minnesota Stormwater Steering Committee: "*The Minnesota Stormwater Manual*." Additional discharge requirements may be imposed by the District in order to achieve water quality standards as specified in Minnesota Rules Chapter 7050 or as specified in an attainable use analysis conducted for a water resource.

These standards and criteria apply to any grading, filling or other land alteration which removes surface vegetation from any lands which may reasonably be expected to introduce sediment into public waters within the District. At present this standard is applied to any activity involving more than one hundred cubic yards of material. This performance regulation applies to any development whether new or a redevelopment. A threshold by acreage or other criteria is not applied.

6.3.6 Pollutant Loading Requirements

The District adopts by reference the requirements, if any, of the MPCA with respect to pollutant loadings including those established by Total Maximum Daily Load (TMDL) studies.

6.3.7 Variances

The District may, upon application, modify or permit variance from the minimum standards and criteria and from adopted rules if it is determined that such modification or variance is consistent with the general welfare. In allowing any modification or variance, the District may, if it deems such action advisable and reasonable in the circumstances, condition modification or variance so as to conserve natural resources of the state using sound scientific principles for the protection of the public health and welfare and the provident use of the natural resources. The applicant for a variance which, in the opinion of the District, may result in a material adverse effect on the environment may be requested by the District to demonstrate the nature and extent of the effect. The applicant may show that there is no feasible and prudent alternative and the conduct at issue is consistent with and reasonably required for promotion of the public health, safety, and welfare in light of the state's paramount concern for the protection of its air, water, land and other natural resources from pollution, impairment, or destruction. Economic considerations alone shall not constitute justification for a modification or variance.

Requests for variance will be acted upon promptly by the District. Specific time lines are not established for variances because of the complexity of the requests and consideration necessary to justify a modification or variance though three months is considered a reasonable period.

6.4 Information Program

The District Information Program consists of publication of pertinent portions of its annual report and distribution of articles and news releases, prepared by its Administrator, to widely distributed local newspapers and interested members of the community. The annual report identifies the Managers, current advisory committee members, how to contact the organization, its role in local water management, the goals and policies of the organization, when public meetings are held, how the Organization is financed, where the Plan can be viewed, and other information relative to the implementation of the Plan. The District prepared a videotape presentation that was shown on public cable television and is available through schools and libraries within the District. Besides these written and audiovisual communications, the Board of Managers also holds an annual tour of the District for the purpose of discussing and inspecting projects and other aspects of the work of the

District. This annual tour is attended by members of the public and representatives of other public authorities and state and metropolitan agencies.

The District also has established and supports two advisory committees in which members of the public may participate: one is a Technical Advisory Committee (TAC) composed primarily of municipal engineers who advise the District engineer and offer review comments and advice; the other is a Citizens' Advisory Committee, which is charged with organizing public seminars on significant topics such as water quality and wetland issues, as well as other matters that the committee deems of sufficient importance.

6.5 Data Collection Programs

The District conducts a lake and stream monitoring program for water quality purposes. The District has expanded these programs to address water quality impairments that must be remediated through the MPCA's TMDL process. These changes are expected to refine and strengthen data collection practices of the District. It is also expected that these changes will facilitate use of the data by units of government involved in collecting water quality and quantity management data. This data collection program is adequate to prescribe what BMPs must be adopted in order to achieve water quality goals for both lakes and streams. Additionally, the District intends to initiate a citizen stream monitoring program in the future. The District encourages the local units of government collecting data to submit the data to the District and other regulatory agencies to be included in the overall data collection program.

6.5.1 Location of Sampling Sites

The stream and lake level sampling locations are shown on Figure 2-7 (page 2-21) Section 2.0.

6.5.2 Lake Water Quality Monitoring Protocol

Following completion of the Use Attainability Analyses (UAAs) for its 15 major lakes and their respective watersheds, the District intends to resume its normal, rotating lake monitoring program. That program involves monitoring of one-third of the District lakes during each of three consecutive years, followed by data analysis and reporting of results, including updated temporal trend analyses during the fourth year.

