Surface Water Management Plan
Wetland Inventory & Management Plan

FEBRUARY 2005

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Honorable Mayor and City Council
City of Prior Lake
16200 Eagle Creek Avenue Southeast
Prior Lake, MN 55372-1714

Re: Local Surface Water Management Plan
Our File No. 566-03-113

Dear Mayor and Council:

With this letter we formally transmit the final report of the Local Surface Water Management Plan (LSWMP) for the City of Prior Lake. This plan is intended to be a component of Prior Lake's 2020 Comprehensive Plan. The information presented in this report is based on costs and data that were available in 2004. The LSWMP incorporates comments from watersheds, the Metropolitan Council, Forest Lake City Council and City Staff.

The trunk storm sewer system is presented on Maps 1 through 5. A capital improvement program for the completion of the trunk storm sewer system has been developed.

We would be pleased to discuss the contents of this report and the findings of our study with the City Council and Staff or other interested parties at any mutually convenient time.

Respectfully submitted,

BONESTROO, ROSENE, ANDERLIK & ASSOCIATES, INC.

Robert R. Barth
RRB:gs

PROFESSIONAL CERTIFICATION

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.

Earth Evans, P.E.

Date: 1/26/07 Reg. No. 44235

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EXECUTIVE SUMMARY

This report provides the City of Prior Lake with a Local Surface Water Management Plan (LSWMP) that will serve as a policy basis for the management of the surface water system throughout the City. The LSWMP is intended to complement the City's Comprehensive Plan 2030 and official controls governing stormwater. The LSWMP will carry the City through the end of 2015. Periodic amendment to the Plan will occur in the intervening 10 years so that the Plan remains current to watershed plan amendments and revisions and current to the "state of the art" in surface water management.

The Prior Lake LSWMP will serve as a comprehensive planning document to guide the City in conserving, protecting, and managing its surface water resources. The LSWMP meets requirements as established in Minnesota Rules 8410. In addition, the participation of other organizations, particularly Scott County WMO and Prior Lake Spring Lake Watershed District, ensures the City's compliance with local and regional expectations.

The City will submit its LSWMP to Metropolitan Council, Scott County WMO, and PLSLWD for review. These entities have 60 days for their review after written receipt of the City Plan.

Three other activities complement the LSWMP. The Wetland Management Plan (WMP) provides an assessment and management plan for numerous wetlands within the 2030 growth area. The WMP is based upon standard assessment methodology and is utilized, in conjunction with the LSWMP hydrologic modeling, to determine future use of wetland basins for storage, retention, and infiltration. The WMP constitutes section 4 of this report. The second activity is the Upland Management Plan. Like its wetland counterpart, this Plan provides an assessment and management plan for resources – this time upland resources. The City will utilize this information in open space and park planning. The third activity is the Public Works Design Manual (PWDM). The PWDM summarizes the policy and recommendations set forth in the LSWMP and provides design standards and a method of enforcing water resource management concepts detailed in the LSWMP.

This report is a culmination of the activities described above and is organized as follows:

- Section 2, Land and Water Resources Inventory, describes the physical environment including watersheds and drainage patterns, dominant land uses, and significant water bodies within the City.
- Section 3 - Goals, Policies and Guidelines - lists the City's goals and policies along with public agency requirements affecting surface water management in the City.
- Section 4, Wetland Management Plan, presents the results of an assessment of the City's larger wetlands within the 2020 growth areas. The Wetland Plan identifies specific strategies for mitigating wetland impacts often associated with development.
- Section 5, System Assessment and Design, presents an overview of all the major watersheds in the City. This section describes in detail the affect rural drainage has on municipal systems both now and in the future. Section 5 also provides detail on a model of the storm water management system within the four focus areas. The focus areas are soon to develop portions of the larger study area where conceptual ponds and trunk pipes are sized and shown, where trunk alignments are shown, and where volumes, discharge rates, and capital costs are analyzed.
- Section 6, Implementation Plan, covers regulatory responsibilities, priority implementation items, educational programs, operation and maintenance, the capital improvement program, and financing considerations. A plan amendment process is also identified and the distinction between major and minor amendment outlined.
- Section 7, Summary and Recommendations, contains a summary the SWMP and makes recommendations for implementing the Plan.

It should be noted that the land use plan identifies future land use for areas within the 2030 growth boundary. Service areas for the sewer and water system can be effectively defined by this boundary. In contrast, the surface water system is defined by topography and the drainage that currently moves through the newly developing areas must continue to be accommodated in the post development condition. For this reason, the modeling and management strategies incorporated in the LSWMP must deal substantively with the large rural and agricultural areas that will continue to drain through the City even after build out of the 2030 Plan. For instance, drainage to Prior Lake extends as far south as the PLSLWD boundary. This drainage extends almost to Cynthia Lake, three miles south of the growth boundary and incorporates the discharge from Fish Lake, which is over 2.5 miles south of the growth boundary. So, while the 2030 Land Use Plan forms the basis of the urban system outlined in this report, this urban system is also determined by these large rural drainage areas discharging to Prior Lake.

The intent of the ponding system described in this report is to reduce the post development peak to a rate more in line with natural conditions. This protects the city's lakes, wetlands, and channels from erosion and flooding. Volume control, though not specifically required by the LSWMP, is aimed at reducing the post development runoff depth and is included as a requirement in the PWDM. By reducing the post development runoff depth through volume reduction and infiltration – to something more akin to the depths seen off the natural landscape – lake, wetland and channel protection is

augmented. Infiltration will also help achieve the PLSLWD's retention goals which are outlined later in this report.

A change in land use from agricultural and natural to urban is the primary factor driving the need for the Prior Lake Surface Water Management Plan. The goal of the plan is to mitigate the impacts caused by urbanization.
Most of Prior Lake falls within the jurisdiction of the Prior Lake Spring Lake Watershed District since, quite obviously, most the City's drainage – both current and within the 2030 growth area – ends up in either Prior Lake or in the Prior Lake outlet channel. A portion of the City and City 2030 growth area falls within the Scott County WMO. This area lies northwest of Spring Lake and generally drains toward Louisville Swamp, which lies approximately 2 miles west of the 2030 growth area boundary.

The Prior Lake Spring Lake Watershed District encompasses approximately 42 square miles of land in the jurisdictions of five local units of government: Prior Lake, Savage, Shakopee, Sand Creek Township, and Spring Lake Township. Most of the district's land area falls within Prior Lake's current limits and 2030 growth area. The primary water resources within the district, which are discussed in detail below, include Spring Lake, Upper and Lower Prior Lakes, Rice Lake, and Crystal Lake. Jeffers Pond and Pike Lake are notable water resources that form a portion of the Prior Lake outlet channel.

Historically, three other watershed management organizations operated near the City of Prior Lake. These were the Sand Creek, Credit River, and Shakopee Basin WMOs. All three WMOs were determined to be "non-implementing" and subsequently they were disbanded by the state Board of Soil and Water Resources. Scott County then assumed the powers of these organizations through creation of the Scott County WMO. The Scott WMO includes all of Scott County not currently managed by the PLSLWD, the Lower Minnesota River Watershed District, the Vermillion WMO or the Black Dog WMO.

The primary Scott WMO hydrologic features within Prior Lake's existing or 2030 boundary include Campbell, Markley, Mystic and Howard Lakes.

This Goals and Policies section of the SWMP outlines goals and policies specific to surface water management in Prior Lake and its environs. The goals and policies are broad statements regarding the motivation and intent of the SWMP. The policies that follow the individual goals are specific requirements that promote attainment of the goal.

The City of Prior Lake has maintained its natural drainage patterns throughout most of its development. The City's goal is to foster continued optimum use of that natural drainage system while enhancing the overall water quality entering the lakes. The intent is to prevent flooding while using identified best management practices to enhance surface water quality with minimal capital expenditures by the City.

Upon approval of this LSWMP by the two watersheds with jurisdiction over the City, it is the City's intent to assume all permitting powers within it jurisdiction. Currently, the Scott County WMO does not issue permits, so no impact to this organization would

occur. The Prior Lake Spring Lake Watershed District does issue permits for any planned activity that disturbs more than 10,000 square feet of land area. This threshold rises to one acre if the activity is not near a lake, wetland, or the Prior Lake outlet channel.

Since the watershed would still permit activities outside the City's jurisdiction its permit process would remain in place. Within its jurisdiction, the City will use the permit submittal requirements outlined in the watershed rules and updates. This will ensure consistency of approach for all projects. Once the LSWMP is approved, the city will enter into a memorandum of understanding, regarding the transfer of permit authority for the PLSWD to the city.

The PLSLWD would continue in its role as a project review agency though it may defer to the City review process for projects that don't have a direct impact on Prior Lake or the Prior Lake outlet channel. The Prior Lake-Spring Lake Watershed District will also continue to have responsibility for water quality monitoring.

The Prior Lake LSWMP envisions the City and its two watersheds as partners in implementing this plan. In the PLSLWD lands, the City envisions the watershed taking the lead on water quality and lake water quality issues. The City and watershed would be equally responsible for implementation of the volume management targets discussed in Section 5 of this Plan with the City taking the lead in the 2030 expansion areas and the watershed taking the lead in areas outside the 2030 boundary.

The goal of this wetland inventory is the management of wetlands based on the functions they perform and to determine appropriate protection strategies for stormwater discharge to the wetlands if a land use change occurs that triggers a NPDES permit. Since smaller wetlands are not typically used as major components in a stormwater storage system, we focused our inventory on wetlands shown on the National Wetland Inventory (NWI) Map that were over 0.5 acres in size.

The inventory and assessment of wetlands through the Wetland Management Plan (section 4) allows the city to set up priorities based upon wetland functions and values. This plan includes a wetland inventory and ranking system that will assist the city in establishing priorities and focusing available resources for wetland protection, enhancement and restoration. Because all wetlands have value, all are protected, to some degree, in this plan.

The plan is designed to provide the following benefits:

- Provide wetland inventory, assessment, and management information:
- Aid in administration of the Wetland Conservation Act (WCA) by providing information regarding the wetlands functions:
- Enhance wildlife values of wetlands:
- Provide and enhance recreational values:
- Designate wetland restoration/enhancement opportunities:
- Protect wetlands and adjacent resources that provide valuable ecological support:

- Provide stormwater protection for wetlands.

It should be noted that the wetland inventory has been created for planning purposes only. Regulation of activities potentially impacting individual wetlands will be based on a site-specific delineation of the wetland boundary as part of a proposed project.

All of the inventoried wetlands within the study area were classified for Stormwater and Habitat Protection. Stormwater Protection standards are listed in Table 4.2 and 4.3 and Habitat Protection Recommendations are listed in Table 4.4. The Stormwater Protection Standards include Water Quality and Quantity Protection. The Habitat Protection Recommendations include Buffer Zones and No Grading Recommendations.

Water quality plays a significant role in the overall quality of a wetland. When the quality of the incoming water declines, the wetland's plant community may change to fewer numbers of species and retain only those species that are tolerant of high nutrient and sediment loads. Once a wetland's plant community is changed, the wetland's character and ecosystem will change, often to a less valuable system in terms of biodiversity, habitat for wildlife, and aesthetic enjoyment. Pretreatment requirements have been developed to maintain the character of the wetland. BMPs can be used to accomplish the pretreatment requirements given in Table 4.2.

In the recent past, surface water management plans have protected wetlands from nutrients but not water fluctuations or duration. In fact, it was common to use wetlands to reduce flooding potential through sizing storm sewer pipes to maximize bounce and detention time in wetlands.

This plan addresses stormwater quantity impacts to wetlands by providing protection strategies to maintain the existing integrity of the wetland through special protection strategies for highly, moderately, and slightly susceptible rankings and are described in Table 4.3.

Wetland restoration/enhancement sites were identified during the field inventory and will be further investigated at the time of development under the requirements spelled out in the PWDM and ordinance. The wetland restoration portion of the filled out MnRAM will be reviewed at the time of development to determine the potential for restoration of wetlands on the property. The potential for wetland restoration will be determined based on the ease with which the wetland could be restored, the number of landowners within the historic wetland basin, the size of the potential restoration area, the potential for establishing buffer areas or water quality ponding, and the extent and type of hydrologic alteration.

Section 5 of the Plan serves two functions. The system assessment portion catalogues the various assessments of problems that the Plan must address whether they relate to water quality, wetland protection, flooding, volume management, or lakes management. The intent is to identify the source of problems and, more importantly, specific actions the City will take to address these problems either independently or in collaboration with

some other organization – most commonly one of the watershed management organizations. The purpose of the system design portion of this section is to identify and quantify the infrastructure needed to allow continued development in Prior Lake while avoiding the negative impacts, such as flooding and water resource degradation, often associated with development.

The system design portion of this section describes the 2030 growth area surface water management system and is intended to be used as a planning and analysis tool. This system is shown in maps 1 through 5. The discussion of the system revolves around answering the following questions:

- What are the general drainage patterns of the 2030 and existing system?
- What does the 2030 system entail in terms of storage, conveyance, volumes, and discharge rates?
- Where does the proposed system discharge and what constraints in the existing system limit discharge of the 2030 system?
- What is the impact of agricultural drainage, outside the 2030 growth area, on the proposed and existing urban system?
- How have proposed wetland bounce, and duration of HWL, been determined by management guidelines of the Wetland Management Plan, section 4 of the LSWMP?
- What opportunities exist for obtaining the retention storage identified by the PLSLWD both in the 2030 growth area and outside it?
- What is the impact of the City of Prior Lake's 2030 urban system on agricultural areas and other municipalities?
- Are there any existing ponds where calculated HWL is a concern?

A number of water bodies within the existing City and its 2030 growth boundary are listed in the state impaired waters list. Known as the 303(d) list from the applicable section of the federal Clean Water Act, these waters are ones that do not currently meet their designated use due to the impact of a particular pollutant or stressor. If monitoring and assessment indicate that a water body is impaired by one or more pollutants, it is placed on the list. At some point a strategy would be developed that would lead to attainment of the applicable water quality standard. The process of developing this strategy is commonly known as the Total Maximum Daily Load (TMDL) process.

When discussing nutrient impacts to lakes the nutrient most commonly identified is phosphorus. Through its own monitoring efforts and those of the Citizen Assisted Monitoring Program (CAMP) run by Metropolitan Council, the PLSLWD has been collecting data on nutrient loading into the impaired waters, and others, identified above. According to the PLSLWD 2003 Annual Report:

> All of the lakes in the District are either eutrophic or hypereutrophic except for Cates Lake and Lower Prior Lake, which are on the upper boundary of mesotrophy. Review of Table 4.5 and comparison with the TSI descriptions in Table 4.3 shows that both Cates Lake and Lower Prior Lake are very close to the boundary for a eutrophic lake, and this boundary is where problems really start to become evident. The western end of Lower Prior Lake is mesotrophic/eutrophic largely because of water flowing through this end from Upper Prior Lake to the outlet. The rest of

> Lower Prior Lake has a limited watershed and is isolated from a majority of the inflowing water from Upper Prior Lake.

The continued assessment of these lakes has led the PLSLWD to emphasize reduction in phosphorus loading to the lakes. This will also be the focus of a watershed-based TMDL, when developed, for the impaired waters listed in table 5.1. Since the mercury TMDL will be regional in nature, the City of Prior Lake and PLSLWD will focus their efforts on reducing nutrient loading. According to the PLSLWD:

> For noticeable improvements to occur in lake water quality, TSI values need to be reduced to 55 or less. On the reverse, if these lakes are allowed to decline further, algae blooms will become worse and fish kills are probable.

In addition to collecting and reporting on the above data, the PLSLWD has created a model to quantify the internal and external phosphorus load for Spring and Upper Prior Lakes. This modeling effort is summarized in the 2003 Annual Report:

> In summary, sediment phosphorus release and recycling accounts for approximately 43 to 78% of the total phosphorus load for Spring Lake and 49% of the total phosphorus load for Upper Prior Lake. As a result, significant water quality improvements in each lake will require implementation of lake improvement options that would greatly minimize the potential for sediment phosphorus release. In addition, significant reductions in phosphorus from County Ditch 13 and Spring Lake should result in significant water quality improvements in Spring Lake and Upper Prior Lake, respectively. To a lesser degree, senescing macrophytes and bottom-feeding fish also affect the water quality of Spring and Upper Prior Lakes, since each of them contribute approximately 5 to 15% of the total phosphorus load to each lake.

The Water Resources Management Plan for the PLSLWD, completed in 1999, identified several planning efforts, that would occur subsequent to the Plan, to address issues with the Prior Lake water levels and outlet operation. These included:

- Calibrating an hydrologic model for the watershed
- Designing improvements to the outlet channel for full-development conditions
- Addressing flood prone structures on Prior Lake
- Addressing increases in runoff volume as development occurs

The PLSLWD report Prior Lake Outlet Channel and Lake Volume Management Study (May, 2003) addresses these issues in detail. The 100-year floodplain elevation for Prior Lake established by FEMA is 908.9 MSL. There are 79 homes around the lake with low openings lower than this floodplain elevation. Fifty-one of these have low openings below 907.6 and ten have low openings below or within one foot of the lakes 904.0 OHW. According to PLSLWD information, this 904.0 elevation has been exceeded a total of 259 days since 1983.

Since development tends to improve drainage pathways and increase runoff volume, the impact of future development on Prior Lake could, without mitigation, increase the frequency of water levels above the 904.0 OHW.

To assess the impact development might have on water levels in Prior Lake, the PLSLWD created a calibrated model of the watershed. The calibration of this model

started with standard curve numbers for the subwatersheds tributary to the lake and, through the calibration process, modified these until modeled results matched monitored lake levels for the 1998 to 2001 period. The hydrologic modeling for the LSWMP is based upon this calibrated watershed model. The difference between the two, is that the LSWMP model looks at the conditions that will exist when build out occurs in the 2030 growth area. Additionally, the LSWMP model includes more detail on the storage and conveyance system necessary to serve the 2030 growth area.

Subsection 5.4 provides specific issues in the surface water management system for Prior Lake's 2030 growth area. The study area has been broken into 21 major drainage districts, which are further divided into subdistricts. The nomenclature for the major drainage districts is based on the Prior Lake Spring Lake Watershed District (PLSLWD) modeling and major tributary water bodies. Total acreage for major drainage districts should roughly match the existing work completed by the Watershed District. Section 5.4 describes each drainage district in detail.

Section 6, Implementation Plan, of the Prior Lake SWMP describes those activities and programs the City might develop toward improving its surface water management program. Capital outlay for the surface water system (pipes, channels, and ponds) shown on the system maps will be large. For this reason a financing mechanism, called an area charge, is developed in this section. Based on the Capital Improvement Plan and the developable acreage, an area charge is developed and application of this charge is discussed.

The concept of an area charge to finance expansion of the trunk stormwater management system is not a new concept for the City. Since its report titled Trunk Storm Sewer Fee Determination Study (February, 2001) the City has quantified future trunk and ponding needs and developed an area charge based on actual costs of these needs spread across the potential developable acreage. With the analysis contained within the SWMP the City will update the fees for the 2030 growth area.

Section 6 also includes:

- An overview of the City's NPDES permit
- A discussion of operation and maintenance procedures and strategies
- An outline of an education program
- Financial considerations for the storm water utility
- A section referencing applicable design standards for stormwater management
- A section on Watershed implementation priorities
- Implementation priorities for the City
- A discussion of the process for amending this plan and an annual report to council

Appendix D summarizes the modeled system costs by element, by major watershed, and for the system as a whole.

The potential system, as shown in system maps, carries an estimated cost of $14,858,788. and serves as a basis for development fees in the City. This cost includes indirect costs of 30% on trunk and pond construction and indirect costs of 10% on easement acquisition.

Table 6.1 presents a financial model for the City of Prior Lake. The cost elements come directly from the 2030 stormwater system design as described in the system maps and the appendices to this report. The various trunk elements are organized by prospective year of implementation as well as whether they constitute a pond cost or trunk pipe cost. Total costs for the 2030 system are $10,836,957. It is important to note that the system analysis was complete to estimate costs, and does not represent final design.

Sections 6.2 and 6.3 develop an area charge for the City of Prior Lake that can be applied to future development within the City. The area charge has been constructed methodically as follows:

1. Pond and trunk costs for near term development have been estimated. A stormwater CIP has been created as shown in appendix D and table 6.1.
2. Net assessable acreage has been determined.
3. The base area charge has been modified into a land use based area charge through the use of equivalent acres.

A storm water system is a major investment for the City of Prior Lake – both in terms of initial capital cost and in terms of ongoing maintenance costs. The capital improvement program outlines the costs for new trunk system construction which will be funded by area charges. System maintenance is funded by the city's storm water utility.

The city's storm water system maintenance responsibilities include the following:

- Street sweeping
- Cleaning of sump manholes and catch basins
- Repair of catch basins and manholes
- Assessing pipe condition (typically by televising)
- Inspection of storm sewer inlet and outlet structures
- Pond mowing and other vegetation maintenance
- Excavation of accumulated sediments from ponds
- Maintenance or other structural BMPs owned by the City

The city has maintained its pipe system for decades and staff has a strong grasp on the costs associated with this. As new development brings more ponds into the system, city staff will find that pond maintenance becomes an increasingly large portion of both staff time and maintenance budget. It is important to quantify the extent of this future commitment so that the funds necessary for pond maintenance activities can be collected via the city's storm water utility.

The City of Prior Lake implemented a stormwater utility in 1993. The current quarterly residential charge is $6.00 per residential unit. Annual revenue from the stormwater utility has grown as shown in table 6.5.

Generally, revenue has grown not because of increases in the charge (the charge has gone from $5.63 in 1997 to $6.00 in 2005, an increase of 6.6%) but due to development bringing in more properties over which to collect the charge. With this increased revenue, though, has come an increase in the City's maintenance responsibilities.

In the past the stormwater utility has funded a staff position, programs, and capital expenditures. The 2002 capital projects totaled $140,000 and included a dredging project, a lake bank stabilization project, and some storm drainage improvements.

In order that storm water utility (SWU) funding keeps pace with increase in municipal maintenance responsibilities, the city should plan for the costs to conduct periodic pond maintenance. Limited data on maintenance activities has been developed by watershed management organizations. A review of this data suggests an annual maintenance budget of $1,250 per acre-foot of wet volume or $4,350 per acre of surface at NWL. Either parameter is relatively easy to track. This $1,250 per acre-foot maintenance item can be translated into a per household cost by virtue of the fact that one acre-foot is sufficient pond wet volume for 20 acres of residential development. Assuming 2.5 units per gross acre, then $1,250 per year is spread among 50 units - $25 per unit per year.

The current residential rate is $24 per unit per year. The current charges provide approximately $300,000 per year in revenue of which only about $20,000 to $40,000 has been used for pond maintenance. As the city's maintenance responsibilities grow the storm water utility funding also needs to grow to keep pace.

Prior Lake is a regulated MS4 under the Phase II NPDES Permit. There is a cost associated with preparing an NPDES permit and the associated Storm Water Pollution Prevention Plan (SWPPP). Some estimate cities the size of Prior Lake will spend $50,000 every five years for permit preparation. For Prior Lake it is reasonable to assume that $10 per household will be spent every five years – adding $2 per year to the individual household's storm water utility bill.

The NPDES permit and SWPPP commit the city to certain activities, including capital projects, for the purpose of improving the quality of the city's storm water discharge. The U.S. EPA has estimated that the financial commitments that city's will make may total $10 per household per year. Others place this figure at $20. Since many of the activities identified by the SWPPP may already be funded (like street sweeping and pond maintenance) the $20 figure is probably too high. For the purposes of planning increases in SWU collection the $10 per year figure should be used. Table 6.5 summarizes the additional storm water utility charges identified above.

The City of Prior Lake's implementation priorities include building the stormwater management system described in this report. Other implementations priorities relate to downtown redevelopment, retention storage, and adequate funding.

Originally, City Prior Lake and Prior Lake Spring Lake Watershed District staff discussed the possibility of creating an overall stormwater management plan for the downtown area that, once approved by the Watershed, would allow the City sole permit authority for construction and reconstruction projects in the downtown area. In 2003, as the City moved forward designing the rainwater gardens for Erie Street and City Hall and the street reconstruction project for downtown it became apparent that how downtown redevelops, and what sort of water quality and quantity retrofits can be implemented, depends on factors that cannot be adequately quantified at this time. Consequently, at

that time the City opted not to submit such a plan but rather would have the Watershed permit the specific projects.

In 2007 the City will undertake a downtown stormwater management study in cooperation with the district. Provisions for downtown permitting authority will be spelled out in a MOA with the District. The results of the 1007 study will begin to be implemented in 2011 or when the downtown area reconstruction begins. In the interim, the City will continue to look for opportunities to retrofit small site BMPs, water quality improvements, and rate control improvements as warranted by downtown redevelopment activities.

Other implementation priorities for the City as it adopts this Plan and begins the implementation phase of the Plan include:

1. Assisting the PLSLWD in implementing its retention storage program. Specific areas with high potential for City implementation are indicated on the system maps and within the body of this Plan.
2. Increasing Storm Water Utility Funding so that the City can meet its current and future obligations toward pond maintenance, NPDES compliance, and mitigation that may come out of the City's non-degradation analysis.
3. Application of the revised area charge outlined in this report and update of the area charge based on increases in land value and construction costs.
4. Implementation of the rate control targets as outlined in the appendices and stormwater modeling that supports this plan.
5. Application of the wetland susceptibility criteria in determining how wetlands are used for flood storage, retention, and rate control.
6. Working with the PLSLWD regarding the feasibility of augmenting storage in Buck Lake.
7. Working with the City of Shakopee toward redefining rate control objectives from their Sand Creek drainage which will ultimately enter the City of Prior Lake system through its Louisville Swamp system.

The Prior Lake SWMP is intended to extend through the year 2015. For the plan to remain dynamic, an avenue must be available to implement new information, ideas, methods, standards, management practices and any other changes that may affect the intent and/or results of the SWMP.

A brief annual report will be made by City staff summarizing development changes, capital improvements, and other water management-related issues that have occurred over the past year. The review will also include an update on available funding sources for water resource issues. Grant programs are especially important to review since they may change annually. These changes do not necessarily require individual amendments. The report can, however, be considered when the plan is brought up to date. The annual report should be completed by July 1st to allow implementation items to be considered in the normal budget process.

The following recommendations are presented for the City Council's consideration based upon the data compiled in this report:

1. The Surface Water Management Plan as presented herein be adopted by the City of Prior Lake.
2. Standard review procedures be established to ensure all new development or redevelopment within the City is in compliance with the grading and stormwater management controls determined by this Plan.
3. Detailed hydrologic analyses be required or all development and redevelopment activities.
4. Final high water levels governing building elevations adjacent to ponding areas and floodplains be established as development occurs or when drainage facilities are constructed.
5. Overflow routes be established and maintained to provide relief during extreme storm conditions, which exceed design conditions.
6. A surface water system maintenance program be established to ensure the successful operation of the system.
7. The erosion and sedimentation control criteria for new developments be enforced.
8. An education program for City residents, staff, and development community be implemented.
9. Amendments to the plan be adopted and implemented as warranted by future standards or regulations.
10. That the plan be updated in 2010 or earlier if needed.
11. Promote the use of small-site/distributed BMPs to help achieve water quality and volume control goals.
12. Pursue partnerships with watershed management organizations and other agencies to incorporate volume control BMPs into re-development projects, including City projects.
13. Ordinances be revised to be consistent with rules detailed in the PWDM regarding water resource management.

1. INTRODUCTION

1.1 Background

This report provides the City of Prior Lake with a Local Surface Water Management Plan (LSWMP) that will serve as a guide to managing the surface water system throughout the City. The LSWMP is intended to complement the City's 2030 land use plan as formalized in the Comprehensive Plan 2030. The LSWMP will carry the City through the end of 2015. Periodic amendment to the Plan will occur in the intervening 10 years so that the Plan remains current to watershed plan amendments and revisions and current to the "state of the art" in surface water management.

The City of Prior Lake is located in north central Scott County at the nexus of major transportation corridors including Trunk Highway 13, Scott County Road 21 and Scott County Road 42. According to some estimates, Scott County is the 15th fastest growing county in the nation, and Prior Lake has seen a good portion of this growth.

The Village of Prior Lake was incorporated in 1891. In the period from the 1870's to the 1920's little growth occurred in the City. During this period, much of the activity in the Village related to Prior Lake and its role as one of the preeminent recreation destinations of that era. The lake remains a recreational focus and forms one part of the City's three-fold recreational system:

1. Lakes and natural areas
2. Parks, trails and active recreational facilities
3. Venues such as Mystic Lake Casino and the City's golf clubs

It has been since the 1960's, and the City's emergence as a suburban community, that the City's growth has escalated with the greatest growth occurring in the last 20 years. Table 1.1 provides City populations and population projections from 1980 through 2020. As the city continues to grow, the importance of adequate surface water management controls also grows. The intent of the Prior Lake LSWMP is to detail what these controls are and make the connection between these controls and the overall city goal of preserving and enhancing its natural resources and protecting its residents from flooding.

Table 1.1
Population and Households

Year	Population	Number of Households
1980	7,284	2,313
1990	11,482	3,901
1995	13,427	4,630
2000	16,034	6,167
2010	21,000	8,077
2020	28,445	10,971

Lakes define the City since the core of the community developed between Upper and Lower Prior Lake. The City's uniqueness is tied to the lake. Consequently, effective surface water management cuts to the core of the City's vision for the future.

1.2 Purpose and Scope

The Prior Lake LSWMP will serve as a comprehensive planning document to guide the City in conserving, protecting, and managing its surface water resources. The LSWMP meets requirements as established in Minnesota Rules 8410. In addition, the participation of other organizations, particularly Scott County WMO and Prior Lake Spring Lake Watershed District, ensures the City's compliance with local and regional expectations.

According to the 1999 PLSLWD Plan local plans must do the following:

- Describe existing and proposed environment and land use
- Provide a narrative addressing stormwater infrastructure philosophy, which details regulatory authority, and implementation and financial responsibilities.
- Define areas and elevations of stormwater storage adequate to meet performance standards established in the watershed plan
- Identify quality and quantity protection methods which meet standards
- Identify regulated areas and potential easements or land acquisition areas
- Outline a procedure for submitting annual reports to agencies which document Wetland Conservation Act and monitoring program data consistent with state compatibility guidelines
- Set forth an implementation program, including a description of official controls, inspection and maintenance, and capital improvement plan
- Describe official controls and the responsible unit of government in the following areas: wetlands, erosion control, shoreland, floodplain, grading, and drainage

The City will submit its LSWMP to Metropolitan Council, Scott County WMO, and PLSLWD for review. These entities have 60 days for their review after written receipt of the City Plan.

In a four-part process, the Prior Lake LSWMP does the following:

- Collects and compiles the efforts of agencies and organizations including the City, its departments and residents. This includes past reports and studies, management

plans, monitoring studies, as well as completed and proposed improvement projects.

- Reviews the current state of the City's surface water resources in the context of goals and policies, ordinances, operations and maintenance, flood mitigation, and achievement of targeted water quality levels in its surface water bodies.
- Establishes reasonable, achievable and affordable goals, and supports them by a strong regulatory and management culture. Develops an implementation plan that includes projects and processes that derive from a thorough assessment of current City problem areas and current City surface water regulations and controls.
- Provides a blueprint for construction of new surface water systems as the City expands into its 2030 growth area. Using advanced surface water modeling software, a system of pond, wetlands and pipes is developed and costs applied to these future systems. The costs give the City a framework for understanding the impact development will have on City finances and applying these costs equitably to development.

In order to arrive at a LSWMP that adequately addresses surface water related issues, the emphasis has been to work with others to identify important issues through review and meetings. City staff has participated in collecting data, providing feedback, and contributing knowledge of local systems to aid in developing a strategy that encompasses water quality and quantity issues. The City of Prior Lake is the organizer of the final document though contributions from the watersheds have been substantial.

Two other activities complement the LSWMP. The Wetland Management Plan (WMP) provides an assessment and management plan for numerous wetlands within the 2030 growth area. The WMP is based upon standard assessment methodology and is utilized, in conjunction with the LSWMP hydrologic modeling, to determine future use of wetland basins for storage, retention, and infiltration. The WMP constitutes section 4 of this report. The second activity is the Upland Management Plan. Like its wetland counterpart, this Plan provides an assessment and management plan for resources – this time upland resources. The City will utilize this information in open space and park planning.

Based on the guidance provided by the Prior Lake city council and staff, this report addresses the city's current surface water management needs and provides a framework for successful implementation of a comprehensive storm water management program. A specific outline of the steps involved in the preparation of the SWMP is presented below:

1. System Inventory and Mapping – Analyze drainage patterns and develop a trunk storm water system map for the 2030 drainage system.
2. Goals, Policies and Guidelines – Develop goals and policies that guide the city's surface water management philosophy. Augment design guidelines for development and redevelopment. This gives the City guidance for facilities design and standards for reviewing development plans. Included in this process is determining all regulatory agencies involved in the storm water

management of the City and working with City staff to develop feasible goals, policies and guidelines.

3. System Analysis and Design – Analyze the storm water system and develop a recommended system. A system model was created that extended beyond the city's current boundary into future development areas. This step also includes specific recommendations for system upgrades and improvements due to erosion and flooding issues.
4. Cost Estimates and Capital Improvement Program – For the recommended system, develop itemized cost estimates of facilities. These are planning-level estimates, suitable for budgeting and decision making. Feasibility studies will be needed for more detailed costs. In addition, a 5-10 year CIP has been developed to coordinate system construction with growth.
5. Storm water Ordinances – Recommend ordinances or revision to existing ordinances.
6. Storm water System Management – Provide recommendations on operating and maintaining the storm water system as well as best management practices (BMPs) for water quality and erosion control. Information regarding compliance with NPDES Phase II Storm water Permits is also included.

Prior Lake presents something of a contrast. In older parts of town, city staff must meet the challenges of maintaining an older storm drainage system. In other areas, new development is adding new infrastructure to the storm water system and thus increasing the city's maintenance responsibilities. The SWMP is primarily aimed at this new development and the goals, policies, guidelines, controls, and preliminary system design reflect that emphasis.

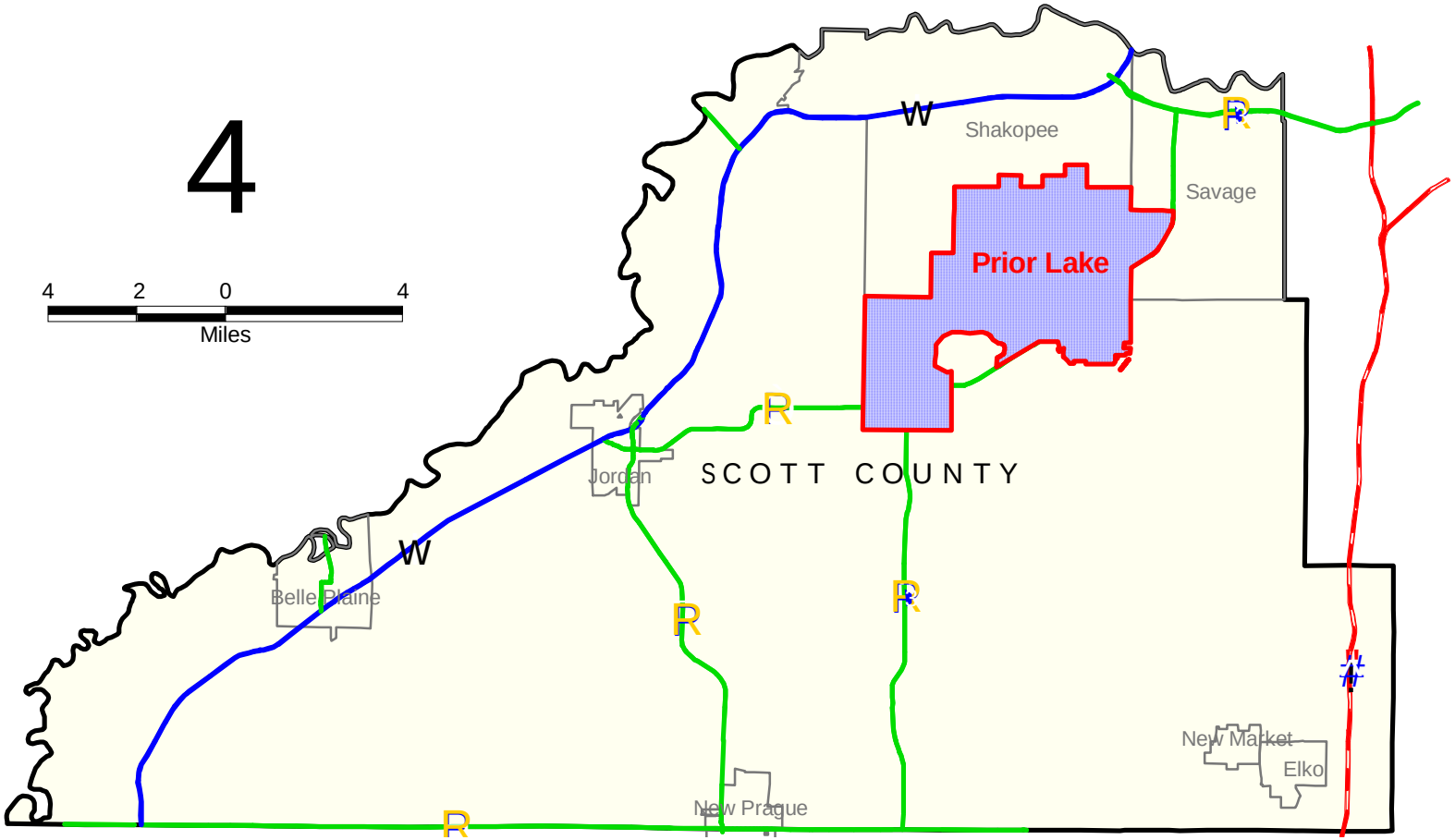
1.3 Organization

This report is a culmination of the activities described above and is organized as follows:

- Section 2, Land and Water Resources Inventory, describes the physical environment including watersheds and drainage patterns, dominant land uses, and significant water bodies within the City.
- Section 3 - Goals, Policies and Guidelines - lists the City's goals and policies along with public agency requirements affecting surface water management in the City.
- Section 4, Wetland Management Plan, presents the results of an assessment of the City's larger wetlands within the 2030 growth areas. The Wetland Plan identifies specific strategies for mitigating wetland impacts often associated with development.
- Section 5, System Analysis and Design, presents an overview of all the major watersheds in the City. This section describes in detail the affect rural drainage has on municipal systems both now and in the future. Section 4 also provides detail on the proposed storm water management system within the four focus areas. The focus areas are soon to develop portions of the larger study area where specific ponds and trunk pipes are sized and shown, where trunk alignments are

shown, and where specific volumes, discharge rates, and capital costs are calculated.

