



VOLUME 3 IMPLEMENTATION PLAN

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3.1 INTRODUCTION

This volume of the Plan constitutes the MCWD Implementation Plan. It serves as an actionable roadmap, outlining natural resource issues within the Minnehaha Creek Watershed, the system drivers that cause those issues, and the management strategies that the District and its partners can employ to achieve measurable change in identified goals.

Also included is a description of the MCWD's Balanced Urban Ecology philosophy of water resource planning and implementation, which emphasizes the social and economic value created when built and natural systems work in harmony. Following is an outline of MCWD's methodology to prioritize water resource issues, how it plans and implements its management strategies, how programs are aligned to accomplish the MCWD mission, and the administrative procedures that govern MCWD efforts.

Nested within this volume, the District's overarching Implementation Plan has been further subdivided geographically into eleven (11) subwatershed implementation plans. Each of these plans lays out a framework for actions that can be taken by the District and its partners to address the combination of issues and drivers, unique to each area of the watershed.

These subwatershed plans are not intended to serve as a prescriptive formula for action. Watershed issues and the stressors driving the system may be relatively static, but the successful implementation of solutions requires partners to be able to respond fluidly to opportunities emerging across the landscape. Accordingly, each subwatershed plan is designed to provide a foundation to guide future collaborative implementation efforts.

3.2 DISTRICT PHILOSOPHY

The MCWD sees natural resources as an integral component of vibrant communities, serving to create a sense of place, providing vital connections, and enhancing social and economic value. It aspires to a vision of a landscape of vibrant communities where the natural and built environments in balance create value and enjoyment.

This vision stems from the District's 2014 adoption of the Balanced Urban Ecology policy, which now serves as the MCWD's underlying organizational strategy. This strategy prioritizes partnership with the land use community to integrate policy, planning and implementation and to leverage the value created when built and natural systems are in harmony.

This policy guided the creation of the Minnehaha Greenway, and was developed in direct response to a series of policy analyses that identified



Frozen Minnehaha Falls, Nathan Lodermeier



Big Island on Lake Minnetonka, Peter Stratmoen



Six Mile Creek



the governance gap between land use and water planning and called for increased water and land use planning integration to improve the watershed management model in Minnesota.

For example, the 2007 Evaluation Report on Watershed Management, drafted by the Office of the Legislative Auditor, concluded that efforts to manage water quality are most effective when coordinated with land use decisions.

Reinforcing these findings, in 2009 the Minnesota Environmental Initiative found that water and land planning in Minnesota is compartmentalized at all levels, under separate bodies of regulation and various agency jurisdictions. This evaluation noted that “a coordinated planning cycle will result in more informed land use decisions and a better balance between planning and implementation activities for land and water resources.”

Similarly, a 2011 Hennepin County Water Governance Project noted a complicated relationship between politically managed built systems and watershed based management that requires significant effort to coordinate. This study recognized “the potential for implementing good water management practices through better integration of water management plans and comprehensive land use plans of all kinds. Effective collaboration in the planning stage before spending funds on intensive capital improvement projects can save valuable resources.”

The 2013 Water Regulation and Governance Evaluation, drafted by the Minnesota Pollution Control Agency (MPCA), found that opportunities to address land use and water connections have waned in recent decades, that state land use statutes lack an explicit connection to water plans, and that the major water management goals of the state can be achieved only by strong integration with land use management.

One reason for the persistent disconnect between watershed management and land use planning has been the difficulty in synchronizing planning between watershed districts and land use authorities. Land use decisions are made relatively quickly compared with the historically static ten-year plans developed by watershed districts. Land may be bought and sold, platted, and moved into construction within months. For watershed planners working under fixed ten-year plans and state rules, this can make it difficult to integrate watershed capital improvements or design enhancements into the development plans of a private or institutional developer.

A secondary issue has been the prevailing perception of watershed organizations acting principally as regulatory agencies. Historically, watershed districts have used regulation as a foundational tool to connect with local land use planning and infrastructure investment. Such programs

Successful, sustainable, livable communities are built on a foundation of integrated planning – planning that recognizes communities as living organisms and takes into consideration all components of the urban ecology.



Lake Bde Maka Ska / Calhoun



guarantee a certain level of integration of water resource planning into the built environment. However, this view often results in watershed districts receiving development or infrastructure plans later in the approval process, during permit review, rather than in the due diligence or feasibility period of development or infrastructure planning.

Recognizing these challenges within the realm of water management, and the opportunity for MCWD to meaningfully integrate its work into the planning of vibrant communities, the District has strategically realigned its planning and implementation model emphasizing water's complementary, rather than competing, role in the urban landscape.

A source of inspiration for the District's Balanced Urban Ecology policy was the 1994 Hennepin Community Works model. This well-respected urban planning model acknowledged the power of natural systems to be developed as the underlying structure of place, underpinning local community identity. Community Works found that well designed and carefully integrated natural systems and infrastructure projects are able to maintain and enhance the long-term tax base of neighborhoods while improving the quality of life.

Since its adoption in 2014, the District now views its mission of water resource protection and improvement through the lens of its Balanced Urban Ecology policy:

Rather than viewing the natural and built environments as a clash of opposing forces, we recognize the interrelated and interdependent character of modern life; communities cannot thrive without healthy natural areas, and healthy natural areas become irrelevant without the interplay of human activity. This is the integrated setting in which we live. Indeed, our quality of life and our economic wellbeing are inextricably linked. Any notion that land development and environmental protection are locked in a winner-take-all battle is sadly outdated.

Successful, sustainable, livable communities are built on a foundation of integrated planning – planning that recognizes communities as living organisms and takes into consideration all components of the urban ecology.

Our work will be strengthened through these collaborative efforts. Not only will they offer greater community impact, they will produce creative public-private funding opportunities that will leverage scarce resources and maximize benefits. Going it alone is no longer the best path forward.

The Balanced Urban Ecology policy represents the MCWD’s fundamental philosophy and way of doing business and is guided by the following three principles:

- » Intensifying and maintaining focus on high-priority projects
- » Partnering with others to pursue watershed management goals
- » Being flexible and creative in adapting to the needs of partners

3.3 DISTRICT GOALS

The District has established four strategic goals. All specific issues within the watershed nest under these goals.

- » **Water Quality** - To preserve and improve the quality of surface and groundwater.
- » **Water Quantity** - To manage the volume and flow of stormwater runoff to minimize the impacts of land use change on surface and groundwater.
- » **Ecological Integrity** - To restore, maintain, and improve the health of ecological systems.
- » **Thriving Communities** - To promote and enhance the value of water resources in creating successful, sustainable communities.

While the Plan is organized around these four simple strategic goals, the MCWD recognizes that watershed management requires a holistic approach of ecosystem management. Accordingly, it approaches planning and implementation in a manner that integrates hydrologic, chemical, physical, biological and built components of the subwatershed system. Further discussion of the District’s goal-setting and evaluation framework is provided in Section 3.7.

3.4 IMPLEMENTATION MODEL

The District’s approach under this Plan is guided by the Balanced Urban Ecology policy and its principles of focus, partnership, and flexibility. The implementation model to support this approach is ongoing and iterative, but can be simplified into four basic steps:

1. Understanding resource needs
2. Understanding land use plans and opportunities
3. Integrating and prioritizing
4. Program implementation



Minnehaha Creek, Nathan Lodermeier

The following sections provide further detail on each of these elements. Each of the District's eleven (11) subwatershed plans in Section 3.9 follows this sequence.

3.4.1 UNDERSTANDING RESOURCE NEEDS

The first element of the District's implementation model is to understand water resource needs on a subwatershed basis. The MCWD maintains multiple technical data sets, summarized in Volume 2, that provide the District and its partners with the information needed to guide implementation planning. Analysis of these data enables the District to identify areas of highest need, based on sound science. This represents the first step in the iterative process of establishing implementation priorities.

Each subwatershed plan within Section 3.9 follows an issues, drivers, and strategies sequence as described below.

Issues

For purposes of Plan organization, all natural resource issues within the District are nested within the three strategic goal areas of Water Quality, Water Quantity, and Ecological Integrity. Each of these three goal areas are described in more detail below.

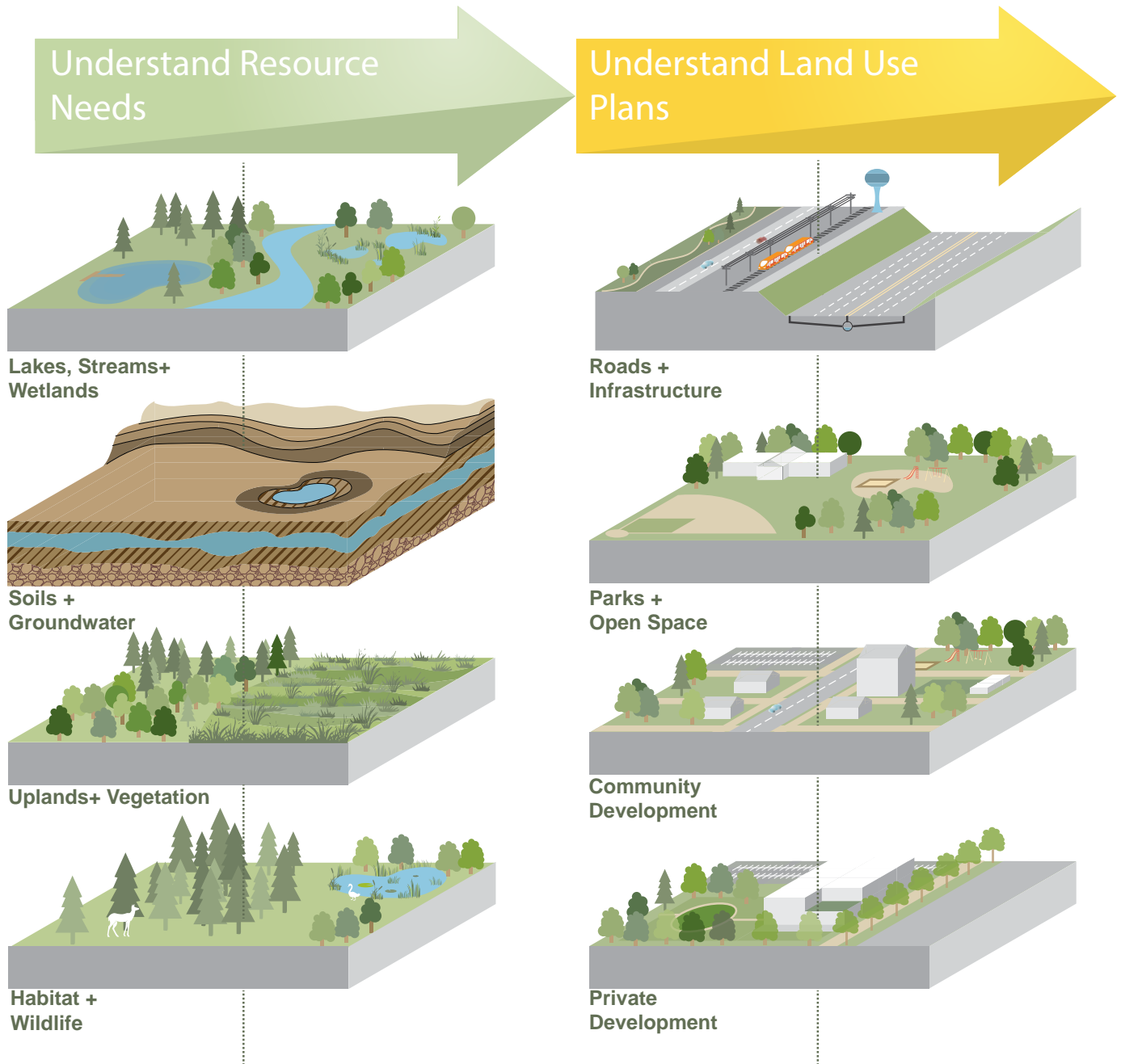
No issues are outlined within the goal area of Thriving Communities. Thriving Communities serves as an overarching organizing element to guide the District in implementing its natural resource mission. The District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. As such, this goal area is informed by the goals of individual communities and no specific issues are identified within this plan under Thriving Communities.

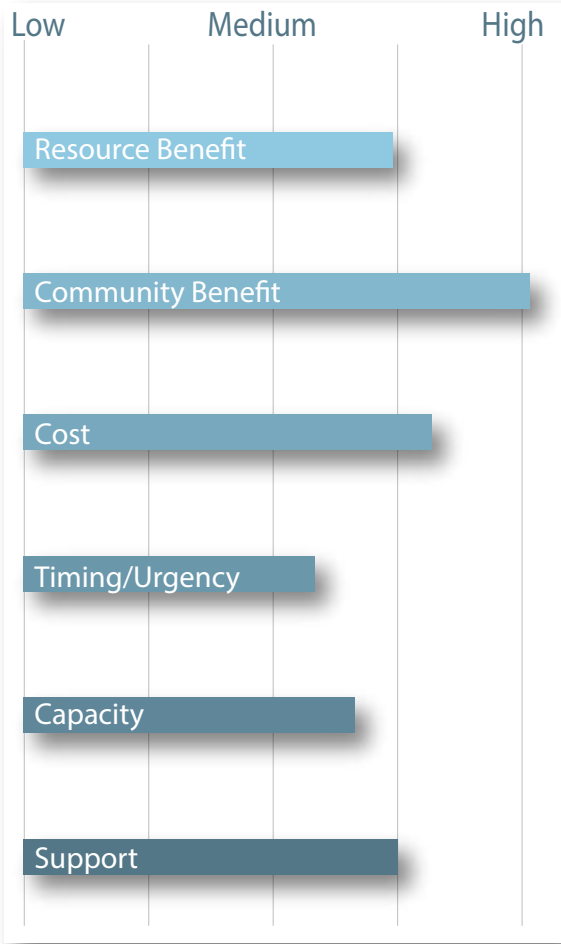
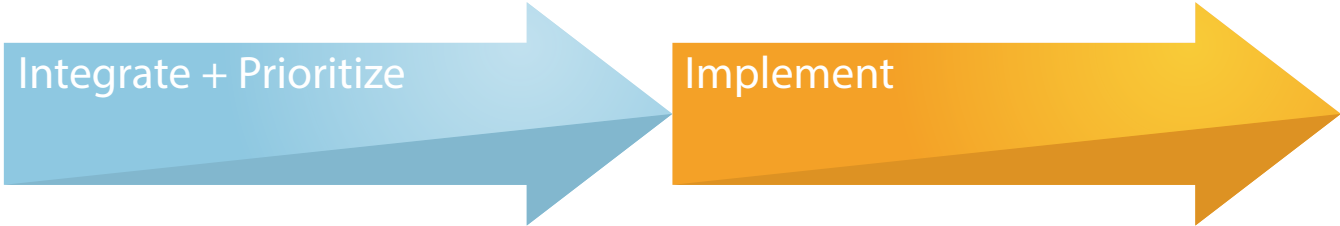
Water Quality Issues

The Environmental Protection Agency (EPA) and the Minnesota Pollution Control Agency (MPCA) define acceptable water quality as that which supports the designated use of the waterbody (e.g. fishable, swimmable, drinkable).

Pollution discharged to waterbodies impacts water quality. Pollutant discharge within the Minnehaha Creek watershed is primarily from non-point sources, carried to lakes, streams and wetlands by snowmelt or rainfall that runs across the landscape. Land use within the landscape influences both the quality and quantity of the runoff. Runoff contains sediment, nutrients and other contaminants that exceed what lakes, streams and wetlands would receive in an undeveloped watershed.

IMPLEMENTATION MODEL





Within freshwater systems, an excess of nutrients like phosphorus (eutrophication) is the most common problem impacting the use of lakes and streams. Phosphorus impacts algal and plant productivity, water clarity, fish habitat and aesthetics. While other pollutants do stress freshwater systems, phosphorus is used as standard indicator of the health of a system.

This Plan considers good water quality to be achieved when the physical, chemical, biological and aesthetic characteristics of a waterbody support designated use. Because the principal standard by which water quality is judged is total phosphorus concentration, the water quality emphasis of this Plan is on reducing phosphorus loads to lakes to achieve standards set by the state.

Water Quantity Issues

As watersheds are altered and developed by humans, the flow of water across the landscape changes. In undeveloped watersheds rainfall largely infiltrates into the ground. However, historically, as watersheds were built out, drainage systems were installed both to remove surface water and lower groundwater for agricultural production, and to channelize and accelerate removal of surface runoff for urban development and infrastructure.

As watersheds began to include built components, channels were straightened, wetlands were filled, drainage ways were placed into pipes, natural vegetation was removed, and hard surfaces (parking lots, roofs, roads, etc.) were built.

Combined, these modifications reduce the infiltration and storage of water. The result is larger volumes of water draining through the system faster. The volume of water and the rate at which it moves through the watershed are defined as water quantity issues.

Water quantity is most often recognized as flooding. Flooding occurs when a watershed is overwhelmed with rainfall that cannot infiltrate into the ground, or be appropriately stored on the landscape. Flooding can occur at a system level, across the watershed on major lakes and streams, or more locally in ponds and in street systems that cannot adequately store or convey the water being received during and after storm events.

However, water quantity is also an issue when there is not enough water. Water is essential for aquatic life and the health of aquatic systems. Streams with highly modified watersheds, like Minnehaha Creek, have a high proportion of hard surface that pipes water directly to the stream. In an undeveloped condition water would be stored in wetlands or infiltrated into the ground. This water then would be slowly released into the stream channel, promoting long periods of stable water flow. In modified watersheds stream flow can be “flashy,” with water moving through the system quickly after rainfall events.



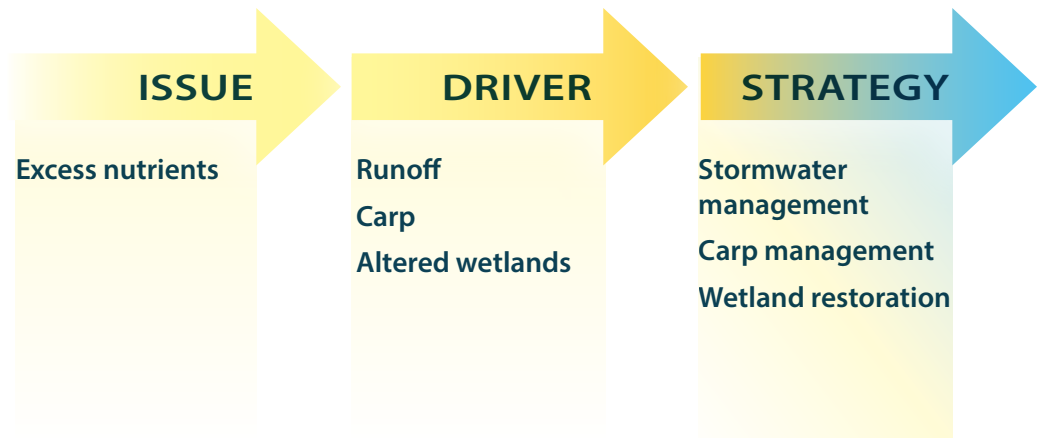
Stream monitoring equipment



Lake Hiawatha during the 2014 flood, Erdahl Aerial Photos



Mallard ducks at Lake Calhoun, credit: Svetlana Schulte



In streams like Minnehaha Creek, this can result in intermittent flow and periods where the channel is dry. This water quantity issue directly impacts the ecological health of the stream, stressing fish, macroinvertebrates, plants, and other aquatic life.

Within this Plan, the District is focused on water quantity issues that stress the regional system. In general, the District considers LGUs to have the primary role with respect to flood prevention and management by virtue of their roles in land use planning and development regulation, as owner and operator of stormwater conveyance infrastructure, and as the implementing authority for the National Flood Insurance Program and the state floodplain management program (Minn Rules 6120). The District’s primary roles related to flood management are: (1) management of the Lake Minnetonka/Minnehaha Creek regional conveyance system through the operation of Grays Bay Dam; (2) providing cities and the public with flood prediction data using the District’s Hydraulic and Hydrologic model; (3) preserving local flood storage volume by regulating floodplain fill during development permitting; and (4) implementing and promoting stormwater management practices to address pollutant loading, prevent local peak flow increase and provide for volume reduction. The District serves as a technical resource and will work with its

partners to plan and implement solutions that create a more resilient system that is capable of handling both ends of the water quantity spectrum.

Ecological Integrity Issues

Ecological integrity encompasses issues of water quality and water quantity, but is broken out for simplicity in Plan organization. The three primary elements of an ecosystem are its structure, composition and function. Structure refers to all of the living and non-living physical components that make up an ecosystem. Composition refers to the variety of living things within an ecosystem. Function refers to all of the natural processes that occur within an ecosystem.

Ecological integrity exists when the composition and function of the ecosystem are unimpaired by stresses from human activity. It exists when natural ecological processes are intact and self-sustaining, where the system evolves naturally and with a capacity for self-renewal.

Within this plan, ecological integrity focuses on achieving balance between the built and natural environments, with ecosystems providing the highest possible measures of structure, composition and function. Within the implementation plan, emphasis is placed not only on improving structure, composition and function at an individual resource level, but on connectivity between aquatic and terrestrial ecosystems, and connectivity at a regional landscape scale.

Drivers

Within each subwatershed plan, issue drivers are identified. A driver of a water quality, water quantity, or ecological integrity issue is a driving force or stressor that causes a biological community or physical structure to change. For example, in regards to water quality issues, stormwater runoff and altered wetlands can drive excess nutrient loading, increase the quantity of water flowing downstream, and degrade habitat and ecological integrity.

Management Strategies

To guide planning and implementation efforts, the District has established a simple framework of general strategies that will address the identified issues. Management Strategies correlate directly to the drivers of the subwatershed system. If, for example, stormwater runoff is driving an increase in water quantity and degrading water quality, the appropriate management strategy will be managing stormwater runoff through the use of best management practices tailored to the individual circumstance. If degraded water quality within a lake is driven by the presence of common carp and internal loading, management strategies may include rough fish management, and alum dosing. These strategies cover both the short and

To better integrate our efforts with those acting on the landscape and address the dynamic environment in which water resource management efforts are implemented, the District has adopted a partnership framework to create alignment between our goals and the goals of others.



Monarch caterpillar

long-term, and serve to guide the identification and prioritization of individual implementation efforts.

3.4.2 UNDERSTANDING LAND USE PLANS

The second element of the District's implementation model is to understand the land use setting. Guiding all of District's implementation efforts to protect and improve the landscape is the principle of integrated planning, through collaboration with public and private partners. To better combine our efforts with those acting on the landscape, and to operate effectively within the dynamic environment in which water resource management efforts are implemented, the District has adopted a partnership framework to create alignment between our goals and the goals of others.

The District uses several mechanisms to understand the land use environment within its boundaries and align its water resource planning with land use planning. These include, but are not limited to:

- » Review and coordination of local water management plans
- » Annual meetings with cities
- » Exchange of land use, infrastructure, park, and capital improvement plans with cities, counties, and agencies
- » Early regulatory coordination on pending development activity
- » Coordination agreements with public and private partners

This effort to improve communication and collaboration between the District and its communities is further described in Section 3.6.

3.4.3 INTEGRATING AND PRIORITIZING

The subwatershed plans in Section 3.9 describe the resource needs and corresponding management strategies across the District's eleven (11) subwatersheds. The District recognizes that it is not feasible to address all of the resource issues throughout the watershed within a 10-year plan cycle. For this reason, the District prioritizes using both its knowledge of water resource needs and its understanding of land use plans and opportunities.

When setting implementation priorities, the MCWD considers factors such as these:

- » Water resource issues/impairments
- » Public value of resources

- » Probability of achieving measurable resource improvement
- » Local partnerships and support
- » Known project opportunities
- » Funding opportunities

The MCWD first uses its water resource data to identify issues and set implementation priorities across the District. For example, based on long term monitoring data, the District can prioritize water quality issues based on the degree of water quality impairment. This information enables the District to identify regionally significant waterbodies that are the most degraded, as well as waterbodies that currently meet standards but are at a “tipping point” – poised to become impaired.

In addition to prioritizing based on water resource data, the District also considers what is happening on the landscape. For instance, if an area is projected to undergo significant redevelopment, or there is a major infrastructure project planned by another entity, these changes may present opportunities to address water resource issues in ways that are well-integrated with land use plans and more cost-effective.

The District prioritizes at multiple scales. At a subwatershed scale, the District identifies priorities for implementation based on the resource needs of that system. Then as opportunities for implementation arise, the District can weigh them against the resource needs and priorities it has identified.

Prioritization is also done at a watershed-wide scale. The District has found that it can most effectively achieve its mission to manage and improve water resources, not when it seeks to apply its resources evenly across the watershed at all times, but rather when it coordinates its programs and capital investments so as to focus on specific areas of high need and opportunity. For this reason, the District identifies priority subwatersheds on which to focus on system-level planning and implementation.

Through sustained focus in a subwatershed, the District is able to develop a thorough understanding of a system’s issues and drivers, build relationships, identify opportunities, and coordinate plans and investments with its partners for maximum natural resource and community benefit. This focused approach is best suited in areas where there are significant resource needs and a level of complexity that require sustained effort and coordination across multiple public and private partners. This process is described further in the next section.



Boardwalks trace a restored stream at the Minnehaha Creek Preserve.



Establishing implementation priorities is an iterative process. The priorities identified in this Plan are based on information available at the time the Plan was drafted; however, the District recognizes the need to continually scan for threats and opportunities and adjust its priorities accordingly. In cases where new priorities are identified that are beyond the scope of this Plan, the District will pursue a plan amendment as described in Section 3.8.

3.4.4 PROGRAM IMPLEMENTATION

The last element is implementation. The District has a wide range of programs and services that work together to make progress toward the District's goals and provide value to its communities. These services include:

- » Monitoring – collecting and analyzing data to identify issues and inform implementation
- » Technical Assistance – providing guidance to landowners, cities, and others on the planning, funding, and implementation of best management practices
- » Permitting Assistance – assisting applicants by coordinating with other regulatory agencies and identifying alternatives that meet the applicants' goals and meet or exceed natural resource protection requirements
- » Education and Outreach – providing education and capacity building for communities and residents
- » Capital Improvement Projects – constructing physical improvements on the landscape
- » Land Conservation – preserving and restoring high-value green infrastructure
- » Ecosystem Management – managing invasive species, such as carp, for water quality and ecological integrity benefit
- » Grants – identifying funding sources through the District's own competitive grants or other federal, state, and regional sources

Focal Subwatershed Planning

The previous section describes the rationale behind the District's selection of priority subwatersheds. The District has identified three priority subwatersheds in which to focus its implementation efforts for the 2018-2027 plan cycle – Minnehaha Creek, Six Mile Creek-Halsted Bay, and Painter Creek. These three subwatersheds have been prioritized based on a combination of resource needs and opportunities, as described briefly below and in more detail in the respective subwatershed plans in Section 3.9.

As the regional water resource authority, the District is responsible to understand hydrologic systems on a watershed basis and what is needed for their health and sustainability. Through its review of local water plans, the District seeks to engage its LGUs as partners in incorporating this basis of knowledge and understanding into the exercise of land use planning, regulatory, capital, infrastructure maintenance and related local authorities.



Sunset at the Burwell House on Minnehaha Creek, Aldo Abelleira

Within these focal subwatersheds, the District acts as a convener to bring together cities, counties, park districts, and others involved in land use change to develop a coordinated implementation and investment plan. Through this planning process, the parties align goals and plans to create a roadmap for implementation including both short-term actions and long-term efforts that can be executed as land use change takes place. This scale of coordinated implementation planning also positions the District and its partners well to pursue federal, state, and regional funding sources.

Minnehaha Creek

The Board has identified the section of Minnehaha Creek through Hopkins and St. Louis Park as a priority focus area because of its resource needs – Minnehaha Creek and downstream Lake Hiawatha are impaired and this stretch of creek was identified as contributing the highest pollutant loads; and its opportunities – the area is undergoing significant land use planning and redevelopment for reasons including the planned light rail transit system. The District has also identified opportunities to extend stream restoration and stormwater management efforts downstream through partnerships with the cities of Edina and Minneapolis and the Minneapolis Park and Recreation Board and through grant funding received from the Federal Emergency Management Agency (FEMA) to repair stream damage that occurred during the 2014 flood event.



Six Mile Marsh

Six Mile Creek-Halsted Bay

The Six Mile Creek-Halsted Bay focal geography is a complex system that spans four communities, two counties, and a significant portion of Three Rivers Park District land. It is resource-rich with 17 lakes Halsted Bay of Lake Minnetonka, and over 6,000 acres of wetlands. Six of these lakes are classified as impaired under Minnesota Pollution Control Agency standards with Halsted Bay requiring the largest load reduction of any waterbody in the District. The subwatershed is experiencing significant growth and development activity that creates opportunities, and an urgency, for integrated land use and water resource planning.



Rolling hills restoration in Painter Creek subwatershed

Painter Creek

The Painter Creek Subwatershed contains a number of large wetlands, many of which have been ditched or otherwise altered, that are connected by Painter Creek. The system delivers high phosphorus loads to Jennings Bay on Lake Minnetonka, which is listed as impaired and requires the second largest load reduction in the District. Painter Creek is also impaired by excess E. coli bacteria. The subwatershed includes areas of high quality wetland and upland, including several regionally significant ecological areas. The MCWD has previously established a partnership with the United States Army Corps of Engineers (USACE), which identified the potential restoration of four of the major wetland marsh systems that would be eligible for funding under the Federal Section 206 Program.

Opportunity-Driven Implementation

In addition to these focused planning and implementation efforts, the District’s approach watershed-wide is to remain responsive to opportunities created by land use change or partner initiatives. Development of local water plans will produce a coordination framework through which the District will maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined in the subwatershed plans in Section 3.9 and determine the appropriate response. As noted above, the District has a range of services it can mobilize to address resource needs and support partner efforts. As the District evaluates opportunities for implementation, it custom-tailors its response based on the community and resource need. The level of response will also depend on the urgency of the opportunity and the District’s capacity. For instance, in some cases, the District may play more of a supporting role by providing data and technical assistance or helping to pursue grant funds. In other cases, the District may take a lead role by developing a management plan or implementing a capital project.

Implementation Funding

A key to any successful implementation effort is developing a funding strategy. In recent years, the District’s planning and implementation model has evolved, as described in previous sections. This shift in approach prioritizes resources and actions on a watershed and subwatershed basis, to achieve a larger scale of measurable natural resource benefit. This, of course, is complemented by remaining responsive to opportunities that emerge from the public and private partners of the District.

While this mode and scale of implementation has demonstrated substantial results already, it has also been limited by the District’s ad valorem tax levy – requiring a complementary focus on developing funding strategies that leverage outside monies from grants, partnerships, and innovative financing to supplement the District’s tax levy.

Consequently, a critical component of all implementation plans will be the development of a funding strategy that identifies the sources, uses, and timing of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District’s public and private partners as capital projects or programs are advanced. Therefore, any costs identified within this Plan are projections. Intended expenditures will be refined during project development and budgeting, and among other things will reflect the District’s intent to complement its ad valorem funds with other funding sources.



NEMO boat tour



Subwatershed planning meeting



Tour at the Minnehaha Creek Preserve Program

3.5 MCWD PROGRAMS

The MCWD exists to protect and improve land and water for current and future generations. It does this work through public and private partnerships guided by the Balanced Urban Ecology policy, which emphasizes the social and economic value created when built and natural systems are planned to work in harmony.

The two overarching organizational strategies with which the District will achieve its mission are:

- » Developing high impact capital improvement projects that are integrated with non-water initiatives through multi-jurisdictional partnerships; and
- » Improving the integration of land-use and water resource planning and policies to produce value-added partnerships with private development and public infrastructure investments.

All District programs work in support of these efforts. Descriptions of the major District program areas are provided below. These programs include:

- » Planning
- » Research and Monitoring
- » Permitting
- » Education and Communications
- » Capital Improvement Projects
- » Land Conservation
- » Project Maintenance and Land Management
- » Incentive Programs

3.5.1 PLANNING

Program Purpose

District planning is focused in three main areas:

- » Developing high impact capital improvements
- » Developing policies to improve the integration of land-use and water planning and implementation
- » Aligning and deploying District programs and resources to address identified opportunities

Capital Project Planning

Over recent years, the District has invested significant organizational effort to develop new policy models for planning and partnerships, with the goal of improving the success of capital project implementation in partnership with the local land-use community. The District's capital improvement planning model is described in more detail in Section 3.5.5.

Policy Development

Following the Balanced Urban Ecology policy, the Planning program seeks to develop shifts in policy that increase the synergy of land-use and water planning. Specifically, the District wishes to improve collaboration with public and private partners in the following areas:

- » Private development
- » Public infrastructure planning and investment (e.g. parks, roads, utilities)
- » Land use and water planning and policy

Section 3.6 outlines how the District will collaborate with local municipalities through the development and coordination of Local Surface Water Management Plans, to continue strengthening partnership connections in these areas.

The District will also rely heavily on its Permitting Program and Education and Communications Program, to improve integration in these areas and increase awareness of partnership opportunities by:

- » Engaging the private development community and
- » Working with land use planning staff and officials

Aligning and Deploying Program Resources

The District's Planning Program also works pro-actively with the MCWD Board of Managers to scan the environment for opportunities to achieve the District's mission, and recommends the alignment and deployment of policy, project, and program resources. This work includes periodically conducting strategic assessments of existing and proposed District programming, recommending and maintaining organizational alignment, and evaluating and reporting on District effectiveness.

3.5.2 RESEARCH AND MONITORING

Program Purpose

The Research and Monitoring program serves as the scientific base to implement the District's mission, by collecting and analyzing data across the watershed's natural resources. This information is used primarily to inform



Staff gathering a sample



Winter chloride sampling



Zebra mussels on Lake Minnetonka

District planning and implementation, and secondarily to inform and educate members of the public. The program has the four following areas of focus:

- » Diagnosing drivers of water resource issues
- » Collaborating to identify management strategies
- » Broadly characterizing ecological health
- » Communicating analyses of data and recommendations

It accomplishes these goals through the following programmatic activities:

- » Diagnostic monitoring – smaller scale, higher resolution monitoring that identifies the cause of water resource impairment, to inform planning and implementation.
- » Anchor monitoring – maintaining long-term data sets across the watershed, at select representative sites, to monitor watershed-scale trends over time.
- » Performance monitoring – pre- and post-project monitoring at priority project sites to demonstrate efficacy.
- » E-Grade – broadly characterizing ecosystem health at a subwatershed or system scale to support planning and public communications.

Section 2.1.2 of the Plan provides an overview of monitoring locations, frequency, and parameters. These are evaluated annually and may be adjusted to serve program purposes.

The Research and Monitoring program also includes aquatic biology expertise focused on assessing and managing the impact of aquatic invasive species (AIS) within the watershed. District AIS monitoring and management efforts help to inform a more holistic interpretation of the watershed's ecological health. Programming focused on AIS includes the following activities:

- » Managing species with high ecological impact (i.e. common carp), in coordination with capital project planning, to improve water quality and ecological integrity.
- » Early detection monitoring and rapid response – conduct monitoring to identify recent introductions and respond with management and control, where appropriate, to address ecological impact and prevent new infestations.
- » Promoting research – encourage strategic partnerships that advance the use of the watershed as a living laboratory to advance AIS science while informing District planning and implementation.

- » Supporting the prevention efforts led by District partners – develop financial and technical partnerships to influence, engage and support partners in AIS prevention activities.

3.5.3 PERMITTING

Program Purpose

The primary purpose of the Permitting program is to review and oversee construction activity to protect the District’s natural resources from degradation that can occur as a result of land use change.

The program also uses early engagement to identify and foster partnerships with property owners, developers and local land use authorities, to achieve project outcomes that exceed regulatory requirements and create mutual benefit.

Given that Permitting program staff interact with the public on a daily basis, the program also serves as a public face of the District. This enables the Permitting program to operate in an educational capacity with respect to property owners, the development community and the District’s municipalities.

The Permitting program performs the following five functions:

- » Permit Administration – development plan review and permit issuance
- » Oversight and Compliance – field inspections and compliance enforcement
- » Partnerships – identifying and developing public-private partnerships to achieve outcomes that exceed requirements
- » Communication and Education – increasing public awareness of water resource management needs and the MCWD’s vision and mission
- » District Obligations - fulfilling the District’s own legal obligations including administering the Minnesota Wetland Conservation Act (WCA) and complying with its stormwater permit under the federal National Pollutant Discharge Elimination System (NPDES) program

Permit Administration and Compliance

Future development and redevelopment in the watershed is expected to have an impact on water and other natural resources. The District administers a permitting program so that construction projects that change land use comply with standards that limit these impacts. These standards are contained in the District Rules, which presently include regulations for:



Staff inspecting a retaining wall



Staff doing a stormwater pond inspection



Staff inspecting a construction site

- » Erosion and Sediment Control
- » Floodplain Alteration
- » Wetland Protection
- » Dredging
- » Shoreline and Streambank Stabilization
- » Waterbody Crossings and Structures
- » Stormwater Management
- » Appropriations
- » Illicit Discharge Detection and Elimination

The dredging, shoreline and streambank, and waterbody crossing rules also allow the Minnesota Department of Natural Resources (DNR) to maintain a General Permit for work within District boundaries that meets District rule requirements, thus relieving landowners of the need to obtain a DNR individual permit as well. The last substantial review and revision of the District Rules was in 2014. The District monitors developments in approaches toward regulatory protection and assesses its own permitting experience on an ongoing basis for the purpose of periodic rule-making to improve its Rules.

The District works with permit applicants, and coordinates with other permitting agencies, to ensure that plans, designs, and specifications for proposed construction projects meet requirements that minimize the impact a project will have on the watershed's natural resources. Once a project has been approved and moves into construction, the District monitors construction for compliance with the approved design. District permits require the landowner to assume responsibility for ongoing maintenance of stormwater management facilities and preservation of wetland buffers. Ordinarily, a private landowner must record this obligation on the property title, while maintenance obligations assumed by units of government are established by means of written agreement. The District's Permitting program also includes tracking facility maintenance and buffer preservation over time. Because of its legacy nature and resource limitations, there is a substantial deferred maintenance concern as to both public and private stormwater basins throughout the watershed. As noted in Appendix A, the District has begun discussions with its LGUs about approaches to addressing this concern.

The District's enforcement process typically occurs in steps. When a potential violation is observed, the District seeks to confirm the violation and obtain voluntary compliance with the permittee and responsible construction

firm. If compliance is not achieved, District staff may issue a temporary field compliance order and/or provide notice for a compliance hearing before the Board of Managers, which then may issue an order. During this process, District staff will coordinate with the local land use authority and any other agency that may have jurisdiction over the violation so that enforcement is efficient and consistent. If compliance does not result, the District, under Minnesota Statutes §§103D.545 and 103D.551, may seek enforcement of its order or other remedies in Minnesota District Court, though this step rarely has been required. If a violation presents an occurring or threatened risk of harm to water resources, the District may not follow this enforcement sequence but may move to stop work or issue a compliance order immediately.

Coordination with Local Government Units

The framework for District coordination of its regulatory program with the land use and water resource regulatory programs of its local government units (LGUs) is established through the local water planning process under Minnesota Statutes §§103B.211 and 103B.235. This framework is described extensively in Section 3.6, below.

Under those statutes, an LGU may choose to exercise sole regulatory authority over erosion control, stormwater management, floodplain alteration, wetland protection and/or waterbody crossings and structures. It also may elect to serve as the WCA implementing agency. If it chooses for the District to withdraw its own regulatory authority in any of these areas, it first must establish, for District approval, that it has adequate regulatory standards, as well as procedures and capacity to implement its program. The local plan also must provide for periodic mutual review of LGU program implementation.

Conversely, if the District will continue to exercise its authority within an LGU's boundaries, it will not assert the right to review or mandate changes in the LGU's standards or procedures. In this case, the LGU will remain subject to separate federal and state mandates (e.g., NPDES, Minnesota shoreland and floodplain programs, WCA, Safe Drinking Water Act) with respect to its regulatory program.

Appendix A describes how, through the local plan process, the District and its LGUs will establish a framework to coordinate where both agencies are implementing regulatory programs. The purposes of this coordination are to ensure early mutual awareness of proposed development activity, afford certainty and consistency to applicants and permittees, and provide for efficient and cost-effective compliance oversight.

Early Coordination and Value-Added Partnership

The broader District intention with respect to its Permitting program, and a



Cottageville Park ribbon cutting



Master Water Stewards project



Storm drain stenciling

substantial policy orientation underlying this WMP, is its effort to more closely integrate land use planning and water resource management. Principally, this will occur through closer coordination with LGUs at a planning level and in early development review. Appendix A outlines the coordination framework that the District hopes to achieve with interested LGUs.

The goals of this approach include the following:

- » Incorporate regional water resource considerations into development regulation before broader patterns of land development are fixed or regional infrastructure investments programmed.
- » Foster closer integration of water resource management standards into land development codes.
- » Identify opportunities to add public value to public or private development by enhancing development design to integrate water resource elements, or by cooperation between development or public infrastructure activity and independent District capital work.

It should be emphasized that the District will not impose any mandate on private development to participate in this sort of partnership exploration. A property owner or developer that simply wishes to obtain its permit and proceed with its work may apply and have its project reviewed and approved in accordance with District Rules. Similarly, if an owner or developer begins a mutual exploration but later determines simply to proceed with its project, it always will retain the right and ability to do so.

3.5.4 EDUCATION AND COMMUNICATIONS

Program Purpose

The District's Education and Communications program supports the District's mission by:

- » Promoting and supporting the policy objectives of Balanced Urban Ecology to integrate land-use and water planning
- » Supporting District programs by building awareness and support for the District and cultivating partnerships
- » Affecting change on the landscape by providing target audiences with the knowledge and skills needed to take action

The program also fulfills the District's obligations for public education and outreach under its Municipal Separate Stormwater System (MS4) Permit. The program provides this support through a variety of program initiatives, including but not limited to:

- » Developing a Balanced Urban Ecology education program for policy makers, business leaders, and the land-use planning community that promotes and develops knowledge about the added value created when development, public infrastructure, planning, and policy are coordinated early with the District.
- » Engaging communities in the planning, design, and place-based programming of District capital projects.
- » Maintaining a network of public agencies and non-profit partners that align with and support the District’s mission and implementation priorities.
- » Creating broad and targeted awareness of District initiatives and through newsletters, fact sheets, media, website, events, and other means.
- » Managing a Citizen Advisory Committee to engage a broad and representative cross-section of watershed residents in the District’s planning, policy development, and implementation.
- » Providing target audiences with the skills they need to adopt clean water practices through trainings and workshops, including: Non-point Education for Municipal Officials (NEMO), Clean Water Summit, winter maintenance, turf maintenance, raingardens, and shoreline restoration.
- » Providing engaged citizens with skills to implement clean water practices and to influence others on clean water issues through programs such as Master Water Stewards and the Watershed Association Initiative.



Lake Minnetonka shoreline restoration



Cottageville Park, Erdahl Aerial Photos



Long Lake wetland restoration

3.5.5 CAPITAL IMPROVEMENT PROJECTS

Program Purpose

The District’s implementation plan includes a capital improvement plan (CIP). In accordance with Minnesota Rules 8410.0105, subpart 2, the CIP describes structural solutions to attain the District’s Water Quality, Water Quantity, Ecological Integrity and Thriving Communities strategic goals.

The CIP table in Section 3.10 groups capital projects by subwatershed. The organizing principle of the Plan is to make these four strategic goals concrete on a subwatershed basis. This is done by analyzing the water resource issues, causes of those issues, stakeholder capacities, and opportunities within each subwatershed. Like the other elements of the District’s implementation plan, the CIP is derived through this analysis. The identification of potential funding sources in the CIP table is not intended to be exclusive of other sources of funding that may become available or appropriate during the planning period.

The CIP reflects the Balanced Urban Ecology approach described in Section 3.2 of the Plan. Subwatershed assessment has identified certain capital projects that are specific as to project location and as to the land alteration, technique, or technology to be implemented. However, other projects have less specificity. The CIP defines them by a set of prioritized water quality, water quantity, and ecological integrity needs within an identified part of the subwatershed; a set of approaches suited to address those needs; and a programmed spending cap for such work over the planning period. The District will maintain a posture of ongoing monitoring of land use developments and landowner interests, communication with public and private interest holders and feasibility review. In that posture, the District will be prepared to recognize opportunities and initiate specific projects that address the defined subwatershed water resource issues cost-effectively and also support other public and private goals.

The CIP is a planning tool. It also is a means to inform partners, District residents and other interested parties as to the District's scope and priorities for its capital work over the planning period. A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs and other policy considerations before a formal decision to proceed to construction is made. The "Procedures" section below describes the development and evaluation steps that will occur before the District will commit resources to a project.

That section also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with the procedures described below.

A capital improvement is "a physical improvement that has an extended useful life" (Minn. Rules 8410.0020, subpart 3). The District undertakes a variety of such improvements to achieve its water resource goals. The District's capital work includes both the construction or installation of structural improvements (e.g., lake outlet or water elevation management structures, water quality treatment devices, structural shoreline stabilization) and improvements in the form of permanent land alterations (e.g., stormwater basins, wetland restorations). The capital work that the District has identified for potential implementation over the planning period is listed in the CIP. Implementation of this work will follow the "Procedures" section below.

Certain District improvements with capital improvement aspects are not considered capital improvements, and for that reason are not in the CIP or subject to capital improvement procedures. For example:

- » Some actions are larger scale improvements to the natural environment but are not considered a “physical improvement with an extended life.” These may include, for example, vegetation restoration and management in wetlands or on upland, lake treatments for water quality, and rough fish management.
- » Some District activities may include work of a capital nature, but as a subordinate element of a non-capital program. Examples here include smaller-scale water quality or shoreline stabilization work funded principally for education or demonstration purposes; boardwalks and educational signage for recreational sites; and temporary barrier installations for fish management.
- » The District is programming, and intends to budget for, grant programs that fund work by partners to advance the District’s water quality, water quantity and ecological integrity goals. Funded work may be capital in nature, but BWSR rules stipulate that these incentive programs may be administered separately from the CIP. A description of these programs is found at Section 3.5.5 of this Plan.
- » Maintenance and capital replacement for existing District projects will be administered under the District’s Project Maintenance and Land Management Program. A description of this program is found at Section 3.5.7 of this Plan.

Procedures

Before implementing a capital project or committing levied funds to its design or construction, the District will perform feasibility work to identify an effective design concept; develop confidence that the property agreements, permits and approvals to build and maintain it can be obtained; and establish a project cost estimate. Pursuant to Minnesota Statutes §103B.251, the District then will provide notice of a public hearing before the Board of Managers. The Board will consider the presentation of District staff and engineer, as well as input offered by partners and interested parties. On the basis of that information, the Board will decide whether the project should be established. In addition to statutory notice, the District will provide written notice to all properties within 600 feet of the project location.

In the course of feasibility work for a project, the District expects to maintain close coordination with the host LGU. LGU support for a project will be an important consideration in the District decision to advance a project and



Cottageville Park

the District expects that, in all but the unusual case, this support will be an element of the feasibility work. Nevertheless, in addition to the above statutory process, before the Board establishes a capital improvement project for which District-levied funds are estimated to exceed \$300,000, the District will seek a resolution of support or equivalent project concurrence from the LGU(s) where the project is located.

In addition, before the Board approves final design of such a project, the District will hold at least one public information meeting at a location near the project site, with notice to properties within 600 feet of the project location as well as published notice in an appropriate local newspaper.

The District also will review its CIP each year, as a part of its budgeting process. The District will review the status of all capital projects and their priority for budget and levy purposes, and will allocate funds for the following year accordingly. On a two-year basis, the District will review its capital improvement program and its capital project priorities more comprehensively, on a District-wide and a subwatershed basis, to meet the requirements of Minnesota Rules 8410.0150, subpart 3.E.

As a part of annual budgeting, by late June each year, the District will transmit revised copies of its 10-year CIP to Hennepin and Carver Counties and all of the cities within the District for a 30-day review and comment opportunity. No later than late August each year, the District will mail Hennepin and Carver Counties copies of any comments from cities, and District responses. At the pleasure of either County, but by the first Friday in November, the District will meet with the County Board to discuss the District's CIP and annual budget and levy. Any comments received from the County Board will be considered by the District Board of Managers, and any resulting levy decrease or, if permitted, increase will be certified to the County Auditor before the date it certifies the County levy to the State.

Minnesota Rules 8410.0140 and Section 3.8 of this Plan describe the procedures to amend the Plan. An amendment will be required when the District elects to proceed beyond feasibility or conceptual design to advance a capital improvement that is not in the CIP. An amendment for this purpose may concern a single project, or may be programmatic. When the District undertakes a collaborative planning process for a subwatershed or other defined hydrologic area, as generally defined in Section 3.4 of this Plan, the outcome of that process normally will be an implementation plan for the planning area that includes capital projects. Here, the entire slate of potential capital projects would be incorporated into the CIP by a plan amendment.

Project Maintenance

When District staff presents a capital improvement to the Board for the

purpose of a decision to establish the improvement under Minnesota Statutes §103B.251, the record before the Board will include a general description of maintenance requirements and a general estimate of maintenance costs. Maintenance of existing District capital improvements will be programmed and carried out under the District's Project Maintenance and Land Management Program and funding determined through annual budgeting. Pursuant to a project agreement, maintenance responsibility for a District capital improvement may be allocated to a partner such as a property owner or an LGU. As a general policy, the District will prefer to maintain its own projects, including both structural elements and vegetation. However, in any event it will seek a fair allocation of maintenance costs and in appropriate cases may agree to allocate the maintenance responsibility, or a part of it, to a partner.

3.5.6 LAND CONSERVATION

Program Purpose

The District operates a Land Conservation Program to conserve natural resource areas for the purpose of protecting and enhancing water resources and ecological integrity. Under the Land Conservation Program, the District may acquire land in fee title or may acquire an easement or lesser interest.

The District acquires land interests for several purposes. The land may be a desired site for a District capital project or other improvement identified in its implementation plan. In this circumstance, the acquisition typically would be considered an element of the project in question and would not be funded or carried out under the Land Conservation Program.

Differently, a tract of land may be a site suited for improvements not yet programmed, but may be available under favorable conditions. Preserving the land in its unimproved state, or actively restoring and managing its ecological condition, may serve water resource goals identified in the subwatershed plan. A primary purpose of the Land Conservation Program is to conserve, restore and enhance green infrastructure for regional stormwater management, regional management of sediment and phosphorus flows resulting from land alteration, corridor protection, habitat, and other water resources benefits.

Background

In the District's 2007 watershed management plan, targets for land rights acquisition were mapped by identifying strategic locations at a landscape scale. Qualifying lands were those with resources protecting surface water and groundwater quality and quantity; those demonstrating high-value habitat characteristics; those protecting aquatic habitat; or those offering habitat supporting aquatic-based species abundance. More specifically, the District sought to:



Staff seeding wild rice



- » Create corridors along streams and channels to provide buffers for water quality and stream stability and create wildlife corridors.
- » Include wetlands previously identified with exceptional or high vegetative diversity or wildlife habitat, or moderate-to-high restoration potential.
- » Include high-value upland areas, such as forested areas with connected habitat and high potential infiltration or evapotranspiration.
- » Incorporate land cover types identified in the Minnesota Land Cover Classification System (MLCCS) survey conducted by Hennepin County as minimally disturbed with potential high-value habitat.
- » Contain areas with multiple natural resource values, such as Minnesota County Biological Survey (MCBS) sites of biodiversity significance; Metro regionally significant ecological areas; or areas where the DNR had documented rare or threatened species.
- » Incorporate green and natural resource corridors as designated by the DNR, Metropolitan Council, Hennepin County and local communities.

Section 2.3 includes a map for each subwatershed (titled Recreation and Other Features) showing lands where the District owns fee title or a conservation easement as a result of implementing the Land Conservation Program over the prior planning period. As the result of applying the above criteria, the District has acquired rights in ecologically connected tracts that together afford the District a land platform for regionally significant work in locations such as the Painter Creek and Six Mile Creek subwatersheds. However, acquisition strategy was not explicitly driven by aggregating holdings for such purposes or by the intent to serve specifically prioritized subwatershed goals.

Program Description

The Plan is oriented on achieving District strategic water quality, water quantity and ecological integrity goals. Each subwatershed plan will particularize these goals at a subwatershed level and identify implementation actions to achieve them. Land Conservation Program activity will be driven more specifically to achieve these subwatershed goals and to facilitate these implementation actions. The District will seek to implement the Program through the partnership framework of the Plan, so that District land and easement acquisitions and other Program activity defining land use and protection will align with land use priorities of local units of government, park agencies and other local partners.

In addition to its own acquisition of lands and land rights, under the Land Conservation Program the District may direct funds and staff resources toward



Six Mile Marsh prairie restoration



Prairie seed collection



Katrina Marsh, Erdahl Aerial Photos

the following, when they serve District strategic goals:

- » Assisting landowners and local units of government to explore conservation options.
- » Encouraging natural-resource oriented land management and ecological restoration.
- » Facilitating conservation development by participating in local land use planning and ordinance development, assisting technical evaluation and serving as a conservation easement holder.
- » Supporting cost-share, partnership, and tax incentive opportunities for landowners and other partners.

This Plan specifically supports District land rights acquisition through a watershed-wide implementation program. This program specifies a 10-year budget for the Land Conservation Program, further broken down into Program activities ranging from land rights acquisitions and management of District landholdings, to technical assistance. Acquisitions under the implementation program budget will link to land rights acquisition needs, as well as land management, technical assistance and similar support activities, identified through subwatershed planning. As Table 3.17 indicates, the District estimates expending \$25 million over the 10-year planning period for land rights acquisitions, with a portion of that amount to support related program elements listed above. This budget amount is net of funds received into the program by grants, property reconveyance and any other external source. The acquisition expenditure of \$25 million, or an average of \$2.5 million/year, encompasses both direct spending and debt service for financed acquisitions. The District will rely principally on its ad valorem levy to meet this spending level, though also will consider other sources as may be available.

The implementation program description does not identify specific acquisitions. Instead, it references land-based implementation actions that will achieve subwatershed goals. Land rights availability is highly opportunity-based and, further, identifying specific properties in a plan format would put public funds at a disadvantage in negotiating with landowners. In addition, the timing of land rights purchases typically is driven by external (landowner) requirements that would not easily accommodate additional procedures to formally incorporate specific acquisitions into the Plan. The above implementation program description, with its linkage to identified subwatershed goals, and in conjunction with the procedures stated here, is intended to meet Plan requirements for capital expenditures.

In addition, individual land acquisition opportunities not specifically rooted

in subwatershed implementation programs may arise. The District may have an opportunity to acquire a fee or easement interest for a favorable price. It may be property owned by the state for nonpayment of taxes and available to local units of government, or private land placed on the market on favorable terms, or offered to the District at a below-market price for tax benefits or other reasons. It may be undevelopable land that has a low market value but value for water resource purposes.

The Land Conservation Program allows the District to acquire such lands or easements. Before committing funds to acquire a fee or easement interest under this circumstance, the Board of Managers will consider and make findings as to the following:

- » The potential suitability of the property for a capital project or other project identified in the Plan.
- » The potential for the land rights to facilitate the District’s pursuit of its strategic water quality, water quantity and ecological integrity goals with respect to the specific subwatershed.
- » The market value of the rights to be acquired, by means of appraisal or other valuation as the Board of Managers determines appropriate for the transaction.
- » The extent to which the water resource purposes of the acquisition may be achieved without the District’s spending public funds, due to physical, regulatory or similar constraints on use of the property.
- » Ongoing property management costs.
- » The District’s ability to dispose of its property interests if the potential use on which the decision to acquire is based fails to materialize.