Monitoring activities include water quality sampling at a single site, generally at the deepest point in the lake that best represents its limnological properties. Samples are collected once in early-spring, within 2 weeks of ice-out. before thermal stratification develops, and six times during the summer and early-fall months, (mid-May to mid-September). On each sampling date samples are collected from the upper mixing zone of the lake and along a 1-meter interval depth profile, from surface to within ½- meter off the bottom.

Samples collected from the upper mixing zone are analyzed for total- and soluble reactive-phosphorus, and chlorophyll *a* concentrations, plus algal cell density counts. Samples taken at depth are analyzed for total phosphorus. Additionally pH, conductivity, and dissolved oxygen

concentrations are measured along the 1-meter depth interval profile, and the Secchi disc transparency of the water is measured. Comparable monitoring at additional sampling sites may also be undertaken where lake basin morphology has created distinctly different hydrologic or limnologic sub-basins, or where major lake tributaries influence lake water quality.

6.5.3 Stream Water Quality Monitoring Protocol

The District conducts stream water quality monitoring activities at three permanent flow-gaging and automated sampling stations, year-round (see Figure 2-7, page 2-21). These three District stations and the MC's Watershed Outlet Monitoring Program (WOMP) station are distributed along the creek as follows:

Main Stem	West 98th Street 106th Street (Metropolitan Council)
North Branch	West 72nd Street
South Branch	West 78th Street

Comprehensive data collection occurs at these sties including information on the following parameters:

Hydrology

- Streamflow; Flow (cfs)

Meteorology

- Daily Precipitation Totals (inches/day)

Water Quality

Basic Parameters

- Laboratory pH
- Alkalinity (mg/L as $CaCO_3$)
- Hardness (mg/L as $CaCO_3$)
- Conductivity (µmhos/cm)

Solids

- Total suspended solids: TSS (mg/L)
- Volatile suspended solids; VSS (mg/L)
- Turbidity (NTU)

Oxygen Demand

- Total biochemical oxygen demand; Total BOD_5 (mg/L)
- Carbonaceous biochemical oxygen demand; $CBOD_5$ (mg/L)
- Total chemical oxygen demand; COD (mg/L)
- Total dissolved chemical oxygen demand; Dissolved COD (mg/L)

Nutrients

- Total phosphorus; TP (mg/L)
- Dissolved phosphorus; TDP (mg/L)
- Soluble reactive phosphorus; SRP (mg/L)
- Total Kjeldahl nitrogen; TKN (mg/L)
- Nitrate nitrogen; NO_3-N (mg/L)
- Nitrite nitrogen; NO_2-N (mg/L)
- Ammonia nitrogen; NH_3-N (mg/L)

Heavy Metals

- Total cadmium; Cd (mg/L)
- Total chromium; Cr (mg/L)
- Total copper; Cu (mg/L)
- Total lead; Pb (mg/L)
- Total nickel; Ni (mg/L)
- Total zinc; Zn (mg/L)

Samples are collected on a stage-activated basis during periods of elevated stream flow following runoff-producing storm events throughout the ice-free season. These storm event-related samples are supplemented by collection of monthly fair weather grab samples, year-round.

Stream water quality monitoring also includes annual surveys of seven reference stream reaches (see Figure 2-7, Section 2.0, page 2-21) to reassess their conditions as part of a recurrent Ecological Use Classification analysis of Nine Mile Creek. Each year these same stream reaches are reevaluated to determine stream substrate and aquatic habitat conditions, and both benthic macroinvertebrates and fish species present are quantified. Biological monitoring of benthic invertebrates and fish are conducted according to MPCA- and MDNR-approved methods, including electrofishing with backpack shocking equipment to determine if biotic impairments exist that would result in the creek's inclusion on the MPCA Impaired Waters list..

6.5.4 Periodic Analysis of Data

Lake water quality data will be collected over a 3-year period and reported out each 4th year, on a cyclical basis, in a summary report. Stream water quality samples are analyzed and reported annually in the annual report of the District.

6.6 Management Programs

The District will require local plans to assess the need for periodic maintenance of municipal infrastructure and specify any new programs or revisions to existing programs needed to accomplish the District goals and objectives. Each Comprehensive Storm Water Management Plan must further identify whether the municipality or private parties are responsible for maintenance. Each local plan must, at a minimum, assess or require local plans to assess:

a. the need and frequency for sweeping of public and private streets and parking lots;

b. the need and frequency for inspecting stormwater outfalls, sumps, and ponds;

c. the adequacy of maintenance programs for stormwater facilities and water level control structures;

d. the need to establish a water body management classification system to provide for water quality and quantity management based on a hierarchical basis;

e. the need to establish local spill containment cleanup plans; and

f. the need for other management programs as considered necessary.