- Section 6, Implementation Plan, covers regulatory responsibilities, priority implementation items, educational programs, operation and maintenance, the capital improvement program, and financing considerations. A plan amendment process is also identified and the distinction between major and minor amendment outlined.
- Section 7, Summary and Recommendations, contains a summary the SWMP and makes recommendations for implementing the Plan.



Bonestroo Rosene Anderlik & Associates
Engineers & Architects

City of Prior Lake

Local Surface Water Management Plan

Project Location

- Interstate Highway
- US Highway
- Minnesota State Highway
- Project Area
- City Boundary
- County Boundary

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January 2007

2. LAND AND WATER RESOURCE INVENTORY

2.1 Land Use

Figure 2 provides the 2030 land use plan for the City of Prior Lake. Figure 3 provides a guide to the timeframe over which annexation will occur. City growth will be concentrated in the areas around Spring Lake and to the west of Spring Lake. Obviously, growth requires planning for other utilities and transportation in addition to surface water planning. These utilities are being studied under the auspices of the Comprehensive Plan 2030.

It should be noted that the land use plan identifies future land use for areas within the 2030 growth boundary. Service areas for the sewer and water system can be effectively defined by this boundary. In contrast, the surface water system is defined by topography and the drainage that currently moves through the newly developing areas must continue to be accommodated in the post development condition. For this reason, the modeling and management strategies incorporated in the LSWMP must deal substantively with the large rural and agricultural areas that will continue to drain through the City even after build out of the 2030 Plan. For instance, drainage to Prior Lake extends as far south as the PLSLWD boundary. This drainage extends almost to Cynthia Lake, three miles south of the growth boundary and incorporates the discharge from Fish Lake, which is over 2.5 miles south of the growth boundary. So, while the 2030 Land Use Plan forms the basis of the urban system outlined in this report, this urban system is also determined by these large rural drainage areas discharging to Prior Lake.

The comprehensive plan provides a significant amount of narrative and statistical detail on existing and proposed land use and the reader is referred to that document for more information on land use planning. The hydrologic modeling that supports the LSWMP used the land use plan to determine hydrologic characteristics of the future landscape. Elsewhere existing land use was assumed.

Changes from undeveloped land uses, like agricultural and natural, to more heavily developed land uses like low, medium and high density residential, and commercial have a pronounced affect on hydrology. The increased impervious surface associated with the urban land uses leads to higher runoff peak flows and increased runoff volume. Table 2.1 shows how volume and peak increase for two typical rainfall events.

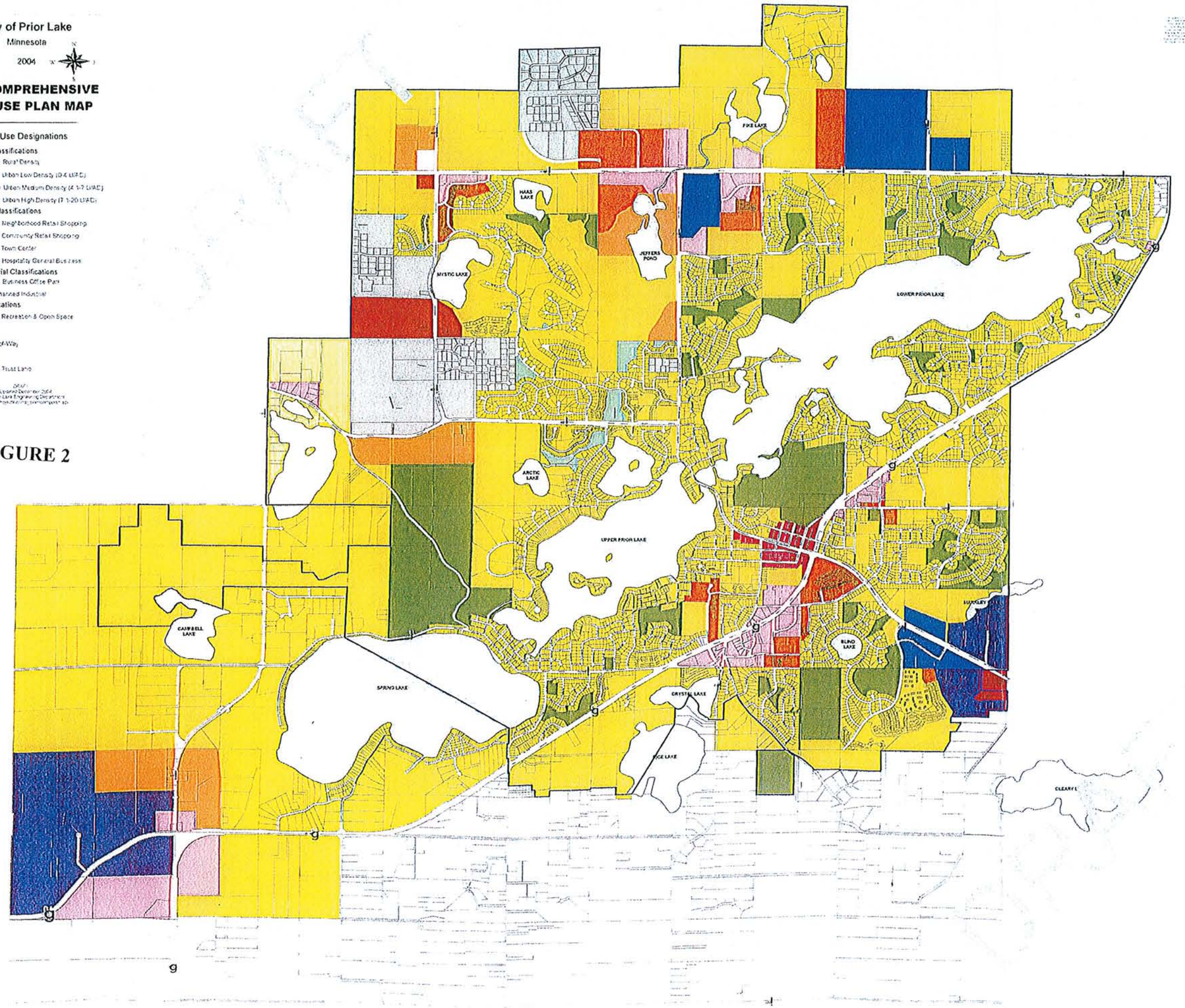

City of Prior Lake
Minnesota
2004
2030 COMPREHENSIVE LAND USE PLAN MAP
Land Use Designations
Residential Classifications
R-RD: Rural Density
R-LD: Urban Low Density (0-4 U/AC)
R-MD: Urban Medium Density (4.1-7 U/AC)
R-HD: Urban High Density (7.1-20 U/AC)
Commercial Classifications
C-NR: Neighborhood Retail Shopping
C-CC: Community Retail Shopping
C-TC: Town Center
C-HG: Hospitality General Business
Office / Industrial Classifications
C-BO: Business Office Park
I-PI: Planned Industrial
Public Classifications
R-OS: Recreation & Open Space
Park
Right-of-Way
Lake
SMSC Trust Land
FIRE LAKE
HAAS LAKE
JEFFERS POND
MYSTIC LAKE
LOWER PRIOR LAKE
ARCTIC LAKE
UPPER PRIOR LAKE
CAMPBELL LAKE
SPRING LAKE
BLIND LAKE
CRYSTAL LAKE
ICE LAKE
CLEARY L

FIGURE 2

PRIOR LAKE / SPRING LAKE ANNEXATION

EXHIBIT 2

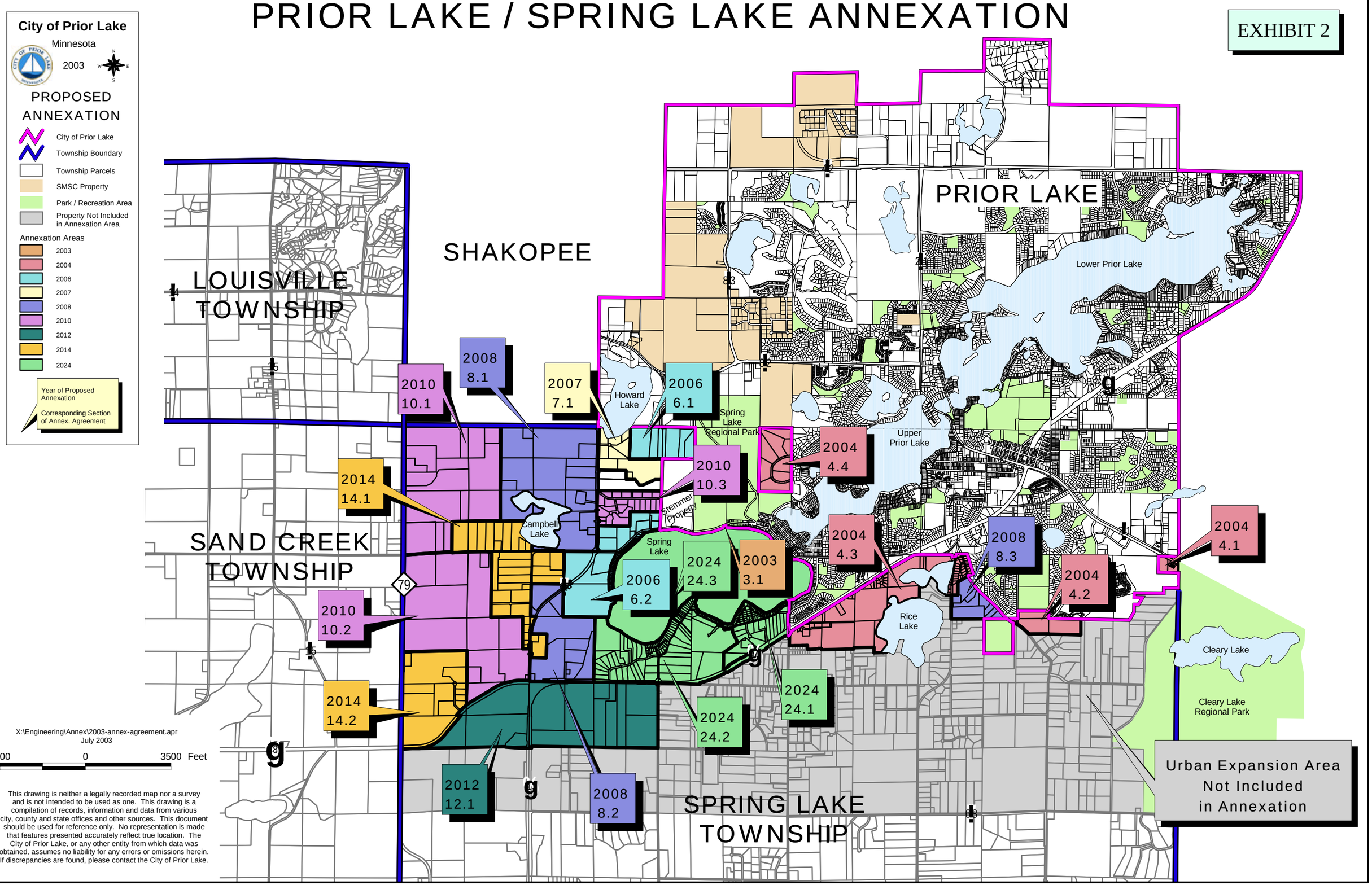


Table 2.1
Land Use Based Peak and Volume Comparisons

Land Use	2-year (2.8") SCS Type II, 24-hour Rainfall		100-year (6.1") SCS Type II, 24-hour Rainfall	
	Runoff Peak	Runoff Volume	Runoff Peak	Runoff Volume
	cfs/ac	inches	cfs/ac	Inches
Natural	0.03	0.2	0.4	1.8
Agricultural (row crop in May and June)	0.3	0.8	1.3	3.4
Low Density Residential (35% impervious)	0.5	0.8	2.3	3.4
Commercial (85% impervious)	1.9	2.0	4.8	5.2

The intent of the ponding system described in this report is to reduce the post development peak to a rate more in line with natural conditions. This protects the city's lakes, wetlands, and channels from erosion and flooding. The use of Volume control is aimed at reducing the post development runoff depth. By reducing the post development runoff depth through infiltration and other methods – to something more akin to the depths seen off the natural landscape – lake, wetland and channel protection is augmented. Volume control will also help achieve the PLSLWD's retention goals which are outlined later in this report.

A change in land use from agricultural and natural to urban is the primary factor driving the need for the Prior Lake Surface Water Management Plan. The goal of the plan is to mitigate the impacts caused by urbanization.

2.2 Topography and Watersheds

The topography and geology of Prior Lake was influenced by several ice sheets that advanced and retreated across southern Minnesota during the glacier age. The most recent glacier deposited light yellowish-brown or light olive-brown, calcareous, moderately fine textured material. The glacial action of the area resulted in the current irregular topography, called an ice-stagnation and disintegration moraine. Some areas contain deep unconsolidated surficial material, up to several hundred feet deep.

The City of Prior Lake is located on the upland area of the south side of the Minnesota River, in Scott County. The area has considerable relief, with steep slopes and potholes common throughout the region. Many of the potholes are low wetland areas.

The City of Prior Lake and the Prior Lake hydrologic system are part of the larger Minnesota River watershed. The City of Prior Lake is approximately 4 miles south of the Minnesota River and drainage within the Prior Lake system is to the north and northeast. The City's Prior Lake system connects directly to the River through the operation of the Prior Lake outlet, which is owned and maintained by the PLSLWD. A portion of the City, northwest of Spring Lake and within the Scott County WMO jurisdiction, drains northeast into Shakopee.

Prior to 1983, Prior Lake was a land-locked lake which had a natural outlet approximately 18 feet above what was considered normal water level. In 1981 plans were prepared for constructing a 36" RCP outlet pipe from Prior Lake which outletted on the west side of County Road 21 into what is known as "Jeffers Pond." This project also included upgrading the existing ditch and culvert system to drain the water all the way to the Minnesota River. The water level to which Prior Lake is allowed to be drained is 902.5, 18" below the Ordinary High Water Level (OHWL) of 904.0 as established by the Department of Natural Resources. According to DNR lake level records dating back to 1940, the lake level has varied from 893.48 feet to 905.68 feet, with a long-term average of 901.97 feet.

Most of Prior Lake falls within the jurisdiction of the Prior Lake Spring Lake Watershed District since, quite obviously, most the City's drainage – both current and within the 2030 growth area – ends up in either Prior Lake or in the Prior Lake outlet channel. A portion of the City and City 2030 growth area falls within the Scott County WMO. This area lies northwest of Spring Lake and generally drains toward Louisville Swamp, which lies approximately 2 miles west of the 2030 growth area boundary.

The Prior Lake Spring Lake Watershed District encompasses approximately 42 square miles of land in the jurisdictions of five local units of government: Prior Lake, Savage, Shakopee, Sand Creek Township, and Spring Lake Township. Most of the district's land area falls within Prior Lake's current limits and 2030 growth area. The primary water resources within the district, which are discussed in detail below, include Spring Lake, Upper and Lower Prior Lakes, Rice Lake, and Crystal Lake. Jeffers Pond and Pike Lake are notable water resources that form a portion of the Prior Lake outlet channel.

Historically, three other watershed management organizations operated near the City of Prior Lake. These were the Sand Creek, Credit River, and Shakopee Basin WMOs. All three WMOs were determined to be "non-implementing" and subsequently they were disbanded by the state Board of Soil and Water Resources. Scott County then assumed the powers of these organizations through creation of the Scott County WMO. The Scott WMO includes all of Scott County not currently managed by the PLSLWD, the Lower Minnesota River Watershed District, the Vermillion WMO or the Black Dog WMO.

The primary Scott WMO hydrologic features within Prior Lake's existing or 2030 boundary include Mystic, Campbell, Markley and Howard Lakes.

2.3 Soils

Soils of the Prior Lake area are classified into three associations:

1. Lester, Webster, Glencoe Association
2. Hayden and Lester soils and Peat bogs Association, and
3. Burnsville, Hayden, Kingsley, Scandia Association.

Information about each of the soil series listed above is available from the Scott County Soil Survey. Table 2.2 shows the drainage characteristic of each soil series from the above associations.

Table 2.2
Soil Drainage Characteristics

Soil Series	Draining Characteristic	Soil Type
Burnsville, Hayden, Kingsley and Scandia1	well drained to excessively drained	B
Glencoe	very poorly drained	D
Hayden	well drained	B
Lester	well drained	B
Peat Bogs	poorly drained	D
Webster	poorly drained	D

Note: Because the Burnsville, Hayden, Kingsley and Scandia series has formed from a mixing of two different kinds of glacial drift, it is impractical to separate each into a separate series.

The drainage nature of the soil is important for determining the surface water runoff from a given area. If the soil is well-drained, a significant portion of the precipitation will be infiltrated into the ground, whereas if a soil is very poorly drained, most of the precipitation will flow from the site of impact.

The hydrologic soil group (HSG) defines a soils propensity to generate runoff for a given rainfall event. Four HSG groups area identified: A, B, C, D. HSG A soils have the lowest potential to generate runoff and are typically sandy or gravelly soils. HSG D soils have the highest potential to generate runoff and typically consist of muck, peaty muck, and tight clay soils. The associations found within the Prior Lake LSWMP study area fall into HSG B to D, indicating a moderate to high potential to generate runoff.

Hydric soils are those characteristic soils found in wetland areas. A wetland must possess three technical criteria in order for it to be identified as a wetland. These three are: 1) hydrophytic vegetation, 2) hydric soils, and 3) wetland hydrology. The definition of a hydric soil is: “a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part”. A list of hydric soils found in Scott County is shown in Table 2.3.

Table 2.3
Hydric Soils of Scott County

Map Symbol	Soil Map Unit Name	Soil Name	Soil Acres	Soil Percent Of Map Unit
Bc	BLUE EARTH SILTY CLAY LOAM	BLUE EARTH	1162	100
Cc	COMFREY SILTY CLAY LOAM	COMFREY	1157	100
De	DUELM FINE SANDY LOAM 0 to 3 Percent Slopes	DUELM	262	100
Df	DUNDAS SILT LOAM 0 to 2 Percent Slopes	DUNDAS	1061	100
Fa	FAXON SILTY CLAY LOAM 0 to 6 Percent Slopes	FAXON	1193	100
Ga	GLENCOE SILTY CLAY LOAM	GLENCOE	7939	100
Ia	ISANTI FINE SANDY LOAM	ISANTI	349	100
Oa	OSHAWA SILTY CLAY LOAM	OSHAWA	603	100
Pa	PEAT AND MUCK, SHALLOW 0 to 2 Percent Slopes	PALMS	3769	100
PbA	PEAT, DEEP 0 to 2 Percent Slopes	HOUGHTON	13130	100
Ra	RAUVILLE SILTY CLAY LOAM	OSHAWA	969	100
Wb	WEBSTER-GLENCOE SILTY CLAY LOAMS	WEBSTER GLENCOE	11020 6754	50 30
Wc	WEBSTER-LE SUEUR SILTY CLAY LOAMS	WEBSTER	6716	50

2.4 Key Water Resources

Upper and Lower Prior Lake

Upper Prior Lake lies between Lower Prior Lake and Spring Lake and is connected to Lower Prior Lake through a channel under County Road 21. Both these lakes have high watershed to lake area ratios and this, particularly is why they have problems due to nutrient loading. Upper Prior Lake has a surface area of approximately 340 acres and a total watershed area of 16,460 acres – a ratio of 48 to one. This ratio is extremely high for any water body. Lower Prior Lake has a surface area of 827 acres and a total

watershed area (including that tributary to Upper Prior Lake) of 19,560 acres – a ratio of 24 to one. Both lakes are relatively deep with a maximum depth of 56 feet in the Lower and 43 feet in the Upper, although much of upper Prior Lake is shallow, and the lake has an average depth of 8 feet. The Prior Lake outlet channel leaves Lower Prior Lake at its far western shore near County Road 21. Both Upper and Lower Prior Lake have a public water access.

Spring Lake

Spring Lake drains to Upper Prior Lake through a culvert and channel. Its 12,930 acre watershed compares to a lake surface area of 630 acres. Spring Lake has a maximum depth of 37 feet and an average depth of 18 feet, according to information provided by the PLSLWD. Upper and Lower Prior Lakes and Spring Lake all have a substantial amount of residential development around them. Spring Lake has a public water access.

Rice and Crystal Lakes

Rice and Crystal Lakes are connected though Rice Lake lies a little higher than Crystal. The Rice Lake drainage includes 1,100 acres – mostly agricultural – versus a lake area of approximately 30 acres. This equates to a watershed to lake ratio of 37 to 1. The Rice Lake ordinary high water level is 945. Crystal Lake also has a high ratio with 1,340 acres draining to its 32 acre surface, a ratio of 42 to 1. Both lakes are relatively shallow with Crystal having a maximum depth of approximately 26 feet. Current information indicates that no part of Rice Lake exceeds the 10 foot depth. Neither Rice nor Crystal Lakes have public water access.

Pike Lake

Pike Lake is a shallow lake through which the Prior Lake outlet channel passes. Pike Lake has a surface area of 57 acres and a watershed area of 21,770 acres – a ratio of 382 to 1. While it is true that Pike Lake has a large tributary area due to the outlet channel, Lower Prior Lake has much better quality than Pike Lake. An analysis completed for the Outlet Channel EAW showed that Pike Lake tends to have higher water quality when the outlet is open compared to when it is closed, presumably because the water from Lower Prior Lake dilutes the high-nutrient levels in Pike Lake.

Jeffers Pond is another notable water resources within the PLSLWD portions of the City. These two water bodies are classified as wetlands by the DNR and not as much information is available for them as is available for the other lakes described above. Mystic Lake has relatively low watershed to lake area ratios. Jeffers Pond also has a high ratio due the Prior Lake outlet channel running through it.

Prior Lake Outlet Channel

In 1979 the Minnesota Department of Natural Resources (MnDNR) issued a permit to the PLSLWD for construction of the Prior Lake Outlet Channel. The district entered into a

joint powers agreement with Prior Lake and Shakopee in 1981 regarding the channel and the outlet system was first used in 1983. The outlet box consists of a 36-inch RCP pipe surrounded by a concrete structure with adjustable gates. The maximum discharge capacity is determined to be 65 cfs though the discharge rate falls to about 40 cfs at the 902.7 elevation. Currently the PLSLWD, City of Prior Lake and other partners are implementing a plan to restore and enhance the Prior Lake Outlet Channel.

Campbell Lake

Campbell Lake lies northeast of Spring Lake within the jurisdiction of the Scott County WMO. Aerial photography and USGS mapping indicate that Campbell Lake discharges to the northwest through a ditch. It is not known at what elevation this would occur. The lake's OHW is 925.5'. Campbell Lake is also characterized by a well developed wetland fringe and is relatively shallow for a lake though the actual maximum depth is not known. All this lakes drainage area is agricultural. Campbell lake does not have a public access.

Howard Lake

This lake's OHW is 957.2'. Like Campbell it has large, shallow wetland areas around its perimeter and it is not a deep lake though the actual maximum depth is not known. Based on USGS mapping the lake apparently discharges west into Shakopee though it is not known at what elevation, or how frequently, this occurs.

Markley Lake

Markley Lake straddles the City's eastern boundary toward the south part of town. The lake is landlocked and wide fluctuation in water levels has historically been a problem. Total lake area is approximately 21 acres and maximum depth is 22 feet. The characteristic feature of Markley Lake is its steep and heavily wooded slopes. Since it is landlocked the lake must be carefully managed. The City of Prior Lake Trunk Storm Sewer Fee Determination Study (February, 2001) considered a pumping station and forcemain from Markley Lake into the Credit River.

2.5 Existing Flood Insurance Studies

A Flood Insurance Study, dated March 1978, was completed for the City of Prior Lake by the Federal Insurance Administration (FIA). This study updated a Flood Hazard Boundary Map that was prepared by the FIA in 1975. The 1978 Flood Insurance Study was based on Prior Lake being a land-locked lake, no outlet was considered in the analysis. The method applied a water mass balance model to generate historic lake levels. That study established a 100-year elevation of 909.3 for Prior Lake and 914 for Spring Lake, which is the current elevation the City regulates the lake at for flood insurance purposes.

In September of 1994 a Flood Insurance, Interim Hydrology Report, was prepared by the US Army Corp of Engineers for the FIA to see if the 100-year flood elevation could be

lowered for Prior Lake. Several models over the past have been run with the results of each as shown in Table 2-4.

Table 2.4
Flood Insurance Study Results

Model	Agency	Event		Elevation
SCS, 1988	Watershed	7.2”	100-Year 10-Day Runoff, TR-20	909.2
HEC-1, 1994	Corp	7.2”	100-Year 10-Day Runoff	908.75
HEC-1, 1994	Corp	10.9”	100-Year 10-Day Rainfall, new CN’s	908.83
HEC-1, 1994	Corp	10.9”	100-Year 10-Day Rainfall, old CN’s	908.4
FIS, 1978	Barr		100-Year, Water Mass Balance	909.3

The SCS TR-20 and the HEC-1 models used a starting water surface elevation of 902.0 for Prior Lake and assumed that the outlet structure was closed. The 1978 FIS model resulted in the most critical elevation for Prior Lake. The adjusted critical elevation adopted by the FIA is 909.3 for Prior Lake.

The United States Army Corps of Engineers and the Federal Emergency Management Agency have mapped other floodplains within the City, 2030 growth area, and further south. Floodplains have been determined over the following components of the drainage system:

1. Fish Lake through the Buck Lake channel into Spring Lake
2. Rice Lake and Crystal Lake complex
3. Pike Lake
4. Spring Lake
5. Upper and Lower Prior Lakes

2.6 Other Natural, Biologic, and Water Resources

Upland and wetland water resources were thoroughly inventoried in the two studies that ran parallel to the LSWMP effort. The Wetland Management Plan, included as section 4 of this report, uses an assessment of each wetland as a method of determining its susceptibility to impacts from storm water runoff. This information is used to design a surface water storage system that protects the 2030 growth area from flooding while protecting valuable wetland resources.

The Natural Resources Inventory and Land Cover Mapping is a separate document. This provides detail on pre-agricultural vegetation and existing vegetation and will serve the City in its park and open space planning activities.

3. GOALS AND POLICIES

3.1 Purpose

The primary goal of Prior Lake's Local Surface Water Management Plan (LSWMP) is to plan for the orderly management of stormwater as development occurs in the city. The plan provides clear guidance on how Prior Lake intends to manage surface water in terms of both quantity and quality.

Much has changed since the city prepared its first LSWMP in 1973. Since that time the city has seen a marked increase in residential and commercial development. Not accounting for population growth due to annexation, city population has increased by 4,552 people from 1990 to 2000 (40%). Population growth combined with increased regulation of stormwater at both the state and federal level necessitate that the city's stormwater management goals evolve.

The goals and policies detailed in the LSWMP focus on future development as much as they do on the existing state of things. This dual emphasis on existing and future ensures that future development augments rather than diminishes the natural and built environments.

3.2 Background

3.2.1 2020 Vision and Strategic Plan

In 2002 Prior Lake embarked on a strategic planning process intended to identify the communities vision of itself in the year 2020. The committee convened for the visioning process included over 60 community volunteers from all walks of life. This group identified key issues facing the City:

- Growth and Land Management, including growth/land use, annexation, and relationship between downtown and the lake.
- Economic Vitality, including commercial development, financial resources, economic base and downtown redevelopment
- City/Community Quality and Amenities, including youth and senior citizen activities, trails, general amenities, housing stock and City aesthetics.

- City Services and Assets, including infrastructure and public safety.
- Preservation of Natural Resources, including environment and water quality.
- Intergovernmental Cooperation and Planning
- Community Leadership and Involvement

The Prior Lake LSWMP is a piece of a larger effort, conducted in partnership with the City's two watershed organizations, toward addressing the 2020 vision of natural resources preservation.

The key issues facing the City constitute its vision statements. The elements of that vision become the City's implementation goals out into the future. The 2020 vision includes goals in a variety of areas. Of specific importance in the context of the LSWMP are the following:

City Financial Resources
4) Update and implement a system for development-related fees to support community expansion and infrastructure needs.

Infrastructure
8) Continue City commitment to on-going infrastructure maintenance and replacement.

Natural Resources
1) Adopt and implement a plan to improve surface water quality.
2) Adopt and implement a Comprehensive Lake Management Plan for Prior Lake and other lakes within the City cooperatively with the watershed(s).
5) Develop and maintain City property, parks, and playfields in an environmentally responsible and aesthetically pleasing manner.

Downtown Redevelopment
Install rainwater gardens and other needed storm water devices to facilitate downtown improvements.

3.2.2 Comprehensive Plan 2020

The continued growth of Prior Lake has necessitated that its comprehensive plan be updated. The primary purpose of this effort is determination of the land use plan (included in the LSWMP as figure 2) which becomes the basis of the hydrologic calculations summarized in the LSMWP. Prior Lake completed its first comprehensive plan in 1973 and subsequent updates occurred in 1981 and 1996. These Comprehensive Plans are mandated by the Metropolitan Land Planning Act. The goals of the Prior Lake 2020 Comprehensive Plan are:

- Housing Quality and Diversity
- Environmental and Natural Resource Protection
- Economic Vitality
- Security

- Access
- Information and Technology
- Human Development

Specific to the goals and policies of this Local Surface Water Management Plan are the following 2020 Comprehensive Plan objectives under the Environmental and Natural Resource Protection goal.

OBJECTIVE No. 1: Provide suitable passive open space for the preservation of the natural environment and the enjoyment of residents.

POLICIES:

a. Retain natural ponding areas and wetlands, as appropriate.

b. Encourage platting of large planned unit developments.

OBJECTIVE No. 2: Provide for conservation and protection of the lakes and surface water.

a. Adopt and implement a plan to improve surface water quality.
b. Adopt and implement a Comprehensive Lake Management Plan for Prior Lake and other lakes within the City cooperatively with the Watershed District.
c. Adopt a program which ensures an acceptable level of lake access parking and responsible lake utilization.
d. Implement a groundwater plan emphasizing production, conservation, education, communication, and landscape maintenance.
e. Participate with the Prior Lake-Spring lake watershed District in developing and implementing a land management program for upstream storage.

The Prior Lake LSWMP expands upon the goals and objectives provided in the 2020 vision and the 2020 Comprehensive Plan.

3.3 City of Prior Lake LSWMP Goals and Policies

This section of the LSWMP outlines goals and policies specific to surface water management in Prior Lake and its environs. The goals and policies identified below are broad statements regarding the motivation and intent of the LSWMP. The policies that follow individual goals are specific requirements that promote attainment of the goal.

The City of Prior Lake has maintained its natural drainage patterns throughout most of its development. The City's goal is to foster continued optimum use of that natural drainage system while enhancing the overall water quality entering the lakes. The intent is to

prevent flooding while using identified best management practices to enhance surface water quality with minimal capital expenditures by the City.

The City of Prior Lake has adopted by ordinance the 1989 edition of MPCA publication "Protecting Water Quality in Urban Areas" for implementing best management practices for erosion control. The City of Prior Lake goals were established along the guidelines of the goals developed by the Metropolitan Surface Water Management Act (M.S. 473.875 to 473.883).

> *"The purpose of the surface water management programs required by Sections 473.875 to 473.883 is to preserve and use natural water storage and retention systems in order to (a) reduce to the greatest practical extent the public capital expenditures necessary to control excessive volumes and rates of runoff, (b) improve water quality, (c) prevent flooding and erosion from surface flows, (d) promote ground water recharge, (e) protect and enhance fish and wildlife habitat and water recreational facilities, and (f) secure the other benefits associated with the proper management of surface water."* (Ref. 20.)

3.3.1 Water Quantity

Goal 1:

Protect, preserve, and use natural surface and groundwater storage and retention systems to control excessive volumes and rates of runoff and flooding.

Policy 1.1:

Preserve and optimize where feasible the retention capacities of the present drainage systems by utilizing lakes, ponds, and wetlands for storing stormwater runoff. Measures shall be taken in newly developing watersheds to limit the proposed runoff rates to the existing rates or lower, or to the rates as specified in Policy 1.9 for the Jeffers Pond District. The City will partner with the PLSLWD toward implementing its retention storage goals within areas of the City that fall under municipal jurisdiction.

Policy 1.2:

Establish 100-year flood levels based on critical storm events.

Policy 1.3:

Alteration of wetlands is discouraged. Alteration may be allowed on individual basis if the alteration can be accomplished within the regulations of all federal, state, county, and local agencies that have jurisdiction over the particular wetland.

Policy 1.4:

Newly constructed detention areas shall meet the standards of the Public Works Design Manual (PWDM).

Policy 1.5:

All minor storm sewer system design and analyses shall be based on the 10 year rainfall event consistent with the standards of this plan and the City's PWDM.

Policy 1.6:

Pond detention basin facilities shall be designed for the 100 year rainfall event, consistent with the standards of this plan and the City's Public Works Design Manual.

Policy 1.7:

All hydrologic studies and drainage design shall be based on ultimate development of the 2020 plan. In some cases near term conditions should also be analyzed to determine whether unrestricted drainage from rural areas may lead to construction of interim facilities, or management base upon interim HWLs or discharge rates.

Policy 1.8:

There are numerous basins throughout Prior Lake which have no surface water outlet and are considered to be "landlocked". It is Prior Lake's policy to require the lowest building elevation opening be located 3 feet higher than the high water level of an adjacent water body. In the case of a land-locked basin, the City may require the openings to be set higher than the natural run-out elevation, depending on wetland vegetation. Emergency overflows shall be provided to any areas in new development without an overflow or outlet, however it is the policy of the City to include volume storage and leave landlocked basins disconnected when possible.

The intent is to store two one-hundred year storms back-to-back within landlocked basins and provide from this calculated elevation the required 3 feet of freeboard because elevations in excess of 100-year storms can be obtained through incremental smaller events. The outlet elevation needs to be carefully scrutinized. In cases of heavily wooded fringe areas around landlocked basins, it may be necessary to set the outlet elevation lower to prevent the killing of trees.

Policy 1.9:

In order to mitigate future development flows from increasing erosion potential to the outlet channel from Prior Lake the proposed two year event discharge rates will be held to rates agreed to in the Joint Powers Agreement (JPA) with the PLSLWD.

Policy 1.10:

All developments shall, to an extent determined by the City, provide land, funding, or a combination of both for developing regional detention sites to achieve the existing rates as indicated in this plan.

Policy 1.11:

Implement volume control and encourage low impact development techniques in developing and redeveloping areas to minimize runoff volumes that tend to increase with an increase in impervious area.

Policy 1.12

Regional detention basins are used to manage peak flow rates and provide flood storage and flood retention. On-site detention basins are utilized when regional basins are not in place or are not feasible. The city encourages the use of regional versus on-site basins for rate control and flood protection. Where flood and rate control basins are not feasible or desired.

Policy 1.13

Promote the use of overland versus pipe conveyance so that the benefits of natural channels can be realized. These benefits include filtration, flow attenuation, infiltration, and other water quality and quantity benefits. The city encourages the use of natural vegetation within overland conveyance systems.

3.3.2 Water Quality

Goal 2:

Identify and plan for means to effectively protect and improve water quality.

Policy 2.1:

The City will work with the PLSLWD on implementation of TMDL(s) for impaired water bodies in the City. The City will also complete a Nondegradation analysis as required by the MPCA.

Policy 2.2:

Actively develop and implement a community education program relating to preserving and improving water quality. This will principally be carried out through articles contained in the quarterly newsletter sent to all residents within Prior Lake.

Policy 2.3:

Construct sediment basins at outlets of storm sewers meeting the requirements of the Nationwide Urban Runoff Program (NURP) criteria, which serve to remove nutrients and sediments from runoff.

Policy 2.4:

Construct skimmers on new pond outlets to retain floating debris and oils.

Policy 2.5:

Environmental manholes (3 ft. sumps) shall be placed at the last manhole structure, which is road accessible, prior to discharge to remove sediments. Sump manholes are scheduled to be cleaned three times per year by the Public Works Department.

Policy 2.6:

Construct, where practicably feasible, storm water quality ponds which will serve not only new development, but also existing development where the situation arises to treat those areas that were established prior to detention pond criteria developed under EPA's Nationwide Urban Runoff Program (NURP).

Policy 2.7

Construct rainwater gardens or other smaller water quality retrofits within the downtown area and as redevelopment occurs in other untreated areas.

Policy 2.8

On-site treatment is the preferred method of implementing water quality. The more disperse the water quality system the longer lasting its performance. On-site treatment refers to more than just water quality ponds. It also includes reduced imperviousness, direct discharge of impervious surface onto pervious and not directly into the storm sewer system, use of rainwater gardens and filtration devices, and other such techniques that have the net result of reducing runoff volumes.

3.3.3 Recreation and Fish and Wildlife

Goal 3:

Protect and enhance fish and wildlife habitat and water recreational facilities.

Policy 3.1:

To the greatest possible extent, natural areas shall be preserved, especially when adjacent to wetland areas.

Policy 3.2:

Buffer zones of natural vegetation shall be maintained around lakes, ponds and wetlands as much as possible.

Policy 3.3:

Coordinate with the Department of Natural Resources (DNR) to protect rare and endangered species.

Policy 3.4:

Explore with the DNR and the Prior Lake/Spring Lake Watershed District new methods of eradicating or controlling eurasion water milfoil.

Policy 3.5:

Enforce the Wetland Conservation Act of 1991 in order to protect wetlands.

3.3.4 Enhancement of Public Participation; Information and Education

Goal 4:

Inform and educate the public concerning urban stormwater management and the problems pollutants cause if allowed to enter into our water resources.

Policy 4.1:

Enact a public education program based on the following objectives to reduce storm water pollution:

1) Raise awareness of the problem and solutions,

2) Promote community ownership of the lakes,
3) Recognize responsible parties and actions to date,
4) Merge public feedback into program execution.

3.3.5 Public Ditch Systems

Goal 5:

Organize a method in which to manage public ditch systems.

Policy 5.1:

No public ditches have been identified within the City of Prior Lake. If the need arises, the City will organize a method to manage public ditches.

3.3.6 Groundwater

Goal 6:

Promote ground water recharge, unless prevented by wellhead protection plan.

Policy 6.1:

Contribute to regional groundwater and source water protection planning.

Policy 6.2:

Provide a permanent ponding volume below the outlet or overflow in ponds and wetlands to promote ground water recharge.

Policy 6.3:

Maximize infiltration with the use of bioretention basins, infiltration basins, and other BMPs whenever possible, in open areas within all proposed developments following the State Stormwater Manual guidelines.

3.3.7 Wetlands

Goal 7:

Protect and preserve wetlands through administration of the Wetland Conservation Act.

Policy 7.1

Act as the local government unit responsible for enforcing the Wetland Conservation Act of 1991.