Acquisition Procedures

For any land rights acquisition under the Land Conservation Program, the District will follow these procedures:

1. The District will solicit review by a technical advisory team that includes staff from several natural resource agencies. The advisory team’s recommendations will be a part of the record forwarded to the Board of Managers as it decides on a potential acquisition.
2. The District will consult with the local unit of government in which the land is located regarding alignment of the District’s proposed acquisition with local land use, park and related plans. The precise means of consultation will vary depending on circumstances such as the extent of ongoing coordination, timing urgency, the sensitivity of negotiations, the scale of the acquisition, and what District staff deter-



Grays Bay dam, Dale Antonson



Low impact development practices in St. Louis Park



Underground stormwater treatment in Minneapolis

mines to be warranted in order to understand the LGU's position with confidence. The result of the consultation also will be forwarded to the Board of Managers.

3. The acquisition will be valued by appraisal or other means pursuant to a written appraisal policy adopted by the Board of Managers.
4. The District's legal counsel will be retained to advise as to the structure and terms of, and prepare the necessary documents for, the transaction.
5. In accordance with Minnesota Statutes §103B.251 governing capital expenditures, the Board of Managers will notice and hold a public hearing to receive public comment on the proposed acquisition.
6. The Board of Managers will approve any acquisition in open meeting.

These steps may be updated from time to time by the Board of Managers without a formal amendment to this plan, provided that they continue to advance a detailed and thorough case-by-case review of each potential transaction, have an appropriate level of legal review, and continue to require approval of all transactions by the Board of Managers.

Land Management and Restoration

When an acquisition occurs, the District will prepare a management plan for the property that will present a recommended management status and, as relevant, evaluate restoration opportunities and costs in more detail. Site management and restoration activities on District land or pursuant to a District easement may be funded under the Land Conservation Program or under another identified land restoration program. The types of activities that the District may include in parcel restoration work include activities such as the following:

1. Regrading for natural system restoration.
2. Excavating to enlarge wetland or improve wetland functions and values.
3. Re-meandering of a small section of creek, ditch or other watercourse.
4. Removing drainage tiles, placing ditch plugs and other steps to restore natural hydrology.
5. Installing erosion control and stabilizing banks with engineered and bioengineered features.
6. Installing local stormwater conveyance/control structures such as culverts and weirs.
7. Installing stormwater treatment best management practices.

- 8. Planting native vegetation.
- 9. Managing existing vegetation and invasive species via cutting, herbicides, prescribed burning and other techniques.

When the proposed work constitutes a capital improvement, it will be considered and authorized pursuant to the formal process specified at Minnesota Statutes §103B.251. If the proposed work is a capital improvement beyond the scope of restoring the natural features and function of the acquired property, it will not fall within the Land Conservation Program and must be established independently through applicable plan amendment and ordering procedures.

Partners

There are a number of other units of government with which the District may collaborate under this Program. Table 3.1 lists some of the agencies active in the District and roles in the Land Conservation Program these agencies may assume:

Table 3.1 MCWD Land Conservation Program potential partners

Organization/Agency	Role
MCWD	Acquisition of conservation easements and fee title; restoration of conserved lands; cost-share on private land restoration
Cities	Varies by city. Some have active land and easement acquisition programs. Others use park dedication through the development process to help secure greenway areas. Also see LGU requirements below.
Minneapolis Park and Recreation Board	Park and trail acquisition and management
Hennepin County Dept. of Environmental Services	Acquisition of donated conservation easements; cost-share and technical assistance for restoration and best management practices
Hennepin County Regional Rail Authority	Trail acquisition and maintenance
Carver County Parks	Park and trail acquisition and management
Three Rivers Park District	Park and trail acquisition and management
Metropolitan Council	Partial funding for regional parks and trails
State of Minnesota	DNR owns and manages Wolsfeld Woods and Woodrill Scientific and Natural Areas. DNR provides grants to cities for acquisition. Funding for state and regional parks and trails.

Organization/Agency	Role
US Department of Agriculture/Natural Resources Conservation Service and Farm Services Agency	Cost-share and technical assistance for restoration and best management practices
US Fish and Wildlife Service	Cost-share and technical assistance for restoration
The Trust for Public Land	Assists government agencies and non-profit organizations with acquisitions, financing for acquisitions, and prioritizing lands to conserve in urban and developing areas.
MN Land Trust	Acquires and monitors conservation easements, primarily through donation or as part of conservation development projects. Works with individual landowners and developers.
The Nature Conservancy	Owns and manages two nature reserves in the District – Hardscrabble Woods (Minnetrista), Ferndale Marsh (Wayzata)
Embrace Open Space	Education, technical assistance, and communications on open space issues for local communities.
Wildlife Organizations (e.g. MN Waterfowl Association)	Cost-share and technical assistance for restoration

3.5.7 PROJECT MAINTENANCE AND LAND MANAGEMENT (PMLM)

Program Purpose

Actions detailed in the subwatershed plans will require ongoing maintenance and management activities. The PMLM program’s role is to maintain the District’s capital investments, manage District lands, operate functional District infrastructure, and coordinate the District’s response for flood events. The PMLM program has compiled an Operations and Maintenance (O&M) Manual which outlines the inspection, operation, and maintenance requirements and responsibilities for each of the District’s past capital improvement projects. The O&M Manual will be updated regularly to include new capital improvement projects as they are implemented.

The PMLM program has also assembled an Infrastructure Maintenance Plan, which identifies annual repairs and their associated costs needed to repair and replace District infrastructure as it ages. Implementation of the District’s Infrastructure Maintenance Plan will pro-actively address issues with aging infrastructure and limit liability associated with infrastructure failure. The Capital Improvement Program includes a cost estimate for the ongoing project maintenance and land management activities.

The District is the drainage authority for County Ditches 10, 14, 15, 17, 27, 29, and 32 and Judicial Ditch 2, as described in Section 2.2.4 and shown on Figure 2.5. The PMLM program includes inspecting and maintaining public drainage systems within the District as required under the drainage code, Minnesota Statute Chapter 103E. County Ditches 14, 17, and 29, within urban areas of the District, have been replaced by storm sewers or a combination of storm sewers and open channel. County Ditches 15 and 32 continue to serve drainage purposes, but principally as municipal stormwater conveyance. The drainage code allows for a drainage system to be abandoned, in whole or part, if it no longer provides a drainage benefit to assessed lands. It also provides for a system to be transferred to a municipality or other body when the system is better managed as stormwater conveyance infrastructure rather than under the drainage code. The District, in cooperation with the relevant local government units, may consider whether one or more of its urban systems is appropriately subject to a shift in management pursuant to these drainage code provisions. County Ditches 10 and 27, and Judicial Ditch 2, are altered natural watercourses that continue to provide valuable drainage conveyance for agricultural and other purposes. The District intends to continue to manage these systems under the drainage code.

3.5.8 INCENTIVE PROGRAMS

Program Purpose

To facilitate actions to improve stormwater management, enhance water resources, and implement green infrastructure, the District will administer cost-share grant programs to provide financial assistance to landowners, the development community, and public agencies. Two specific programs, Opportunity Grants and Stewardship Grants, are described below.

Opportunity Grants:

The Opportunity Grant will provide financial incentives for value added collaboration with public agencies, private developers and land owners.

The District will provide financial incentive for actions that advance its strategic goals, address drivers of watershed impacts in a subwatershed plan, and align with the management strategies identified and prioritized within the plan. The District anticipates grant opportunities arising via three routes:

- » Public agency coordination
- » MCWD permitting program
- » Landowner and developer requests

Based on the coordination framework that the District will establish with engaged local government units through this Plan and the local water plans,



Residential rain garden



the District intends to formulate a periodically updated Project Priority List. Grant opportunities will be evaluated for proof of concept, cost, and benefit, and measured against subwatershed priority issues, drivers, and management strategies.

The District will use this Project Priority List to formulate a planned approach to potential financial incentive opportunities, allowing the District's Opportunity Grant to become increasingly synchronized with two- to three-year public agency infrastructure investment plans and planned development.

In addition to its effort to become integrated earlier in public infrastructure and development planning, the District also will remain responsive to opportunities for green infrastructure improvements identified through the District's Permitting Program or brought forward by individual landowners. District funding and applicant cost-share would apply not to defray applicant compliance costs, but to secure benefits beyond or independent of compliance. In this setting, the District would evaluate an opportunity only with landowner or developer interest and with a clear understanding as to any effect on the timing of the permit review process. A landowner or developer who seeks a required District permit and does not wish to explore District funding for added value will be entitled to standard permit review procedures and timing.

These opportunities similarly will be evaluated for proof of concept, cost, and benefit, and measured against subwatershed priority issues, drivers and management strategies and, on that basis, added to the existing Project Priority List.

Stewardship Grants:

The Stewardship Grant will incentivize the installation of best management practices by public agencies, private organizations, non-profit groups, and neighborhoods who will promote those practices to others through robust education and outreach plans.

The District will provide financial incentives for projects that have meaningful, measurable natural resource benefits, and that serve as effective, valuable education tools in their communities. The District believes that by seeing tangible, effective improvements on the landscape and learning about their importance from their neighbors and other community leaders, people are more likely to make similar improvements on their property. This enhances not only the impact of the District's education activities, but also, the water quality benefit of the District's work.

The District anticipates identifying opportunities for grant funding through the following routes:



Kayakers on Minnehaha Creek

- » WAI and Master Water Stewards Program
- » Proactive recruitment in focal geographies and near MCWD project sites
- » Soliciting proposals for projects that align with District mission and priorities
- » MCWD's Planning and Permitting Programs

Program Administration:

Annual funding for the District grant program will be set through the budget process. The District will administer the program by means of program guidance documents adopted by the Board of Managers. Guidance will describe how the District will generate and maintain Project Priority Lists and will specify procedures by which the District will solicit, accept, and review cost-share proposals. The guidance also will refine terms of grant programs including who may apply, project funding limits, cost-share obligations, and how the above funding criteria will be refined and applied to evaluate proposals.

Minnesota Rules 8410.0105 establishes cost-share and grant programs as a separate category of implementation action. Although District-supported projects necessarily will not proceed through the District's own capital improvement program, they may include elements of capital construction. At the same time, a project may be principally for experimental, demonstration, or education purposes.

These purposes may include supporting research to advance water resource protection knowledge, demonstrating innovative methods, developing local capacity for water resource protection, or fostering community service and public education. As appropriate, demonstration and education benefits will be secured through program requirements for educational signage and reasonable access for public viewing.

Because an action supported by District cost-sharing may involve a substantial District funding contribution and a significant alteration of the environment of a capital or non-capital nature, it is important that the District afford some measure of public process. Largely this will be achieved through the very nature of the District's collaborative approach from which the Project Priority List will develop, but as described above, opportunities may arise independently of that process.

The formal structure by which the District will manage its cost-share expenditures is as follows:

First, the overall program funding level will be set annually through the District's budgeting process. This is an open process that occurs in August and early September each year, and includes a public hearing required by statute at which all parties can review and address the Board of Managers on the District's proposed program budget.

Second, grant funding proposals will be processed and evaluated according to adopted written guidance as described above, to: (a) provide for consistency in District review and selection of proposals for funding; and (b) direct District funds to projects and locations that will further Plan goals and priorities effectively. The District will enter into formal grant agreements with awardees to guarantee project completion and maintenance.

Third, the Citizens' Advisory Committee will have a formalized role in reviewing both program guidance and submitted proposals. The Board and, where delegated grant approval authority, the Administrator carefully will consider the committee's recommendations.

The District invites a partnership framework that fosters increased and early flow of information, to provide for a stronger coordination of land use and water resource management, and to achieve water quality and flood management goals.



Bikers enjoy one of the many trail systems woven throughout the watershed



Wildflowers



Canoe on lake, Garrett Graves



Lake Hiawatha into Minnehaha Creek, Brianna PrahI

3.6 REVIEW OF LOCAL WATER PLANS AND MUNICIPAL COORDINATION

3.6.1 STATUTORY REQUIREMENTS FOR LOCAL WATER PLANS

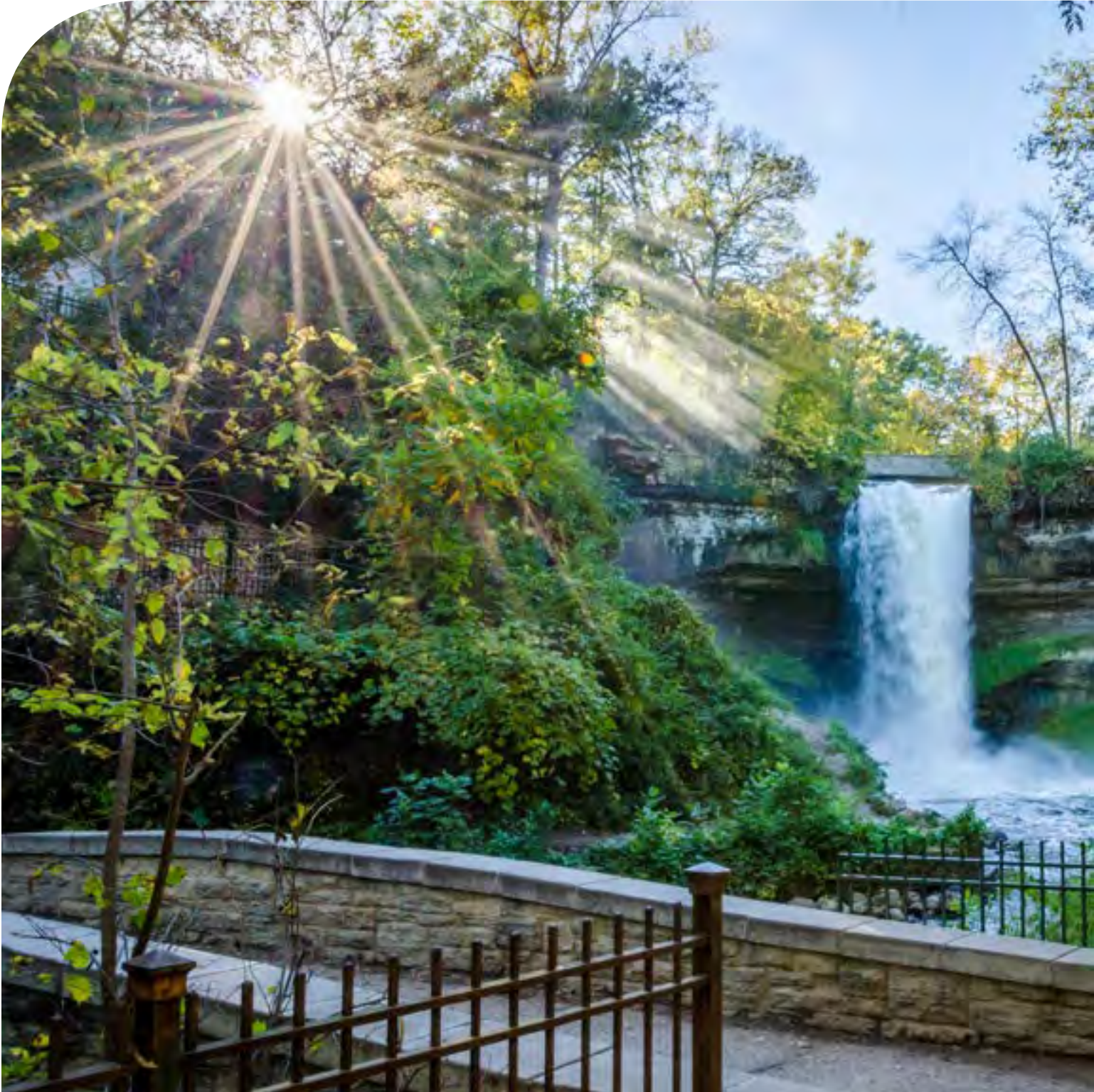
Minnesota Statutes §103B.235 prescribes that after the District watershed management plan (WMP) is approved or amended, each local government unit (LGU) having land use planning and regulatory responsibility for territory within the District must prepare a local water management plan, capital improvement program, and official controls as necessary so that local water management conforms with the WMP within the time period prescribed in the WMP implementation program. The local water plan, in turn, is a required element of the LGU comprehensive land use management plan that it must prepare and maintain in accordance with Minnesota Statutes §§473.858-473.864.

This planning framework shows the link that the legislature has recognized between land use and water resource planning. More precisely, it reflects the legislature's intent that regional development patterns and infrastructure, as well as site-level development, both the province of the LGU as the local land use authority, be well integrated with the hydrologic systems within which they are set. As the regional water resource authority, the District is responsible to understand hydrologic systems on a watershed basis and what is needed for their health and sustainability. Through its review of local water plans, the District seeks to engage its LGUs as partners in incorporating this basis of knowledge and understanding into the exercise of land use planning, regulatory, capital, infrastructure maintenance, and related local authorities.

Local water management plans must conform to Minnesota Statutes §103B.235, Minnesota Rules 8410.0160 and this Plan. The District approach to local plan requirements reflects a change from the approach under the District's 2007 WMP, as described below. The specific requirements for local water management plans under this Plan are detailed in Appendix A.

3.6.2 DISTRICT APPROACH TO LOCAL WATER PLANNING

The District's 2007 WMP was organized around the District's eleven subwatersheds and phosphorus load reduction goals for the principal receiving waters within each subwatershed. Necessary load reductions then were allocated among local government units. Local plans were required to commit to reductions identified in the 2007 WMP by identifying and programming capital projects and other implementation actions that would produce the required reductions. This approach was similar in form to the



Minnehaha Falls, Tom Dixon



federal Total Maximum Daily Load (TMDL) process. In part, it defined needed phosphorus load reductions for non-impaired waters within the District and other waters for which federal TMDLs have not been adopted.

This framework has produced some very useful collaborative efforts, but more so had the tendency to send District projects off on a separate trail from local projects and to consider land use regulation as a role carried out in a reactive fashion and separate from District- or LGU-initiated project work. The District's identification of the LGU share of pollutant load reduction appeared more as a mandate and less as something that the District could facilitate through coordination.

This Plan departs from the prior centering on phosphorus load reductions, and the prior mandate imposed on LGUs to specify and implement actions to achieve those reductions. There are two chief reasons for this:

- » The past 10-year planning period has witnessed a continuing evolution in LGU capacity, the relationship of the District and LGUs, and the District's approach to partnership. LGUs within the watershed have water resource capacity and knowledge needed to recognize water resource needs and incorporate them into development controls, capital programs and planning. LGUs have been operating under federal municipal stormwater (MS4) permits and, in some cases, federal antidegradation (formerly "non-degradation") requirements, for nearly 15 years and have institutionalized baseline stormwater management programs to meet MS4 permit requirements. Under the District's partnership approach, the District is not seeking to mandate LGU actions toward goals identified in the Plan, but instead to invite those LGUs that see alignment between their goals and District goals to use their local water plan to, in effect, present their vision for collaboration.
- » This Plan reflects the District's movement from a water quality criterion based predominantly on phosphorus concentration to a broader approach to ecosystem evaluation. This broader approach is reflected in the District's Ecosystem Evaluation Program ("E-Grade"), a method that evaluates subwatershed health from the standpoint of flood control, biodiversity, habitat diversity, recreation, drinking water supply and nutrient cycling.
- » The E-grade recognizes a broader concept of hydrologic function and beneficial public use. This increases both the need to work, and the benefit from working, in concert with LGUs and other local partners so that outcomes of potential resource investments can be assessed from all relevant standpoints and investments are leveraged to achieve multiple public and private goals.

3.6.3 THE ROLE OF THE LOCAL WATER PLAN IN ACHIEVING REGIONAL LAND AND WATER GOALS

An important component of the local water plan is defining a set of protocols that supports ongoing communication and promotes value-added collaboration between the District and LGU. Through these communications, the District and LGU will coordinate programs and be best situated to anticipate and identify opportunities for collaboration.

The District invites a partnership framework that fosters increased and early flow of information, to provide for a stronger coordination of land use and water resource management, and to achieve water quality and flood management goals. Targeted areas of collaboration include:

- » Land use policy development and its implementation through planning activities including long-range land use and infrastructure plans and area-wide plans
- » Capital improvement feasibility planning for public infrastructure including roads, sewer, and drinking water supply
- » Land use and development regulation, from initial development feasibility through ongoing inspection and facility maintenance functions
- » LGU operations and facility maintenance

The District asks that the LGU plan complete the assessment of water resource needs by identifying local water resource issues and provide finer-grained data concerning those issues. Then, it will look to the LGU to describe how it intends to align planning, regulatory and investment decisions to address both District- and LGU-identified water resource goals. The framework for communication and collaboration will be the key to creating opportunities for partnership at the intersection of municipal, private and District interests.

As it implements the WMP over the ten-year planning period, the District will be engaged in a continuing process of reviewing priorities and programming the commitment of technical resources and funds. The District is inviting each LGU to use its local plan to communicate its interest in the collaborative relationship described in this section and to help erect the framework that the District and LGU will use over the planning period to promote opportunities to achieve mutual goals. The LGU is invited to use its local water plan to articulate its water resource goals; how it will pursue these in conjunction with its development, transportation, parks and recreation and other public goals; and how it proposes to integrate its vision, investments, expenditures and regulatory programs with those of the District. The District is prepared to program staff capacity to track planning, development, public infrastructure



The watershed features numerous canoeing and boating opportunities



A young fisherman casts his line on Lake Minnewashta



The Minneapolis skyline overlooks Lake of the Isles, Noah Kleinschmidt



Red Osier Dogwood

The most substantial policy shift from the previous WMP to this one is the District's effort to more closely integrate land use planning and water resource management.

and program activity within interested LGUs, so as to position the District to work with public and private interests within those LGUs in pursuit of the shared and compatible goals of each.

In addition to capital projects and other work undertaken collaboratively, the District will continue to implement projects and programs independently as well. As the District programs resources for this work, local water plans, and LGU implementation of those plans, will be relevant in that District efforts will tend to leverage greatest benefit within a local setting where the LGU is working toward complementary goals and the stakeholder environment otherwise is supportive. The following are examples where decisions as to District spending and use of resources are likely to depend in part on local water plan focus and LGU commitment as shown in the local plan and the LGU's implementation of it:

- » Joint grant applications: Coordination to seek funding for work that serves aligned interests of the District and LGU
- » District incentive programs: Grant or cost-share funds awarded at the discretion of the Board of Managers to an LGU, or to institutional or individual property owners within an LGU
- » Technical assistance: Services of the District staff or engineer to assist LGUs and their residents in resolving water resource issues or pursuing opportunities in areas such as flood management, wetland banking and others

- » Education initiatives and coordination of education activities for MS4 compliance and other purposes
- » Conservation third party: Helping LGU and its property owners achieve mutual conservation goals by serving as easement holder for conservation development, assuming wetland bank maintenance obligations, and similar roles
- » Watershed management district: Using watershed district authority to establish localized taxing district to allow lake associations or other groups with common, geographically defined interests to raise funds in order to pursue community goals

3.6.4 DISTRICT REVIEW AND APPROVAL OF LOCAL WATER PLANS

Review and Implementation Procedure

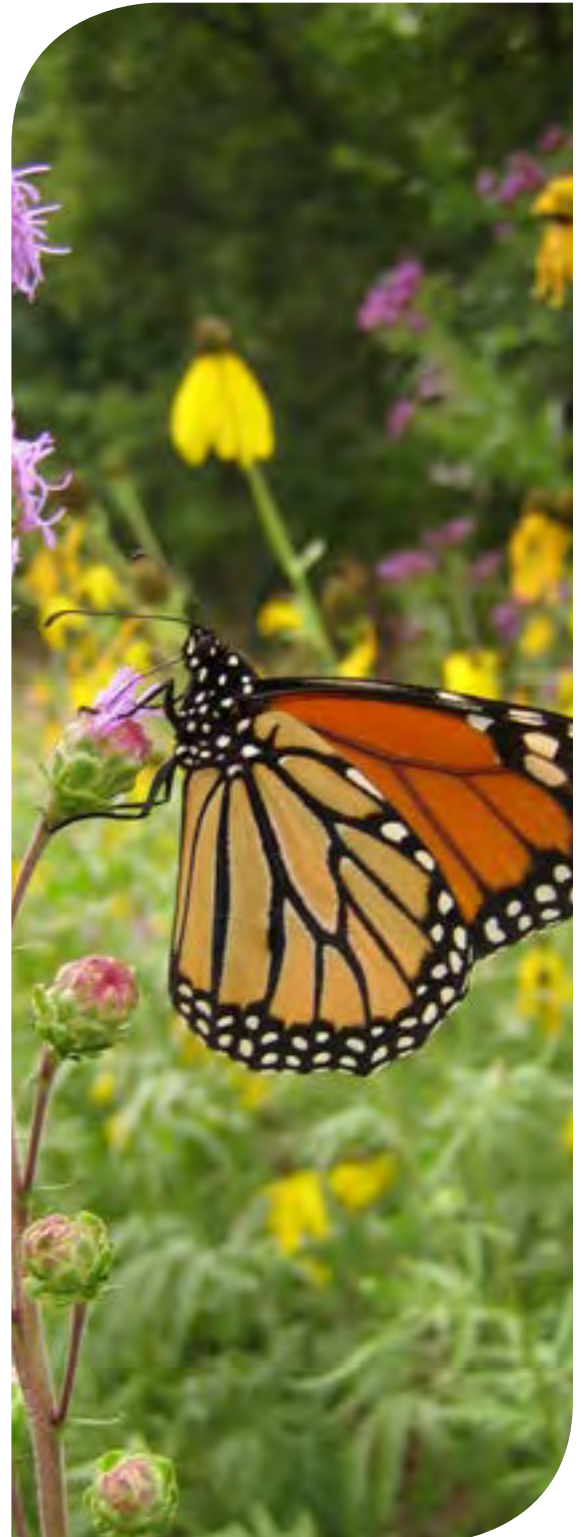
Minnesota Statutes §103B.235 states that each LGU must adopt a local water plan not more than two years before its local comprehensive land use plan is due. Before an LGU adopts its local water plan, it must submit its plan to the District for review and approval. Approval rests on the District's finding that the local plan is consistent with the WMP.

The District must complete its review within 60 days of receipt. If it finds that the local water plan is not yet complete or not consistent with the WMP, it will advise the LGU and will provide guidance as will be helpful to the LGU in preparing a final plan for District approval. Within this review period, the District may receive comments from the Metropolitan Council addressing the question of consistency with the Council's comprehensive development guide for the metropolitan area. The District must take these comments into account in its review.

After District approval, the LGU must adopt and implement its plan within 120 days, must notify the District and Metropolitan Council within 30 days thereafter, and must complete any required amendments to its official controls within 180 days.

Water Resource Official Controls

The LGU, under its police powers, and the District, under Minnesota Statutes §103D.341, each have the authority to adopt and apply rules and permitting requirements for activities that may create impacts on water resources. These are parallel authorities and, ordinarily, a landowner or other responsible party must obtain permits from both the LGU and the District, and therefore meet both sets of regulatory requirements.



A Monarch butterfly on a Blazing Star

An LGU may elect to simplify this duplication by requesting that the District cease to apply its rules within the LGU's boundaries on District approval of the LGU local water plan. Specifically, Minnesota Statutes §103B.211, subdivision 1(a)(3), authorizes the District to regulate the use and development of land within its boundaries when one or more of the following conditions exist:

- » The LGU does not have a District-approved local water plan, or has not adopted the implementation program described in the plan;
- » An application to the LGU for a permit for the use and development of land requires an amendment to or variance from the adopted local water plan or its implementation program; or
- » The LGU has authorized the organization to require permits for the use and development of land.

Pursuant to the third condition, an LGU may specify in its local plan that it does not wish the District to cease exercising regulatory authority within its boundaries. However, if it does wish the District to cease exercising such authority, it must meet the standards set forth in this section. These standards are intended to assure the District that LGU official controls are at least as protective of water resources as the District rules, that the LGU has made a conscious decision to allocate sufficient resources to the regulatory program, that it has procedures in place to provide for proper monitoring and compliance oversight after permit issuance, and that the District can remain informed as to the operation of the LGU regulatory program.

An LGU may elect to exercise sole regulatory authority in the following specific areas of District regulation: erosion control, floodplain alteration, wetland protection, waterbody crossings and structures, and stormwater management rules. The District in all cases will continue to apply its dredging and shoreline and streambank stabilization rules within the LGU, as they concern inter-jurisdictional resources that LGUs have limited authority to regulate. Also, it will continue to apply its appropriations and illicit discharge rules, as it is under an independent statutory mandate to implement these rules. The LGU may choose to assume sole authority for all five listed rules, or fewer. The local plan must identify those District rules for which it wishes to assume sole regulatory authority.

The following are the standards the District will apply when an LGU has requested that the District cease exercising authority with respect to one or more of its rules:

- » For the relevant District rule, the local plan must include existing or proposed ordinances for a District determination that they are at

least as protective of water resources as the associated District rules. District staff may provide checklists of substantive requirements and other guidance to LGUs for their use in understanding the standards that must be met. A proposed ordinance need not be submitted in final form, provided there is adequate detail for a District determination. If the ordinance has not yet been adopted, the District plan approval resolution may be contingent on confirming that the adopted ordinance conforms to the proposed ordinance as approved.

- » Procedural details of local ordinances (relating to, for example, permit processing, hearings or public notice) may differ from District rules provided they do not compromise water resource protection.
- » The LGU must describe the technical expertise it has or will acquire to implement its ordinances, and provide an estimate of its annual cost to implement its program.
- » The local plan must establish written protocols for: (i) LGU procedures to administer and enforce its water resource ordinances, including maintenance of those stormwater practices constructed or installed for compliance with LGU ordinances and that the LGU owns or has assumed the obligation to maintain; and (ii) procedures for District review of LGU regulatory program implementation. Administration and enforcement procedures must address work without a permit; active work under permit; maintenance of vegetated buffers; and maintenance of stormwater management practices.
- » The following will apply to LGU administration of its rules:
 - With respect to proposed activities of state agencies or any other entity over whom the LGU does not have regulatory jurisdiction, the LGU authorizes the District to exercise jurisdiction.
 - The LGU need not formally issue itself a permit for its own activities, but for each activity that would be subject to permitting if performed by another party, the LGU will prepare a memorandum documenting its review and determination that its ordinance standards are met. These memoranda will be available to the District in any review of LGU permitting activity.
 - If a permit application requires an amendment to or variance from an LGU ordinance approved by the District under this section, the District will have permitting jurisdiction.
 - The District will retain permitting jurisdiction as required by a legal obligation under its NPDES MS4 permit or any other independent law.



Dutch Lake



- As a general matter or on a case-by-case basis, the LGU may request that the District exercise its regulatory jurisdiction, and the District may accede to that request.
- » If the District revises a rule in a manner that it considers significant, and thereafter advises the LGU in writing, the LGU will revise its own ordinance to maintain equivalent water resource protection. If the District has not approved the LGU’s revision within six months or such other time as mutually agreed, the District may reassert regulatory jurisdiction with respect to the affected rule. If an LGU chooses not to make the revision, it may authorize the District to reassert its regulatory authority for that rule within LGU boundaries.
- » The District may reassert regulatory jurisdiction if the District Board of Managers finds that the LGU is not implementing its local water plan or the regulatory program. Before the Board reasserts jurisdiction, the District will engage the LGU to review concerns and work with the LGU to mutually address those concerns.
- » The District’s withdrawal of regulatory authority will expire two years after it adopts the ten-year WMP that succeeds this one, or at another time by agreement of the District and LGU.



Fisherman on Lake Harriet, Stan Waldhauser



Langdon Lake



A stream in the Schutz Lake subwatershed

Minnesota Wetland Conservation Act

The local plan must state whether the LGU intends to assume the role of “local government unit” responsible to implement the Minnesota Wetlands Conservation Act (WCA) within that part of the LGU that lies within the watershed or, conversely, whether it chooses for the District to assume that role. If the former, it must describe the technical expertise it has or will acquire to implement WCA, describe how it will monitor and enforce WCA compliance, and present an estimate of its annual cost to implement and enforce WCA. If the LGU elects to assume the role of WCA LGU, the District asks that it include in its local plan a commitment to reasonable coordination and consultation between the LGU member of the Technical Evaluation Panel and District regulatory staff.

3.7 EVALUATION AND REPORTING

3.7.1 GOAL-SETTING FRAMEWORK

Section 3.3 describes the District’s four strategic goals of Water Quality, Water Quantity, Ecological Integrity, and Thriving Communities. As noted in previous sections, the strategic goal of Thriving Communities serves to guide the District in implementing its natural resource mission in ways that meaningfully contribute to the development of thriving communities. Progress toward this strategic goal is not subject to measurement through the water resource

metrics of Minnesota Rules 8410, but will be tracked by means developed in conjunction with the District's individual communities. Progress toward the remaining three strategic goals will be assessed as discussed in this section.

Each of the District's strategic goals encompasses a range of goals specific to concerns at a subwatershed or other more local level. In addition, to evaluate the performance of individual capital projects or other initiatives, in order to address project function, refine subwatershed implementation plans or provide for meaningful technology transfer, requires performance monitoring that is project and location specific. To assess progress toward the strategic goals, then, the District must develop and track more specific, quantifiable goals and metrics.

In addition, the District's implementation approach, based on collaborative planning with its stakeholders and largely opportunity-driven, means that it is not practical to prescribe specific local goals at the beginning of the ten-year planning cycle.

For these reasons, the District intends to set goals, establish performance monitoring plans and evaluate performance through a sequential process that begins with strategic goals and long-range targets and leads to subwatershed and then project-specific targets, performance measurement and evaluation.

Table 3.2 describes the District's strategic goals and the long-range targets associated with each. For the goal areas of water quality and ecological integrity, the measurable target is to achieve state standards for the impaired waters in the District. These impairments and the associated Total Maximum Daily Load (TMDL) studies are discussed further in Section 3.7.3. The measurable target for the water quantity is to, at a minimum, prevent an increase in peak stormwater flow or stormwater flow volume at critical locations. In addition, the District has identified a target of preserving existing wetland acreage as a means to serve all three of these strategic goals. Apart from the District's own wetland restoration work, it tracks gain and loss of wetland acreage through its implementation of WCA and its own wetland rule.

As discussed in Section 3.4, over the planning period the District will pursue a priority subwatershed approach, in which the District will implement coordinated projects and initiatives within a defined subwatershed identified through a planning process that integrates local interests. The result of this planning process will be an implementation program that addresses subwatershed-specific issues and priorities articulated in the Plan. The implementation program will include implementation goals and targets, and a plan of monitoring or other performance measurement that will allow performance toward these goals and targets to be assessed. When

an individual project or initiative is pursued independent of the priority subwatershed process, a component of the design will include a statement of project targets and a performance assessment plan specifically oriented toward the project goals and targets.

The Plan, at Section 3.9, also includes certain already-defined capital projects that are intended to reduce phosphorus loading. For these, each project description includes an estimated load reduction. These estimates will be refined through project feasibility and design.

Table 3.2 District goals and targets

Strategic Goal	Description	Long-Range Targets
Water Quality	Conserve, maintain, and improve the aesthetic, physical, chemical, and biological composition of surface and groundwater within the District.	Achieve state standards for nutrient, chloride, <i>E. coli</i> , and dissolved oxygen impairments in the District.
Water Quantity	Maintain or reduce existing flows from drainage within the watershed to decrease the negative effects of stormwater runoff and bounce from existing and proposed development as well as provide low flow augmentation to surface waters. Protect and maintain existing groundwater flow and promote groundwater recharge.	No net increase in volume or rate of stormwater runoff.
Ecological Integrity	Maintain and enhance floral and faunal quantity and ecological integrity of upland and aquatic resources throughout the watershed.	Achieve state standards for fish and macroinvertebrate bioassessment impairments in the District.
All of the above	Maintain or increase existing acreage of wetlands in the watershed and achieve no net loss in their size, quality, type, and biological diversity.	No net loss of wetland acreage.

3.7.2 TYPES OF EVALUATION AND REPORTING

The District uses a variety of methods to evaluate performance and measure progress toward District goals, as described below. These evaluation and reporting processes are designed to meet the requirements of MN Rules 8410 and the District’s Municipal Separate Storm Sewer System (MS4) Permit.

Table 3.3 provides a summary of key metrics that are tracked by the District, the programs responsible for tracking them, and the frequency with which they will be reported. These metrics will be tracked by subwatershed and summarized as part of the District’s reports to the MN Pollution Control Agency and MN Board of Water and Soil Resources and in accordance with the biannual evaluation required by Minnesota Rules 8410. The reporting function will serve as a vehicle to engage with these agencies on matters of performance and accountability.



Frozen Minnehaha Creek, Aldo Abelleira

Observed Outcomes

The District has a robust monitoring program that measures progress toward the District's water quality, water quantity, and ecological integrity goals using a variety of metrics. This includes regular baseline monitoring to identify impairments and track trends over time; expanded monitoring through the District's E-grade program to broadly characterize ecosystem health on a 10-year rotating basis; and effectiveness monitoring to more directly measure the effectiveness of select District capital projects. The District's monitoring program is described in more detail in Section 2.1, including a summary of monitoring locations, parameters measured, and frequencies.

Projected Outcomes

Given the length of time it can take to observe changes in water quality, water quantity, and ecological integrity on the landscape, and the complexity of linking those changes causally to the District's work, the District also relies on projections or estimates to measure progress toward its goals. This includes the use of models to estimate metrics like phosphorus load reduction or volume reduction resulting from District capital projects, permit compliance, and grants. The District tracks as well a number of discrete metrics that serve as surrogates for water quality, water quantity, and ecological integrity benefit, such as acres of wetland restored and lineal feet of shoreline restored.

The District also tracks a number of metrics related to citizen engagement and awareness based on the assumption that increased awareness leads to action. Through various methods of data collection, the District is able to assess how many people are being reached, what they are learning, and the actions they are taking to protect and improve water quality. Approximately every five years the District conducts a public opinion survey of its residents to assess their level of awareness of the District and water quality issues, their perception of the condition of local lakes and streams, the personal actions they take to protect clean water and other metrics. The District also tracks and evaluates participation in its events, workshops, and programs such as Master Water Stewards and Watershed Association Initiative. Analytics from the District's online presence provide information on how many people are following the District's social media accounts (Facebook, Twitter, Instagram and YouTube), subscribe to the District's on-line newsletter, and visit the District's website.

While the District does not define specific issues or targets related to its strategic goal of Thriving Communities, the District is interested in quantifying and tracking outcomes related to broader community value. Examples include increased green space, access to water resources, and recreational opportunities.

District Effectiveness

As part of the development of this Plan, the District undertook an internal

strategic planning process to establish clear and focused mission, vision, goals, and guiding principles; and to evaluate District programs to ensure alignment with the mission and improve effectiveness. The process resulted in a Strategic Alignment Plan that established clear and focused priorities for each program and the District as a whole. The District intends to use this Strategic Alignment Plan as a foundation to evaluate new initiatives and revisit existing work to ensure that the District maintains its focus and alignment moving forward.

3.7.3 TOTAL MAXIMUM DAILY LOAD (TMDL) REQUIREMENTS

As noted previously, there are a number of impaired waters in the District for which TMDL studies have been completed (see Table 3.4). Through these TMDLs, the MPCA allocates pollutant load reduction obligations among entities determined to be responsible for pollutant loads to the impaired water, which includes the municipalities, road authorities and other MS4s such as the District whose stormwater conveyance systems outlet to the impaired water. These obligations become conditions of MS4 National Pollutant Discharge Elimination System (NPDES) stormwater permits administered by the MPCA. MS4s are then required to report annually to the MPCA on their progress toward achieving the necessary reductions.

The District's capital projects and other initiatives often are accomplished in partnership with its local government units (LGUs) and with a contribution of funds or other elements of value from those partners. Although the District is a regulated MS4, its jurisdiction is limited to areas served by storm water conveyances that are owned or operated by the District, so there have been few load reduction obligations assigned directly to the District through these TMDLs. For both of these reasons, the District adopted and implements a policy (Resolution 13-062) that describes how load reduction credits for District water quality improvement projects are allocated among itself and other LGUs for the purpose of TMDL reporting.

Under this policy, load reduction first is allocated to MS4 project partners in proportion to those partners' share of project funding, typically as the allocation is defined in the project agreement. Then, reduction is allocated to meet any WLA assigned directly to the District. Remaining credit then is allocated among LGUs within the drainage area of the impaired water, in proportion to their TMDL-assigned WLAs. The District adopted this policy with support from MPCA staff, and it was incorporated into both the Minnehaha Creek-Lake Hiawatha TMDL and the MCWD Upper Watershed TMDL.

The main purpose behind the policy is to ensure that credit for pollutant reductions achieved through District projects is distributed equitably and in a way that limits obstacles to collaboration among its member communities.



White water lilies



Kayakers on Long Lake



Lake Harriet, Margi MacMurdo

Table 3.3 Metrics tracked by MCWD

Strategic Goal	Metric	Programs	Reporting Frequency
Water Quality	Lake and stream concentrations for: Total and dissolved phosphorus Total suspended solids Chlorophyll-a Secchi disc depth Dissolved oxygen Chlorides E. coli bacteria (streams only)	Research and Monitoring	Annually
	Lake and stream trends for: Total phosphorus Total suspended solids Chlorophyll-a Secchi disc depth	Research and Monitoring	Annually
	Phosphorus load reduction (modeled)	Projects, Grants, Permitting	At least every 2 years
	Stream discharge and trends	Research and Monitoring	At least every 2 years
	Volume of runoff (modeled)	Projects, Grants, Permitting	At least every 2 years
	Index of Biotic Integrity for fish and macroinvertebrates	Research and Monitoring	Every 10 years
	MPCA Stream Habitat Assessment	Research and Monitoring	Every 10 years
	Shoreline/streambank restored	Projects	At least every 2 years
	Wetland restoration/loss	Projects, Permitting	At least every 2 years
	All of the above	Community engagement: Participants in events, workshops, and programs Analytics on District website, social media, and newsletter	Education and Communications
Public opinion survey responses			Every 10 years

The policy recognizes that the portion of load reduction not resulting from the specific financial or other value contribution from a project partner MS4 ordinarily derives from the District's watershed-wide *ad valorem* tax levy. Importantly, this policy encourages LGUs to collaborate with the District to put projects where they will be most effective for improving the resource and where opportunities exist, without concern for political boundaries.

As explained in MPCA guidance documents, the method that the MPCA presently requires for MS4s to report on TMDL load reduction progress gives reporting primacy to the MS4 in whose boundaries a best management practice or activity is located. This MS4 reports the entirety of the estimated reduction. Other MS4s that have contributed to the BMP/activity may report it without a quantified reduction. Those MS4s that discharge to the impaired water but that have not contributed to the cost of the BMP/activity do not report it. This is different from the District policy; the District is concerned that it may serve to introduce local interests concerning project location, and otherwise may have the effect of discouraging collaboration among the District and its LGUs. The District will work with the MPCA and its LGUs to explore and address this policy concern.

In addition to its own evaluation and reporting efforts, the District intends to serve in a coordinating role to track collective progress toward TMDL goals among MS4s within its boundaries.

Table 3.4 Impaired Waters with Approved TMDLs

Waterbody	Pollutant	Target	Reduction Needed
Brownie Lake	Chloride	See TCMA Chloride TMDL	
Diamond Lake	Chloride	See TCMA Chloride TMDL	
Dutch Lake	Total Phosphorus	40 µg/L	262 lbs
East Auburn Lake	Total Phosphorus	40 µg/L	626 lbs
Forest Lake	Total Phosphorus	40 µg/L	147 lbs
Gleason Lake	Total Phosphorus	60 µg/L	447 lbs
Hadley Lake	Total Phosphorus	40 µg/L	72 lbs
Halsted Bay	Total Phosphorus	40 µg/L	4210 lbs
Holy Name Lake	Total Phosphorus	60 µg/L	350 lbs
Jennings Bay	Total Phosphorus	40 µg/L	2518 lbs
Lake Hiawatha	Total Phosphorus	50 µg/L	1907 lbs
Lake Nokomis	Total Phosphorus	50 µg/L	399 lbs
Lake Virginia	Total Phosphorus	40 µg/L	77 lbs
Langdon Lake	Total Phosphorus	60 µg/L	84 lbs
Long Lake	Total Phosphorus	40 µg/L	742 lbs
Minnehaha Creek	E. coli	See Minnehaha Creek TMDL	
Minnehaha Creek	Chloride	See TCMA Chloride TMDL	
Mooney Lake	Total Phosphorus	60 µg/L	81 lbs
Painter Creek	E. coli	See Upper Watershed TMDL	
Parley Lake	Total Phosphorus	60 µg/L	998 lbs
Peavey Lake	Chloride	See TCMA Chloride TMDL	
Powderhorn Lake	Chloride	See TCMA Chloride TMDL	
School Lake	Total Phosphorus	60 µg/L	176 lbs
Snyder Lake	Total Phosphorus	60 µg/L	22 lbs
Stone Lake	Total Phosphorus	40 µg/L	29 lbs
Stubbs Bay	Total Phosphorus	40 µg/L	199 lbs
Tamarack Lake	Total Phosphorus	40 µg/L	0 lbs
Tanager Bay	Total Phosphorus	40 µg/L	753 lbs
Turbid Lake	Total Phosphorus	40 µg/L	138 lbs
Unnamed Creek (07010206-718)	Chloride	See TCMA Chloride TMDL	
Wassermann Lake	Total Phosphorus	40 µg/L	470 lbs
West Arm	Total Phosphorus	40 µg/L	1602 lbs
Wolsfeld Lake	Total Phosphorus	40 µg/L	232 lbs

3.8 PLAN AMENDMENTS

The Plan will extend through the year 2027. The Plan will remain in effect as revised and amended, until superseded by a subsequent plan approved by the Board of Water and Soil Resources (BWSR) and adopted by the District.

Only the District Board of Managers can initiate a formal plan amendment. Other individuals or entities may petition the Board to initiate an amendment, but the decision to do so will remain a matter for the Board's discretion. All plan amendments must follow the process provided in Minnesota Statutes, 103B.231, subdivision 11, except in the following two instances:

- » Plan changes that do not constitute plan amendments. When such changes are made, they will be distributed to those on the distribution list indicated below in a form that communicates deleted and new text. These changes include the following:
 - Plan reformatting or reorganization;
 - Revision of a procedure meant to streamline plan administration;
 - Clarification of existing plan goals or policies;
 - Inclusion of additional data that don't require interpretation;
 - Expansion of public process;
 - Adjustments in implementing program activities within the District's discretion.
- » With respect to changes to the District's implementation action table that fall within this subsection, this subsection will be implemented through a revised table distributed annually. Such changes may include a change in the timing of one or more actions, or a substantial change in the estimated cost of a program or project.
 - Minor plan amendments. The District will send the proposed amendment to each of the plan review authorities, as defined in Minnesota Rules 8410, for a review and comment period of at least 30 days. The notice will state that the minor amendment procedure is being followed, and will direct that comments be sent to the District and to BWSR. The amendment will be considered a minor amendment if:
 - BWSR has agreed that the amendment is minor or has failed to act within five working days of the end of the comment period, or such other period to which BWSR and the District have agreed;
 - Neither the Hennepin nor the Carver County Board of Commissioners has filed an objection to the amendment

with the District and BWSR within the comment period, or such other period to which the County and the District have agreed; and

- The amendment is not needed to make the Plan consistent with an approved and adopted county groundwater plan.
- » Before adopting a proposed minor amendment, the District will hold a public meeting to explain and receive comment on the amendment. This will occur after legal notice of the meeting has been published twice, at least seven and at least 14 days before the meeting date.

The District maintains and annually solicits applications for a Citizens Advisory Committee to provide advice and recommendations on watershed issues, including amendments to its Plan. For ten-year plan amendments, the District will also establish technical and policy advisory committees, consistent with the process used for development of this Plan as described in Appendix B.

The District will transmit draft and final amendments to the distribution list electronically, and in paper format to any entity that has requested to receive amendments in that form. Draft amendments will show deleted text as stricken and new text as underlined. A final amendment adopted by the District will be in the form of replacement pages for the Plan, with each page renumbered as appropriate and stating the effective date of the amendment.

The District will maintain a distribution list of agencies and individuals who have received a copy of the Plan, which includes “plan review authorities” as defined in Minnesota Rules 8410. The District will distribute copies of an adopted amendment to all on the distribution list and post the amendment on its website within 30 days of adoption.

It is the intent of this section to conform to procedures stated in Minnesota Rules 8410. If BWSR should amend those rules in any manner that makes them inconsistent with this section, the District will adjust its amendment practice to maintain conformity with Minnesota Rules 8410 pending any formal amendment of this section.

3.9 SUBWATERSHED PLANS

This section contains information specific to each of the District’s eleven subwatersheds. Each subwatershed plan follows the same sequence: existing conditions and issues; causes; management strategies; and implementation priorities. The implementation plan for each subwatershed identifies specific, known projects and initiatives but also provides for projects and initiatives to develop specificity through planning, collaborative processes, and opportunities.

3.9.1 CHRISTMAS LAKE SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Christmas Lake Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District’s philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Christmas Lake is a 1.2 square mile (742 acre) subwatershed located along the southwestern boundary of the MCWD and includes portions of the cities of Chanhassen and Shorewood, with a small area in Excelsior.

The subwatershed is dominated by single family residential uses (47%) and the 276 acre Christmas Lake (37%), with the remaining balance being primarily wetland or woodland (13%). There are a few isolated wetlands in the watershed and some that are riparian to the lake.

A small stream drains the upper part of the subwatershed and outlets into the southwest side of Christmas Lake. Some of the

small basins in the subwatershed are landlocked and have no natural outlet. The subwatershed discharges into St. Albans Bay of Lake Minnetonka.

Water quality in Christmas Lake is better than state standards and is typically among the best in the District. Zebra mussels infested Christmas Lake in 2014 and are now established lake wide. The channel that conveys drainage from the southern subwatershed unit to the lake is experiencing some erosion, possibly conveying sediment to the lake, and phosphorus concentrations in the stream are elevated compared to state standards.

Management strategies within the Christmas Lake subwatershed will focus on protecting water quality in the lake by limiting nutrients and sediment in stormwater runoff. The District will collaborate on these management strategies with local and state government, developers, lake associations, citizens’ groups and other parties to implement. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water



Christmas Lake

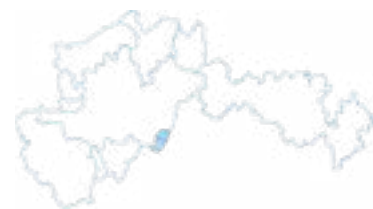


Figure 3.1 Christmas Lake Base map



resource issues categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Christmas Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality Lakes and Streams

The Christmas Lake subwatershed is dominated by Christmas Lake itself. Water quality in Christmas Lake is better than state standards and is typically among the best in the District.

There is a small stream that conveys drainage from the upper subwatershed to Christmas Lake. While it is not listed as an Impaired Water for nutrients, the stream exhibits significantly high total phosphorus concentrations, and exceeds state river eutrophication standards.

Zebra mussels are established in the lake, and when abundant, can drive water quality changes through their filtering ability and can have the potential to mask other nutrient loading issues.

Wetlands

There are few wetlands in the Christmas Lake subwatershed, totaling about 33.7 acres. Most are small and isolated, but there are some riparian to the lake that provide fish and wildlife habitat.

Groundwater

While most of the subwatershed has only low to moderate sensitivity to pollution, some scattered areas are classified as highly sensitive. The entire subwatershed is designated as a Wellhead Protection Area. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity

Surface flows in the Christmas Lake subwatershed are routed primarily through a system of culverts connecting small depressions. A small channel drains the upper subwatershed into the southeast corner of Christmas Lake. A few locations



Barrier in Christmas Lake

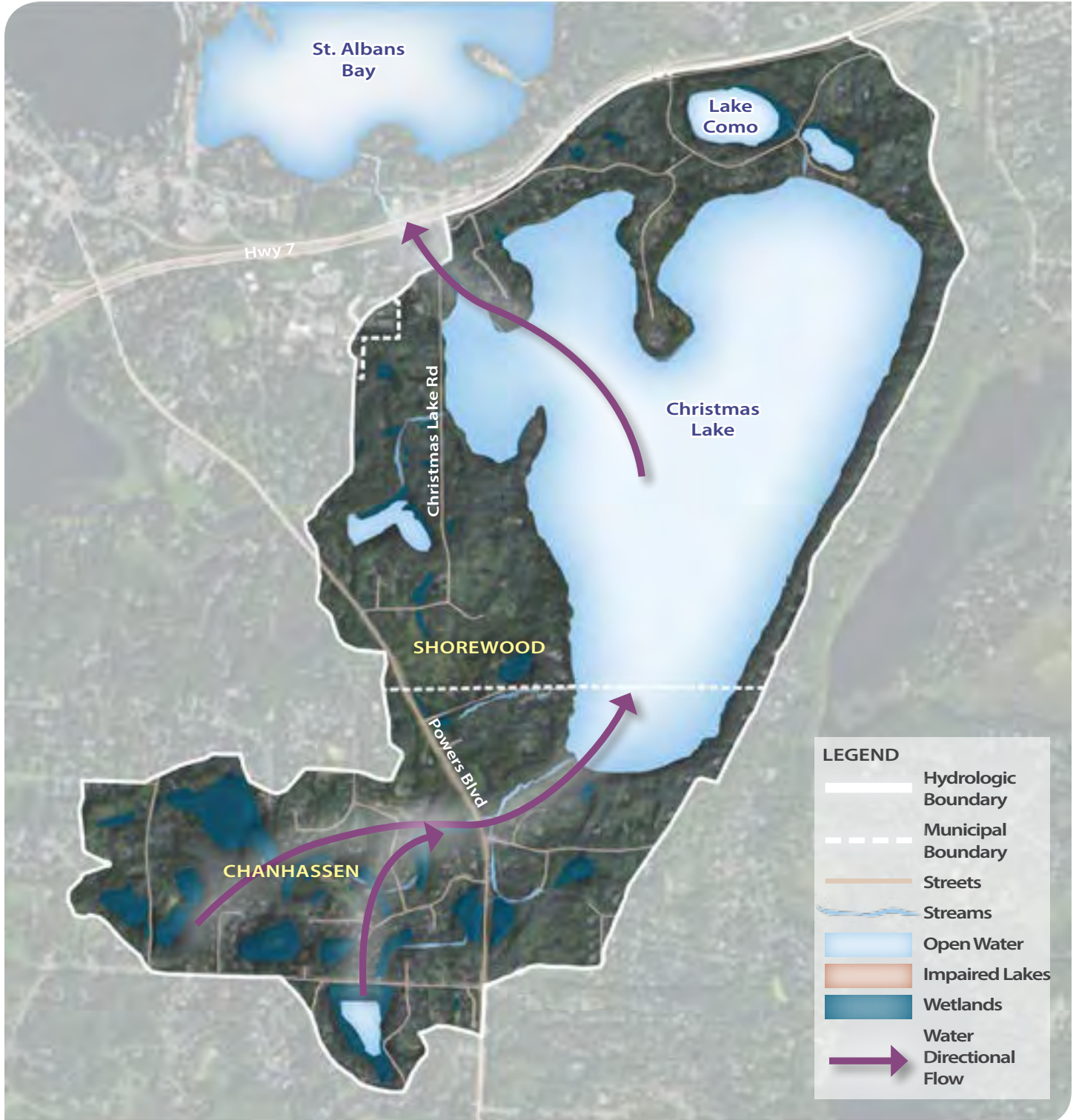
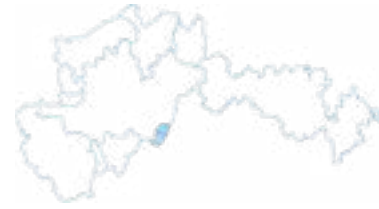


Figure 3.2 Christmas Lake Water Resources map



have been identified through observation or the District's modeling as being vulnerable to localized flooding.