6.7 Potential Structural Solutions to Problems

Potential structural solutions are intended to avoid or minimize public expenditures to correct or alleviate flooding or pollution problems. These solutions complement the regulatory program of the District. Potential structural solutions are defined as a "project" or a "capital improvement."

"Project" means planning development, construction, maintenance, repair or improvement of the watershed district for a purpose for which the District is established. Minn. Stat "103D.011 subd. 21." Projects include diagnostic study of water pollution caused by point or nonpoint sources, planning to implement BMPs recommended by MPCA or other BMPs authority, and the physical features constructed or actions taken to implement. Minn. Stat. "103F.711 subd. 8."

"Capital Improvement" means a physical improvement that is not directed toward maintenance of an in-place system during its life expectancy. Minn. Rules '8410.0020 subp. 3.

Projects and capital improvements are identified through a three-step process. First, each water resource is inventoried and assessed to identify its existing and potential beneficial uses. Second, existing and potential beneficial uses are analyzed to determine which uses are attainable. Third, best management plans are prepared to implement those practices necessary to attain the identified beneficial uses. Projects and capital improvements are designed as part of this third step. Capital improvements identified as part of this step are then incorporated into the Capital Improvement Program of the District. Capital improvements may be financed through a variety of means over and above those levies available to fund projects.

These structural solutions, including the Capital Improvement Program, are prioritized and scheduled for financing through the Watershed Act §103B or the Metropolitan Surface Water Management Act §103D. The financing used varies depending upon the particular project or improvement at issue and other factors such as prior levies and restraints upon increased levies. The financing schedule identifies projects and capital improvements, cost estimates, schedules for construction and anticipated sources of revenue for each item, see Tables 8-2a, 8-2b, and 8-3, pages 8-4, 8-5, and 8-7, respectively.

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7.0 Impact on Local Government

7.1 Impact on Local Governments

This section outlines how the Nine Mile Creek Watershed District's (NMCWD's) implementation program will affect local government in terms of cost and administrative issues.

The NMCWD's intention is to work cooperatively with its municipalities, and to limit additional requirements imposed upon local units of government as much as possible while still accomplishing the District's purposes and implementing the Plan. The District's implementation program will be funded through tax levies. The District taxes would not affect local unit of government's levy limits. However, there would be a financial impact to the residents of the cities and townships that reside in the NMCWD's watershed.

Some of the implementation program elements reflect the goals, policies, and requirements of state and regional units of government that local units of government would need to address in any case.

The majority of the municipalities already have ordinances or other regulatory controls in place that address many of the NMCWD requirements. Applicable ordinances or other regulatory controls address shorelands, floodplains, wetland protection, stormwater management, erosion control, and stormwater system maintenance. Local governments must adopt the MDNR's Shoreland management regulations, if required by the MDNR.

The District will work with the Cities on the initial stages of the permitting process to address District goals and objectives. The Cities may have to update and/or adopt ordinances or other regulatory controls to meet the goals and objectives of this Plan.

In 2007, the District will be revising it's Rules and Regulations and will consider the development of performance standards in cooperation with the municipalities.

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8.0 Implementation Priorities

8.1 Background and Historic Projects

The Nine Mile Creek Watershed District (NMCWD) prefers to undertake Basic Water Management Projects on a cooperative basis in response to petitions from its constituent cities, but reserves the right to initiate projects itself. Many of the projects completed previously, for either flood control or water quality management purposes, were cooperative Basic Water Management Projects (see Figure 1-2, page 1-13), including:

- Marsh Lake, 1970
- Bredesen Park, 1973-78
- Normandale Lake, 1978
- Lower Valley Restoration, 1990-91
- Hopkins Culvert, 1993
- Lake Smetana, 1998-99 and 2001-02
- Bush Lake Outlet, 1999-2000
- Minnetonka Lakes Improvements, 2003-06
- Bloomington Culvert 2006-ongoing

8.2 Pending Projects

With the impending completion of the Minnetonka Lakes Improvements Project in 2006, the District is now shifting its focus onto implementation of the recommended best management practices (BMPs) from the 15 lake/watershed Use Attainability Analyses (UAAs) completed during the past 10 years. These recommendations are summarized, generally, in Table 8-1 by lake. Details of the recommended projects, including preliminary cost estimates are presented in Tables 8-2a and 8-2b.