Policy 7.2

Discourage wetland disturbance. Wetlands must not be drained or filled, wholly or partially, unless replaced by restoring or creating wetland areas of at equal public value, as permitted by the Wetland Conservation Act. (Ord. 93-05, 3-15,93)

Policy 7.3

Up to one-half acre of "debit" wetland (filled or drained) will be allowed to be replaced through wetland "credit" in a bank which is located outside of Prior Lake's city limits, but State and County governments are exempt from this policy (M.S. 103G.222 (e)).

Policy 7.4

Restrict clearing and grading within close proximity of the wetland boundary to provide for a protective buffer strip of natural vegetation to promote infiltration of sediment and nutrients. In the event that grading occurs close to the wetland boundary native plant materials shall be reestablished as a buffer strip.

Policy 7.5

Establish for City use a wetland bank account to allow for wetland debits and credits for city projects.

Policy 7.6

Require that a wetland assessment be prepared for any project that includes a wetland.

The Wetland Management Plan, section 4 of this report, incorporates assessments of some of the larger wetlands within the 2020 growth area. These assessments will serve in lieu of this requirement for these specific locations until the spring of 2010. For projects that involve wetlands not assessed or for projects involving assessed wetlands after 2010, a wetland assessment using MnRAM methodology must be prepared and submitted with other review materials as spelled out in the PWDM.

3.3.8 Erosion and Sediment Control

Goal 8:

Prevent erosion of soil into surface water systems through enforcement of City SWPPPP.

Policy 8.1:

Erosion control plans shall be required for all land disturbance activities. The erosion control plans shall be consistent with the criteria as outlined in MPCA's "Protecting Water Quality In Urban Areas". Items to be checked are: silt fence and strawbale locations, maximum slopes, grading limits, etc.

Policy 8.2:

Temporary sediment basins shall be constructed in areas of new development to prevent sediment from leaving the construction area, as required by the NPDES Permit.

Policy 8.3:

Streets and property adjacent to construction areas shall be kept free from sediment carried by construction traffic.

Policy 8.4:

The City may prohibit work in areas having steep slopes and high erosion potential. The provisions of the shoreland ordinance should be followed to prevent impact to these erosion sensitive areas.

Policy 8.5:

The City shall maintain a street sweeping program to minimize sediment entering the drainage system. Streets will be swept twice yearly, once in the spring and once in the fall, unless overridden by the City SWPPP.

Policy 8.6:

Establishment of temporary and permanent vegetation shall be required to minimize the time that a graded area remains in an exposed condition.

Policy 8.7:

All existing storm drain inlets and conveyance systems shall be adequately protected from sedimentation.

3.3.9 Prior Lake's NPDES Permit

Goal 9:

Operate and manage the City's surface water system consistent with best current practices and the City's NPDES Permit

Policy 9.1:

Projects to correct existing deficiencies, to the extent they are identified, will be prioritized as follows:

1. Projects intended to reduce or eliminate flooding of structures in known problem areas
2. Projects intended to improve water quality in the City's lakes
3. Projects intended to retrofit water quality treatment into downtown redevelopment activities
4. Projects intended to reduce maintenance costs
5. Projects intended to restore wetlands and habitat

Policy 9.2:

The City will actively inspect, and properly operate, maintain and repair its storm water system. The City will follow a regular inspection, cleaning, and repair schedule. Frequency of maintenance will be event-based and informed by experience and inspection history.

Policy 9.3:

The City will follow best management practices on its own lands and for its own projects including street reconstruction projects – in accordance with the NPDES construction site permit and the City's NPDES MS4 Permit.

3.3.10 Financial Management

Goal 10:

Ensure that the costs of the surface water system are equitably distributed.

Policy 10.1:

The City will continue to update and apply area based charges so that the surface water related costs of development can be fairly borne by the development.

Policy 10.2:

The City will periodically update its storm water utility rate structure to accomplish the following:

1. Meet the requirements of its NPDES permit
2. Provide for the maintenance of ponds and outfall structures
3. Conduct repairs to the system
4. Update its system planning efforts
5. Implement rainwater gardens or other water quality retrofits with its downtown or other untreated redevelopment

3.4 County, State and Federal Agency Requirements

This section of the LSWMP presents a synopsis of the current agency requirements while acknowledging the existence of other requirements that may be applicable. The City is committed to the preservation and enhancement of its wetlands and water resources through full compliance with local, state, and federal wetland regulations.

3.4.1 Minnesota Department of Natural Resources

At the state level, Types 3, 4, and 5 wetlands are protected by the DNR by statute. These are areas typically recognized as wetlands and are generally characterized by open water and emergent vegetation throughout most of the year. The state has jurisdiction over only those wetlands appearing on the state's inventory of protected waters. Further, wetlands in the inventory were generally those in excess of 10 acres in rural areas or in excess of 2.5 acres in municipalities and incorporated areas. Map 1 shows some of the protected waters within the Prior Lake LSWMP study area.

If an area meets the jurisdictional criteria but is not on the state's inventory, it is not regulated by the DNR. If it does not meet the statutory criteria but is listed on the inventory, it still is subject to MNDNR regulation. There is no mechanism presently for adding or deleting wetlands. The inventory was begun in the late 1970s and all state inventories were completed during the early 1980s.

The MNDNR rules specify that permits may not be issued for any project except those that provide for public health, safety, and welfare. Any private development projects are effectively excluded from permit consideration by this requirement.

The other powers and duties of this Minnesota state agency and its commissioner are wide-ranging. As they affect surface water management within the City they include:

- Regulation of all public waters inventory waterbodies within the City – to the extent of their ordinary high water level.
- Regulation of certified floodplains around rivers, creeks, lakes and wetlands.
- Management of the Flood Hazard Mitigation program

3.4.2 U.S. Army Corps of Engineers (USACE)

Under Section 404 of the Clean Water Act, including subsequent modifications, the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE) regulate the placement of fill into all wetlands of the U.S. In 1993, there was a modification of the definition of "discharge of dredged material" to include incidental discharges associated with excavation. This modification of the "discharge of dredged material" definition meant that any excavation done within a wetland required the applicant to go through Section 404 permitting procedures. In 1998, however, this decision was modified so that excavation in wetlands is now regulated by the USACE only when it is associated with a fill action.

3.4.3 Board of Water and Soil Resources (BWSR)

The local and regional wetland rules are governed by the Wetland Conservation Act (WCA). The WCA, passed in 1991, extends protection to all wetlands unless they fall under one of the exemptions of the WCA. The WCA follows a "no net loss" policy. The wetlands covered under the WCA must not be drained or filled, wholly or partially, unless replaced by restoring or creating wetland of at least equal public value under an approved replacement plan. Replacement ratio is typically 2:1 (2 acres created for every 1 acre filled) for wetland impacts.

A designated Local Government Unit (LGU) is responsible for making exemption and no-loss determinations and approving replacement plans. Currently, Prior Lake acts as the LGU for WCA within the City's subdivision authority.

The powers and duties of this Minnesota state agency also include:

- Coordination of water and soil resources planning among counties, watersheds, and local units of government.
- Facilitation of communication among state agencies in cooperation with the Environmental Quality Board.
- Approval of watershed management plans.

3.4.4 Minnesota Pollution Control Agency

The USACE implements provisions of Section 404 of the Clean Water Act with guidance from the EPA through a permitting process. The Section 404 permit also requires a Section 401 water quality certification before it is valid. The EPA has given Section 401 certification authority to the MPCA.

The powers and duties of this Minnesota state agency and its commissioner include:

- Fulfilling mandates from the EPA, particularly in regard to the Clean Water Act.
- Administration of Prior Lake's NPDES Phase II MS4 permit.
- Administration of the NPDES construction site permit program.
- Administration of the NPDES industrial site discharge permit program.
- Development of TMDLs for waterbodies and watercourses in Minnesota (often in conjunction with other agencies or joint powers organizations such as watersheds).

3.4.5 Environmental Protection Agency

As it relates to surface water management, this agency is charged with interpreting and applying aspects of the Clean Water Act. This has led to the City's need for its NPDES MS4 permit. Total maximum daily load limits, a new initiative mandated by the EPA, also stem from the EPA's role as steward of the Clean Water Act.

3.4.6 Prior Lake Spring Lake Watershed District and Scott County Watershed Management Organization

The powers and duties of these Minnesota statutory authorities include:

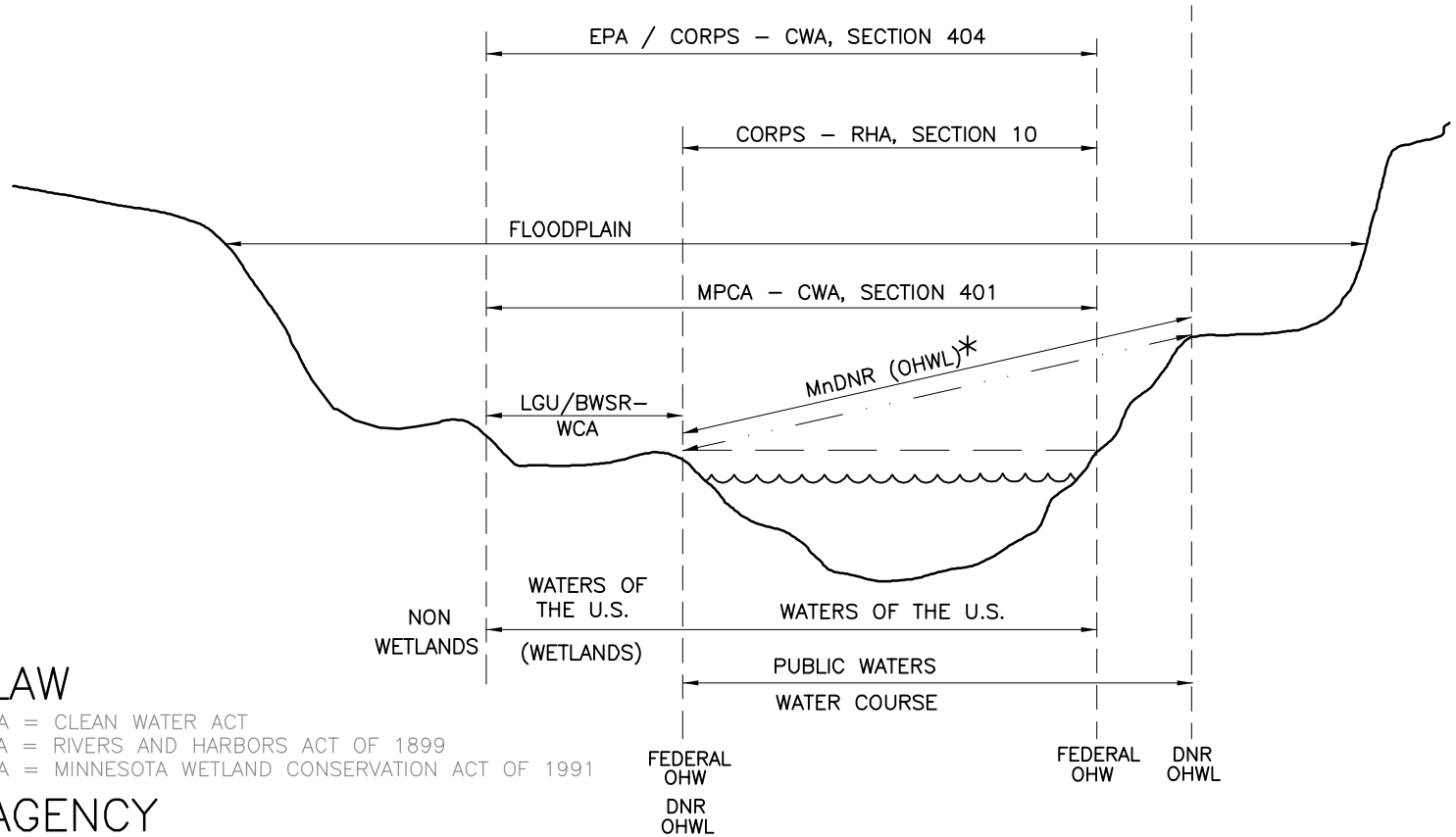
- Approval authority over local water management plans.
- Ability to develop rules regarding management of the surface water system
- Ability to determine a budget and raise revenue for the purpose of covering administrative and capital improvement costs.
- Regulation of land use and development when one or more of the following apply:
    - The City does not have an approved local plan in place
    - The City is in violation of their approved local plan
    - The City authorizes the watershed toward such regulation

3.4.7 State and Federal Jurisdictional Boundaries for Public Wetlands and Waters

Wetlands are delineated in accordance with the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1987). Wetlands must have a predominance of hydric soils. Hydric soils, by definition, are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, under normal circumstances, a prevalence of hydrophytic (water tolerant) vegetation typically adapted for life in saturated soil conditions. The USACE and the BWSR regulate wetlands as defined by a jurisdictional delineation.

For wetlands that fall under the MNDNR jurisdiction, the Ordinary High Water Level (OHW) determines the boundary of MNDNR jurisdiction. The OHW is established by the DNR. A summary of agency jurisdiction is presented in figures 4 and 5.

MINNESOTA STATE AND FEDERAL JURISDICTION OVER "WATERS"



LAW

CWA = CLEAN WATER ACT
RHA = RIVERS AND HARBORS ACT OF 1899
WCA = MINNESOTA WETLAND CONSERVATION ACT OF 1991

AGENCY

EPA = U.S. ENVIRONMENTAL PROTECTION AGENCY
CORPS = U.S. ARMY CORPS OF ENGINEERS
BWSR = MINNESOTA BOARD OF WATER AND SOIL RESOURCES
MnDNR = MINNESOTA DEPARTMENT OF NATURAL RESOURCES
LGU = LOCAL GOVERNMENTAL UNIT
MPCA = MINNESOTA POLLUTION CONTROL AGENCY

* THIS LINE COULD CHANGE ELEVATION AT ANY GIVEN X–SECTION. CONSEQUENTLY THE JURISDICTION CHANGES

PUBLIC WATERS: WATER COURSE

CITY OF PRIOR LAKE

SURFACE WATER MANAGEMENT PLAN

FIGURE 4

Bonestroo Rosene Anderlik & Associates

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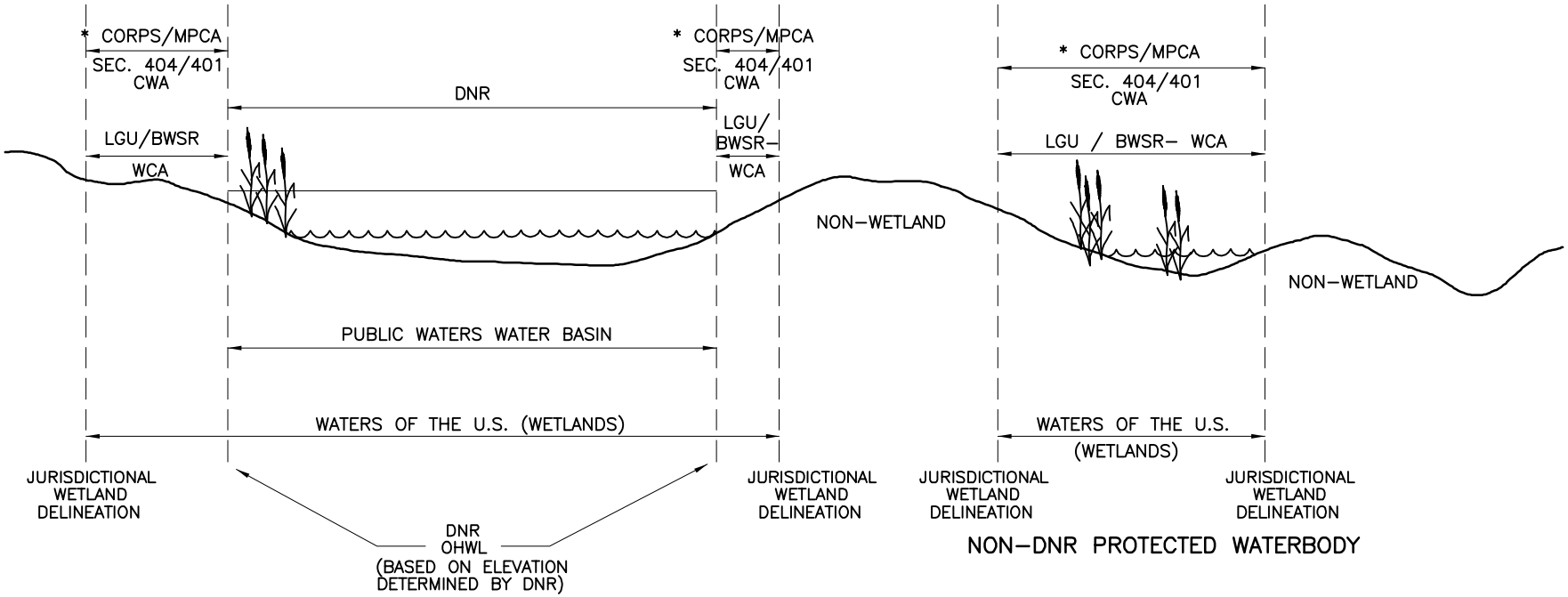
MINNESOTA STATE AND FEDERAL JURISDICTION OVER "WATERS"



LAW

CWA = CLEAN WATER ACT
WCA = MINNESOTA WETLAND CONSERVATION ACT

AGENCY

CORPS = U.S. ARMY CORPS OF ENGINEERS
BWSR = MINNESOTA BOARD OF WATER AND SOIL RESOURCES
DNR = MINNESOTA DEPARTMENT OF NATURAL RESOURCES
LGU = LOCAL GOVERNMENTAL UNIT
MPCA = MINNESOTA POLLUTION CONTROL AGENCY

* U.S. ARMY CORPS OF ENGINEERS. THE CORPS HAS JURISDICTION ON WETLANDS THAT ARE PART OF, OR CONNECTED BY TRIBUTARY, TO A NAVIGABLE WATER.

PUBLIC WATERS: WATER BASIN

CITY OF PRIOR LAKE

SURFACE WATER MANAGEMENT PLAN

FIGURE 5

Bonestroo Rosene Anderlik & Associates

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3.5 Agency Contacts

The primary contacts for local regulating agencies described above are presented below. These contacts are accurate as of December, 2004.

City of Prior Lake

City Engineer
City of Prior Lake
16200 Eagle Creek Ave. S.E.
Prior Lake, MN 55372
(952) 447-9830

Director of Public Works
City of Prior Lake
17073 Adelmann St. S.E.
Prior Lake, MN 55372
(952) 440-9890

Scott County WMO

c/o Scott County Natural Resources Manager
Scott County
200 Fourth Avenue West
Shakopee, MN 55379
(952) 496-8054

Prior Lake Spring Lake Watershed District

District Administrator
15815 Franklin Trail, Suite 100
Prior Lake, MN 55372
(952) 447-4166

Scott County Soil and Water Conservation District

District Manager
Scott County Soil and Water Conservation District
7151 West 190th Street, Suite 125
Jordan, MN 55352
(952) 492-5425

Minnesota Department of Natural Resources

Area Hydologist
Minnesota Department of Natural Resources

1200 Warner Road
St. Paul, MN 55106
(651) 772-7910

Board of Water and Soil Resources

Board Conservationist
Board of Water and Soil Resources
One West Water Street, Suite 200
St. Paul, MN 55107
(651) 296-3767

3.6 Water Resource Management-related Agreements

The City of Prior Lake is party to a 1981 joint powers agreement with the City of Shakopee and the Prior Lake Spring Lake Watershed District regarding the outlet channel for Prior Lake.

3.7 Impacts of the Prior Lake LSWMP on Other Units of Government

Upon approval of this LSWMP by the two watersheds with jurisdiction over the City, it is the City's intent to assume all permitting powers within it jurisdiction. Currently, the Scott County WMO does not issue permits, so no impact to this organization would occur. The Prior Lake Spring Lake Watershed District does issue permits for any planned activity that disturbs more than 10,000 square feet of land area. This threshold rises to one acre if the activity is not near a lake, wetland, or the Prior Lake outlet channel.

Since the watershed would still permit activities outside the City's jurisdiction its permit process would remain in place. Within its jurisdiction, the City will use the permit submittal requirements outlined in the watershed rules and updates. This will ensure consistency of approach for all projects.

The PLSLWD would continue in its role as a project review agency though it may defer to the City review process for projects that don't have a direct impact on Prior Lake or the Prior Lake outlet channel. The Prior Lake-Spring Lake Watershed District will also continue to have responsibility for water quality monitoring.

The Prior Lake LSWMP envisions the City and its two watersheds as partners in implementing this plan. In the PLSLWD lands, the City envisions the watershed taking the lead on water quality and lake water quality issues. The City and watershed would be equally responsible for implementation of the volume management targets discussed in Section 5 of this Plan with the City taking the lead in the 2020 expansion areas and the watershed taking the lead in areas outside the 2020 boundary.

The Scott County WMO portion of the City's current and 2020 boundary drains toward the City of Shakopee and Credit River. The flows and routes that discharge from Prior Lake into Shakopee were developed in consultation with the City of Shakopee and in conjunction with their surface water planning efforts. Further coordination will be needed to address the concerns of the WMO when areas within the upper reaches of the WMO watershed are proposed for development.

3.8 Watershed Goals and Strategies that Affect the City of Prior Lake

The City of Prior Lake goals and policies, outlined above, are a close reflection of those of the watersheds, only presented through the municipal filter. The PLSLWD has, over the past two years, developed goals related to volume management that will have a profound affect on the City as it implements its surface water system. Specifically, the PLSLWD is looking for 1,500 to 3,000 acre-feet of retention storage so that the impact of future development on Prior Lake and its outlet channel can be mitigated.

The PLSLWD has determined that increasing the outlet channel's permitted capacity above the current 65 cubic feet per second is not a viable option due to high cost, permitting problems, and downstream environmental impacts. What is needed is retention storage, which is storage without discharge. This retention volume, once filled, is emptied through evaporation, infiltration, or transpiration. One method of increasing the capacity of volume storage is through the restoration and creation of new wetland areas within the agricultural areas of the district. Through partnership with the District, these potential wetland creation sites can be planned for and set aside for the benefit of water quality and volume storage. District identified wetlands and low areas can be pursued through the City process as a result of this partnership

The 1,500 to 3,000 acre-feet of storage needed presents a challenge to both the City and the watershed, as does obtaining this storage while managing the City's wetlands according to the Wetland Management Plan. A large part of the volume storage will occur in existing natural wetlands. Each wetland will be rated for its susceptibilities to retaining the necessary volumes, forming a balance needed for wetland preservation with the system's volume storage needs. This approach, as well as the creation of new wetland areas will allow both wetland preservation and volume management to be accomplished.

4. WETLAND MANAGEMENT PLAN

4.1 Wetland Inventory Goals

The goal of this wetland inventory is the management of wetlands based on the functions they perform and to determine appropriate protection strategies for stormwater discharge to the wetlands if a land use change occurs that triggers a NPDES permit. Since smaller wetlands are not typically used as major components in a stormwater storage system, we focused our inventory on wetlands shown on the National Wetland Inventory (NWI) Map that were over 0.5 acres in size.

The inventory and assessment of wetlands allows the city to set up priorities. This plan includes a wetland inventory and ranking system that will assist the city in establishing priorities and focusing available resources for wetland protection, enhancement and restoration. Because all wetlands have value, all are protected, to some degree, in this plan.

The plan is designed to provide the following benefits:

- Provide wetland inventory, assessment, and management information:
- Aid in administration of the Wetland Conservation Act (WCA) by providing information regarding the wetlands functions:
- Enhance wildlife values of wetlands:
- Provide and enhance recreational values:
- Designate wetland restoration/enhancement opportunities:
- Protect wetlands and adjacent resources that provide valuable ecological support:
- Provide stormwater protection for wetlands.

It should be noted that this wetland inventory has been created for planning purposes only. Regulation of activities potentially impacting individual wetlands will be based on a site-specific delineation of the wetland boundary as part of a proposed project.

4.2 Wetland Identification

Wetland identification numbers used in the wetland inventory are based on the township, range and section in which the wetlands exist.

Each wetland is identified by the following numbers: county code (CC), township (T), range (R), section (S) and then an individual number for the wetland within the section. The following is an example of the wetland ID.

19	115	22	23	003
CC	T	R	S	Wetland No.

The wetland designation can be found on the Wetland Inventory Maps located in the back of the report.

4.3 Wetland Mapping

An ARC/INFO Geographic Information System (GIS) was used to aid in the inventory and final mapping of wetlands within the study area. The GIS database provides the city with a map that can be easily updated and integrated with other mapped data. The wetland Map includes the wetland location, estimate of the wetland boundary and Rankings that describe overall quality of the basin. The Stormwater Drainage Map includes the wetland location, estimated wetland boundary and Stormwater Rankings that describe susceptibility of the wetland to stormwater impacts. Preliminary layouts for future development should consider the wetland boundaries on the map as a guide. The wetland boundaries should be delineated early in the platting process to avoid development within the wetlands and buffer zones.

Since smaller wetlands are not typically used as major components in a stormwater storage system, the scope included collecting field information on all wetlands that are over 0.5 acres in size based on the NWI. The wetlands evaluated are shown on the Functional Ranking Map. It is important to note that several of the “not inventoried” wetlands shown on the map were less than the 0.5 acres based on the NWI, but based on Minnesota Land Cover Classification System (MLCCS) and field observations the boundaries have been enlarged to encompass the approximate entire wetland boundary.

4.4 Wetland Evaluation Methodology

4.4.1 Minnesota Routine Assessment Method

Wetlands are valued for a wide range of functions they perform, such as improving water quality, flood water attenuation, and providing fish and wildlife habitat. Recently, wetland scientists have developed methods to assess the functions of individual wetlands. The assessment evaluates characteristics such as plant community diversity and structure, connectivity to other habitat types, location in the watershed, and a wide range of other factors. The assessment is like a “report card” which evaluates the wetland’s functions and quality.

A combination of the Minnesota Routine Assessment Method Version 2.0 and 3.0 (MnRAM) was used to assess the functions of all the wetlands inventoried for this plan. This method was developed by the Minnesota Interagency Wetland Group as a field

evaluation tool to assess wetland functions on a qualitative basis. It is intended to document the field observations and interpretations of professionals who have had training and experience in wetland science. This method is not intended to be a rigid procedure but rather an aid to complement trained observation and interpretive skills with additional qualitative evaluation.

Wetlands were visited by trained personnel using MnRAM to assess wetland functions for Hydrologic Regime, Aesthetics, Restoration Potential, Wildlife Habitat, and Floral Diversity/Integrity. A ranking for Exceptional, High, Medium, and Low were provided for each function assessed and the results are provided in Appendix E.

4.4.2 Database

All the MnRAM data sheets were entered into a database available for use by the City. The database allows for quick retrieval of information for each wetland and allows queries to be performed to complete special searches within the database. For example, a search can be done to list all the wetlands that have high floral diversity.

4.5 Required Submittals at the Time of Development

In addition to a wetland delineation a Minnesota Routine Assessment Method 3.0 (MnRAM) should be provided to the City for each wetland located on the property at the time of development. MnRAM can be applied by a wetland professional hired by the applicant or it can be completed by the City with the time billed back to the applicant. The City or County will utilize the completed MnRAM and compare the condition of the wetland at the time of this plan's inventory with the existing condition and determine if the wetland ranking for storm water and buffer protections should be modified. The Wetland Ranking will be determined based on the following section "Wetland Ranking Methodology".

4.6 Wetland Ranking Methodology

Following the assessments of wetland functions, the next step in developing this plan was the ranking of each wetland for future management. Management recommendations are closely related to the functions each wetland performs in comparison to other wetlands in the study area.

It is important to note that the comparison domain for the wetlands is the study area. It is possible that a wetland found within the study area may not be considered to be of high quality if compared to a wetland in northern Minnesota, but in comparison with wetlands in the area, the wetland may be valuable for the functions it performs.

4.6.1 Habitat Protection/Wetland Ranking

An overall functional ranking for the wetlands within the study area categorized the wetlands into Unique, High, Moderate, and Low. These rankings are based on the wetland floral diversity/integrity combined with the wildlife habitat ranking determined

from MnRAM. The process that was used to determine the overall functional ranking is presented in detail in the Overall Functional Ranking Flow Chart (Figure 6). The ranking for the wetlands is shown on the Functional Ranking Map.

4.6.2 Stormwater Protection Ranking

One of the purposes of this Wetland Inventory was to determine stormwater protection standards for wetlands. There are many types of wetlands, each determined by its hydrology and vegetative composition.

The wetland's sensitivity to stormwater input is dependent on the wetland's community type and the quality of its plant community. Some wetlands (e.g., sedge meadows with carex species) are sensitive to disturbance and will show signs of degradation unless water quality, bounce and duration are maintained at existing conditions after construction. On the other hand, there are other wetlands (e.g., floodplain forests) which are better adapted to handle the fluctuating water levels and influx of sediment often associated with stormwater.

Site visits to the wetlands included a determination of the wetland plant community (-ities) and Floral Diversity using the key provided in MnRAM Version 2.0 and 3.0. The *Guidance for Evaluating Urban Storm Water and Snowmelt Runoff Impacts to Wetlands* completed by the State of Minnesota Storm Water Advisory Group was used as a guide in the determination of wetland sensitivity to stormwater.

This document divides wetlands into rankings that include: highly susceptible, moderately susceptible, slightly susceptible, and least susceptible. These rankings are provided on the Stormwater Susceptibility Map. The following are the procedures that were used to determine the wetland susceptibility ranking.

<u>Highly Susceptible:</u> A wetland is considered highly susceptible if:

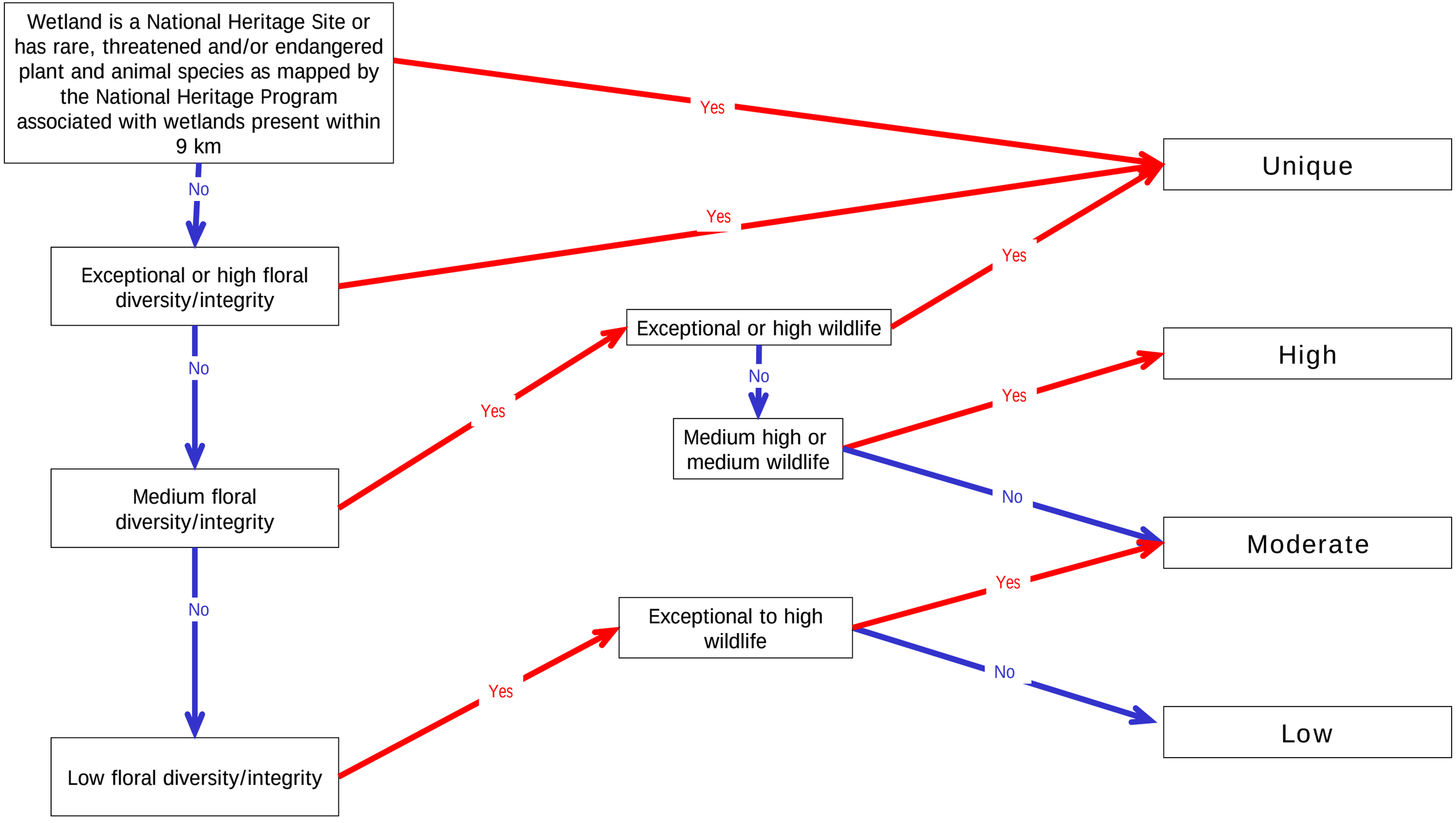
- Forty percent or more of the wetland complex has a highly susceptible wetland community (-ities) as shown in Table 4.1 and;
- Highly susceptible wetland community (-ities) have medium to exceptional floral diversity/integrity.

<u>Moderately Susceptible:</u> A wetland is considered moderately susceptible if:

- Forty percent or more of the wetland complex has a moderately susceptible wetland community (-ities) as shown in Table 4.1 and;
- Moderately susceptible wetland community (-ities) have medium to exceptional floral diversity/integrity.

<u>Slightly and Least Susceptible:</u> Wetlands with low floral diversity, as determined by

MnRAM, were considered to be least susceptible wetlands. Wetlands that do no fall under the high, moderate, or least susceptible categories are considered slightly susceptible. (Note: This category also includes wetlands or wetland complexes that contain 40 percent floodplain forest, which is a slightly susceptible wetland community, with medium to exceptional floral diversity.)



Overall Functional Ranking Flow Chart

Figure 6

Surface Water Management Plan
Prior Lake, Minnesota

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Bonestroo Rosene Anderlik & Associates
Engineers & Architects

Table 4.1
Wetland Community Susceptibility to Stormwater Impacts

Highly Susceptible Wetland Communities*		**Moderately Susceptible Wetland Communities***
Sedge Meadow	Low Prairies	Shrub-Carrs
Bogs	Coniferous Swamps	Alder Thickets
Coniferous Bogs	Hardwood Swamps	Fresh (wet) Meadows
Open Bogs	Seasonally Flooded Basins	Shallow Marsh
Calcareous Fens		Deep Marsh

* Wetland community (-ities) determined using key provided in MnRAM Version 2.0.

4.7 Wetland Management Standards and Recommendations

All of the inventoried wetlands within the study area were classified for Stormwater and Habitat Protection. Stormwater Protection standards are listed in Table 4.2 and 4.3 and Habitat Protection Recommendations are listed in Table 4.4. The Stormwater Protection Standards include Water Quality and Quantity Protection. The Habitat Protection Recommendations include Buffer Zones and No Grading Recommendations.

The following sections provide details of each protection strategy developed for wetlands within the City and County.

4.7.1 Water Quality

Water quality plays a significant role in the overall quality of a wetland. When the quality of the incoming water declines, the wetland's plant community may change to fewer numbers of species and retain only those species that are tolerant of high nutrient and sediment loads. Once a wetland's plant community is changed, the wetland's character and ecosystem will change, often to a less valuable system in terms of biodiversity, habitat for wildlife, and aesthetic enjoyment. Pretreatment recommendations have been developed to maintain the character of the wetland. BMPs can be used to accomplish the pretreatment requirements given in Table 4.2.

Table 4.2
Stormwater Protection Standards

Management Category	**Stormwater Phosphorus Pretreatment Recommendations**
Highly Susceptible[1]	150 ppb[2]
Moderately Susceptible	200 ppb
Slightly Susceptible	200 ppb
Least Susceptible	250 ppb

1) Includes lakes, creeks, streams, and rivers (as defined by the USGS).
2) A multi-cell configuration with lower cell being a constructed wetland or infiltration basin is recommended to achieve these levels of removal.

4.7.2 Water Quantity

In the recent past, surface water management plans have protected wetlands from nutrients but not water fluctuations or duration. In fact, it was common to use wetlands to reduce flooding potential through sizing storm sewer pipes to maximize bounce and detention time in wetlands.

This plan addresses stormwater quantity impacts to wetlands by providing protection strategies to maintain the existing integrity of the wetland through special protection strategies for highly, moderately, and slightly susceptible rankings and are described in Table 4.3 below.

Table 4.3
Wetland Quantity Standards

Hydroperiod Standard	Highly Susceptible	Moderately Susceptible	Slightly Susceptible	Least Susceptible
Storm Bounce 100-year	Existing	Existing plus 0.5 feet	Existing plus 1 foot	No limit
Discharge Rate	Existing	Existing	Existing or less	Existing or less
Inundation Period for 1 & 2 yr precipitation event	Existing	Existing plus 1 day	Existing plus 2 days	Existing plus 7 days
Inundation Period for 10 yr precipitation event	Existing	Existing plus 7 days	Existing plus 14 days	Existing plus 21 days
Outlet control elevation	Existing	Existing	(0-2 ft above existing overflow)	(0-4 feet above existing overflow)

"Existing" in this chart means the existing hydrologic conditions. If there have been recent significant changes in conditions, it means the conditions that established the current wetland.

4.7.3 Wetland Buffer Strip and Setback Protection

A wetland buffer is a vegetated area that surrounds a wetland and reduces negative impacts to wetlands from adjacent development. The needs identified for the establishment of wetland buffers are related to the functions that wetlands perform. Wetlands perform a variety of functions such as groundwater recharge, stormwater retention to improve water quality and reduce flooding, and wildlife habitat. Wetlands

are often neighborhood amenities because they can provide screening from adjacent neighbors and wildlife viewing opportunities.

Wetland buffers can help mitigate potential development impacts to wetlands by reducing erosion by stormwater; filtering suspended solids, nutrients, and harmful substances; and moderating water level fluctuations during storms. Buffers also provide essential wildlife habitat for feeding, roosting, breeding, and rearing of young, and cover for safety, movement, and thermal protection for many species of birds and animals.

Buffer Width Effectiveness for Wetland Protection

Buffer strips help mitigate the impacts of development adjacent to wetlands. Catch basins and storm sewers typically collect street and front yard drainage and direct the drainage to an appropriately sized pond for pretreatment prior to discharge to a wetland or waterbody. Backyard drainage typically reaches wetlands or waterbodies without pretreatment, thereby allowing lawn and garden chemicals, sediments, pet wastes, fertilizer and other types of contaminants to directly impact the receiving waterbody.