Most of the wetlands in the subwatershed are combination discharge-recharge, but some of the wetlands with the highest functions and values in the watershed are discharge wetlands. Changes in the surficial groundwater table or flow can negatively impact discharge wetlands' vegetation and biota, making it important to protect and increase groundwater recharge.

Ecological Integrity Lakes and Streams

Christmas Lake is one of a few lakes in the Metro Region that can support a two-story fishery, supporting both cold-water species in the cooler, deeper portions of the lake and warm-water species in the warmer water above the thermocline.

Zebra mussels infested Christmas Lake in 2014 and while initial treatments controlled the population within the treatment area, they were found established lake wide by fall of 2015. The zebra mussel population in Christmas Lake is expected to be limited due to low algal concentrations in the lake; however, even a small population could impact the healthy native mussel population in the lake.

There is an abundant and diverse aquatic plant community in the lake that benefits biodiversity and habitat diversity. The invasive Eurasian watermilfoil and curly leaf pondweed are both present in the lake, but thus far have not had a great impact on the overall aquatic plant community.

Wetlands

Wetland assessments have classified one small wetland as having exceptional vegetative diversity and another has high diversity. Three wetlands were classified as having exceptional aesthetic and fish habitat values. Their conservation is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

Uplands and Natural Corridors

The subwatershed is almost fully developed, and there are only a few remaining patches of undeveloped landscape. Most of these areas are wetlands or wooded portions of large residential lots. No areas within the subwatershed have been identified by the DNR or the Minnesota County Biological Survey (MCBS) as being high-value or ecological areas.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or



Carp in Christmas Lake

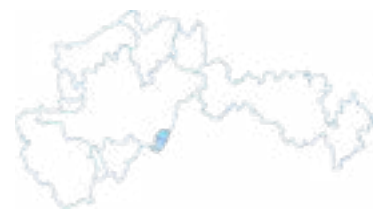


Figure 3.3 Christmas Lake Parks, Trails, and Open Space map



physical structure to change. Example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Christmas Lake subwatershed.

The principal issues within the Christmas Lake subwatershed are:

Water Quality

- » Excessive nutrients from stream input

Water Quantity

- » Localized flooding

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Stormwater runoff
- » Altered channels

Altered Wetlands

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved fraction) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients causing nutrient impairments in downstream surface waters.

There are few remaining wetlands in the Christmas Lake subwatershed aside from those riparian to the lake. There is a series of flow-through, riparian small ponds and altered wetlands along the small channel that drains the upper subwatershed into the southwest corner of Christmas Lake.

That channel has elevated concentrations of total phosphorus, one of the sources of which could be wetland export.

Stormwater Runoff

Watershed runoff from rainfall events or stormwater can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding and change stream flow that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

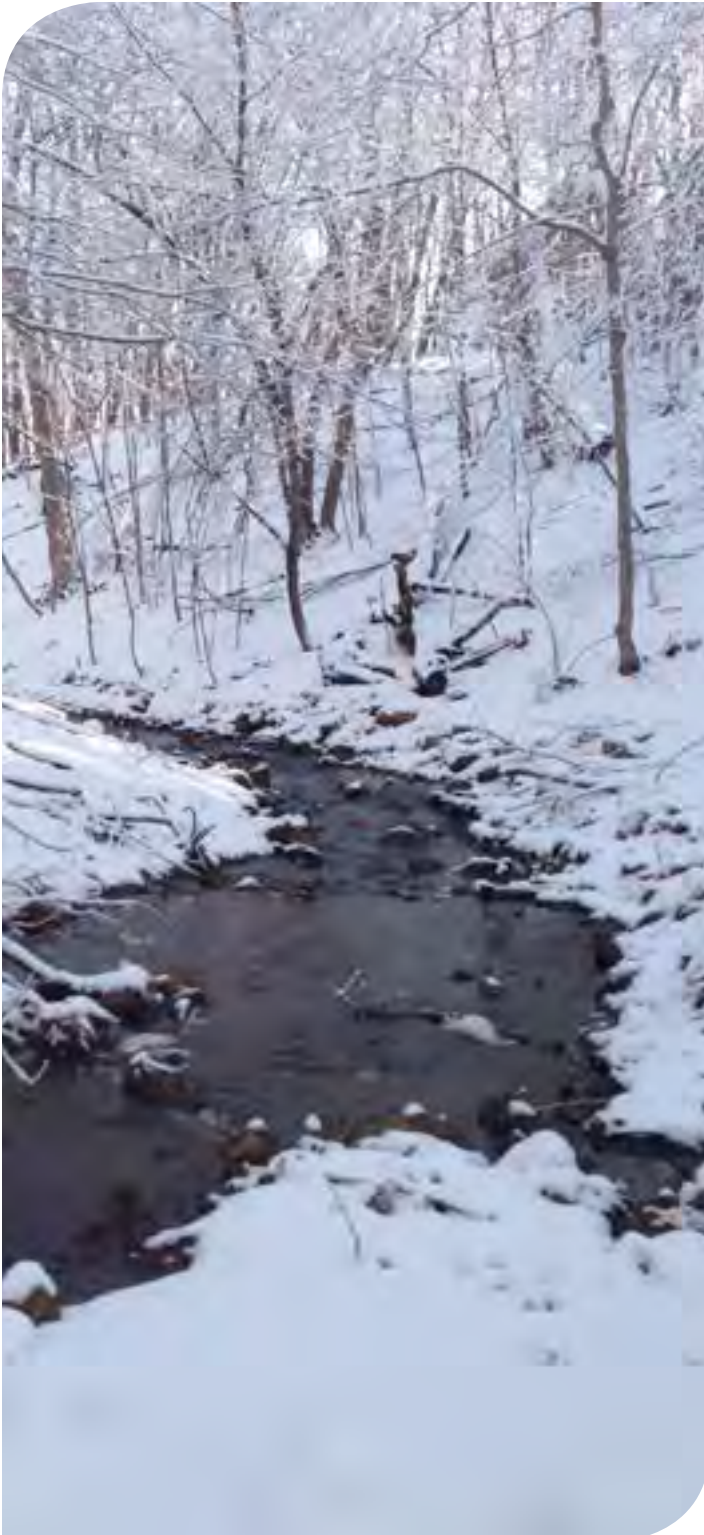
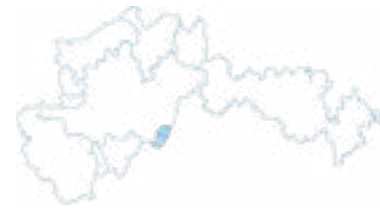
While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up pollutants such as excess nutrients, bacteria (e.g., *E. coli*), chloride from road salt, and toxic pollutants. In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters, because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

The Christmas Lake subwatershed is almost fully developed with single family residential uses. Storm water runoff is conveyed to either the drainage channel in the upper subwatershed or directly to the lake. There is some water quality treatment of this runoff. The channel has elevated concentrations of total phosphorus, the source of which could be untreated stormwater runoff, wetland export, sedimentation from an eroding channel, or a combination of these sources.

Altered Channels

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel



Christmas Creek in winter

alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

The channel that drains the upper subwatershed is likely to be a historically ephemeral stream that was an outlet for wetlands and which conveyed large events and snowmelt, but has been altered and straightened to convey urbanized stormwater runoff. Portions of the channel are confined to storm sewer. Below Powers Boulevard, the stream is experiencing some erosion, which may be conveying excess sediment and nutrients to the lake and stressing the local biotic community.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Christmas Lake subwatershed. These strategies are both short- and long-term, and establish a framework for the Christmas Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

The series of wetlands west of, and in, Curry Farms Park in Chanhassen, through which the upper subwatershed channel flows, was classified with moderate restoration potential. Each of these wetlands was assessed as being currently of moderate vegetative quality. Wetland restoration may improve habitat and aesthetics as well as reduce the export of nutrients into the channel downstream to Christmas Lake.

Stormwater Management

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

The overall strategy for protecting water quality in Christmas Lake is to reduce pollutant loading and stormwater runoff volume from the subwatershed by retrofitting developed areas with Best Management Practices (BMPs) as infrastructure and development/redevelopment opportunities arise, and to encourage property owners to incorporate BMPs on their own properties.

Stream Channel Restoration

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and re-aeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Below Powers Boulevard, the stream is experiencing some erosion, which may be conveying excess sediment and nutrients to the lake and stressing the local biotic community. Stream restoration would stabilize the streambanks, filter overland runoff, enhance habitat, and reduce nutrient and sediment load downstream.

Watershed Protection

Several areas of the watershed are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of the development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

The highest value resource in the subwatershed is Christmas Lake with its excellent water quality and unique two-story fishery, supporting both cold and warm water species. Protecting the lake from future degradation is a high priority. As infill development and redevelopment occurs, opportunities should be evaluated to achieve net reductions over current stormwater runoff volume and pollutant loads.

LAND USE

EXISTING CONDITIONS

The subwatershed includes portions of the cities of Shorewood and Chanhassen, with a small area in Excelsior. The subwatershed is fully developed with single family residential (47%) dominating the land use, followed by open water (37%), and undeveloped land (13%) which is primarily undevelopable wetland.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Sections 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for 2018-2027 (see Appendix B for details on the public input process). This information was used to broadly characterize opportunities, and to inform the development of the District's implementation plans. The information received

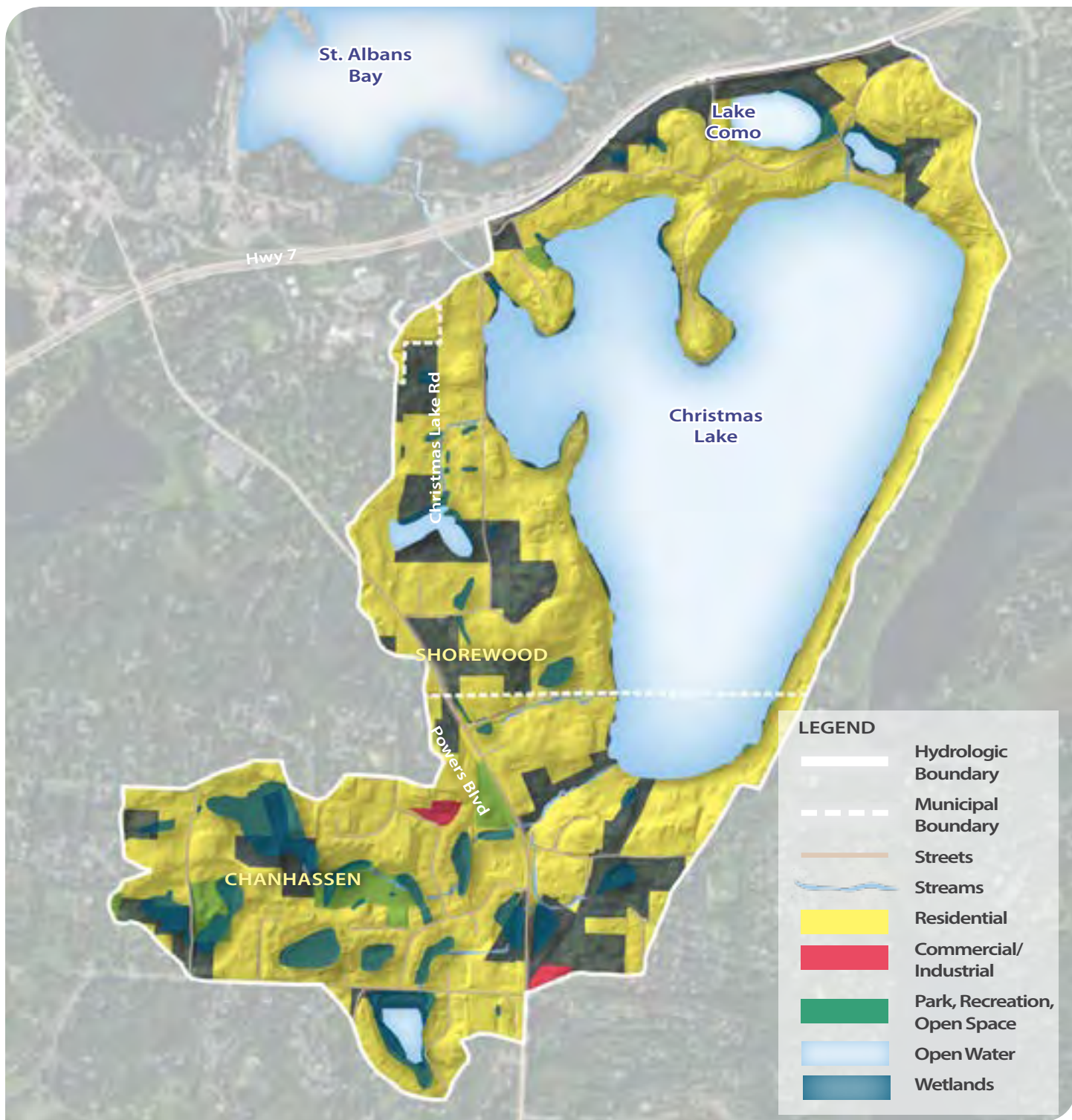
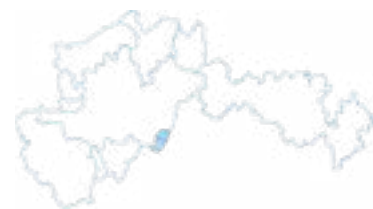


Figure 3.4 Christmas Lake Land Use map



was used only as a guide during the development of this Plan to inform the District of opportunities for partnership on the near term horizon, and was not intended to be exhaustive or restrict future collaborative efforts.

As discussed in Section 3.6, the District intends to cultivate a framework for two-directional coordination with communities on an ongoing basis, to stay apprised of emerging needs at a local level, and to identify and evaluate opportunities to implement management strategies outlined in this Plan over the next ten years. The District recognizes that local needs, opportunities and priorities may shift over time. Therefore, this Plan does not intend to capture or prescribe opportunities for partnership over a ten-year term.

Long term goals, growth and private development, and public investment in infrastructure differ across each community – and therefore, frameworks for ongoing coordination will be custom tailored based on the individual needs of each community. Coordination may occur at varying levels, through various means, with communities across the following areas:

- » Regulation of, and partnership with, private development
- » Collaboration on public planning and investment (e.g. parks, roads, utilities)
- » MS4 compliance
- » Development and implementation of TMDLs

Through the information gathering processes of this Plan, the District was informed that the subwatershed is largely residential with potential future redevelopment identified on the lake and along Christmas Lake Road. Within the subwatershed, there are some localized flooding issues which the cities will seek to address as part of future road improvements.

There is an active lake association for Christmas Lake, and priority issues identified by the group include aquatic invasive species (AIS) prevention and management, regulation of single family home redevelopment, and shoreline erosion from boat wakes.

Both the municipalities and Christmas Lake Association are actively engaged in protecting Christmas Lake. By City of

Shorewood ordinance, watercraft must be inspected for AIS before entering Christmas Lake. Such inspections are provided at the boat launch for no charge.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

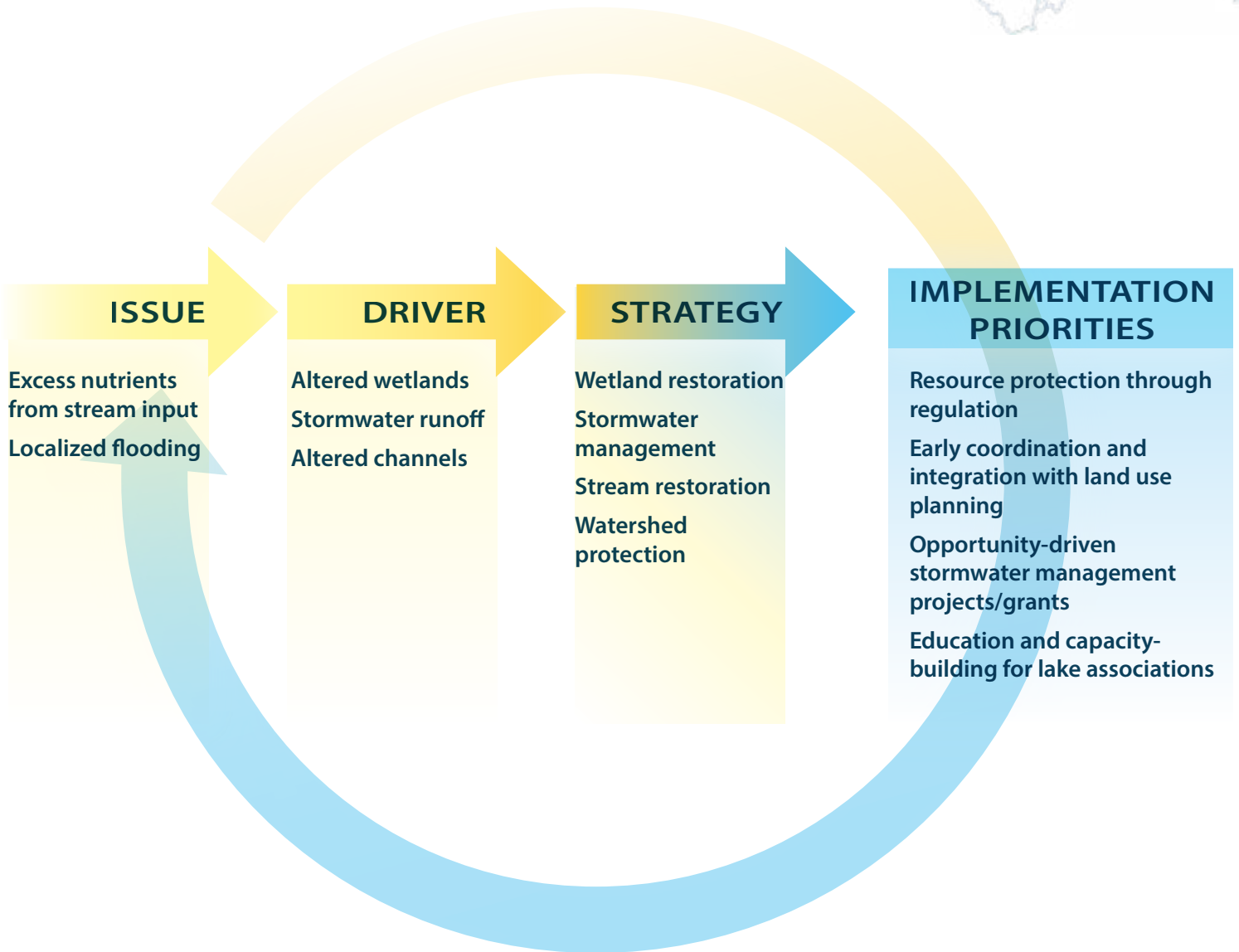
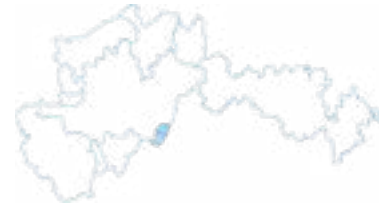
IMPLEMENTATION PRIORITIES

As described in previous sections, water quality in Christmas Lake is better than state standards and is typically among the best in the District. The channel that conveys drainage from the southern subwatershed unit to the lake is experiencing some erosion, possibly conveying sediment to the lake, and phosphorus concentrations in the stream are elevated compared to state standards.

Based on these conditions, management strategies within the subwatershed will focus on protecting water quality in the lake by limiting nutrients and sediment in stormwater runoff. This will be achieved primarily through the District's rules which require no net increase in runoff and pollutant loading for new developments. For redevelopment, the rules require a reduction in runoff and pollutant loading depending on the development size and current conditions.

The Christmas Lake subwatershed is relatively small and mostly built out, so the District expects implementation opportunities from land use change to be limited. The Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout the Plan and determine the appropriate response. The District has a



wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects.

As noted in the previous section, there is an active lake association for Christmas Lake. The District will continue to work with its lake associations to provide education and technical assistance to build their capacity and target implementation efforts.

Zebra mussels infested Christmas Lake in 2014 and are now established lake wide. The zebra mussel population in Christmas Lake is expected to be limited due to low algal concentrations in the lake. The District will continue to monitor any impacts or trends.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. In the future, should the District or a partner determine that

a larger or more concentrated scale of capital and program implementation may be needed, a discrete subwatershed planning process may be initiated to:

- » Provide high resolution diagnostic of watershed issues and drivers
- » Map current projected land use and infrastructure changes
- » Define a detailed and integrated capital and program implementation plan
- » Outline a funding strategy including program costs and sources

The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Plan.

CAPITAL IMPROVEMENT PLAN

The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District's scope and priorities for its capital work over the planning period. A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other policy considerations before a formal decision to proceed to construction is made. Section 3.5.5 describes the development and evaluation steps that will occur before the District will commit resources to a project.

Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures.

A critical component of any project will be the development of a funding strategy that identifies the sources, uses, and timing of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District's public and private partners as capital projects are advanced. Therefore, any costs identified within this Plan are projections. Intended expenditures will be refined during project development and budgeting, and among other things will reflect the District's intent to complement its ad valorem funds with other funding sources.

Table 3.5 Christmas Lake Subwatershed CIP

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Christmas Lake, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Christmas Lake displays excellent water quality but is sensitive to potential future loading increases. The channel that conveys drainage from the southern subwatershed unit to the lake exhibits phosphorus concentrations that are elevated compared to state standards.
Outcome	Reduction of pollutant loading to Christmas Lake; reduction of stormwater runoff volume and rate and associated impacts; protection and enhancement of groundwater recharge, stream base flow, and wetland hydrology.
Estimated Cost	Capital costs: \$200,000, excluding land, in 2017 dollars.
Potential Funding Sources	MCWD levy, partner contributions, grants
Schedule	2018-2027

3.9.2 DUTCH LAKE SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Dutch Lake Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Dutch Lake is a 3.0 square mile (1,888 acre) subwatershed located along the northwestern boundary of the MCWD and includes portions of the cities of Mound and Minnetrista. The subwatershed is generally characterized by undeveloped land (50%), including numerous large wetland systems and wooded areas, low-density development (20%), agricultural uses (10%), parks and open spaces (6%), and water (10%). Mound Westonka High School is a large, institutional use in the eastern subwatershed.

The subwatershed includes large areas of undisturbed or minimally disturbed wetland and woodland. Much of the subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor and by the City of Minnetrista as a natural resources corridor due to the predominance and contiguity of wetlands.

The Dutch Lake subwatershed has two large wetland systems, which through a series of ditches and culverts both drain to Dutch Lake, the primary receiving water within the subwatershed. The small stream that drains wetlands on the west side of Dutch Lake flows intermittently. There is one primary stream, Dutch Creek, which serves as the outlet of Dutch Lake and flows to Lake Minnetonka: Jennings Bay.

The Dutch Lake subwatershed has several issues relating to water quality, water quantity, and ecological integrity. Dutch Lake is impaired by excess nutrients and the inlet and outlet of Dutch Lake have elevated levels of total phosphorus. The outlet of Dutch Lake is also at high risk of chloride impairment. The fish and vegetation communities in Dutch Lake and its inlet and outlet may be negatively impacted by nutrient enrichment, low dissolved oxygen, and reduced water clarity. The subwatershed

also contains areas of high quality, extensively connected wetland and upland, including several regionally significant ecological areas. Overall, the system has moderate to high ecological integrity.

Management strategies within the Dutch Lake subwatershed will focus on promoting infiltration, reducing pollutant loading, managing carp, improving biodiversity and protecting existing resources. The District will collaborate on these management strategies with local and state government, developers, lake associations, citizens' groups and other parties to implement. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Dutch Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality Lakes and Streams

Dutch Lake is listed on the State's Impaired Waters list for nutrient/eutrophication biologic indicators, and a TMDL identifying nutrient load reduction goals and suggested actions has been completed.

No streams are listed as Impaired Waters; however, both Dutch Creek and a small stream draining wetlands on the west side of Dutch Lake have elevated total phosphorus concentrations. In addition, Dutch Creek has elevated chloride concentrations and is at high risk of chloride impairment.

Wetlands

The Dutch Lake subwatershed has two large riparian wetlands –

DUTCH LAKE SUBWATERSHED



Figure 3.5 Dutch Lake Base map



one on the north side and one on the west side of Dutch Lake - that have scored highly on vegetative diversity, fish and wildlife habitat, or aesthetics. The subwatershed also has numerous small wetlands. These wetlands are sensitive to the quality of stormwater inputs and should be protected.

Groundwater

There are wide areas of aquifer sensitivity in the Dutch Lake Subwatershed, particularly those within wellhead protection areas. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity

There are no known flooding issues, but modeling suggests that the Dutch Lake culvert may provide less freeboard than required. This culvert is also unstable and needs maintenance.

There are wetlands and streams in the subwatershed that rely on steady inflow from surficial groundwater. A small area of the subwatershed is within a Wellhead Protection Area and there may be restrictions on the use of infiltration as a water quality practice within that area.

Ecological Integrity Lakes and Streams

Dutch Lake maintains a moderately healthy fishery, according to limited fish data. Although excess nutrients, reduced water clarity, and low dissolved oxygen may negatively impact the lake's fish community. Dutch Lake is infested with Eurasian watermilfoil, and overall the aquatic vegetation community is degraded due to excess nutrients and low water clarity. Dutch Lake has significant woodland or wetland fringes, which are ecologically beneficial.

Streams in the subwatershed include a small stream that drains wetlands on the west side of Dutch Lake and Dutch Creek, which serves as an outlet to Dutch Lake and flows into Lake Minnetonka: Jennings Bay. In the small unnamed stream on the west side of Dutch Lake, total phosphorus concentrations are elevated relative to the state river eutrophication standards. Dutch Creek shows elevated concentrations of total phosphorus and dissolved oxygen levels that fall below the state standard several times per year. Chloride concentrations are also elevated and the stream is at high risk of surpassing the state chloride standard. Stream connectivity is also low, as there are several culverts and road crossings that may impede passage for fish and other aquatic organisms.



Dutch Lake

DUTCH LAKE SUBWATERSHED

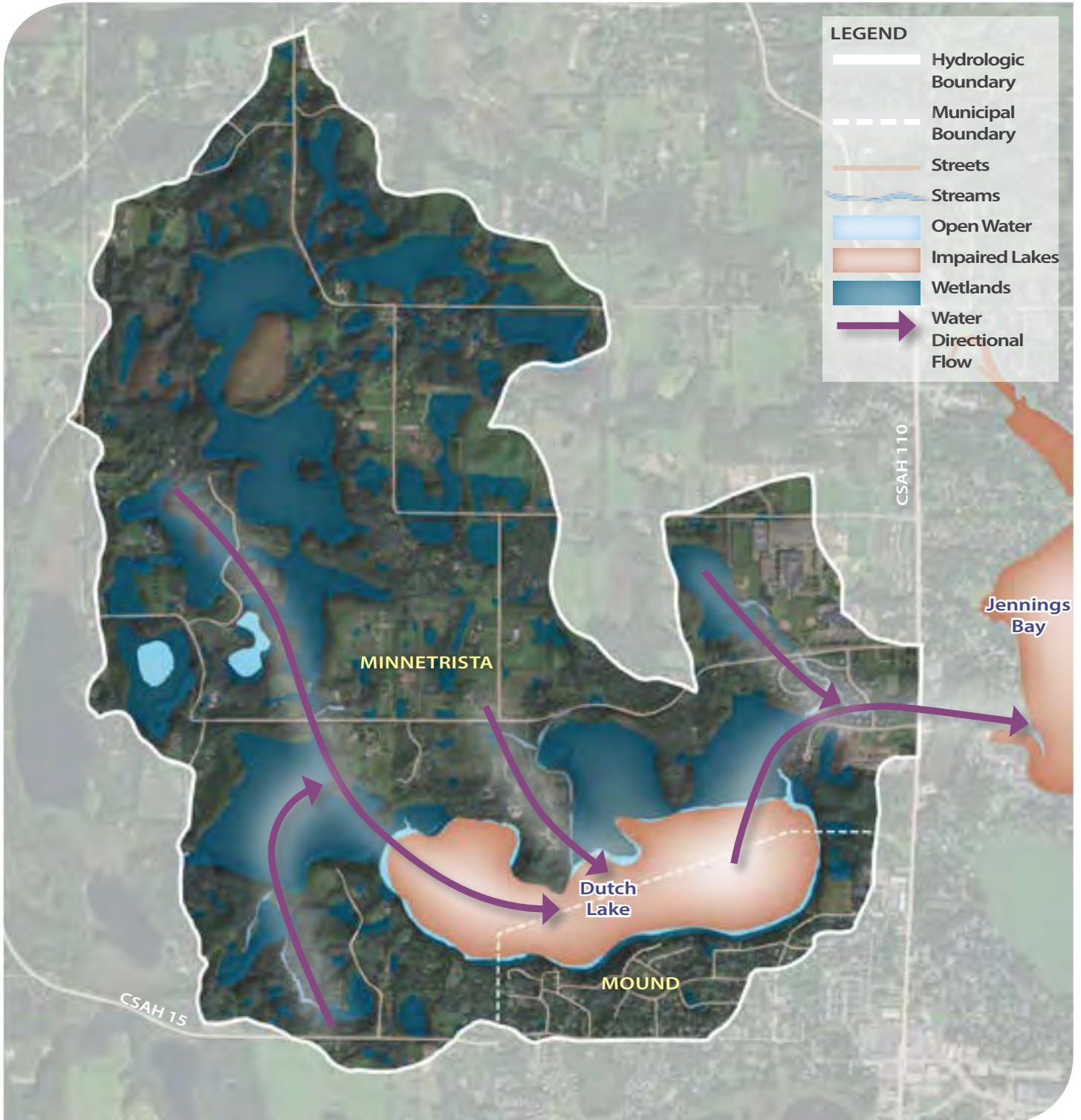


Figure 3.6 Dutch Lake Water Resources map



Wetlands

There are extensive high quality wetlands in the subwatershed. Due to the predominance and contiguity of wetlands, much of the subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor and by the City of Minnetrista as a natural resources corridor. Wetland assessments have classified two wetlands in the subwatershed (one north and one west of Dutch Lake) as having excellent vegetative diversity, fish and wildlife habitat, or aesthetics. Further, these wetlands are large and have high connectivity, which makes them more likely to support notable diversity and/or abundance of wildlife. Wetlands in the subwatershed should be protected and considered for preservation to maximize habitat and biodiversity.

Uplands and Natural Corridors

Within the subwatershed, there are extensive corridors of upland habitat that should be protected. On the west side of Dutch Lake there are two native plant communities classified as Imperiled or Imperiled/Vulnerable: a 25-acre Tamarack Swamp and a 32-acre Sugar Maple-Basswood-Bitternut Hickory Forest, which are part of a native plant corridor between Dutch Lake and Long Lake/Little Long Lake.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Dutch Lake subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Dutch Lake subwatershed are:

Water Quality

- » Excess nutrients
- » Low dissolved oxygen (DO)
- » Elevated chloride concentrations

Water Quantity

- » Culverts may need repair or replacement

Ecological Integrity

- » Fish community in Dutch Lake may be negatively impacted by reduced clarity and low DO
- » Degraded aquatic plant community
- » Nutrient enrichment and low DO in Dutch Creek Inlet and Outlet could negatively impact biota

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Carp
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading

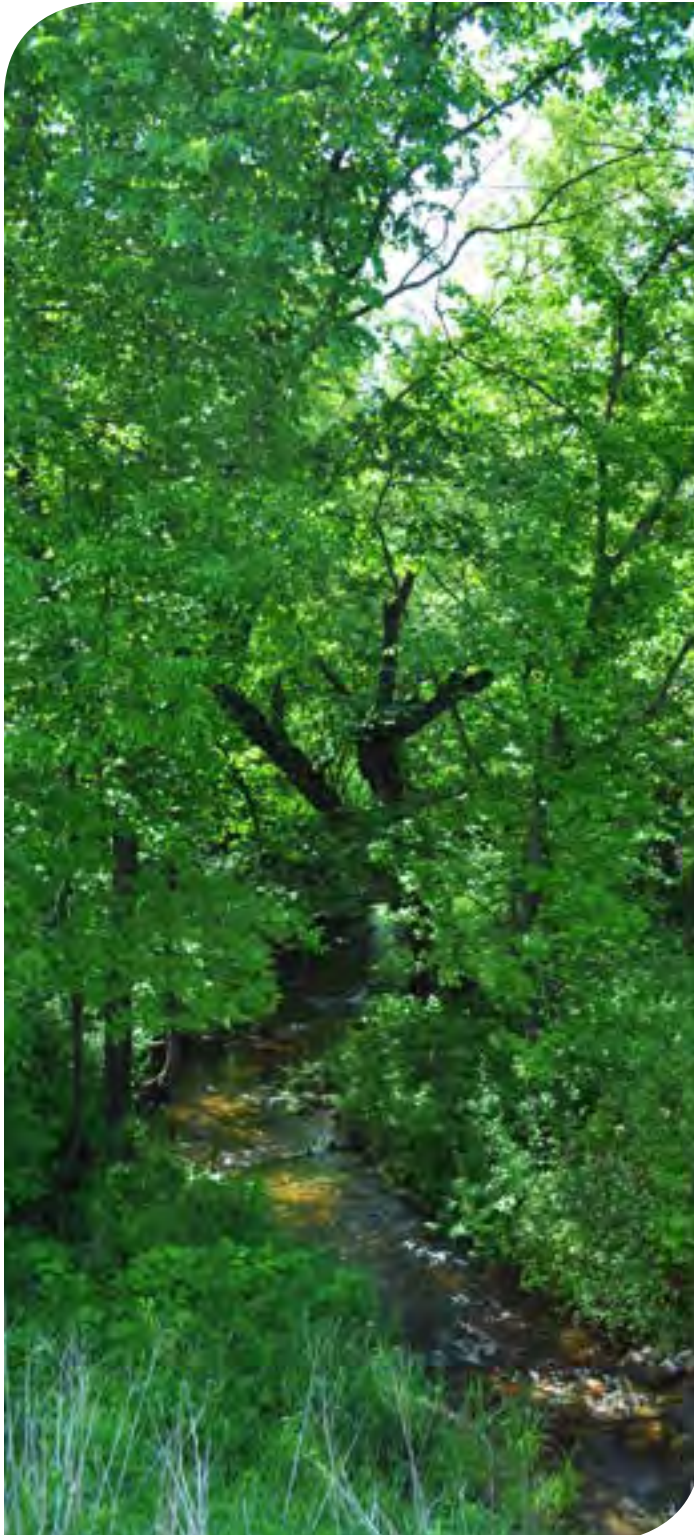
Altered Wetlands

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Many wetlands in the subwatershed are of high or exceptional quality, but some have been ditched or altered in the area's agricultural past. As a result of alteration, the natural hydrology of wetlands is disrupted. Water quality monitoring shows excess nutrients in Dutch Lake and Dutch Creek. Wetland alteration may have caused export of nutrients from upstream wetlands to these water bodies, contributing to water quality issues.

Carp

Invasive common carp negatively impact water quality and



Stream in Dutch Lake Subwatershed

ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse state, and is often characterized by a significant loss of natural vegetation, harmful algal blooms, and the release of phosphorus from re-suspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

Common carp were noted in the TMDL for Dutch Lake as being present and a potential source of water quality and ecological issues, but at an unknown level. Dutch Lake outlets to Jennings Bay of Lake Minnetonka, which has been confirmed to have a high abundance of common carp. A carp assessment would need to be completed in the Dutch Lake subwatershed to determine the impact carp are having in the system, and to develop management strategies.

Stormwater Runoff

Watershed runoff from rainfall events or stormwater can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

Dutch Lake is impaired for excess nutrients, and Dutch Creek has elevated total phosphorus concentrations relative to state river eutrophication standards. Runoff from lawns, streets, and agriculture in the subwatershed could be a source of nutrients and sediment to these water bodies. The Dutch Lake TMDL requires a sixty percent reduction in nutrients from stormwater runoff to meet state lake water quality standards.

Altered Channels

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

There are only a few channels in the subwatershed upstream of Dutch Lake, and they have not been evaluated. Dutch Creek is relatively unaltered, but there are areas with little bank vegetation to buffer runoff and stabilize banks.

Internal Sediment Phosphorus Loading

Long-term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

The Dutch Lake TMDL found that internal sediment load contributes an estimated 30 percent of the annual phosphorus

load to the lake, and requires a ten percent reduction in that internal sediment load to meet state lake water quality standards.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Dutch Lake subwatershed. These strategies are both short- and long-term, and establish a framework for the Dutch Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

Although there are large, high quality wetlands in the subwatershed, there are several wetlands that have high or moderate restoration potential. Numerous other small wetlands of moderate restoration potential are located throughout the subwatershed. If restored, these wetlands could improve vegetative diversity and provide connected habitat within the watershed in addition to improving the water quality of Dutch Lake and Dutch Creek.

Carp Management

Historically, carp management focused on removal of carp

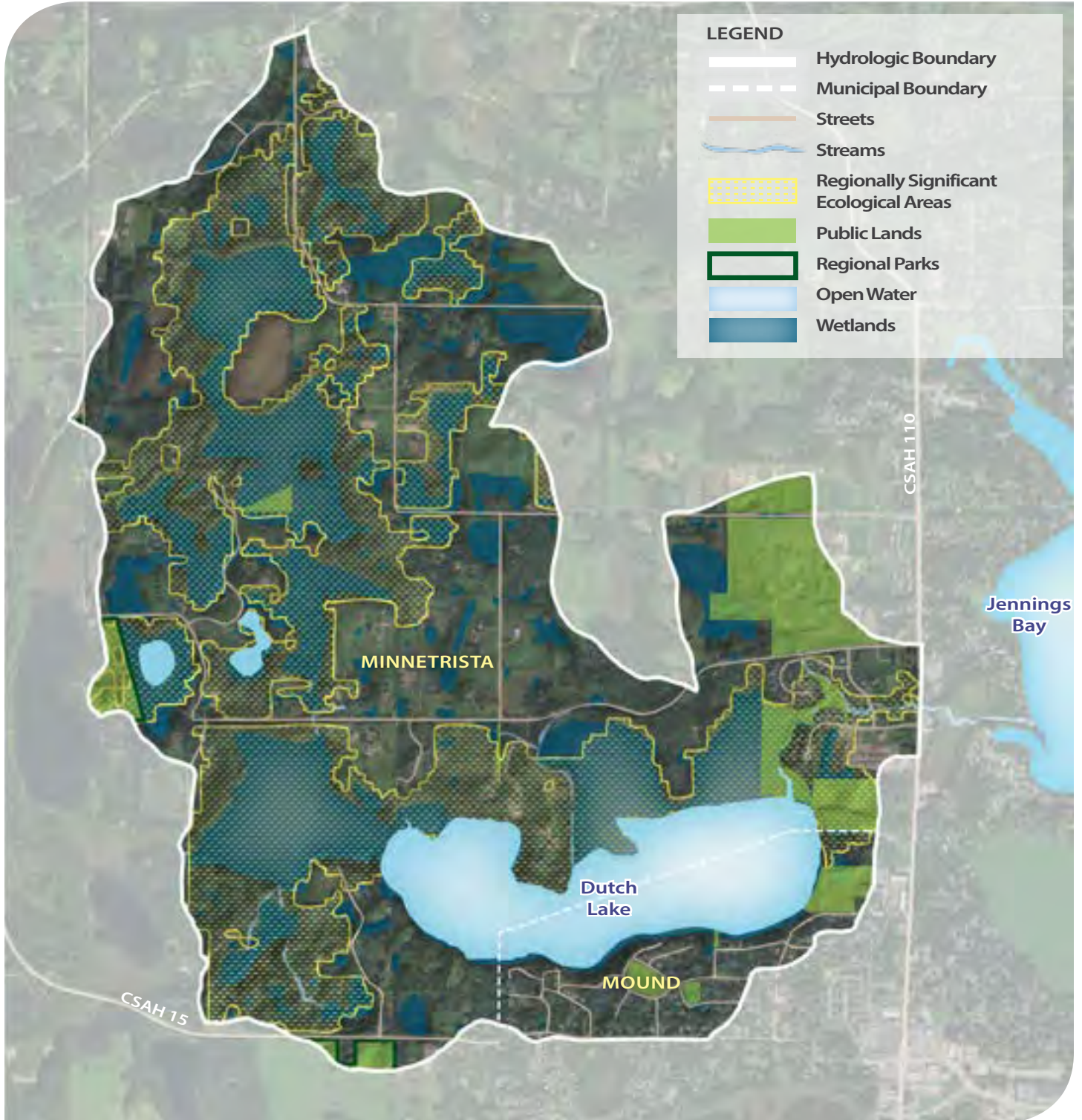


Figure 3.7 Dutch Lake Parks, Trails, and Open Space map



populations from impacted water bodies without any consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal, but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

Surveys should be conducted to determine the abundance of common carp in Dutch Lake and could warrant a subwatershed-wide assessment to inform management strategies. Carp management may need to occur prior to implementing other strategies to reduce internal loading.

Stormwater Management

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

In the Dutch Lake subwatershed, the focus will be on installing infiltration and load reduction BMPs, requiring stormwater pretreatment before discharge into any wetland, and enhancing buffers along Dutch Creek. The Dutch Lake TMDL also recommended enhancing shoreline buffers to filter runoff from lakeshore turf grass lawns. The District is also considering other strategies to reduce nutrient loads from the subwatershed. These include promoting repair or replacement of failing septic systems, assessing phosphorus loading from Camp Christmas Tree, and implementing BMPs on the Camp Christmas Tree property if necessary.

Stream Channel Restoration

Stream restoration focuses on balancing stormwater

conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and re-aeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Dutch Creek and other channels in the watershed should be investigated for restoration potential. While there is no biologic monitoring data available to document whether current conditions are stressful to aquatic life, Dutch Creek could benefit from streambank stabilization, buffer enhancement, improvements to stream aeration, and habitat enhancement.

Internal Sediment Phosphorus Control

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Once nutrient loads from the subwatershed have been reduced and common carp managed to low densities, an internal load reduction strategy, such as alum treatment or a flocculation system, should be considered for Dutch Lake. Additional data will need to be collected to determine appropriate treatment options.

Watershed Protection

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of development. This is accomplished by conserving biologically significant upland



Tamarack trees in Turner Wetland

areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

There are extensive high quality wetlands and uplands in the subwatershed. Much of the subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor and by the City of Minnetrista as a natural resources corridor. These natural areas are large and have high connectivity, creating corridors of habitat between Dutch Lake and Long Lake/Little Long Lake. The focus in this subwatershed will be to preserve these high-value resources through Land Conservation, where appropriate, and by working with cities and developers to minimize disturbance during development and construction.

LAND USE

EXISTING CONDITIONS

The subwatershed includes portions of the cities of Mound and Minnetrista. Land use in the subwatershed is generally characterized by undeveloped land (50%), including numerous large wetland systems and wooded areas, low-density development (20%), agricultural uses (10%), parks and open spaces (6%), and water (10%). The subwatershed includes large areas of undisturbed or minimally disturbed wetland and wooded areas. Much of the subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor and by the City of Minnetrista as a natural resources corridor due to the predominance and contiguity of wetlands.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Section 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for 2018-2027 (see Appendix B for details on the public input process). This information was used to broadly characterize opportunities, and to inform the development of the District's implementation plans. The information received

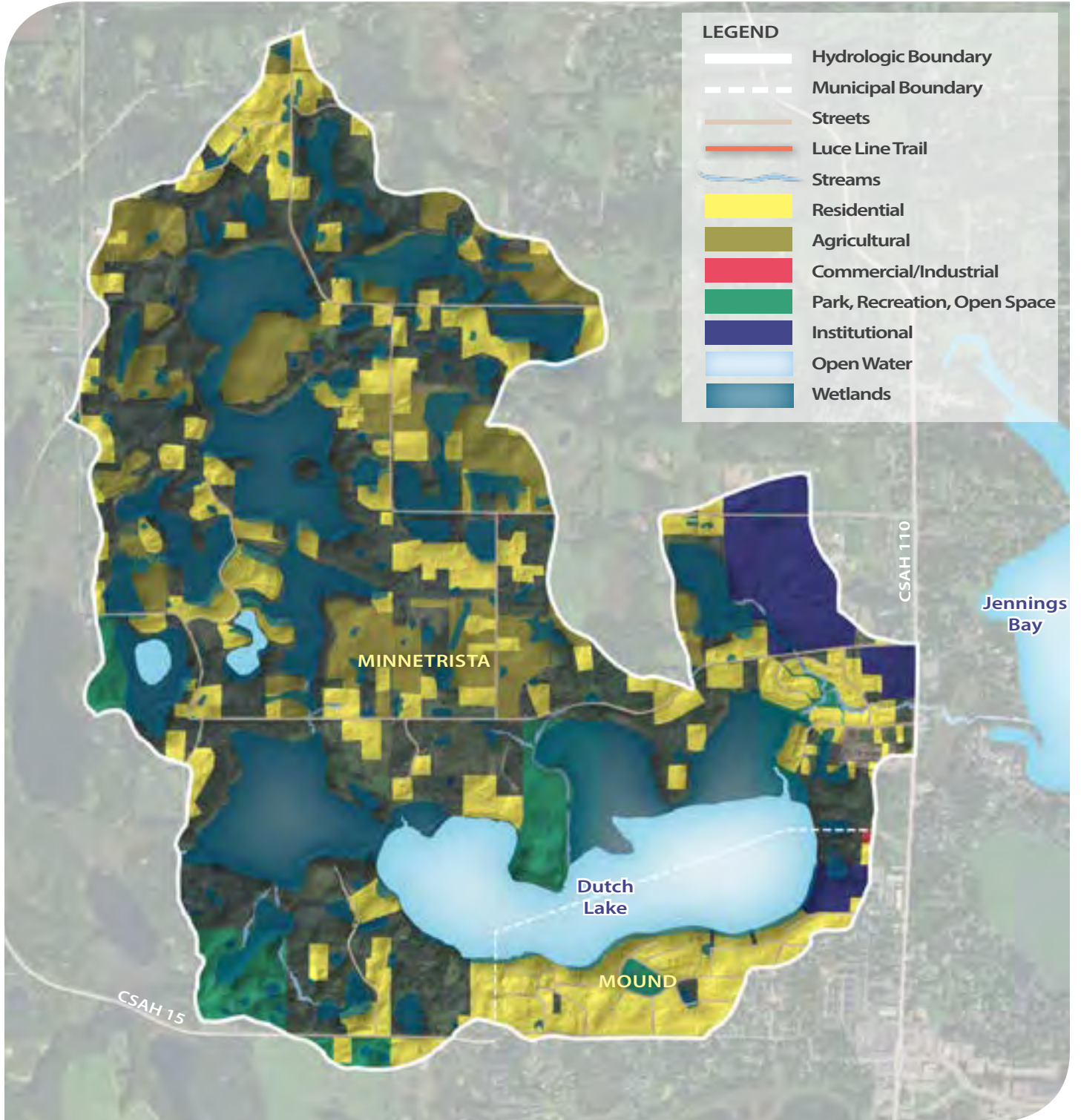


Figure 3.8 Dutch Lake Land Use map





was used only as a guide during the development of this Plan to inform the District of opportunities for partnership on the near term horizon, and was not intended to be exhaustive or restrict future collaborative efforts.

As discussed in Section 3.6, the District intends to cultivate a framework for two-directional coordination with communities on an ongoing basis, to stay apprised of emerging needs at a local level, and to identify and evaluate opportunities to implement management strategies outlined in this Plan over the next ten years. The District recognizes that local needs, opportunities and priorities may shift over time. Therefore, this Plan does not intend to capture or prescribe opportunities for partnership over a ten-year term.

Long term goals, growth and private development, and public investment in infrastructure differ across each community – and therefore, frameworks for ongoing coordination will be custom tailored based on the individual needs of each community. Coordination may occur at varying levels, through various means, with communities across the following areas:

- » Regulation of, and partnership with, private development
- » Collaboration on public planning and investment (e.g. parks, roads, utilities)
- » MS4 compliance
- » Development and implementation of TMDLs

During the information gathering processes of this Plan, one of the priorities identified by cities in the Dutch Lake Subwatershed was maintaining the area's rural character and access to natural resources. There was little anticipated for development or infrastructure investment within this subwatershed in the near-term, though some single family home rebuilds on Dutch Lake are expected.

There is an active lake association for Dutch Lake that is working to expand its membership. The Association plans to conduct outreach efforts to promote native shoreline plantings and residential stormwater management through raingardens or other BMPs.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, Dutch Lake is impaired by excess nutrients, and the inlet and outlet of Dutch Lake have elevated levels of total phosphorus. The outlet of Dutch Lake is also at high risk of chloride impairment. The fish and vegetation communities in Dutch Lake and its inlet and outlet may be negatively impacted by nutrient enrichment, low dissolved oxygen, and reduced water clarity. The subwatershed also contains areas of high quality, extensively connected wetland and upland, including several regionally significant ecological areas.

Based on these conditions, management strategies within the subwatershed will focus on promoting infiltration, reducing pollutant loading, managing carp, improving biodiversity and protecting existing resources.

The Dutch Lake subwatershed is relatively small and there is little anticipated for development or infrastructure investment within this subwatershed in the near-term, so the District expects limited opportunities to arise from land use change. However, the Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection

and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects.

In 2012, the District installed a sand-iron filter on the creek that flows into the northwest side of Dutch Lake in order to remove dissolved phosphorus. The project showed a significant reduction in phosphorus levels initially, but its performance has declined. The District is investigating why performance has declined and will seek to restore and maintain project function.

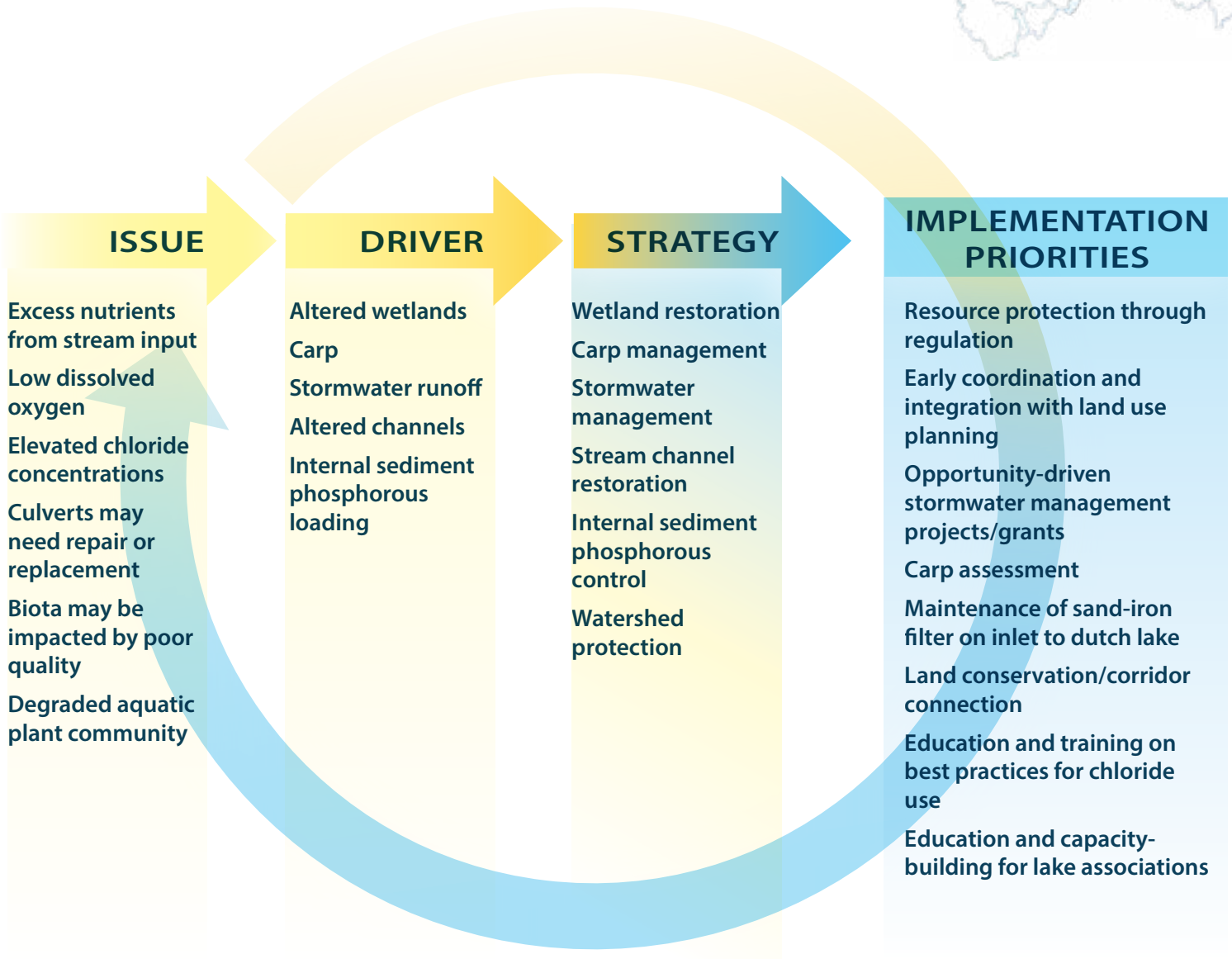
High quality wetlands and uplands in the subwatershed are extensive. The focus in this subwatershed will be to preserve these high-value resources through Land Conservation, where appropriate, and by working with cities and developers to minimize disturbance during development and construction.

The District may pursue a carp assessment for the Dutch Lake subwatershed as part of a larger assessment for the northwestern bays of Lake Minnetonka and their tributary subwatersheds. The goal of the assessment would be to understand the movement and recruitment patterns of carp in the system to inform management efforts. This work will be dependent on the District's ability to secure partner support and funding.

Dutch Creek was identified as being at high risk for chloride impairment. The District will continue to monitor chloride levels and provide education and training for public and private applicators and residents on best practices for chloride use.

As noted in the previous section, there is an active lake association for Dutch Lake. The District will continue to work with its lake associations to provide education and technical assistance to build their capacity and target implementation efforts.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. In the future, should the District or a partner determine that a larger or more concentrated scale of capital and program implementation may be needed, a discrete subwatershed planning process may be initiated to:



- » Provide high resolution diagnostic of watershed issues and drivers
- » Map current projected land use and infrastructure changes
- » Define a detailed and integrated capital and program implementation plan
- » Outline a funding strategy including program costs and sources

The details of such a plan would provide the information needed

for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Plan.

CAPITAL IMPROVEMENT PLAN

The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District's scope and priorities for its capital work over the planning period. A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified

in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other policy considerations before a formal decision to proceed to construction is made. Section 3.5.5 describes the development and evaluation steps that will occur before the District will commit resources to a project.

Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures.

A critical component of any project will be the development of a funding strategy that identifies the sources, uses, and timing of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District's public and private partners as capital projects are advanced. Therefore, any costs identified within this Plan are projections. Intended expenditures will be refined during project development and budgeting, and among other things will reflect the District's intent to complement its ad valorem funds with other funding sources.

Table 3.6 Dutch Lake Subwatershed CIP

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Dutch Lake and downstream Jennings Bay, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Dutch Lake exceeds state excess nutrient standards. A TMDL identified a need to reduce external phosphorus loading by 60% (193 pounds) to Dutch Lake.
Outcome	Reduction of pollutant loading to Dutch Lake and downstream Jennings Bay; reduction of stormwater runoff volume and rate and associated impacts; protection and enhancement of groundwater recharge, stream base flow, and wetland hydrology.
Estimated Cost	Capital costs: \$780,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

3.9.3 GLEASON LAKE SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Gleason Lake Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District’s philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Gleason Lake is a 6.8 square mile (4,365 acre) subwatershed located along the northern boundary of the MCWD and includes portions of the cities of Minnetonka, Orono, Plymouth and Wayzata. The subwatershed is generally characterized by low density development, including many single-family homes (58%), water (9%), parks and open spaces (8%), and undeveloped land (7%). The subwatershed contains several lakes, including Gleason, Hadley, Mooney, Kreatz and Snyder. Some scattered wetlands are identified as having high vegetative diversity and wildlife habitat.