Prioritization of Projects

The Nine Mile Creek Watershed District has developed a prioritization tier system for considering projects that are initiated by the District or through petition.

First Priority	Projects based on the Nine Mile Creek Use Attainability Analysis, Completed and Future Use Attainability Analyses, and TMDL-related Projects/Studies.
Second Priority	Enhancement/Improvements to Previously Completed UAA or Other Projects Completed by the District.
Third Priority	Other projects related to water resources management.

The Implementation Program will be reviewed and updated at least biannually.

The District will continue to implement its projects typically through a petitioning process to assure strong coordination and partnership with the affected municipalities. However, the District reserves the right to implement projects on its own without a petition. The District reserves the right to initiate projects with a compelling need even without a petition. Other flood control or water quality management projects not currently foreseen by this Plan may also be undertaken following the Plan Amendment process described in Section 10.0.

8.3 Future Capital Improvement Projects

In addition to pending water quality improvement projects recommended by UAA reports, the District intends to be actively involved in Total Maximum Daily Load (TMDL) studies and other programs that may lead to future capital improvement projects. Tables 8-2a and 8-3 detail actions the District intends to take over the next 10 years to implement this Water Management Plan. Table 8-4 is a yearly summary of anticipated activities over the next 10 years.

Table 8-3 Explanatory Information

The Section, Objection/Action column in Table 8-3 refers to the section, objective and action item in Chapter 4 of this plan.

The initials in the Potential Partners and Funding Sources column in Table 8-3 are:

NM – Nine Mile Creek Watershed District

L - Local or regional government

S - State assistance/cost-share/grant

F - Federal assistance/cost-share/grant

NG – Non-governmental organization

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9.0 Implementation Components

9.1 Regulatory Controls

Each municipality, in its local comprehensive stormwater management plan, must provide for the adoption of necessary regulatory controls, stormwater design standards, education programs, data collection programs, and maintenance programs that are identified in this plan within two years of the date of the adoption of this plan.

9.2 Responsibilities

The District is responsible for all aspects of implementation. Local units of government are only responsible for preparing a conforming local water management plan. As part of that plan each municipality must develop a qualifying comprehensive wetlands management plan and assess the adequacy of specified management programs. Municipalities designated as local units of government pursuant to the Wetlands Conservation Act (WCA) must also enforce that Act. Hennepin County is responsible for groundwater planning in accord with the Board of Water and Soil Resources (BWSR)-approved plan.

Where WCA duties have been assumed by municipalities, assistance and responsibilities of the District are limited to providing technical assistance as requested by LGUs. For those municipalities that have chosen not to assume WCA responsibilities, the District has assumed those duties.

LGUs must adopt regulatory controls that, at a minimum, incorporate best management practices (BMPs) and best available technologies as promulgated by the Minnesota Pollution Control Agency (MPCA).

LGUs must adopt regulatory controls that address erosion and sedimentation for projects not subject to grading and land alteration requirements of the District. This requirement includes an obligation to consider single-family residential lot permitting.

LGUs will be responsible for enforcement of adopted floodplain and shoreland ordinances. The District will only undertake enforcement when the failure of the LGU to act leads to conditions that independently constitute a violation of the rules and regulations of the District or other governing law by which the District possesses a right of action.

9.3 Capital Improvement Program

The Capital Improvement Program is set forth in Section 8.0 of this Plan.