Buffer strips can provide needed treatment of stormwater drainage to protect wetlands from human impacts as areas develop. A secondary benefit is valuable habitat protection, especially near aquatic areas. Habitats adjacent to aquatic areas generally have a higher density of bird species than other habitats (Johnson, 1992). The reasons for this include: the proximity of habitat requirements (i.e., food, cover, and water), the increased number of niches (because of wider diversity of plant species and structure), and the high edge-to-area ratio that results from the linear shape of most riparian zones (MPCA, 1997).

As the buffer width increases, the effectiveness of removing sediments, nutrients, and other pollutants from surface water increases. In additions, as buffer width increases, direct human impacts, such as dumped debris (i.e., garbage, lawn and garden cuttings, or fill) and trampled vegetation will decrease. A field study of wetland buffers in Seattle showed that 95% of buffers less than 50 feet wide suffered a direct human impact within the buffer, while only 35% of buffers wider then 50 feet suffered direct human impact (Schueler, 1995). An overview of scientific literature on wetland buffers suggests the following minimum buffer widths for protection of these buffer functions (MPCA, 1997):

Water Quality Protection:	25 feet or more
(Depends on vegetation, slope, density and type of adjacent land use and quality of receiving water)	
Protection from human encroachment:	50 – 150 feet or more
Bird Habitat preservation:	50 feet or more
Protection of threatened, rare or endangered species:	100 feet or more

Although these buffer widths are suggested by the MPCA, the Wetland Conservation Act may require a different minimum buffer width to obtain wetland credits. The most recent Wetland Conservation Act Rules should be reviewed to determine the minimum buffer widths for credits.

Setbacks of 10 feet between structures and the edge of the buffer are the minimum recommended by the Minnesota Pollution Control Agency (MPCA, 1997). A setback of 20 feet from the wetland is recommended as part of this plan to insure there is usable space between structures and buffers and to prevent encroachment of lawns into buffer areas. For purposes of this plan a structure is anything which is built or constructed, an edifice or building of any kind, or any piece of work artificially build up or composed of parts jointed together in some definite manner.

Buffer strip features outlined in Table 4.4 below, are recommended standards based on the wetland management classifications that are shown on the Functional Classification Map. The purpose of these features it to mitigate the impacts (e.g., stormwater, human encroachment, etc.) of development. The PWDM will spell out specific buffer requirements required for development.

Table 4.4
Recommended Wetland Buffer Strip Features

Wetland Type	**Unique**	**High**	**Moderate**	**Low**
Buffer Strip Average Width	40 feet from delineated wetland edge	30 feet from delineated wetland edge	20 feet from delineated wetland edge	15 feet from delineated wetland edge
Buffer Strip Minimum Width	30 feet from delineated wetland edge	20 feet from delineated wetland edge	15 feet from delineated wetland edge	10 feet from delineated wetland edge
Structural Setback Distance	20 feet – from upslope buffer edge to building or other structure	20 feet – from upslope buffer edge to building or other structure	20 feet – from upslope buffer edge to building or other structure	20 feet – from upslope buffer edge to building or other structure
Native Vegetation in Buffer Strip	*Requirements below	*Requirements below	** Optional	** Optional

* Buffer area vegetation shall be considered adequate when the buffer has a continuous dense layer of perennial grasses, flowers, trees and/or shrubs. Vegetation shall be considered unacceptable if:

1) It is composed of noxious weeds (70% or more); or
2) Topography or sparse vegetation tends to channelize the flow of surface water; or
3) For some other reason the vegetation is unlikely to retain nutrients and sediment.

** While native vegetation is not required as part of this plan, a buffer may not be acceptable for Public Value Credit under the Wetland Conservation Act if it does not contain native vegetation.

4.8 Wetland Restoration/Enhancement Opportunities

Wetland restoration/enhancement sites were identified during the field inventory and will be further investigated at the time of development. The wetland restoration portion of the filled out MnRAM will be reviewed at the time of development to determine the potential for restoration of wetlands on the property. The potential for wetland restoration will be determined based on the ease with which the wetland could be restored, the number of landowners within the historic wetland basin, the size of the potential restoration area, the potential for establishing buffer areas or water quality ponding, and the extent and type of hydrologic alteration.

Wetlands and low areas identified by the PLSLWD for volume management and wetland restoration should be considered. Wetlands that have hydrologic restoration proposed would likely qualify as wetland banking or mitigation sites if restored. Wetland banking is a type of mitigation, or replacement for wetland losses, allowed under State and Federal rules. Wetland banking allows the appropriate amount and type of wetland acreage to be purchased from an account holder who has a "bank" of functioning wetlands. These wetlands may have been restored from previously drained or filled wetlands, or created where wetlands did no previously exist. Wetland banking is contrasted with project-specific replacement where the project sponsor creates or restores a wetland specifically to replace a wetland that is being drained or filled. Project specific replacement is usually done on-site, while wetland banks are typically located in another place in the community or watershed. Site-specific replacement should be encouraged when a wetland restoration or creation is possible on-site. When site-specific replacements are not ecologically appropriate, then wetland banks located within the City and County should be the next priority. The funding for the wetland restoration sites can come from a variety of sources, which include:

- BWSR Banking Money for Road Construction Projects
- Department of Natural Resources, Conservation Partners and Community Environmental Partnerships grants
- Department of Natural Resources Greenway grants
- Soil and Water Conservation District grants
- Prior Lake Spring Lake Watershed District grants

4.9 Wetland Stewardship

There are a number of things that residents, cities, or counties can do voluntarily to enhance wetlands and buffer strips that surround wetlands. This section describes some of these practices.

4.9.1 Enhancement

Native wildflowers, grasses, shrubs and trees can be planted in the wetland or the adjacent buffer areas to enhance habitat and stormwater filtering. Habitat can be enhanced by creating more vertical layers (such as adding trees or shrubs where these are absent), and by adding plants that provide food and cover, such as fruiting shrubs. Increasing the structural and plant species diversity in the landscape provides additional habitat niches, and can increase the numbers and species of animals using the area. Many of these plants also make the landscape more attractive for human inhabitants.

Species that are native to the area will probably require the least maintenance, survive harsh Minnesota weather more easily, and provide the greatest habitat benefits. The book Landscaping for Wildlife by Carroll Henderson and other references that are available in most bookstores or from Minnesota Extension Services, can help landowners to add plants that enhance the wetland and increase the variety of attractive plants and wildlife.

4.9.2 Control of Invasive Exotic Species

Several non-native species (sometimes called exotics) have become problems in Minnesota wetlands and adjacent uplands. These include purple loosestrife, European buckthorn, black locust, reed canary grass, and leafy spurge. These plants invade native plant communities and can take over rapidly, eliminating native plants that provide important food and habitat benefits.

Invasion by exotic species can be controlled by minimizing disturbance to wetlands and buffer areas as much as possible to avoid the creation of openings for exotics to invade. Small populations of many exotic species can be controlled by hand removal or direct application of appropriate herbicides that are licensed for use near water. The Minnesota DNR provides information about identifying or controlling exotic species around wetlands.

4.9.3 Habitat Structures

Wetlands provide important habitat for many species of birds and other animals. Adding wood duck nest boxes and other types of nesting structures for ducks and other birds can augment nesting habitat, help birds to avoid predators, and enhance opportunities to view and enjoy wildlife. The Minnesota DNR, Minnesota Waterfowl Association, and other habitat enhancement organizations can provide information about the types and sources of structures available. Retaining or adding stones, logs, and dead trees near wetlands and within buffers provides habitat for turtles, other reptiles and amphibians, and resting areas for birds and animals.

Habitat areas may also become refuges for large populations of deer, geese, and wildlife that may become a nuisance in urban areas. When needed, population control measures should be included in management plans for these areas. Minnesota DNR staff can provide assistance in the development and implementation of these plans.

4.9.4 Learning Opportunities

Schools and other organizations can adopt wetlands and adjacent areas for use as outdoor classrooms. Students, parents, and teachers can add native wetlands and upland plants, habitat structures, and other enhancements to increase learning opportunities and encourage other wetland owners in the area to make similar enhancements.

5. SYSTEM ASSESSMENT AND DESIGN

5.1 General

This section of the Prior Lake Local Surface Water Management Plan (LSWMP) serves two functions. The system assessment portion catalogues the various assessments of problems that the Plan must address whether they relate to water quality, wetland protection, flooding, volume management, or lakes management. The intent is to identify the source of problems and, more importantly, specific actions the City will take to address these problems either independently or in collaboration with some other organization – most commonly one of the watershed management organizations.

The system design portion of this section describes the 2030 growth area surface water management system. This system is shown in maps 1 through 5. The discussion of the proposed system revolves around answering the following questions:

- What are the general drainage patterns of the 2030 and existing system?
- What does the 2030 system entail in terms of storage, conveyance, volumes, and discharge rates?
- Where does the proposed system discharge and what constraints in the existing system limit discharge of the 2030 system?
- What is the impact of agricultural drainage, outside the 2030 growth area, on the proposed and existing urban system?
- How have proposed wetland bounce, and duration of HWL, been determined by management guidelines of the Wetland Management Plan, section 4 of the LSWMP?
- What opportunities exist for obtaining the retention storage identified by the PLSLWD both in the 2030 growth area and outside it?
- What is the impact of the City of Prior Lake's 2030 urban system on agricultural areas and other municipalities?
- Are there any existing ponds where calculated HWL is a concern?

Maps 1 through 5 show the major drainage divides, storage areas, conveyance (including pipe and channels), wetlands and lakes that have been incorporated into the Prior Lake LSWMP.

The purpose of Maps 1 through 5, and the system design portion of this section, is to identify and quantify the infrastructure needed to allow continued development in Prior Lake while avoiding the negative impacts, such as flooding and water resource degradation, often associated with development.

5.2 System Assessment

5.2.1 Water Quality Assessments

5.2.1.1 Clean Water Act Assessments

A number of water bodies within the existing City and its 2030 growth boundary are listed in the state impaired waters list. Known as the 303(d) list from the applicable section of the federal Clean Water Act, these waters are ones that do not currently meet their designated use due to the impact of a particular pollutant or stressor. If monitoring and assessment indicate that a water body is impaired by one or more pollutants, it is placed on the list. At some point a strategy would be developed that would lead to attainment of the applicable water quality standard. The process of developing this strategy is commonly known as the Total Maximum Daily Load (TMDL) process and involves the following phases:

1. Assessment and listing
2. TMDL study
3. Implementation plan development and implementation
4. Monitoring of the effectiveness of implementation efforts

Responsibility for implementing the requirements of the federal Clean Water Act falls to the U.S. Environmental Protection Agency (USEPA). In Minnesota the USEPA delegates much of the program responsibility to the state Pollution Control Agency (MPCA). Information on the MPCA program can be obtained at the following web address: http://www.pca.state.mn.us/water/tmdl/index.html. The following is an excerpt from the MPCA website describing the program and its need:

> The Clean Water Act requires states to publish, every two years, an updated list of streams and lakes that are not meeting their designated uses because of excess pollutants. The list, known as the 303(d) list, is based on violations of water quality standards and is organized by river basin. Environmental organizations and citizen groups have sued the EPA because states have not made adequate progress to meet Section 303(d) requirements. The EPA has been sued for various reasons. Over the past 10 years, lawsuits have been filed in 42 states and the District of Columbia. Of those, 22 have been successful. There is currently no such lawsuit in Minnesota. However, beyond the federal requirements, there are many reasons for us to move forward with the development of TMDLs. Foremost is the need to clean up our rivers, streams and lakes to maximize their contributions to the state's economy and quality of life and to protect them as a resource for future generations.
>
> For each pollutant that causes a water body to fail to meet state water quality standards, the federal Clean Water Act requires the MPCA to conduct a TMDL study. A TMDL study identifies both point and nonpoint sources of each pollutant that fails to meet water quality standards. Water quality sampling and computer modeling determine how much each pollutant source must reduce

its contribution to assure the water quality standard is met. Rivers and streams may have several TMDLs, each one determining the limit for a different pollutant.

Table 5.1 lists the 303(d) impaired waters within the existing boundary and 2030 growth boundary.

Table 5.1
303(d) 2004 Final List of Impaired Waters
Within the City of Prior Lake and its 2030 Growth Area

Water Body	Year First Listed	DNR #	Affected Use	Pollutant or Stressor	TMDL start/ TMDL complete
Spring	2002	70-0054	Aquatic recreation	Excess nutrients	2004/2008
Spring	1998	70-0054	Aquatic consumption	Mercury, FCA	1999/2011
Upper Prior	2002	70-0072	Aquatic recreation	Excess nutrients	2004/2008
Upper Prior	2002	70-0072	Aquatic consumption	Mercury, FCA	2002/2015
Lower Prior	2002	70-0026	Aquatic consumption	Mercury, FCA	2002/2015
Pike	2002	70-0076	Aquatic recreation	Excess nutrients	2007/2011

Notes: FCA stands for fish consumption advisory and is thus not an independent pollutant or stressor.
Source: MPCA

The Minnesota River, downstream of the Prior Lake outlet channel, is also listed. This listing will potentially affect management of drainage that directly discharges to the outlet channel. The river's affected uses are aquatic consumption, aquatic recreation, and aquatic life and the pollutants or stressors that have been identified as causing these impairments are the following:

- Fecal coliform
- Low oxygen
- Mercury
- PCB
- Turbidity

The absence of a waterbody from the 303d List does not necessarily mean the reach is meeting its designated uses. It may be that the reach has either not been sampled or there are not enough data to make an impairment determination. Additionally, where mercury is identified as a stressor, the TMDL approach will be regional in nature as mercury is most commonly an air-borne pollutant.

Most likely the PLSLWD will be the lead agency charged with developing TMDL's for the basins identified above. The City must be involved in developing the implementation plan. It is likely that once a TMDL plan is in place this LSWMP will have to be amended to incorporate the requirements of the TMDL.

Only a handful of TMDLs have been completed or are in process – none for the water bodies identified above. As shown in table 4.1 the first TMDL implementation plan is due in 2008 for excess nutrients in Spring Lake and Upper Prior Lake.

City of Prior Lake Actions: The City of Prior Lake will, through its development review and permitting process, quantify the change in nutrient loading due to implementation of water quality treatment in developments. This quantification will be linked to the city's GIS mapping so that a database can be maintained of how nutrient loading has been changed. The City will use its hydrologic model to determine the extent to which volume management has reduced nutrient loadings to the lakes and outlet channel.

5.2.1.2 Prior Lake Spring Lake Watershed District Assessments

When discussing nutrient impacts to lakes the nutrient most commonly identified is phosphorus. Through its own monitoring efforts and those of the Citizen Assisted Monitoring Program (CAMP) run by Metropolitan Council, the PLSLWD has been collecting data on nutrient loading into the impaired waters, and others, identified above.

The PLSLWD water quality data collection and monitoring efforts consist of tributary/outlet monitoring and in-lake monitoring. Tributary/Outlet monitoring and other sampling occurs at the following locations:

- County Ditch 13 at the second/upstream crossing of Hwy 13 (PLSLWD site CD 1)
- Outlet of the Hwy 13 Treatment Wetland (PLSLWD site CD2)
- Outlet of the desiltation basin on County Ditch 13 tributary just upstream of Spring Lake (PLSLWD site CD3)
- Outlet from Lower Prior Lake (PLSLWD site PLO)
- Outlet from Spring Lake (PLSLWD site SLO)

A total of six lakes within the PLSLWD were monitored in 2003 as part of the Metropolitan Council's CAMP. These were:

- Spring Lake
- Upper Prior Lake
- Lower Prior Lake
- Pike Lake
- Fish Lake
- Cates Lake

Each of the lakes was monitored by volunteers in one location, usually the deepest area of the lake. Samples were collected approximately every two weeks between April and October and were sent to the Metropolitan Council's laboratory for analysis of Total Phosphorus, Total Kjeldahl Nitrogen, and Chlorophyll-a. Volunteers also measured

surface water temperature and Secchi disk transparency, and rated the physical condition and recreational suitability of the lake during each visit.

Summaries of the CAMP monitoring program results are provided the Metropolitan Council's Environmental Services (MCES) 2003 report. Table 5.2 summarizes some of this data and is reprinted from the PLSLWD 2003 Annual Report

Table 5.2
Growing Season (May –Sept.) Average Lake Monitoring Results, 2000-2003
From PLSLWD 2003 Annual Report

Lake	**Total Phosphorus, µg/L**				**Secchi disk, meters**				**Chlorophyll-a, µg/L**			
	2000	**2001**	**2002**	**2003**	**2000**	**2001**	**2002**	**2003**	**2000**	**2001**	**2002**	**2003**
Spring	170	93	148.8	103.9	1.54	1.1	0.6	1.6	50	58.3	116.6	44.2
Upper Prior 1	85	88*	102	64.5	1.36	0.8*	0.7	1.4	63	80*	62.3	54.9
Upper Prior 2			96.0				0.8				67.0	
Lower Prior 1	24	21	26.5	40.4	2.89	2.4	2.5	3.3	12	14	13.0	8.0
Lower Prior 2	28	29	37.3		1.99	1.8	1.8		17	22	27.5	
Fish	46	66	76.4	53.5	2.59	2.8	1.0	2.4	18	19	37.5	25
Pike 1	136	139	198	225.6	0.31	1.3	0.5	0.8	13	102	57.0	120.3
Pike 2			97.0[+]				0.5				74.0	
Cates			22.2	29.1			1.7	1.8			7.7	4.8

Notes: *Samples unintentionally weighted toward poorer-quality late summer months, which may have biased results.
[+]Three TP data points are missing from the database.

Lake water quality is often described by the "trophic" or nutrient status. In oligotrophic lakes low concentrations of nutrients lead to a reduced ability to support aquatic life, including algal blooms. Oligotrophic lakes are considered clean. Further along the spectrum of nutrient concentration are mesotrophic, eutrophic and hypereutrophic lakes. Mesotrophic lakes are still considered suitable for recreational purposes while eutrophic, and, particularly, hypereuthrophic lakes frequently see algal blooms thereby reducing their suitability for recreational purposes.

Scientists use a tool called the Carlson Trophic State Index (TSI) to determine where a lake lies on the spectrum from oligotrophic to hypereutrophic. TSIs are calculated based on water quality indicators such as total phosphorus concentration (TP), chlorophyll-a concentration (Chl-a), and Secchi disk transparency. Phosphorus is often the nutrient that limits plant growth is lake systems. Additions of phosphorus (e.g., external P inputs) will therefore enhance plant growth, including algae. Chl-a is a green pigment in algae. Chl-a concentration provides an indication of how much algae are in the water body. Secchi depth, the third trophic state indicator, is a measure of lake transparency or clarity. Murky and cloudy lakes have low Secchi disk readings, which usually correspond to higher TP and Chl-a concentrations.

TSIs are calculated based on relationships between these indicators and trophic status. Higher TSIs correspond to high nutrient status. Table 5.3 comes from the MPCA's lake data website and explains the relationship between the TSI value and lake nutrient status.

Table 5.3
Carlson's Trophic State Index (TSI) Explanation

TSI <30	Classic Oligotrophy; Clear water, oxygen through the year in the hypolimnion, salmonid fisheries in deep lakes.
TSI 30-40	Deeper lakes still exhibit classical oligotrophy, but some shallower lakes will become anoxic in the hypolimnion during the summer.
TSI 40-50	Water moderately clear, but increasing probability of anoxia in hypolimnion during summer.
TSI 50-60	Lower boundary of classical eutrophy: Decreased transparency, anoxic hypolimnion during the summer, macrophyte problems evident, warm-water fisheries only.
TSI 60-70	Dominance of blue-green algae, algal scums probable, extensive macrophyte problems.
TSI 70-80	Heavy algal blooms possible throughout the summer, dense macrophyte beds, but extent limited by light penetration. Often would be classified as hypereutrophic.
TSI > 80	Algal scums, summer fish kills, few macrophytes, dominance of rough fish.
From: The Minnesota Pollution Control Agency (MPCA) lake data web site.	

MCES, in the context of its CAMP program, develops lake grades for its monitored basins. Table 5.4, from the PLSLWD 2003 Annual Report, illustrates the relationship between trophic status and this lake grade.

Table 5.4
Relationship of MCES Lake Grade to Trophic Status

MCES Lake Grade	**A**	**B**	**C**	**D**	**F**
	←	—	—	—	→
Trophic Status	**Oligotrophic**	**Mesotrophic**		**Eutrophic**	**Hypereutrophic**

Table 5.5 presents the TSI values with the MCES lake grades.

Table 5.5
Trophic Status of District Lakes, 2003

	2003						Previous MCES Grades		
Lake	**TSI (TP)**	**TSI (Chl-a)**	**TSI (SD)**	**TSI (Ave)**	**MCES Grade**	**Trophic Status**	**2002**	**2001**	**2000**
Spring	71	68	53	64	C	Eutrophic	F	D	D
Upper Prior 1	64	70	55	63	C	Eutrophic	D	D	D
Lower Prior 1	57	51	43	50	B	Mesotrophic	B	B	B
Fish	62	62	47	57	C	Eutrophic	D	B	C
Pike 1	82	78	63	74	F	Hypereutrophic	F	D	D
Cates	53	46	52	50	B	Mesotrophic	B	N/A	N/A

According to the PLSLWD 2003 Annual Report:

> All of the lakes in the District are either eutrophic or hypereutrophic except for Cates Lake and Lower Prior Lake, which are on the upper boundary of mesotrophy. Review of Table 4.5 and comparison with the TSI descriptions in Table 4.3 shows that both Cates Lake and Lower Prior Lake are very close to the boundary for a eutrophic lake, and this boundary is where problems really start to become evident. The western end of Lower Prior Lake is mesotrophic/eutrophic largely because of water flowing through this end from Upper Prior Lake to the outlet. The rest of Lower Prior Lake has a limited watershed and is isolated from a majority of the inflowing water from Upper Prior Lake.

The continued assessment of these lakes has led the PLSLWD to emphasize reduction in phosphorus loading to the lakes. This will also be the focus of a watershed-based TMDL, when developed, for the impaired waters listed in table 5.1. Since the mercury TMDL will be regional in nature, the City of Prior Lake and PLSLWD will focus their efforts on reducing nutrient loading. According to the PLSLWD:

> For noticeable improvements to occur in lake water quality, TSI values need to be reduced to 55 or less. On the reverse, if these lakes are allowed to decline further, algae blooms will become worse and fish kills are probable.

In addition to collecting and reporting on the above data, the PLSLWD has created a model to quantify the internal and external phosphorus load for Spring and Upper Prior Lakes. This modeling effort is summarized in the 2003 Annual Report:

> In summary, sediment phosphorus release and recycling accounts for approximately 43 to 78% of the total phosphorus load for Spring Lake and 49% of the total phosphorus load for Upper Prior Lake. As a result, significant water quality improvements in each lake will require implementation of lake improvement options that would greatly minimize the potential for sediment phosphorus release. In addition, significant reductions in phosphorus from County Ditch 13 and Spring Lake should result in significant water quality improvements in Spring Lake and Upper Prior Lake, respectively. To a lesser degree, senescing macrophytes and bottom-feeding fish also affect the water quality of Spring and Upper Prior Lakes, since each of them contribute approximately 5 to 15% of the total phosphorus load to each lake.

City of Prior Lake Actions: The City of Prior Lake and Prior Lake Spring Lake Watershed District should consider whether moving forward jointly on a nutrient TMDL is warranted. Near term development of a TMDL and the subsequent implementation plan makes sense for several reasons:

- The TMDL will target nutrients. Nutrient reduction, and improvement in lake water quality, is a primary goal of both the City and watershed district.
- The tributary area to all the impaired lakes is completely under the jurisdiction of either the City (existing boundary and 2030 growth boundary) or watershed, which makes for clearer lines of authority in implementation.
- Certain efforts toward volume retention – necessary for managing Prior Lake and the outlet – will tend to reduce nutrient loading. It is not known if efforts completed before creation of a TMDL will be credited toward the TMDL implementation. Both the City and the watershed would stand to benefit if their volume management strategies, as they are implemented, were also considered steps to TMDL implementation.
- The more of the City that develops prior to a TMDL, the more of the City that might be subject to retrofits to meet the requirements of the TMDL implementation plan. If the TMDL precedes development then the cost of implementation can be borne by development rather than directly through the City's storm water utility and general fund or the watershed levy.

5.2.1.3 Scott County Watershed Management Organization Assessments

The Scott County WMO is in the early stages of its existence and thus has not had the time to organize around an assessment of water quality within its jurisdiction. Its 2004 Comprehensive Water Resources Management Plan includes limited assessments of a couple lakes including Markley within the City of Prior Lake. To date no long term water quality trend is obtainable from the Markley Lake monitoring, which has been occurring for seven years. In 2003 the lake was given a grade of "C", which indicates that it lies between mesotrophic and eutrophic. Refer to table 4.3 for a description of these terms.

Campbell Lake and Howard Lake have not been assessed as to their water quality. It is generally understood that these lakes are subject to frequent late summer algal blooms indicating that they likely tend toward the eutrophic to hypereutrophic end of the water quality spectrum.

5.2.2 Water Quantity Assessments

5.2.2.1 City Identified Problem Areas

Cates channel should be monitored for future erosion.

5.2.2.2 Pike Lake and Jeffers Pond Districts

In 2001 the City of Prior Lake prepared its Trunk Storm Sewer Fee Determination Study. The purpose of this study was to take the land slated for development at that time (generally land within the City limits) and develop a plan for providing a stormwater management system for that land. The study's emphasis was toward developing a defensible area charge. In order to estimate costs for the future stormwater management system some modeling was conducted. Within the Jeffers Pond and Pike Lake Districts this modeling became the basis for an agreement between the Prior Lake Spring Lake Watershed District and the City of Prior Lake regarding allowable discharge rates from the Pike Lake and Jeffers Pond districts.

The agreement that was arrived at between the Watershed and City is summarized in a memorandum to the City from the Watershed's engineer. This memorandum is dated July 21, 2003 and is included in appendix E. The essence of the agreement is that allowable 100-year rates of 35 cfs and 300 cfs were set for the Jeffers Pond and Pike Lake Districts, respectively. The allowable 2-year rates were set at 23.3 cfs and 206 cfs from the Jeffers Pond and Pike Lake Districts, respectively. Tables 5.6 and 5.7 are reprinted from that memorandum and distribute the allowable flow to specific subdistricts. The subdistrict nomenclature is from the 2001 Study. Similar tables appear in section 6 of this Plan detailing the revised targets for these areas in the context of more recent modeling efforts. The allowable rates will remain those in tables 5.6 and 5.7. The more recent modeling results in section 6 are not intended to revise that already agreed upon rates and are presented merely as illustration that the allowable rates have been considered in the modeling and system planning efforts. This rate scheduled will be replaced when a Joint Powers Agreement (JPA) for the operation and maintenance of the Prior Lake Outlet channel is approved by the City.

Table 5.6
PLSLWD memo Table #1: 2-YR Peak Flow Rates

Discharge Subwatershed	Subwatersheds Upstream	Total Subwatershed Area (ac)	Subwatershed Regulated Peak Flow[T] (cfs)	Subwatershed Regulated Peak Flow + 25% (cfs)	Discharge/ Acre (cfs)
JP-2	JP-1	105.2	18.6	23.3	0.22
Jeffers District Total			**18.6**	**23.3**	**0.22**
PL-5	PL-1, 2, 3, 4, 17	350.1	51.5*	51.5*	0.20
PL-7	PL-6, 8, 9, 10	232.7	45.8	57.3	0.25
PL-11		144.2	29.7	37.1	0.26
PL-12	PL-13	173.5	7.6	7.7*	0.04
PL-16		34.0	7.6	9.5	0.28
PL-18		7.7	1.8	2.3	0.30
PL-21		4.9	1.6	2	0.41
Pike Lake District Total			**164.7**	**206.0**	**0.22**

Table 5.7
PLSLWD memo Table #2: 100-YR Peak Flow Rates

Discharge Subwatershed	Subwatersheds Upstream	Total Subwatershed Area (ac)	Subwatershed Regulated Peak Flow** (cfs)	Discharge/Acre (cfs)
JP-2	JP-1	105.2	35	0.33
Jeffers District Total			**35**	**0.33**
PL-5	PL-1, 2, 3, 4, 17	350.1	51.5	0.20
PL-7	PL-6, 8, 9, 10	232.7	93.5	0.40
PL-11		144.2	114.0	0.79
PL-12	PL-13	173.5	7.7	0.04
PL-16		34.0	26.4	0.78
PL-18		7.7	3.2	0.42
PL-21		4.9	2.7	0.55
Pike Lake District Total			**299**	**0.42**

[T] Peak flow values taken from Prior Lake – Spring Lake Watershed District Outlet Channel XP-SWMM model.
* Maximum runoff value assumed as 100-yr peak flow rate from City of Prior Lake Trunk Storm Sewer Study if runoff value in Prior Lake – Spring Lake Watershed District Outlet Channel XP-SWMM model was greater.
** Peak flow values taken from City of Prior Lake Trunk Storm Sewer Study.

5.2.2.3 PLSLWD Volume Management

The Water Resources Management Plan for the PLSLWD, completed in 1999, identified several planning efforts, which would occur subsequent to the Plan, to address issues with the Prior Lake water levels and outlet operation. These included:

- Calibrating an hydrologic model for the watershed
- Designing improvements to the outlet channel for full-development conditions
- Addressing flood prone structures on Prior Lake
- Addressing increases in runoff volume as development occurs

The PLSLWD report Prior Lake Outlet Channel and Lake Volume Management Study (May, 2003) addresses these issues in detail. The 100-year floodplain elevation for Prior Lake established by FEMA is 908.9 MSL. There are 79 homes around the lake with low openings lower than this floodplain elevation. Fifty-one of these have low openings below 907.6 and ten have low openings below or within one foot of the lakes 904.0 OHW. According to PLSLWD information this 904.0 elevation has been exceeded a total of 259 days since 1983.

Since development tends to improve drainage pathways and increase runoff volume, the impact of future development on Prior Lake could, without mitigation, increase the frequency of water levels above the 904.0 OHW.

To assess the impact development might have on water levels in Prior Lake, the PLSLWD created a calibrated model of the watershed. The calibration of this model started with standard curve numbers for the subwatersheds tributary to the lake and, through the calibration process, modified these until modeled results matched monitored lake levels for the 1998 to 2001 period. The hydrologic modeling for the LSWMP is based upon this calibrated watershed model. The difference between the two, is that the LSWMP model looks at the conditions that will exist when build out occurs in the 2030 growth area. Additionally, the LSWMP model includes more detail on the storage and conveyance system necessary to serve the 2030 growth area.

Table 5.8 summarizes the volumetric increase in runoff volume as the study area converts from current uses to future, with future consisting primarily of residential. The reader should refer to the study itself for the finer distinctions between existing and future land use assumptions. It should also be noted that the volume calculations assumed no application of any runoff management techniques.

Table 5.8
PLSLWD Volume Study
Model Results Summary

	Runoff Volume (ac-ft)	
Year	Existing	Future
1998	19,700	23,900
1999	19,400	23,000
2000	10,800	12,900
2001	17,300	20,600

Based on the representative years and the assumptions regarding land use change, annual runoff volume increases anywhere from 2,100 ac-ft from the year 2000 rainfall season to 4,600 ac-ft in the 1999 rainfall season. This increase runoff volume has a direct correlation to levels in Prior Lake and the frequency of exceedence of the 904.0 level. The conclusions are that if no water resource management actions are taken to reduce these developed runoff volumes, then Prior Lake will experience more frequent flooding and this flooding will occur for longer durations than currently seen.

The PLSLWD volume assessment identified five strategies for addressing future lake levels. These included:

- Outlet structure modifications
- Rule revisions
- A Land Management Program for acquiring and preserving upstream storage
- Low home flood-proofing or buy out
- Outlet channel improvements
- Implementing volume management rules for new and re-development

The district eliminated the option of increasing the overall capacity of the outlet (by adding a second pipe) due to the high cost, difficulty in permitting, and downstream environmental impacts. Instead, the district intends to improve the efficiency of the current structure and optimizing outlet operation, which will provide a small calculated reduction in the future HWLs in Prior Lake.

Flood proofing and buy out have high potential but require substantial funding. Whether this strategy can be used or not depends upon this funding as well as the willing participation of landowners around the lake.

The most effective mitigation strategies, other than removing the homes, are retention storage in the watershed and volume control measures. The District's goal is to acquire between 1,500 and 3,000 acre-feet of retention storage. By District estimates this would be 38 to 75 acre-feet per year.

5.3 System Design

5.3.1 Hydrologic Modeling Discussion

Stormwater runoff is defined as that portion of precipitation which flows over the ground surface during, and for a short time after, a storm. The quantity of runoff is dependent on the intensity of the storm, the amount of antecedent rainfall, the length of the storm, the type of surface upon which the rain falls, and the slope of the ground surface.

The intensity of a storm is described by the amount of rainfall that occurs over a given time interval. Storms are typically characterized by their return frequency. A return frequency designates the average time span during which a single storm of a specific magnitude is expected to recur. Thus, the degree of protection afforded by storm sewer facilities is determined by selecting a return frequency for analysis.

For the Prior Lake SWMP the following return frequencies were used:

- 10-year Rational Method for storm sewer design
- 100-year, 24-hour (Type II distribution) event for overland drainage and pond storage design

A 100-year, 24-hour frequency event (6.0 inches in 24 hours for Scott County) has a 1% chance of occurring or being exceeded in any given year. This design rainfall return period is commonly used for flood control throughout Minnesota.

As development occurs in Prior Lake, actual storm sewer design should be a 10-year minimum recurrence for lateral, or local, systems in residential and commercial areas. This implies that no street, parking lot, or backyard ponding would occur for the 10-year design event. Trunk facilities should be analyzed and designed to accommodate the 100-year ponded discharges plus 10-year rational flows from areas that enter the trunk to be carried to the next storage area downstream.

In general, complete protection against large, infrequent storms with return intervals greater than 100 years is only justified for important flood control projects. For most developing areas like Prior Lake, the cost of constructing a large capacity storm drainage system (for events greater than the 100-year) is much greater than the amount of property damage that would result from flooding caused by a larger than 100-year event occurring in a system designed for the 100-year event.

The excess runoff caused by storms greater than the 10-year will be accommodated by transient street ponding and overland drainage routes. Providing areas for this short-term flooding and overland drainage reduce flood damage due to larger than design events. Provisions should be made to provide or preserve overland drainage routes for emergency overflows.

A number of methods have been developed to determine the expected maximum rate of runoff from a known area for a specific design storm, given land use and soil moisture conditions. The preliminary trunk storm sewer design presented in this plan is based on the Rational Method and the pond design on the XP-SWMM computer program.

The modeling involves the selection or computation of a time of concentration and a runoff coefficient. The time of concentration is the time required for the runoff from a storm to become established and for the flow from the most remote point (in time, not distance) of the drainage area to reach the design point. The time of concentration will vary with the type of surface receiving rain and the slope of the surface.

A minimum time of concentration of 15 minutes was selected for the design of the trunk storm sewer system. Shorter times may be utilized in lateral system design. As the stormwater runoff enters the system, the flow time in the storm sewer is then added to the time of concentration, resulting in a longer time of concentration and thus lower average rainfall intensity as the flow moves downstream from the initial design point.

The percentage of rainfall falling on an area that must be collected by a storm sewer facility is dependent on watershed variables such as:

- Soil perviousness
- Ground slope
- Vegetation

- Surface depressions
- Development type
- Antecedent rainfall

These factors are taken into account when selecting a runoff coefficient (C) in the Rational Method or a runoff curve number (CN) for use in XP-SWMM.

In the Rational Method, the runoff coefficient for urban areas varies from 0.2 for parks to 0.95 for asphalt and concrete surfaces, while in XP-SWMM (or more correctly, the SCS methodology which XP-SWMM incorporates), the CN varies from 58 for parks to 98 for asphalt and concrete surfaces. CN values depend on the type of soil, cover type and hydrologic condition. Under fully developed conditions, the values of CN will rise with increases in impervious area caused by street surfacing, building construction, and grading.

Table 5.9 provides CN values and runoff coefficients used in the SWMP modeling. To ensure consistency with this Plan future analyses, whether they be for development proposals or other city projects, should use the values contained within Table 5.7. For other types of land use not identified in the table, SCS Technical Release 55 (TR-55) curve numbers should be used.

As noted earlier, the predominant hydrologic soil group (HSG) within the study area is HSG B to HSG D. Table 4.7 CN values reflect HSG B. To the extent that soils fall into the C or D categories they should be modified accordingly. The CN values also reflect Antecedent Moisture Condition II (AMC II), which is a typical assumption in hydrologic analyses. AMC II simply implies that average soil moisture conditions apply prior to simulation of the design event.

Table 5.9
Runoff Coefficients

Land Use Type	Average Runoff Coefficient C for Rational Method			CN Value
	5 year	10 year	100 year	
Park/Open Space	0.16	0.25	0.30	60
Low Density Residential (30% impervious)	0.33	0.45	0.50	72
Medium Density Residential (65% impervious)	0.59	0.63	0.72	85
High Density Residential (72% impervious)	0.66	0.70	0.77	88
Commercial/Industrial (85% impervious)	0.76	0.79	0.85	92
Ponds	1	1	1	99

As mentioned, the computer modeling of stormwater quantities for pond design and trunk pipes was carried out using the computer software HydroCAD. HydroCAD stormwater runoff hydrographs are calculated in accordance with SCS TR-20 methodology. Hydrograph routing through channels and detention basins is performed using the Storage-Indication method. Storm distributions of SCS 24-hour Type I, IA, II, and III storm distributions are allowed in the model. All analyses performed within the context of this report have been conducted using Type II storm distributions.

5.3.2 System Design Recommendations and Discussion

The City of Prior Lake has a Public Works Design Manual (PWDM) first prepared in 2002, is currently being revised to include rules governing development hydrology and water resource management issues. The following discussion is meant give background information and provide the technical basis of some of the PWDMs requirements. This discussion and background information should not be considered rule and it does not substitute for or supersede the specific requirements of the City's Ordinances and PWDM, or the Rules of the Prior Lake-Spring Lake Watershed District and the Scott Watershed Management Organization.

5.3.2.1 Conveyance and Storage System Concepts

Storm Sewer and Channels

In the Prior Lake SWMP, a combination of storm sewer and channels has been used to transport simulated stormwater runoff. Only major storm sewer trunks, 24 inches and larger and related facilities have been considered in this study. A complete system consists of a complex web of trunks, manholes, lateral lines, overland drainage ways, catch basin leads, catch basins, pond inlets and outlets and all other items.