The eastern portion of the subwatershed drains through several wetlands including Kreatz and Snyder Lakes and then to County Ditch #15, which discharges into Gleason Lake. The western watershed drains through Hadley Lake and then south to Gleason Lake Creek, which outlets the south end of Gleason Lake and flows by channel and culvert to Glenbrook Pond. The Pond outlets to a storm sewer that discharges downstream to Wayzata Bay. Mooney Lake is naturally land-locked, but the City of Plymouth, in coordination with the District, maintains the capacity to reduce high water by pumping from the lake toward Hadley Lake.

Gleason Lake subwatershed has several issues relating to water quality, water quantity and ecological integrity. Four lakes in the subwatershed, Mooney, Kreatz, Gleason and Hadley are listed on the State’s Impaired Waters list for excessive nutrients. One county ditch also has elevated levels of total phosphorus and chloride. Modeling predicts that the subwatershed will experience localized flooding during large rain or snowmelt events due to overtopping of infrastructure. Overall, the system has moderate ecological integrity. There are areas of high quality wetland, which must be protected, but the lower watershed

lacks high-quality wetland and habitat connectivity. There are also impaired macroinvertebrate and fish communities within the subwatershed, as well as invasive vegetation and low dissolved oxygen.

Management strategies within Gleason Lake subwatershed will focus on promoting infiltration, reducing pollutant loading, improving biodiversity and protecting existing resources. The District will collaborate on these management strategies with local and state government, developers, lake associations, citizens’ groups and other parties to implement. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Gleason Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality Lakes and Streams

Four lakes in the subwatershed are listed on the State’s Impaired Waters list, with average summer nutrient concentrations greater than the state standard: Gleason, Hadley, Mooney and Kreatz Lakes. In addition, Snyder Lake exceeds the state water quality standards, but does not meet the state’s size threshold for impairment. A TMDL identifying nutrient load reduction goals and suggested actions has been completed for those lakes. Water quality data are limited for the other lakes in the subwatershed.

The inlet to Gleason Lake has elevated levels of total phosphorus and chloride. Gleason Creek, the outlet to Gleason Lake, also has elevated levels of chloride.

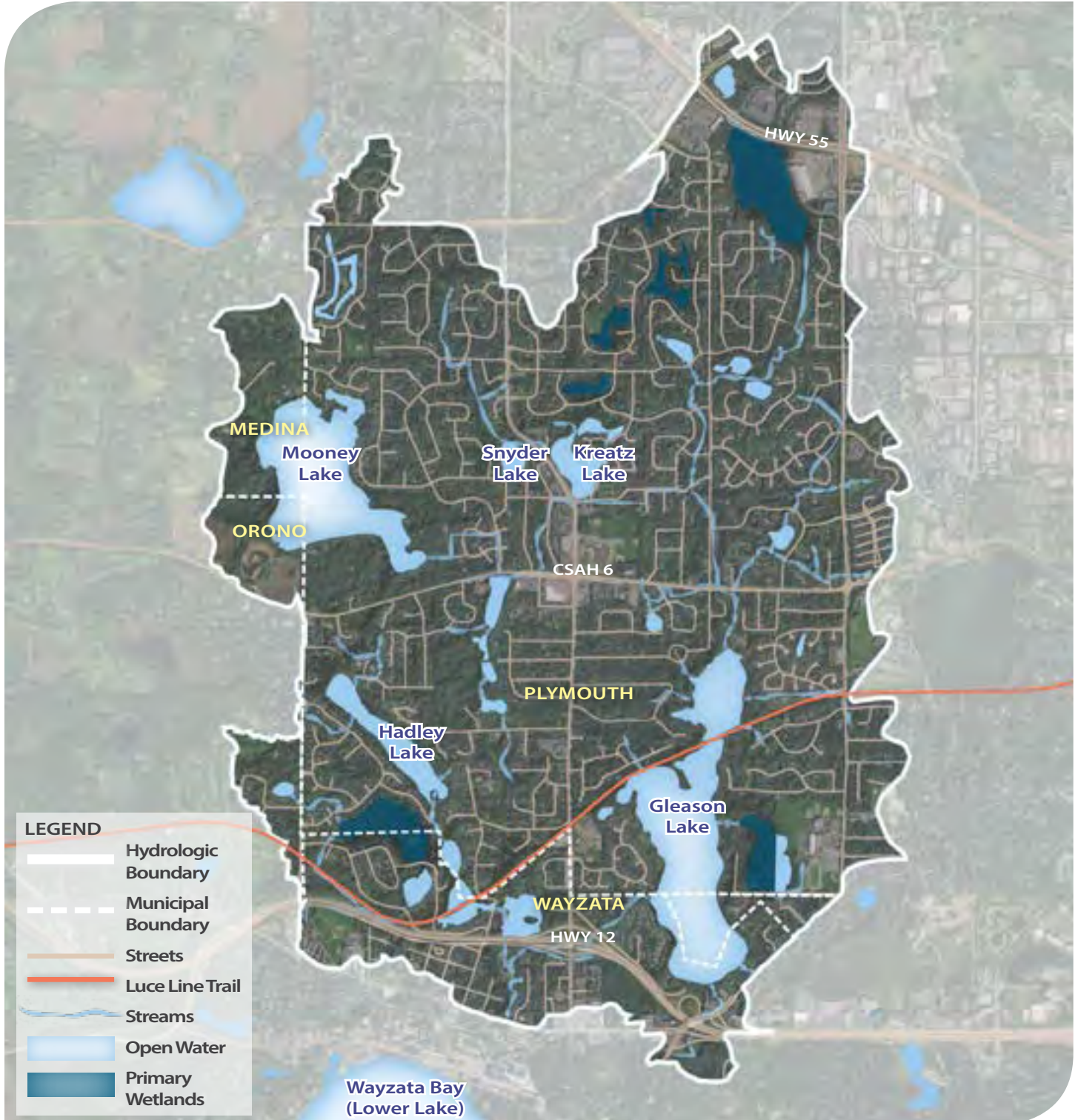
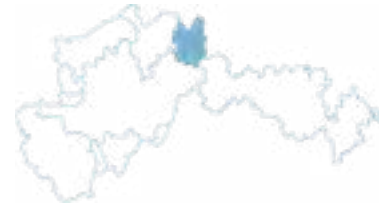


Figure 3.9 Gleason Lake Base map



Wetlands

Most of the wetlands in the subwatershed have been impacted by development and stormwater inflow, and serve mainly to protect downstream water quality.

Groundwater

There are areas of aquifer sensitivity in the subwatershed. The entire Gleason Lake subwatershed has been designated by the Minnesota Department of Health as a Drinking Water Supply Management Area and as a Wellhead Protection Area for City of Plymouth public wells. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity

Locations throughout the system have been identified through observation and the District’s modeling as vulnerable to localized flooding.

Many of the wetlands in this subwatershed are groundwater-fed discharge or recharge-discharge wetlands. Groundwater recharge is important within the subwatershed to maintain wetland hydrology and stream baseflow, as well as to recharge aquifers that supply public and private drinking water wells.

Nearly the entire subwatershed is within a Wellhead Protection Area and there may be restrictions on the use of infiltration as a water quality practice.

Mooney Lake has no natural outlet. In 2007, the City of Plymouth and the District undertook a cooperative project to install infrastructure to support future emergency pumping, including an outlet pipe, lift station, and connection to the Plymouth storm sewer system. Plymouth is responsible for operating the system, and the District is responsible for monitoring downstream areas and potential adverse impacts.

Ecological Integrity Lakes and Streams

Data suggest that Gleason Lake maintains a moderately healthy fishery and vegetation community, although the vegetation community lacks biodiversity. Curly leaf pondweed is present and has been managed in the lake.

Gleason Creek also has a highly degraded macroinvertebrate community dominated by pollution-tolerant species. The Creek experiences periods of low dissolved oxygen. No fish data are available for any streams within the subwatershed.



Gleason Lake

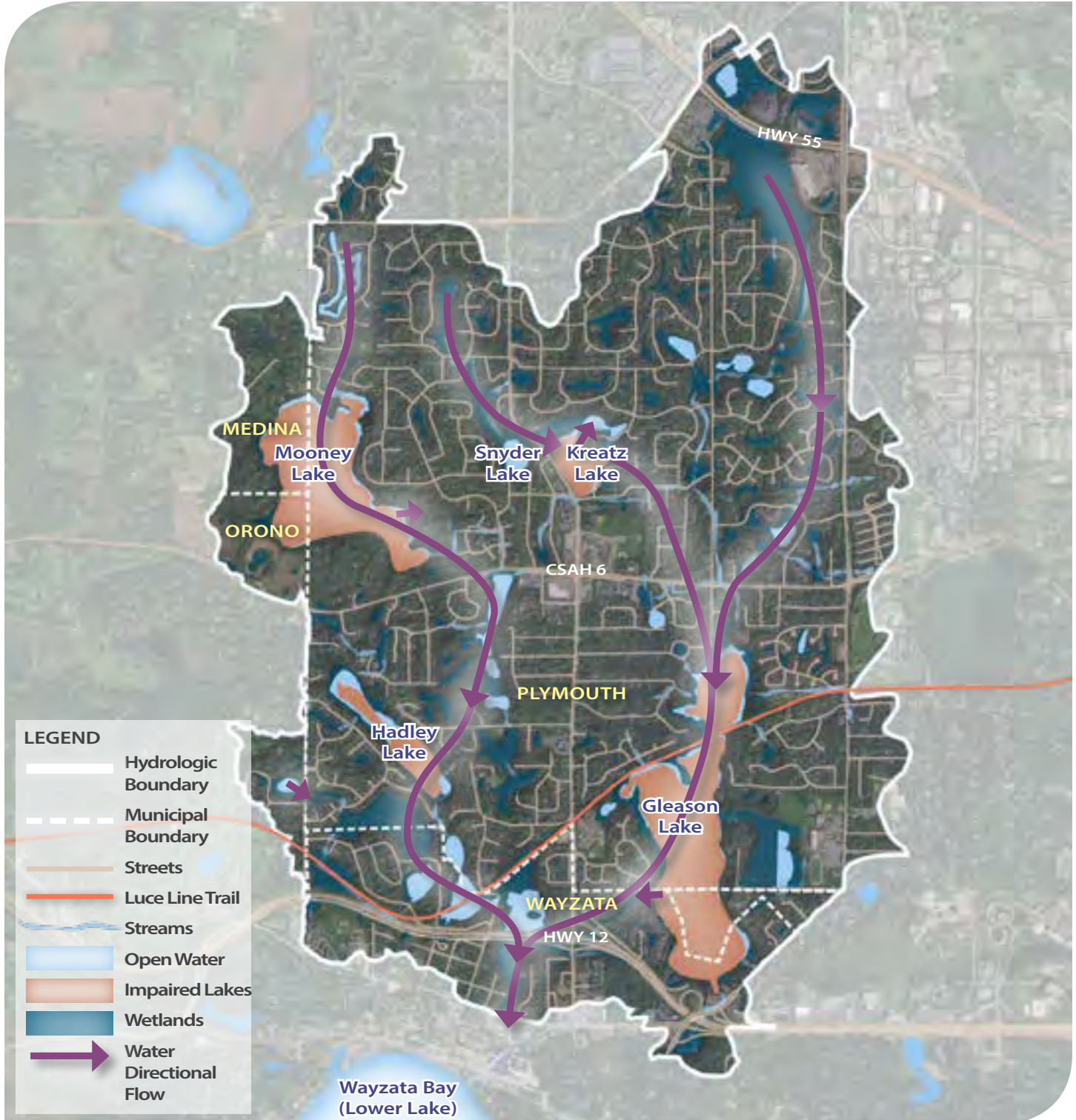
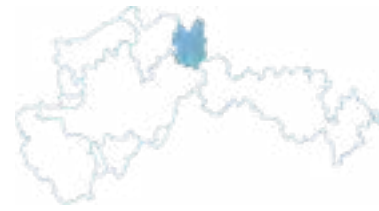


Figure 3.10 Gleason Lake Water Resources map



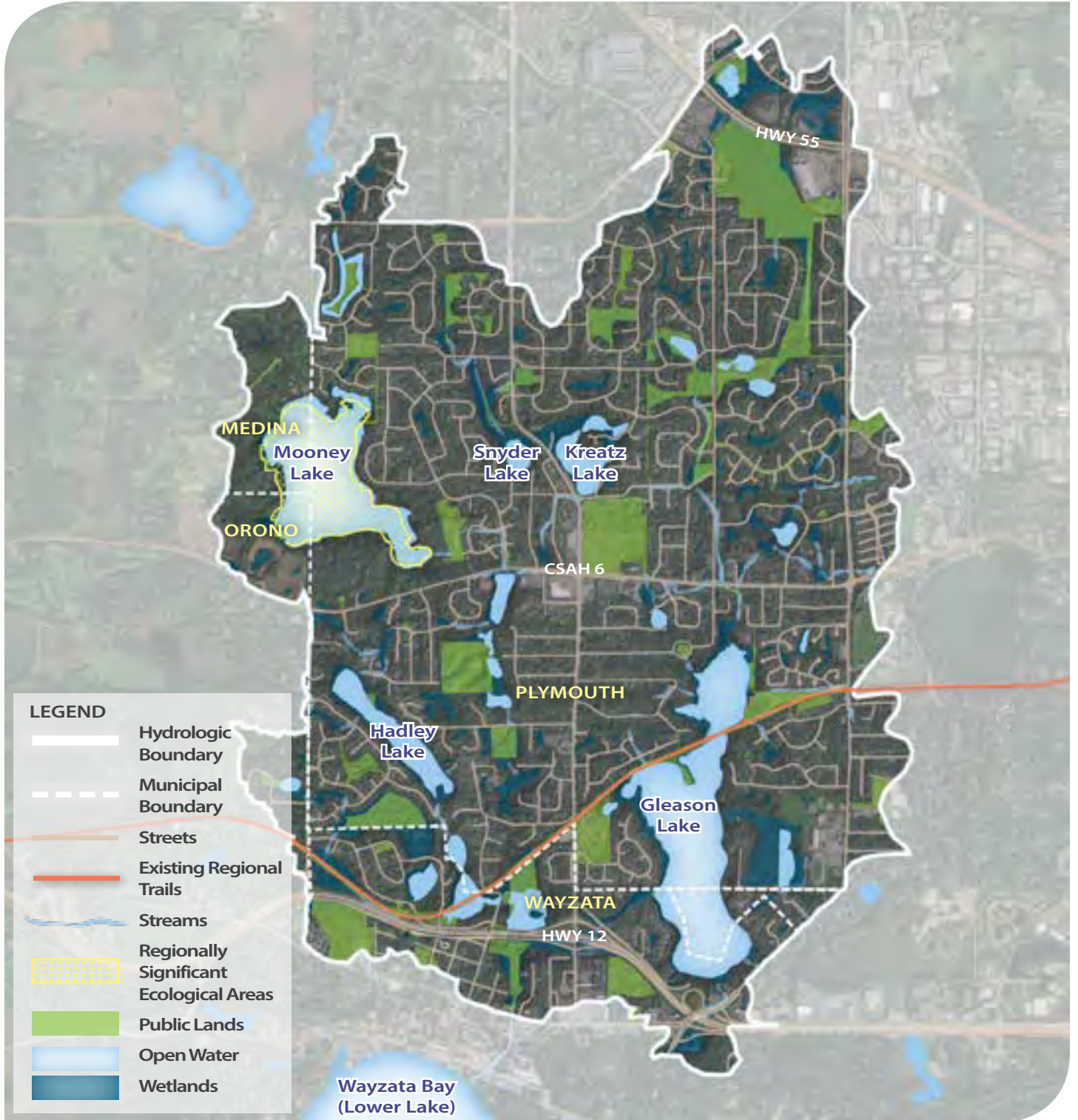
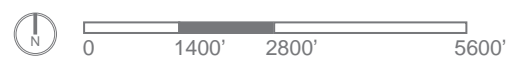
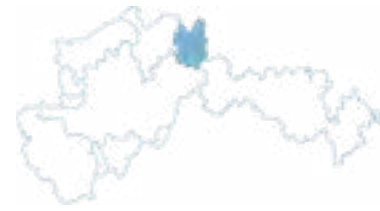


Figure 3.11 Gleason Lake Parks, Trails, and Open Space map





Wetlands

Scattered wetlands have been identified as having high vegetative diversity and wildlife habitat, as well as high aesthetic values. Two large wetlands scored highly on vegetative diversity, fish and wildlife habitat or aesthetics. Wetlands with these qualities are in need of protection. Their conservation is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

One small wetland within in the watershed has high restoration potential and a few small wetlands have moderate restoration potential.

Uplands and Natural Corridors

Uplands in the subwatershed are mostly developed, with few intact areas of minimal disturbance. The Minnesota Biological Survey (MBS) did not identify any landscape areas of biological significance in this subwatershed. Some wooded and wetland areas around Hadley Lake and a few pocket wetlands and wooded areas elsewhere in the subwatershed provide the most significant areas of habitat and biological integrity.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Gleason Lake subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Gleason Lake subwatershed are:

Water Quality

- » Excess nutrients in lakes and streams
- » Low dissolved oxygen
- » Elevated chloride concentrations in streams

Water Quantity

- » Localized flooding
- » Emergency pumping from Mooney Lake

Ecological Integrity

- » Degraded macroinvertebrate community
- » Degraded and disconnected wetland and terrestrial corridors

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading
- » Water quality from upstream waterbodies

Altered Wetlands

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved fraction) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

There are scattered wetlands in the Gleason Lake subwatershed. County Ditch #15, which flows south through open channel and storm sewer along Dunkirk Lane, flows through some ponds and small remnant wetlands. South of County Road 6 it flows through a pond/wetland system before discharging into Gleason Lake. Nutrient concentrations in the channel at the lake's inlet are elevated, which is likely a combination of nutrient load from the urbanized subwatershed and load from sediment release in the altered wetlands.

Stormwater Runoff

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up pollutants such as excess nutrients, bacteria (e.g., *E. coli*), chloride from road salt, and toxic pollutants. In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters, because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally, as impervious cover, altered drainage, and stormwater runoff within a watershed increase, the quality of lakes, streams and wetlands decreases.

Gleason, Hadley, Mooney and Kreatz Lakes exceed the state standard for total phosphorus, and Gleason Creek has elevated levels of phosphorus and chloride. Runoff from lawns and streets in the subwatershed could be a source of phosphorus and chloride to these water bodies. The Upper Watershed Lakes TMDL requires reductions in nutrients from stormwater runoff to meet state lake water quality standards in each lake by 64, 41, 89, and 33 percent respectively.

Altered Channels

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and

increased sediment transport which can negatively impact fish and macroinvertebrate communities.

At least two altered channels exist within the Gleason Lake subwatershed. County Ditch #15 drains the upper watershed to Gleason Lake. County Ditch #32 is the channelized portion of Gleason Creek, the outlet of Gleason Lake. Gleason Creek has a highly degraded macroinvertebrate community, which is likely due in part to habitat degradation that occurred when the stream was channelized. No data exist for macroinvertebrate communities in County Ditch #15.

Internal Sediment Phosphorus Loading

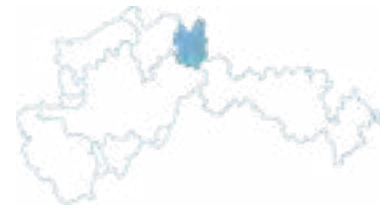
Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Internal loading does not appear to be a significant issue for Mooney and Kreatz Lakes, but the Upper Watershed Lakes TMDL requires reductions in nutrients from internal sources to meet state lake water quality standards of 50 percent in Gleason Lake and 54 percent in Hadley.

Upstream Waterbodies

Headwater streams, lakes and wetlands contribute water and nutrients to downstream receiving waters impacting the quality of these water bodies. Lakes and wetlands with poor water quality ultimately contribute nutrients to downstream waters that can lead to eutrophication. Consequently, restoration of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Mooney Lake is upstream of Hadley Lake, which is tributary to Gleason Lake. Kreatz and Snyder Lakes are also upstream of Gleason Lake, which exceeds the state standard for total phosphorus. High-phosphorus discharge from these upstream



lakes likely contributes to elevated phosphorus concentrations to tributary lakes and eventually to Gleason Lake.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Gleason Lake subwatershed. These strategies are both short- and long-term, and establish a framework for the Gleason Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying

hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

The District has identified one small wetland within in the watershed with high restoration potential and several small wetlands with moderate restoration potential.

Stormwater Management

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure



Hadley Lake

management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

In the Gleason Lake subwatershed, the focus will be on installing infiltration and load reduction BMPs, requiring stormwater pretreatment before discharge into any wetland, enhancing buffers along streambanks, regulating freeboard required on new developments and redevelopments, and requiring local plans to discuss flood prevention and mitigation. In addition, actions to limit new or reduce existing stormwater volumes to Mooney Lake will help to minimize adverse effects from high water levels.

Stream Channel Restoration

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and reaeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

In the Gleason Lake subwatershed, there are limited options to restore streams to more natural conditions. However, County Ditches #15 and #32, Gleason Creek, and other channels should be comprehensively inspected to determine the extent of any current or potential erosion and restoration needs. In 2012, the District partnered with the City of Plymouth to complete a stream stabilization project.

Internal Sediment Phosphorus Control

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

The 2014 TMDL determined that internal load plays a significant role in the water quality of Gleason and Hadley Lakes. Additional information such as bathymetry and sediment core release data is necessary to determine the most effective approach to internal load management in Hadley Lake. An alum treatment within Gleason Lake may reduce release of internal nutrient loads.

Restoration of Upstream Waterbodies

Upstream water bodies that are currently impaired can discharge large nutrient loads to downstream water bodies thereby contributing to downstream water quality impairments. Therefore, prior to, or concurrent with, significant efforts to restore downstream water quality, the water quality in upstream water bodies must be improved. Nutrient impaired upstream lakes may require external and internal nutrient reductions using the strategies listed in this section.

The 2014 Upper Watershed Lakes TMDL determined that phosphorus export from stream water bodies such as Mooney, Hadley, Kreatz and Snyder Lakes and several wetlands, was contributing to the impairment the water quality of Gleason Lake. Improvement to those upstream water bodies is essential to the improvement of Gleason Lake.

LAND USE

EXISTING CONDITIONS

Most of the subwatershed is within the city of Plymouth, with a portion of the City of Wayzata, and very small areas within Medina, Minnetonka, and Orono. The subwatershed is generally characterized by low density development, including many single-family homes (58%), water (9%), parks and open spaces (8%), and undeveloped land (7%). The subwatershed contains several lakes, including Gleason, Hadley, Mooney, Kreatz and Snyder. Some scattered wetlands are identified as having high vegetative diversity and wildlife habitat.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Sections 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

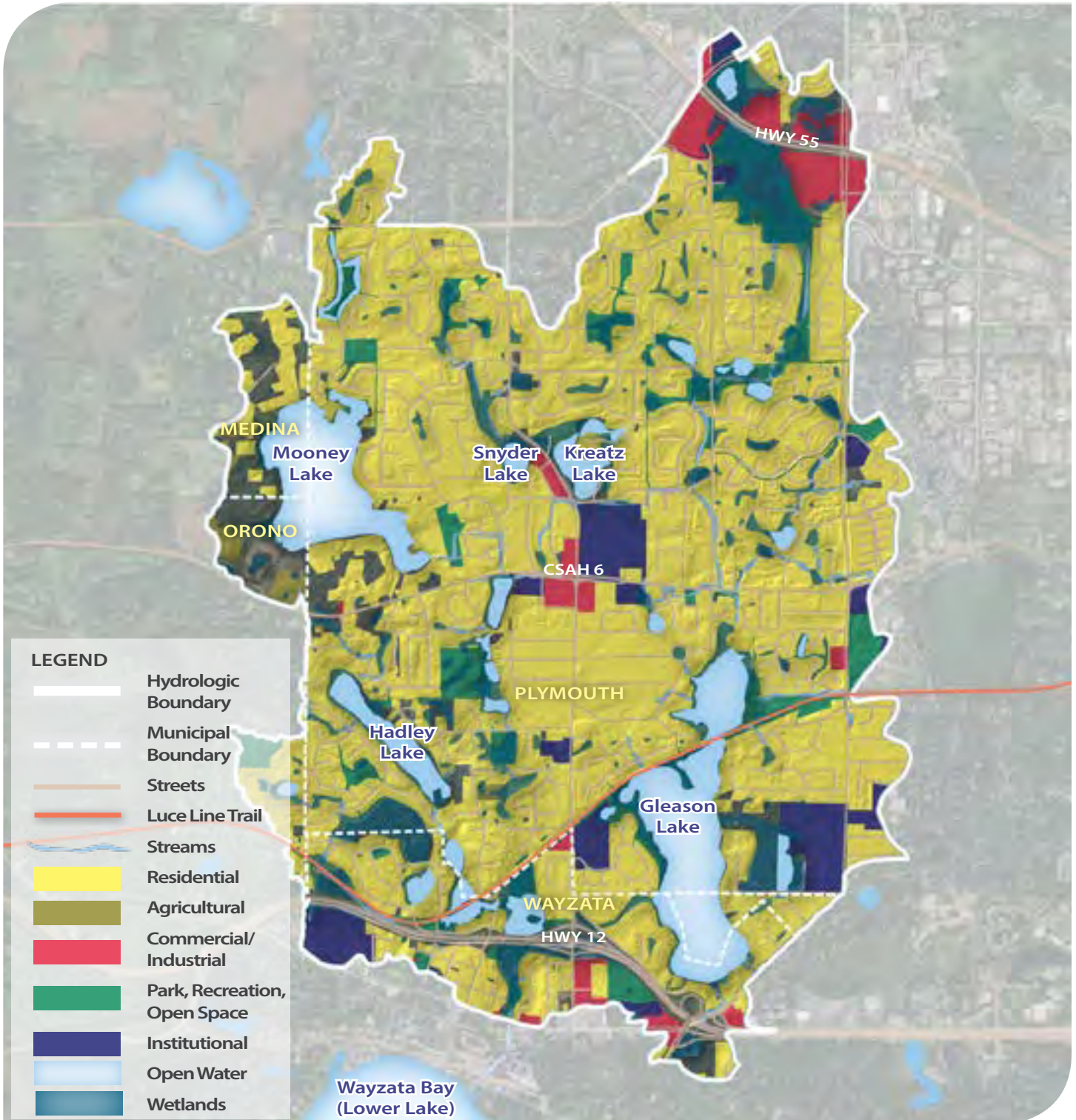
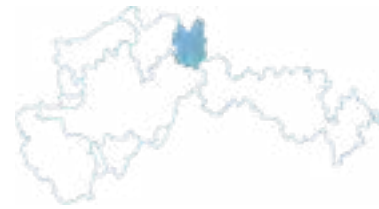


Figure 3.12 Gleason Lake Land Use map



As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for 2018-2027 (see Appendix B for details on the public input process). This information was used to broadly characterize opportunities, and to inform the development of the District’s implementation plans. The information received was used only as a guide during the development of this Plan to inform the District of opportunities for partnership on the near term horizon, and was not intended to be exhaustive or restrict future collaborative efforts.

As discussed in Section 3.6, the District intends to cultivate a framework for two-directional coordination with communities on an ongoing basis, to stay apprised of emerging needs at a local level, and to identify and evaluate opportunities to implement management strategies outlined in this Plan over the next ten years. The District recognizes that local needs, opportunities and priorities may shift over time. Therefore, this Plan does not intend to capture or prescribe opportunities for partnership over a ten-year term.

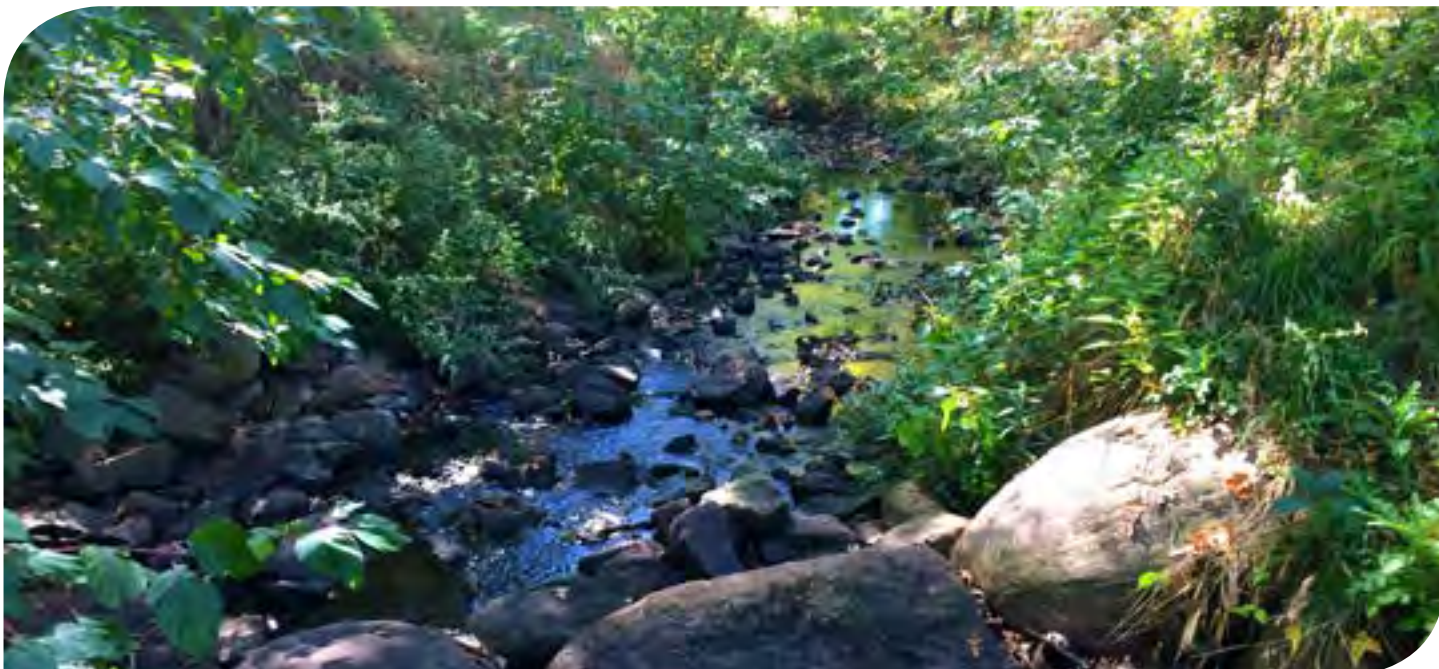
Long term goals, growth and private development, and public investment in infrastructure differ across each community – and therefore, frameworks for ongoing coordination will be custom

tailored based on the individual needs of each community. Coordination may occur at varying levels, through various means, with communities across the following areas:

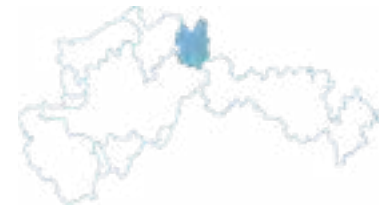
- » Regulation of, and partnership with, private development
- » Collaboration on public planning and investment (e.g. parks , roads, utilities)
- » MS4 compliance
- » Development and implementation of TMDLs

Through the information gathering processes of this Plan, the District was informed that the cities do not expect any major development to occur within the subwatershed in the near future, though there may be some pockets of residential infill. The cities will seek to incorporate stormwater Best Management Practices (BMPs) in municipal infrastructure projects, where possible. The City of Plymouth has a number of drainage improvement, stormwater management, and stream restoration projects identified in its 5-year CIP that may present opportunities for District partnership.

The City of Plymouth conducts some of its own water quality,



Chelsea Woods stream restoration



quantity, and effectiveness monitoring and also develops some education materials related to water resources. The District and City will seek to coordinate on these programmatic activities to minimize duplication of effort.

There are active lake associations for both Mooney and Gleason Lakes. The Gleason Lake Association conducts some monitoring of water quality and invasive species and has also undertaken some invasive vegetation management. The associations look to the District for technical assistance and guidance to support their management efforts.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, the Gleason Lake subwatershed has several issues relating to water quality, water quantity and ecological integrity. Four lakes in the subwatershed, Mooney, Kreatz, Gleason, and Hadley, are listed on the State's Impaired Waters list for excessive nutrients. One county ditch also has elevated levels of total phosphorus and chloride. Modeling predicts that the subwatershed will experience localized flooding during large rain or snowmelt events due to overtopping of infrastructure. There are areas of high quality wetland, which must be protected, but the lower watershed lacks high-quality wetland and habitat connectivity. There are also impaired macroinvertebrate and fish communities within the subwatershed, as well as invasive vegetation and low dissolved oxygen.

Based on these conditions, management strategies within Gleason Lake subwatershed will focus on promoting infiltration, reducing pollutant loading, improving biodiversity, and protecting existing resources. In past years, the District has worked in partnership with the cities in this subwatershed to implement regional stormwater management and stream restoration projects.



Gleason Lake

The Gleason Lake subwatershed is mostly developed and there is little anticipated near-term development within this subwatershed, so the District expects opportunities from land use change to be limited. The City of Plymouth has a number of drainage improvement, stormwater management, and stream restoration projects identified in its 5-year CIP that may present opportunities for District partnership. The Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects.

The inlet to Gleason Lake has elevated levels of total phosphorus and chloride. Gleason Creek, the outlet to Gleason Lake, also has elevated levels of chloride. The District will continue to monitor chloride levels and provide education and training for public and private applicators and residents on best practices for chloride use.

As noted in the previous section, there are active lake associations for Mooney and Gleason Lakes. The District will continue to work with its lake associations to provide education and technical assistance to build their capacity and target implementation efforts.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. In the future, should the District or a partner determine that a larger or more concentrated scale of capital and program implementation may be needed, a discrete subwatershed planning process may be initiated to:

- » Provide high resolution diagnostic of watershed issues and drivers
- » Map current projected land use and infrastructure changes
- » Define a detailed and integrated capital and program implementation plan
- » Outline a funding strategy including program costs and sources

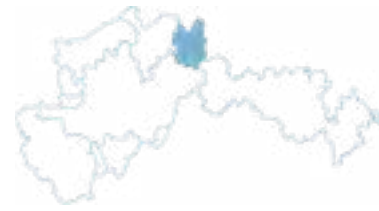
The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Plan.

CAPITAL IMPROVEMENT PLAN

The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District’s scope and priorities for its capital work over the planning period. A project’s inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other policy considerations before a formal decision to proceed to construction is made. Section 3.5.5 describes the development and evaluation steps that will occur before the District will commit resources to a project.

Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures.

A critical component of any project will be the development of a funding strategy that identifies the sources, uses, and timing



of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District’s public and private partners as capital projects are advanced. Therefore, any costs identified within this Plan are projections. Intended

expenditures will be refined during project development and budgeting, and among other things will reflect the District’s intent to complement its ad valorem funds with other funding sources.

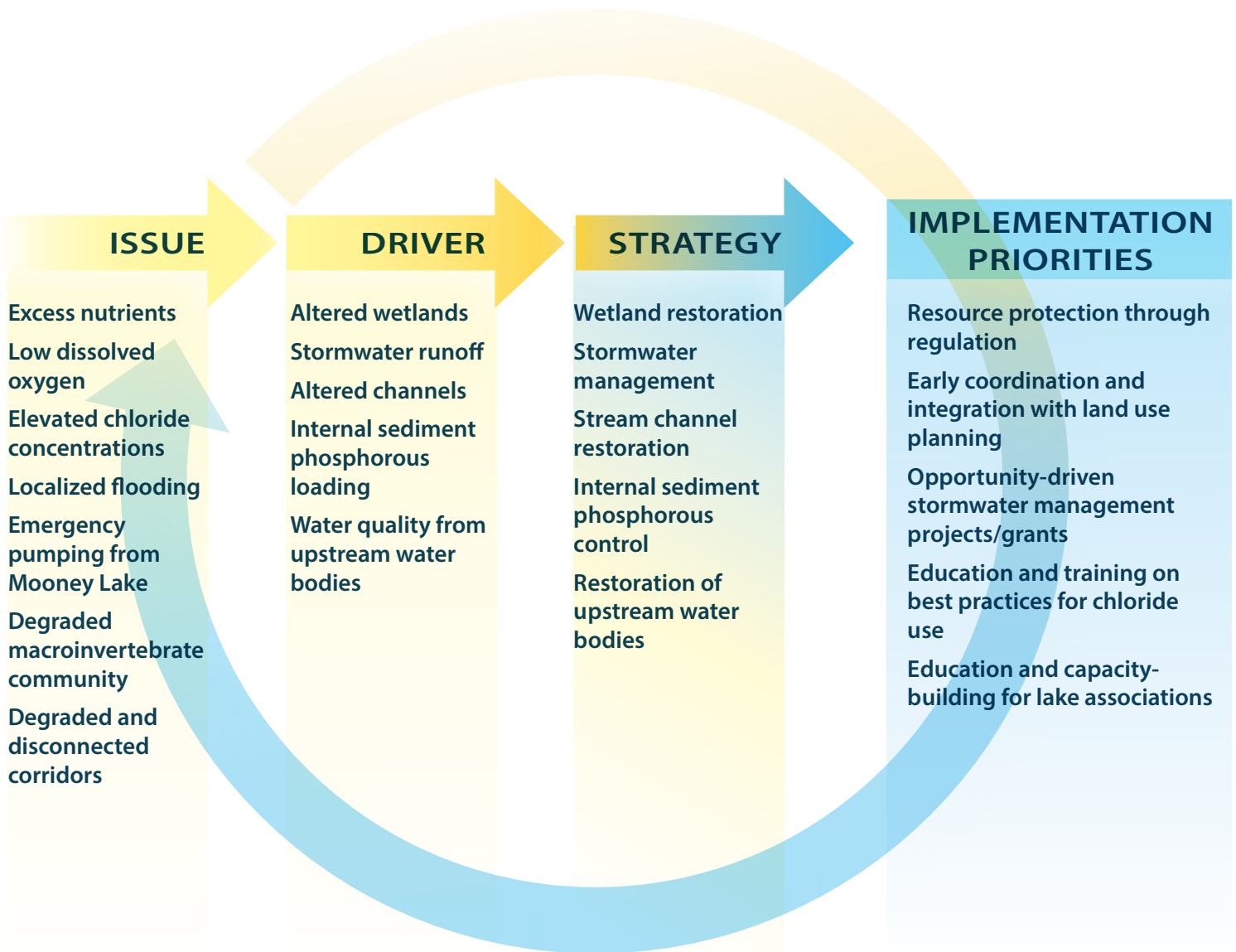


Table 3.7 Gleason Lake Subwatershed CIP

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Gleason, Mooney, Hadley, and Snyder lakes, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Four lakes in the subwatershed exceed state excess nutrient standards - Gleason, Hadley, Mooney, and Snyder. A TMDL identified a need to reduce external phosphorus loading by 64% (207 pounds) to Gleason Lake, 90% (58 lbs) to Mooney Lake, 41% (25 lbs) to Hadley Lake, and 33% (4 lbs) to Snyder Lake.
Outcome	Reduction of pollutant loading to Gleason, Hadley, Mooney, and Snyder lakes; reduction of stormwater runoff volume and rate and associated impacts; protection and enhancement of groundwater recharge, stream base flow, and wetland hydrology.
Estimated Cost	Capital costs: \$600,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

3.9.4 LAKE MINNETONKA SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Lake Minnetonka Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District’s philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Lake Minnetonka is a 50.8 square mile (32,515 acre) subwatershed located in the western portion of the MCWD and includes portions of the cities of Chanhassen, Deephaven, Excelsior, Greenwood, Long Lake, Minnetonka, Minnetonka Beach, Minnetrista, Mound, Orono, Shorewood, Spring Park, Tonka Bay, Victoria, Wayzata and Woodland.

The subwatershed is generally characterized by water (45%), most of which is Lake Minnetonka, and low density development (30%). The subwatershed also contains undeveloped land (13%), parks and open spaces (6%), and agricultural land (2%).

Most land in the subwatershed is developed, although the upper subwatershed includes some large agricultural and forested areas, with wetlands scattered throughout.

Lake Minnetonka is the primary receiving water within the subwatershed. Drainage is conveyed from the watershed to Lake Minnetonka through several streams, including Gleason Creek, Long Lake Creek, Classen Creek, Painter Creek, and Six Mile Creek, as well as through smaller channels or storm sewers. The subwatershed outlets through a control structure on Grays Bay into Minnehaha Creek.

The Lake Minnetonka subwatershed has several issues relating to water quality, water quantity and ecological integrity. Four bays (Halsted, Jennings, West Arm, Stubbs) and Forest Lake are listed on the State’s Impaired Waters List due to excess nutrients, and pursuant to an approved Total Maximum Daily Load (TMDL) require both external and internal load reductions. Impairments are generally a product of large tributary drainage areas (e.g. Six Mile Creek – Halsted, Painter Creek – Jennings) and the level of internal loading (phosphorus into the water column from organic sediments) which can be exacerbated by the presence of common carp and some aquatic plants.



Lake Minnetonka from LRT Trail

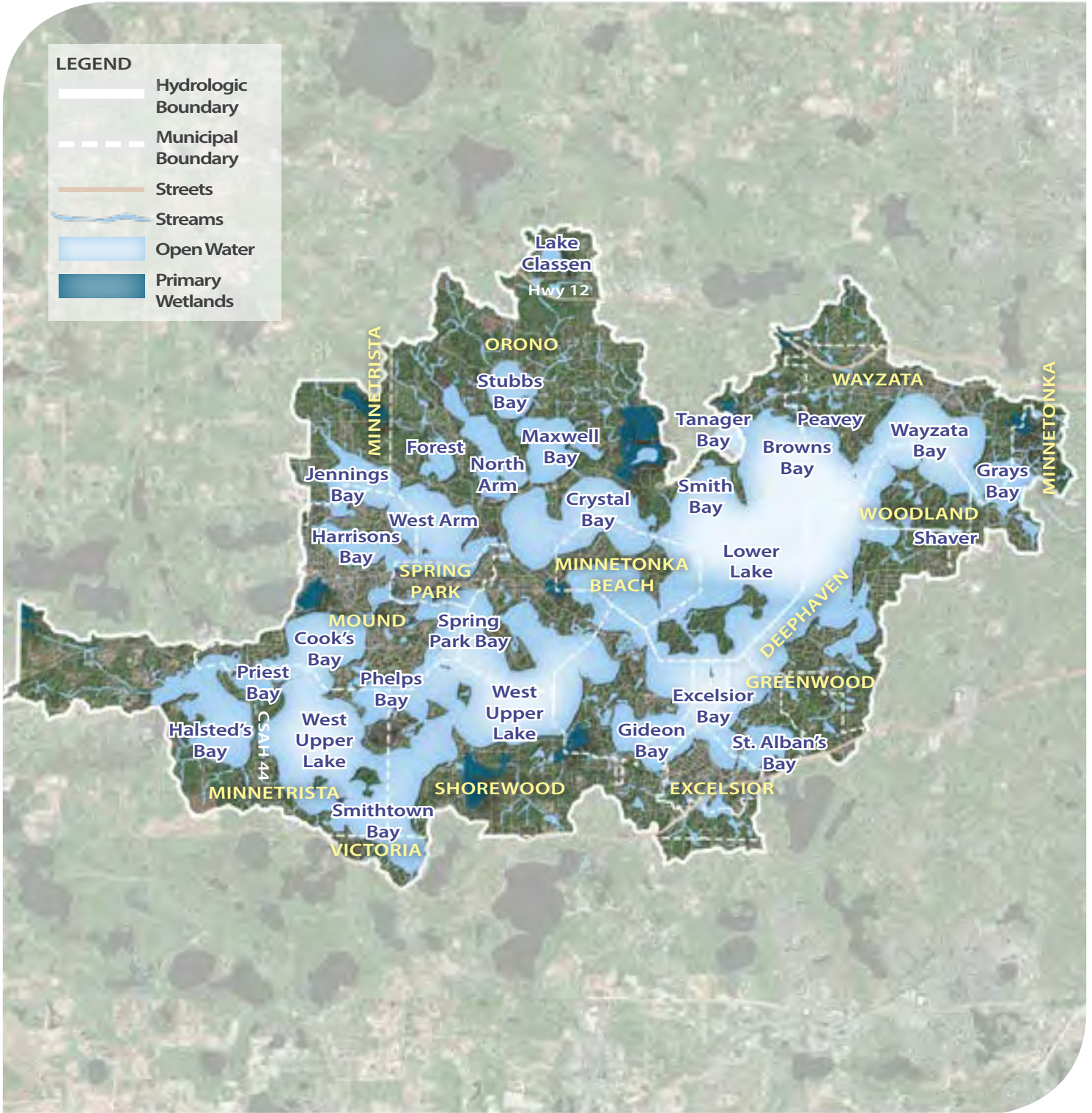


Figure 3.13 Lake Minnetonka Base map



Regarding water quantity, there are locations in the subwatershed within Lake Minnetonka's floodplain that are subject to localized flooding due to the volume of water received from tributary subwatersheds, which can cause lake levels to rise. Lake levels are managed through the operation of the Gray's Bay Dam, informed by existing lake level, downstream capacity in Minnehaha Creek, seasonal variation, and precipitation predicted through partnership with the National Weather Service.

Lake Minnetonka does contain aquatic invasive species, but overall, the subwatershed enjoys high ecological integrity with an excellent fish community in Lake Minnetonka and exceptional vegetative diversity in wetlands.

Management strategies within the subwatershed will focus on addressing impaired bays within Lake Minnetonka by reducing external loading to the lake from upstream tributary subwatersheds, and by addressing internal loading within the lake; protecting existing high value natural resources; and improving ecological integrity by promoting shoreline best management through partnership with local communities, shoreline contractors and landowners. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Lake Minnetonka subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality **Lakes and Streams**

Four bays in Lake Minnetonka (Halsted Bay, Jennings Bay,

Stubbs Bay and West Arm) and Forest Lake are listed on the State's Impaired Waters list for nutrients, with average summer phosphorus concentrations greater than the state standards. External loading from the watershed and internal loading from lake sediments are contributing to these concentrations. Peavey Lake is listed as impaired for chlorides.

Zebra mussels are present throughout the entire lake, and are likely influencing increases in water clarity throughout the lake and reductions in Chlorophyll-a in some areas of the lake.

At this time, no streams are listed as impaired. Classen Creek, which serves as the outlet of Lake Classen and flows to Stubbs Bay, and two other small streams are not listed as Impaired Waters for nutrients, but have high total phosphorus concentrations which exceed state river eutrophication standards for phosphorus.

Wetlands

There are wetlands in the subwatershed with high vegetative diversity that are sensitive to the quality of stormwater inputs.

Groundwater

There are areas of moderate to high aquifer sensitivity in the subwatershed. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity

The District's hydrologic model predicts several locations where trails or provide drives may overtop during large rain events.

Lake levels on Lake Minnetonka are managed by the Gray's Bay Dam. The lake outlets through an adjustable structure on Gray's Bay which controls Lake Minnetonka discharge into Minnehaha Creek. In an effort to reduce flooding on Lake Minnetonka and Minnehaha Creek the District operates this structure in accordance with the Headwaters Control Structure Management Policy and Operating Procedures, which was approved by the Minnesota DNR. The operating plan prescribes discharge zones based on the time of year, the existing lake level, creek capacity in Minnehaha Creek, and forecasted precipitation identified through partnership with the National Weather Service.

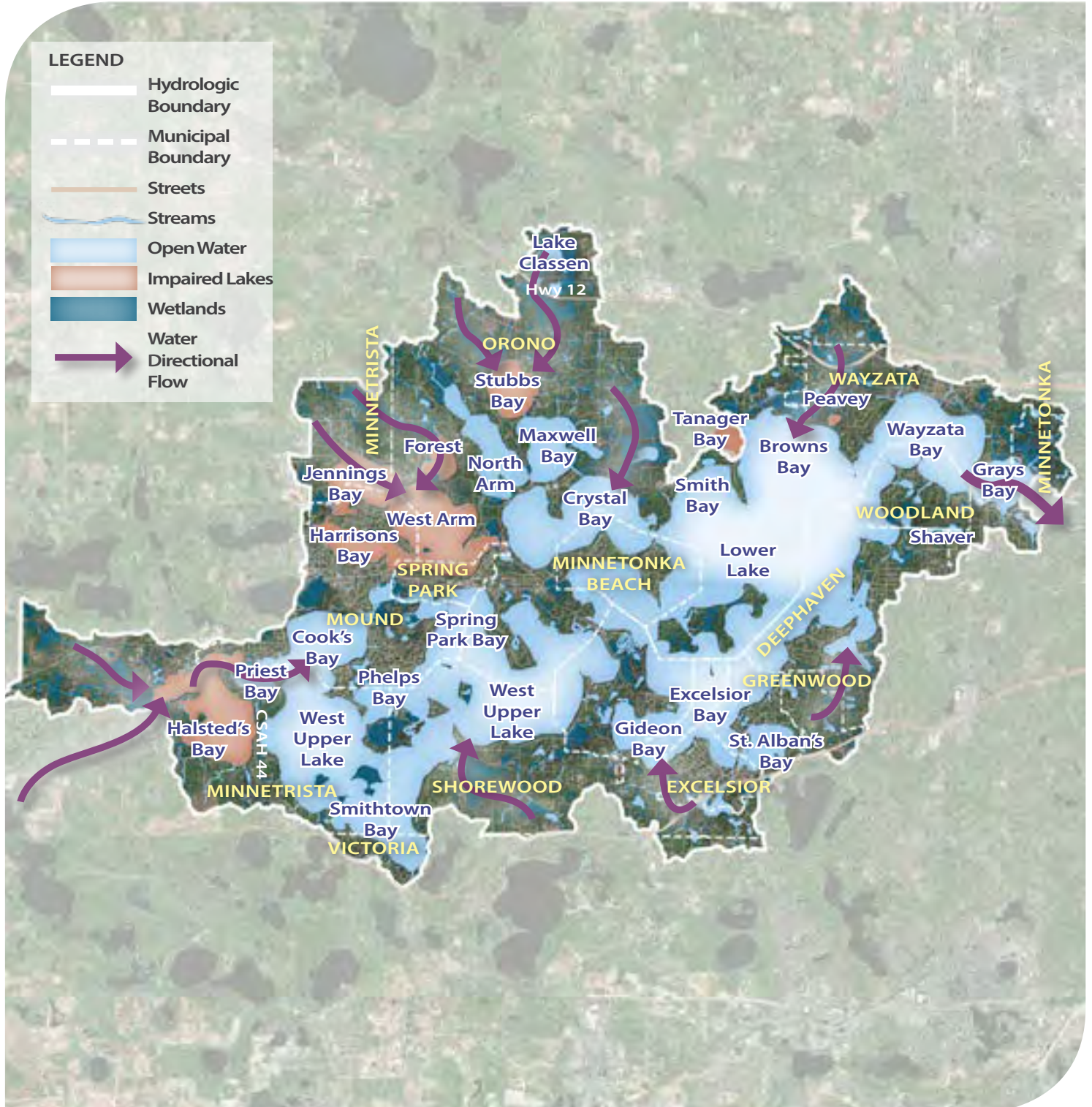


Figure 3.14 Lake Minnetonka Water Resources map



There are wetlands in the subwatershed that rely on steady inflow from surficial groundwater. Groundwater recharge is important within the subwatershed to maintain wetland hydrology and stream baseflow, as well as to recharge aquifers that supply public and private drinking water wells.

Ecological Integrity

Lakes and Streams

The Lake Minnetonka subwatershed enjoys moderate to high ecological integrity. Lake Minnetonka is the primary receiving water in the subwatershed. The fish community in Lake Minnetonka is excellent and is actively managed by the DNR. Invasive species are present within the lake, including zebra mussels, Eurasian watermilfoil, Curlyleaf Pondweed, Common Carp and Flowering Rush. Eurasian watermilfoil and Curlyleaf Pondweed can be found throughout the lake, but in varying densities, and often mixed in with abundant native plants. Common carp are present throughout the lake, but are generally overabundant in the degraded receiving bays of the lake, such as Halsted Bay. Flowering Rush is present, but limited in distribution around the lake and at low densities.

Classen Creek, the primary stream in the subwatershed, has locations of moderately complex habitat and morphology, but in general the stream is less complex and more altered. The creek contains a degraded macroinvertebrate community, which consists primarily of pollution-tolerant species, and is lacking certain classes of organisms. Monitoring reveals nutrient enrichment and low DO, which likely impact the macroinvertebrates in Classen Creek. The creek also contains a weir and generally has low flow, two factors that limit connectivity.

Wetlands

Scattered wetlands in the subwatershed have been classified as wetlands with high vegetative diversity and wildlife habitat, the largest of which are Classen Lake Marsh and French Lake Marsh. Only one wetland, which surrounds Lake Marion, is considered to have high restoration potential, but all are in need of protection. Conservation of wetlands is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

Uplands and Natural Corridors

Several locations within the subwatershed have been identified



Sunset over Lake Minnetonka, Jordan Black



Gray's Bay Dam



Tonka Bay shoreline



by Hennepin County and the DNR as important natural corridors containing high quality aquatic and upland habitat. For example, there are patches of intact sugar maple forest that must be protected. Many of the higher quality aquatic upland habitats are patchy and disconnected, and new connected habitat should be created when possible.

Shoreland within this subwatershed is heavily altered. A 2010 shoreland inventory found that of the 122 miles of Lake Minnetonka shoreline, over 65% was modified as rip-rap.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Lake Minnetonka subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Lake Minnetonka subwatershed are:

Water Quality

- » Excess nutrients

Water Quantity

- » Localized flooding

Ecological Integrity

- » Degraded macroinvertebrate populations
- » Altered shoreline

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Stormwater runoff
- » Common carp

- » Altered channels
- » Internal sediment phosphorus loading
- » Water quality from upstream waterbodies

Altered Wetlands

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Some wetlands in the subwatershed are of high quality, and do not appear to be significantly altered by ditching and draining. These wetlands are sensitive to the quality of stormwater inputs and rely on groundwater to maintain their hydrology. Altered wetlands upstream of Lake Minnetonka may be in part responsible for elevated phosphorus levels in some of Lake Minnetonka's bays. For example, the Six Mile Marsh wetland complex upstream of Halsted Bay contributes to Halsted Bay's impaired phosphorus concentrations.