9.4 Enforcement

In the event that the rules and regulations of the District are violated, the District will take the following steps:

1. The violator and the municipality in which the violation occurred will be notified of the violation in writing and requested to attend an inspection of the occurrence.
2. Upon inspection, the violator will be notified of the observations made during the inspection and informed of necessary remedial action and a reasonable date for completion of remedial action.
3. In the event that the violator does not undertake the necessary remedial action or fails to complete it, the District will commence immediate civil proceedings and seek an order to show cause why the violator should not be compelled to comply or why the District should not be permitted to take remedial action and seek damages against the violator. Prior to commencing action, the District will notify the municipality, should it desire to join in the action.
4. In the event that the violator fails to comply, the District will take remedial action and seek lawful compensation and damages.
5. In the event that the District observes any conduct or thing that may constitute criminal violation, the District will notify the municipality in which the observation occurred for criminal enforcement.
6. These procedures will be followed regardless of whether the violator is a public or private entity.

In the event that there are violations of ordinances or other regulatory controls of the local unit of government, the unit will be responsible for enforcement unless the violation also constitutes an independent violation of the rules and regulations of the District. If an independent violation exists, then the District will request the municipality to take action and, absent action, proceed to enforce the District obligation.

9.5 Administration Process

Amendments to local plans shall be submitted to the District for review and approval. Reviews may be conducted by the Technical and Citizen advisory committees and must be conducted by the Board of Managers. In the event that approval is not granted, then within the 3 months immediately succeeding disapproval, the local plan may be revised and resubmitted for reconsideration of approval.

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10.0 Amendments to the Plan

Any amendment to this plan must be made in accord with this procedure. This Plan extends for ten (10) years following the year in which it is approved and adopted as provided by law. This plan shall remain in effect pending adoption and approval of any succeeding plan. Any person may propose to the Board of Managers, an amendment to the Plan. The Board of Managers may then initiate the amendment procedure.

10.1 General Amendment Procedure

All amendments to this plan or any local plan must adhere to the review process provided in Minnesota Statutes, Section 103B.231, Subdivision 11, except when the proposed amendments constitute minor amendments and:

A. The District has held a public meeting to explain the amendments and published a legal notice of the meeting twice, at least seven days and fourteen days before the date of the meeting;

B. The District has sent copies of the amendments to the affected local units of government, the Metropolitan Council (MC), and the State review agencies for review and comment; and

C. The Board has either agreed that the amendments are minor or failed to act within 45 days of receipt of the amendments.

10.2 Minor Amendments to Capital Improvements

Amendments to the approved capital improvement program may be considered to be minor plan amendments if the following conditions are met:

A. The original plan set forth the capital improvements but not to the degree needed to meet the definition of "capital improvement program" as provided in Minnesota Statutes, Section 103B.205, Subdivision 3; and

B. The county has approved the capital improvement in its revised, more detailed form.

10.3 Form of Amendments

Unless the entire document is reprinted, all amendments adopted must be printed in the form of replacement pages for the plan, each page of which must:

A. On draft amendments being considered, show deleted text as stricken and new text as underlined;

B. Be renumbered as appropriate; and

C. Include the effective date of the amendment.

10.4 Distribution of Amendments

The District shall maintain a distribution list of agencies and individuals who have received a copy of the Plan and shall distribute copies of amendments within 30 days of adoption. The District will consider sending drafts of proposed amendments to all plan review authorities to seek their comments before establishing a hearing date or commencing the formal review process.

List of Abbreviations and Acronyms

BMP	Best Management Practices
BWSR	Board of Water and Soil Resources
CAC	Citizens Advisory Committee
District	Nine Mile Creek Watershed District
FEMA	Federal Emergency Management Agency
HBI	Hilsenhoff Biotic Index
IBI	Index of Biotic Integrity
IC	Impervious Cover
ICI	Invertebrate Community Index
LGU	Local Government Unit
MC	Metropolitan Council
MCES	Metropolitan Council Environmental Services
MDIF	Metropolitan Development and Investment Framework
MDH	Minnesota Department of Health
MDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
MRAP	Minnesota River Assessment Project
MRIP	Minnesota River Implementation Project
MSL	Mean Sea Level
MUSA	Metropolitan Urban Service Area
MWCC	Metropolitan Waste Control Commission
NEMO	Nonpoint Education for Municipal Officials
NMCWD	Nine Mile Creek Watershed District
NURP	Nationwide Urban Runoff Program
QHEI	Qualitative Habitat Evaluation Index
TAC	Technical Advisory Committee
TMDL	Total Maximum Daily Load
TSI	Carlson's Trophic State Index
TSI_{SD}	Trophic State Index, Secchi disc basis
USC	United States Code
UAA	Use Attainability Analyses
U.S. EPA	United States Environmental Protection Agency
WBI	Wetlands Biotic Index
WCA	Wetlands Conservation Act
WERF	Water Environment Research Foundation
WOMP	Watershed Outlet Monitoring Program

Glossary

Aerobic: describes life or process that requires the presence of molecular oxygen (see anoxic).