Proper design of a storm sewer system requires that all sewer lines be provided with access through manholes for maintenance and repair operations. Generally, spacing of manholes should be no greater than 400 feet. Intervals on larger diameter lines can be increased when the pipes are sufficiently large for a person to physically enter the storm sewer pipe for maintenance operations. Regardless of sewer size, manholes should normally be provided at all junction points and at points of abrupt alignment or grade changes.

Although lateral systems are designed for the 10-year storm event, their performance must be analyzed for storms exceeding the design storm. Lateral and trunk pipes will surcharge when the design storm is exceeded. During surcharging, the pipes operate as closed conduits and become pressurized with different pressure heads throughout the system. Low areas that are commonly provided with catch basins become small detention ponds often performing like pressure relief valves with water gushing out of some locations. For this reason, it is extremely important to ensure that these low areas have an acceptable overland drainage route with proper transfer capacity.

At a minimum, ponding on streets must meet all of the requirements of the 100-year design criteria. For safety reasons, the maximum depth should not exceed two feet at the deepest point and the lowest exposed building elevation should be at least one foot above the elevation to which water could rise before overflowing through adjacent overland routes.

All storm sewer facilities, especially those conveying large quantities of water at high velocities, should be designed with efficient hydraulic characteristics. Manholes and other structures at points of transition should be designed and constructed to provide gradual changes in alignment and grade. Pond outlet control structures should be designed to allow water movement in natural flow line patterns, to minimize turbulence, to provide good self-cleaning characteristics, and to prevent damage from erosion.

Intake structures should be liberally provided at all low points where stormwater collects and at points where overland flow is to be intercepted. Inlet structures are of special importance, since it is a poor investment to have an expensive storm sewer line flowing partially full while property is being flooded due to inadequate inlet capacity. Inlets should be placed and located to eliminate overland flow in excess of 1,000 feet on minor streets, or a combination of minor streets and swales, and 600 feet on collector streets and arterials. Additionally, inlets should be located such that 3 cfs is the maximum flow at the inlet for the 10-year design storm. Intake grates and opening should be self-cleaning and designed to minimize capacity reduction when clogged with twigs, leaves and other debris.

Effective energy dissipation devices or stilling basins to prevent stream bank or channel erosion at all stormwater outfalls should be provided. The following recommendations should be kept in mind when designing an outlet:

- Inlet and outlet pipes of stormwater ponds should be extended to the pond normal water level whenever possible.
- Outfalls with velocities of less than 4 fps that project flows downstream into the channel in a direction 30 degrees or less from the normal channel axis generally do not require energy dissipators or stilling basins, but do require rip rap protection.
- Where an energy dissipator is used, it should be sized to provide an average outlet velocity of less than 6 fps, unless rip rap is also used. In the latter case, the average outlet velocity should not exceed 8 fps.
- Where outlet velocities exceed 8 fps, the design should be based on the unique site conditions present. Submergence of the outlet or installation of a stilling basin approved by the City is required when excessive outlet velocities are experienced.
- In the case of discharge to channels, rip rap should be provided on all outlets to an adequate depth below the channel grade and to a height above the outfall or channel bottom. It should be placed over a suitably graded filter material and filter fabric to ensure that soil particles do not migrate through the rip rap and reduce its stability. Rip rap should be placed to a thickness at least 2.5 times the mean rock diameter so as to ensure that it will not be undermined or

rendered ineffective by displacement. If rip rap is used as protection for overland drainage routes, grouting may be recommended.

- Overland drainage routes where velocities exceed 8 fps should be reviewed by the City Engineer and approved only when suitable stabilization measures are proposed.

Open channels and swales are recommended where flows and small grade differences prohibit the economical construction of an underground conduit and in areas where open channel type drainage will enhance the aesthetic qualities of a development. Whenever possible, a minimum slope of 2% should be maintained in unlined open channels and overland drainage routes. Slopes less than 2% and greater than 1% are difficult to construct and maintain and may require an underdrain system. Slopes less than 1% should not be allowed. Side slopes should be a maximum of 4:1 (horizontal to vertical) with gentler slopes being desirable. Where space permits, slopes should be cut back to match existing grade.

In general the flatter the channel side slopes and the more meandering the channel alignment the more natural the channel will appear. Natural looking channels use significantly more space than common ditches. One method of providing this space is to incorporate greenway corridors over the channel area.

Rock rip rap should be provided at all points of juncture between two open channels and where storm sewer pipes discharge into a channel. The design velocity of an open channel should be sufficiently low to prevent erosion of the bottom. Rip rap or concrete liners should be provided in areas where high velocities cannot be avoided. Periodic cleaning of an open channel is required to ensure that the design capacity is maintained. Therefore, all channels should be designed to allow easy access for equipment.

Sanitary sewer manholes that could be subject to temporary inundation, due to their proximity to ponds, channels, or roadway low points, should be equipped with watertight castings. Precautions should be taken during construction to prevent the entrance of stormwater into the sanitary sewer. When access is required at all times, sanitary manholes located near ponding areas should be raised above the 100-year high water level. Future storm drainage construction should include provisions for improving the water tightness of nearby sanitary sewer manholes. All newly constructed sanitary manholes in the vicinity of ponding areas and open channels described in this report should be waterproof.

Ponds

Stormwater ponding areas are an essential part of any storm drainage system. These areas provide locations where stormwater flows can be reduced to provide flood protection for downstream areas. The numerous natural depressions found throughout Prior Lake have been incorporated into the Plan as ponding areas. The effective use of ponding areas enables the installation of outflow storm sewers and channels with reduced capacities, since the duration of the design storm is effectively increased over the total

time required to fill and empty ponds. Smaller capacity trunk storm sewer and channels provide a cost savings to the City.

The use of ponds to control stormwater runoff rates is a recent phenomenon. Historically, older cities (including the older portions of Prior Lake) have piped stormwater directly to the nearest large receiving water or river. Continued use of this practice has both cost and regulatory implications. In terms of cost, few cities have the funds necessary to build pipes that provide 100-year protection to properties. In fact, the older cities that have historically piped all their stormwater find that the systems they constructed provide nowhere near the 100-year protection found in newer cities that have used ponds. In terms of the regulatory control, many direct discharges (without ponding) to waters of the state are precluded. At present, even direct discharges to wetlands that are not considered waters of the state are regulated through the NPDES construction permit.

Cost and regulatory considerations aside, well designed ponds:

1. Improve water quality
2. Recharge the groundwater table
3. Provide aesthetic, recreational and wildlife benefits

Ponds improve stormwater quality by allowing nutrients and sediments carried by runoff to settle before discharge to important receiving waters. Groundwater recharge is increased by restricting the outflow rate from a pond, thus allowing more water to infiltrate into the soil. Careful planning of ponds can enhance a development's appeal and still provide efficient stormwater management. In fact, lots with pond frontage command a higher price than lots without.

Most of the ponding areas proposed in this plan collect water from large regional drainage areas. To provide proper protection for adjacent property, the design storm for ponding areas is the maximum flood from a Type II, 24-hour, 100-year rainfall event (6.0 inches of rain in 24 hours). To provide an additional safety factor, the lowest exposed structure elevation in a development should be at least two feet above the 100-year high water level. The lowest exposed elevations of structures that are adjacent to ponds should be certified by the builder during basement construction to ensure adequate freeboard.

Runoff determinations for pond design vary from those for storm sewer calculations. The critical storm for storm sewer design is the short, high intensity storm, whereas the critical storm for pond design is of longer duration, since water is being stored for longer periods of time and released at a slower rate.

The use of computer modeling in the analysis of the ponding system has allowed the efficient review of several complicated routing patterns, each comprised of several ponds. The pond storage and outflow rates, adjusted by lag time, were determined by the program for all the ponds identified in this Plan. The lag time is significant as it represents the attenuation of peak flows at each pond and generally shows that the peaks are not occurring at the same time. This implies that the direct runoff to a pond has

generally passed through to the downstream trunk system before the inflow of large volumes of runoff from upstream ponds.

5.3.2.2 Water Quality System Concepts

Establishing the highest water quality goals that are both reasonable and sustainable is one of the objectives of the Prior Lake Local Surface Water Management Plan. The only effective way to maintain high quality water bodies is to prevent sediment, nutrients and other materials from entering the storm drainage system. Complete interception of stormwater for treatment at the point of discharge is not currently feasible, though the City encourages the implementation of techniques such as rainwater gardens, infiltration areas, and filtration swales etc. that capture a portion of runoff at the point of generation. Application of these small-scale techniques should be on a site specific basis.

Pollutant Control

The three main sources for degradation of water quality are:

1. Solids and associated chemicals (including calcium chloride and salt) from erosion and street sanding,
2. Composted decay around ponds, and
3. Fertilizers and other chemicals from farming practices, impervious surfaces, or lawn care.

Identification of the source and implementation of reasonable control measures can minimize the degradation of Prior Lake's water bodies.

In areas where extensive development is taking place, stormwater runoff frequently contains substantial quantities of solids. Most commonly, these sediments are carried by runoff into the storm sewer from large grading sites though fully developed areas also generate sediment loads particularly from winter sanding operations and in areas of structurally failing pipes. For developing areas, strict on-site erosion control practices are required to prevent sediments from entering downstream water bodies. Inspections should be conducted by the City to verify that the erosion control practices have been installed and maintained properly. Even with extensive erosion control practices, sediment and airborne particulates will continue to enter surface waters of the City.

The importance of erosion control measures during construction cannot be overemphasized. The Best Management Practices (BMPs) recommended in the Minnesota Pollution Control Agency's (MPCA) Protecting Water Quality in Urban Areas should be followed for all development. The Minnesota general National Pollutant Discharge Elimination System (NPDES) stormwater permit for construction activity requires a permit for construction activities that disturb one or more acres.

When disturbing 10 or more acres, developers are required to provide temporary settling ponds to treat the runoff from their grading sites. These ponds are intended to prevent the introduction of sediment and its associated pollution into the storm sewer system and are

required to function, in their various forms, until grading has ceased and adequate cover has been established. At a minimum, these temporary sedimentation basins should meet the requirements set forth in the NPDES general permit for construction activities.

When the outlet for a siltation basin, either permanent or temporary, is located below the normal water surface, the basin can also serve to confine floating solids that may otherwise enter a downstream pond or lake. This practice is typically referred to as skimming. If a hazardous material such as fuel oil were to spill, a skimmer structure would retain it within the basin and thus isolate it for easy access and prompt cleanup. Skimmer structures should be used for all constructed ponds upstream of wetlands, lakes, rivers and streams. For constructed ponds that discharge into other constructed ponds, skimmer structures are not as important.

Ideally, some sort of solids removal system should be installed wherever a storm sewer outlets into a pond. In certain cases, settling chamber (sump) type catch basins or manholes can be provided for storm sewers that discharge into ponds. The Prior Lake Public Works Design Manual requires 3-foot sumps in the last manhole prior to discharge into a water body. These can provide effective removal of sand and gravel, which may be flushed into the storm sewer from streets and highways, but are ineffective in the removal of finer particles such as silts and clays. Use of this type of catch basin or manhole should be limited to those areas where regular maintenance is practical and to where the sump can be realistically expected to intercept sand from winter sanding operations and gravel from driveways and construction sites.

Of late a concern regarding West Nile virus and mosquito breeding habitat has called into question the use of sump manholes. The latest data suggests that many different breeding environments exist for the mosquitoes that carry the virus including ponds, wetlands, catch basins, and manholes. Obviously, eliminating these elements of the system is not feasible. Though they should be used sparingly, sump manholes should not be prohibited due to a concern over West Nile virus.

It bears repetition that a solids removal structure must be regularly maintained if it is to remain effective. Since maintenance is the controlling factor in the long term performance of sediment control measures, ponds are recommended over sump manholes. Sump manholes, if numerous, often go without maintenance. An individual pond requires more maintenance time than a sump, but system maintenance time goes down when ponds are the preferred method of sediment removal as long as pond slopes and benching allow access by maintenance equipment (see Chapter 5 for pond grading requirements). For this reason sump manholes should be limited to storm sewer lines discharging directly to wetlands, lakes, rivers, streams, ravines, and constructed channels and should be avoided upstream of constructed ponds. In all cases, the location, type, and number of sediment control structures must be established at the time of final design of that portion of the storm sewer system. Maintenance of the system is discussed further in Section 6.

Even with the best and most expensive solids removal system, contamination of ponds and lakes will occur unless particular attention is paid to those activities that occur after development of a site. Developers must utilize the BMPs to minimize erosion during the mass grading phase of construction. But property owners must also use care in the development and maintenance of their lawns and open areas. Debris is frequently raked from lawns into gutters; from there, if it is not removed, it washes into the storm sewer system.

Generally speaking, water quality ponding within a development has to treat storm water to the level required by the downstream receiving water body and its attendant management strategy. The Prior Lake Public Works Design Manual calls for detention pond design according to the design program developed by William Walker. At a minimum, though, detention ponds should contain wet volume equivalent to the runoff from a 2.5 inch rainfall over their tributary area.

Occasionally, with small plats (of 5 acres of less), water quality ponding cannot be constructed to the extent required by the Plan without severely hampering the site development or destroying other habitat such as upland grasslands and forests. In such cases, it is within the City's discretion to reduce the required water quality ponding and/or require other methods such as filtration swales or filter beds.

Water Quality Modeling

When necessary for modeling a series of water quality ponds, PondNet water quality management model or P-8 model is recommended. PondNet is an empirical model developed from data collected by the Environmental Protection Agency (EPA) Nationwide Urban Runoff Program (NURP). The model predicts the phosphorus removal efficiency of a large number of hydrologically connected ponds. Phosphorus is the primary nutrient modeled because it has been found to be the nutrient most likely to promote the growth of algae in lakes.

A limitation of the PondNet model is its inability to predict phosphorus concentrations in large, deep water bodies. In general, water bodies larger than 20 acres or with mean depths greater than 10 feet should be modeled with in-lake models, many of which are now available.

Values for average runoff phosphorus concentrations, average annual summer runoff coefficients and the resulting phosphorus export coefficients were determined for use in the model. The values are shown in Table 5.10 along with the range of published literature values.

Table 5.10
Phosphorus Concentrations and Export Coefficients

Land Use	Model Parameters			Published Values P export Coefficients (lbs/ac)
	P concentration (µg/l)	Runoff Coefficient* (%)	P export Coefficients (lbs/ac)	
Park/Open Space	200	0.07	0.14	0.09 - 0.3
Low Density Residential (30% impervious)	450	0.21	0.97	0.45 - 2.7
Medium Density Residential (65% impervious)	500	0.47	1.64	0.45 - 2.7
High Density Residential (72% impervious)	500	0.55	2.31	0.45 - 2.7
Commercial/Industrial (85% impervious)	600	0.68	3.08	0.70 - 3.0

* 2-year storm frequency (2.5" of precipitation in 24 hours)

The export coefficients reflect a large increase in nutrient loading as land use changes from open space and agricultural to urban. The main reason for this increase is the large increase in runoff rate and volume, caused by the amount of impervious area, which washes off the pollutant buildup from those surfaces.

Computer models that predict concentrations and removal efficiencies for heavy metals are currently available. These models predict removal efficiency in terms of inflow particle distribution and the pond's ability to remove suspended solids. Based on a number of studies recently performed by various agencies, it can be assumed that wet detention ponds which remove 60 percent of phosphorus also remove high percentages of heavy metals. Table 5.11 shows the benefits of wet detention ponds as estimated by the DNR in Wisconsin.

Table 5.11
Benefits of Wet Detention Ponds

Pollutant	Average Reduction (%)
Lead	70
Zinc	70
Bacteria	70
Diazinon (pesticide)	17
Phthalate	80
Sediment	90

Based on these findings, it can be assumed that water quality ponds which reduce phosphorus loadings by 60% under standard runoff concentrations will also reduce heavy metal concentrations by 70% and sediments by 90%. For this reason it is sufficient to model for phosphorus and from those results infer removals of other pollutants according to the percentages in table 4.3.

Actual modeling of water quality basins and their treatment capacities can be cumbersome for developers and their engineers. A simple criterion is that every water quality basin should provide wet volume (volume below the normal water level) equivalent to the post development site runoff for the 2.5-inch rainfall event. Ponds designed in this manner will meet a 60% removal efficiency while providing excess volume for sediment storage.

Local vs. Regional Water Quality

The ponds shown in maps 1 through 5 are flood control basins and are not generally considered areas for water quality treatment. Water quality treatment is not considered a regional element but rather something to be installed with individual developments. Regional water quality treatment is considered less effective than local treatment and some analyses suggest that regional water quality basins can become pollutant sources rather than sumps. Additionally, by dispersing water quality to the local level, a wider range of techniques can be used such as:

- filtration swales
- infiltration swales
- infiltration basins
- structural units like swirl separators
- sand filters
- reducing and disconnecting impervious surface

5.3.2.3 The Use of Wetlands in the Surface Water System

This LSWMP seeks to use the abundant wetlands within the City as a part of the natural storm drainage system. This involves maintaining water quality, reducing flooding and erosion, and stabilizing or restoring water levels. Wetlands are important physical, educational, ecological, aesthetic, recreational and economic assets to the City.

Historically, most of the wetlands in the City have been affected by agriculture or urbanization. In urbanizing areas, wetland degradation can be an ongoing process. However, some degraded wetlands can be improved by stabilizing water levels and reducing sediment loads.

Water quality plays a significant role in the overall quality of a wetland. When the quality of the incoming stormwater declines, the wetland's plant community may become less diverse, retaining only those species that are tolerant of high nutrient and sediment loads. Once a wetland's plant community is changed, the wetland's character and

ecosystem will change, often to a less valuable system in terms of diversity, wildlife habitat and aesthetic qualities.

Aerial photos show that numerous wetlands within the 2030 growth area have been drained, via tile or ditching, and are now vegetated primarily with reed canary grass. These areas are potential restoration sites since the wetland's natural storage will be needed when the area develops. Storage can be restored by breaking tile lines and berming across ditches.

In the recent past, LSWMPs have addressed wetland protection from nutrient loadings, but not from water fluctuations or sustained water levels. Wetlands were commonly used for flood storage. The Minnesota Stormwater Advisory Group published a guidance document that looked at the implications of this practice. It was found that stormwater bounce and duration affected some types of wetlands, but not others. The guidance document presented specific guidelines on what wetlands were most affected by stormwater bounce and sustained water levels. A wetland's sensitivity is affected by vegetation type, hydrology, soils, topography and chemistry. Section 4, Wetland Management Plan, applies the concept of susceptibility to the Prior Lake surface water system.

In all instances, future developments (including road projects and redevelopment projects) should incorporate some ponding upstream of wetlands. It is the method of the Plan to show storage in wetland locations with the understanding that minimum control measures upstream of the wetland will be installed. These minimum control measures include:

- Water quality ponding for runoff generated by the 2.5-inch rainfall event
- Rate control to predevelopment conditions for the 10-year, 24-hour rainfall event

Where wetlands are identified as high quality and susceptible to negative impacts from urban runoff quality and volume then additional control measures should be implemented including:

- Infiltration in addition to 2.5-inch water quality criterion
- Filtration (via swales or rainwater gardens) in addition to 2.5-inch water quality criterion
- Rate control to predevelopment conditions for the 100-year, 24-hour event

In order to determine what level of upstream control is necessary, assessments of wetlands using standard assessment methodology (Minnesota Routine Assessment Methodology, for instance) should be provided in submittals for developments and projects that involve discharges to wetlands, unless these wetlands were included in the assessment summary in Section 4. In such a case, only after 2010 would these also have to be assessed by project proposers.

Depending on the quality of the wetland in question, rate control upstream of the wetland could be to the 100-year predevelopment rate. Generally, the rate control proposed in the Plan is to a lower rate, which approaches a preagricultural rate. The additional rate reduction would occur in the wetlands themselves. In many cases this will involve constructing multi-stage control structures for wetland outlets. Construction of these wetland outlets should be a part of any project that uses the wetland for a portion of its flood storage. In some cases developments and other projects will rely solely on constructed ponds that discharge directly to waterways or lakes. In some cases these wetlands, along with other basins, would also incorporate a retention volume – as discussed above regarding volume impacts to Prior Lake.

Table 5.12 lists differing wetland types and their susceptibility to impacts from stormwater. Table 5.12 also appears as table 4.1 in section 4. It is reprinted here for ease of reference.

Table 5.12
Wetland Community Susceptibility to Stormwater Impacts

Highly Susceptible Wetland Communities*		**Moderately Susceptible Wetland Communities***
Sedge Meadow	Low Prairies	Shrub-Carrs
Bogs	Coniferous Swamps	Alder Thickets
Coniferous Bogs	Hardwood Swamps	Fresh (wet) Meadows
Open Bogs	Seasonally Flooded Basins	Shallow Marsh
Calcareous Fens		Deep Marsh

* Wetland community (-ities) determined using key provided in MnRAM Version 2.0.

Subsection 5.4 describes the surface water system proposed for development within the 2030 growth area. In general, storage is located in existing topographic low areas and these areas are often wetlands. Appendix C provides calculated flood storage for the proposed basins.

In many cases, the numbered ponds shown on maps 1 through 5 will be wetlands and these wetlands will have differing susceptibilities to stormwater impacts as indicated in the table above and, more substantively, in section 4. To the extent that some of the proposed ponds in maps 1 through 5 are wetlands, then a portion of the flood storage indicated in appendix C will fall outside and not within the wetland area.

The following general criteria should be used to determine what type of rate control and water quality treatment would likely occur upstream of a wetland.

- Case 1: regional pond is a “least susceptible” wetland or not a wetland
    - Water quality volume can be built into the regional pond if it is not a wetland, otherwise water quality volume per the requirements of the NPDES construction permit is required.
    - All flood storage can occur within the regional pond

- Case 2: regional pond is a “slightly susceptible” or “moderately susceptible” wetland
    - Water quality volume is built upstream of the regional pond/wetland
    - Flood storage is provide upstream of regional pond/wetland such that the predevelopment 10-year rate is maintained to the wetland

- Case 3: regional pond is a “highly susceptible” wetland
    - Water quality volume is built upstream of the regional pond/wetland
    - Flood storage is provided upstream of the regional pond/wetland such that the predevelopment 100-year rate is maintained to the wetland

Tables 4.2 and 4.3 provide numeric targets that augment the concepts described above.

5.4 System Description

This subsection provides information on the surface water management system for Prior Lake’s 2030 growth area. The model was built based on the Prior Lake Spring Lake Watershed District (PLSLWD) model and served the purpose of determining overall infrastructure capital requirements.

The Study area is broke into 21 major drainage districts, which are further divided into sub-districts. Total acreage for major drainage districts should roughly match the existing work completed by the Watershed District.

The model included outlets for many of the landlocked basins within the City, to determine the potential future infrastructure needs. The inclusion of a landlocked basin outlet in the model is not a guarantee that the outlet will be approved or built. Proposals to add outlets to landlocked basins will be evaluated on an individual basis at the time of development, and must meet the requirements of the PWDM and the Rules of the PLSLWD or Scott WMO, and as stated in chapter 3 it is the policy to encourage that landlocked basins remain disconnected whenever possible.

Some changes are bound to occur in the growth assumptions on which this model is based. Further study, or a more detail added to the District’s model may result in recommendations for changes to the stormwater management rules implemented by the City of Prior Lake. The City should work under the leadership of the Watershed District on issues of floodplain management by assisting in periodically refining the active surface water management model and changing stormwater management policy when warranted.

The following table lists the major drainage districts and abbreviation used for mapping. The following sections describe each drainage district in detail.

Table 5.13
Drainage Districts

Drainage District	Abbreviation	Acres
Buck Lake	BLK	4336.7**
Campbell Lake	CALK	422.0
County Ditch 13	CD13	5638.2*
Credit River	CR	976.4
Crystal Bay	CRBA	529.0
Crystal Lake	CRLK	164.6
East Rice Lake	ERLK	435.1
Howard Lake	HLK	558.8
Jeffers Pond	JP	812.8
Louisville Swamp	LSW	1987.3
Lower Prior Lake	LPPL	2859.0
Markley Lake	ML	528.6
Mystic Lake	MLK	227.8
Pike Lake	PL	1507.8
Rice Lake	RLK	727.0
Sioux Community	SC	771.2
Spring Central	SPC	416.2
Spring Lake	SPLK	1857.4
Spring West	SPW	384.5
Upper Prior Lake	UPPL	1516.2

*Includes Swamp and Sutton Lake drainage area
**Includes Fish Lake drainage area

Appendix A details the drainage areas for the subdistricts within each drainage district. Appendices B and C detail the pond and trunk storm sewer data. Appendix D lists the proposed pond and storm sewer costs for each district. Refer to the sytem maps at the end of the report for detailed topography, storm sewer, pond locations and drainage districts. The discussion of specific major drainage districts is generally organized in an upstream to downstream manner.

The system maps that show the 2030 system include the “Vc” notation on several ponds. This designator refers to the PLSLWD having identified that basin as a potential component in its volume management strategy – the general parameters of which are discussed earlier in this section. The “V” refers to volume and the subscript “c” refers to the Watershed’s desire that the City take the lead in implementing volume management in areas that are, or soon will be, within the City limits. In other locations a “Vw” is noted. These are also potential components in a volume management system with the subscript “w” indicating that the Watershed would take the implementation lead in these locations since they lie outside the 2030 growth boundary and thus will not fall within City jurisdiction.

EAST RICE LAKE (ERLK)

The East Rice Lake drainage district is the farthest upstream area tributary to Crystal Lake. Under existing conditions it consists of a system of wetlands connected by agricultural ditches. Runoff flows from south to north. ERLK-P1 provides the primary rate control before discharging to Rice Lake under Panama Avenue. This major district's tributary area is primarily agricultural and outside the 2030 Urban Boundary. ERLK is shown on map 3.

RICE LAKE (RLK)

Rice Lake is the central feature of this district. Rice Lake is located west of Panama Avenue and south of County Road 13, as shown on map 4. The majority of land that constitutes this district lies outside the 2030 growth area but will drain into the growth area with no additional rate control over what occurs today. Modeling for the Rice Lake district assumes existing land cover and discharge patterns.

Under existing conditions Rice Lake (RLK-P1) and Crystal Lake are connected via a channel. For proposed conditions the outlet has been revised to a 48" outlet to restrict flows upstream into fully developed Prior Lake. Three subdistricts, beyond RLK-P1, provide additional rate control and flood storage. There are 170.5 acres of agricultural drainage tributary to RLK-P1 from the south via an existing ditch. The 100-year discharge from the agricultural land is 33.6 cfs and the location where this enters the 2030 system is indicated on map 4.

Some grading and excavation is necessary at RLK-P2 to provide additional flood storage. RLK-P4 is designated a highly susceptible wetland (MNRAM number 191142210013). Since it is the farthest upstream in the system, meeting the water quality and quantity standards for wetlands of this type should be feasible. Even with the small drainage area, local ponding is required to maintain the integrity of RLK-P4.

CRYSTAL LAKE (CRLK)

The Crystal Lake drainage district consists only of Crystal Lake and a small existing NURP pond, CRLK-P2 northwest of County Road 13. The total drainage area is 176.4 acres, and is shown on map 3 and 4. Proposed development in CRLK is medium density residential and preliminary plans for Heritage Landing are currently being developed for the area tributary to CRLK-P2. Crystal Lake is tributary to UPPL-P13 via a 24" outlet. CRLK-P1 receives runoff from RLK-P1. To protect the downstream fully developed storm sewer system, significant rate control was provided in Rice Lake and Crystal Lake due to the tributary off-site agricultural drainage from the south.

BUCK LAKE (BLK)

The Buck Lake drainage district consists of 4,336.7 acres. It is located on the south side of Spring Lake. It lies fully outside the study area, but is tributary to SPLK-P8 and therefore was modeled to determine the impact from the agricultural drainage on the urban system.

The extensive Buck Lake drainage system begins as far south as Fish Lake and consists of channels and wetlands. Overall the land tributary to this system is fairly well drained. It should be noted that the channel that connects Fish Lake to Buck Lake and Buck Lake to DNR wetland 206W (BLK-P1) is a DNR protected waterway. Buck Lake provides the majority of the flood storage and rate control before discharging to SPLK-P8. The drainage area is well connected by channels, although several large wetlands provide storage on the east side of Fairlawn Avenue.

As stated, Buck Lake and its drainage is not within the 2030 growth boundary. Consequently, modeling of the 2030 system assumes the entirety of this drainage remains under its current land cover, which is primarily agricultural. Based on existing conditions modeling, the 100-year discharge from the Buck Lake drainage district into the urban system is 497.6 cfs. The 100-year HWL in the farthest downstream wetland is 922.0, which overtops Trunk Highway 13 (Langford Boulevard). The simulated HWL for BLK-P1 backs into Buck Lake to a limited extent. Ultimately, though, not a lot of storage in Buck Lake can be used before the water tops Trunk Highway 13.

It should be noted that the PLSLWD has not targeted Buck Lake as a location for volume management. Considering that the basin is quite large and apparently under utilized for storage, it would make sense for the City and Watershed to study the feasibility of controlling discharge from Buck Lake with the intent of creating more storage in this basin.

Refer to system map 4 for detailed topography, subdistricts, ponding and storm sewer. The off-site drainage area to Buck Lake includes Concord, Spring Southeast and Spring East from the Prior Lake Spring Lake Watershed District (PLSLWD) model.

SPRING CENTRAL (SPC)

The Spring Central drainage lies between the Buck Lake and County Ditch 13 drainage districts and, like these districts, discharges into Spring Lake's southwest lobe. The Spring Central drainage currently consists of ditches that pass through wetland areas designated as least susceptible in the Wetland Management Plan (section 4). A total of 416 acres drain to Spring Lake via the Spring Central system – approximately 186 acres of which lie outside the City's 2030 growth boundary.

Two basins are proposed upon development of this drainage. These basins, SC-P1 and P2, occur in locations identified by the PLSLWD as strategic locations for considering retention storage – with the City taking the lead on implementation. The proposed normal water levels for these basins were developed with the idea of providing some retention in the basins. Thorough study of retention implementation is not within the scope of this Plan and no specific direction is provided by the Watershed as to the amounts of retention desired in any one location.

COUNTY DITCH 13 (CD13)

County Ditch 13 drainage district lies on the southwest side of Spring Lake, shown on system map 4 and 5. As with Buck Lake, a significant drainage area outside the 2030 growth boundary is tributary to the small portion of this drainage within the boundary. This drainage spans 3763.5 acres and reaches as far south as Sutton Lake. These areas, though within PLSLWD jurisdiction, would lie outside City jurisdiction well beyond the 2030 timeframe. County Ditch 13 is the primary conveyance from Sutton Lake to CD-P1 – the only 2030 proposed basin within this drainage. The high modeled flow under existing agricultural conditions (assumed conditions for 2030 as well) result from the lake of storage evident is this district due to decades of agricultural drainage practices.

CD13-P1 is a very important wetland because it is strategically located to intercept and control the extensive upstream drainage, and, as a wetland determined to be "least susceptible" to impacts from urban stormwater, it is appropriate to use the basin as a major flood storage component without running into excessive concerns for the impacts of bounce. This Plan proposes a substantial bounce on this wetland, from 916.0' to 930.0' – a HWL that would require raising Langford Blvd. If the PLSLWD were to pursue storage upstream of CD13-P1, the storage proposed in this basin could be reduced. Note that CD13-P1 is designated as a strategic location for considering retention storage – with the City as the lead in implementation.

SPRING WEST (SPW)

Spring West is located southwest of Spring Lake. It consists of 385 acres, shown on system map 5. Under existing conditions it consists of a system of agricultural ditches, ponding behind Langford Avenue before discharging to SPLK-P1. Drainage flows from the south to north.

Grading revisions are necessary at SPW-P1 to create a large pond, outside the existing channel. The modeled outlet is a 24" rather than the existing 36" to provide additional rate control. The existing channel was primarily used for ponding at SPW-P2. The proposed outlet under Langford Avenue, from SPW-P2, is also smaller.

The locations for ponds SPW-P1 and P2 do not occur on inventoried wetland sites but on otherwise low areas adjacent to the ditches that drain these districts. Note that both subdistricts SPW-1 and SPW-2 have locations where potential retention areas are identified.

SPRING LAKE (SPLK)

Spring Lake is located directly upstream of Upper Prior Lake. The primary waterbody is Spring Lake, SPLK-P1 in modeling nomenclature. There are 1,858 acres within the Spring Lake district, plus 11,629 acres of other drainage much of which, like the Buck Lake and CD13 drainage, lies outside the 2030 growth area. Subdistrict 1 is by far the largest within this system and includes Spring Lake itself, wetland areas adjacent to the lake and slopes that drain directly to the lake.

Other than the large central subdistrict and Spring Lake itself, the remainder of this district is organized into a system of drainage areas and ponds around the periphery of Spring Lake. The predominant 2030 land use is urban low density residential. SPLK-2 consists primarily of land that forms Spring Lake Regional Park and as such is one area where no change to existing drainage patterns is anticipated. Otherwise notable features of the 2030 system include regional ponds for SPLK-2 and SPLK-5 subdistricts. SPLK-P5 is a potential wetland/storage restoration to provide rate control and sedimentation capacity to an existing drainage notable for the amount of sediment it currently delivers to Spring Lake.

Proposed pond SPLK-P7 would be formed by excavation and berming. Otherwise the storage in other proposed ponds would be provided by existing topography. There are several wetlands identified as least susceptible by the Wetland Plan. Among these, SPLK-P2, P3, P4, and P5 have been proposed with more restrictive outlets to maximize rate control under proposed conditions. Appendix B provides detail on the outlet sizes proposed for these basins while appendix C provides the basin discharge rates.

SPLK-P5, P6, P7 and P9 have all been designated as potential retention areas. The table at the end of this section provides prospective retention volumes based on the modeling assumptions that guide this Plan. As with any retention basin, if a valved outlet were provided then flood storage and retention volume could overlap. Without the ability to draw a basin down, any increase in retention volume comes at the expense of guaranteed flood storage.

Spring Lake discharges into Upper Prior Lake via an existing channel. No modifications to this route or its capacity are proposed in this Plan.

CRYSTAL BAY (CRBA)

The Crystal Bay district lies west of Upper Prior Lake, bounded by County Road 82 to the north and Howard Lake Road to the west. It is shown on system map 1. A large portion of Spring Lake Regional Park lies within CRBA-2. Of the 529 acre drainage area, only the eastern edge of CRBA-2 has been developed (as urban low density residential). The entire CRBA drainage district is tributary to Upper Prior Lake via the 18” culvert under Fremont Avenue. Only a small portion west of Arctic Lake, CRBA-P2, is left to be developed medium density residential.

The topography on the east side of CRBA-P2 is characterized by steep slopes. Drainage travels west to east. No agricultural drainage from off-site is tributary to the CRBA system. CRBA-P1, P2, and P3 were all designated as least susceptible wetlands in the Wetland Management Plan – incorporated as section 4 of this report. Therefore, flood storage and rate control have been maximized in these basins.

UPPER PRIOR LAKE (UPPL)

The Upper Prior Lake drainage district consists of 1,516 acres and is shown on system maps 1, 3 and 4. The major waterbody is UPPL-P4, Upper Prior Lake. It is directly tributary to Lower Prior Lake (LPPL-P1) via an existing channel under County Road 21. No changes are proposed for this channel connection between the two portions of Prior Lake.

The majority of the area in UPPL is fully developed. Therefore no major changes are proposed to the existing trunk storm sewer routing. Several least susceptible wetlands are utilized for regional ponding. UPPL-P5 is a moderately susceptible wetland (MNRAM number 191142203001). Refer to tables 4.2 and 4.3 for specific requirements regarding treatment for these two wetland types.

UPPL-P13 receives discharge from CRLK and its upstream tributaries via an existing 24" outlet. UPPL-P13 discharges via a 48" culvert under County Road 13 to an existing backyard ravine. This is a potential problem area due to the high discharge and should be evaluated for erosion.

UPPL-P14 overflows the road during 100-year events, assuming the existing outlet.

The ravine that UPPL-P7 and P9 discharge into adjacent to UPPL-P4 has been utilized for proposed conditions. To protect the ravine a 36" outlet from P7 and a 12" outlet from P6 was modeled. The revised HWLs provide adequate freeboard to adjacent structures.

LOWER PRIOR LAKE (LPPL)

The Lower Prior Lake drainage district is the downstream portion of the Prior Lake chain. Much of its drainage area is developed and includes the Prior Lake downtown. No significant changes are proposed for the existing drainage patterns and routing. The only additions are outlets to currently landlocked ponds LPPL-P6, P2, P10, P8 and P3. With ponds P2 and P3, small lift stations and force main were modeled. It is also possible to raise the NWL of the ponds and use gravity pipe as outlets (i.e. provide a piped emergency overflow and allow infiltration to operate below this).

There are 2,859 acres within the LPPL district, 1,921 acres of which are tributary to LPPL-P1. The district is shown on system maps 1, 2 and 3. LPPL-P1 outlets to JP-P5 via the Prior Lake outlet channel.

JEFFERS POND (JP)

Jeffers Pond drainage district is located in the northwest corner of Prior Lake. The topography is characterized by steep wooded bluffs and several interconnected wetlands. The district is bounded to the north by County Road 42 and to the east by County Road 21, as shown on system map 1. Drainage is routed from southwest to northeast.

The majority of the Jeffers Pond district is undeveloped woods and grasslands. The southwest portion is developed as low density residential. Preliminary design is underway for the undeveloped portions of Jeffers Pond district in JP-5 and JP-6. There are 732 acres of tributary area, with 19,298 acres of ponded tributary area from LPPL-P1.

Lower Prior Lake outlets via the Prior Lake Outlet Channel into the Jeffers Pond district at JP-P5. The channel is noted on map 1 by dashed lines. Proposed conditions modeling assumes the upgrades noted in the Environmental Assessment Worksheet (EAW) for the Prior Lake Outlet and Channel Improvement Project, prepared by PLSLWD in 2004, have been implemented. These improvements include, but aren't limited to: a new outlet for LPPL-P1, a weir waterfall overflow from JP-P5, upgrades to the channel crossing from JP-P7 under County Road 42. The improvements are designed to improve wildlife habitat, aesthetics and stabilize the outlet channel. The channel stabilization will also improve the water quality in Jeffers Pond and downstream Pike Lake. It is important to provide water quality ponds in new developments before discharging to the Jeffers Pond district regional ponds. The cost estimates in Appendix D do not include any upgrades that are a part of the EAW because these costs will be borne by the PLSLWD.

Berming is necessary on the east side of JP-P1, P2, and P3 to provide additional storage. Construction costs have been included for these ponds since they lie outside the EAW study area. The final downstream pond in the system is JP-P7. JP-P7 acts primarily as a channel during low flow events; during high flow 100-year events, ponding occurs behind County Road 42.