Stormwater Runoff

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that

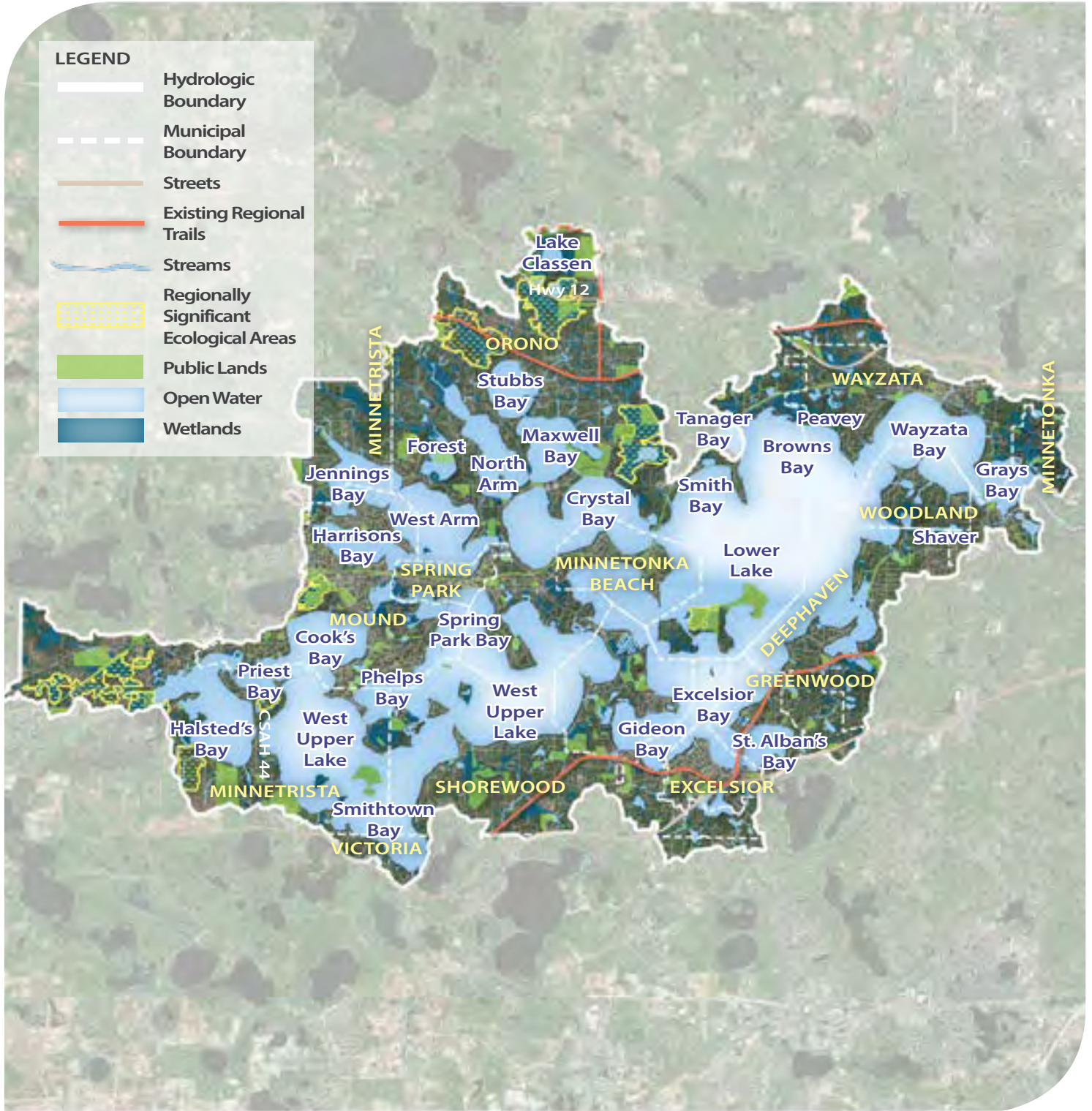


Figure 3.15 Lake Minnetonka Parks, Trails and Open Space map





negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally, as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

The Lake Minnetonka subwatershed is almost fully developed with mostly single family residential uses, but also some agriculture in the western portion of the subwatershed. These land uses increase the volume of stormwater runoff and the phosphorus loads carried by this runoff. Four bays in Lake Minnetonka and Forest Lake exceed the state standard for total phosphorus, and runoff from lawns, streets and agriculture in the subwatershed is a significant source of excess nutrients and sediment.

Carp Management

Historically, carp management focused on removal of carp populations from impacted water bodies without any consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal, but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

Carp are known to be driving water quality and ecological issues in Halsted Bay and carp management is part of implementation plan for the Six Mile Creek–Halsted Bay Subwatershed. Surveys should be conducted to determine the abundance of common carp in the northwestern bays (Jennings, West Arm, Forest Lake) and could warrant an assessment of the tributary

subwatersheds (Dutch Lake and Painter Creek) to inform management strategies. Carp management may need to occur prior to implementing other strategies to reduce internal loading.

Altered Channels

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Classen Creek, the primary stream in the Lake Minnetonka subwatershed, has been historically altered, which has degraded habitat complexity and channel morphology. The creek has a small earth dam and concrete weir, as well as several areas of significant streambank erosion. These factors probably contribute to the stream's degraded macroinvertebrate community. Other channels in the subwatershed have not been assessed, but have also been altered historically.

Internal Sediment Phosphorus Loading

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Four bays in Lake Minnetonka (Halsted Bay, Jennings Bay, Stubbs Bay and West Arm) and Forest Lake exceed the state standard for total phosphorus and are listed as Impaired Waters. Internal phosphorus loading is likely contributing to these high phosphorus concentrations, especially in Halsted and Jennings Bays, which were secondary receiving waters for municipal wastewater treatment plants until the 1970s. Excess phosphorus loads from wastewater treatment plant discharge may still be

present in the bottom sediments. The Upper Minnehaha Creek Watershed Nutrient and Bacteria TMDL requires a 70 and 79 percent reduction in internal load in Halsted and Jennings Bays, respectively.

Upstream Waterbodies

Headwater streams, lakes and wetlands contribute water and nutrients to downstream receiving waters impacting the quality of these water bodies. Lakes and wetlands with poor water quality ultimately contribute nutrients to downstream waters that can lead to eutrophication. Consequently, restoration of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Phosphorus export from upstream wetland and stream systems within the subwatershed may be a contributing source of phosphorus to Lake Minnetonka and other downstream water bodies. There are several tributary streams to Lake Minnetonka, including Long Lake Creek, Gleason Creek, Classen Creek, Painter Creek, and Six Mile Creek and associated wetland complexes are exporting and conveying excess nutrient and sediment loads to the bays of Lake Minnetonka.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Lake Minnetonka subwatershed. These strategies are both short- and long-term, and establish a framework for the Lake Minnetonka subwatershed Implementation Plan programs and projects.

Wetland Restoration

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while

minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

Only one wetland within the Lake Minnetonka subwatershed, the wetland that surrounds Lake Marion, is considered to have high restoration potential. Other wetlands are not currently high priorities for restoration, but only a few have scored highly on vegetative diversity, wildlife habitat, or aesthetics. Outlet monitoring at certain wetlands could be performed to document phosphorus export, which could be followed by new assessments for restoration potential.

Stormwater Management

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

The focus in the Lake Minnetonka subwatershed will be on reducing nutrient and sediment loading into upstream waterbodies, installing infiltration and load reduction BMPs, requiring stormwater pretreatment before discharge into any wetland, and continuing to address the legacy effects of wastewater treatment discharge into Halsted and Jennings Bays.

Carp Management

Historically, carp management focused on removal of carp populations from impacted water bodies without any consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal but also on the long-term



Flowering Rush by swimming buoy



Gray's Bay boardwalk, Malery Renee



Zebra Mussel

prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

While common carp are known to be present, not much is known about their extent and whether they are impacting water quality. It is necessary to perform feasibility studies which include assessments of carp and other rough fish population and their migration patterns.

Stream Channel Restoration

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and re-aeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Classen Creek and other channels in the watershed should be investigated for restoration potential. Given the elevated phosphorus levels and degraded macroinvertebrate community in Classen Creek, the creek likely would benefit from streambank stabilization, buffer enhancement, improvements to stream aeration, and habitat enhancement.

Internal Sediment Phosphorus Control

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Additional water quality monitoring data, sediment chemistry,

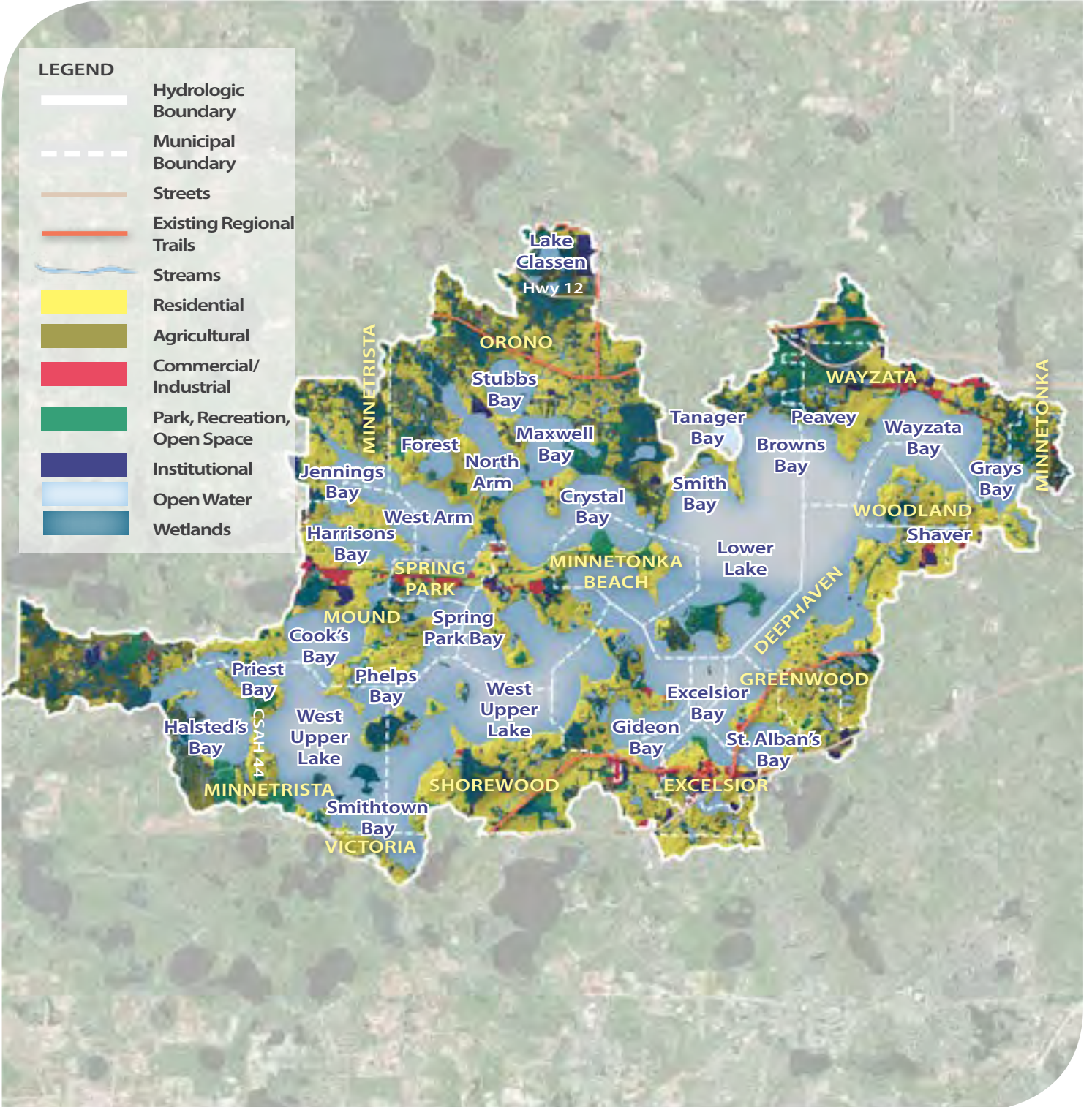


Figure 3.16 Lake Minnetonka Land Use map





and fish and aquatic vegetation surveys are necessary to evaluate the most appropriate techniques to improve water quality in Halsted and Jennings Bays, and other water bodies with internal phosphorus loading. Future alum treatment will be considered.

Restoration of Upstream Waterbodies

Upstream water bodies that are currently impaired can discharge large nutrient loads to downstream water bodies thereby contributing to downstream water quality impairments. Therefore, prior to, or concurrent with, significant efforts to restore downstream water quality, the water quality in upstream water bodies must be improved. Nutrient impaired upstream lakes may require external and internal nutrient reductions using the strategies listed in this section.

The Lake Minnetonka subwatershed is downstream from nine other subwatersheds, each of which outlets through streams, channels, and storm sewers into Lake Minnetonka. The focus will be on restoration of those upstream water bodies to improve the impaired bays and lakes and protect the current good water quality of the lower lake.

LAND USE

EXISTING CONDITIONS

The subwatershed includes portions of the cities of Chanhassen, Deephaven, Excelsior, Greenwood, Long Lake, Minnetonka, Minnetonka Beach, Minnetrista, Mound, Orono, Shorewood, Spring Park, Tonka Bay, Victoria, Wayzata and Woodland. The subwatershed is generally characterized by water (45%), most of which is Lake Minnetonka, and low density development (30%). The subwatershed also contains undeveloped land (13%), parks and open spaces (6%), agricultural land (2%).

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Section 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans,

and priorities for 2018-2027 (see Appendix B for details on the public input process). This information was used to broadly characterize opportunities, and to inform the development of the District's implementation plans. The information received was used only as a guide during the development of this Plan to inform the District of opportunities for partnership on the near term horizon, and was not intended to be exhaustive or restrict future collaborative efforts.

As discussed in Section 3.6, the District intends to cultivate a framework for two-directional coordination with communities on an ongoing basis, to stay apprised of emerging needs at a local level, and to identify and evaluate opportunities to implement management strategies outlined in this Plan over the next ten years. The District recognizes that local needs, opportunities and priorities may shift over time. Therefore, this Plan does not intend to capture or prescribe opportunities for partnership over a ten-year term.

Long term goals, growth and private development, and public investment in infrastructure differ across each community – and therefore, frameworks for ongoing coordination will be custom tailored based on the individual needs of each community. Coordination may occur at varying levels, through various means, with communities across the following areas:

- » Regulation of, and partnership with, private development
- » Collaboration on public planning and investment (e.g. parks, roads, utilities)
- » MS4 compliance
- » Development and implementation of TMDLs

Given the large size of the Lake Minnetonka subwatershed, it is useful to divide the subwatershed into subunits based on similar issues and priorities. The eastern portion of the subwatershed is the most developed, including the cities of Wayzata, Woodland, Deephaven, Greenwood, Excelsior, Minnetonka, Shorewood, Minnetonka Beach, and Tonka Bay. The water quality of Lake Minnetonka is better in this part of the subwatershed than it is farther west, but cities in this portion of the Lake are still concerned with stormwater management and low impact development and redevelopment. Other management priorities in this portion of the subwatershed are

to become more flood resilient and to protect wetlands.

The northwestern portion of the watershed, which includes the cities of Orono, Minnetrista, Mound, and Spring Park, consists mostly of shoreline and large-lot residential properties. Priorities in this portion of the subwatershed include maintaining a more rural character and protecting natural resources such as naturalized shorelines of lakes. The City of Mound is interested in continuing to invest in development in the downtown area and redevelopment around Lake Minnetonka.

The southwestern portion of the subwatershed is the most rural and includes the cities of Mound, Minnetrista, and part of Victoria. The cities in this management area desire to maintain their rural character through low density development and proximity to nature and trails. They expect a need to accommodate development with investment in infrastructure such as roads and sewers, but they aim to protect and enhance natural resources.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, the Lake Minnetonka subwatershed has several issues relating to water quality, water quantity and ecological integrity. Four bays (Halsted, Jennings, West Arm, Stubbs) and Forest Lake are listed on the State's Impaired Waters List due to excess nutrients. Impairments are generally a product of large tributary drainage areas (e.g. Six Mile Creek – Halsted, Painter Creek – Jennings) and the level of internal loading (phosphorus into the water column from organic sediments) which can be exacerbated by the presence of common carp and some aquatic plants. There are locations in the subwatershed within Lake Minnetonka's floodplain that

are subject to localized flooding due to the volume of water received from tributary subwatersheds, which can cause lake levels to rise. Lake Minnetonka contains aquatic invasive species, but overall, the subwatershed enjoys high ecological integrity with an excellent fish community in Lake Minnetonka and exceptional vegetative diversity in wetlands.

Based on these conditions, management strategies within the subwatershed will focus on addressing impaired bays within Lake Minnetonka by reducing external loading to the lake from upstream tributary subwatersheds and by addressing internal loading within the lake; protecting existing high value natural resources; and improving ecological integrity by promoting shoreline best management through partnership with local communities, shoreline contractors and landowners.

The eastern portion of the subwatershed is mostly developed, while areas in the west and north are still undergoing development. Some investment and roads and parks is planned throughout the subwatershed. Specific opportunity areas identified include downtown Mound, Excelsior Commons, and the Wayzata lakefront. The cities in the subwatershed acknowledge the importance of stormwater management and will look for opportunities to incorporate Best Management Practices (BMPs) as redevelopment and infrastructure investment occurs.

This Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity. As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects.

The District manages lake levels on Lake Minnetonka through the operation of the Gray's Bay Dam, informed by existing lake level, downstream capacity in Minnehaha Creek, seasonal variation, and precipitation predicted through partnership with the National Weather Service.



The District will continue to promote and provide education to cities and residents on the value of native shoreline plantings. The District funded the development of the Lake Minnetonka Guide to Shoreline Gardens that is a useful resource for lakeshore homeowners.

The District may pursue a carp assessment for the northwestern bays of Lake Minnetonka (Jennings, West Arm, Forest Lake) and their tributary subwatersheds (Dutch Lake and Painter Creek). The goal of the assessment would be to understand the movement and recruitment patterns of carp in the system to inform management efforts. This work will be dependent on the District's ability to secure partner support and funding.

Other invasive species are also present within the lake, including zebra mussels, Eurasian watermilfoil, Curlyleaf Pondweed and flowering rush. The District does not actively manage for any of these species, but will continue to monitor any impacts on water quality or ecological integrity. The Lake Minnetonka Conservation District regularly harvests the Eurasian watermilfoil that grows densely in several bays and channels and inhibits boat traffic.

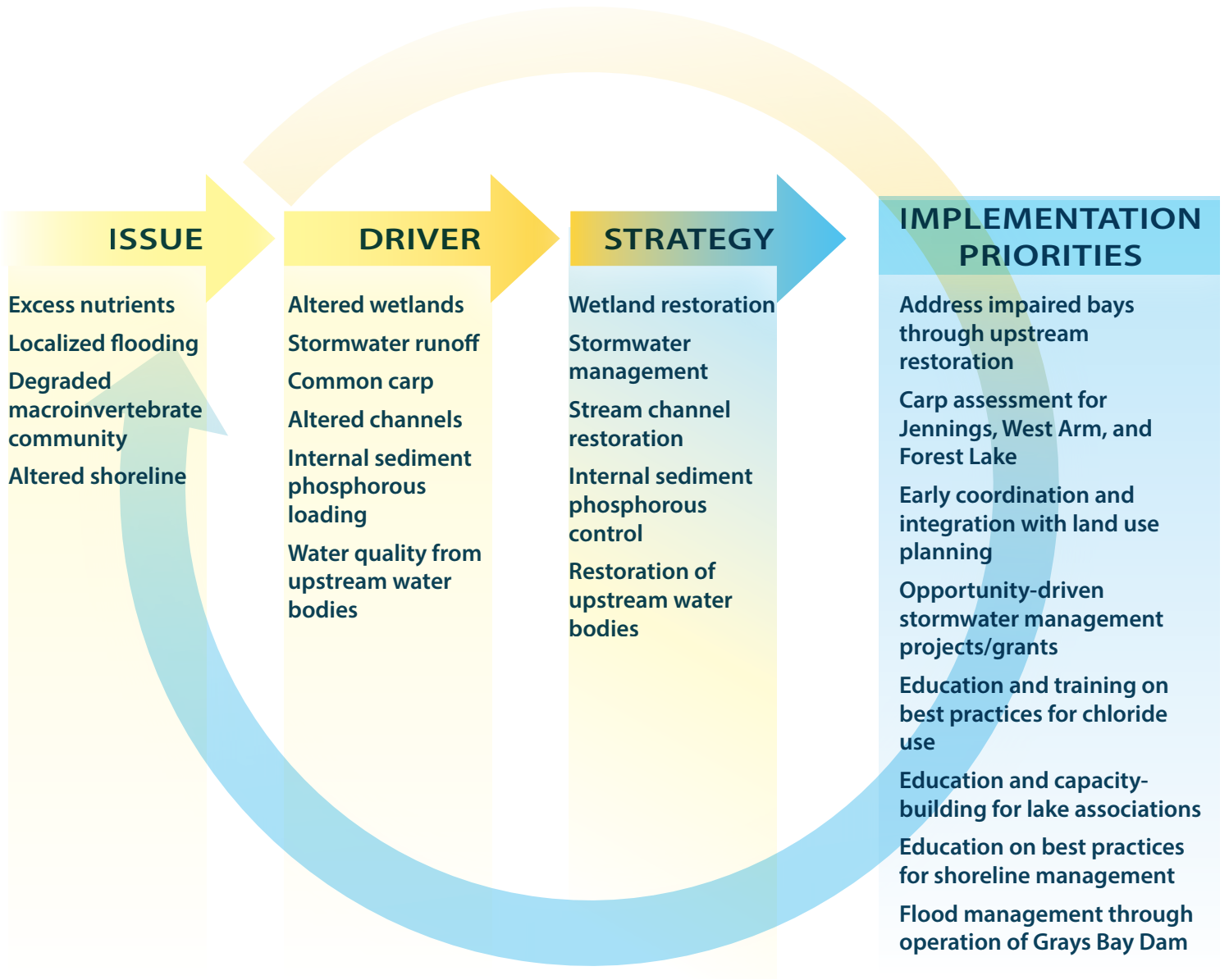
Peavey Lake is impaired for excess chlorides. The District will continue to monitor chloride levels and provide education and training for public and private applicators and residents on best practices for chloride use.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. The CIP also includes a project to address Halsted Bay internal loading as part of the broader Six Mile Creek-Halsted Bay implementation plan discussed in section 3.9.11. In the future, should the District or a partner determine that a larger or more concentrated scale of capital and program implementation may be needed, a discrete subwatershed planning process may be initiated to:

- » Provide high resolution diagnostic of watershed issues and drivers
- » Map current projected land use and infrastructure changes



Canoe on Lake Minnetonka, Garrett Graves





- » Define a detailed and integrated capital and program implementation plan
- » Outline a funding strategy including program costs and sources

The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Plan.

CAPITAL IMPROVEMENT PLAN

The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District's scope and priorities for its capital work over the planning period. A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other policy considerations before a formal decision to proceed to construction is made. Section 3.5.5 describes the development and evaluation steps that will occur before the District will commit resources to a project.

Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures.

A critical component of any project will be the development of a funding strategy that identifies the sources, uses, and timing of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District's public and private partners as capital projects are advanced. Therefore, any costs identified within this Plan are projections. Intended expenditures will be refined during project development and budgeting, and among other things will reflect the District's intent to complement its ad valorem funds with other funding sources.

Table 3.8 Lake Minnetonka Subwatershed CIP

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Lake Minnetonka, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Four bays (Halsted, Jennings, West Arm, Stubbs) and Forest Lake are listed on the State's Impaired Waters List due to excess nutrients. A TMDL identified a need to reduce external phosphorus loading by 60% (116 pounds) to Forest Lake, 73% (2087 lbs) to Halsted Bay, 72% (1563 lbs) to Jennings Bay, and 51% (142 lbs) to Stubbs Bay.
Outcome	Reduction of pollutant loading to Lake Minnetonka; reduction of stormwater runoff volume and rate and associated impacts; protection and enhancement of groundwater recharge, stream base flow, and wetland hydrology.
Estimated Cost	Capital costs: \$1,000,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

Project	Halsted Bay Internal Phosphorus Load Reduction
Description	The Halsted Bay Internal Phosphorus Load Reduction project consists of an aluminum sulfate (alum) treatment on Halsted Bay to reduce internal phosphorus loading. A dosing study was completed in 2013 to estimate the required aluminum concentration to bind 90% of mobile phosphorus. It recommended the application of alum to Halsted Bay in three treatment zones ranging from 60 g Al/m ² to 140 g Al/m ² .
Need	A Load Management Feasibility Study completed for Halsted's Bay determined that internal phosphorus loading provides 40% (2,705 pounds) of the phosphorus loading to Halsted Bay. The study recommended an 84% (2,278 pound) reduction in internal phosphorus loading.
Outcome	The alum application is proposed to reduce mobile sediment phosphorus by 90%, which would result in a parallel reduction in internal phosphorus loading.
Estimated Cost	Capital costs: \$1,400,000 in 2017 dollars based on a 20 year project life.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Lake Minnetonka, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Four bays (Halsted, Jennings, West Arm, Stubbs) and Forest Lake are listed on the State's Impaired Waters List due to excess nutrients. A TMDL identified a need to reduce external phosphorus loading by 60% (116 pounds) to Forest Lake, 73% (2087 lbs) to Halsted Bay, 72% (1563 lbs) to Jennings Bay, and 51% (142 lbs) to Stubbs Bay.
Outcome	Reduction of pollutant loading to Lake Minnetonka; reduction of stormwater runoff volume and rate and associated impacts; protection and enhancement of groundwater recharge, stream base flow, and wetland hydrology.
Estimated Cost	Capital costs: \$1,000,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

Project	Halsted Bay Internal Phosphorus Load Reduction
Description	The Halsted Bay Internal Phosphorus Load Reduction project consists of an aluminum sulfate (alum) treatment on Halsted Bay to reduce internal phosphorus loading. A dosing study was completed in 2013 to estimate the required aluminum concentration to bind 90% of mobile phosphorus. It recommended the application of alum to Halsted Bay in three treatment zones ranging from 60 g Al/m ² to 140 g Al/m ² .
Need	A Load Management Feasibility Study completed for Halsted's Bay determined that internal phosphorus loading provides 40% (2,705 pounds) of the phosphorus loading to Halsted Bay. The study recommended an 84% (2,278 pound) reduction in internal phosphorus loading.
Outcome	The alum application is proposed to reduce mobile sediment phosphorus by 90%, which would result in a parallel reduction in internal phosphorus loading.
Estimated Cost	Capital costs: \$1,400,000 in 2017 dollars based on a 20 year project life.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

3.9.5 LAKE VIRGINIA SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Lake Virginia Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District’s philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Lake Virginia is a 6.2 square mile (3,991 acre) subwatershed located in the southwestern portion of the MCWD and includes the cities of Chanhassen, Chaska, Shorewood, and Victoria. The subwatershed is generally characterized by low density development (26%), parks and open spaces (28%), water (22%), undeveloped land (12%), and agricultural uses (7%). Lake Minnewashta Regional Park and parts of the Minnesota Landscape Arboretum are within the subwatershed’s boundaries. The Southwest Hennepin LRT Regional Trail also passes across the northwest corner of the subwatershed.

There are areas of high ecological value within corridors of aquatic and upland habitat. Thirty-nine percent of the wetlands in the subwatershed are classified as “preserve” by the Functional Assessment of Wetlands due to their exceptional or high vegetative diversity, or fish or wildlife habitat value.

Lakes Minnewashta and Virginia are the primary receiving waters within the subwatershed. Tamarack Lake and Lake St. Joe are additional lakes in the subwatershed. There is a small stream known as Minnewashta Creek that conveys discharge from Lake Minnewashta to Lake Virginia. The Lake Virginia subwatershed discharges by a small channel to Lake Minnetonka: Smithtown Bay.

The Lake Virginia subwatershed has several issues relating to water quality, water quantity and ecological integrity. Lake Virginia and Tamarack Lake are listed as Impaired Waters for excess nutrients and a TMDL identifying nutrient load reduction goals and suggested actions has been completed. Overall, the system has moderate ecological integrity. Low dissolved oxygen in Lake Virginia may be negatively impacting the fish community. Lakes Minnewashta and Virginia are also infested

with Eurasian watermilfoil, Curlyleaf Pondweed and zebra mussels.

Management strategies within Lake Virginia subwatershed will focus on promoting infiltration, reducing pollutant loading, improving biodiversity and protecting existing resources. The District will collaborate on these management strategies with local and state government, developers, lake associations, citizens’ groups and other parties. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Lake Virginia subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality

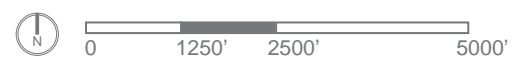
Lakes and Streams

Lake Minnewashta, Lake Virginia, Lake St. Joe and Tamarack Lake are lakes within the subwatershed. Minnewashta Creek conveys discharge from Lake Minnewashta to Lake Virginia.

Lake Virginia and Tamarack Lake are listed as Impaired Waters for excess nutrients, although Tamarack Lake varies from slightly below to slightly above the state standard. Lake Minnewashta and Lake St. Joe have historically met or bettered state water quality standards, although Lake St. Joe can experience algal blooms. Both Minnewashta and Virginia are listed as Impaired Waters for excess mercury in fish tissue, and the State of Minnesota has completed a statewide TMDL for those impairments.



Figure 3.17 Lake Virginia Base map



Virginia and Lake Minnewashta have zebra mussels, which can influence water quality changes and food web changes when abundant. The zebra mussel population in Lake Virginia is small, and no zebra mussels have been found in the main body of Lake Minnewashta.

Minnewashta Creek outlet historically has relatively low TP concentrations and loading, although loading does show an increase during high flow years.

Wetlands

There are wetlands in the subwatershed with excellent and high vegetative diversity that are sensitive to the quality of stormwater inputs.

Groundwater

There are areas of aquifer sensitivity in the subwatershed. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water quantity

Several locations may experience flooding during large rain

events, according to the District's model. There are wetlands in the subwatershed that rely on steady inflow from surficial groundwater. Portions of the subwatershed are within city Wellhead Protection Areas and there may be restrictions on infiltration in some sensitive areas. There are two landlocked subwatershed units that may in the future be considered for constructed outlets.

Ecological Integrity Lakes and Streams

Fisheries range in health throughout the subwatershed. Lake Minnewashta is known for its fishing, but in Lake Virginia, where common carp and other rough fish are abundant, low dissolved oxygen may be impacting the fish community.

The aquatic vegetation community in Lake Minnewashta supports moderate species diversity, but contains aquatic invasive species, including Eurasian watermilfoil and Curlyleaf pondweed. The lake is also listed as infested for zebra mussels, but management has so far contained them to the channel area where the access is located. Lake Virginia also contains Eurasian watermilfoil, Curlyleaf pondweed and zebra mussels, although zebra mussels are generally found in low numbers. Tamarack Lake's aquatic vegetation community is degraded, showing low



Lake Minnewashta



Figure 3.18 Lake Virginia Water Resources map



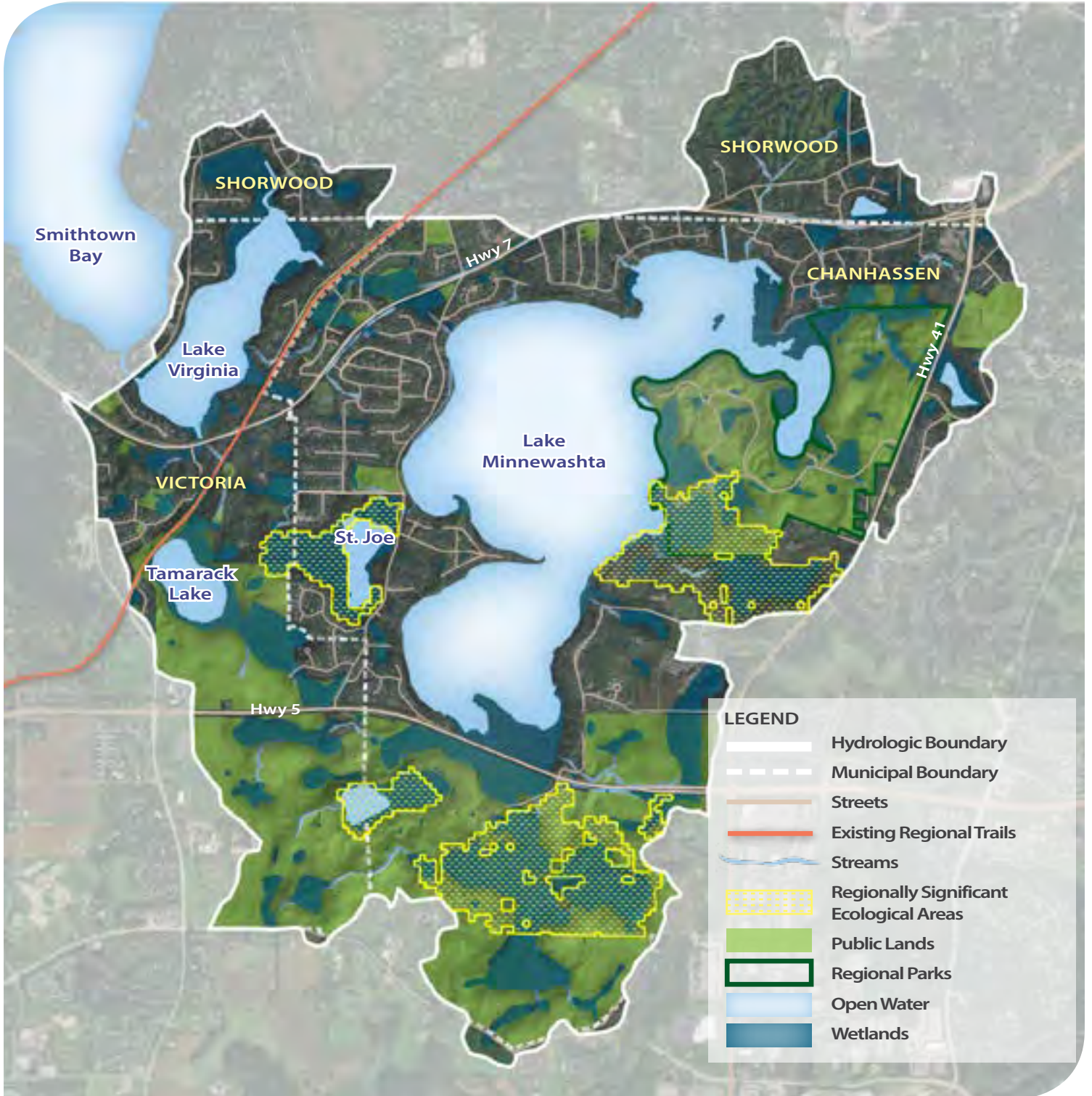


Figure 3.19 Lake Virginia Parks, Trails and Open Space map





species diversity often including non-native and/or intolerant species.

Wetlands

There are wetlands in the subwatershed with exceptional to high fish and wildlife habitat and exceptional to high vegetation quality. Many of these wetlands are within the boundary of Lake Minnewashta Regional Park or the Minnesota Landscape Arboretum and are already protected. Opportunities exist to protect the wetlands surrounding both Tamarack Lake and Lake St. Joe.

Uplands and Natural Corridors

There are areas of high ecological value within corridors of upland habitat. Some areas are protected within local and regional parks or the Landscape Arboretum, while other areas are privately owned.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Lake Virginia subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Lake Virginia subwatershed are:

Water Quality

- » Excess nutrients in Impaired Waters
- » Protecting good water quality in some lakes

Water Quantity

- » Localized flooding

Ecological Integrity

- » Protecting wetland and terrestrial corridors

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Common carp
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading

Altered Wetlands

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Many wetlands in the subwatershed are of high or exceptional quality, and do not appear to be significantly altered by ditching and draining. Minnewashta Creek does flow through a riparian wetland between Lakes Minnewashta and Virginia, but it is unclear whether that wetland impacts downstream nutrient loading. Several of the wetlands do receive stormwater and may be impacted in the future by that loading.

Carp

Invasive common carp negatively impact water quality and ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse state, and is often characterized by a significant loss of natural vegetation, harmful algal blooms, and the release of phosphorus from resuspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

Fish survey data is limited, but common carp appear to be abundant in Lake Virginia, where low dissolved oxygen is thought to be impacting more sensitive fish species. Carp could be partially responsible for Lake Virginia's impaired water quality, since bottom feeding by carp releases nutrients into Lake Virginia's water column. These nutrients could then be conveyed downstream to Lake Minnetonka: Smithtown Bay. The extent of the carp population and its migratory and spawning habits is not known.

Stormwater Runoff

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally, as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

Lake Virginia and Tamarack Lake are impaired for excess nutrients, and runoff from lawns, streets and agriculture in the subwatershed could be a source of nutrients and sediment to these lakes. The 2011 Lake Virginia TMDL requires a 27 percent

reduction in phosphorus load from the watershed to meet state nutrient standards. The 2014 TMDL for Tamarack Lake does not require a specific load reduction, but recommends reducing nutrient loading from the subwatershed so that the lake may more consistently meet state standards.

Altered Channels

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Minnewashta Creek flows through several culverts along its 1.2 mile course to Lake Virginia, and these culverts impair connectivity in the Creek. Some reaches of the creek have also been channelized. No data exist on the biotic communities within Minnewashta Creek, but these channel alterations likely impair biotic communities.

Internal Sediment Phosphorus Loading

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

No sediment release data are available, but the 2011 Lake Virginia TMDL determined that internal sediment release was not a significant factor in the Lake Virginia impairment, specifying just a five percent reduction of the internal nutrient load.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the



drivers impacting its water resources, the District has developed general strategies to guide actions in the Lake Virginia subwatershed. These strategies are both short- and long-term, and establish a framework for the Virginia Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and

overall needs of the subwatershed system.

Although many wetlands in the subwatershed have exceptional to high fish and wildlife habitat and vegetation quality, there are several wetlands that have high or moderate restoration potential. This includes a wetland through which Minnewashta Creek flows on its way to Lake Virginia. If restored, this wetland could improve vegetative diversity and provide connected habitat within the watershed in addition to potentially improving the water quality of Lake Virginia.

Carp Management

Historically, carp management focused on removal of carp populations from impacted water bodies without any consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.



Lake Minnewashta

While common carp are known to be present in Lake Virginia, not much is known about their extent or whether they are impacting water quality of Lake Virginia. To undertake a rough fish management program, it would be necessary to perform feasibility studies to assess carp and other rough fish populations and their migration patterns.

Stormwater Management

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

In the Lake Virginia subwatershed, the focus will be on installing infiltration and load reduction BMPs, requiring stormwater pretreatment before discharge into any wetland, and protecting wetland vegetation quality and diversity by limiting the hydrological bounce from inflow to the wetlands.

Stream Channel Restoration

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and re-aeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

While opportunities to restore a more natural form and function are limited, Minnewashta Creek should be investigated for restoration potential, including need for streambank repair, buffer enhancement, and habitat enhancement.

Internal Sediment Phosphorus Control

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment

phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Additional information is necessary to evaluate management options for Lake Virginia. While the 2011 TMDL found that sediment release is likely not a significant driver of annual lake loading, the potential impacts of rough fish and invasive aquatic vegetation should be further investigated to establish the appropriate future course of action.

LAND USE

EXISTING CONDITIONS

The subwatershed includes a portion of the cities of Chanhassen, Chaska, Shorewood, and Victoria. Land use in the subwatershed is generally characterized by low density development (26%), parks and open spaces (28%), water (22%), undeveloped land (12%), and agricultural uses (7%). Lake Minnewashta Regional Park and parts of the Minnesota Landscape Arboretum are within the subwatershed's boundaries. The Southwest Hennepin LRT Regional Trail also passes across the northwest corner of the subwatershed.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Section 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for 2018-2027 (see Appendix B for details on the public input process). This information was used to broadly characterize opportunities, and to inform the development of the District's implementation plans. The information received was used only as a guide during the development of this Plan to inform the District of opportunities for partnership on the

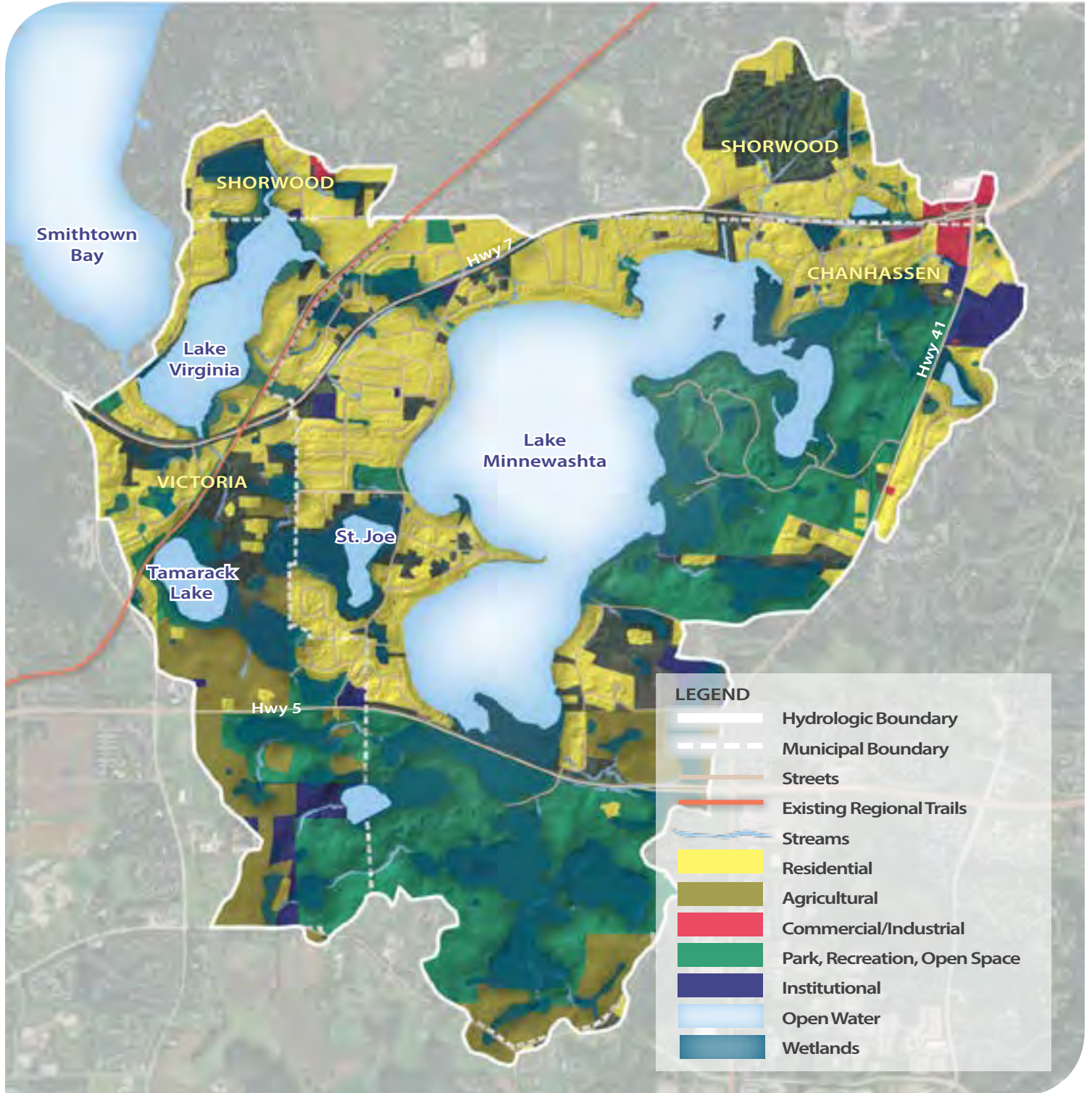
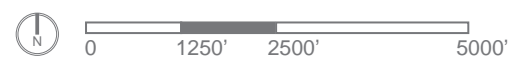


Figure 3.20 Lake Virginia Land Use map



near term horizon, and was not intended to be exhaustive or restrict future collaborative efforts.

As discussed in Section 3.6, the District intends to cultivate a framework for two-directional coordination with communities on an ongoing basis, to stay apprised of emerging needs at a local level, and to identify and evaluate opportunities to implement management strategies outlined in this Plan over the next ten years. The District recognizes that local needs, opportunities and priorities may shift over time. Therefore, this Plan does not intend to capture or prescribe opportunities for partnership over a ten-year term.

Long term goals, growth and private development, and public investment in infrastructure differ across each community – and therefore, frameworks for ongoing coordination will be custom tailored based on the individual needs of each community. Coordination may occur at varying levels, through various means, with communities across the following areas:

- » Regulation of, and partnership with, private development
- » Collaboration on public planning and investment (e.g. parks, roads, utilities)
- » MS4 compliance
- » Development and implementation of TMDLs

Through the information gathering processes of this Plan, the District was informed that the subwatershed is mostly developed, and there is little anticipated for near-term development or infrastructure investment. There are septic systems on the east side of Lake Virginia that are a potential source of nutrients to the lake. Sanitary sewer has been installed, and residents are expected to connect over time as septic inspections indicate the need.

The Lake Minnewashta Preservation Association is an active association on Lake Minnewashta. The Association plans to continue to raise funds to perform invasive species treatments (e.g. Eurasian watermilfoil management) and is also working to develop a contingency fund for unanticipated events, such as the 2016 zebra mussel infestation.



Stream running to Lake Minnewashta



IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, Lake Virginia and Tamarack Lake are impaired for excess nutrients and low dissolved oxygen in Lake Virginia may be negatively impacting sensitive fish species. Common carp could be partially responsible for Lake Virginia's impaired water quality. Lake Virginia and Lake Minnewashta have been infested with Eurasian watermilfoil, Curlyleaf Pondweed and zebra mussels. The subwatershed also contains wetlands with exceptional to high fish and wildlife habitat and vegetation quality.

Based on these conditions, management strategies within the subwatershed will focus primarily on stormwater management to reduce pollutant loading, promoting infiltration, improving biodiversity, protecting existing resources, and evaluating the presence and managing the impact of common carp.

The Lake Virginia subwatershed is relatively small and there is little anticipated for near-term development or infrastructure investment, so opportunities from land use change may be limited. The Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital

projects.

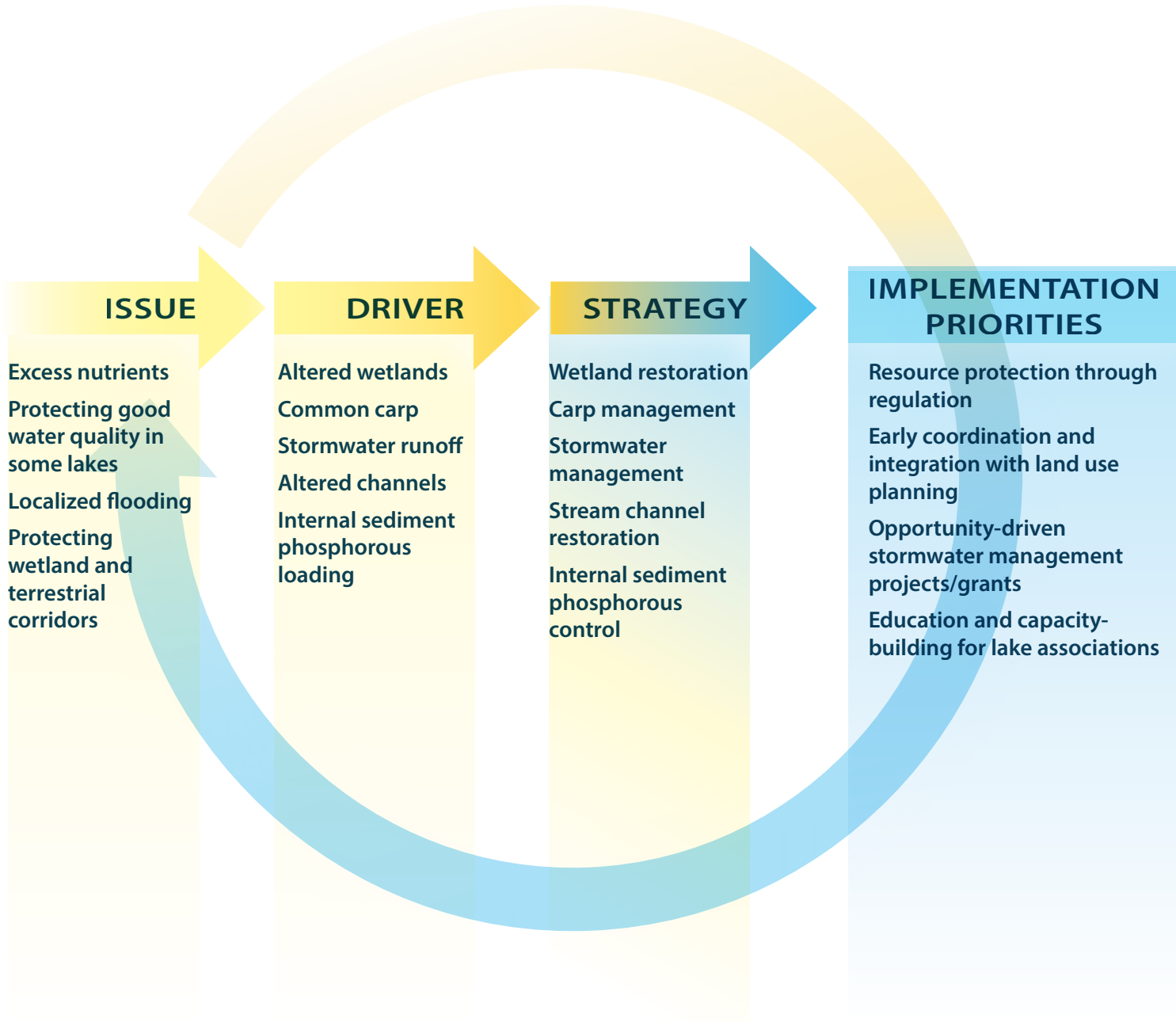
The District will pro-actively coordinate the permitting of future land use change with its LGUs to explore opportunities to create public-private partnerships to address stormwater management goals in ways that exceed regulatory requirements. As noted in the previous section, there is an active lake association for Lake Minnewashta. The District will continue to work with its lake associations to provide education and technical assistance to build their capacity and target implementation efforts. The District will continue to monitor any impacts or trends related to the zebra mussel infestation.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. In the future, should the District or a partner determine that a larger or more concentrated scale of capital and program implementation may be needed, a discrete subwatershed planning process may be initiated to:

- » Provide high resolution diagnostic of watershed issues and drivers
- » Map current projected land use and infrastructure changes
- » Define a detailed and integrated capital and program implementation plan
- » Outline a funding strategy including program costs and sources
- » The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Plan.

CAPITAL IMPROVEMENT PLAN

The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District's scope and priorities for its capital work over the planning period. A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to





achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other policy considerations before a formal decision to proceed to construction is made. Section 3.5.5 describes the development and evaluation steps that will occur before the District will commit resources to a project.

Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state

and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures.

A critical component of any project will be the development of a funding strategy that identifies the sources, uses, and timing of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District’s public and private partners as capital projects are advanced. Therefore, any costs identified within this Plan are projections. Intended expenditures will be refined during project development and budgeting, and among other things will reflect the District’s intent to complement its ad valorem funds with other funding sources.

Table 3.9 Lake Virginia Subwatershed CIP

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Lake Virginia, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Lake Virginia exceeds state nutrient standards. A 2011 TMDL study identified a need to reduce phosphorus loading by 20% (77 pounds), most of which is from external sources (71 pounds).
Outcome	Reduction of pollutant loading to Lake Virginia; reduction of stormwater runoff volume and rate and associated impacts; protection and enhancement of groundwater recharge, stream base flow, and wetland hydrology.
Estimated Cost	Capital costs: \$650,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

3.9.6 LANGDON LAKE SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Langdon Lake Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Langdon Lake is a 1.7 square mile (1,056 acre) subwatershed located along the western boundary of the MCWD and includes portions of the cities of Minnetrista and Mound. The subwatershed is generally characterized by low density development (32%), including many single-family homes, water (22%), parks and open spaces (21%), undeveloped land (18%), and agricultural uses (2%). The Dakota Rail Trail traverses this subwatershed on the north side of Langdon Lake, and Gale Woods Regional Park occupies a portion of the western subwatershed.

The western half of the subwatershed is dominated by a mosaic of forest and woodland, wetland, and open water, including Black Lake and Saunders Lake. The largely intact open space surrounding Black Lake and the north and west sides of Saunders Lake are classified as a Regionally Significant Ecological Area.

Langdon Lake is the primary receiving water within the subwatershed. Two other receiving waters within the subwatershed carry an informal lake designation: Saunders Lake and Flanagan Lake, both of which could be classified as wetlands. There is a small channel that conveys discharge from the outlet of Saunders Lake to Langdon Lake. Langdon Lake discharges through a culvert under Highway 110 into Lost Lake, which outlets into Lake Minnetonka: Cooks Bay. The subwatershed is bisected by a railroad corridor, which influences its hydrology.

Langdon Lake subwatershed has several issues relating to water quality, water quantity, and ecological integrity. Langdon Lake is impaired by excess nutrients, and a TMDL requires

both external and internal load reductions. Water quality may be impacting the fish community in Langdon Lake, which has not been formally assessed since 1993, but is dominated by bullheads. Recent plant surveys show a degraded aquatic plant community, which in turn limits the fishery. In addition, culverts in the subwatershed need maintenance to ensure adequate conveyance and flood storage. Overall, the system enjoys moderate to high ecological integrity, with wetlands containing high vegetative diversity and extensive connected natural corridors containing high quality habitat. These areas should be protected.

Management strategies within the Langdon Lake subwatershed will focus on nutrient reductions, while promoting infiltration, reducing pollutant loading, improving biodiversity, and protecting existing resources. The District will collaborate on these management strategies with local and state government, developers, lake associations, citizens' groups and other parties to implement. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

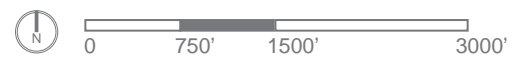
This section of the Plan outlines existing conditions and water resource issues categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Langdon Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality Lakes and Streams

Langdon Lake is listed on the State's Impaired Waters list for excessive nutrients. Internal loading (potentially impacted by a historic wastewater treatment plant) and external loading coming from stormwater runoff and the upstream wetland system may be contributing to these concentrations.



Figure 3.21 Langdon Lake Base map



At this time, no streams are listed as Impaired Waters. The Langdon Lake inlet and outlet streams are within the state river eutrophication standards.

Wetlands

There are wetlands in the subwatershed with high vegetative diversity that are sensitive to the quality of stormwater inputs.

Groundwater

There are areas of very high and high aquifer sensitivity in the subwatershed. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity

Culverts in the subwatershed and outlets on Flanagan and Saunders Lakes need maintenance to ensure adequate conveyance and flood storage.

Preservation of upstream storage in Flanagan and Saunders Lakes and other wetlands is necessary to provide downstream flood protection.

There are wetlands in the subwatershed that rely on steady inflow from surficial groundwater. Groundwater recharge is important within the subwatershed to maintain wetland hydrology and stream baseflow, as well as to recharge aquifers that supply public and private drinking water wells.

Portions of the subwatershed are within city Wellhead Protection Areas and there may be restrictions on infiltration in some sensitive areas.

Ecological Integrity Lakes and Streams

The Langdon Lake subwatershed is notable for its ecological resources and large wetlands.

Langdon Lake is the primary receiving water in the subwatershed and is listed on the State's Impaired Waters list for excessive nutrients. The last fish survey was completed in 1993, but the community was dominated by bullheads at that time. The aquatic plant community is also degraded, which in turn impacts the fishery.