Algae: simple plants found in water and elsewhere, having no roots, flowers, or seeds; frequently microscopic and may grow in simple colonies, singular: *alga*

Anaerobic: describes processes that occur in the absence of molecular oxygen.

Anoxic: describes no oxygen in the water. Often occurs near the bottom of eutrophic lakes in summer and under the ice in winter.

Aquifer: saturated permeable geologic unit(s) that can transmit significant quantities of water under ordinary hydraulic gradients.

Artesian: an aquifer in which the water is under sufficient head to cause it rise above the zone of saturation at that place if opportunity were afforded to do so.

Bathymetric map: a map showing the bottom contours and depth of a lake. Can be used to calculate lake volume.

Bedrock aquifer: one or more saturated geologic units composed of sedimentary, metamorphic, or origineous rock that can transmit significant quantities of water under ordinary hydraulic gradients.

Bed load: the part of the stream's sediment load that is rolling and sliding along because it is too heavy to be carried by suspension.

Benthic: describes stream and lake bottoms.

Benthic aquatic invertebrates: insects and simple animals that live near stream and lake bottoms.

Blooms: sudden abundant growth of algae, usually consisting of one or a few species, which ahs the effect of greatly reducing transparency.

Braided stream: a stream with complex, anastamosing multiple channels rather than a single larger channel.

Chlorophyll *a*: green pigment in plants essential to photosynthesis.

Conductance: conductivity, the indirect measure of electrolytes in water; the reciprocal of resistance; an electromotive force of 1 volt between two points is 1 mho or 1 siemens(S); specific conductance, usually the electron flow between two cm^2-electrodes, set 1 cm apart.

Deleterious: having a harmful effect.

Dimictic: describes lakes with two mixing periods, typically in spring and fall.

Discharge: the volume of stream flow passing a point during some period of time; often expressed as cfs or cubic feet/second.

Ecology: scientific study of relationships among animals, plants, other organisms, and their environments.

Ecoregion: an environmental area characterized by a specific land use, soil types, land surface form, and potential natural vegetation.

Ecosystem: a system of interrelated organisms and their physical-chemical environment.

Epilimnion: upper, warm layer of a lake during summer thermal stratification.

Erosion: wearing away of the lands or structures by running water, glaciers, winds, and waves.

Euphotic zone: upper region of lake where photosynthesis occurs because of adequate amounts of light and nourishment.

Eutrophic: Gr. "well-nourished"; describes a lake of high photosynthetic productivity.

Eutrophication: the process of physical, chemical, and biological changes associated with nutrient, organic matter, and silt enrichment and sediment of a lake or reservoir. If the process is accelerated by human influences it is cultural eutrophication.

Export coefficient: an estimate of the expected annual amount of a nutrient transported from its source to a lake. Expressed in terms of mass per area per unit of time.

External loading: nutrients or pollutants arriving at a body of water via eternal routes, for example, influent streams.

Flood profile: a set of elevations established along a stream or riparian to a lake that results from the storage of surface water runoff.

Floodplain: an area defined to be used for the storage of surface water runoff.

Geology: the science which treats of the origin, history, and structure of the earth, as recorded in the rocks; together with the forces and processes now operating to modify rocks.

Glacial drift: poorly sorted, permeable sediment which was deposited by glaciers.

Groundwater: water found beneath the soil surface and saturating the strata at which it is located; often connected to lakes.

Groundwater sensitivity: a qualitative or semiquantitative measure of the vulnerability of an aquifer to contamination.

Hydrology: the applied science concerned with the waters of the earth in all its states—their occurrences, distribution, and circulation through the unending hydrologic cycle of: precipitation; consequent runoff, stream flow, infiltration, and storage; eventual evaporation; and reprecipitation.

Hydrologic cycle: process of water falling to the earth as rain or snow, flowing across or under the ground into rivers and to the ocean, and evaporating back into the air.