Section 5 of this report summarizes an agreement regarding discharge rate from a small portion of the Jeffers Pond district into the outlet channel. Table 5.12, which follows the discussion of Pike Lake, summarizes the modeling conducted for this plan and compares the new rates obtained from this modeling to those previously agreed to.

PIKE LAKE (PL)

Pike Lake drainage district is in the far northern portion of the study area, adjacent to Shakopee. There are a total of 1,508 acres within the district and 19,405 acres of ponded area tributary to PL-P16 (Pike Lake). The region is shown on system maps 1 and 2. Drainage travels from east to west via a system of wetlands, proposed ponds, and trunk storm sewer.

Pike Lake is the farthest downstream portion of the Prior Lake watershed within the study area – it receives discharge from JP-P7 through the Prior Lake outlet channel under County Road 42. Pike Lake discharges via a 36" outlet north to Shakopee. For fully developed conditions, 100-year event, PL-P16 overflows the existing road, elevation 824, roughly 0.5-feet.

PL-P9 is a highly susceptible wetland (MNRAM number 191152225002). Refer to tables 4.2 and 4.3 for quantity and quality standards when discharging to a highly susceptible wetland. It is important to construct local ponds to protect the regional PL-P9.

Berming and some excavation are necessary for the ponds north of County Road 42 to provide additional storage. Significant excavation is required for PL-P7.

Table 5.14 compares the proposed discharges from the Prior Lake storm water model to the agreements for Pike Lake and Jeffers Pond discharge that were enacted in 2003. The Prior Lake storm water model was created for the Surface Water Management Plan from XP-SWMM software using a model provided by the PLSLWD as a base. The original agreement on subwatershed discharge rates resulted in part from HydroCAD modeling done for Prior Lake in the preparation of the 2001 Trunk Storm Sewer Fee Determination Study. The new software was chosen to promote consistency between City and Watershed modeling efforts. The new software uses different algorithms for calculating peak water levels and discharges and leads to slightly different results for these over what the older HydroCAD model provided – even given the same input parameters. The strategy in modeling Pike Lake and Jeffers Pond in XP-SWMM has been to keep the modeled flows below those memorialized in the agreement with the intent that the agreement remains the final word on rate control for the Jeffers Pond and Pike Lake Districts.

Table 5.14
Comparison of SWMP Modeled Flows
to 2003 City of Prior Lake/PLSLWD Agreement

Rainfall Event	2003 Agreement				2005 SWMP			
	District	Area	Subwatershed Regulated Peak Flow + 25%	Discharge Per Acre	District	Area	Discharge Rate	Discharge Per Acre
		(ac)	(cfs)	(cfs/ac)		(ac)	(cfs)	(cfs/ac)
2-YR	JP-2	105.2	23.3	0.22	JP-2	105.3	15.9	0.15
	Table 5.6 Jeffers Pond	**105.2**	**23.3**	**0.22**		**105.3**	**15.9**	**0.15**
	PL-5	350.1	51.5	0.20	PL-5	437.0	32.3	0.07
	PL-7	232.7	45.8	0.25	PL-7	289.2	22.7	0.08
	PL-11	144.2	29.7	0.26	PL-12	172.2	7.0	0.04
	PL-12	173.5	7.6	0.04	PL-14	130.4	13.0	0.10
	PL-16	34.0	7.6	0.28	PL-15	31.3	0.8	0.03
	PL-18	7.7	1.8	0.30	PL-18	16.1	1.2	0.07
	PL-21	4.9	1.6	0.41	PL-20	38.1	2.6	0.07
	Table 5.7 Pike Lake	**947.1**	**206**	**0.22**		**1114.3**	**79.6**	**0.07**
100-YR					JP-2	105.3	28.6	0.18
	Table 5.6 Jeffers Pond	**105.2**	**35**	**0.33**	**JP-2**	**105.3**	**28.6**	**0.18**
	PL-5	350.1	51.5	0.20	PL-5	437.0	48.0	0.11
	PL-7	232.7	93.5	0.40	PL-7	289.2	71.5	0.25
	PL-11	144.2	114.0	0.79	PL-12	172.2	7.4	0.04
	PL-12	173.5	7.7	0.04	PL-14	130.4	17.4	0.13
	PL-16	34.0	26.4	0.78	PL-15	31.3	4.3	0.14
	PL-18	7.7	3.2	0.42	PL-18	16.1	5.9	0.37
	PL-21	4.9	2.7	0.55	PL-20	38.1	4.3	0.11
	Table 5.7 Pike Lake	**947.1**	**299**	**0.42**		**1114.3***	**158.8**	**0.14**

* PL-P19 not part of comparison since it is outside of the previous study area. Pond added due to level of detail of SWMP.

HOWARD LAKE (HLK)

Information collected for the Wetland Inventory indicates that Howard Lake is highly susceptible to impacts associated with urban stormwater. Consequently, the use of this basin in the 2030 urban system must be restricted compared to similarly sized basins elsewhere in the City. Fortunately, Howard Lake's smaller natural tributary drainage area also means that the future urban drainage area to the lake will also be small – so meeting the management strategy for Howard Lake should not be an issue. In part, the high quality of the lake is a function of its limited drainage area.

Howard Lakes drainage totals 559 acres and includes small wetlands separated from Howard Lake by steep slopes and hills. In order to protect Howard Lake, existing discharge and bounce is essentially maintained in the 2030 proposed system. This holds true for the 1, 10, and 100-YR rainfall events. Currently the lake discharges through a culvert under Marschall Road into a complex of wetlands within the Campbell Lake subdistrict CALK-2. The 2030 drainage plan anticipates that the future Howard Lake drainage continue in this pattern to proposed basin CALK-P2, which will discharge into

Campbell Lake. Alternately, if development in CALK-2 benefits from routing discharge around this subdistrict and its wetland complex, then Howard Lake's discharge could be sent directly to Campbell Lake via a pipe under Marschall Road. From a stormwater management perspective, either route would be acceptable since the choice of route has no bearing on the calculated discharge from Campbell Lake.

CAMPBELL LAKE (CALK)

Campbell Lake drainage district is located northwest of Spring Lake, bounded by 170th Street and Marschall Road. It consists of roughly 422 acres and is shown on system map 5. The district is characterized by steep slopes surrounding Campbell Lake: CALK-P1. Campbell Lake is designated as a least susceptible wetland in the Wetland Inventory (section 4).

Given Campbell Lake's status as "least susceptible" to impacts from urban stormwater and its large size, it follows that maximum rate control should be obtained within Campbell Lake. This said, the proposed bounce of 926.0' to 927.8' would be considered moderate and more in line with a higher susceptibility ranking.

Though not identified as such by the PLSLWD in their initial look at retention potential because it lies outside their jurisdiction, Campbell Lake holds some promise as a retention basin and implementing some retention here would promote reduction in volumetric discharge to Louisville Swamp and, ultimately, the Minnesota River.

LOUISVILLE SWAMP (LSW)

The Louisville Swamp drainage district is located on the far western portion of the 2030 growth area and is shown on system map 5. It is bounded on the western edge by Baseline Road. It covers roughly 1,987 acres of currently agricultural land. Proposed development is urban low density residential in this districts northern portion and a mix of urban medium and high density residential and planned industrial in its southern portions.

Under existing conditions, the LSW drainage is characterized by agricultural ditches. Two specific ditch alignments occur in the 2030 growth area portion of the drainage:

1. A northerly ditch beginning at Campbell Lake through DNR 57W (LSW-P9) under Baseline Road to Marystown Road (County Road 15).
2. A southerly ditch beginning at pond LSW-P2 and meeting the northerly ditch east of Marystown Road. These ditches are more defined and other tributary ditches more prevalent in areas east of Baseline Road – areas that are outside the 2030 growth boundary.

East of Marystown Road the combined ditches become a DNR protected waterway that crosses under U.S. Highway 169. This unnamed protected waterway enters Louisville Swamp, which lies adjacent to the Minnesota River near the confluence of Sand Creek with the River.

For the 2030 system this Plan envisions eliminating the current ditch and drained wetland system and restoring storage to the landscape. At LSW-P2, for instance, the future storage could be significantly increased and infiltration promoted if the large wetland south of the proposed storage basin were restored and used for retention storage and infiltration. This implementation concept would be particularly appropriate here as the surrounding landscape is envisioned as planned industrial in the 2030 growth plan – implying that more runoff will be generated in these areas than elsewhere in the Louisville Swamp drainage.

Similarly, within proposed basin LSW-P9 a significant amount of storage exists such that retention volume and infiltration, in addition to the rate control set by this Plan, could occur – significantly lowering both peak rates and annual runoff volumes discharged downstream into Louisville Swamp and the Minnesota River. LSW-P9 holds a strategic location for implementation of the retention concept since it receives runoff from approximately 756 acres of agricultural land in Shakopee from an area designated as their Sand Creek Drainage by Shakopee's 1999 Comprehensive Stormwater Management Plan. According to Shakopee's Plan developed discharge rates of 1/3 cfs/acre will be allowed from this area upon development. This is approximately the existing rate off the currently agricultural land. It would make sense for Prior Lake and Shakopee to work cooperatively toward lowering this discharge rate particularly since the ditch system that currently delivers runoff south across the border drains a particularly large wetland within Shakopee – a wetland that seemingly has significant potential for decreasing the target discharge rate and implementing some retention.

There are 756.3 acres of off-site agricultural land tributary from the north in Shakopee. This runoff enters at West 160th Street East, roughly 500-feet west of Baseline Avenue.

CREDIT RIVER (CR)

The Credit River district lies on the southeast corner of the study area, shown on system map 3. It consists of 976 acres of primarily developed area. Subdistricts 1 through 4 are tributary to CR-P2 which is currently landlocked. Drainage districts 5-7 travels west to east, toward the Credit River. Since Credit River district is tributary to existing agricultural area outside the City limits, this is a priority region for volume control since increased volume associated with urban stormwater systems has been shown to negatively impact agricultural lands due to frequent inundation of crop during late season times when crop drying is important.

The bounce and inundation period requirements are being met for CR-P5, the only moderately susceptible wetland within the system without an existing piped outlet.

CR-P5 requires berming on the east side to close contours around the pond and protect developed lots to the east.

MARKLEY LAKE (ML)

The Markley Lake drainage district consists of 529 acres in the southeast corner of Prior Lake, as shown on system map 3. The drainage moves southwest to northeast to Markley Lake (ML-P2). ML-P2 will discharge via a 12" forcemain to the Credit River – as proposed in the 2001 Trunk Storm Sewer Fee Determination Study. Much of Markley Lake is developed in a mix of commercial/industrial and residential. Portion of the ML-1, 2, and 3 subdistricts remain to be developed.

There are several moderately and least susceptible wetlands in Markley Lake district. To maintain the integrity of these wetlands, especially as commercial/industrial development progresses, local water quality ponding is necessary.

ML-P1 requires excavation to create a pond adjacent to Markley Lake. Most of the other ponds and wetlands utilized for regional ponding in Markley Lake don't require any grading. Since ML discharge east outside the Prior Lake City Limits to existing agricultural land, this area has been identified as a priority for volume control.

MYSTIC LAKE (MLK)

Mystic Lake drainage district lies just south of County Road 42. It consists of 228 acres, shown on system map 1. Much of the Mystic Lake drainage area is Shakopee Mdewaketan Sioux Community Trust Land and Mystic Lake Casino property.

MLK-P1 is tributary to SC-P1 (Haas Lake) which is a moderately susceptible wetland. Therefore rate control from MLK-P1 has been greatly restricted by the 12" outlet on the north side of the lake.

SIOUX COMMUNITY (SC)

The Sioux Community drainage district drains south to north into Shakopee. It is so named due to the large amount of SMSC Trust land within the district. It consists of 771 acres, shown on system map 1. County Road 42 splits the drainage area.

Much of the drainage area within the Sioux Community remains to be developed. A portion of SC-3 and the majority of SC-7 are SMSC Trust Land with low development densities. The remaining land is slated for medium density residential, except a small portion of commercial in SC-2 along County Road 42.

Haas Lake (SC-P1) is the largest regional pond in the system. It receives discharge from MLK-P1. SC-P1 is characterized by steep slopes adjacent to the lake and is designated a moderately susceptible wetland (MNRAM number 19115227006). Currently discharge is restricted from MLK-P1 to sustain existing inundation and bounce in SC-P1. Future development around the lake should required local ponding to protect the lake and ravines that surround it. Shoreline protection is required by the City around the lake.

There are a series of ravines north of County Road 42 that SC drains to at the Shakopee city limits. To prevent erosion in these ravines, ponds are located upstream with significant rate control. Additional excavation and grading is required at SC-P7 in order to provide adequate flood storage before discharging north into Shakopee due to the large ponded and direct tributary area.

POTENTIAL RETENTION

As stated earlier, this Plan identifies certain areas identified by the Prior Lake Spring Lake Watershed District as having high potential for volume retention. In the discussion of specific drainage systems other basins are identified that also have some potential for application of this concept. The system maps identify only those prospective locations for retention identified by the Watershed, and do not show those that may be discussed in the preceding text. It should be emphasized that any large basin, regardless of which Watershed it lies in, has potential for application of retention and infiltration concepts. This is particularly true for basins termed "least susceptible" where the fluctuations in water level that occur due to retention storage will have less impact on current wetland functions and values. Table 5.15 summarizes retention volumes that might be available between this Plan's proposed outlet elevations and the lowest elevation evident in a particular basin. Table 5.15 is not intended to stipulate that a particular amount retention is required, it is only intended a first step in defining what the current surface water modeling provides by way of potential retention volume.

Table 5.15
Potential Retention Volume

Pond Number	Retention Volume (ac-ft)
SPLK-P5	5.6
SPLK-P6	7.7
SPLK-P7	6.1
SPLK-P9	3.5
SPC-P1	9.2
SPC-P2	9.0
CRLK-P1	41.5
RLK-P1	262.8
SPW-P1	7.7
SPW-P2	3.2
CD13-P1	42.9

6. IMPLEMENTATION PLAN

6.1 General

The Implementation Plan section of the Prior Lake LSWMP describes a range of activities and programs that support improvement of the City's surface water management program. Capital outlay for the surface water system (pipes, channels, and ponds) shown on the system maps will be large. For this reason a financing mechanism, called an area charge, is developed in this section. Based on the Capital Improvement Plan and the developable acreage, an area charge is developed and application of this charge is discussed.

The concept of an area charge to finance expansion of the trunk stormwater management system is not a new concept for the City. Since its report titled Trunk Storm Sewer Fee Determination Study (February, 2001) the City has quantified future trunk and ponding needs and developed an area charge based on actual costs of these needs spread across the potential developable acreage. With the analysis contained within the LSWMP the City will update the fees for the 2030 growth area.

Much of this section of Prior Lake's LSWMP focuses on the analysis that supports the development of the area charge. There are also several City planning and budgeting documents that outline surface water management activities undertaken by the City. Those documents are identified in Table 6.0, and are incorporated by reference into this Plan.

Table 6.0.

Plan/Document	**Revision Frequency/Notes**
Capital Improvement Program	Annually
City Budget Documents	Annually
Storm Water Pollution Prevention Program	Every five years (minimum)
Joint Stormwater Education Plan for Scott County	Every five years
Downtown Stormwater Plan	To be developed in 2007

Section 6 also includes:

- An overview of the City's NPDES permit
- A discussion of operation and maintenance procedures and strategies
- An outline of an education program
- Financial considerations for the storm water utility
- A section referencing applicable design standards for stormwater management
- A section on Watershed implementation priorities
- Implementation priorities for the City
- A discussion of the process for amending this plan and an annual report to council

6.2 Cost Analysis and Capital Improvement Plan

One of the basic objectives of this study was to determine the cost of completing the City of Prior Lake's trunk stormwater system and at the same time to determine new trunk area charges that will insure availability of sufficient funds for future trunk and pond construction.

The cost estimates presented in this report are based on 2004 construction costs and can be related to the Engineering News Record (ENR) cost index of 7017 (April, 2004). Future changes in this index are expected to fairly accurately reflect changes in construction costs for the trunk stormwater system. This cost analysis is completed for estimation purposed and should not be interpreted as policy.

6.2.1 Cost Estimation Methods

To minimize excavation ponds have generally been proposed for existing low areas. Where natural topography does not lend itself to ponds either excavation or berming is proposed to create the requisite pond areas.

Ponds serve to reduce peak flows. In that capacity they are desirable in and of themselves. Ponds also have an added benefit of reducing downstream pipe sizes and thus trunk pipe costs. Since ponds themselves involve cost it is desirable to reach a balance point between ponds and larger pipes so that the least expensive system is proposed. Generally, when pipes larger than 48-inches are prevalent, overall system costs might be reduced by additional ponding areas.

Trunk pipes are generally located in existing drainage ways so that excessive pipe depth can be avoided. This keeps pipe costs down and is the specific reason why it is best to install trunk pipes in existing drainage ways.

Appendix B provides detail on the pipe system and channel reaches while appendix D provides cost estimates for building these reaches used in the analysis. Appendix D also includes construction costs for ponds, which follow from the pond data provided in appendix C.

6.2.1.1 Pipe Costs

Pipe costs are based upon:

- Pipe construction
- Easement Acquisition
- Indirect Costs

Pipe Construction:

The appendix D pipe costs are based upon a pipe cost matrix that relates pipe cost to diameter and pipe depth. This matrix is based on an analysis of bid tabulations and discussions with large utility contractors. The matrix is updated annually based on the ENR index and more recent bid tabulations as they become available. The per linear foot pipe costs given in appendix D include pipe material costs, installation, manholes, and bedding, as well as restoration and are thus comprehensive in terms of the various costs associated with installing pipe. In many cases, existing channels are used in lieu of trunk pipe. The costs associated with channels are for the excavation and shaping that is usually necessary to make channels function properly.

Easement Acquisition Assumption:

For each pipe reach a cost is included for permanent and temporary easement. Permanent easement is calculated at 100% the fee title value of upland areas – estimated at $100,000 per acre in the year 2004. Appendix D includes no costs for temporary easement. Temporary easement is usually not necessary since construction of facilities occurs on development sites. As pipe depths increase the permanent easement width around the pipe also increases. This is reflected in the cost estimates. For the purposes of estimating costs, it is assumed that 75% of future trunk pipe will fall in dedicated easement or right-of-way, so easement costs are applied to only 25% of trunk footage.

Indirect Costs:

A 30% factor for indirect costs is included in the cost estimate presented in Appendix D – applicable to pipe, channel and pond construction. Indirect costs include engineering, administration, contingencies, and fiscal costs. For easement acquisition a 10% indirect cost has been applied. This accounts for the appraisal and administrative costs associated with easement acquisition.

6.2.1.2 Pond Costs

Pond costs involve the following:

- Pond construction (excavation and berming)
- Easement acquisition

Pond Construction:

The primary element of pond construction is excavation. To some extent berming will also be necessary to create the ponds shown in the system maps at the end of this report. Pond construction costs vary considerably depending on whether excavation is necessary. At one extreme are ponds that obtain their requisite flood storage solely by excavation. At the other extreme are ponds that are existing depressions with the required storage provided or ponds that can be created by berming. To account for the variability in pond construction costs, three different pond construction costs are used. Each of the three is based on a unit cost per acre of pond at high water level (HWL). The three costs and the rationale behind their use are as follows:

1. Minimal excavation or berming: $4,500/acre of pond at HWL
2. Combination of excavation and berming: $9,000/acre of pond at HWL
3. Full excavation of flood storage volume: $13,000/acre of pond at HWL

Appendix D details the costs of pond construction. The construction cost is for providing flood storage only and does not include costs associated with providing water quality treatment. As stated previously, water quality treatment is considered a development cost and not a trunk cost. Creation of water quality volume could occur in the ponds proposed within the developable area, but this cost would be strictly a developer cost with no reimbursement or participation by the City.

Pond Easement Acquisition:

For each pond, a cost is included for permanent easement. Permanent easement is calculated at 50% the fee title value of upland areas (50% x $100,000/acre = $50,000/acre). 50% fee title, instead of 100%, is used to account for the fact that many of these low areas are otherwise undevelopable since many are jurisdictional wetlands or would be used for the required water quality ponding.

No easement cost is associated with existing NWI wetlands or wetlands inventoried as part of the Wetland Management Plan (section 4 of this Plan), although there may be a construction cost to account for required berming or expansion. The easement costs for pond are applied only to those areas that appear to be non-wetland by the methods employed in preparing this plan.

6.2.2 System Costs and Capital Improvement Plan

Appendix D summarizes the analyzed system costs by element, by major watershed, and for the system as a whole. Appendix D serves as the City's stormwater CIP for future development and for calculating area charges.

The analyzed system, as shown in system maps, has an estimated cost of $10,992,289. This cost includes indirect costs of 30% on trunk and pond construction and indirect costs of 10% on easement acquisition.

Table 6.1 presents the stormwater management CIP for the City of Prior Lake. The cost elements come directly from the 2030 stormwater system design as described in the

system maps and the appendices to this report. The various trunk elements are organized by prospective year of implementation as well as whether they constitute a pond cost or trunk pipe cost. Total costs for the 2030 system are $10,836,957.

Table 6.1

Capital Improvement Plan

Year/Phase	Trunk Storm Sewer Element		Pond Cost ($)	Trunk Cost ($)
	Pipe			
	From Point	To Point		
2004	CRLK-P2	CRLK-P1	32,163	147,987
	RLK-P2	RLK-P1	543,201	147,987
	RLK-P3	RLK-P1	145,174	30,003
	RLK-P1	CRLK-P1		157,536
	SPLK-P3	SPLK-P1		18,909
	SPLK-P10		16,283	
	Total		**736,822**	**502,422**
2006	CR-P3	CR-P2	18,609	315,277
	CR-P5	CR-P6		7,564
	CR-P4		8,723	
	CR-P6	Credit River		90,763
	CRBA-P3	CRBA-P2		215,563
	HLK-P2	HLK-P1		68,073
	JP-P1	JP-P2	23,261	38,605
	JP-P2	JP-P3	8,141	19,303
	JP-P3	JP-P4	23,843	38,605
	JP-P4	JP-P5		90,763
	LPPL-P2	LPPL-P1		41,647
	LPPL-P4	LPPL-P1	43,615	30,254
	LPPL-P10	LPPL-P1		75,636
	LPPL-P12	LPPL-P1		115,816
	LPPL-P5		1,163	
	LPPL-P9		7,560	
	LPPL-P11	LPPL-P1	45,360	115,816
	ML-P5	ML-P7	19,191	
	ML-P6	ML-P1		166,400
	ML-P1	ML-P2	414,548	15,001
	ML-P2	Credit River		113,128
	ML-P11	Credit River		7,564
	SPLK-P6	SPLK-P7		44,270
	SPLK-P7	SPLK-P1	40,707	45,382
	SPLK-P5	SPLK-P1	29,077	18,909
	SPLK-P4	SPLK-P1		18,909
	UPPL-P15	UPPL-P8	397,828	52,945

	UPPL-P8	UPPL-P9		26,473
	UPPL-P6	UPPL-P4		71,854
	UPPL-P7	UPPL-P4		25,055
	Total		**1,081,626**	**1,862,013**
2008	CALK-P2	CALK-P1	29,658	13,615
	CALK-P3	CALK-P1	17,446	75,636
	CALK-P1	LSW-P9		200,436
	ERLK-P1	RLK-P1	114,562	13,281
	Total		**161,666**	**302,967**
2010	LSW-P2		55,827	
	LSW-P9	LSW-P7	218,075	12,868
	LSW-P10	LSW-P7	59,316	7,564
	LSW-P11	Shakopee	15,120	7,564
	SPW-P2	SPLK-P1	387,132	200,020
	Total		**735,470**	**228,015**
2012	CD13-P1	SPLK-P1	350,664	94,521
	PL-P1	PL-P2	214,422	98,327
	PL-P2	PL-P4	19,191	310,030
	PL-P3	PL-P4	34,892	40,004
	PL-P4	PL-P5	41,870	154,422
	PL-P5	PL-P16	26,751	115,816
	PL-P6	PL-P7	25,006	166,400
	PL-P9	PL-P8		109,672
	PL-P10	PL-P8		45,382
	PL-P8	PL-P7	6,397	25,737
	PL-P7	PL-P16	106,087	87,694
	PL-P11	PL-P16		75,636
	PL-P13	PL-P12		125,581
	PL-P12	PL-P16	20,935	30,254
	PL-P14	PL-P16	55,827	30,003
	PL-P15	PL-P16		45,382
	PL-P16	Shakopee		50,111
	PL-P17	Shakopee	165,762	3,782
	PL-P18	PL-P16	33,152	7,564
	PL-P19	PL-P16	66,305	37,818
	PL-P20	PL-P16	79,566	41,600
	SC-P1	SC-P2		75,636
	SC-P2	SC-P7	45,941	450,396
	SC-P7	Shakopee	106,087	200,442
	SC-P3	SC-P4	81,415	136,145
	SC-P4	Shakopee	23,261	35,003
	SC-P5	Shakopee	18,028	52,945
	SC-P6	Shakopee	20,354	15,127

	SC-P8	Shakopee	55,827	7,564
	SC-P9	Shakopee	152,501	7,564
	SPC-P2	SPC-P1	171,358	20,002
	SPW-P1	SPW-P2	51,756	238,067
	Total		**1,973,354**	**2,937,627**
2014	LSW-P3		75,599	
	Total		**75,599**	
2024	SPLK-P9	SPLK-P1	26,169	22,691
	SPLK-P8	SPLK-P1		15,217
	SPC-P1	SPLK-P1		175,387
	Total		**26,169**	**213,205**
			Grand Total	**10,836,967**

6.3 Financing and Cost Recovery

6.3.1 Area Charges and Cost Recovery Calculations

The City of Prior Lake currently recovers the cost of its trunk stormwater system through an area charge. This Plan is updating those charges for the 2030 growth area.

At present, the City reduces gross acreage by wetland area and park area to determine a developable acreage. This developable acreage is reduced further to account for area that would not be subject to area charges: storm pond easements, major road right-of-way, greenway corridors, park dedication, and wetland buffers.

The total acreage then available for application of area charges was set at 3,524 acres out of the developable acreage within the 2030 growth area. The acreage to which area charges apply is termed the financing area and includes only those areas developing within the financing analysis period.

For financing purposes, the net developable acreage within the 2030 growth area is 3,524 acres. In order to determine an equitable financing schedule it is also necessary to convert acres into equivalent acres and base the financing analysis on a reasonable break even period.

Typically stormwater area charges are applied to equivalent area with and equivalent acre adjusted to reflect the greater burden placed upon the stormwater system by more impervious land uses like commercial, industrial, and high density residential. Table 6.2 provides a summary of equivalency factors used by the City of Prior Lake. Equivalency

factors are based upon runoff coefficients for the different land uses with urban low and medium density residential considered as a base case.

Table 6.2
Land Use Based Equivalency Factors

Land Use	Factor
Urban Low and Medium Density	1.0
Urban High Density Residential	1.65
Commercial and Industrial	2.07

Table 6.3 presents the cost recovery analysis based upon application of these equivalency factors and a 20-year break even assumption.

Table 6.3
Stormwater Area Charge
50% Land Cost for Constructed Pond Easement

A	B-1	B-2	B-3	C	D	E
Phase	Net Developable (Assessable) Acreage Added - Residential	Net Developable (Assessable) Acreage Added - Non-Residential	Net Developable (Assessable) Acreage Added - TOTAL	Equivalent Area Added	REVENUE Column C x Area Charge of $2790/EqAc	EXPENDITURE City Trunk Costs
(yr)	(ac)	(ac)	(ac)	(EqAc)	($)	($)
2004-2009	1312	133	1445	1587	4,428,595	4,647,517
2010-2014	1467	224	1691	1931	5,386,597	5,950,066
2015-2019	243	10	253	264	735,723	0
2020-2024	135	0	135	135	376,650	239,374
Totals	3,157	367	3,524	3,917	10,927,565	10,836,967

Note: Developable Area within municipal boundary phased in between 2004-2014.

In some instances developers will dedicate or construct at their own cost the trunk infrastructure necessary to serve future upstream development. This Plan serves as a guide as to what is necessary for upstream development. In these cases developers may seek a credit toward area charges – a credit that can be quantified based upon the analysis of the preceding sections.

6.3.2 Area Charge Summary

Sections 6.2 and 6.3 develop an area charge for the City of Prior Lake that can be applied to future development within the City. The area charge has been constructed methodically as follows:

1. Pond and trunk costs for near term development have been estimated. A stormwater CIP has been created as shown in appendix D and table 6.1.
2. Net assessable acreage has been determined.
3. The base area charge has been modified into a land use based area charge through the use of equivalent acres.

6.4 NPDES Permit

Refer to City MS4 permit and Storm Water Pollution Prevention Plan for additional operations, maintenance, and reporting requirements.

6.5 Operation and Maintenance

6.5.1 Activities

A storm water system is a major investment for the City of Prior Lake – both in terms of initial capital cost and in terms of ongoing maintenance costs. The capital improvement program outlines the costs for new trunk system construction which will be funded by area charges. System maintenance is funded by the city's storm water utility.

The city's storm water system maintenance responsibilities include the following:

- Street sweeping
- Cleaning of sump manholes and catch basins
- Repair of catch basins and manholes
- Assessing pipe condition (typically by televising)
- Inspection of storm sewer inlet and outlet structures
- Pond mowing and other vegetation maintenance
- Excavation of accumulated sediments from ponds

The city has maintained its pipe system for decades and staff has a strong grasp on the costs associated with this. As new development brings more ponds into the system, city staff will find that pond maintenance becomes an increasingly large portion of both staff time and maintenance budget. It is important to quantify the extent of this future commitment so that the funds necessary for pond maintenance activities can be collected via the city's storm water utility.

Table 6.4 provides a typical maintenance schedule for wet ponds.

Table 6.4
Wet Pond Maintenance Schedule

Activity	Schedule
Inspect regional pond outlets for clogging.	After significant rainfalls
Inspect for damage. Note signs of hydrocarbon build up. Monitor for sediment accumulation in the facility and forebay. Examine to ensure that inlet and outlet devices are free of debris and operational.	Annual inspection
Repair undercut or eroded areas.	As needed
Mow slopes	Twice annually
Remove sediments from forebay	5 to 7 year cycle
Remove sediment accumulated in main pool	20 to 30 year cycle

Adapted from Watershed Management Institute. 1997. Operation, Maintenance, and Management of Stormwater Management Systems.

As the city obtains more ponds, the management of these might be facilitated by creation of a GIS database for all storm water system infrastructure. Via this database the city could reference, via interactive mapping, maintenance records, videotapes, and maintenance costs for portions of their system.

6.5.2 Stormwater Basins

Stormwater basins represent a sizable investment in the City's drainage system. General maintenance of these facilities helps ensure proper performance and reduces the need for major repairs. Periodic inspections are performed to identify possible problems in and around the basin. Inspection and maintenance cover the following:

- Basin outlets
- Basin inlets
- Side slopes
- Illicit dumping and discharges
- Sediment buildup

Basin Outlets

A key issue with stormwater basins is ensuring that the outlets perform at design capacity. Inspection and maintenance of basin outlets address the following:

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

Basin Inlets

Inspection and maintenance of basin inlets address the following:

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

Side Slopes

Inspection and maintenance of basin side slopes address the following:

- Side slopes are kept well-vegetated to prevent erosion and sediment deposition into the basin. Severe erosion along side slopes can reduce the quality of water discharging from the basin and require dredging of sediments from the basin.
- Noxious weeds are periodically removed from around basins.
- Some basins in highly developed areas require mowing. If mowing is performed, a buffer strip of 20 feet or more adjacent to the normal water level is typically maintained. This provides filtration of runoff and protects wildlife habitat.

Illicit Dumping and Discharges

Inspection and maintenance of illicit dumping and discharges into basins address the following:

- Basins are periodically inspected for evidence of illicit dumping or discharges. The most common of these is dumping of yard waste into the basin.
- Where found, illicit material is removed, and signs are posted as needed prohibiting the dumping of yard waste.
- Water surfaces are inspected for oil sheens. These can be present where waste motor oil is dumped into upstream storm sewers.
- Skimmer structures are installed as needed at outlet structures to prevent oil spills and other floatable material from being carried downstream.
- Skimmer structures are periodically inspected for damage, particularly from freeze-thaw cycles.

Sediment Buildup

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

- Basins are inspected to determine if sediment buildup is causing significant loss of storage capacity from design levels. Excessive sediment buildup significantly reduces the stormwater treatment efficiency of water quality ponds.
- Sediment removal is performed where excessive sediment buildup has occurred. As a general guideline, ponds require dredging every 15 to 20 years.

6.5.3 Sump Manholes and Sump Catch Basins

Sump manholes and sump catch basins are included in storm sewer systems to collect sediments before they are transported to downstream water bodies. These structures keep sediments from degrading downstream water bodies. Once sediments are transported to a lake or pond, they become much more expensive to remove.

Sediments originate primarily from road sanding operations, although construction activity and erosion can also contribute. Since these structures are designed to collect these sediments, they are routinely inspected and cleaned to provide capacity for future sedimentation. Suction vacuum equipment is typically used.

6.5.4 Storm Sewer Inlet Structures

To fully utilize storm sewer capacity, inlet structures are kept operational in order to get runoff into the system. All efforts are made to keep catch basins and inlet flared ends free of debris and sediments so as not to restrict inflow and cause flood damage. Leaf and lawn litter are the most frequent cause of inlet obstructions. On a routine basis, City staff visually inspects inlet structures to ensure they are operational.

6.5.5 Open Channels

Overland flow routes constitute an important part of the surface water drainage system. Open channels are typically vegetated and occasionally lined with more substantial materials. The lined channels typically require little or no maintenance. Vegetated channels are periodically inspected and maintained, as high flows may create erosion within the channel.

Eroded channels can contribute to water quality problems in downstream water bodies as the soil is continually swept away. If not maintained, the erosion of open channels would accelerate and the repair would become increasingly more costly. The use of bioengineering and natural stream technology, which mimics the characteristics of natural streams to promote channel stability, can reduce the potential for erosion.

6.5.6 Piping System

The storm sewer piping system constitutes a multimillion-dollar investment for the City. The City performs a comprehensive maintenance program to maximize the life of the facilities and optimize capital expenditures. The following periodic inspection and maintenance procedures are followed:

- Catch basin and manhole castings are inspected and are cleaned and replaced as necessary.

- Catch basin and manhole rings are inspected and are replaced and/or regrouted as necessary.

- Catch basin and manhole structures are inspected and are repaired or replaced as needed. Pipe inverts, benches, steps (verifying integrity for safety), and walls are checked. Cracked, deteriorated, and spalled areas are grouted, patched, or replaced.

- Storm sewer piping is inspected either manually or by television to assess pipe condition. Items looked for include root damage, deteriorated joints, leaky joints, excessive spalling, and sediment buildup. The piping system is programmed for cleaning, repair, or replacement as needed to ensure the integrity of the system.

6.5.7 De-Icing Practices

Minnesota receives approximately 54 inches of snow during a typical year. This requires a large amount of de-icing chemicals (primarily salt) to be applied to roads and sidewalks each winter.

Estimates indicate that 80 percent of the environmental damage caused from de-icing chemicals is a result of inadequate storage of the material (MPCA 1989). Improper

storage as well as overuse of salt increases the risk of high chloride concentrations in runoff and groundwater. High chloride concentrations can be toxic to fish, wildlife, and vegetation.

The following procedures are used for storing de-icing chemicals in the City.

1. De-icing material is stored in waterproof sheds. Where this is not possible, stockpiles are covered with polyethylene and placed on impervious surfaces.
2. Road de-icing stockpiles are not located near municipal well areas or in other sensitive groundwater areas.
3. Runoff from stockpiles is not allowed to flow directly into streams or wetlands where environmental damage can occur.

Prior Lake has established a detailed "snow and ice removal policy" to address winter maintenance needs. Street conditions are assessed for each individual event and ice control material application is adjusted accordingly. Equipment is maintained in good working order to place ice control material on roadways and is properly calibrated to prevent excessive application. The City is in the process of building its own sand/salt storage facility.

6.5.8 Street Sweeping

Street sweeping is an integral part of the City's effective surface water management system. It greatly reduces the volume of sediments that have to be cleaned out of sump structures and downstream water bodies. The City has a "street sweeping policy" that includes three sweeping operations in a year, or more often as dictated by the City SWPPP. Spring sweeping begins either late March or early April after the risk of later snowfall has passed and targets sand left from winter sanding operations. Fall sweeping occurs after leaf fall. The downtown area is swept every other week.

Prior Lake does not allow residents to rake leaves into the street for pick up, but does provide a compost site where residents can bring their leaves. This greatly reduces the incidence of inlet blockages and protects the water quality of downstream water bodies.

The objective of both programs is to minimize impacts from leaf litter, sand, salt and other debris on the surface waters of the City.

6.5.9 Detection of Illicit Connections

As presented in the goals section Prior Lake will modify its ordinance to prohibit the dumping of hazardous material into the stormwater system. As staffing allows the City will also inspect storm sewer outfalls during dry periods to determine if any illicit sanitary sewer connections are evident.

The City will also begin the process, as staffing allows, of mapping its storm sewer outfalls and integrating this mapping with inspection data.

6.6 Education

6.6.1 General

Education can play an important role in any effort to implement a stormwater management program like the one outlined in this LSWMP. The objectives of an education effort are different, depending on the target audience. In general, the target audience for this education program is City staff, City residents, and the development community. The following sections describe why education of each of these groups is important and presents educational methods that may be used for each audience.

6.6.2 City Staff

City Staff have a wide range of responsibilities for implementing this plan. These include:

- Implementing street sweeping and spill response programs.
- Maintaining detention basin/stormwater management pond performance and system operability.
- Planning for, and management of projects to enhance pollutant removal performance, wetland quality, etc.
- Carrying out grounds maintenance of City-owned lands/facilities in a way that sets a good example for residents.
- Utilizing BMPs in application of ice control material.
- Application of Best Management Practice policies and regulations to new and redevelopment projects.
- Planning and delivering education programs.
- Working out cooperative arrangements with regulatory and non-regulatory organizations to achieve LSWMP objectives.
- Assisting the City Council in the application of the LSWMP policies.

Because these responsibilities involve many different levels of City staff, City staff members are trained to have a basic understanding of the LSWMP, including:

- A description of the major stormwater management issues (including known stormwater management problem areas, stormwater management expectations for

new and re-development projects, and incorporation of stormwater mitigation into capital improvement projects, and regulatory jurisdictions).

- The objectives of the LSWMP and the general approach outlined in the LSWMP for resolution of these issues.
- The responsibilities of the different work units in implementing the LSWMP.
- The information the LSWMP provides.
- Identification of in-house experts.

This information is disseminated in presentations at staff meetings, coverage in internal newsletters, and issuance of internal memos.