The Langdon Lake outlet stream has, for the most part, stayed at or above the DO standard. However, it has dipped below the



Saunders Lake



Figure 3.22 Langdon Lake Water Resources map



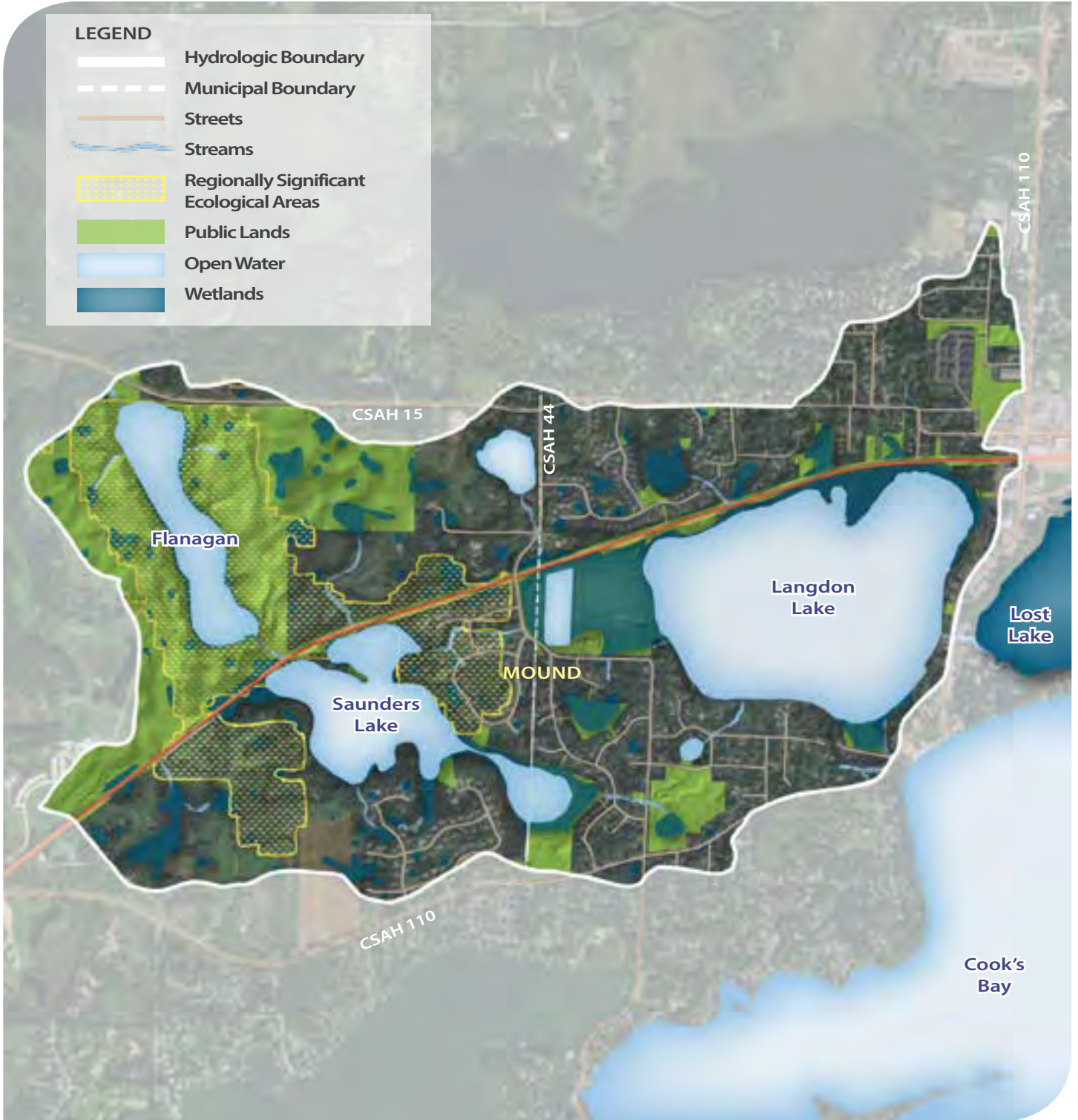


Figure 3.23 Langdon Lake Parks, Trails, and Open Space map





standard intermittently, probably due to low flow and high summer temperatures. There are no fish or aquatic vegetation data for the Langdon Lake inlet or outlet, but there is high connectivity in these streams, with no identified barriers, such as dams, weirs, or culverts.

Wetlands

Wetland assessments have classified a number of wetlands in the subwatershed as having excellent vegetative diversity and wildlife habitat. The highest vegetative diversity was found in the wetland complex associated with Flanagan Lake within the Gale Woods Regional Park and the wetlands riparian to Saunders Lake. These wetlands are in need of protection. Their conservation is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

Uplands and Natural Corridors

Nearly the entire western subwatershed has been identified as important conservation corridors worthy of protection by Hennepin County and the Metropolitan Council. The wide wetland areas along the western and northern areas of Langdon Lake have also been identified. The Dakota Rail Regional Trail may act as a barrier to wildlife migration between the north and south halves of the subwatershed.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Langdon Lake subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Langdon Lake subwatershed are:

Water Quality

- » Excess nutrients

Water Quantity

- » Maintenance of upstream flood storage

Ecological Integrity

- » Protection of high quality wetlands
- » Protection of high quality upland corridors

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Stormwater runoff
- » Internal sediment phosphorus loading
- » Water quality from upstream waterbodies

Altered Wetlands

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from nutrient sinks to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Many wetlands in the subwatershed are of high quality. The primary concern in the subwatershed is the impact of discharge from the old Mound Wastewater Treatment Plant pond on the riparian wetland on the west side of the lake creating a pool of phosphorus in the wetland, which is available for release into the lake.

Stormwater Runoff

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams, and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding and change stream flow in ways that negatively impact habitat for critical

parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams, and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides, and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream, or wetland. Generally, as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams, and wetlands decreases.

Langdon Lake exceeds the state standard for total phosphorus, and runoff from lawns, streets, and agriculture in the subwatershed could be a source of nutrients and sediment to the lake. The 2014 Langdon Lake TMDL requires a 27 percent reduction in nutrient loading from the subwatershed to meet state water quality standards.

Internal Sediment Phosphorus Loading

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity, and in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Langdon Lake exceeds the state standard for total phosphorus and is listed as an Impaired Water. The lake received wastewater

effluent discharge from the Mound Wastewater Treatment Plant in the past (1963-1974), creating a pool of phosphorus in the sediments that is likely contributing to internal phosphorus loading. The 2014 TMDL requires a 21 percent reduction in internal load to meet state standards.

Upstream Waterbodies

Headwater streams, lakes, and wetlands contribute water and nutrients to downstream receiving waters impacting the quality of these water bodies. Lakes and wetlands with poor water quality ultimately contribute nutrients to downstream waters leading to eutrophication. Consequently, restoration of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Phosphorus export from the upstream wetland system within the watershed may be a contributing source of phosphorus to Langdon Lake, and further monitoring and investigation of conditions in Saunders Lake and its discharge should be considered.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Langdon Lake subwatershed. These strategies are both short- and long-term, and establish a framework for the Langdon Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition



Langdon Lake



Saunders rain garden



Saunders Lake

of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology and overall needs of the subwatershed system.

Wetlands within the Langdon Lake subwatershed are not high priorities for restoration, as they are minimally disturbed and have high quality vegetation communities and wildlife habitat. However, outlet monitoring could be performed to document whether there is phosphorus export from the wetland system.

Stormwater Management

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration, and fertilizer management.

The focus in the Langdon Lake subwatershed will be on ensuring that wetlands are adequately buffered, installing infiltration and load reduction BMPs, requiring stormwater pretreatment before discharge into any wetland, and continuing to address the legacy effects of the Mound Wastewater Treatment Plant.

Internal Sediment Phosphorus Control

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

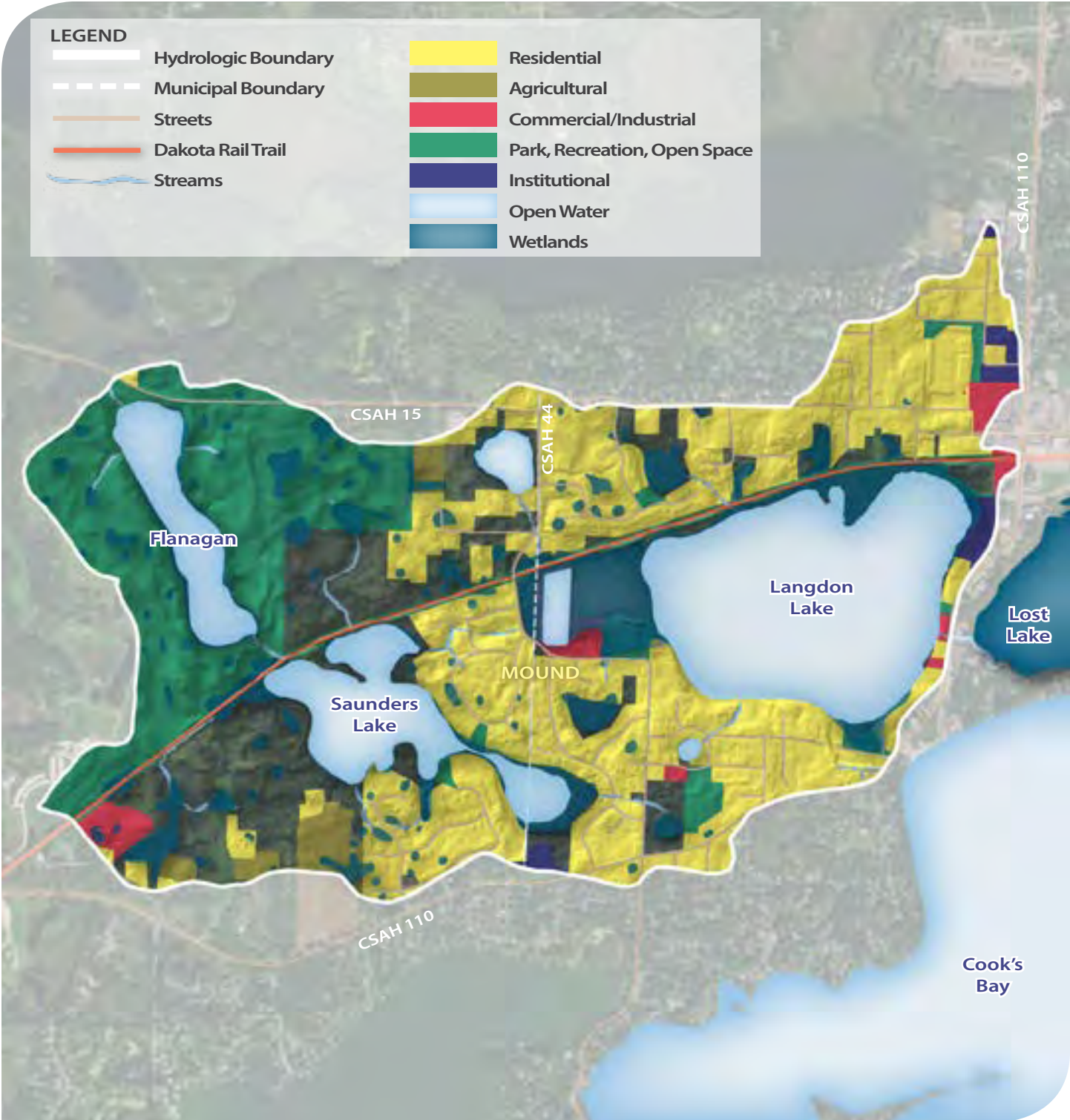


Figure 3.24 Langdon Lake Land Use map





Additional information is necessary to evaluate management options for Langdon Lake. Additional water quality monitoring data, sediment chemistry, and fish and aquatic vegetation surveys are necessary to evaluate the most appropriate techniques to improve water quality in this lake. A future alum treatment may be considered.

Restoration of Upstream Waterbodies

Upstream water bodies that are currently impaired can discharge large nutrient loads to downstream water bodies thereby contributing to downstream water quality impairments. Therefore, prior to, or concurrent with, significant efforts to restore downstream water quality, the water quality in upstream water bodies must be improved. Nutrient impaired upstream lakes may require external and internal nutrient reductions using the strategies listed in this section.

The wetland complexes upstream of Langdon Lake, including Flanagan and Saunders Lakes, should be investigated to determine if they have an impact on the water quality of Langdon Lake. Monitoring outflow from the wetland should occur to determine whether phosphorus concentrations are elevated, suggesting the wetlands are acting as sources rather than sinks of nutrients.

Watershed Protection

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

There are high quality wetlands and uplands in the subwatershed. Much of the western subwatershed has been identified by the DNR as a Metropolitan Conservation Corridor, including areas within Three River Parks District's Gale Woods Regional Park. These natural areas are large and are part of a corridor of habitat between Dutch Lake, Long Lake/Little Long Lake and Whaletail Lake.

The focus in this subwatershed will be to preserve these high-value resources through Land Conservation where appropriate and with Three Rivers Park District as opportunities arise. In addition, the District will work with cities and developers to minimize disturbance during development and construction.

LAND USE

EXISTING CONDITIONS

The subwatershed includes portions of the cities of Minnetrista and Mound. The subwatershed is generally characterized by low density development (32%), including many single-family homes, water (22%), parks and open spaces (21%), undeveloped land (18%), and agricultural uses (2%). The Dakota Rail Trail traverses this subwatershed on the north side of Langdon Lake, and Gale Woods Regional Park occupies a portion of the western subwatershed.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Section 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for 2018-2027 (see Appendix B for details on the public input process). This information was used to broadly characterize opportunities, and to inform the development of the District's implementation plans. The information received was used only as a guide during the development of this Plan to inform the District of opportunities for partnership on the near term horizon, and was not intended to be exhaustive or restrict future collaborative efforts.

As discussed in Section 3.6, the District intends to cultivate a framework for two-directional coordination with communities on an ongoing basis, to stay apprised of emerging needs at a local level, and to identify and evaluate opportunities to implement management strategies outlined in this Plan over the next ten years. The District recognizes that local needs, opportunities and priorities may shift over time. Therefore, this Plan does not intend to capture or prescribe opportunities for partnership over a ten-year term.

Long term goals, growth and private development, and public investment in infrastructure differ across each community – and therefore, frameworks for ongoing coordination will be custom tailored based on the individual needs of each community. Coordination may occur at varying levels, through various means, with communities across the following areas:

- » Regulation of, and partnership with, private development
- » Collaboration on public planning and investment (e.g. parks , roads, utilities)
- » MS4 compliance
- » Development and implementation of TMDLs

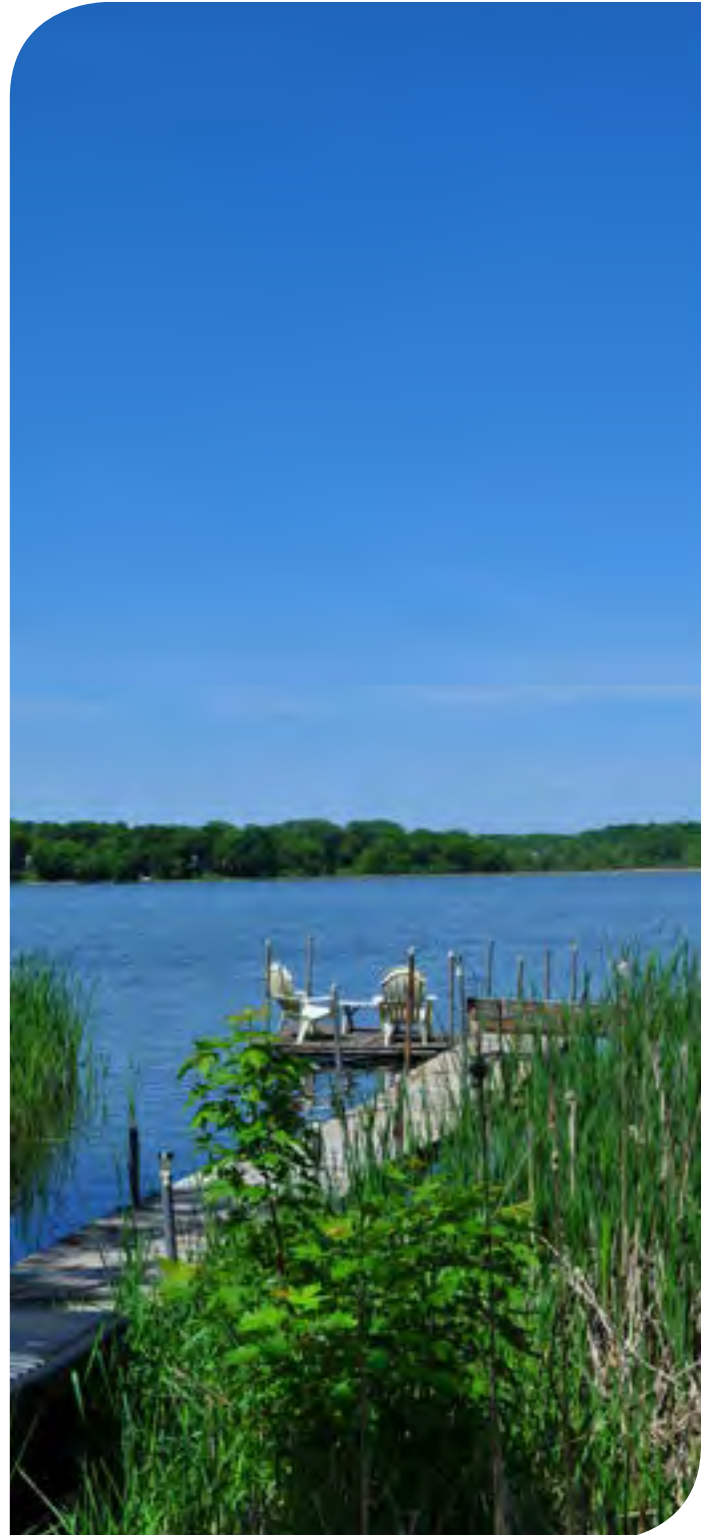
Through the information gathering processes of this Plan, one of the priorities identified by cities in the Langdon Lake Subwatershed was maintaining the area’s rural character and access to natural resources. There is some redevelopment anticipated to the northwest of Langdon Lake, and the Metropolitan Council Environmental Services is planning to replace an interceptor sewer line along County Road 44. These projects may present opportunities to partner on stormwater management or other resource improvements.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

Implementation Priorities

As described in previous sections, Langdon Lake is impaired by excess nutrients, however the inlet and outlet of Langdon Lake are within the state’s eutrophication standards. The fish community in Langdon Lake and its inlet and outlet may be negatively impacted by nutrient enrichment, low dissolved oxygen, and reduced water clarity. The subwatershed also contains areas of high quality wetland and upland, including a regionally significant ecological area.



Langdon Lake



Based on these conditions, management strategies within the subwatershed will focus on reducing pollutant loading, maintaining wetland diversity and stormwater storage, monitoring phosphorus release from wetlands, investigating phosphorus treatment, and protecting existing resources.

The Langdon Lake subwatershed is relatively small. There is some redevelopment anticipated to the northwest of Langdon Lake, and the Metropolitan Council Environmental Services is planning to replace an interceptor sewer line along County Road 44. The Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects. The CIP for the subwatershed, detailed in the next section, includes a project for stormwater management should an opportunity arise through land use change or a partner initiative.

There are extensive high quality wetlands and uplands in the subwatershed primarily incorporated into Gale Woods Regional Park. The focus in this subwatershed will be to preserve similar high-value resources through Land Conservation, where appropriate, and by working with cities and developers to minimize disturbance during development and construction.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. In the future, should the District or a partner determine that a larger or more concentrated scale of capital and program implementation may be needed, a discrete subwatershed planning process may be initiated to:

- » Provide high resolution diagnostic of watershed issues and drivers

- » Map current projected land use and infrastructure changes
- » Define a detailed and integrated capital and program implementation plan
- » Outline a funding strategy including program costs and sources

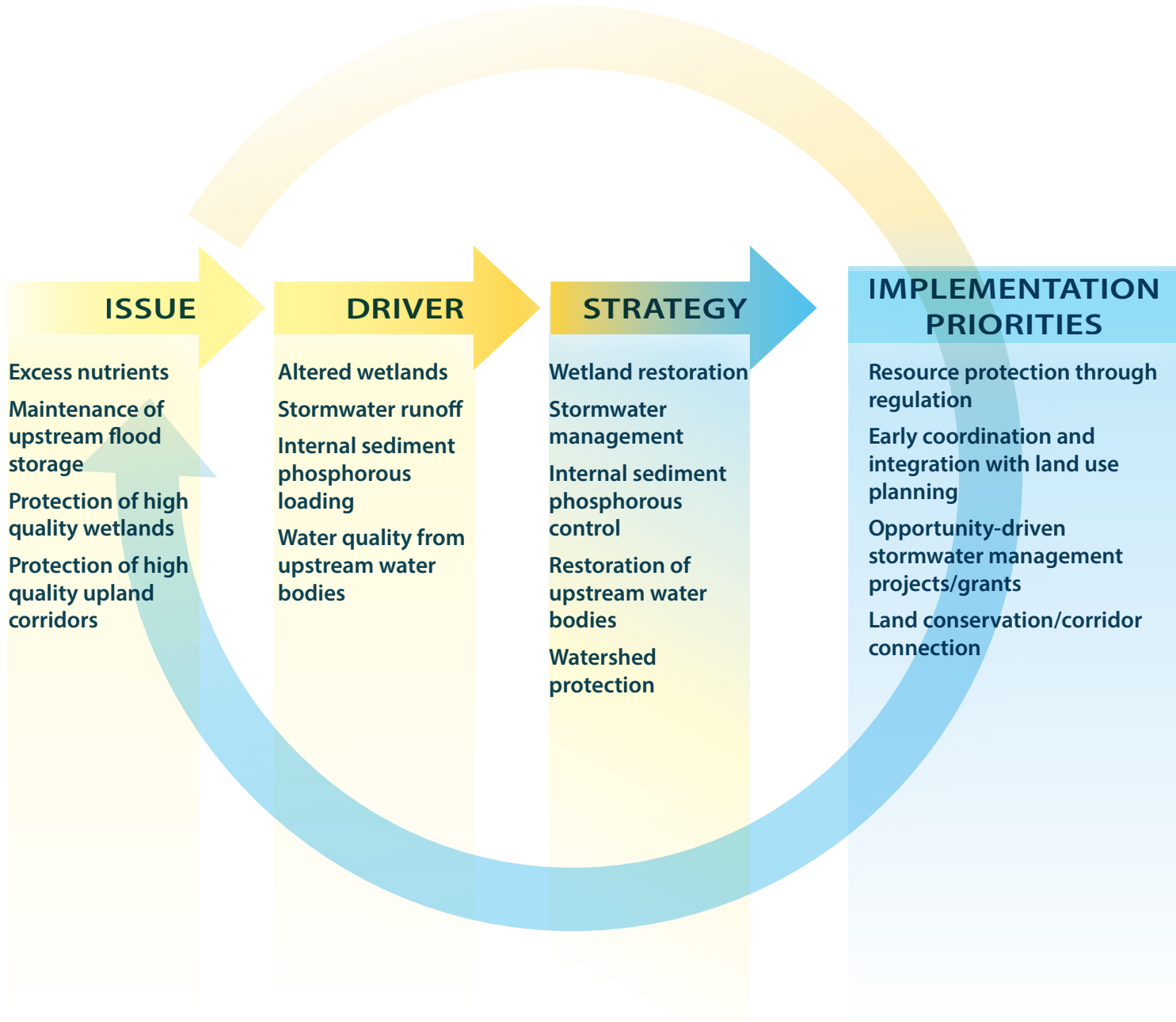
The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Plan.

CAPITAL IMPROVEMENT PLAN

The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District's scope and priorities for its capital work over the planning period. A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other policy considerations before a formal decision to proceed to construction is made. Section 3.5.5 describes the development and evaluation steps that will occur before the District will commit resources to a project.

Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures.

A critical component of any project will be the development of a funding strategy that identifies the sources, uses, and timing of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District's public and private partners as capital projects are advanced. Therefore, any costs identified within this Plan are projections. Intended





expenditures will be refined during project development and budgeting, and among other things will reflect the District's intent to complement its ad valorem funds with other funding sources.

Table 3.10 Langdon Lake Subwatershed CIP

Project	Storm Water Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Langdon Lake, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Langdon Lake exceeds state excess nutrient standards. The 2014 TMDL identified a total phosphorus load reduction of 84 pounds, with 44 pounds from stormwater, for Langdon Lake to meet water quality standards.
Outcome	Reduction of pollutant loading to Langdon Lake; reduction of stormwater runoff volume and rate and associated impacts; protection and enhancement of groundwater recharge, stream base flow, and wetland hydrology.
Estimated Cost	Capital costs: \$230,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

3.9.7 LONG LAKE CREEK SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Long Lake Creek Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Long Lake Creek Subwatershed is 11.9 square miles (7,619 acres) and located along the northern boundary of the MCWD and includes portions of the cities of Long Lake, Medina, Orono and Plymouth. The subwatershed is generally characterized by large areas of undisturbed land (37%) including large wetland and wooded areas, single family-residential in the central and eastern subwatershed (28%), lakes (9%), agriculture (10%), as well as park and open space (10%). The Luce Line Trail passes through this subwatershed, as well as the proposed Southwest Hennepin Regional Trail.

Several large wetlands in the subwatershed have been classified by the *Functional Assessment of Wetlands* as having exceptional vegetative diversity, including School Lake, and two DNR Scientific and Natural Areas, Wolsfeld Woods and Wood-Rill. The Minnesota Biological Survey has also identified both terrestrial and aquatic locations in the watershed with intact native plant communities and good biodiversity.

The headwaters of the subwatershed are Holy Name Lake in the east, and School Lake in the west. Each headwaters drains through streams that converge just north of Long Lake. Together both systems drain approximately 1600 acres into the primary inlet of Long Lake. Long Lake drains south into wetlands that discharge into Tanager Lake, which connects via a channel to Lake Minnetonka. One significant area is landlocked, Lydiard Lake.

Holy Name, School, Wolsfeld, Long, and Tanager Lakes are listed as impaired for excess nutrients, and are part of the Upper Minnehaha Creek TMDL. Upstream lakes and Long Lake's internal loading each provides around 25% of the phosphorus load to Long Lake, with stormwater runoff providing nearly

50%. Upstream lakes and stormwater provide nearly 77% of the phosphorus load to Tanager Lake, with the remaining portion mainly internal loading.

Management strategies within the Long Lake Creek subwatershed will focus on managing common carp, restoring upstream waterbodies, addressing internal loading, performing wetland restorations and managing stormwater runoff. In the past, the District has worked in partnership within this subwatershed to implement regional stormwater management through a series of constructed ponds, treated Long Lake for internal loading, restored natural shorelines, and restored and enhanced wetlands.

Regional partnerships are beginning to form between the Cities of Medina, Long Lake, Orono, Long Lake Waters Association and the MCWD. This partnership seeks to leverage the skills and resources of each entity, by collaborating and identifying shared priorities for the implementation of projects and programs to improve water quality in the Long Lake Creek Subwatershed. Common carp management has been identified as an initiative to prioritize in advance of internal load management, and concurrent with landscape restoration. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity and ecological integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Long Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

[Water Quality Lakes and Streams](#)

Holy Name, Long, School, Tanager and Wolsfeld Lakes are listed

**LONG LAKE
SUBWATERSHED**



Figure 3.25 Long Lake Base map



as impaired for excess nutrients, and are part of the Upper Minnehaha Creek TMDL. While Long Lake Creek is not listed as an Impaired Water for nutrients, the stream exhibits high total phosphorus concentrations relative to the State River Eutrophication Standards.

Upstream lakes and internal loading each provides around 25% of the Phosphorus load to Long Lake, with stormwater runoff providing nearly 46%. External loading from stormwater and upstream lakes provide 77% of the phosphorus load to Tanager Lake, with the remaining portion mainly internal loading.

Wetlands

The Long Lake Creek Subwatershed is a wetland rich system, with wetlands occupying over 22% (1,647 acres) of the subwatershed. The majority of wetlands have been altered and degraded, providing a likely source of phosphorus export into to the watershed.

Groundwater

Many of the major wetlands in this subwatershed act as recharge-discharge wetlands. Groundwater recharge is important within the subwatershed to maintain wetland hydrology and stream baseflow, as well as to recharge aquifers that supply public and private drinking water wells.

Portions of the subwatershed have been designated by the Minnesota Department of Health (MDH) as a Drinking Water Supply Management Area and Wellhead Protection Area for City of Plymouth and City of Long Lake public wells. Much of this area is designated to be of low risk to contamination of the drinking water supply, with a small area located in a till deposit being of moderate risk.

Water Quantity

A series of channels and wetlands drain the western and eastern parts of the subwatershed, before joining together prior to discharging into Long Lake. Flow to Long Lake Creek is controlled by an outlet weir on Long Lake. Six storm sewer outfalls discharge into the creek, which flows through two large wetlands prior to discharging into Tanager Lake and then into Lake Minnetonka: Browns Bay.

Lydiard Lake is landlocked, with no natural outlet. Several locations in the system have been identified through the District's modeling and stream assessments as being vulnerable to localized flooding during large rain events.

Ecological Integrity

Lakes and Streams

Limited fish data exist for most lakes and streams, but a 2013



Long Lake wetland restoration

**LONG LAKE
SUBWATERSHED**



Figure 3.26 Long Lake Water Resources map





Figure 3.27 Long Lake Parks, Trails, and Open Space map





DNR survey on Long Lake found the walleye community was balanced but the low dissolved oxygen and high summer temperatures were potentially limiting growth and survival. A 2010 DNR survey on Long Lake Creek found the fish community was on the border of Poor to Good. Anecdotal information suggests Common Carp are abundant in the subwatershed and may be impacting water quality and ecological integrity.

Aquatic plant biodiversity, as measured by a Floristic Quality Index developed by the DNR, is borderline Poor to Good condition in Lydiard Lake, but Degraded in Long Lake, Dickey's and Wolsfeld. Eurasian watermilfoil and Curlyleaf Pondweed are present in the subwatershed, but not abundant.

Wetlands

Several large wetlands in the subwatershed have been classified by the Functional Assessment of Wetlands as having exceptional vegetative diversity, including School Lake, and two DNR Scientific and Natural Areas: Wolsfeld Woods and Wood-Rill. Their conservation is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

Uplands and Natural Corridors

The Minnesota Biological Survey has identified both terrestrial and aquatic locations in the watershed with intact native plant communities, and those with biodiversity significance. These locations should be considered for preservation and protection to maximize habitat and biodiversity.

Two DNR Scientific and Natural Areas are present in the subwatershed in Wolsfeld Woods and Wood-Rill. Upland, wetland and stream protection and restoration may preserve and enhance connections between these two features.

Drivers

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover.

This section of the Plan outlines the main drivers of water quality, water quantity and ecological integrity issues within the Long Lake Creek subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Long Lake Creek subwatershed are:

Water Quality

- » Excess nutrients

Water Quantity

- » Localized flooding

Ecological Integrity

- » Mostly degraded aquatic plant communities
- » Degraded and disconnected wetland and terrestrial corridors

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Common carp
- » Stormwater runoff
- » Internal sediment phosphorus loading
- » Water quality from upstream waterbodies

Altered Wetlands

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

There are a number of high-quality wetlands in the subwatershed. The two primary upper watershed tributary

streams connect lakes and wetlands in a nearly continuous natural corridor that provides significant functions and values such as runoff storage and water quality treatment as well as habitat and natural resources values. Large wetlands riparian to Long Lake Creek attenuate flooding and provide water quality treatment upstream of Brown's Bay. Protection of these wetlands and corridors is essential to preserving their high level of functions and values and to prevent the negative impacts that follow alteration.

Carp

Invasive common carp negatively impact water quality and ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse state, and is often characterized by a significant loss of natural vegetation, harmful algal blooms, and the release of phosphorus from re-suspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

Carp have been observed throughout the system, and Tanager Lake, which is connected to the rest of the system, has been documented as having a very high abundance of carp. A subwatershed wide assessment should be conducted to determine its level of impact in each waterbody, and develop strategies for management.

Stormwater Runoff

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters,

the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

Holy Name, School, Wolsfeld, Long and Tanager Lakes are listed as impaired for excess nutrients. Stormwater runoff is noted in the TMDL as providing approximately 45% of the nutrient load to Long Lake. It also accounts for 15 to 51% of the loading to Wolsfeld, School and Tanager Lakes.

Internal Sediment Phosphorus Loading

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

According to the TMDL, internal loading accounts for almost 22% of the nutrient load to Long Lake, and also contributes 53% of loading to School Lake, 80% to Holy Name, 16% to Wolsfeld and 20% to Tanager Lake.

Upstream Waterbodies

Headwater streams, lakes and wetlands contribute water and nutrients to downstream receiving waters impacting the quality of these water bodies. Lakes and wetlands with poor water quality ultimately contribute nutrients to downstream waters



Kayaking



Seeding wild rice



Long Lake shoreline

that can lead to eutrophication. Consequently, restoration of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Upstream waterbodies are affecting water quality in several of the impaired lakes, contributing around 28% of the nutrient load to Wolsfeld, 25% to Long and 63% to Tanager Lake.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Long Lake Creek subwatershed. These strategies are both short- and long-term, and establish a framework for the Long Lake Creek subwatershed Implementation Plan programs and projects.

Wetland Restoration

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

While higher quality wetlands are present in the upper watershed, there are several candidate wetland restoration sites in the lower watershed. These sites are riparian to Long Lake Creek, and stream stabilization and restoration could be incorporated into the restoration to reduce sediment and phosphorus loading to Tanager Lake downstream.

Carp Management

Historically, carp management focused on removal of carp populations from impacted water bodies without any consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

A subwatershed wide carp assessment is needed to develop management strategies to sustainably control common carp in this system. Carp management is a pre-requisite before tackling other strategies to reduce internal loading.

Stormwater Management

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

In the Long Lake Creek subwatershed, the focus will be on installing infiltration and load reduction BMPs in the developed areas of the subwatershed and agricultural BMPs to reduce nutrient, sediment, and bacterial loading from agricultural land uses in the upper watershed.

Internal Sediment Phosphorus Control

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to

prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Once common carp have been managed to lower densities, internal load reduction strategies such as alum treatment should be considered. Additional data will need to be collected to determine appropriate treatment options. The Upper Minnehaha Creek Watershed TMDL recommended internal phosphorus control for School, Long, Holy Name, and Tanager Lakes to help improve water quality.

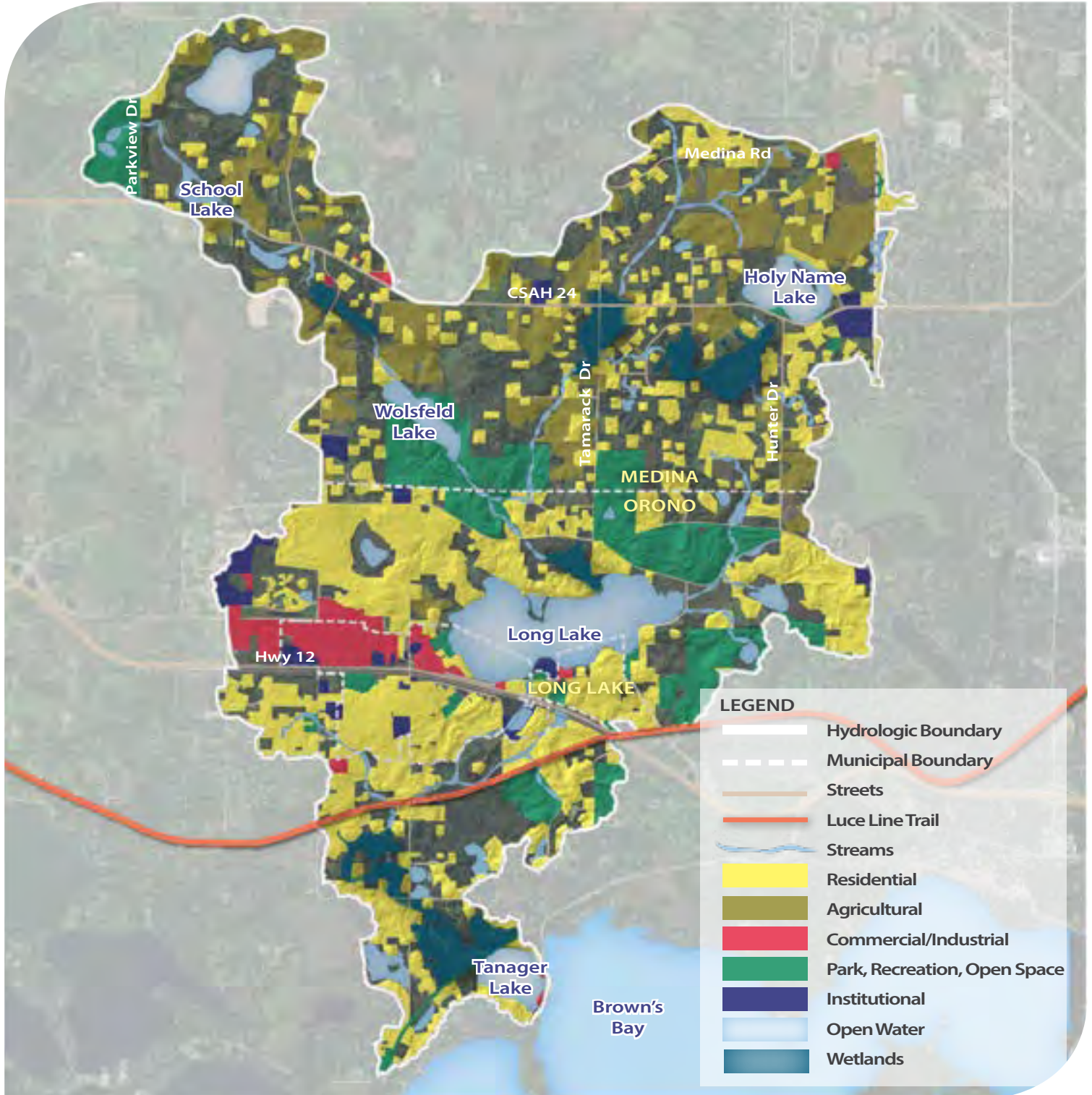
Restoration of Upstream Waterbodies

Upstream water bodies that are currently impaired can discharge large nutrient loads to downstream water bodies thereby contributing to downstream water quality impairments. Therefore, prior to, or concurrent with, significant efforts to restore downstream water quality, the water quality in upstream water bodies must be improved. Nutrient impaired upstream lakes may require external and internal nutrient reductions using the strategies listed in this section.

Managing unique drivers in upstream waterbodies will benefit the system as a whole. Addressing internal loading in School Lake will benefit Wolsfeld Lake as well as other downstream lakes. Addressing various inputs into Wolsfeld Lake will benefit Long Lake and Tanager. Finally, addressing various inputs for Long Lake will benefit Tanager Lake.

Watershed Protection

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.



LEGEND

- Hydrologic Boundary
- Municipal Boundary
- Streets
- Luce Line Trail
- Streams
- Residential
- Agricultural
- Commercial/Industrial
- Park, Recreation, Open Space
- Institutional
- Open Water
- Wetlands

Figure 3.28 Long Lake Land Use map



There are significant natural resources in the subwatershed, including high-quality wetlands, intact native plant communities with biodiversity significance, and valuable connected corridors. Some of these areas are located within two DNR Scientific and Natural Areas, but other important natural resources are privately owned. The focus in this subwatershed will be to preserve these high-value resources through Land Conservation where appropriate and by working with cities and developers to minimize disturbance during development and construction.

LAND USE

EXISTING CONDITIONS

The subwatershed includes portions of the cities of Long Lake, Medina, Orono and Plymouth. The subwatershed is generally characterized by large areas of undisturbed land (37%) including large wetland and wooded areas, single family-residential in the central and eastern subwatershed (28%), lakes (9%), agriculture (10%), as well as park and open space (10%). The Luce Line Trail passes through this subwatershed, as well as the proposed Southwest Hennepin Regional Trail.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Sections 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for 2018-2027 (see Appendix B for details on the public input process). This information was used to broadly characterize opportunities, and to inform the development of the District's implementation plans. The information received was used only as a guide during the development of this Plan to inform the District of opportunities for partnership on the near term horizon, and was not intended to be exhaustive or restrict future collaborative efforts.

As discussed in Section 3.6, the District intends to cultivate a framework for two-directional coordination with communities on an ongoing basis, to stay apprised of emerging needs at a local level, and to identify and evaluate opportunities to

implement management strategies outlined in this Plan over the next ten years. The District recognizes that local needs, opportunities and priorities may shift over time. Therefore, this Plan does not intend to capture or prescribe opportunities for partnership over a ten-year term.

Long term goals, growth and private development, and public investment in infrastructure differ across each community – and therefore, frameworks for ongoing coordination will be custom tailored based on the individual needs of each community. Coordination may occur at varying levels, through various means, with communities across the following areas:

- » Regulation of, and partnership with, private development
- » Collaboration on public planning and investment (e.g. parks , roads, utilities)
- » MS4 compliance
- » Development and implementation of TMDLs

Through the information gathering processes of this Plan, priorities identified by the cities in the Long Lake Creek subwatershed included protecting Long Lake and preserving the rural character of their communities. The cities may find opportunities to collaborate with the MCWD on these priorities by coordinating with the District on road reconstruction, redevelopment, and open space improvement projects expected in the area.

Regional partnerships are beginning to form among the Cities of Medina, Long Lake, and Orono; the Long Lake Waters Association; and the MCWD. This partnership seeks to leverage the skills and resources of each entity, by collaborating and identifying shared priorities for the implementation of projects and programs to improve water quality in the Long Lake Creek Subwatershed. Common carp management has been identified as an initiative to prioritize in advance of internal load management, and concurrent with landscape restoration.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the



watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, Long, Holy Name, School, Tanager, and Wolsfeld Lakes are listed as impaired for excess nutrients. This is driven by a combination of wetlands acting as sources of phosphorus, the presence of common carp, internal loading and runoff and loading from upstream waterbodies. Based on these conditions, management strategies within the subwatershed will focus primarily on wetland restoration, management of common carp, and internal load management.

The Long Lake Creek subwatershed will experience planned development and infrastructure investments over the next 10-15 years. Communities within the subwatershed are currently updating their own comprehensive plans, which will help guide changes across the landscape. This Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning

by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, grants, and capital projects.

In the past, the District has worked in partnership within this subwatershed to implement regional stormwater management through a series constructed ponds, treated Long Lake for internal loading, restored natural shorelines, and restored and enhanced wetlands.

The District will pro-actively coordinate the permitting of future land use change with communities within the subwatershed to explore opportunities to create public-private partnerships to address wetland restoration and stormwater management goals in ways that exceed regulatory requirements.



Long Lake with restored wetlands and treatment ponds

Regional partnerships are beginning to form among the Cities of Medina, Long Lake, Orono, Long Lake Waters Association, and the MCWD. This partnership seeks to leverage the skills and resources of each entity, by collaborating and identifying shared priorities for the implementation of projects and programs to improve water quality in the Long Lake Creek Subwatershed. As opportunities are identified, the partners will define roles, responsibilities and possible sharing of costs. Common carp management has been identified as an initiative to prioritize in advance of internal load management, and concurrent with landscape restoration.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, and given the scale, complexity and multi-jurisdictional nature of the geography, the capital improvement plan for this subwatershed includes a project listing for stormwater management. Carp management may be addressed on a programmatic basis and is therefore not included in the capital improvement tables. In the future, should the District or a partner determine that a larger or more concentrated scale of capital and program implementation be determined to be needed, a discrete subwatershed planning process may be initiated to:

- » Provide high resolution diagnostic of watershed issues and drivers
- » Map current projected land use and infrastructure changes
- » Define a detailed and integrated capital and program implementation plan
- » Outline a funding strategy including program costs and sources

The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Plan.

CAPITAL IMPROVEMENT PLAN

The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District's scope and priorities for its capital work over the planning period.

A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other policy considerations before a formal decision to proceed to construction is made. Section 3.5.5 describes the development and evaluation steps that will occur before the District will commit resources to a project.

Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures.

A critical component of any project will be the development of a funding strategy that identifies the sources, uses, and timing of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District's public and private partners as capital projects are advanced. Therefore, any costs identified within this Plan are projections. Intended expenditures will be refined during project development and budgeting, and among other things will reflect the District's intent to complement its ad valorem funds with other funding sources.



Table 3.11 Long Lake Creek Subwatershed CIP

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Long, School, Wolsfeld, Holy Name, and Tanager Lakes, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Five lakes in the subwatershed exceed state excess nutrient standards - Long, School, Wolsfeld, Holy Name, and Tanager. A TMDL identified a need to reduce external phosphorus loading by 62% (411 pounds) to Long Lake, 81% (32 lbs) to School Lake, 82% (79 lbs) to Wolsfeld Lake, 96% (31 lbs) to Holy Name Lake, and 61% (106 lbs) to Tanager Lake.
Outcome	Reduction of pollutant loading to Long, School, Wolsfeld, Holy Name, and Tanager Lakes; reduction of stormwater runoff volume and rate and associated impacts; protection and enhancement of groundwater recharge, stream base flow, and wetland hydrology.
Estimated Cost	Capital Cost: \$1,320,000.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027



Wetland restoration in the Long Lake Subwatershed

3.9.8 MINNEHAHA CREEK SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Minnehaha Creek Subwatershed, including existing conditions and issues, drivers, management strategies, land use information and an implementation plan. Information regarding the District’s philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

The Minnehaha Creek subwatershed encompasses all of the MCWD downstream of the Grays Bay dam, and is commonly referred to as the “lower watershed.” The subwatershed is 47.3 square miles (30,290 acres) in size and includes portions of the cities of Edina, Golden Valley, Hopkins, Minneapolis, Minnetonka, Plymouth, Richfield, St. Louis Park and Wayzata.

The predominant land use in the subwatershed is single family residential (52%), followed by parks and open space (15%), multi-family residential (8%), water (6%), commercial (5%), institutional (5%), and transportation (5%). The subwatershed is fully developed at typical urban and suburban densities and land uses, and contains a higher level of impervious cover on the land than any of the other ten subwatersheds in the District. Redevelopment and infill development have increased since the 2007 plan, with a notable increase in multi-family residential. Most of the remaining vacant or undetermined land is large wetland or woodland tracts.

Development in this subwatershed has left relatively few large areas of undisturbed or minimally disturbed forest and wetland in the subwatershed. Three areas, including the Grays Bay outlet wetland complex; Diamond Lake; and a portion of the creek corridor in the Mississippi River gorge have been designated Regionally Significant Ecological Areas by the DNR. The Minnesota County Biological Survey (MCBS) did not identify any areas of biodiversity significance in the subwatershed. The creek corridor and the Chain of Lakes in the lower subwatershed are part of a DNR-designated Metro Conservation Corridor.

Formed at the outlet of Grays Bay in Lake Minnetonka and flowing approximately 23 miles to the Mississippi River, Minnehaha Creek is the primary stream within the subwatershed



Fisherman on Lake Harriet, Stan Waldhauser



Lake Calhoun



Falls at Minnehaha, Tom Dixon

**MINNEHAHA CREEK
SUBWATERSHED**

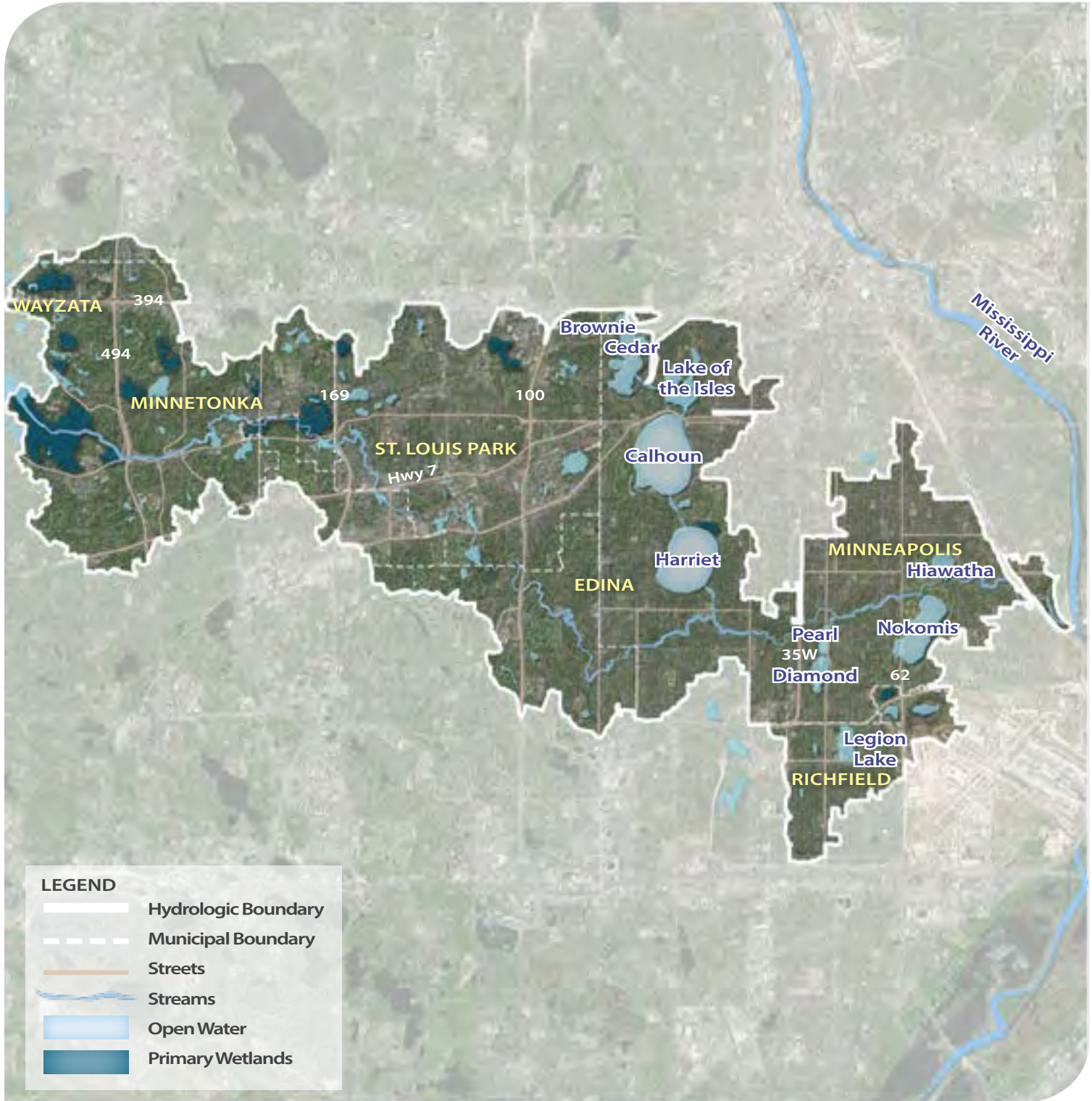
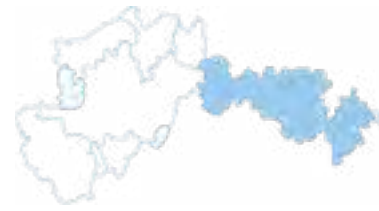


Figure 3.29 Minnehaha Creek Base map



and an iconic and historically significant resource that connects multiple communities and a system of urban parks, lakes and open space. As an outlet for Lake Minnetonka and the upper watershed, Minnehaha Creek must discharge large volumes of water during spring snowmelt runoff, summer and fall. Prior to its confluence at the Mississippi River, Minnehaha Creek flows through Lake Hiawatha and significantly influences water quality within the lake.

A significant area of the central portion of the subwatershed drains through the Minneapolis Chain of Lakes (Brownie, Cedar, Isles, Calhoun, and Harriet) and outlets via channel to Minnehaha Creek. Lake Nokomis is physically disconnected from Minnehaha Creek by a weir to reduce the influence of the creek on the lake's water quality and prevent the introduction of invasive species.

Within the Minnehaha Creek subwatershed, ditching of the stream channel, loss of wetlands, corridor fragmentation and increasing levels of impervious surfaces have disrupted fluvial processes; increased runoff volumes and pollutant loads; decreased infiltration and baseflow; and fragmented and degraded habitat; negatively impacting the ecological integrity of the stream and its riparian systems. As a result, Minnehaha

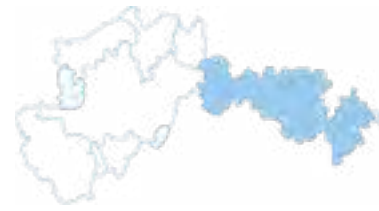
Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved Total Maximum Daily Load (TMDL). Lake Nokomis also has an approved TMDL for excess nutrients and is one of four other lakes in the subwatershed that do not meet state water quality standards for nutrients.

Due to the system's altered hydrology (hard cover and altered wetlands) and upstream drainage area (Lake Minnetonka), several locations along Minnehaha Creek are known to flood during large or extended rain events. Overall, due to the size of the subwatershed and the urban characteristics of the area (developed, fragmented and altered), ecological integrity throughout the subwatershed is highly variable and generally considered to be lacking.

Management strategies within the Minnehaha Creek subwatershed will focus on stormwater management to reduce runoff volume and pollutant loading, stream restoration to stabilize streambanks and improve riparian buffers and habitat,



Greenway Boardwalk



Minnehaha Falls, Peter Stratmoen

and restoration of wetlands and ecological corridors in ways that reduce nutrient loading downstream to Lake Hiawatha while improving ecological integrity and corridor connectivity within the subwatershed.

Since 2010, the District has been working to manage regional stormwater, and expand and connect the riparian greenway in a manner mutually beneficial to the built environment. The District has been focusing on the most degraded section of Minnehaha Creek – between West 34th Street and Meadowbrook Lake in St. Louis Park and Hopkins – to implement a comprehensive corridor restoration that focuses on reducing pollutant loads, mitigating flashy hydrology, reconnecting the riparian corridor, and restoring the physical character of the stream channel.

This geography, known as the Minnehaha Creek Greenway, produced the highest pollutant loading per unit area of any other land area along the entire stream system. The effort to-date has yielded significant results, often through innovative public and private partnerships, resulting in hundreds of acres of regional stormwater management, nearly two miles of restored stream, over ten acres of wetland restoration, public access to over 50 acres of previously inaccessible green space, two miles of new trail network, and improved ecological integrity through a series of vegetative restorations and invasive species management.

Building on these efforts, the District will continue its focus within the Minnehaha Creek Greenway to complete the corridor restoration while also extending its efforts to other critical areas of high need within the Minnehaha Creek subwatershed. An example of identified opportunities in the subwatershed include stormwater management and stream restoration in the cities of Edina and Minneapolis. These opportunities, and others, are summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, specialized studies,

the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Minnehaha Creek subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality Lakes and Streams

The Minnehaha Creek subwatershed includes the Chain of Lakes in Minneapolis and several other smaller lakes. Powderhorn Lake in Minneapolis does not drain to the creek, but rather is pumped to the Mississippi River.

Five lakes in the subwatershed are listed on the State's Impaired Waters list for exceeding the state standard for total phosphorus, with excessive nutrients being conveyed to them from the watershed. TMDLs have been completed for two of those lakes: Hiawatha and Nokomis. Powderhorn and Brownie had been listed previously, but were delisted in 2012 and 2010, respectively.

Two lakes – Powderhorn and Brownie – are impaired by excess chloride, likely from road salt. Diamond Lake is classified as a wetland, but is listed as impaired for chloride in the Twin Cities Metropolitan Area Chloride TMDL.

Minnehaha Creek is included on the State's Impaired Waters List due to excess chloride, fecal coliform concentrations, low dissolved oxygen, as well as impaired fish and macroinvertebrate communities. Total phosphorus concentrations on Minnehaha Creek are less than the state river eutrophication standards with the primary nutrient cycling concern for Minnehaha Creek being its conveyance of phosphorus load to Lake Hiawatha.