Hypolimnion: lower, cooler layer of a lake during summer thermal stratification.

Infiltration: the entrance of water into the soil or other porous material through the interstices or pores of a soil or other porous medium.

Internal loading: nutrients or pollutants recycled to a body of water from its sediments.

Internal nutrient cycling: transformation of nutrients such as nitrogen or phosphorus from biological to inorganic forms through decomposition, occurring within the lake itself.

Isothermal: the same temperature throughout.

Lake management: a process that involves study, assessment or problems, and decisions affecting the maintenance of lakes as thriving ecosystems.

Land use: type of development and use of a land area; urban and agriculture are land uses.

Land cover: undeveloped area of landscape with a distinct type of vegetation. Forests and wetlands are land covers.

Limnetic: open area of a lake, from the edge of the littoral zone to the center of the lake. Also known as pelagic.

Limnology: scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.

Littoral: portion of a water body extending from the shoreline lakeward to the greatest depth occupied by rooted plants.

Loading rate: See export coefficient.

Macrophyte: "large plant"; rooted, seed-producing plants in lakes.

Mesotrophic: describes a lake of moderate photosynthetic productivity.

Metalimnion: thermocline; boundary layer of rapid temperature change between epilimnion and hypolimnion or a thermally-stratified lake.

No net loss: no reduction in the area and value of a wetland from existing conditions.

Nonpoint source: diffuse source of pollutants coming from contaminated underground flow, septic systems leakage, and overland runoff to streams and lakes.

Nonpoint source pollution: pollution originating at a variety of nonlocalized sources, such as street runoff, septic systems, atmospheric deposition, or groundwater.

Nutrient: element or chemical essential to life, including carbon, oxygen, nitrogen, phosphorus, and others.

Nutrient budget: measurement of amount of nutrients (usually phosphorus and nitrogen) coming into a lake or stream, flowing out, and staying in the water and bottom sediments.

Oligotrophic: "poorly nourished"; describes a lake of low photosynthetic productivity.

Permeability: a measure of a rock or soil's ability to transmit water analogous to hydraulic conductivity.

Porosity: the void space in a rock or soil between fractures or grains.

pH: measure of the concentration of hydrogen ions of a substance. Specifically it is the negative logarithm of the molar concentration of hydrogen ions. It ranges from 1 = very acid (high concentration) to 14 = very alkaline (low concentration) of hydrogen ions.

Photosynthesis: biological process by which algae, higher plants, and some bacteria create organic matter from inorganic nutrients using energy captured from light by some pigment, e.g., chlorophyll.

Point source: well-defined source of pollutants, such as a pipe from a municipal wastewater treatment plant or industry.

Pollution: addition, by people or by their activities, of a substance or energy to the environment which causes undesirable effects.

Precipitation: the total measurable supply of water of all forms of falling moisture, including dew, rain, mist, snow, hail, and sleet; usually expressed as depth of liquid water on a horizontal surface in a day, month, or year, and designated as daily, monthly, or annual precipitation.

Recharge: the process whereby an aquifer receives water.

Secchi disc: a white disc about 20 cm in diameter, lowered into water to measure transparency on the basis of visibility.

Stream order: the position a section of a stream occupies in relation to the tributaries contributing to it; the higher the order the more tributaries it has.

TDS: total dissolved solids; filterable residue; usually expressed as g/liter or mg/liter following evaporation of a measured sample of filtered water.

Thalweg, talweg: German for the valley path; the longitudinal deepest channel in a stream bed.

Thermocline: a density gradient or pycnocline owed to changing temperatures; the planar thermocline is the imaginary plane at the depth where the rate of temperature change is the greatest in a vertical temperature profile.

Topography: the physical features of a district or region, such as are represented on maps, taken collectively; especially, the relief and contour of the land.

Trophogenic zone: a region in a body of water where synthesis of organic compounds is predominant; usually refers to the photosynthetic region.

Wellhead protection: the process of mitigating the potential for contamination of a well or well field by instituting controls on land use in the area where the well receives its groundwater.

Zooplankton: the fraction of the plankton community composed of animals; the individual is a zooplankter.

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In order to aid readers, maps, figures, and tables, with few exceptions, follow the page on which they are first mentioned.