6.6.3 City Residents

In order to obtain the necessary political and economic support for successful LSWMP implementation, it is vital to inform City residents about basic stormwater management and water quality concepts, policies and recommendations in the LSWMP, and the progress of stormwater management efforts.

For example, the City has incorporated stormwater management practices into a number of utility reconstruction projects that benefit stormwater quality in the watersheds of some of the City's most visible lakes. It is important that residents know about these projects (including how they were funded) so that they develop an awareness that the City is being responsive to the public interest in protecting these high priority resources and that dedicated financial resources such as revenue from the stormwater utility are being put to work.

This information is presented to the public through the City newsletter: The Wavelength, press releases on the City website or to local papers, through the Mayor's and City Manager's columns, and at public meetings as appropriate. Periodic updates on the progress of LSWMP implementation and information on specific improvement projects is also provided to the public. Again, the City newsletter and press releases to local papers are good methods by which this information is disseminated.

The City's Lake Advisory Committee provides educational brochures on a periodic basis. The City also contributes, through its stormwater utility, to the Citizens Assisted Monitoring Program (CAMP). This Metropolitan Council sponsored program has as one of its primary goals the development of a lakes water quality database to facilitate understanding of the processes involved in urban lakes. The City also conducts bacteria testing at beaches and makes these results available to the public.

6.6.4 Development Community

The LSWMP is designed to provide the official policy direction that City staff and the City Council desire to guide stormwater mitigation for new and redevelopment projects.

The information contained within this plan is disseminated to developers and their consulting engineers as early as possible in the development review process. In this way, developers know what is expected of them and can consider the requirements in their initial assessments of the site as well as incorporate the necessary BMPs in any subsequent designs. Much of the necessary information is disseminated to the developers in an information packet in the development submittal information they receive from the City.

While dissemination of information is valuable, there is no substitute for a meeting between key City staff and the developer as early as possible in the review process. This helps define expectations for submittals, clarify regulatory compliance issues, and provide additional detailed guidance. Developers are encouraged to do this as soon as possible after they have reviewed the LSWMP information and thought about how it applies to their site.

6.7 Financing and the Stormwater Utility

6.7.1 Current Status - Summary

The City of Prior Lake implemented a stormwater utility in 1993. The current quarterly residential charge is $6.00 per residential unit. Annual revenue from the stormwater utility has grown as shown in table 6.5.

Table 6.5
Storm Water Utility Revenue

Year	Annual Revenue ($)
1997	137,000
1999	177,000
2001	257,000
2002	283,000

Generally, revenue has grown not because of increases in the charge (the charge has gone from $5.63 in 1997 to $6.00 in 2005, an increase of 6.6%) but due to development bringing in more properties over which to collect the charge. With this increased revenue, though, has come an increase in the City's maintenance responsibilities.

In the past the stormwater utility has funded a staff position, programs, and capital expenditures. The 2002 capital projects totaled $140,000 and included a dredging project, a lake bank stabilization project, and some storm drainage improvements.

6.7.2 The Stormwater Utility into the Future

In order that storm water utility (SWU) funding keeps pace with increase in municipal maintenance responsibilities, the city should plan for the costs to conduct periodic pond maintenance. Limited data on maintenance activities has been developed by watershed management organizations. A review of this data suggests an annual maintenance budget

of $1,250 per acre-foot of wet volume or $4,350 per acre of surface at NWL. Either parameter is relatively easy to track. This $1,250 per acre-foot maintenance item can be translated into a per household cost by virtue of the fact that one acre-foot is sufficient pond wet volume for 20 acres of residential development. Assuming 2.5 units per gross acre, then $1,250 per year is spread among 50 units - $25 per unit per year.

The current residential rate is $24 per unit per year. The current charges provide approximately $300,000 per year in revenue of which only about $20,000 to $40,000 has been used for pond maintenance. As the city's maintenance responsibilities grow the storm water utility funding also needs to grow to keep pace.

Prior Lake is a regulated MS4 under the Phase II NPDES Permit. There is a cost associated with preparing an NPDES permit and the associated Storm Water Pollution Prevention Plan (SWPPP). Some estimate cities the size of Prior Lake will spend $50,000 every five years for permit preparation. For Prior Lake it is reasonable to assume that $10 per household will be spent every five years – adding $2 per year to the individual household's storm water utility bill.

The NPDES permit and SWPPP commit the city to certain activities, including capital projects, for the purpose of improving the quality of the city's storm water discharge. The U.S. EPA has estimated that the financial commitments that city's will make may total $10 per household per year. Others place this figure at $20. Since many of the activities identified by the SWPPP may already be funded (like street sweeping and pond maintenance) the $20 figure is probably too high. For the purposes of planning increases in SWU collection the $10 per year figure should be used. Table 6.5 summarizes the additional storm water utility charges identified above.

Table 6.6
Future Storm Water Utility Funding

Item	Annual Charge to Single Residential Unit	Quarterly Charge to Single Residential Unit
Current commitments	$24.00	$6.00
Future pond maintenance	$25.00	$6.25
NPDES permit and SWPPP	$2.00	$0.50
NPDES permit compliance	$10.00	$2.50
Total	**$61.00**	**$15.25**

The estimate of stormwater utility funding needs does not include City participation in TMDL processes nor does it include preparation by the City of a non-degradation analysis as currently required in the draft of the new Phase II NPDES Permit. And the estimate of funding needs does not include any mitigation that may occur due to the TMDL or non-degradation processes.

A $61.00/residential unit charge would be close to one of the highest rates among Metro Area cities.

6.8 Design Standards

The City of Prior Lake has produced and regularly updates a Public Works Design Manual. The latest version of this manual is titled Public Works Design Manual, City of Prior Lake, January 2002. This manual, as revised, is adopted by reference into this Surface Water Management Plan as the applicable design standard for surface water management.

6.9 Watershed Implementation Priorities

Among the two watershed districts that cover the City, only the Prior Lake Spring Lake Watershed District has developed a detailed list of implementation priorities. At present the primary implementation priority for Scott WMO is implementation of its Rules, adopted on May 10, 2005.

The Prior Lake-Spring Lake Watershed District has adopted a Water Resources Management Plan that includes programs and projects focused on water quality and runoff management, land management to improve water quality and reduce runoff volumes, and management of the Prior Lake Outlet System. Additional information about the District's implementation priorities, programs and projects can be found at www.plslwd.org or by contacting the District office at (952) 447-4166.

6.10 City of Prior Lake Implementation Priorities

Downtown Redevelopment

In 2007 the City will propose a downtown stormwater management study that will provide a plan for the stormwater management within a downtown overlay. This plan will spell out site specific BMPs for rate and volume control, as well as proposed centralized facilities that will meet City and District rules. Through cooperative effort in creating and reviewing this plan, the City and District can promote further partnership in the implementation phase. Currently reconstruction of a portion of the downtown area is scheduled to begin in 2011. When this reconstruction begins, the approved downtown stormwater management study will be implemented.

Other implementation priorities for the City as it adopts this Plan and begins the implementation phase of the Plan include:

1. Assisting the PLSLWD in implementing its retention storage program. Specific areas with high potential for City implementation are indicated on the system maps and within the body of this Plan.
2. Increasing Storm Water Utility Funding so that the City can meet its current and future obligations toward pond maintenance, NPDES compliance, and mitigation that may come out of the City's non-degradation analysis.

3. Application of the revised area charge outlined in this report and update of the area charge based on increases in land value and construction costs.
4. Implementation of the rate control targets as outlined in the appendices and stormwater modeling that supports this plan.
5. Application of the wetland susceptibility criteria in determining how wetlands are used for flood storage, retention, and rate control.
6. Working with the PLSLWD regarding the feasibility of augmenting storage in Buck Lake.
7. Working with the City of Shakopee toward redefining rate control objectives from their Sand Creek drainage which will ultimately enter the City of Prior Lake system through its Louisville Swamp system.
8. Gaining equivalency with Scott WMO and PLSLWD rules.
9. Working in partnership with WMO and WD to minimize for downstream impacts due to urbanization.
10. Passing ordinance revisions consistent with rules regarding buffer widths by August 9, 2006.
11. Implement the City NPDES permit and SWPPP.

6.11 Amendment Procedures

The Prior Lake LSWMP is intended to extend through the year 2016. For the plan to remain dynamic, an avenue must be available to implement new information, ideas, methods, standards, management practices and any other changes that may affect the intent and/or results of the LSWMP. The amendment procedure for the LSWMP is presented below.

Request for Amendment

Written request for plan amendment is submitted to City staff. The request shall outline the need for the amendment as well as additional materials that the City will need to consider before making its decision.

Staff review of Amendment

A decision is made as to the validity of the request. Three options exist: 1) reject the amendment, 2) accept the amendment as a minor issue, with minor issues collectively added to the plan at a later date, or 3) accept the amendment as a major issue, with major issues requiring an immediate amendment. In acting on an amendment request, City staff shall recommend to City Council whether or not a public hearing is warranted.

Council Consideration

The amendment and the need for a public hearing shall be considered at a regular or special Council meeting. Staff recommendations should also be considered before decisions on appropriate action(s) are made.

Public Hearing and Council

This step allows for public input based on public interest. Council shall determine when the public hearing should occur in the process. Based on the public hearing, the City Council could approve the amendment.

Council Adoption

Final action on an amendment is City Council adoption. However, prior to the adoption, an additional public hearing could be held to review the plan changes and notify the appropriate stakeholders.

Coordination with WMO and WD

To the extent and manner required by the Scott WMO all amendments to the LSWMP shall be submitted to the WMO for review and approval in accordance with applicable state rules and statutes. (Section 103B and Rules)

To the extent and manner required by the PLSLWD all amendments to the LSWMP shall be submitted to the WD for review and approval in accordance with applicable state rules and statutes. (Sections 103B, 103D and Rules)

6.11.1 Minor amendments:

Changes required for TMDL's, Nondegradation Planning, and Ground Water Protection plans will be considered minor amendments to this document.

6.12 Annual Report to Council

A brief annual report will be made by City staff summarizing development changes, capital improvements, and other water management-related issues that have occurred over the past year. The review will also include an update on available funding sources for water resource issues. Grant programs are especially important to review since they may change annually. These changes do not necessarily require individual amendments. The report can, however, be considered when the plan is brought up to date. The annual report should be completed by July 1st to allow implementation items to be considered in the normal budget process.

The City's LSWMP will remain in effect through 2016. The City will then review the LSWMP for consistency with current water resource management methods. At that time, all annual reports and past amendments will be added to the document. Depending on the significance of changes, a new printing of the LSWMP may be appropriate. At a minimum, the Capital Improvement Program should be amended every five years.

7. SUMMARY AND RECOMMENDATIONS

7.1 Summary

The Prior Lake Surface Water Management Plan has a dual purpose: it will serve as a guide for the construction of storm drainage facilities and provide a basis for a consistent approach to water resource protection. The following themes have been incorporated into this LSWMP:

1. Division of the City into drainage districts and subdistricts;
2. Modeling of stormwater runoff under ultimate land use conditions;
3. General layout and sizing of trunk storm sewers and open channels;
4. Tributary areas, storage volumes, and high water levels of all required ponding areas;
5. Development of wetland management policies to ensure compliance with local, state, and federal wetland regulations;
6. Estimated construction and implementation costs of the Surface Water Management Plan; and
7. Storm Water Utility funding needs;
8. Recommendations for education of City residents, staff, and development community.

While providing for public safety through planning for and mitigating flood potential, the stormwater management systems also functions to minimize economic loss and inconvenience of periodic flooding and provides water quality and volume management to retain the high quality of water in the wetlands, lakes and streams.

To provide flood protection for adjacent property, the design storm interval for ponding areas is a 100-year storm as compared to a 5-year or 10-year storm for design of storm sewer piping. To provide an additional safety factor, it is recommended that the lowest exposed opening of a structure in a development should be at least 2 feet above the calculated high water level of an adjacent pond.

The numerous natural wetlands and depressions found throughout Prior Lake have been incorporated into the Surface Water Management Plan as ponding areas. The effective use of ponding areas enables the installation of outflow sewers with reduced capacities since the design storm duration is effectively increased over the total time required to fill

and empty the ponding reservoirs. Storm sewers represent a sizable investment for the community and this investment can be more efficiently utilized by ponding stormwater in designated ponding areas and allowing smaller diameter pipes to be used as outfall lines.

Equally as important as flood control and cost considerations is the use of ponding areas to:

1. Improve water quality;
2. Return stormwater to the groundwater table; and
3. Increase water amenities in developments for aesthetic, recreational and wildlife purposes.

For water quality ponds, the wet volume is the most important consideration. It can be assumed that water quality ponds, which reduce phosphorus loadings by 60% under standard runoff concentrations, will generally reduce heavy metal concentrations by 70% and sediments by 90%.

The trunk storm sewer system alignments shown in this LSWMP are conceptual in nature since future development and the floodplain management requirements of the PLSLWD will determine the exact location of channels or storm sewers.

All storm sewer facilities, especially those conveying large quantities of water at high velocities, should be designed with efficient hydraulic characteristics. Special attention should be given during final design to those lines, which have extreme slopes and create high hydraulic heads. The Best Management Practices (BMPs) recommended by the MPCA should be followed wherever necessary.

7.2 Recommendations

The following recommendations are presented for the City Council's consideration based upon the data compiled in this report:

1. The Surface Water Management Plan as presented herein be adopted by the City of Prior Lake.
2. Standard review procedures be established to ensure all new development or redevelopment within the City is in compliance with the grading and stormwater management controls determined by this Plan.
3. Detailed hydrologic analyses be required or all development and redevelopment activities.
4. Final high water levels governing building elevations adjacent to ponding areas and floodplains be established as development occurs or when drainage facilities are constructed.
5. Overflow routes be established and maintained to provide relief during extreme storm conditions, which exceed design conditions.
6. A surface water system maintenance program be established to ensure the successful operation of the system.

7. The erosion and sedimentation control criteria for new developments be enforced.
8. An education program for City residents, staff, and development community be implemented.
9. Amendments to the plan be adopted and implemented as warranted by future standards or regulations.
10. That the plan be updated in 2010 or earlier if needed.
11. Promote the use of small-site/distributed BMPs to help achieve water quality and volume control goals.
12. Pursue partnerships with watershed management organizations and other agencies to incorporate volume control BMPs into re-development projects, including City projects.
13. Ordinances be revised to be consistent with rules detailed in the PWDM regarding water resource management.

Appendix A – Drainage Areas

APPENDIX A
DRAINAGE AREAS

Subdistrict	Drainage Area (ac)
BUCK LAKE*	
BLK-1	0.0
CAMPBELL LAKE	
CALK-1	277.3
CALK-2	115.0
CALK-3	29.7
COUNTY DITCH 13*	
CD13-1	150.2
CREDIT RIVER	
CR-1	35.3
CR-2	187.4
CR-3	47.6
CR-4	51.1
CR-5	23.4
CR-6	22.6
CRYSTAL BAY	
CRBA-1	38.3
CRBA-2	440.5
CRBA-3	50.2
CRYSTAL LAKE	
CRLK-1	138.6
CRLK-2	26
EAST RICE LAKE*	
ERLK-1	174.0
HOWARD LAKE	
HLK-1	436.5
HLK-2	64.4
HLK-3	19.1
HLK-4	38.8

Subdistrict	Drainage Area (ac)
JEFFERS POND	
JP-1	105.3
JP-2	49.4
JP-3	70.5
JP-4	151.8
JP-5	185.9
JP-6	217.4
JP-7	32.5
LOUISVILLE SWAMP*	
LSW-2	296.1
LSW-3	308.3
LSW-9	488.8
LSW-10	78.9
LSW-11	58.9
LOWER PRIOR LAKE*	
LPPL-1	1920.6
LPPL-2	54.8
LPPL-3	43.9
LPPL-4	39.9
LPPL-5	59.1
LPPL-6	48.9
LPPL-7	49.3
LPPL-8	57.9
LPPL-9	45.1
LPPL-10	96.2
LPPL-11	28.0
LPPL-12	76.8
LPPL-13	109.8

Subdistrict	Drainage Area (ac)
MARKLEY LAKE*	
ML-1	60.0
ML-2	111.9
ML-3	53.9
ML-4	39.8
ML-5	128.8
ML-6	21.2
ML-7	40.9
ML-8	30.6
ML-9	69.9
ML-10	29.3
ML-11	230.6
MYSTIC LAKE	
MLK-1	227.8
PIKE LAKE*	
PL-1	36.5
PL-2	98.7
PL-3	56.2
PL-4	105.3
PL-5	54.6
PL-6	50.9
PL-7	46.8
PL-8	65.9
PL-9	23.9
PL-10	101.7
PL-11	88.0
PL-12	53.8
PL-13	118.4
PL-14	130.4
PL-15	31.3
PL-16	224.2
PL-17	57.1
PL-18	16.1
PL-19	24.2
PL-20	38.1

Subdistrict	Drainage Area (ac)
RICE LAKE*	
RLK-1	424
RLK-2	50.8
RLK-3	52.8
SIOUX COMMUNITY*	
SC-1	176.8
SC-2	174.8
SC-3	112
SC-4	70.2
SC-5	27.3
SC-6	83.5
SC-7	38.8
SC-8	48.7
SC-9	29.9
SPRING CENTRAL*	
SPC-1	50.9
SPC-2	179.3

Subdistrict	Drainage Area (ac)
SPRING LAKE*	
SPLK-1	1025.1
SPLK-2	141.1
SPLK-3	46.0
SPLK-4	67.2
SPLK-5	57.2
SPLK-6	139.3
SPLK-7	58.8
SPLK-8	176.0
SPLK-9	43.9
SPLK-10	33.9
SPLK-11	38.1
SPRING WEST*	
SPW-1	164
SPW-2	117.8

Subdistrict	Drainage Area (ac)
UPPER PRIOR LAKE	
UPPL-1	54.9
UPPL-2	23.1
UPPL-3	38.2
UPPL-4	830.4
UPPL-5	50.2
UPPL-6	158.5
UPPL-7	82.9
UPPL-8	18.5
UPPL-9	38.8
UPPL-10	50.0
UPPL-11	19.9
UPPL-12	9.3
UPPL-13	26.9
UPPL-14	47.4
UPPL-15	23.1
UPPL-16	44.1

NOTE: * only includes drainage area within 2030 boundary, refer to Figure 10 and table below for additional tributary drainage outside 2030 boundary

Subdistrict	Drainage area outside 2030 Boundary
SC-5	9.2
LSW-9	756.3
SPW-1	102.7
CD-13	3763.5
SPC-2	186
BLK-1	4336.7
SPLK-9	30.8
ERLK-1	261.1
RLK-3	28.9
RLK-1	170.5
ML-11	254.7
ML-2	112
LPPL-4	228.7
PL-1	21.7
PL-3	64

Appendix B – Trunk Storm Sewer Data

APPENDIX B
TRUNK STORM SEWER DATA

Flow From	Flow to	Drainage Area			Design Capacity	Pipe Size	
		Direct	Ponded	Total		Existing	Proposed
		(ac)	(ac)	(ac)	(cfs)	(in)	(in)
PRIOR LAKE WATERSHED							
ERLK-P1	RLK-P1	435.1	0.0	435.1	5.5	15	15
RLK-P2	RLK-P1	50.8	0.0	50.8	15.5		24
RLK-P3	RLK-P1	81.7	0.0	81.7	25.5		18
RLK-P1	CRLK-P1	594.5	567.6	1162.1	12.3		48
CRLK-P2	CRLK-P1	26.0	0.0	26.0	4.8		24
CRLK-P1	UPPL-P13	138.6	1188.1	1326.7	10.7	24	24
UPPL-P16	UPPL-P14	44.1	0.0	44.1	7.4	12	12
UPPL-P14	UPPL-P13	47.4	44.1	91.5	7.8	15	15
UPPL-P13	UPPL-P7	26.9	1418.2	1445.1	26.1	48	48
UPPL-P15	UPPL-P8	23.1	0.0	23.1	3.6		12
UPPL-P8	UPPL-P9	18.5	23.1	41.6	2.7		12
UPPL-P10	UPPL-P9	50.0	0.0	50.0	4.6	36	12
UPPL-P9	UPPL-P7	38.8	91.6	130.4	16.4	18.5x29	18.5x29
UPPL-P6	UPPL-P4	158.5	0.0	158.5	7.2		12
UPPL-P7	UPPL-P4	82.9	1575.5	1658.4	58.7	36	36
UPPL-P11	UPPL-P12	19.9	0.0	19.9	2.2	15	15
UPPL-P12	UPPL-P4	9.3	19.9	29.2	3.2	18	18
UPPL-P2	UPPL-P3	23.1	0.0	23.1	1.0	21	12
UPPL-P3	UPPL-P4	38.2	23.1	61.3	1.7	24	12
UPPL-P5	UPPL-P4	50.2	0.0	50.2	3.3	24	12
UPPL-P1	UPPL-P4	54.9	0.0	54.9	4.7	30	12
BLK-P1	SPLK-P8	4336.7	0.0	4336.7	407.4	48	48
SPLK-P8	SPLK-P1	176.0	4336.7	4512.7	221.5	channel	channel
SPC-P2	SPC-P1	365.3	0.0	365.3	32.1	42	18
SPC-P1	SPLK-P1	50.9	365.3	416.2	35.7		36
CD13-P1	SPLK-P1	3913.7	0.0	3913.7	171.0	78	48
SPW-P1	SPW-P2	266.7	0.0	266.7	17.6	30	24
SPW-P2	SPLK-P1	117.8	266.7	384.5	32.4	36	18
SPLK-P6	SPLK-P7	139.3	0.0	139.3	3.3	42	12
SPLK-P7	SPLK-P1	58.8	139.3	198.1	5.0		15
SPLK-P5	SPLK-P1	57.2	0.0	57.2	4.5	36	12
SPLK-P4	SPLK-P1	67.2	0.0	67.2	9.9	21	12
SPLK-P3	SPLK-P1	46.0	0.0	46.0	6.2	21	12
SPLK-P2	SPLK-P1	141.1	0.0	141.1	6.0	24	12
SPLK-P10	SPLK-P9	33.9	0.0	33.9	8.2		12
SPLK-P9	SPLK-P1	74.7	33.9	108.6	10.5		15
SPLK-P11	SPLK-P1	38.1	0.0	38.1	7.0		12
SPLK-P1	UPPL-P4	1025.1	9883.4	10908.5	152.1	channel	channel
CRBA-P3	CRBA-P2	50.2	0.0	50.2	2.7		12
CRBA-P1	CRBA-P2	38.3	0.0	38.3	10.4	18	18
CRBA-P2	UPPL-P4	440.5	88.5	529.0	35.4		36

APPENDIX B
TRUNK STORM SEWER DATA

Flow From	Flow to	Drainage Area			Design Capacity	Pipe Size	
		Direct	Ponded	Total		Existing	Proposed
		(ac)	(ac)	(ac)	(cfs)	(in)	(in)
UPPL-P4	LPPL-P1	830.4	13450.0	14280.4	152.9	channel	channel
LPPL-P2	LPPL-P1	54.8	0.0	54.8	6.9		10" FM
LPPL-P3	LPPL-P1	43.9	0.0	43.9	0.0	unknown	not proposed
LPPL-P4	LPPL-P1	268.6	0.0	268.6	85.5		12
LPPL-P7	LPPL-P1	49.3	0.0	49.3	12.0		15
LPPL-P5	LPPL-P6	59.1	0.0	59.1	9.3	36	36
LPPL-P8	LPPL-P6	57.9	0.0	57.9	0.0	unknown	not proposed
LPPL-P6	LPPL-P1	48.9	117.0	165.9	0.0	unknown	not proposed
LPPL-P9	LPPL-P10	45.1	0.0	45.1	21.6	24	24
LPPL-P11	LPPL-P10	28.0	0.0	28.0	2.0		12
LPPL-P10	LPPL-P1	96.2	73.1	169.3	5.1		12
LPPL-P12	LPPL-P1	76.8	0.0	76.8			24
LPPL-P13	LPPL-P1	109.8	0.0	109.8		36	36
LPPL-P1	JP-P5	1920.6	15218.8	17139.4	57.7		36
JP-P1	JP-P2	105.3	0.0	105.3	24.5	24	24
JP-P2	JP-P3	49.4	105.3	154.7	28.6		24
JP-P3	JP-P4	70.5	154.7	225.2	49.0		24
JP-P4	JP-P5	151.8	225.2	377.0	4.5		12
JP-P5	JP-P6	185.9	17516.4	17702.3	67.6		weir
JP-P6	JP-P7	217.4	17702.3	17919.7	62.0		48
JP-P7	PL-P16	32.5	17919.7	17952.2	62.0		54
PL-P1	PL-P2	58.2	0.0	58.2	4.0		12
PL-P2	PL-P4	98.7	58.2	156.9	20.0		18
PL-P3	PL-P4	120.2	0.0	120.2	10.4		18
PL-P4	PL-P5	105.3	277.1	382.4	35.6		24
PL-P5	PL-P16	54.6	382.4	437.0	48.0		24
PL-P6	PL-P7	50.9	0.0	50.9	6.6		12
PL-P9	PL-P8	23.9	0.0	23.9	3.2		12
PL-P10	PL-P8	101.7	0.0	101.7	4.9		12
PL-P8	PL-P7	65.9	125.6	191.5	46.5		24
PL-P7	PL-P16	46.8	242.4	289.2	71.5		36
PL-P11	PL-P16	88.0	0.0	88.0	6.7		12
PL-P13	PL-P12	118.4	0.0	118.4	5.0		12
PL-P12	PL-P16	53.8	118.4	172.2	7.4		12
PL-P14	PL-P16	130.4	0.0	130.4	17.4		18
PL-P15	PL-P16	31.3	0.0	31.3	4.3		12
PL-P18	PL-P16	16.1	0.0	16.1	5.9		12
PL-P19	PL-P16	24.2	0.0	24.2	4.0		12
PL-P20	PL-P16	38.1	0.0	38.1	4.3		12
PL-P16	Shakopee	224.2	19178.7	19402.9	111.4		36
PL-P17	Shakopee	57.1	0	57.1	8.3		12

APPENDIX B
TRUNK STORM SEWER DATA

Flow From	Flow to	Drainage Area			Design Capacity	Pipe Size	
		Direct	Ponded	Total		Existing	Proposed
		(ac)	(ac)	(ac)	(cfs)	(in)	(in)
TRIBUTARY TO WEST							
HLK-P2	HLK-P1	64.4	0.0	64.4	3.5		12
HLK-P3	HLK-P1	19.1	0.0	19.1	2.4	36	36
HLK-P4	HLK-P1	38.8	0.0	38.8	5.4	24	12
HLK-P1	CALK-P2	436.5	122.3	558.8	2.2	24	12
CALK-P2	CALK-P1	115.0	558.8	673.8	10.4		12
CALK-P3	CALK-P1	29.7	0.0	29.7	4.8		12
CALK-P1	LSW-P9	277.3	703.5	980.8	2.5		12
LSW-P9	LSW-P7	58.9	1737.1	1796.0	10.2		24
LSW-P2	LSW-P4	296.1	186.9	483.0	4.6		15
LSW-P3	LSW-P4	308.3	0.0	308.3	2.8		12
LSW-P10	LSW-P7	78.9	0.0	78.9			12
LSW-P11	Shakopee	58.9	0.0	58.9			12
TRIBUTARY TO NORTH (SHAKOPEE)							
MLK-P1	SC-P1	227.8	0.0	227.8	2.4	12	12
SC-P1	SC-P2	176.8	227.8	404.6	3.3		12
SC-P7	SC-P2	38.8	0.0	38.8	6.7		36
SC-P2	SC-P6	174.8	443.4	618.2	28.2		24
SC-P6	Shakopee	83.5	618.2	701.7	32.0		12
SC-P3	SC-P4	112.0	0.0	112.0	3.0		12
SC-P4	Shakopee	70.2	112.0	182.2	11.3		18
SC-P5	Shakopee	36.5	0.0	36.5	3.8		12
SC-P8	Shakopee	48.7	0.0	48.7			12
SC-P9	Shakopee	29.9	0.0	29.9			12
TRIBUTARY TO EAST (CREDIT RIVER)							
ML-P5	ML-P7	128.8	0.0	128.8	3.5		12
ML-P7	ML-P4	40.9	128.8	169.7	3.5	12	12
ML-P4	ML-P3	39.8	169.7	209.5	15.7	18	18
ML-P3	ML-P2	53.9	209.5	263.4	19.7	27	18
ML-P9	ML-P8	69.9	0.0	69.9	7.2	12	12
ML-P8	ML-P1	30.6	69.9	100.5	6.7	21	12
ML-P10	ML-P6	230.6	0.0	230.6	8.0	12	12
ML-P6	ML-P1	21.2	230.6	251.8	3.5		12
ML-P1	ML-P2	60.0	352.3	412.3	18.4		18
ML-P2	Credit River	223.9	675.7	899.6	44.3		12" FM
ML-P11	Credit River	485.3	0.0	485.3			12
CR-P1	CR-P2	35.3	0.0	35.3	5.5	12	12
CR-P2	CR-P3	187.4	35.3	222.7	6.0	unknown	12 FM
CR-P4	CR-P3	51.1	0.0	51.1	6.5	24	12
CR-P3	Credit River	47.6	273.8	321.4	26.8		24
CR-P5	CR-P6	23.4	0.0	23.4			12
CR-P6	Credit River	22.6	0.0	22.6			12

APPENDIX B
TRUNK STORM SEWER DATA

Flow From	Flow to	Drainage Area			Design Capacity	Pipe Size	
		Direct	Ponded	Total		Existing	Proposed
		(ac)	(ac)	(ac)	(cfs)	(in)	(in)

Existing basin storage, outlet sizes and elevations are based on GIS database and two foot topographic information. This information may differ from that on as-built records. In such cases as-built records should be relied upon.

NOTE:

Abbreviation	Drainage District
BLK	Buck Lake
CALK	Campbell Lake
CD13	County Ditch 13
CR	Credit River
CRBA	Crystal Bay
CRLK	Crystal Lake
ERLK	East Rice Lake
HLK	Howard Lake
JP	Jeffers Pond
LSW	Louisville Swamp
LPPL	Lower Prior Lake
ML	Markley Lake
MLK	Mystic Lake
PL	Pike Lake
RLK	Rice Lake
SC	Sioux Community
SPC	Spring Central
SPLK	Spring Lake
SPW	Spring West
UPPL	Upper Prior Lake

Appendix C – Pond Data

APPENDIX C
POND DATA

Pond Number	Drainage Area			Modeled NWL	Modeled HWL	Area @ NWL	Area @ HWL	Proposed Flood Storage	Proposed 100-Year discharge	100-Year discharge per acre	DNR Protected Waters Inventory	MNRAM Wetland Inventory Designation
	Direct	Ponded	Total									
	(ac)	(ac)	(ac)			(ac)	(ac)	(ac-ft)	(cfs)	(cfs/ac)		
BUCK LAKE												
BLK-P1	4336.7	0.0	4336.7	913.4	920.4	5.3	20.5	106.0	407.4	0.09	206W	-
CAMPBELL LAKE												
CALK-P1	277.3	703.5	980.8	926.0	927.8	49.6	52.0	62.3	2.5	0.00	56P	191142205013
CALK-P2	115.0	558.8	673.8	948.0	953.4	1.4	5.1	17.6	10.4	0.02		191142205012
CALK-P3	29.7	0.0	29.7	958.0	960.1	1.2	3.0	4.4	4.8	0.16		191142205011
COUNTY DITCH 13												
CD13-P1	3913.7	0.0	3913.7	916.0	926.9	17.1	60.3	540.0	171.0	0.04		191142217002
CREDIT RIVER												
CR-P1	35.3	0.0	35.3	912.0	914.9	0.9	2.1	4.3	5.5	0.16		-
CR-P2	187.4	35.3	222.7	890.0	899.7	1.3	7.2	41.2	6.0	0.03		191142201003, 191142201002
CR-P3	47.6	273.8	321.4	922.0	924.8	0.6	3.2	5.3	26.8	0.08		191142201001
CR-P4	51.1	0.0	51.1	924.0	930.0	0.6	1.5	6.3	6.5	0.13		-
CR-P5	23.4	0.0	23.4	956.0	958.0	1.0	2.5	3.5	4.3	0.18		-
CR-P6	22.6	0	23.4	928.0	932.0	0.7	1.9	5.2	6.0	0.26		
CRYSTAL BAY												
CRBA-P1	38.3	0.0	38.3	924.0	924.6	5.0	5.3	3.7	10.4	0.27	168W	191152234007
CRBA-P2	440.5	88.5	529.0	903.1	907.8	0.5	35.0	69.9	35.4	0.07	85P	191152234006, 191142204001
CRBA-P3	50.2	0.0	50.2	976.0	976.5	15.9	16.8	8.9	2.7	0.05	167W	191152233017
CRYSTAL LAKE												
CRLK-P1	138.6	1188.1	1326.7	940.3	943.2	15.0	27.1	66.3	10.7	0.01	61P	191142210001
CRLK-P2	26.0	0.0	26.0	962.0	963.5	0.4	0.5	2.0	4.8	0.18		-
EAST RICE LAKE												
ERLK-P1	435.1	0.0	435.1	945.0	948.5	1.8	19.7	29.6	5.5	0.01		-
HOWARD LAKE												
HLK-P1	436.5	122.3	558.8	960.0	960.9	157.6	168.3	127.4	2.2	0.00	73P	191152232005, 191142205016
HLK-P2	64.4	0.0	64.4	972.0	972.7	18.4	19.0	13.7	3.5	0.05	55W	191142204002
HLK-P3	19.1	0.0	19.1	964.0	964.5	7.5	7.7	3.8	2.4	0.13		191152232006
HLK-P4	38.8	0.0	38.8	962.0	963.0	4.6	5.3	4.8	5.4	0.14		191152233010

APPENDIX C
POND DATA

Pond Number	Drainage Area			Modeled NWL	Modeled HWL	Area @ NWL	Area @ HWL	Proposed Flood Storage	Proposed 100-Year discharge	100-Year discharge per acre	DNR Protected Waters Inventory	MNRAM Wetland Inventory Designation
	Direct	Ponded	Total									
	(ac)	(ac)	(ac)			(ac)	(ac)	(ac-ft)	(cfs)	(cfs/ac)		
JEFFERS POND												
JP-P1	105.3	0.0	105.3	938.0	944.8	0.8	4.0	16.3	24.5	0.23		191152234005
JP-P2	49.4	105.3	154.7	922.0	929.0	0.8	1.4	8.0	28.6	0.18		191152234002
JP-P3	70.5	154.7	225.2	920.0	922.8	2.7	4.1	7.9	49.0	0.22		191152234001
JP-P4	151.8	225.2	377.0	910.0	911.9	38.7	47.0	81.6	4.5	0.01		191152227010
JP-P5	185.9	17516.4	17702.3	876.0	877.0	12.7	13.1	12.9	67.6	0.00	153W	191152227015
JP-P6	217.4	17702.3	17919.7	866.3	869.0	42.3	50.0	133.6	62.0	0.00	77W	191152227016, 191152227017
JP-P7	32.5	17919.7	17952.2	855.9	859.8	0.1	0.5	1.9	62.0	0.00		191152227001
LOUISVILLE SWAMP												
LSW-P2	296.1	186.9	483.0	932.0	940.1	5.8	9.6	61.6	4.6	0.01		191142207004, 191142207003
LSW-P3	308.3	0.0	308.3	932.0	940.0	4.0	13.0	68.0	2.8	0.01		191142207002
LSW-P9	58.9	1737.1	1796.0	920.0	925.2	19.2	37.5	147.0	10.2	0.01	57W	191142206002
LSW-P10	78.9	0.0	78.9	928.0	929.4	8.0	10.2	12.7	4.4	0.06		
LSW-P11	58.9	0.0	58.9	954.0	958.0	1.7	2.6	9.6	5.8	0.10		
LOWER PRIOR LAKE												
LPPL-P1	1920.6	15218.8	17139.4	902.0	903.5	970.0	1041.0	4663.4	57.7	0.00	26P	-
LPPL-P2	54.8	0.0	54.8	901.5	905.5	1.4	2.4	9.1	6.9	0.13		-
LPPL-P3	43.9	0.0	43.9	900.0	904.2	1.7	2.9	9.7	0.0	0.00		-
LPPL-P4	268.6	0.0	268.6	918.0	922.0	4.6	7.5	27.2	85.5	0.32		191152130001
LPPL-P5	59.1	0.0	59.1	930.0	930.6	0.1	0.1	1.6	9.3	0.16		-
LPPL-P6	48.9	59.1	108.0	886.0	891.5	3.4	5.6	24.4	0.0	0.00		191152236001
LPPL-P7	49.3	0.0	49.3	916.0	917.2	4.1	4.8	5.4	12.0	0.24	172W	191152131001
LPPL-P8	57.9	0.0	57.9	904.0	910.7	0.0	1.6	6.0	0.0	0.00		191152236002
LPPL-P9	45.1	0.0	45.1	922.0	927.1	0.2	1.3	4.2	21.6	0.48		-
LPPL-P10	96.2	73.1	169.3	921.0	923.0	14.0	15.1	26.8	5.1	0.03	169P	191142202001
LPPL-P11	28.0	0.0	28.0	934.0	934.7	7.1	7.8	5.4	2.0	0.07	170W	191152235004
LPPL-P12	76.8	0.0	76.8	904.0	907.4	0.5	1.7	3.7	31.7	0.41		
LPPL-P13	109.8	0	109.8	920	920.8	0.5	1	0.6	17.6	0.16		
MARKLEY LAKE												
ML-P1	60.0	352.3	412.3	902.0	903.7	3.0	5.8	7.9	18.4	0.04		-
ML-P2	223.9	675.7	899.6	896.0	898.4	25.2	30.8	78.5	44.3	0.05	21W	191142201017
ML-P3	53.9	209.5	263.4	938.0	942.8	0.8	4.2	12.0	19.7	0.07		191142201012
ML-P4	39.8	169.7	209.5	950.0	951.3	5.9	6.9	8.6	15.7	0.07	187W	191142201011
ML-P5	128.8	0.0	128.8	966.0	969.5	6.8	7.9	25.7	3.5	0.03		191142211001
ML-P6	21.2	230.6	251.8	922.0	925.9	0.8	3.0	9.1	3.5	0.01		191142201007
ML-P7	40.9	128.8	169.7	952.0	952.9	9.7	13.6	10.5	3.5	0.02		191142212002
ML-P8	30.6	69.9	100.5	944.0	945.6	3.6	4.7	6.6	6.7	0.07		191142201008
ML-P9	69.9	0.0	69.9	952.0	952.9	12.3	12.9	9.4	7.2	0.10	53W	191142201009
ML-P10	230.6	0.0	230.6	958.0	958.9	2.7	5.8	5.8	8.0	0.03	177W	191142201005
ML-P11	485.3	0	485.3	940	941	73	90.6	81.8	23.9	0.05		