Minnehaha Creek was evaluated in-detail in 2003, and again in 2012, as part of the District's Minnehaha Creek Stream Assessment, which includes a physical inventory, erosion survey, and a fluvial geomorphic assessment to determine channel stability. Additional survey work was completed

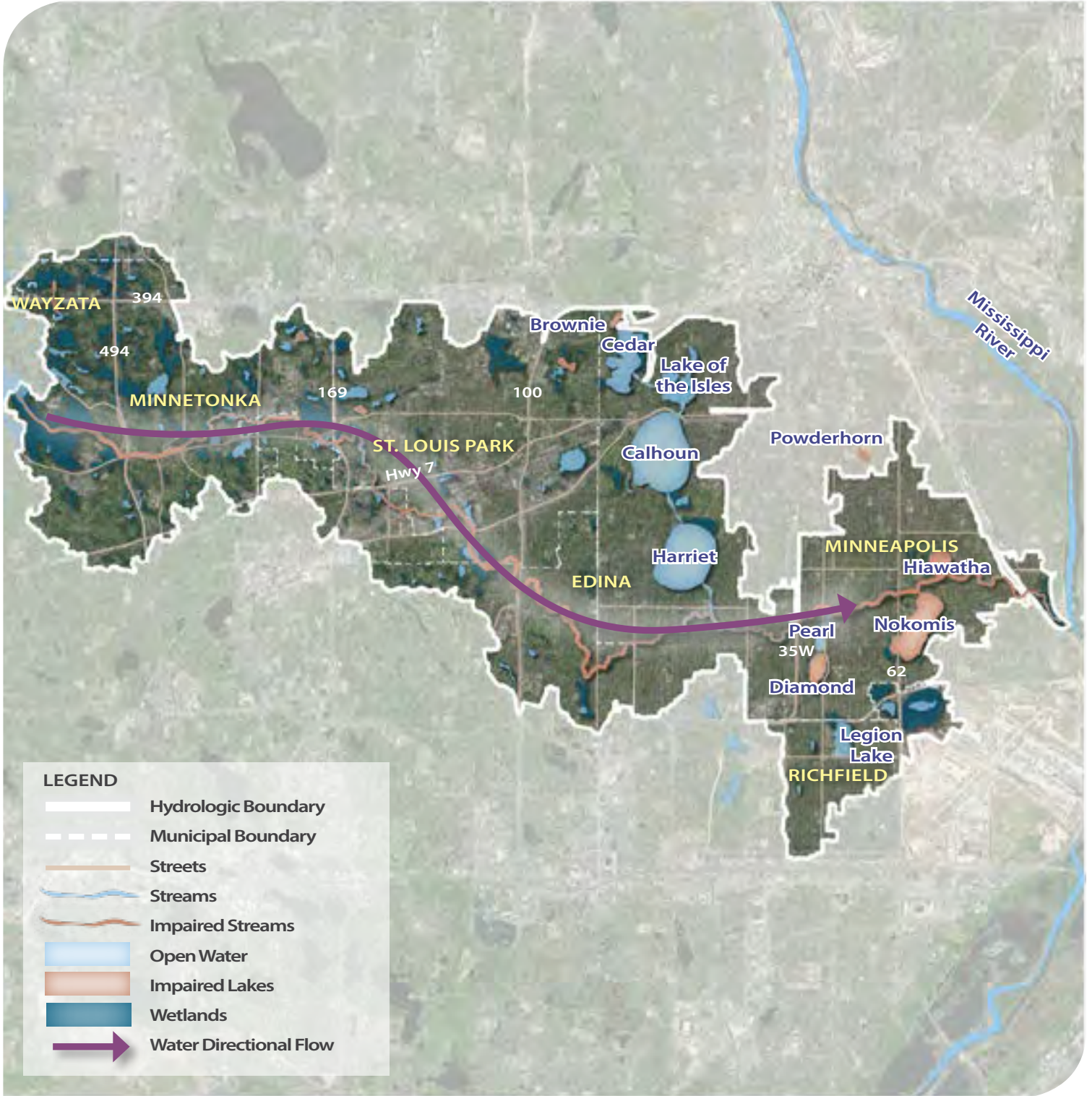
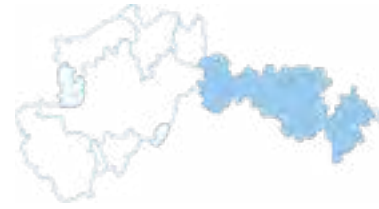


Figure 3.30 Minnehaha Creek Water Resources map



following the 2014 flood to assess damage. These assessments identify a number of areas that would benefit from restoration.

Wetlands

The Minnehaha Creek subwatershed has a large number of wetlands of various sizes distributed across the landscape, including several very large wetland complexes through which the creek flows. Wetlands, including lake systems, cover just over 12 percent of the subwatershed's surface.

The District's Functional Assessment of Wetlands (FAW) indicates that a number of systems score highly on vegetative diversity, fish and wildlife habitat, or aesthetics. Of the wetlands assessed for restoration potential, few wetlands throughout the subwatershed were found to have moderate or high restoration potential, and most of those are small.

No data are available yet to evaluate the ability of the wetlands in the subwatershed to cycle nutrients to and from the subwatershed. E-Grade will assess wetland soil chemistry, overall vegetative conditions, presence or absence of algal blooms, and condition of the buffer and area within 500 feet of the wetlands. Final results of the E-Grade evaluation will be reported in 2018.

Groundwater

The District has identified the infiltration potential of the upland areas within the subwatershed as high to medium with some areas of variability where the soils are organic in nature. Most of the lower subwatershed is classified by the Hennepin County Geologic Atlas as being of high to very high aquifer sensitivity. The upper subwatershed is classified as being generally of low to moderate sensitivity to pollution except directly along Minnehaha Creek and in the large Grays Bay wetland complex.

There are a number of springs and seeps in the Mississippi River gorge area, including Camp Coldwater Spring, the largest limestone bedrock spring in the Metro area. The 2014 Baseflow Study by the University of Minnesota found that there is significant interaction between the creek and shallow groundwater, with some sections primarily gaining water from groundwater inputs while other sections primarily lose water through infiltration.

Much of the subwatershed has been designated by the Minnesota Department of Health as Drinking Water Supply Management Area (DWSMA) and Wellhead Protection Area (WHPA) for various municipal public wells. The MDH has designated areas within the DWSMAs as very high to moderate risk and vulnerability to contamination of the drinking water supply.

Water Quantity

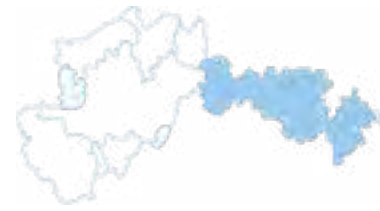
As an outlet for Lake Minnetonka and the upper watershed, Minnehaha Creek discharges large volumes of water during spring snowmelt runoff, summer and fall.

The District manages the Gray's Bay Dam which is an adjustable structure that controls Lake Minnetonka discharges into Minnehaha Creek. The District operates this structure in accordance with the Headwaters Control Structure Management Policy and Operating Procedures, approved by the Minnesota DNR. Operation of the Grays Bay dam is intended to emulate the historical discharge hydrograph and the natural outlet of Lake Minnetonka. The operating plan prescribes discharge zones based on the time of year, the existing lake level, creek capacity in Minnehaha Creek, and forecasted precipitation identified through partnership with the National Weather Service. In drier periods, Lake Minnetonka typically does not discharge water, and portions of the Creek may experience low or even no flow.

In addition to the Gray's Bay Dam, flow in the creek is controlled by numerous other structures, including major weirs at the Browndale Dam, West 54th Street, and Hiawatha Avenue. There are more than 100 bridge crossings, some of which provide a grade control substantial enough to create impoundments, which stagnate water upstream.

There are over 175 identified storm sewer outfalls larger than eight inches in diameter along the length of the creek. This infrastructure results in stormwater reaching the stream quickly, creating "flashy" storm discharges that quickly raise water levels in the creek. Most of these outfalls are located downstream of the Browndale Dam in Edina and Minneapolis.

Locations throughout the system have been identified through observation and the District's modeling and stream assessments as being vulnerable to localized flooding, and streambank



failure and erosion at outlets and culverts from forces created by high water velocity.

Several landlocked basins and many smaller landlocked pocket wetlands exist in the upper reaches of the Minnehaha Creek drainage area including large areas within the City of Minnetonka and portions of Hopkins, Edina and St. Louis Park.

Ecological Integrity
Lakes and Streams

Due to the size of the Minnehaha Creek subwatershed and the urban characteristics of the area, ecological integrity throughout the subwatershed is highly variable and generally considered to be degraded.

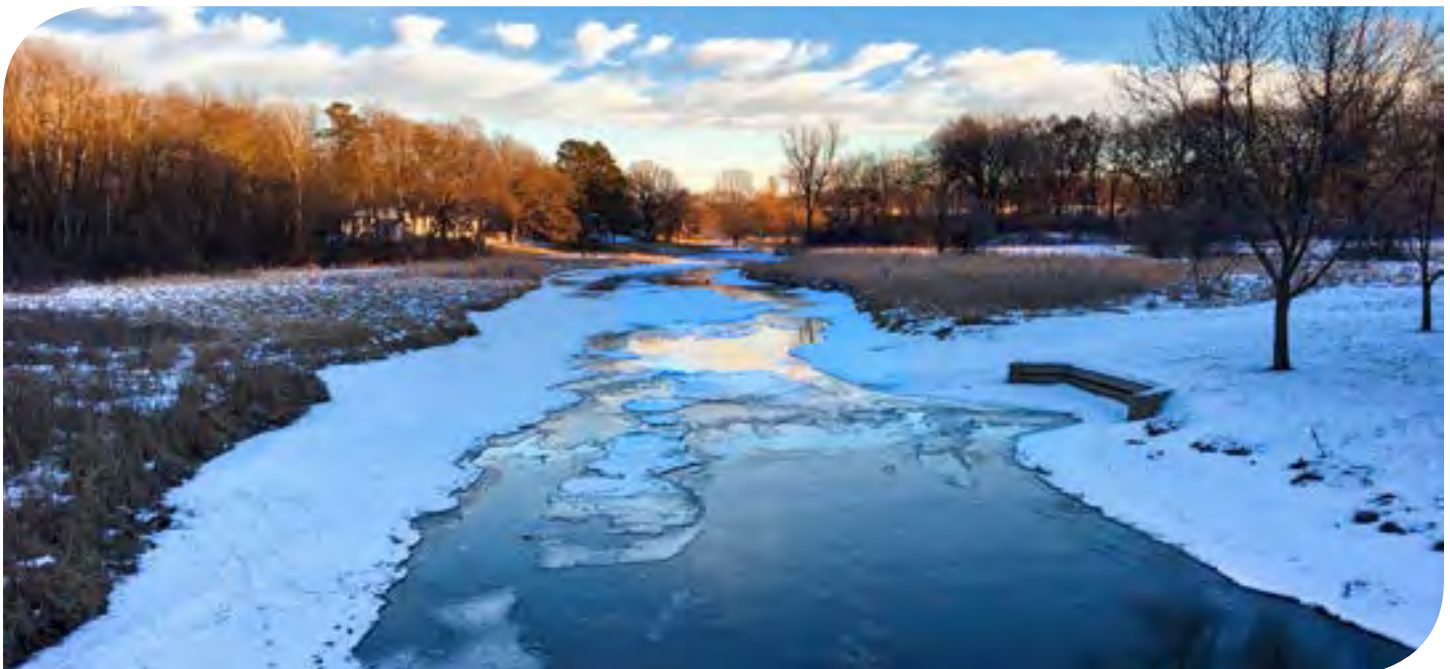
Fish communities throughout the subwatershed are generally characterized as poor. With the exception of Cedar Lake (good) and Lake of the Isles (good), fish assessments in all other lake and stream surveys has resulted in either *poor* or *degraded* classifications.

Approximately 15 percent of the streambank is armored by concrete or masonry retaining walls, rip-rap, or other protection

such as gabion baskets. These are generally for the purpose of controlling erosion and meandering to prevent loss of property, stabilizing steep banks, or protecting structures such as bridges and storm sewer outfalls. Many of these stream walls were presumably constructed by the Works Progress Administration (WPA) during or following the Great Depression.

Minnehaha Creek is listed on the State of Minnesota’s 303(d) list of Impaired Waters for its impaired biotic community. Assessments of fish communities along the Creek consistently return classifications of *degraded* and *poor*, indicating stream disturbance and lack of conditions that support healthy riverine fish communities. Macroinvertebrate sampling along the Creek also classifies a majority of sites as *degraded*, meaning they are highly disturbed, with low species diversity and dominated by pollution-tolerant species.

Many factors contribute to issues associated with degraded ecological integrity including habitat complexity, connectivity, water quality, and hydrology. Stream hydrology is a critical factor in habitat diversity since a stream that is very flashy, that is, one that rises and falls very quickly in response to rain events, or that periodically is dry, stresses aquatic organisms.



Frozen Minnehaha Creek, Aldo Abelleira

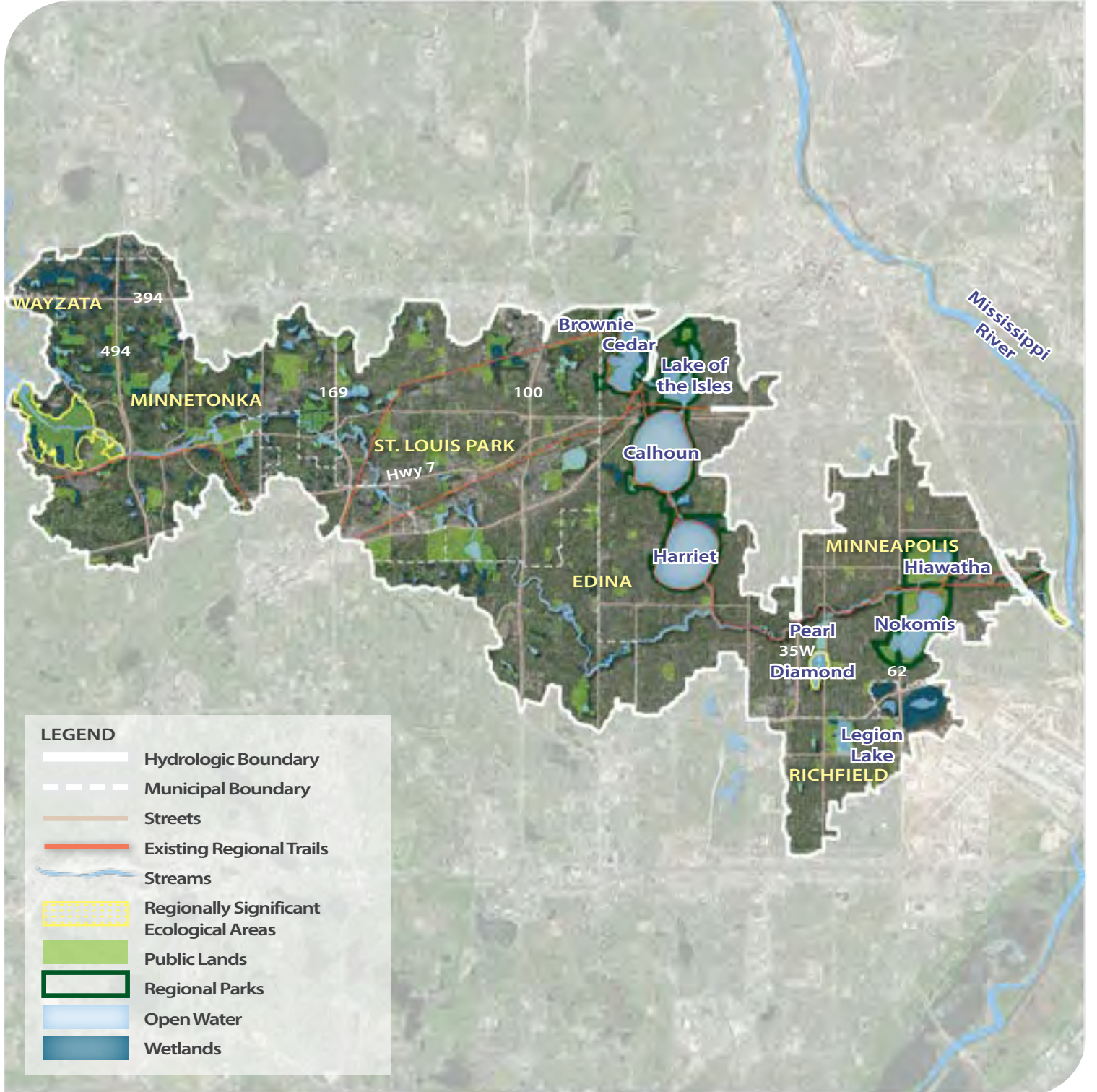
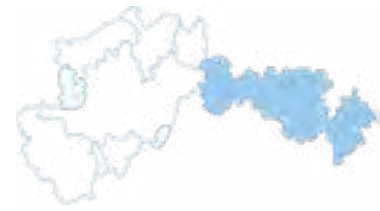


Figure 3.31 Minnehaha Creek Parks, Trails and Open Space map





Minnehaha Falls



Minnehaha Creek



Kayaks on the creek

Wetlands

Although a number of wetlands were identified in the District’s Functional Assessment of Wetlands (FAW) as having exceptional to high aesthetic values, the vegetative communities within these wetlands is generally considered *poor* or *degraded*. Only a scattering of wetlands were identified as having exceptional to high vegetative diversity, which is expected given the urbanized nature of the subwatershed and the likelihood of wetland disturbance and hydrologic impacts. Wetlands riparian to, and in-line with, Minnehaha Creek as well as several wetlands adjacent to lakes were noted as having high fish habitat potential. Only a few of the larger wetlands were assessed as having high wildlife habitat potential, primarily because wetland size is an important factor.

Uplands and Natural Corridors

The Minnesota Biological Survey did not identify any areas of biodiversity significance in the uplands of this subwatershed.

The lower subwatershed – generally the area east of TH 169 – is developed with minimal areas of ecological significance. Regionally significant ecological areas are places where larger tracts of minimally disrupted land provide habitat complexity. The only such area in the Minnehaha Creek subwatershed is the large wetland complex at the outflow from Gray’s Bay, which is the headwaters of Minnehaha Creek, and some wetlands and uplands connecting that complex to other larger wetlands in the upper subwatershed.

DRIVERS

A driver of water quantity, water quality, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Minnehaha Creek subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Minnehaha Creek subwatershed are:

Water Quality

- » Excess nutrients
- » Increasing chloride concentrations
- » Elevated E. Coli concentrations
- » Low dissolved oxygen

Water Quantity

- » Disrupted hydrology
- » Localized flooding
- » Stream flashiness

Ecological Integrity

- » Degraded fish community
- » Degraded macroinvertebrate community
- » Degraded and disconnected wetland and terrestrial corridors

These issues are primarily the result of the following drivers:

- » Stormwater runoff
- » Altered channels
- » Altered wetlands
- » Internal sediment phosphorus loading

Stormwater Runoff

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that

negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up pollutants such as excess nutrients, bacteria (e.g., *E. coli*), chloride from road salt, and toxic pollutants. In more rural areas, stormwater mobilizes pollutants from animal waste and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

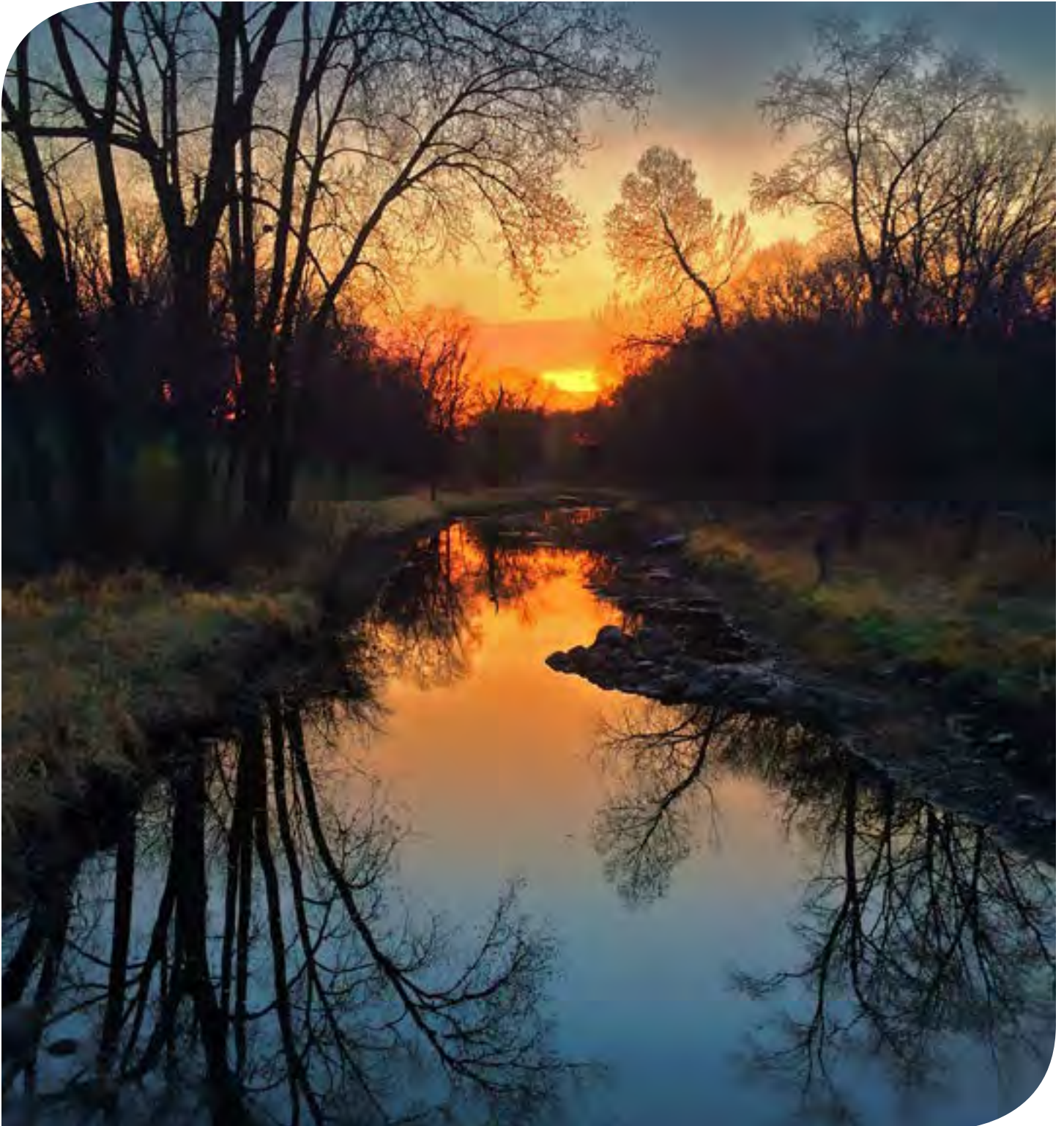
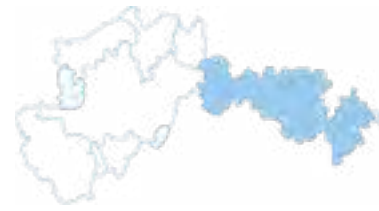
Five lakes in the subwatershed – Hiawatha, Nokomis, Twin, Cobblecrest and Windsor – are listed on the State’s Impaired Waters list for exceeding the state standard for total phosphorus, with excessive nutrients being conveyed to them from the watershed. Two lakes – Powderhorn and Brownie – are impaired by excess chloride, likely from road salt.

Also noted earlier are the impairments that impact Minnehaha Creek including excess chloride, fecal coliform concentrations and low dissolved oxygen as well as impaired fish and macroinvertebrate communities. Total phosphorus concentrations on Minnehaha Creek are less than the state river eutrophication standards with the primary nutrient cycling concern for Minnehaha Creek being its transport of phosphorus load to Lake Hiawatha.

Altered Channels

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Minnehaha Creek was ditched, altered and utilized as a stormwater conveyance system as urban expansion occurred throughout the western metro area. Alterations to Minnehaha Creek have resulted in a disruption of natural stream processes such as sediment transport and channel migration. These unnatural stream characteristics, coupled with the impact



Sunset on creek at Burwell House, Aldo Abelleira

created by in-stream impoundments – Browndale dam and Arden Park – result in habitat and ecological issues that have resulted in impairments throughout the stream system for dissolved oxygen, and fish and macroinvertebrate communities.

Altered Wetlands

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved fraction) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Minnehaha Creek flows through a number of large wetland complexes between its headwaters at the outlet of Lake Minnetonka to its confluence with the Mississippi River. Historic alterations to Minnehaha Creek, as well as urbanization

throughout the subwatershed, have disrupted the natural hydrology of most of the wetlands within this region. Impacts such as this result in altered wetland systems that maintain poor or degraded vegetative communities, lack high level habitat potential, have reduced storage ability during flood events, and may contribute to elevated nutrient concentrations moving throughout the system.

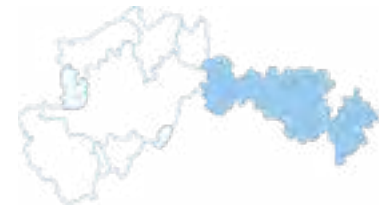
Internal Sediment Phosphorus Loading

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Data suggest that all of the deep lakes within the subwatershed deal with some level of internal phosphorus loading. A variety



MCWD water gauge



of these regionally significant resources – Cedar, Calhoun, Harriet, Lake of the Isles and Nokomis – have received some level of internal loading treatment during the previous 20 years. Internal phosphorus loading is likely a contributing factor to the seasonal fluctuation in phosphorus concentrations within these systems as well as the other deep lakes systems within the Minnehaha Creek subwatershed.

MANAGEMENT STRATEGIES

The District has developed general strategies to guide actions in the Minnehaha Creek subwatershed, informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources. These strategies are both short- and long-term, and establish a framework for the programs and projects utilized in the Minnehaha Creek subwatershed Implementation Plan. To better understand the strategies and efforts of the District and its partners within the Minnehaha Creek subwatershed, it is important to recognize the recent work in this subwatershed and the integration and alignment of natural resource management strategies with the goals of our communities.

Focal Subwatershed Planning

As noted throughout this plan, the District’s overarching organizational strategy is founded in its Balanced Urban Ecology policy. This policy was established as the District’s fundamental philosophy and way of doing business – developed to guide all future planning and watershed management activities in order to achieve its mission of protecting and improving land and water.

The overarching strategy described in Balanced Urban Ecology is a vision of integration with government agencies, private landowners and developers, and philanthropic partners through multi-jurisdictional partnerships, emphasizing the economic and social value that natural systems generate for the built environment. It further describes how our work will be strengthened through these collaborative efforts not only to offer greater community impact, but to produce creative public-private funding opportunities that will leverage scarce resources and maximize benefits.

The origin of the Balanced Urban Ecology policy lies within the Minnehaha Creek subwatershed, in the most urbanized

section of Minnehaha Creek in Hopkins and St. Louis Park, now referred to as the Minnehaha Creek Greenway. As the landscape in this stretch was developed over the past 80 years, wetlands were filled and the creek was straightened, creating a significant tension between the natural and built environments that degraded water quality, increased flood risk and limited recreational access.

A routine permit application by Methodist Hospital in St. Louis Park sparked a series of natural resource improvements that has become one of the largest urban stream restorations in Twin Cities’ history. This corridor initiative provides multiple natural resource and community benefits including restoration of the natural channel hydrology and riparian environment, removal of significant pollutant loads from the creek, downstream Lake Hiawatha and the Mississippi River, access to green space, community connections and job creation.

When Methodist Hospital approached the MCWD with a permit application for its new heart and vascular center, there was an opportunity to align goals. The MCWD restored curves to the straightened stream, improving wildlife habitat and flood storage. The hospital complemented the restoration with a boardwalk to link environmental and human health.

Just upstream, the boardwalk and trail system in the Minnehaha Creek Preserve is a natural oasis in the middle of an urban area. This restoration was achieved in partnership with the City of St. Louis Park, which approached the MCWD to address erosion issues on the creek. The MCWD leveraged state Clean Water Grant funds, obtained donated easements from private landowners and developed project agreements with the City to restore 30 acres of industrialized creek corridor into habitat and parkland, provide stormwater treatment for 80 acres of urban hard surface and connect the residents of 600 housing units to transit and local businesses.

Further upstream, the MCWD worked with the City of Hopkins to transform Cottageville Park from a hidden, troubled pocket park into an expanded playground and community space with a restored creek running through it. Subsurface facilities incorporated into the park restoration provide stormwater treatment for new low-income housing adjacent to the park. Police calls related to park activity, which previously accounted for 20 percent of all City crime, essentially ceased.

As communities' needs change, so does their landscape. What once was a satisfactory use of land often gives way to new ways of doing business. The site of a large cold storage warehouse for decades, 325 Blake Road in Hopkins is a key opportunity for the City to achieve its community development goals in the Blake Road corridor. The MCWD responded to the City's request to collaborate by purchasing the 17-acre site. The property will be made available for redevelopment as guided by the City's vision, while providing for the restoration of another 1,000 feet of Minnehaha Creek riparian corridor along with a regional stormwater management basin that will treat 270 acres of urban stormwater previously discharged untreated directly to the creek. Through coordination among the City of Hopkins, the Metropolitan Council and the MCWD, the stormsewer work to bring this water to the Blake Road property has been incorporated into a programmed sanitary sewer project, resulting in substantial public cost savings.

For businesses to thrive, they often must grow. Japs-Olson Company, one of St. Louis Park's larger employers situated adjacent to the MCWD's Minnehaha Creek Preserve land, encountered several obstacles as it sought to expand its printing business. Rather than contribute to these growing pains with rigid application of regulations, the District worked in partnership to find innovative solutions.

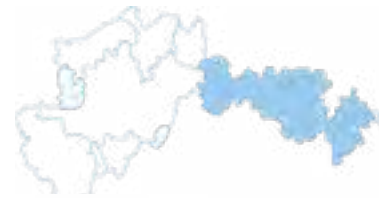
As the result of a series of agreements that also involved the Cities of Hopkins and St. Louis Park, the MCWD received 3.6 acres of land to expand greenspace and provide a trailhead connection to the Preserve, and maintains a constructed wetland basin to treat stormwater from the Japs-Olson expansion along with adjacent road right-of-way previously untreated. The Japs-Olson expansion was finished ahead of schedule and allowed for the creation of 150 jobs.

For the MCWD, outcomes of these partnership efforts included restoration of a substantial length of creek sinuosity, riparian wetland and floodplain; treatment of runoff from several hundred fully developed acres of urban land that previously discharged untreated to the creek; and the creation of both passive and active recreational sites connected to the water environment and integrated with public education about the natural environment. Continued implementation of these management strategies in alignment with the goals of our



HART | HOWERTON

Figure 3.32 Greenway Plan



MINNEHAHA CREEK GREENWAY

local partners will continue to produce greater community impact than if pursued with a singular focus on water resource improvement.

Stormwater Management

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

The most impactful driver of water quality within the Minnehaha Creek subwatershed, stormwater runoff, and its ability to transport excess nutrients and pollutants, negatively impacts lakes, streams and wetlands throughout the region. The overall strategy for protecting water quality within the subwatershed is to reduce pollutant loading and stormwater runoff volume from the landscape. This can be done in a variety of ways, such as installation and load reduction Best Management Practices (BMPs); retrofitting developed areas with BMPs as infrastructure and development/redevelopment opportunities arise; regulating freeboard required on new developments and redevelopments; encourage property owners to incorporate BMPs on their own properties; requiring stormwater pretreatment before discharge into any wetland; enhancing buffers along streambanks; and requiring local plans to discuss flood prevention and mitigation.

In highly developed areas such as the Minnehaha Creek subwatershed, the disruption to the naturally occurring water cycle creates challenges in addressing runoff. Beyond treating rainfall where it falls with site specific BMPs, a proven method for stormwater management is implementation of regional stormwater management opportunities – where large areas of runoff can be directed and treated in a singular location.

In the Minnehaha Creek subwatershed, this has proven to be an effective method and will continue to be a focus for the District and its partners. In the short term, regional stormwater

management opportunities have been identified in the Minnehaha Creek Greenway at 325 Blake Road, at Arden Park in the City of Edina, and at numerous locations along the Minnehaha Parkway Regional Trail in the City of Minneapolis. Efforts will be made to advance these opportunities while continuing to work with our public and private partners to explore additional prospects that have yet to be identified.

Stream Channel Restoration

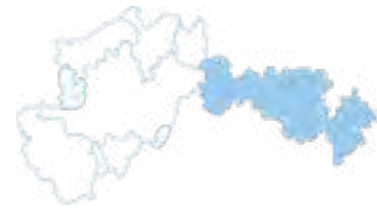
Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and re-aeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Minnehaha Creek maintains a history of man-made alterations as the urban landscape changed, resulting in a disruption of natural stream processes and degraded and fragmented habitat. While stormwater management is an effective tool in addressing stream flashiness and erosive velocities, stream channel restoration provides the opportunity to reinstate a more natural system design within a previously manipulated ecosystem.

A total of approximately one mile of Minnehaha Creek has been restored over the last decade to a meandering channel to reduce peak flows, reconnect the stream to its floodplain, limit erosion, and enhance habitat. Additional reaches of Minnehaha Creek would benefit from channel restoration, streambank stabilization, buffer enhancement, and habitat improvement. MCWD and its partners have been exploring restoration opportunities at Meadowbrook Golf Course, Arden Park in Edina, and various locations along the Minnehaha Parkway in Minneapolis, while continuing to investigate other reaches of the stream where restoration potential exists.

Wetland Restoration

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic



Minnehaha Creek Preserve



Sailboats on Lake Calhoun



Cottageville Park playground

wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

Most of the wetlands within the Minnehaha Creek subwatershed have been altered and disrupted. The District, with its many partners, has worked to restore multiple wetland systems in recent years. MCWD continues to assess and explore wetland function and ecosystems, and will target restoration efforts in ways that provide the greatest benefit to water quality, quantity and ecological integrity, while integrating these efforts within the developed community.

Internal Sediment Phosphorus Control

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

In recent years, the District has partnered to address internal phosphorus loading through a variety of creative management strategies. In Lake Nokomis, an enhanced fish stocking program was implemented to reduce the number of rough fish (bullhead) rooting in the lake sediment by increasing predator fish (walleye) that feed on them. The Taft Lake – Legion Lake project creates a nutrient reduction treatment chain to address phosphorus loading entering upstream Legion Lake (buffers

and infiltration systems) before an alum injection system directly treats Taft Lake internal nutrient loads.

MCWD will continue to assess management options for lake systems throughout the subwatershed. Additional water quality monitoring data, sediment chemistry, and fish and aquatic vegetation surveys are necessary to evaluate the most appropriate techniques to improve water quality.

Watershed Protection

Within the Minnehaha Creek subwatershed, redevelopment of urban and suburban areas provides an opportunity to address previous land use decisions and their negative impact on natural resources. Watershed protection is a critical component to ensure that change on the landscape is leveraged to find greater opportunity for the built environment while layering in water resource protection and ecological enhancement.

LAND USE

EXISTING CONDITIONS

The Minnehaha Creek subwatershed encompasses all of the MCWD downstream of the Grays Bay dam, and is commonly referred to as the “lower watershed.” The subwatershed is 47.3 square miles in size and includes portions of the cities of Edina, Golden Valley, Hopkins, Minneapolis, Minnetonka, Plymouth, Richfield, St. Louis Park and Wayzata.

The predominant land use in the subwatershed is single family residential (52%), followed by parks and open space (15%), multi-family residential (8%), water (6%), commercial (5%), institutional (5%), and transportation (5%). The subwatershed is fully developed at typical urban and suburban densities and land uses and contains a higher level of impervious cover on the land than any of the other ten subwatersheds in the District. Redevelopment and infill development have increased since the 2007 plan, notably with an increase in multi-family residential. Most of the remaining vacant or undetermined land is large wetland or woodland tracts.

LOCAL PLANS AND PRIORITIES

As described in the District’s goals (Section 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving

communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for 2018-2027 (see Appendix B for details on the public input process). This information was used to broadly characterize opportunities, and to inform the development of the District’s implementation plans. The information received was used only as a guide during the development of this Plan to inform the District of opportunities for partnership on the near term horizon, and was not intended to be exhaustive or restrict future collaborative efforts.

As discussed in Section 3.6, the District intends to cultivate a framework for two-directional coordination with communities on an ongoing basis, to stay apprised of emerging needs at a local level, and to identify and evaluate opportunities to implement management strategies outlined in this Plan over the next ten years. The District recognizes that local needs, opportunities and priorities may shift over time. Therefore, this Plan does not intend to capture or prescribe opportunities for partnership over a ten-year term.

Long term goals, growth and private development, and public investment in infrastructure differ across each community – and therefore, frameworks for ongoing coordination will be custom tailored based on the individual needs of each community. Coordination may occur at varying levels, through various means, with communities across the following areas:

- » Regulation of, and partnership with, private development
- » Collaboration on public planning and investment (e.g. parks , roads, utilities)
- » MS4 compliance
- » Development and implementation of TMDLs

Development in this subwatershed has left few large areas of undisturbed or minimally disturbed forest and wetland in the subwatershed. Three areas, including the Grays Bay outlet wetland complex; Diamond Lake; and a portion of the creek corridor in the Mississippi River gorge have been designated

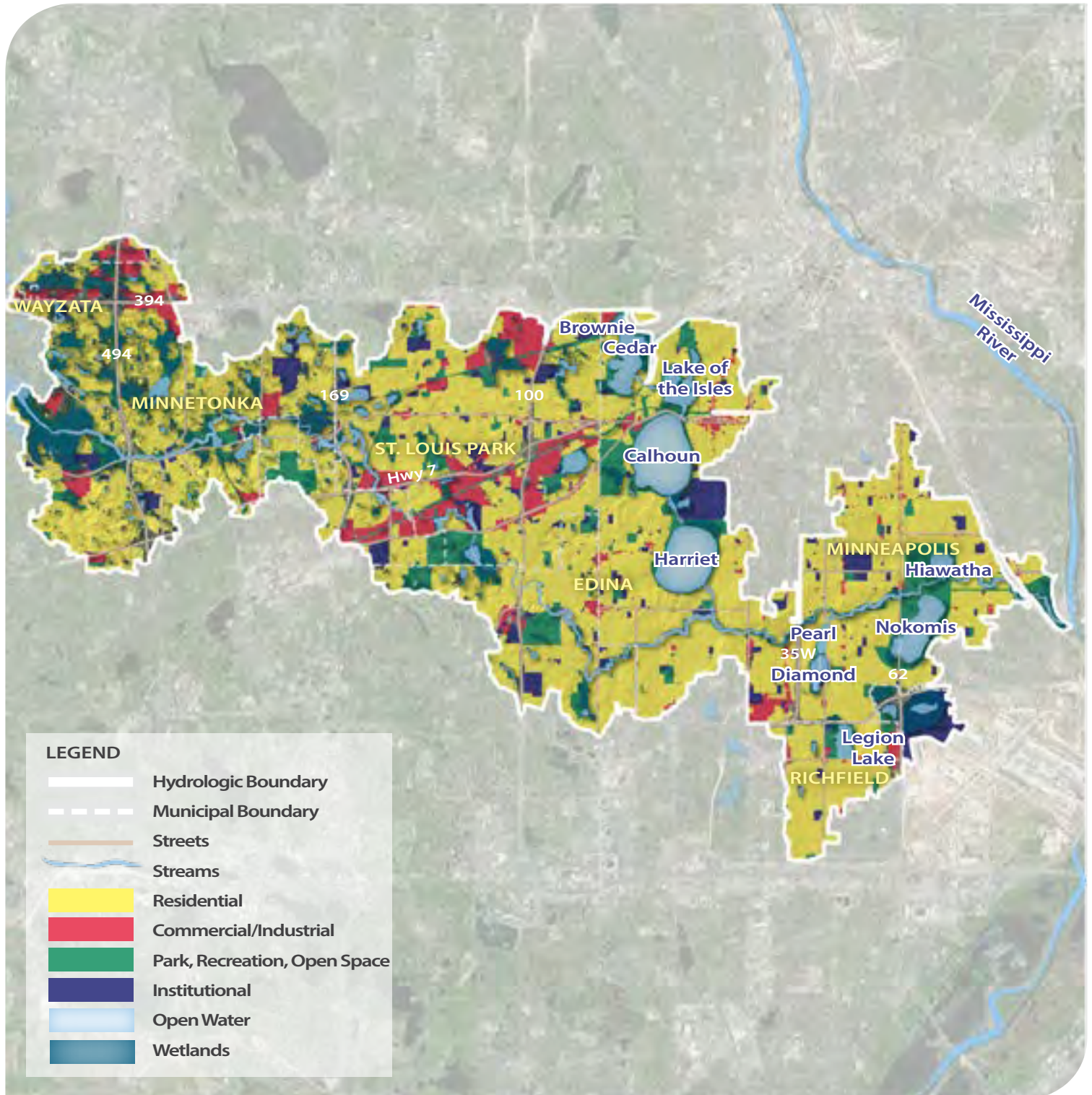
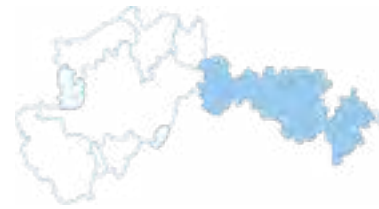


Figure 3.33 Minnehaha Creek Land Use map



Regionally Significant Ecological Areas by the DNR. Although the Minnesota County Biological Survey (MCBS) did not identify any areas of biodiversity significance in the subwatershed, the creek corridor and the Chain of Lakes in the lower subwatershed are part of a DNR-designated Metro Conservation Corridor and will continue to influence land use investment and natural resource enhancement due to the significant value within this urban environment. The Minneapolis Park and Recreation Board has been developing master plans for portions of the creek corridor and Chain of Lakes with the District serving in a technical advisory role.

Over the course of the next ten years, cities and agencies in the Minnehaha Creek subwatershed are expecting to make various infrastructure investments, ranging from road reconstruction and mass transportation projects to park, greenspace, trail, and stormwater management improvements. The goals of our partners, both public and private, and the investments they are planning serve as collaborative opportunities not only to enhance community impact, but to produce creative public-private funding opportunities that will leverage scarce resources and maximize benefits.

It is also evident that throughout the Minnehaha Creek subwatershed, cities place high value on connecting their communities to parks, trails, and natural landscapes, and intend to leverage redevelopment within their communities to improve these connections. With early effort and strengthened communications, cities and private investors will find opportunities to coordinate with the District to further integrate stormwater management, natural resource restoration, and community connections into municipal infrastructure projects and ongoing redevelopment.

There are also a number of active lake and stream associations in the subwatershed, including the East Calhoun Community Organization, Friends of Bass Lake, Friends of Diamond Lake, Friends of Lake Calhoun, Friends of Lake Hiawatha, Friends of Lake Nokomis, and Friends of Minnehaha Creek.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the



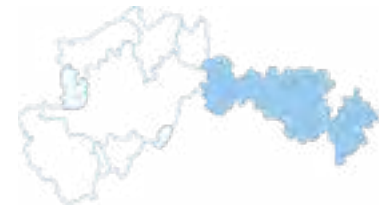
Minnehaha Creek in the winter, climbikerun



Minnehaha Falls sunrise



Cottageville Park



conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, within the Minnehaha Creek Subwatershed, ditching of the stream channel, loss of wetlands, corridor fragmentation and increasing levels of impervious surfaces have disrupted fluvial processes; increased runoff volumes and pollutant loads; decreased infiltration and baseflow; and fragmented and degraded habitat; negatively impacting the ecological integrity of the stream and its riparian systems. As a result, Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities.

Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL. Lake Nokomis also has an approved TMDL for excess nutrients and is one of four other lakes in the subwatershed that do not meet state water quality standards for nutrients.

Due to the system's altered hydrology (hard cover and altered wetlands) and upstream drainage area (Lake Minnetonka), several locations along Minnehaha Creek are known to flood during large or extended rain events. Overall, due to the size of the subwatershed and the urban characteristics of the area (developed, fragmented and altered), ecological integrity throughout the subwatershed is highly variable and generally considered to be lacking.

Based on the water resource needs that exist in the subwatershed and the opportunity to build upon our many successful partnerships with both public and private entities, the District has identified the Minnehaha Creek Subwatershed as a priority area to focus implementation efforts in this plan cycle. The focus within the subwatershed will be stormwater

management to reduce volume and pollutant loading, stream restoration to stabilize streambanks and improve riparian buffers and habitat, and restoration of wetlands and ecological corridors in ways that reduce nutrient loading downstream to Lake Hiawatha while improving ecological integrity and corridor connectivity within the subwatershed.

As noted in previous sections, the District has been focusing on the most degraded section of Minnehaha Creek – between West 34th Street and Excelsior Boulevard in St. Louis Park and Hopkins – to implement a comprehensive corridor restoration that focuses on reducing pollutant loads, mitigating flashy hydrology, reconnecting the riparian corridor, and restoring the physical character of the stream channel. While the District and its partners continue implementation in the Minnehaha Creek Greenway, with projects such as 325 Blake Road and Meadowbrook Golf Course, these efforts continue to expand. Throughout the Minnehaha Creek subwatershed, collaborative opportunities are being explored in other critical areas of high need. Two examples of this are the efforts taking shape in the cities of Edina and Minneapolis.

In Edina, the City and District have been working together to vision a restored Arden Park in a way that layers multiple natural resource benefits together with community benefits. The project includes restoration of over 2,000 feet of Minnehaha Creek stream channel, including removal of one of the last two dams on the creek, and the potential to treat over 100 acres of regional stormwater runoff that currently flows untreated to the creek – all which attract and improve conditions for fish, birds and other wildlife. These efforts are layered with multiple benefits for the community: connecting people visually and physically to the creek with vegetation restoration; providing formal and informal access to new fishing throughout the park; making in-creek recreation more accessible to a larger cross section of users (tubers, kayakers, paddle boarders); providing safer, easier access to the creek; and a new, multi-purpose shelter building.

In Minneapolis, the District is working with the City of Minneapolis and the Minneapolis Park and Recreation Board (MPRB) on a multi-jurisdictional concept plan and capital improvement plan to improve the natural and built environments within the Minnehaha Creek corridor. This partnership will look to master

plan future improvements of the Minnehaha Parkway Regional Trail on Minnehaha Creek – a 253 acre, 5.3 mile parkway with more than 1.4 million visits per year – with the layered goals of regional stormwater management, flood mitigation, and creek and riparian improvements.

Reminiscent of the work throughout the Minnehaha Creek Greenway, these projects strive to correct historic impacts and balance the needs of natural resources while achieving the goals set forth by the communities, their residents, and other public and private partners. The CIP in the following section includes these and other identified project opportunities. With these and all other implementation efforts, the District will bring together the municipalities, Minneapolis Park and Recreation Board, and other affected stakeholders to align goals and develop a specific systems plan.

In addition to these planning and implementation efforts, the District has a wide range of services it can mobilize to address resource needs and support partner efforts as opportunities arise, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, and grants.

Minnehaha Creek, Powderhorn Lake, and Brownie Lake are listed as impaired for excess chlorides. The District will continue to monitor chloride levels and provide education and training for public and private applicators and residents on best practices for chloride use.

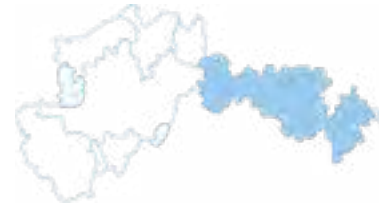
As noted in the previous section, there are a number of active lake associations in the subwatershed. The District will continue to work with its lake associations to provide education and technical assistance to build their capacity and target implementation efforts.

CAPITAL IMPROVEMENT PROGRAM

The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District’s scope and priorities for its capital work over the planning period. A project’s inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other policy considerations before a formal decision to proceed to construction is made. Section 3.5.5 describes the development



Headwaters of Minnehaha Creek



and evaluation steps that will occur before the District will commit resources to a project.

Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures.

A critical component of any project will be the development of a funding strategy that identifies the sources, uses, and timing of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District’s public and private partners as capital projects are advanced. Therefore, any costs identified within this Plan are projections. Intended expenditures will be refined during project development and budgeting, and among other things will reflect the District’s intent to complement its ad valorem funds with other funding sources.

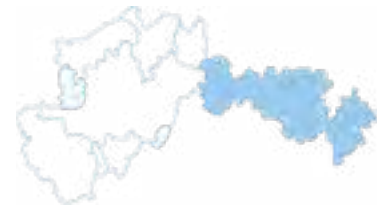
Table 3.12 Minnehaha Creek Subwatershed CIP

Project	Minnehaha Creek FEMA Flood Damage Repairs
Description	Streambank restoration and repair of streambank erosion and other flood damage resulting from 2014 flooding.
Need	The 2014 flooding along Minnehaha Creek caused flood damage in the cities of Edina and Minneapolis. The District coordinated review of the flood damage with the Federal Emergency Management Agency (FEMA). FEMA approved 35 sites to receive federal funding to implement flooding repairs. The project would repair streambank erosion and other flood damages identified by the District and FEMA in 2014.
Outcome	Stabilized streambanks with both bioengineering and hard armoring to reduce erosion and protect the stream channel; Improve ecological integrity of the stream corridor through this reach; enhance riparian habitat and native vegetative communities.
Estimated Cost	\$920,000
Potential Funding Sources	District levy and Federal Emergency Management Agency (FEMA) grant
Schedule	2017-2018

Project	325 Blake Road Regional Stormwater and Greenway
<p>Description</p>	<p>Opportunity to manage approximately 270 acres of regional stormwater runoff at 325 Blake Road. The project requires construction of onsite stormwater management facilities to treat inflow from two diversion structures – Powell Road and Lake Street – which are already in place. The project also includes restoration of four to six acres of industrial land along Minnehaha Creek to restored greenway and riparian corridor.</p>
<p>Need</p>	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>The TMDL report calls for a reduction of 1,907 lbs/year throughout the subwatershed in order for Lake Hiawatha to meet an in-lake nutrient concentration of 50 ug/L. The TMDL draft report also identifies a need to reduce bacterial (E. coli) loading in order to meet the state standard. At this time with our current understanding, the best approaches for addressing excess bacteria loads appear to be source reduction or volume control practices.</p> <p>The District has been focusing on the most degraded section of Minnehaha Creek – between West 34th Street and Meadowbrook Lake in St. Louis Park and Hopkins – to implement a comprehensive corridor restoration that focuses on reducing pollutant loads, mitigating flashy hydrology, reconnecting the riparian corridor, and restoring the physical character of the stream channel.</p> <p>In 2011 the District made a strategic acquisition of land at 325 Blake Road as part of a regional scale effort to establish the Minnehaha Greenway. This effort identified opportunities for area wide stormwater improvement, ecological restoration of the Minnehaha Creek riparian zone and corridor linkage with upstream/downstream restoration projects. Portions of the site not utilized for watershed restoration will be sold for redevelopment to capture a return on the initial investment.</p>

Outcome	<p>The site and project represent a critical piece of the District’s larger strategic initiative within the Minnehaha Creek Greenway focused on improving the quality and managing the quantity of stormwater runoff; enhancing the ecological integrity of the stream system; and facilitating broader community goals of economic development and livability by allowing the restored stream system to be integrated into the developed landscape.</p> <p>This project will implement over 270 acres of regional stormwater treatment to address water quality and quantity entering Minnehaha Creek, restore riparian and stream channel habitat, and expand the Minnehaha Creek Greenway while providing access to upstream and downstream project initiatives. The project is estimated to achieve a phosphorus reduction of 181 lbs/year and a volume reduction of 11.83 acre-feet/year. These estimates will be refined through project feasibility and design.</p>
Estimated Cost	\$2,750,000
Potential Funding Sources	District levy and Minnesota Public Facilities Authority (50%)
Schedule	2018-2019

Project	Meadowbrook Golf Course Ecological Restoration
Description	Partnership with the Minneapolis Park and Recreation Board (MPRB) to reconfigure and enhance Meadowbrook Golf Course to restore and improve the ecological integrity of the Minnehaha Creek stream corridor, and connect the Minnehaha Creek Greenway through MPRB land to the City of Edina parks and trails system.
Need	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>The TMDL report calls for a reduction of 1,907 lbs/year throughout the subwatershed in order for Lake Hiawatha to meet an in-lake nutrient concentration of 50 ug/L. The TMDL report also identifies a need to reduce bacterial (E. coli) loading in order to meet the state standard. At this time with our current understanding, the best approaches for addressing excess bacteria loads appear to be source reduction or volume control practices.</p> <p>Situated within the most degraded section of Minnehaha Creek – between West 34th Street and Meadowbrook Lake in St. Louis Park and Hopkins – the project addresses historic issues such as ditching of the stream channel, loss of wetlands, corridor fragmentation, and fragmented and degraded habitat, all of which negatively impact the ecological integrity of the stream and its riparian systems and contribute to impairments of Minnehaha Creek.</p>

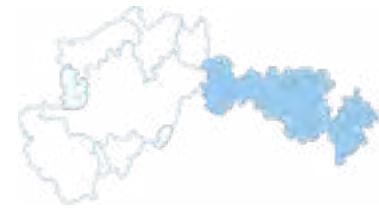


Outcome	Improve ecological integrity of the stream corridor through this reach; improve ecological integrity of upland within the golf course and improve wetland function and value on site; improve water quality for Minnehaha Creek and downstream Lake Hiawatha; maintain or increase flood storage capacity to improve golf course resilience and reduce flood severity of adjacent neighborhoods; connect Minnehaha Creek Greenway trails through MPRB land to City of Edina parks and trails system in a manner that respects adjoining landowners' interests.
Estimated Cost	\$2,200,000
Potential Funding Sources	District levy, Minneapolis Park and Recreation Board, and Hennepin County grant funding
Schedule	2018-2019

Project	Arden Park Stream Restoration
Description	Partnership with the City of Edina to restore Arden Park and the Minnehaha Creek corridor through the park. . The project includes stream restoration, including the removal of one of the last two dams on the creek, regional stormwater management, habitat improvements, and enhanced parkland to provide stream accessibility and recreation opportunities.
Need	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>The TMDL report calls for a reduction of 1,907 lbs/year throughout the subwatershed in order for Lake Hiawatha to meet an in-lake nutrient concentration of 50 ug/L. The TMDL report also identifies a need to reduce bacterial (E. coli) loading in order to meet the state standard. At this time with our current understanding, the best approaches for addressing excess bacteria loads appear to be source reduction or volume control practices.</p> <p>The grade control structure is a known contributor to existing impairments, acting as a barrier to fish passage and creating an impoundment that causes accumulation of sediment, thus degrading upstream aquatic habitat (Minnehaha Creek Stream Assessment 2003, 2012). The dam has altered the function and value of the creek system by removing connectivity to habitat for spawning and forage, while increasing residence time of water and surface area making the water warmer. These impediments increase algal growth and accumulation of decaying vegetation, which uses oxygen and creates an environment that is harmful for fish and macroinvertebrates.</p>

Outcome	Improve ecological integrity of the stream corridor through this reach; improve ecological integrity of upland within the park; implement regional stormwater management for approximately 100 acres; expand and enhance recreation opportunities, safety, and community connections to Minnehaha Creek. The project is estimated to achieve a phosphorus reduction of 29.5 lbs/year and a volume reduction of 10 acre-feet/year. These estimates will be refined through project feasibility and design.
Estimated Cost	\$4,100,000
Potential Funding Sources	District levy, City of Edina, and grant opportunities
Schedule	2018-2019

Project	Greenway to Cedar Trail Connection and Streambank Restoration
Description	Partnership with the City of St. Louis Park to enhance Minnehaha Creek Greenway connections to the Cedar Regional trail and restore a degraded section of Minnehaha Creek through streambank stabilization and vegetative enhancement.
Need	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>The Minnehaha Creek Greenway is bisected by rail and regional trail, without access to upstream and downstream restoration initiatives. The rail line and train bridge crossing at Minnehaha Creek not only acts as an impediment to community connections by blocking access to the regional trail and Greenway, the stream channel at this location was historically manipulated, causing stream bank degradation and unnatural riparian structure.</p>
Outcome	Improve ecological integrity of the stream corridor through this reach; improve stream channel stabilization; enhance riparian habitat and native vegetative communities; expand and enhance recreation opportunities, safety, and community connections to Minnehaha Creek and the Minnehaha Creek Greenway.
Estimated Cost	\$510,000
Potential Funding Sources	District levy, City of St. Louis Park, and grant opportunities
Schedule	2019-2020

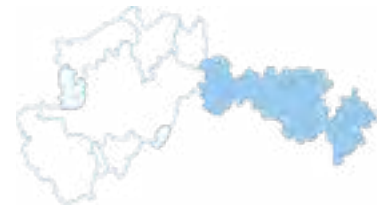


Project	Boone-Aquila Floodplain
Description	Floodplain restoration and stormwater management project developed in coordination with public and private partners to address localized flooding and stormwater runoff in the Minnehaha Creek Greenway.
Need	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>The TMDL report calls for a reduction of 1,907 lbs/year throughout the subwatershed in order for Lake Hiawatha to meet an in-lake nutrient concentration of 50 ug/L. The TMDL report also identifies a need to reduce bacterial (E. coli) loading in order to meet the state standard. At this time with our current understanding, the best approaches for addressing excess bacteria loads appear to be source reduction or volume control practices.</p> <p>The District has been focusing on the most degraded section of Minnehaha Creek – between West 34th Street and Meadowbrook Lake in St. Louis Park and Hopkins – to implement a comprehensive corridor restoration that focuses on reducing pollutant loads, mitigating flashy hydrology, reconnecting the riparian corridor, and restoring the physical character of the stream channel.</p> <p>Historic development within this corridor resulted in large areas of floodplain fill, areas of localized flooding and impervious surfaces constructed within the floodplain and riparian zone of Minnehaha Creek.</p>
Outcome	Improve ecological integrity of the stream corridor through this reach; expand floodplain storage in degraded section of Minnehaha Creek; enhance riparian habitat and native vegetative communities; expand and enhance recreation opportunities, safety, and community connections to Minnehaha Creek and the Minnehaha Creek Greenway.
Estimated Cost	\$500,000
Potential Funding Sources	District levy, public and private partner contributions, and grant opportunities
Schedule	2019-2020

Project	Cottageville Park Phase II Riparian Restoration
Description	Continued implementation of the Minnehaha Creek Greenway corridor restoration that will focus on reconnecting the riparian corridor, and restoring the physical character of the stream channel on an expanded portion of Cottageville Park.