APPENDIX C
POND DATA

Pond Number	Drainage Area			Modeled NWL	Modeled HWL	Area @ NWL	Area @ HWL	Proposed Flood Storage	Proposed 100-Year discharge	100-Year discharge per acre	DNR Protected Waters Inventory	MNRAM Wetland Inventory Designation
	Direct	Ponded	Total									
	(ac)	(ac)	(ac)			(ac)	(ac)	(ac-ft)	(cfs)	(cfs/ac)		
MYSTIC LAKE												
MLK-P1	227.8	0.0	227.8	960.0	960.9	71.6	73.7	70.0	2.4	0.01	79W	191152228016
PIKE LAKE												
PL-P1	58.2	0.0	58.2	990.0	997.7	0.4	3.0	13.1	4.0	0.07		-
PL-P2	98.7	58.2	156.9	980.0	986.5	0.6	3.3	12.7	20.0	0.13		191152224002
PL-P3	120.2	0.0	120.2	884.0	891.8	3.3	6.0	35.0	10.4	0.09		191152223007
PL-P4	105.3	277.1	382.4	878.0	884.0	1.8	7.2	27.0	35.6	0.09		-
PL-P5	54.6	382.4	437.0	856.0	859.8	1.6	2.3	7.4	48.0	0.11		191152223006
PL-P6	50.9	0.0	50.9	902.0	906.7	0.6	4.3	13.8	6.6	0.13		191152224007
PL-P7	46.8	242.4	289.2	824.0	829.5	1.0	1.6	7.2	71.5	0.25		-
PL-P8	65.9	125.6	191.5	894.0	896.0	0.8	1.1	5.1	46.5	0.24		191152226002
PL-P9	23.9	0.0	23.9	932.0	932.6	6.4	6.6	4.1	3.2	0.13		191152225002
PL-P10	101.7	0.0	101.7	922.0	927.3	1.5	3.5	8.4	4.9	0.05		191152226010
PL-P11	88.0	0.0	88.0	864.0	871.0	1.0	3.7	16.5	6.7	0.08		191152226006
PL-P12	53.8	118.4	172.2	838.0	842.8	2.3	3.6	14.1	7.4	0.04		191152226007
PL-P13	118.4	0.0	118.4	870.0	872.2	10.7	16.0	29.2	5.0	0.04		191152226009
PL-P14	130.4	0.0	130.4	862.0	869.3	1.7	4.8	23.5	17.4	0.13		191152222007
PL-P15	31.3	0.0	31.3	870.0	871.1	3.1	3.4	3.7	4.3	0.14		191152222009
PL-P16	224.2	19178.7	19402.9	821.5	824.4	63.3	68.8	292.3	111.4	0.01		191152223003
PL-P17	57.1	0.0	57.1	802.0	806.0	1.0	2.5	7.0	8.3	0.15		
PL-P18	16.1	0.0	16.1	836.0	838.5	0.4	0.5	1.1	5.9	0.37		
PL-P19	24.2	0.0	24.2	860.0	863.5	0.5	1.0	2.6	4.0	0.17		
PL-P20	38.1	0.0	38.1	870.0	875.2	0.6	1.2	4.7	4.3	0.11		
RICE LAKE												
RLK-P1	594.5	567.6	1162.1	946.0	946.9	152.8	163.5	142.3	12.3	0.01	60P	191142210011
RLK-P2	50.8	0.0	50.8	958.0	958.7	6.4	7.6	9.2	15.5	0.31		-
RLK-P3	81.7	0.0	81.7	952.0	954.0	0.2	2.4	5.7	25.5	0.31		-
SIOUX COMMUNITY												
SC-P1	176.8	227.8	404.6	898.0	899.2	30.2	32.5	42.0	3.3	0.01		191152227006
SC-P2	174.8	443.4	618.2	886.0	890.5	3.0	7.9	25.6	28.2	0.05	78W	191152222004
SC-P3	112.0	0.0	112.0	912.0	913.0	9.4	14.0	24.5	3.0	0.03		191152228004
SC-P4	70.2	112.0	182.2	900.0	902.5	2.2	4.0	10.7	11.3	0.06		191152221003
SC-P5	36.5	0.0	36.5	884.0	885.5	0.5	3.1	5.9	3.8	0.10		191152221002
SC-P6	83.5	618.2	701.7	886.0	892.4	0.4	3.5	16.1	32.0	0.05		191152221001
SC-P7	38.8	0.0	38.8	880.0	883.7	1.0	1.6	5.5	6.7	0.17		-
SC-P8	48.7	0.0	48.7	922.0	924.1	2.9	4.8	8.0	4.7	0.10		
SC-P9	29.9	0.0	29.9	912.0	914.0	1.4	2.3	4.7	3.6	0.12		

APPENDIX C
POND DATA

Pond Number	Drainage Area			Modeled NWL	Modeled HWL	Area @ NWL	Area @ HWL	Proposed Flood Storage	Proposed 100-Year discharge	100-Year discharge per acre	DNR Protected Waters Inventory	MNRAM Wetland Inventory Designation
	Direct	Ponded	Total									
	(ac)	(ac)	(ac)			(ac)	(ac)	(ac-ft)	(cfs)	(cfs/ac)		
SPRING CENTRAL												
SPC-P1	50.9	365.3	416.2	918.0	919.6	4.0	6.2	8.2	35.7	0.09		191142208011
SPC-P2	365.3	0.0	365.3	924.0	930.6	4.0	10.2	46.9	32.1	0.09		191142217001
SPRING LAKE												
SPLK-P1	1025.1	9883.4	10908.5	910.3	911.9	647.0	775.0	3463.4	152.1	0.01	54P	191142209001
SPLK-P2	141.1	0.0	141.1	916.0	917.0	19.8	21.7	21.8	6.0	0.04	185P	191142204004
SPLK-P3	46.0	0.0	46.0	914.0	915.8	2.0	4.8	5.9	6.2	0.13		191142204003
SPLK-P4	67.2	0.0	67.2	926.0	929.2	1.4	4.6	10.7	9.9	0.15		-
SPLK-P5	57.2	0.0	57.2	917.0	918.6	4.0	5.0	7.2	4.5	0.08		191142209001, 191142209002
SPLK-P6	139.3	0.0	139.3	928.0	930.6	5.9	11.6	22.8	3.3	0.02		191142208004
SPLK-P7	58.8	139.3	198.1	924.0	925.5	3.6	7.0	8.2	5.0	0.03		191142208009
SPLK-P8	176.0	4336.7	4512.7	910.0	912.6	60.0	69.7	180.7	221.5	0.05	59W	191142209002
SPLK-P9	74.7	33.9	108.6	920.0	923.8	2.5	4.5	13.3	10.5	0.10		191142209007
SPLK-P10	33.9	0.0	33.9	956.0	957.6	1.4	2.8	3.4	8.2	0.24		191142210004
SPLK-P11	38.1	0.0	38.1	950.0	950.3	2.7	3.0	2.2	7.0	0.18		191142210002
SPRING WEST												
SPW-P1	266.7	0.0	266.7	936.0	942.9	4.2	8.9	49.8	17.6	0.07		191142218001
SPW-P2	117.8	266.7	384.5	934.0	938.0	2.4	6.4	24.0	32.4	0.08		-
UPPER PRIOR LAKE												
UPPL-P1	54.9	0.0	54.9	912.0	914.5	0.5	4.8	6.6	4.7	0.09		191152234009
UPPL-P2	23.1	0.0	23.1	904.5	907.2	0.9	1.1	4.6	1.0	0.04		191152234012
UPPL-P3	38.2	23.1	61.3	904.5	906.8	2.4	3.5	7.3	1.7	0.03		-
UPPL-P4	830.4	13450.0	14280.4	902.0	903.5	410.0	426.0	1937.6	152.9	0.01	72P	-
UPPL-P5	50.2	0.0	50.2	904.0	905.2	5.7	6.6	6.4	3.3	0.07	184P	191142203001
UPPL-P6	158.5	0.0	158.5	918.0	922.0	2.3	9.4	27.1	7.2	0.05	183W	191142203002, 191142203003, 191142202003, 191142202005
UPPL-P7	82.9	1575.5	1658.4	918.0	920.2	3.1	11.5	19.1	58.7	0.04		191142202004
UPPL-P8	18.5	23.1	41.6	924.0	925.9	1.7	2.2	2.2	2.7	0.06		191142202011
UPPL-P9	38.8	91.6	130.4	922.0	922.9	2.7	7.4	6.9	16.4	0.13	181W	191142202010
UPPL-P10	50.0	0.0	50.0	924.0	925.1	5.1	6.0	6.0	4.6	0.09	180W	191142202009
UPPL-P11	19.9	0.0	19.9	932.4	932.8	0.0	0.1	0.7	2.2	0.11		-
UPPL-P12	9.3	19.9	29.2	930.0	930.7	0.1	1.0	0.3	3.2	0.11		-
UPPL-P13	26.9	1418.2	1445.1	941.2	942.9	1.0	1.9	5.8	26.1	0.02		191142202006
UPPL-P14	47.4	44.1	91.5	943.8	946.1	0.1	1.6	2.6	7.8	0.09		191142202007
UPPL-P15	23.1	0.0	23.1	966.0	966.5	5.7	6.0	2.9	3.6	0.16		-
UPPL-P16	44.1	0.0	44.1	966.0	966.9	5.7	6.3	6.7	7.4	0.17		191142211002

Appendix D – Stormwater System Costs

APPENDIX D
STORM WATER SYSTEM COSTS

Point		Existing or Proposed	Size	Length	Unit Cost	Pond Area at HWL	City Trunk Costs			
							Construction	Easement Acquisition	Cont., Eng., Admin., Fiscal	Total Cost
From	To		(in)	(ft)	($)	(ac)	($)	($)	($)	($)
CAMPBELL LAKE										
CALK-P2						5.1	22,950	0	6,885	29,658
CALK-P3						3.0	13,500	0	4,050	17,446
CALK-P2	CALK-P1	Proposed	12	180	49		8,787	2,066	2,843	13,615
CALK-P3	CALK-P1	Proposed	12	1000	49		48,816	11,478	15,793	75,636
CALK-P1	LSW-P9	Proposed	12	2650	49		129,363	30,418	41,851	200,436
COUNTY DITCH 13										
CD13-P1						60.3	271,350	0	81,405	350,664
CD13-P1	SPLK-P1	Proposed	48	300	234		70,229	3,444	21,413	94,521
CREDIT RIVER										
CR-P3						3.2	14,400	0	4,320	18,609
CR-P4						1.5	6,750	0	2,025	8,723
CR-P3	CR-P5	Proposed	24	2450	90		220,171	28,122	68,864	315,277
CR-P5	CR-P6	Proposed	12	1200	49		58,579	13,774	18,951	90,763
CR-P6	Credit River	Proposed	12	100	49		4,882	1,148	1,579	7,564
CRYSTAL BAY										
CRBA-P3	CRBA-P2	Proposed	12	2850	49		139,126	32,713	45,009	215,563
CRYSTAL LAKE										
CRLK-P2						0.5	5,850	22,500	4,005	32,163
CRLK-P2	CRLK-P1	Proposed	24	1150	90		103,346	13,200	32,324	147,987
EAST RICE LAKE										
ERLK-P1						19.7	88,650	0	26,595	114,562
ERLK-P1	RLK-P1	Proposed	15	150	59		8,820	1,722	2,818	13,281
HOWARD LAKE										
HLK-P2	HLK-P1	Proposed	12	900	49		43,934	10,331	14,213	68,073
JEFFERS POND										
JP-P1						4.0	18,000	0	5,400	23,261
JP-P2						1.4	6300	0	1,890	8,141
JP-P3						4.1	18450	0	5,535	23,843
JP-P1	JP-P2	Proposed	24	300	90		26,960	3,444	8,432	38,605
JP-P2	JP-P3	Proposed	24	150	90		13,480	1,722	4,216	19,303
JP-P3	JP-P4	Proposed	24	300	90		26,960	3,444	8,432	38,605
JP-P4	JP-P5	Proposed	12	1,200	49		58,579	13,774	18,951	90,763

APPENDIX D
STORM WATER SYSTEM COSTS

Point		Existing or Proposed	Size	Length	Unit Cost	Pond Area at HWL	City Trunk Costs			
							Construction	Easement Acquisition	Cont., Eng., Admin., Fiscal	Total Cost
From	To		(in)	(ft)	($)	(ac)	($)	($)	($)	($)
LOUISVILLE SWAMP										
LSW-P2						9.6	43,200	0	12,960	55,827
LSW-P3						13.0	58,500	0	17,550	75,599
LSW-P9						37.5	168,750	0	50,625	218,075
LSW-P10						10.2	45,900	0	13,770	59,316
LSW-P11						2.6	11,700	0	3,510	15,120
LSW-P9	LSW-P7	Proposed	24	100	90		8,987	1,148	2,811	12,868
LSW-P10	LSW-P7	Proposed	12	100	49		4,882	1,148	1,579	7,564
LSW-P11	Shakopee	Proposed	12	100	49		4,882	1,148	1,579	7,564
LOWER PRIOR LAKE										
LPPL-P4						7.5	33,750	0	10,125	43,615
LPPL-P5						0.1	900	0	270	1,163
LPPL-P9						1.3	5,850	0	1,755	7,560
LPPL-P11						7.8	35,100	0	10,530	45,360
LPPL-P2	LPPL-P1	Proposed	10" FM	600	44		26,400	6,887	8,609	41,647
LPPL-P4	LPPL-P1	Proposed	12	400	49		19,526	4,591	6,317	30,254
LPPL-P10	LPPL-P1	Proposed	12	1000	49		48,816	11,478	15,793	75,636
LPPL-P11	LPPL-P1	Proposed	24	900	90		80,879	10,331	25,297	115,816
LPPL-P12	LPPL-P1	Proposed	24	900	90		80,879	10,331	25,297	115,816
MARKLEY LAKE										
ML-P1						5.8	75,400	290,000	51,620	414,548
ML-P5						7.9	35,550	0	10,665	45,941
ML-P5	ML-P7	Proposed	12	1600	49		78,106	18,365	25,268	121,018
ML-P6	ML-P1	Proposed	12	2200	49		107,395	25,253	34,744	166,400
ML-P1	ML-P2	Proposed	18	150	68		10,152	1,722	3,218	15,001
ML-P11	Credit River	Proposed	12	100	49		4,882	1,148	1,579	7,564
ML-P2	Credit River	Proposed	12" FM	1600	45		72,000	18,365	23,437	113,128
MYSTIC LAKE										
No cost associated with Mystic Lake Watershed										

APPENDIX D
STORM WATER SYSTEM COSTS

Point		Existing or Proposed	Size	Length	Unit Cost	Pond Area at HWL	City Trunk Costs			
							Construction	Easement Acquisition	Cont., Eng., Admin., Fiscal	Total Cost
From	To		(in)	(ft)	($)	(ac)	($)	($)	($)	($)
PIKE LAKE										
PL-P1						3.0	39,000	150,000	26,700	214,422
PL-P2						3.3	14,850	0	4,455	19,191
PL-P3						6.0	27,000	0	8,100	34,892
PL-P4						7.2	32,400	0	9,720	41,870
PL-P5						2.3	20,700	0	6,210	26,751
PL-P6						4.3	19,350	0	5,805	25,006
PL-P7						1.6	14,400	80,000	12,320	106,087
PL-P8						1.1	4,950	0	1,485	6,397
PL-P12						3.6	16,200	0	4,860	20,935
PL-P14						4.8	43,200	0	12,960	55,827
PL-P17						2.5	22,500	125,000	19,250	165,762
PL-P18						0.5	4,500	25,000	3,850	33,152
PL-P19						1.0	9,000	50,000	7,700	66,305
PL-P20						1.2	10,800	60,000	9,240	79,566
PL-P1	PL-P2	Proposed	12	1300	49		63,461	14,922	20,530	98,327
PL-P2	PL-P4	Proposed	18	3100	68		209,798	35,583	66,498	310,030
PL-P3	PL-P4	Proposed	18	400	68		27,071	4,591	8,580	40,004
PL-P4	PL-P5	Proposed	24	1200	90		107,839	13,774	33,729	154,422
PL-P5	PL-P16	Proposed	24	900	90		80,879	10,331	25,297	115,816
PL-P6	PL-P7	Proposed	12	2200	49		107,395	25,253	34,744	166,400
PL-P9	PL-P8	Proposed	12	1450	49		70,783	16,644	22,899	109,672
PL-P10	PL-P8	Proposed	12	600	49		29,290	6,887	9,476	45,382
PL-P8	PL-P7	Proposed	24	200	90		17,973	2,296	5,622	25,737
PL-P7	PL-P16	Proposed	36	350	184		64,459	4,017	19,740	87,694
PL-P11	PL-P16	Proposed	12	1000	49		48,816	11,478	15,793	75,636
PL-P13	PL-P12	Proposed	12	1700	49		82,987	19,513	26,848	128,581
PL-P12	PL-P16	Proposed	12	400	49		19,526	4,591	6,317	30,254
PL-P14	PL-P16	Proposed	18	300	68		20,303	3,444	6,435	30,003
PL-P15	PL-P16	Proposed	12	600	49		29,290	6,887	9,476	45,382
PL-P16	Shakopee	Proposed	36	200	184		36,834	2,296	11,280	50,111
PL-P17	Shakopee	Proposed	12	50	49		2,441	574	790	3,782
PL-P18	PL-P16	Proposed	12	100	49		4,882	1,148	1,579	7,564
PL-P19	PL-P16	Proposed	12	500	49		24,408	5,739	7,896	37,818
PL-P20	PL-P16	Proposed	12	550	49		26,849	6,313	8,686	41,600

APPENDIX D
STORM WATER SYSTEM COSTS

Point		Existing or Proposed	Size	Length	Unit Cost	Pond Area at HWL	City Trunk Costs			
							Construction	Easement Acquisition	Cont., Eng., Admin., Fiscal	Total Cost
From	To		(in)	(ft)	($)	(ac)	($)	($)	($)	($)
RICE LAKE										
RLK-P2						7.6	98,800	380,000	67,640	543,201
RLK-P3						2.4	10,800	120,000	15,240	145,174
RLK-P2	RLK-P1	Proposed	24	1150	90		103,346	13,200	32,324	147,987
RLK-P3	RLK-P1	Proposed	18	300	68		20,303	3,444	6,435	30,003
RLK-P1	CRLK-P1	Proposed	48	500	234		117,048	5,739	35,688	157,536
SIOUX COMMUNITY										
SC-P2						7.9	35,550	0	10,665	45,941
SC-P3						14.0	63,000	0	18,900	81,415
SC-P4						4.0	18,000	0	5,400	23,261
SC-P5						3.1	13,950	0	4,185	18,028
SC-P6						3.5	15,750	0	4,725	20,354
SC-P7						1.6	14,400	80,000	12,320	106,087
SC-P8						4.8	43,200	0	12,960	55,827
SC-P9						2.3	20,700	115,000	17,710	152,501
SC-P1	SC-P2	Proposed	12	1000	49		48,816	11,478	15,793	75,636
SC-P2	SC-P7	Proposed	24	3500	90		314,531	40,174	98,377	450,396
SC-P7	Shakopee	Proposed	36	800	184		147,336	9,183	45,119	200,442
SC-P3	SC-P4	Proposed	12	1800	49		87,869	20,661	28,427	136,145
SC-P4	Shakopee	Proposed	18	350	68		23,687	4,017	7,508	35,003
SC-P5	Shakopee	Proposed	12	700	49		34,171	8,035	11,055	52,945
SC-P6	Shakopee	Proposed	12	200	49		9,763	2,296	3,159	15,127
SC-P8	Shakopee	Proposed	12	100	49		4,882	1,148	1,579	7,564
SC-P9	Shakopee	Proposed	12	100	49		4,882	1,148	1,579	7,564
SPRING CENTRAL										
SPC-P2						10.2	132,600	0	39,780	171,358
SPC-P2	SPC-P1	Proposed	18	200	68		13,535	2,296	4,290	20,002
SPC-P1	SPLK-P1	Proposed	36	700	184		128,919	8,035	39,479	175,387

APPENDIX D
STORM WATER SYSTEM COSTS

Point		Existing or Proposed	Size	Length	Unit Cost	Pond Area at HWL	City Trunk Costs			
							Construction	Easement Acquisition	Cont., Eng., Admin., Fiscal	Total Cost
From	To		(in)	(ft)	($)	(ac)	($)	($)	($)	($)
SPRING LAKE										
SPLK-P5						5.0	22,500	0	6,750	29,077
SPLK-P7						7.0	31,500	0	9,450	40,707
SPLK-P9						4.5	20,250	0	6,075	26,169
SPLK-P10						2.8	12,600	0	3,780	16,283
SPLK-P8	SPLK-P1	Proposed	12	200	49		9,763	2,296	3,159	15,127
SPLK-P6	SPLK-P7	Proposed	15	500	59		29,401	5,739	9,394	44,270
SPLK-P7	SPLK-P1	Proposed	12	600	49		29,290	6,887	9,476	45,382
SPLK-P5	SPLK-P1	Proposed	12	250	49		12,204	2,870	3,948	18,909
SPLK-P4	SPLK-P1	Proposed	12	250	49		12,204	2,870	3,948	18,909
SPLK-P3	SPLK-P1	Proposed	12	250	49		12,204	2,870	3,948	18,909
SPLK-P9	SPLK-P1	Proposed	12	300	49		14,645	3,444	4,738	22,691
SPRING WEST										
SPW-P1						8.9	40,050	0	12,015	51,756
SPW-P2						6.4	28,800	320,000	40,640	387,132
SPW-P1	SPW-P2	Proposed	24	1850	90		166,252	21,235	51,999	238,067
SPW-P2	SPLK-P1	Proposed	18	2000	68		135,354	22,957	42,902	200,020
UPPER PRIOR LAKE										
UPPL-P15						6.0	54,000	300,000	46,200	397,828
UPPL-P15	UPPL-P8	Proposed	12	700	49		34,171	8,035	11,055	52,945
UPPL-P8	UPPL-P9	Proposed	12	350	49		17,086	4,017	5,527	26,473
UPPL-P6	UPPL-P4	Proposed	12	950	49		46,375	10,904	15,003	71,854
UPPL-P7	UPPL-P4	Proposed	36	100	184		18,417	1,148	5,640	25,055

STORMWATER SYSTEM TOTAL $10,992,289

Note:
1) Cost estimates for this report are based on 2004 construction costs related to ENR cost index 7298 (September, 2004).
2) Land costs for easements assumed at $100,000/acre. 50% land costs for constructed pond easements.
3) Engineering, Contingencies, Administration, and Fiscal at 30% applied to construction and 10% applied to land costs.

Appendix E – MnRAM Summary Report

City of Prior Lake
MnRAM Summary Report

WetlandID	Hydrologic Regime	Aesthetics	Restoration Potential	Wildlife Habitat	Strmwater Susceptibility	Floral Diversity	Functional Ranking
19114220100	Medium	Medium	No Potential	Low	Least	Low	Low
19114220100	High	Medium	No Potential	Low	Least	Low	Low
19114220100	Medium	High	No Potential	Low	Least	Low	Low
19114220100	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220100	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220100	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220100	Medium	Medium	Medium	Medium	Least	Low	Low
19114220100	High	Medium	No Potential	Low	Least	Low	Low
19114220100	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19114220101	Medium	High	No Potential	Medium	Moderate	Medium	High
19114220101	Medium	High	No Potential	Medium	Least	Medium	High
19114220101	High	Medium	No Potential	Low	Least	Low	Low
19114220101	Medium	Medium	No Potential	Low	Least	Low	Low
19114220101	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220101	Medium	Low	Low	Low	Least	Low	Low
19114220101	Medium	Low	Low	Medium	Least	Low	Low
19114220101	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220101	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220200	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220200	High	High	No Potential	Low	Least	Low	Low
19114220200	High	High	No Potential	Medium	Least	Low	Low
19114220200	Medium	Medium	No Potential	Low	Least	Low	Low
19114220200	Medium	High	No Potential	Medium	Least	Medium	High
19114220200	Medium	Medium	No Potential	Low	Least	Low	Low
19114220200	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220200	High	Medium	No Potential	Medium	Moderate	Medium	High

WetlandID	Hydrologic Regime	Aesthetics	Restoration Potential	Wildlife Habitat	Strmwater Susceptibility	Floral Diversity	Functional Ranking
19114220200	Medium	High	No Potential	Medium	Least	Low	Low
19114220201	Medium	Medium	No Potential	Low	Least	Low	Low
19114220201	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220201	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220300	High	Medium	No Potential	Exceptional	Moderate	Medium	Unique
19114220300	Medium	High	No Potential	Medium	Least	Low	Low
19114220300	Medium	High	No Potential	Medium	Least	Low	Low
19114220400	Medium	Medium	High	Exceptional	Least	Low	Moderate
19114220400	High	Low	Low	Exceptional	Least	Low	Moderate
19114220400	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220400	High	Medium	No Potential	Medium	Least	Low	Low
19114220400	High	Medium	No Potential	Medium	Least	Low	Low
19114220400	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220400	Medium	Low	Low	Exceptional	Highest	Medium	Unique
19114220400	High	Medium	High	Medium	Highest	Medium	High
19114220401	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220500	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220500	High	Medium	No Potential	Medium	Moderate	Medium	High
19114220500	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220500	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220500	Medium	Low	Medium	Medium	Least	Low	Low
19114220500	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220500	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220500	Medium	Low	Medium	Medium	Least	Low	Low
19114220500	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19114220501	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220501	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220501	Medium	Low	No Potential	Medium	Least	Low	Low
19114220501	Medium	Medium	No Potential	Medium	Least	Low	Low

WetlandID	Hydrologic Regime	Aesthetics	Restoration Potential	Wildlife Habitat	Strmwater Susceptibility	Floral Diversity	Functional Ranking
19114220501	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220501	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220501	Medium	Medium	Low	Medium	Highest	Medium	High
19114220501	High	Medium	Low	Medium	Least	Low	Low
19114220600	Medium	Low	Low	Medium	Least	Low	Low
19114220600	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220600	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220600	Medium	Low	Low	Medium	Least	Low	Low
19114220600	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220600	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220700	High	Medium	No Potential	Medium	Least	Low	Low
19114220700	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220700	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220700	Medium	Low	Medium	Low	Least	Low	Low
19114220700	Medium	Medium	No Potential	Medium	Slightly	Low	Low
19114220700	High	Low	Medium	Medium	Least	Low	Low
19114220700	Medium	Medium	No Potential	Low	Least	Low	Low
19114220800	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220800	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220800	High	Medium	Low	Low	Least	Low	Low
19114220800	High	Medium	No Potential	Medium	Least	Low	Low
19114220800	High	Medium	Medium	Medium	Least	Low	Low
19114220800	High	Medium	No Potential	Medium	Least	Low	Low
19114220800	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220800	High	Medium	No Potential	Medium	Least	Low	Low
19114220801	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220801	Medium	Medium	No Potential	Low	Least	Low	Low
19114220900	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220900	Medium	Medium	No Potential				Low

WetlandID	Hydrologic Regime	Aesthetics	Restoration Potential	Wildlife Habitat	Strmwater Susceptibility	Floral Diversity	Functional Ranking
19114220900	High	Medium	No Potential	Low	Least	Low	Low
19114220900	Medium	Medium	No Potential	Medium	Least	Low	Low
19114220900	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114220900	High	Medium	No Potential	Medium	Least	Low	Low
19114220900	Medium	Medium	No Potential	Low	Least	Low	Low
19114220900	High	Medium	No Potential	Medium	Least	Low	Low
19114221000	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114221000	Medium	Medium	No Potential	Low	Least	Low	Low
19114221000	High	Low	Medium	Medium	Moderate	Medium	High
19114221000	High	Medium	No Potential	Medium	Moderate	Medium	High
19114221000	High	Low	Medium				Low
19114221000	High	Medium	No Potential	Medium	Highest	High	Unique
19114221000	Medium	Low	Low	Medium	Moderate	Medium	High
19114221000	High	Medium	No Potential	Medium	Least	Low	Low
19114221000	Medium	Low	Medium	Low	Least	Low	Low
19114221001	High	Medium	No Potential	Medium	Least	Low	Low
19114221001	Medium	Medium	No Potential	Medium	Least	Low	Low
19114221001	Medium	Low	Medium				Low
19114221001	Medium	Low	Medium				Low
19114221100	High	High	No Potential	Medium	Moderate	Medium	High
19114221100	High	Medium	No Potential	Low	Least	Low	Low
19114221100	High	Medium	No Potential	Medium	Least	Low	Low
19114221100	Medium	Medium	High	Medium	Moderate	Medium	High
19114221100	High	High	No Potential	Medium	Moderate	Medium	High
19114221100	Medium	High	Medium	Medium	Least	Low	Low
19114221200	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19114221200	Medium	High	No Potential	Medium	Moderate	Medium	High
19114221200	Low	Medium	Not Ranked	Low	Least	Low	Low
19114221200	Medium	Medium	No Potential	Medium	Moderate	Medium	High

WetlandID	Hydrologic Regime	Aesthetics	Restoration Potential	Wildlife Habitat	Strmwater Susceptibility	Floral Diversity	Functional Ranking
19114221200	High	Medium	No Potential	Medium	Least	Low	Low
19114221700	Medium	Low	No Potential	Low	Least	Low	Low
19114221700	Medium	Medium	No Potential	Medium	Least	Low	Low
19114221700	Medium	Low	Medium	Medium	Least	Low	Low
19114221700	Medium	Low	Low	Medium	Least	Low	Low
19114221700	Medium	Low	Low	Medium	Least	Low	Low
19114221700	Medium	Low	Medium	Medium	Least	Medium	High
19114221700	Low	Medium	No Potential	Low	Least	Low	Low
19114221700	High	Low	No Potential	Medium	Least	Low	Low
19114221701	High	Low	No Potential	Medium	Least	Low	Low
19114221701	Medium	Low	Medium	Medium	Moderate	Medium	High
19114221701	High	Medium	No Potential	Medium	Least	Low	Low
19114221800	Medium	Medium	No Potential	Medium	Least	Low	Low
19114221800	High	Low	Medium	Medium	Least	Low	Low
19114221800	Medium	Low	Medium	Low	Least	Low	Low
19114221800	Medium	Low	Medium	Low	Least	Low	Low
19114221800	Medium	Low	Medium	Low	Least	Low	Low
19115213000	Medium	Medium	No Potential	Medium	Least	Low	Low
19115213000	Medium	Medium	No Potential	Medium	Least	Low	Low
19115213000	High	Medium	No Potential	Medium	Least	Medium	High
19115213000	Medium	Medium	No Potential	Medium	Least	Low	Low
19115213100	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19115220500	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115220800	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222100	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222100	Medium	Low	Low	Medium	Least	Low	Low
19115222100	Medium	Low	Medium	Medium	Least	Low	Low
19115222100	Medium	Medium	Medium	High	Moderate	Medium	Unique
19115222100	Not Ranked	Not Ranked	Not Ranked				Not Ranked

WetlandID	Hydrologic Regime	Aesthetics	Restoration Potential	Wildlife Habitat	Strmwater Susceptibility	Floral Diversity	Functional Ranking
19115222100	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222100	High	Low	Not Ranked	Medium	Moderate	Medium	High
19115222100	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222100	Medium	Low	Medium	Medium	Least	Low	Low
19115222200	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222200	High	Medium	No Potential	Medium	Least	Low	Low
19115222200	Medium	Medium	Medium	Medium	Least	Medium	High
19115222200	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222200	Medium	Low	No Potential	Medium	Moderate	Medium	High
19115222200	High	Low	No Potential	Medium	Least	Low	Low
19115222200	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222200	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222200	Medium	Medium	Low	Medium	Least	Low	Low
19115222201	High	Medium	No Potential	Medium	Moderate	High	Unique
19115222201	Medium	Low	Not Ranked	Medium	Least	Low	Low
19115222201	High	Medium	No Potential	Low	Least	Low	Low
19115222300	High	Medium	No Potential	Medium	Moderate	Medium	High
19115222300	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222300	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222300	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222300	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222300	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222300	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222300	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222400	High	Medium	Low	High	Moderate	Medium	Unique
19115222400	Medium	Medium	No Potential	Medium	Least	Medium	High
19115222400	Medium	Medium	No Potential	Medium	Highest	High	Unique
19115222400	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222400	Not Ranked	Not Ranked	Not Ranked				Not Ranked

WetlandID	Hydrologic Regime	Aesthetics	Restoration Potential	Wildlife Habitat	Strmwater Susceptibility	Floral Diversity	Functional Ranking
19115222400	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222400	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222400	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222400	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222401	High	Medium	No Potential	High	Moderate	High	Unique
19115222500	Medium	High	No Potential	Medium	Least	Medium	High
19115222500	High	Medium	No Potential	Medium	Highest	High	Unique
19115222500	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222500	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222500	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222500	Medium	Medium	No Potential	Medium	Moderate	High	Unique
19115222600	High	Medium	No Potential	Medium	Moderate	Medium	High
19115222600	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222600	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19115222600	Medium	Medium	No Potential	Medium	Moderate	High	Unique
19115222600	Medium	Medium	No Potential	Medium	Moderate	High	Unique
19115222600	Medium	Medium	No Potential	Low	Least	Low	Low
19115222600	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222600	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222600	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222601	Medium	Medium	No Potential	Low	Least	Low	Low
19115222601	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222601	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222601	Medium	High	No Potential	Medium	Least	Low	Low
19115222601	Medium	Medium	No Potential	Medium	Slightly	Medium	High
19115222601	High	Medium	Low	Medium	Least	Low	Low
19115222601	Not Ranked	Not Ranked	No Potential				Not Ranked
19115222601	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222601	Not Ranked	Not Ranked	Not Ranked				Not Ranked

WetlandID	Hydrologic Regime	Aesthetics	Restoration Potential	Wildlife Habitat	Strmwater Susceptibility	Floral Diversity	Functional Ranking
19115222601	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19115222602	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19115222700	Medium	Medium	No Potential	Low	Least	Low	Low
19115222700	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222700	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222700	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222700	Medium	Low	No Potential	Medium	Highest	Medium	High
19115222700	Medium	Medium	Not Ranked	Medium	Moderate	Medium	High
19115222700	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222700	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19115222700	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19115222701	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222701	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222701	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222701	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222701	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222701	Medium	Medium	Medium	Medium	Moderate	Medium	High
19115222701	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222701	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222701	High	Medium	Medium	Medium	Least	Low	Low
19115222701	High	Low	Medium	Medium	Least	Low	Low
19115222702	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19115222720	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222800	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222800	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222800	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222800	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222800	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222800	Medium	Low	Medium	Medium	Least	Low	Low

WetlandID	Hydrologic Regime	Aesthetics	Restoration Potential	Wildlife Habitat	Strmwater Susceptibility	Floral Diversity	Functional Ranking
19115222800	Medium	High	No Potential	Medium	Least	Low	Low
19115222800	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222800	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222801	Not Ranked	Low	Not Ranked				Not Ranked
19115222801	Low	Medium	No Potential	Low	Least	Low	Low
19115222801	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19115222801	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19115222801	Medium	Medium	No Potential	Medium	Least	Low	Low
19115222801	High	Medium	No Potential	Low	Least	Low	Low
19115222801	High	Medium	No Potential	Medium	Least	Low	Low
19115222801	Medium	Medium	No Potential	Low	Least	Low	Low
19115222801	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115222801	Medium	Medium	No Potential	Medium	Moderate	High	Unique
19115223200	Medium	Medium	No Potential	Low	Moderate	Not Ranked	Low
19115223200	Medium	Medium	Low	Medium	Least	Low	Low
19115223200	Medium	Low	Low	Medium	Moderate	High	Unique
19115223200	High	High	No Potential	High	Moderate	High	Unique
19115223200	High	Medium	Medium	High	Least	High	Unique
19115223200	Medium	Medium	No Potential				Low
19115223200	Medium	Medium	No Potential	Low	Moderate	Not Ranked	Low
19115223300	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223300	Medium	Medium	No Potential	Medium	Least	Low	Low
19115223300	Medium	Medium	No Potential	Medium	Least	Medium	High
19115223300	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223300	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223300	Low	Medium	No Potential	Low	Least	Low	Low
19115223300	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223300	High	Medium	No Potential	Medium	Least	Low	Low
19115223300	Medium	Medium	No Potential	Low	Least	Low	Low

WetlandID	Hydrologic Regime	Aesthetics	Restoration Potential	Wildlife Habitat	Strmwater Susceptibility	Floral Diversity	Functional Ranking
19115223301	High	Medium	No Potential	Medium	Least	Low	Low
19115223301	Medium	Low	No Potential	Medium	Moderate	High	Unique
19115223301	High	Low	Medium	Medium	Least	Low	Low
19115223301	Medium	Medium	No Potential	Medium	Least	Low	Low
19115223301	Medium	Medium	No Potential	Medium	Least	Low	Low
19115223301	High	Medium	High	Medium	Least	Low	Low
19115223301	High	Medium	Medium	Medium	Least	Low	Low
19115223301	Medium	Medium	No Potential	Medium	Least	Low	Low
19115223301	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223301	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19115223302	Medium	Medium	No Potential	Low	Least	Low	Low
19115223302	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223400	High	Medium	No Potential	Medium	Least	Low	Low
19115223400	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223400	Medium	Medium	No Potential	Low	Least	Low	Low
19115223400	Medium	Medium	No Potential	Low	Least	Low	Low
19115223400	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223400	Medium	Medium	No Potential	Medium	Least	Low	Low
19115223400	Medium	Medium	No Potential	High	Least	Medium	Unique
19115223400	Medium	High	No Potential	Medium	Least	Low	Low
19115223400	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223401	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223401	Medium	Medium	No Potential	Medium	Moderate	Medium	High
19115223401	Medium	Medium	No Potential	Medium	Least	Low	Low
19115223500	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223500	Not Ranked	Not Ranked	Not Ranked				Not Ranked
19115223500	Medium	Medium	No Potential	Medium	Moderate	High	Unique
19115223500	Medium	Medium	No Potential	Medium	Least	Low	Low
19115223500	Not Ranked	Not Ranked	Not Ranked				Not Ranked

WetlandID	Hydrologic Regime	Aesthetics	Restoration Potential	Wildlife Habitat	Strmwater Susceptibility	Floral Diversity	Functional Ranking
19115223600	Medium	Medium	Medium	Medium	Least	Low	Low
19115223600	High	Low	Medium	Medium	Least	Low	Low
19115223600	Medium	Medium	No Potential	Medium	Least	Low	Low
19115223600	Medium	Medium	Low	Medium	Least	Low	Low
1912204008	High	Medium	Not Ranked	High	Highest	High	Unique