Need	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>Recent work within the most degraded section of Minnehaha Creek – between West 34th Street and Meadowbrook Lake in St. Louis Park and Hopkins – included implementation of Cottageville Park to address regional stormwater, stability of the Minnehaha Creek channel, and ecological restoration, all issues within the Minnehaha Creek subwatershed. Cottageville Park is an amenity on Minnehaha Creek that provides recreation, greenspace and trails, with an opportunity to expand these efforts to surrounding property, further protecting and enhancing the stream corridor.</p>
Outcome	Improve ecological integrity of the stream corridor through this reach; improve stream channel stabilization; enhance riparian habitat and native vegetative communities; expand and enhance recreation opportunities, safety, and community connections to Minnehaha Creek and the Minnehaha Creek Greenway.
Estimated Cost	\$280,000
Potential Funding Sources	District levy, partner contributions, and grant opportunities
Schedule	2019-2020

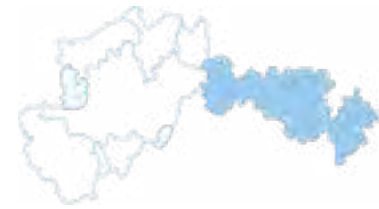
Project	West Blake Greenway Enhancement
Description	Opportunity to expand the Minnehaha Creek Greenway and restore a degraded section of Minnehaha Creek through streambank stabilization, wetland and upland restoration, and vegetative enhancement.
Need	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>The Minnehaha Creek Greenway is bisected by multiple county roads and state highways, including Blake Road and Highway 7. These roadways create barriers for wildlife by diminishing continuity and access to upstream and downstream restoration initiatives. The crossings at Minnehaha Creek also are an impediment to community connections by blocking access to upstream and downstream Greenway trails. The stream channel at this location flows into a large wetland complex that was historically manipulated, causing stream bank degradation and unnatural riparian and wetland structure.</p>



Outcome	Improve ecological integrity of the stream corridor through this reach; improve stream channel stabilization; enhance riparian habitat and native vegetative communities; expand and enhance recreation opportunities, safety, and community connections to Minnehaha Creek, local wetland environments and the Minnehaha Creek Greenway.
Estimated Cost	\$420,000
Potential Funding Sources	District levy, partner contributions, and grant opportunities
Schedule	2020-2021

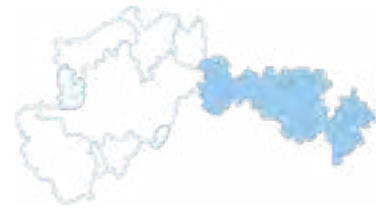
Project	Meadowbrook Greenway Expansion
Description	Opportunity to expand the Minnehaha Creek Greenway through the restored Meadowbrook Golf Course to downstream parks and open space areas within the City of Edina.
Need	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>Access to the Minnehaha Creek Greenway presently ends at Excelsior Boulevard in St. Louis Park, north of adjacent Meadowbrook Golf Course. The roadway and golf course create barriers for wildlife by diminishing continuity and access to upstream restoration initiatives and downstream parkland, open space, and Meadowbrook Lake. The golf course on Minnehaha Creek also acts as an impediment to community connections by blocking access to upstream and downstream Greenway trails. As part of this plan the stream channel at this location is projected to be restored in 2018-2019, restoring ecological integrity, adding riparian structure, and providing a new greenway and conservation corridor.</p>
Outcome	Enhance riparian habitat and native vegetative communities; expand and enhance recreation opportunities, safety, and community connections to Minnehaha Creek, Meadowbrook Lake and the Minnehaha Creek Greenway.
Estimated Cost	\$950,000
Potential Funding Sources	District levy, partner contributions, and grant opportunities
Schedule	2020-2021

Project	Hiawatha Golf Course Restoration
Description	Partnership with the Minneapolis Park and Recreation Board (MPRB) and City of Minneapolis to reconfigure and enhance Hiawatha Golf Course to restore and improve the ecological integrity of the Minnehaha Creek stream corridor, address direct stormwater discharge to Lake Hiawatha, address localized flooding issues within the City, and further connect the community to new trail and recreation opportunities on MPRB land.
Need	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>The TMDL report calls for a reduction of 1,907 lbs/year throughout the subwatershed in order for Lake Hiawatha to meet an in-lake nutrient concentration of 50 ug/L. The TMDL report also identifies a need to reduce bacterial (E. coli) loading in order to meet the state standard. At this time with our current understanding, the best approaches for addressing excess bacteria loads appear to be source reduction or volume control practices.</p> <p>Catalyzed by flooding in Spring 2014 and the need to work with the Federal Emergency Management Agency (FEMA) on restoration of land and property damaged by flooding, the MPRB has designated the Hiawatha Golf Course a priority location for long-term investments and improvement, and includes this site in its ecological systems plan that establishes a vision to make parks and public lands more environmentally friendly.</p> <p>In addition, the City has undertaken a flood reduction study for this area with goals that include reducing and managing localized flooding and achieving pollutant load reductions toward meeting the Lake Hiawatha/Minnehaha Creek TMDL. The City is also evaluating hydraulic, hydrologic and groundwater contributions to the ponds on the Hiawatha Golf Course.</p>
Outcome	Improve ecological integrity of the stream corridor through this reach; improve stream channel stabilization; expand floodplain storage; address stormwater management issues; enhance riparian habitat and native vegetative communities; expand and enhance recreation opportunities, safety, and community connections to Minnehaha Creek and Lake Hiawatha.
Estimated Cost	\$1,940,000
Potential Funding Sources	District levy, partner contributions, and grant opportunities
Schedule	2020-2021



Project	Minnehaha Parkway Stormwater Management
Description	Partnership with the Minneapolis Park and Recreation Board (MPRB) and City of Minneapolis to implement regional stormwater management by diverting direct storm sewer discharge along the Minnehaha Parkway into the buffer and riparian area for filtration/infiltration.
Need	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>The TMDL report calls for a reduction of 1,907 lbs/year throughout the subwatershed in order for Lake Hiawatha to meet an in-lake nutrient concentration of 50 ug/L. The TMDL report also identifies a need to reduce bacterial (E. coli) loading in order to meet the state standard. At this time with our current understanding, the best approaches for addressing excess bacteria loads appear to be source reduction or volume control practices.</p> <p>In addition, the 2003 and 2012 Minnehaha Creek Stream Assessment(s) identified two major issues impacting water quality and biotic integrity in the Creek: flashy storm event flows that often result in streambank erosion; and low base flows, which reduce habitat and limit biotic integrity. The high percent of impervious surface in this urbanized subwatershed has reduced the amount of stormwater that naturally infiltrates to surficial groundwater and which helps sustain base flow. This stormwater is efficiently conveyed to the creek through stormsewers, which results in the flashy flows.</p> <p>The extensive storm sewer network that drains directly to Minnehaha Creek transports sediment, nutrient and pollutant loads, creating discharges that enter the stream system and flow to downstream Lake Hiawatha.</p>
Outcome	Improve ecological integrity of the stream corridor through this reach; improve stream channel stabilization; intercept and remove storm sewer outfalls; address stormwater management issues; enhance riparian habitat and native vegetative communities; expand native vegetation communities and reduce maintenance of parkland; enhance base flow conditions in Minnehaha Creek; expand and enhance recreation opportunities on Minnehaha Creek and Lake Hiawatha. The project is estimated to achieve a phosphorus reduction of 229 lbs/year, total suspended solids reduction of 34.1 tons, and a volume reduction of 5.2 acre-feet/year. These estimates will be refined through project feasibility and design.
Estimated Cost	\$1,400,000
Potential Funding Sources	District levy, partner contributions, and grant opportunities
Schedule	2021-2022

Project	Stormwater Volume and Pollutant Load Reduction
<p>Description</p>	<p>Implementation of opportunities to reduce stormwater volumes and nutrient loading to Minnehaha Creek and Lake Hiawatha, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.</p>
<p>Need</p>	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>The TMDL report calls for a reduction of 1,907 lbs/year throughout the subwatershed in order for Lake Hiawatha to meet an in-lake nutrient concentration of 50 ug/L. The TMDL report also identifies a need to reduce bacterial (E. coli) loading in order to meet the state standard. At this time with our current understanding, the best approaches for addressing excess bacteria loads appear to be source reduction or volume control practices.</p> <p>In addition, the 2003 and 2012 Minnehaha Creek Stream Assessment(s) identified two major issues impacting water quality and biotic integrity in the Creek: flashy storm event flows that often result in streambank erosion; and low base flows, which reduce habitat and limit biotic integrity. The high percent of impervious surface in this urbanized subwatershed has reduced the amount of stormwater that naturally infiltrates to surficial groundwater and which helps sustain base flow. This stormwater is efficiently conveyed to the creek through stormsewers, which results in the flashy flows.</p> <p>Specific project locations and methods will be identified and implemented to reduce nutrient and bacterial loading to Minnehaha Creek and thus to Lake Hiawatha; decrease peak discharge rates in Minnehaha Creek to reduce streambank erosion; and increase baseflow in the Creek to improve its biotic integrity. These projects are intended to reduce annual volume and peak flows discharged to the Creek; increase infiltration to surficial groundwater; and reduce nutrient and bacterial export to the Creek.</p> <p>Identifying specific implementation sites under this capital project element will be an ongoing process informed by refined technical knowledge of pollutant sources and geomorphological phenomena, available land and willing public or private partners. Priorities are set foremost by diagnosing the spatial distribution of pollutant loading to Minnehaha Creek.</p>

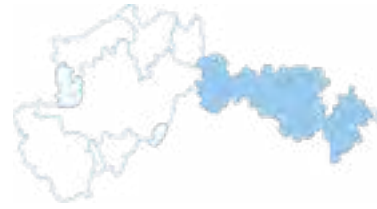


Outcome	Improve ecological integrity of the stream corridor through this reach; improve stream channel stabilization; intercept and remove storm sewer outfalls; address existing stormwater management issues; minimize new pollutant loads conveyed by runoff and generated within Minnehaha Creek; minimize new volumes generated by new development; protect stream base flows and wetland and surficial groundwater hydrology; enhance riparian habitat and native vegetative communities.
Estimated Cost	\$2,450,000
Potential Funding Sources	District levy, partner contributions, and grant opportunities
Schedule	2018-2027

Project	Channel/Streambank Restoration
Description	The District will undertake channel/streambank restoration projects to improve ecological integrity, natural aesthetic and recreational value of Minnehaha Creek including but not limited to: removing or modifying grade controls to allow fish passage and a more natural hydrologic condition; preserving and expanding wooded/vegetated riparian buffers along the entire stream length; reconstructing or re-meandering channel and floodplain where space allows to improve geomorphic/hydrologic form and function and in-stream habitat; stabilizing banks using bioengineering techniques; establishing areas to preserve and enhance view-sheds; and establishing recreational corridor connectivity through passive uses such as trails and vistas.
Need	<p>Minnehaha Creek is listed as an impaired water for multiple parameters, including fecal coliform bacteria, chloride, low dissolved oxygen, and fish and macroinvertebrate communities. Further, due to the sediment and nutrient loads transported by Minnehaha Creek, downstream receiving waterbody Lake Hiawatha is impaired for excess nutrients, and, along with Minnehaha Creek, has an approved TMDL.</p> <p>The 2003 and 2012 Minnehaha Creek Stream Assessment(s) identified numerous areas of erosion along the length of the creek, as well as a general lack of stream complexity and lack of habitat for macroinvertebrates and fish largely driven by stream aggradation in impounded areas often upstream of artificial grade controls.</p> <p>The District will investigate improvement opportunities to high-priority reaches including those identified in the Stream Assessment. Priority reaches are those where stream restoration could improve streambank stability to “Good” as measured by Pfankuch stability rating relative to Rosgen stream type, or those where the Stream Visual Assessment Protocol (SVAP) mean score could be improved to 5.0 or better, or by one full point.</p> <p>The 2018 FEMA flood repair projects are an example of a project opportunity and could expand to include additional channel/streambank restoration elements that would be coordinated with the City of Minneapolis and the Minneapolis Park and Recreation Board.</p>

Outcome	Stabilize streambanks with bioengineering to reduce erosion; improve riparian zone with native vegetation; improve fish and macroinvertebrate habitat; improve ecological integrity of the stream corridor.
Estimated Cost	\$3,120,000
Potential Funding Sources	District levy, partner contributions, and grant opportunities
Schedule	2018-2027

**MINNEHAHA CREEK
SUBWATERSHED**



3.9.9 PAINTER CREEK SUBWATERSHED PLAN:

INTRODUCTION

This subwatershed plan contains information specific to the Painter Creek Subwatershed, including existing conditions and issues, drivers, management strategies, and an implementation plan. Information regarding the District’s philosophy, goals, and implementation approach can be found in Volume 3, Sections 2-8 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

This Implementation Plan for the Painter Creek subwatershed summarizes issues of water quality, water quantity, and ecological integrity. The Plan identifies what is driving these issues, and outlines a roadmap of management strategies to guide the implementation efforts of the District, and its public and private partners.

Painter Creek is a 13.5 square mile (8,667 acre) subwatershed located along the northwestern boundary of the Minnehaha Creek Watershed District (MCWD or District) and includes portions of the cities of Medina, Orono, Maple Plain, Independence and Minnetrista.

The subwatershed is generally characterized by large areas of undisturbed land (37%) including numerous large wetland systems and wooded areas, agricultural uses (19%), low density development (19%), and the 2,700 acre Baker Park (19%) owned by Three Rivers Park District. The Luce Line Trail traverses this subwatershed on the north side of Painter Marsh.

Large areas of undisturbed or minimally disturbed forest and wetland including Baker Park Reserve and Painter Marsh, have been designated Regionally Significant Ecological Areas by the DNR. Several areas have been found by the Minnesota County Biological Survey to be of moderate to high biodiversity significance, including tamarack swamp complexes east of Katrina Lake.

The headwaters of the subwatershed is Katrina Lake (202 Acres), a shallow marsh system located within Three Rivers Park District’s Baker Park Reserve, which drains via Painter Creek through a series of large interconnected wetland systems into Jennings Bay on Lake Minnetonka.

This system delivers high phosphorus loads to Jennings Bay on Lake Minnetonka, which is listed as impaired for excess nutrients due to loading coming from Painter Creek and internal loading from within Jennings Bay. The lower reaches of Painter Creek are also impaired by excess *E. coli* bacteria. The subwatershed experiences some localized flooding due to the system’s altered hydrology (hard cover and altered wetlands) and conveyance systems (culverts and ditches). Overall, the system enjoys moderate to high ecological integrity, with areas of high quality wetland and upland, including several regionally significant ecological areas.

Management strategies within the Painter Creek subwatershed will focus on restoring wetland and stream systems in ways that reduce nutrient loading downstream to Jennings Bay, while improving ecological integrity and corridor connectivity within the subwatershed.

The MCWD has previously established a partnership with the United States Army Corps of Engineers (USACE), which identified the potential restoration of four of the major wetland marsh systems within this subwatershed under the Federal Section 206 Program. Before this work is advanced, MCWD will develop a specific systems plan for this subwatershed in partnership with local municipalities and landowners. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Painter Creek subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

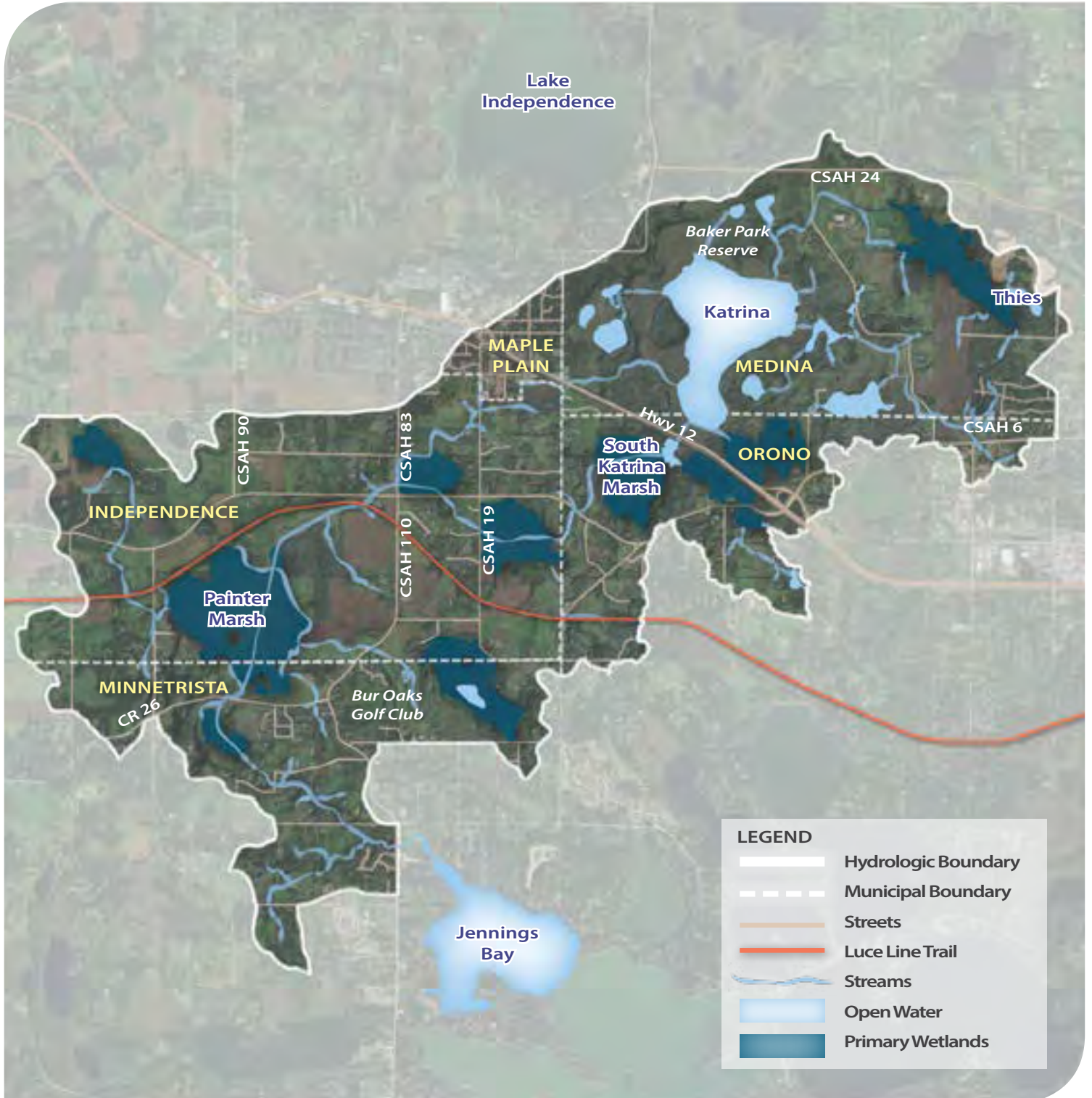


Figure 3.34 Painter Creek Base Map



Water Quality

Lakes and Streams

The Painter Creek subwatershed is a wetland dominated system with no lakes within the principal drainage area (Katrina Lake is classified as a wetland).

While Painter Creek is not listed as an Impaired Water for nutrients, the stream exhibits significantly high total phosphorus concentrations, and exceeds state river eutrophication standards. Phosphorus loads increase from upstream to downstream, and dissolved oxygen can fall below state standards during low flows.

Based on MCWD monitoring data, it is estimated that Painter Creek contributes between 33% - 50% of the total annual phosphorus load to Jennings Bay on Lake Minnetonka, which is listed as an Impaired Water.

Painter Creek exceeds state standards for *E. coli* bacteria concentration. A Total Maximum Daily Load (TMDL) Study was completed in 2014.

Wetlands

The Painter Creek Subwatershed is a wetland rich system, containing approximately 2,500 acres of wetlands.

Based on monitoring data, many of the major wetland marsh systems on the main stem of Painter Creek are a source of dissolved phosphorus, due to their historic hydrologic alternation and current degraded state.

Many of the wetlands are high quality, are designated as regionally significant, and have been identified as having exceptional vegetative diversity, fish and wildlife habitat.

Groundwater

There are a number of areas in the subwatershed that are highly sensitive to aquifer impacts, particularly the wetlands along the main stem of the Painter Creek corridor. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity

Drainage is conveyed through the subwatershed through culverts and small channels to wetlands, most of which are ditched and drain to Painter Creek.

Locations throughout the system have been identified through observation and the District's modeling and stream assessments as being vulnerable to localized flooding, and



Katrina Marsh, Erdahl Aerial Photos

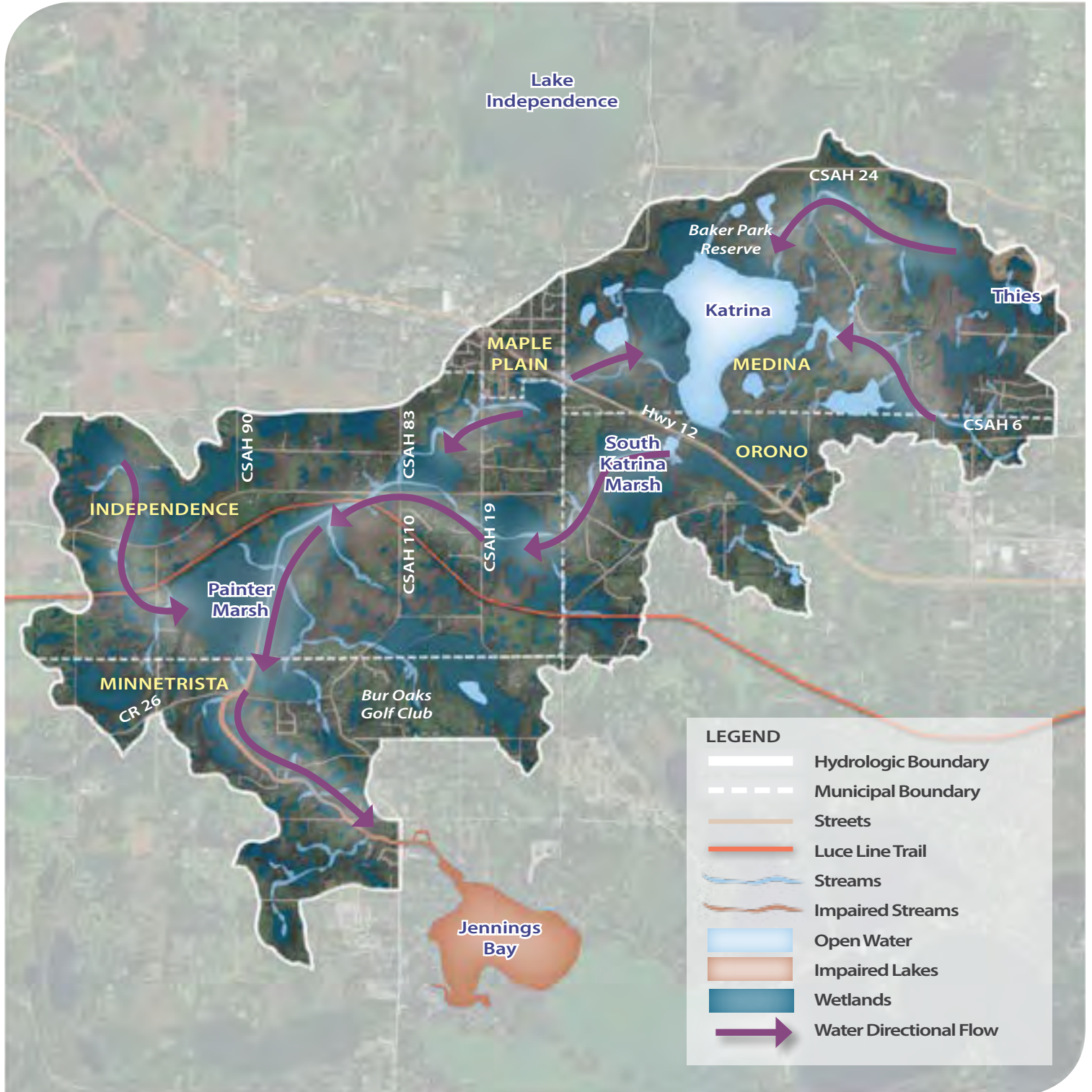


Figure 3.35 Painter Creek Water Resources Map



erosion from high velocities, causing streambank failure and erosion at outlets and culverts.

Many of the major wetlands in this subwatershed act as recharge-discharge wetlands. Groundwater recharge is important within the subwatershed to maintain wetland hydrology and stream baseflow, as well as to recharge aquifers that supply public and private drinking water wells.

Ecological Integrity Lakes and Streams

Most of the subwatershed is characterized by large open areas of woodland, grassland, and wetlands punctuated by agriculture and low density development.

Limited fish data suggest the stream maintains a moderately healthy fishery, but it is likely due to colonization from Jennings Bay. The macroinvertebrate data show a highly degraded community impacted by poor water quality, low dissolved oxygen, and lack of habitat.

Wetlands

Wetland assessments have classified a number of wetlands in the subwatershed as having excellent to high vegetative diversity and habitat, in need of protection. Their conservation is integral to achieving ecological integrity, water quality, stormwater management and floodplain management goals.

Uplands and Natural Corridors

Several areas within the subwatershed (see Figure 3.97 in Volume 2 for locations) have been found by the Minnesota County Biological Survey to be of moderate to high biodiversity significance, including tamarack swamp complexes east of Katrina Lake. Some of these are located within the Baker Park Reserve, while others are privately held. The high quality locations that are outside the regional park should be considered for preservation and protection to maximize habitat and biodiversity.

Large areas of undisturbed or minimally disturbed forest and wetland, including Baker Park Reserve and Painter Marsh, have been designated Regionally Significant Ecological Areas by the DNR. These two areas are connected by Painter Creek. Upland, wetland, and stream protection and restoration may preserve

and enhance connections between these two features.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Painter Creek subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Painter Creek subwatershed are:

Water Quality

- » Excess nutrients
- » Low dissolved oxygen
- » Elevated E. coli concentrations

Water Quantity

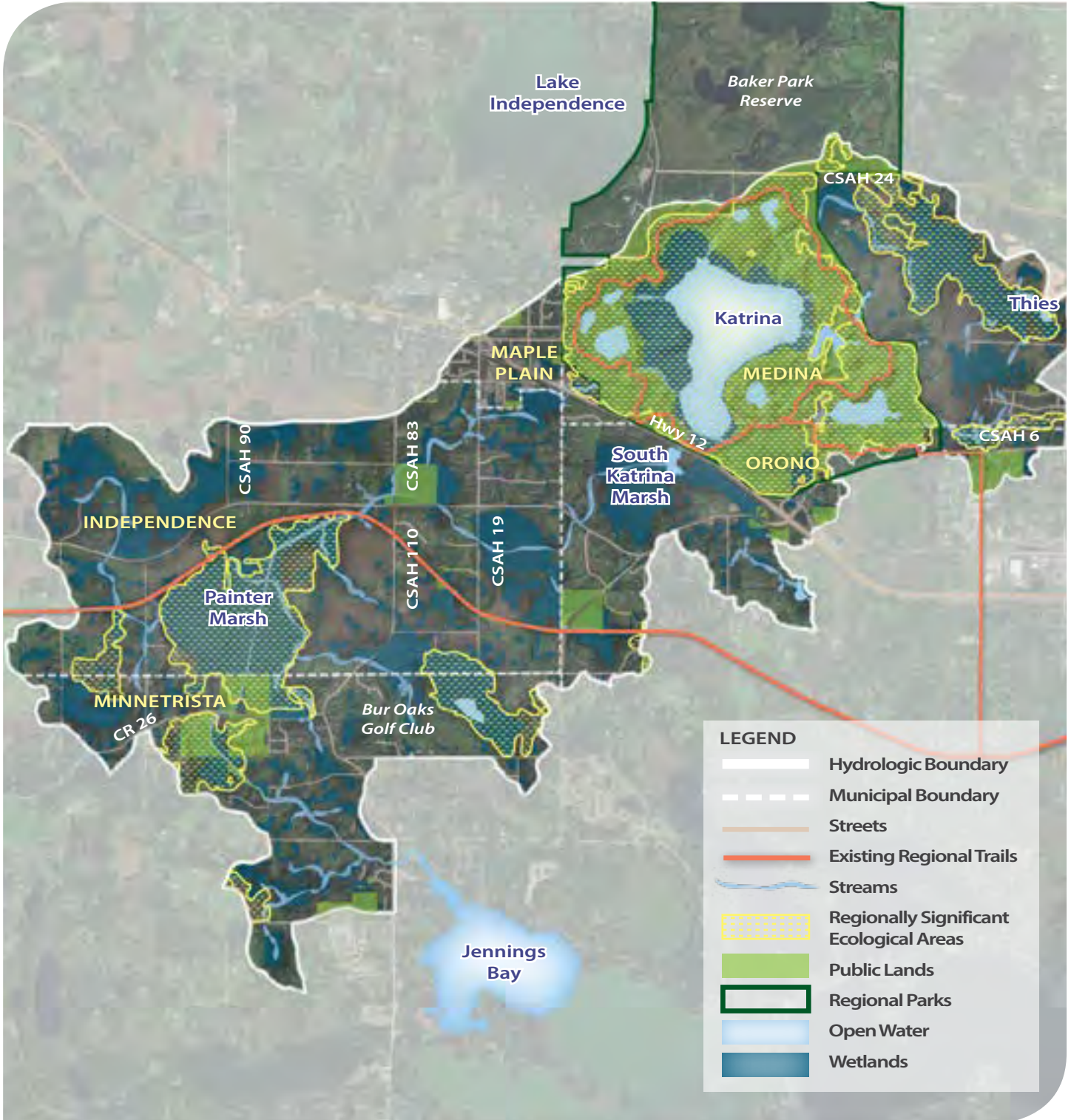
- » Localized flooding

Ecological Integrity

- » Degraded macroinvertebrate community
- » Degraded and disconnected wetland and terrestrial corridors

These issues are primarily the result of the following drivers:

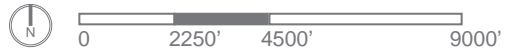
- » Altered wetlands
- » Common carp
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading
- » Upstream waterbodies



LEGEND

- Hydrologic Boundary
- Municipal Boundary
- Streets
- Existing Regional Trails
- Streams
- Regionally Significant Ecological Areas
- Public Lands
- Regional Parks
- Open Water
- Wetlands

Figure 3.36 Painter Creek Parks, Trails and Open Space Map



Altered Wetlands

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

Painter Creek is a county ditch that flows through a number of wetlands between its headwaters at the outlet of Lake Katrina to its mouth at Jennings Bay. This ditching has partially drained and disrupted the natural hydrology of these wetlands. Water quality monitoring shows elevated concentrations of nutrients in Painter Creek, and this wetland alteration may be one of the sources of excess phosphorus in the stream, which contributes to the impairment of Jennings Bay.

Carp

Invasive common carp negatively impact water quality and ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse state, and is often characterized by a significant loss of natural vegetation, harmful algal blooms, and the release of phosphorus from resuspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

There has been only one fish survey completed on Painter Creek below Painter Marsh, and carp were found to be relatively abundant. There are weirs and culverts along Painter Creek that may function as barriers, but carp are persistent and known to travel long distances to spawn. The fish may be using Painter Creek to move between Lake Minnetonka and spawning areas in the deeper wetlands upstream. Bottom feeding in the deeper



A prairie in Painter Creek subwatershed



Painter marsh, Erdahl Aerial Photos



Painter Creek weir



wetlands could release nutrients into the wetland water column, which could then be conveyed by Painter Creek to Jennings Bay. The extent of the carp population and its migratory and spawning habits is not known.

Stormwater Runoff

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

Painter Creek contains high levels of *E. coli*. The TMDL concluded that the primary source of these bacteria was fecal matter from the horses, cattle, chickens, turkeys, geese, deer, ducks and other domesticated animals and wildlife in the subwatershed. Rain and snowmelt conveys this waste to the stream, where it is a source not only of bacteria but also of nutrients. Runoff from agriculture and pasture lands also conveys nutrients and sediment to the Creek, where they contribute to high phosphorus concentrations in the Creek and downstream Jennings Bay.

Altered Channels

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Painter Creek is Hennepin County Ditch #10, established in 1905 to provide drainage for agriculture, a function which continues today. For much of its length, it is a straight, trapezoidal channel that provides minimal fish and macroinvertebrate habitat. The macroinvertebrate communities in Painter Creek are highly degraded, and lacking the variety that would be expected in a natural, less-altered stream with better habitat. The stream is low in dissolved oxygen, and those species that are present are pollution-tolerant. The Painter Creek Stream Assessment found several locations on the Creek with streambank erosion that would benefit from stabilization.

Internal Sediment Phosphorus Loading

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Lake Katrina has elevated levels of total phosphorus. No sediment release data are available, but as a deep wetland, it likely experiences moderate to high internal phosphorus loading.

Upstream Waterbodies

Headwater streams, lakes and wetlands contribute water and nutrients to downstream receiving waters impacting the quality of these water bodies. Lakes and wetlands with poor water quality ultimately contribute nutrients to downstream waters that can lead to eutrophication. Consequently, restoration

of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Lake Katrina has elevated levels of total phosphorus. Agriculture and large-lot residential properties contribute phosphorus and sediment to the lake. As a wetland, Katrina has not been officially listed as an Impaired Water, but its high-phosphorus discharge is likely contributing to elevated phosphorus concentrations in Painter Creek and excess phosphorus loads to Jennings Bay.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Painter Creek subwatershed. These strategies are both short- and long-term, and establish a framework for the Painter Creek subwatershed Implementation Plan programs and projects.

Focal Subwatershed Planning

As noted throughout this plan, the District's overarching organizational strategy is founded in its Balanced Urban Ecology policy. It describes a vision of integration with government agencies, private landowners and developers, and philanthropic partners through multi-jurisdictional partnerships, emphasizing the economic and social value that natural systems generate for the built environment. It further describes how our work will be strengthened through these collaborative efforts to not only offer greater community impact, but to produce creative public-private funding opportunities that will leverage scarce resources and maximize benefits.

Based on the water resource needs that exist in the subwatershed, the scale and complexity of the system, and the opportunity to partner with and access funding for wetland restoration work through the United States Army Corps of Engineers (USACE) as described below, the District has identified the Painter Creek Subwatershed as a priority area to focus implementation efforts in this plan cycle. The District's focus within the subwatershed will be on restoring wetland and stream systems in ways that reduce nutrient loading downstream to Jennings Bay of Lake Minnetonka, while improving ecological integrity and corridor connectivity within the subwatershed.

Similar to its approach in the Six Mile Creek-Halsted Bay subwatershed, before any work is advanced, the District will work with the municipalities and affected landowners to develop a specific systems plan for this subwatershed that integrates and aligns the District's goals and plans with those of its partners. This coordination effort is expected to begin in 2018.

Wetland Restoration

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

In 2009, the District completed an outlet weir modification at the outlet of Painter Marsh and a stream meandering to return a portion of Painter Creek downstream of Highway 26 to a more natural shape and restore native vegetation in its surrounding wetland. This project was intended to reduce erosion and sedimentation in the main channel, improve water quality, and improve habitat. The District has been working with the United States Army Corps of Engineers (USACE), which identified the potential restoration of four of the major wetland marsh systems within this subwatershed under the Federal Section 206 Program. Before this work is advanced, MCWD will develop a specific systems plan for this subwatershed in partnership with local municipalities and landowners.

Carp Management

Historically, carp management focused on removal of carp populations from impacted water bodies without any



Painter Creek

consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

While carp are known to be present in Painter Creek downstream of Painter Marsh, not much is known about their extent and whether they are impacting upstream wetland complexes and Lake Katrina. As the wetland marsh system restoration projects are advanced, carp and other rough fish population and migration patterns will be assessed.

Stormwater Management

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

The focus in the Painter Creek subwatershed will be on ensuring Painter Creek and its tributaries are adequately buffered, proper manure management is practiced in the riparian areas, and stormwater runoff volume from developed areas is reduced to limit export of nutrients and sediment into Painter Creek, Lake Katrina, and Jennings Bay.

Stream Channel Restoration

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and re-

aeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Approximately 2,000 feet of Painter Creek have already been restored to a meandering channel to reduce peak flows, limit erosion, and enhance habitat. Additional reaches of the stream downstream of Painter Marsh would benefit from streambank stabilization, buffer enhancement, and habitat improvement.

Internal Sediment Phosphorus Control

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Additional information is necessary to evaluate management options for Lake Katrina. Additional water quality monitoring data, sediment chemistry, and fish and aquatic vegetation surveys likely are necessary to evaluate the most appropriate techniques to improve water quality in that wetland.

Restoration of Upstream Waterbodies

Upstream water bodies that are currently impaired can discharge large nutrient loads to downstream water bodies thereby contributing to downstream water quality impairments. Therefore, prior to, or concurrent with, significant efforts to restore downstream water quality, the water quality in upstream water bodies must be improved. Nutrient impaired upstream lakes may require external and internal nutrient reductions using the strategies listed in this section.

Lake Katrina is the headwaters of Painter Creek, and its water quality influences the Creek. In addition, Painter Creek flows through several wetland complexes, each of which may be contributing to conditions in the Creek and nutrient loading into Jennings Bay. Previous studies have emphasized the need for a whole-subwatershed approach to managing water quality



in these upstream water bodies. The District work with the USACE to identify the potential restoration of four of the major wetland marsh systems within this subwatershed will guide management strategies for this complex system.

Watershed Protection

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect these areas by minimizing the impacts of the development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

There are areas of biodiversity significance and mostly intact native communities in the subwatershed. Most of these are located within the Baker Park Regional Reserve, but some areas are privately held. Painter Creek and riparian wetlands function as a connecting corridor through the subwatershed. The focus in this subwatershed will be to preserve high-value resources through Land Conservation where appropriate and by working with cities and developers to enhance stream and wetland buffers and to minimize disturbance during development and construction.

LAND USE

EXISTING CONDITIONS

The subwatershed includes portions of the cities of Medina, Orono, Maple Plain, Independence, and Minnetrista. Land use in the subwatershed is generally characterized by large areas of undisturbed land (37%) including numerous large wetland systems and wooded areas, agricultural uses (19%), low density development (19%), and the 2,700 acre Baker Park (19%) owned by Three Rivers Park District. The Luce Line Trail traverses this subwatershed on the north side of Painter Marsh.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Section 3.3), the District

strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.

As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for 2018-2027 (see Appendix B for details on the public input process). This information was used to broadly characterize opportunities, and to inform the development of the District's implementation plans. The information received was used only as a guide during the development of this Plan to inform the District of opportunities for partnership on the near term horizon, and was not intended to be exhaustive or restrict future collaborative efforts.

As discussed in Section 3.6, the District intends to cultivate a framework for two-directional coordination with communities on an ongoing basis, to stay apprised of emerging needs at a local level, and to identify and evaluate opportunities to implement management strategies outlined in this Plan over the next ten years. The District recognizes that local needs, opportunities and priorities may shift over time. Therefore, this Plan does not intend to capture or prescribe opportunities for partnership over a ten-year term.

Long term goals, growth and private development, and public investment in infrastructure differ across each community – and therefore, frameworks for ongoing coordination will be custom tailored based on the individual needs of each community. Coordination may occur at varying levels, through various means, with communities across the following areas:

- » Regulation of, and partnership with, private development
- » Collaboration on public planning and investment (e.g. parks , roads, utilities)
- » MS4 compliance
- » Development and implementation of TMDLs

Through the information gathering processes of this Plan, one of the priorities identified by cities in the Painter Creek Subwatershed was maintaining the area's rural character

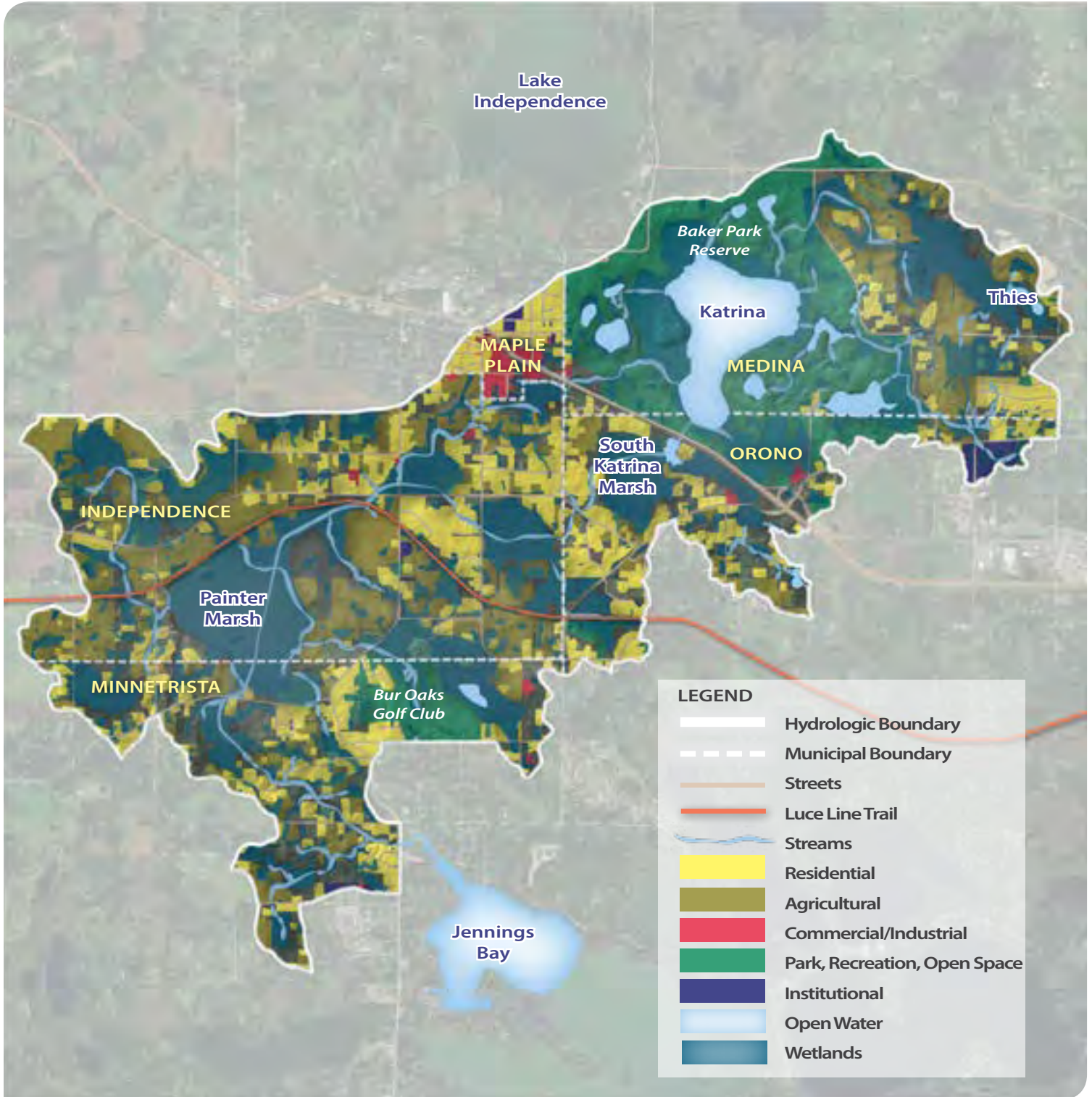


Figure 3.37 Painter Creek Land Use Map





and access to open space. Little near-term development or infrastructure investment is anticipated within this subwatershed. The City of Medina and Three Rivers Park District expressed interest in partnering to improve manure management in the subwatershed and to address some areas of local flooding. The cities also voiced interest in continuing to utilize the District as a technical resource.

There is an opportunity for the District and the United States Army Corps of Engineers to continue a previously-established partnership to pursue the restoration of four major wetland marsh systems within the Painter Creek Subwatershed. The proposed restoration work could be eligible for funding under the federal Section 206 Program.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, the Painter Creek Subwatershed contains a number of large wetlands, many of which have been ditched or otherwise altered, that are connected by Painter Creek. The system delivers high phosphorus loads to Jennings Bay of Lake Minnetonka, which is listed as impaired and requires the second largest load reduction in the District. Painter Creek is also impaired by excess *E. coli* bacteria. The subwatershed includes areas of high quality wetland and upland, including several regionally significant ecological areas. The MCWD has previously established a partnership with the United States Army Corps of Engineers (USACE), which identified the potential restoration of four of the major wetland marsh systems under the Federal Section 206 Program.

Based on the water resource needs that exist in the subwatershed and the opportunity to partner with and

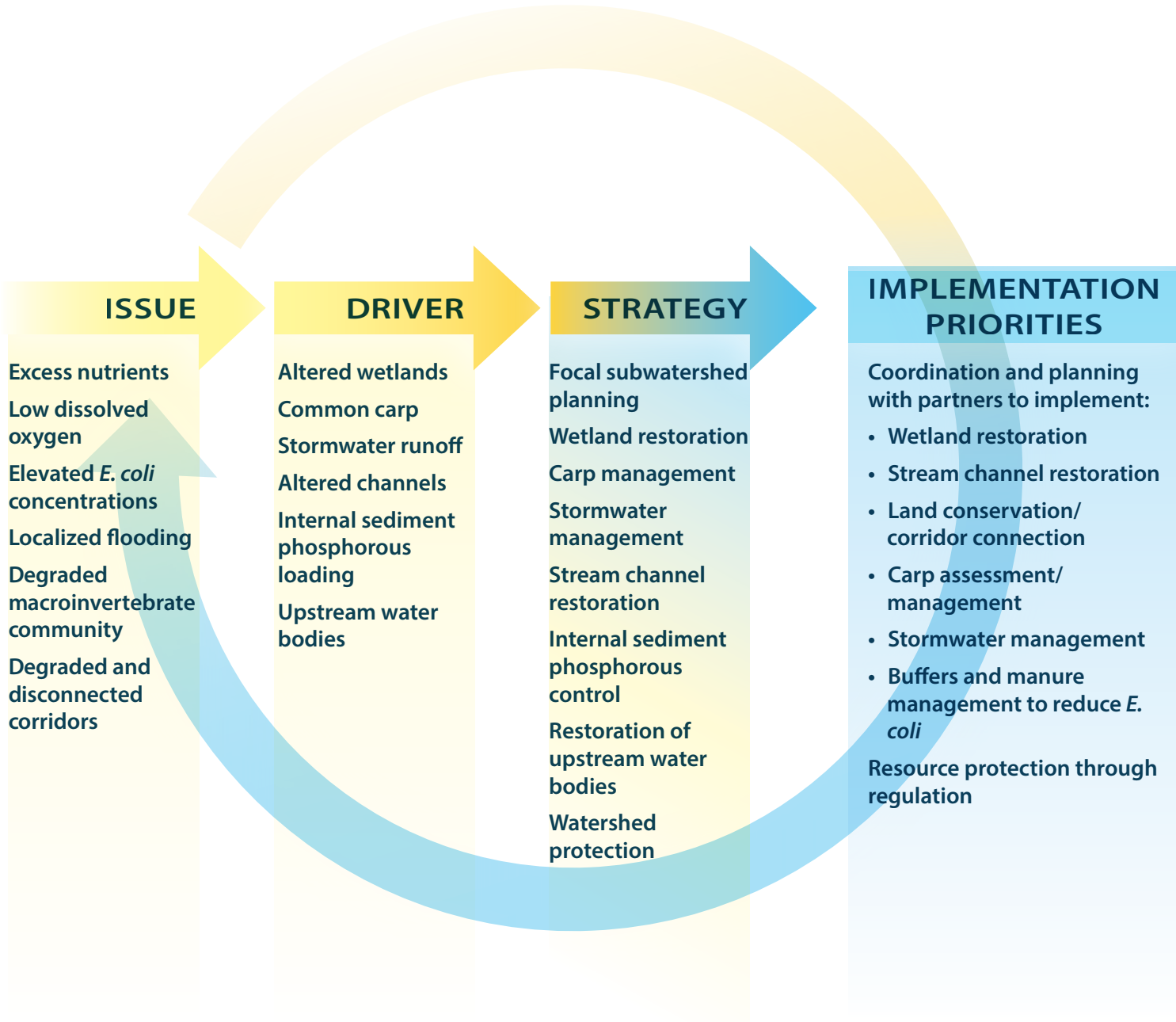
access funding through the USACE, the District has identified the Painter Creek Subwatershed as a priority area to focus implementation efforts in this plan cycle. The focus within the subwatershed will be on restoring wetland and stream systems in ways that reduce nutrient loading downstream to Jennings Bay of Lake Minnetonka, while improving ecological integrity and corridor connectivity within the subwatershed.

The CIP in the following section includes the four specific wetland restorations that have been identified by the USACE. The partnership with the USACE requires the District, as the local sponsor, to have land rights over the project areas. A number of these land rights have already been secured through easement or fee title. Part of the planning effort over the next plan cycle will be to work with the landowners around these wetlands to obtain the remaining land rights needed to complete the restoration work.

As noted in previous sections, this subwatershed contains a number of high value wetlands and uplands, including Baker Park Reserve and Painter Marsh which have been designated as Regionally Significant Ecological Areas by the DNR. These two areas, as well as the proposed USACE wetland restoration projects, are all connected by Painter Creek, presenting an opportunity to further preserve and enhance this valuable corridor through land conservation and capital improvement initiatives. The District's CIP includes additional wetland restoration, stream restoration, and stormwater management projects beyond the four defined USACE projects in order to explore these restoration opportunities for additional water quality, water quantity, and ecological integrity benefit.

The District may pursue a carp assessment for the Painter Creek subwatershed as part of a larger assessment for the northwestern bays of Lake Minnetonka and their tributary subwatersheds. The goal of the assessment would be to understand the movement and recruitment patterns of carp in the system to inform management efforts. This work will be dependent on the District's ability to secure partner support and funding.

As noted previously, Painter Creek is impaired by excess *E. coli* bacteria and has an approved TMDL. The focus for addressing this impairment will be to work with the municipalities and





key landowners to ensure that Painter Creek and its tributaries are adequately buffered and proper manure management is practiced in the riparian areas.

Before any of the above work is advanced, the District will bring together the municipalities, Three Rivers Park District, and other affected landowners to align goals and develop a specific systems plan for this subwatershed. In addition to this District-led planning effort, the District has a wide range of services it can mobilize to address resource needs and support partner efforts as opportunities arise, including data collection and diagnostics, technical and planning assistance, permitting assistance, education and capacity building, and grants.

CAPITAL IMPROVEMENT PLAN

The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District's scope and priorities for its capital work over the planning period. A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other policy considerations before a formal decision to proceed to

construction is made. Section 3.5.5 describes the development and evaluation steps that will occur before the District will commit resources to a project.

Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures.

A critical component of any project will be the development of a funding strategy that identifies the sources, uses, and timing of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District's public and private partners as capital projects are advanced. Therefore, any costs identified within this Plan are projections. Intended expenditures will be refined during project development and budgeting, and among other things will reflect the District's intent to complement its ad valorem funds with other funding sources.



Rolling Hills restoration in the Painter Creek subwatershed

Table 3.13 Painter Creek Subwatershed CIP

Project	Potato Marsh Restoration
Description	The Potato Marsh project will consist of scraping a formerly farmed and degraded 45-acre wetland to lower its bottom elevation and create deeper pools. A new weir will be constructed at the outlet of Painter Creek with stoplogs to adjust water depth. Tamarack trees and a native wetland vegetation community will re-established through planting and seeding, and will be maintained through water-level alteration via the weir. Upstream bank erosion will be repaired, as well.
Need	The current condition of the altered wetland is a hybrid cattail and reed canary grass monoculture with sediment laden inflows due to streambank erosion. The surrounding landscape is dominated by large agricultural tracts, but the upper watershed contains large areas of undisturbed forests and high-quality wetlands. Baker Park Reserve and a large area in the lower subwatershed are also part of a DNR-designated Metro Conservation Corridor. The Minnesota Biological Survey identifies several areas outside of the project area in the subwatershed as areas of moderate or high biodiversity significance, including a tamarack swamp complex east of Lake Katrina and patches of maple-basswood and oak forest.
Outcome	The project will provide hydrologic and vegetative tamarack swamp restoration and creation of more diverse open water habitat, improved overall wetland function, reduction of sediment inflows by natural upstream erosion protection, increased stormwater and runoff retention period, groundwater filtration, decreased sediment loads resulting from deeper wetland pools, and increased phosphorus absorption throughout the system. This project will be the first in the expansion and connection of an existing natural resource corridor connecting the upper Painter Creek subwatershed and the lower Painter Creek subwatershed.
Estimated Cost	Capital costs: \$870,000, excluding land, in 2017 dollars.
Potential Funding Sources	MCWD levy, USACE Section 206, partner contributions, grants
Schedule	2019 with project monitoring activities and effectiveness evaluation to continue for 5 years past project completion.

Project	SOBI Marsh Restoration
Description	The SOBI Marsh project includes construction of a swale along the existing channel of Painter Creek and scraping of surrounding areas to expose the native seedbed within the 120-acre wetland. In select areas with existing erosion, natural bank erosion protection including planting and placement of scraped material will occur. Additional scraped material will be used to enlarge two existing hills. No modification of existing culverts and no weir construction is planned.
Need	The current condition of SOBI Marsh is an altered wetland with a hybrid cattail and reed canary grass monoculture and areas of bank erosion. This project location provides a vital link between the South Katrina Marsh wetland restoration and the Potato Marsh wetland restoration.

Outcome	The project will undertake a hydrologic and vegetative wetland restoration and creation of more diverse open water habitat. Sediment inflows will be reduced by natural bank erosion protection. This specific project will provide a critical hydraulic balance to upstream and downstream project components and supports the systems approach of restoration of the larger wetland complex.
Estimated Cost	Capital costs: \$240,000, excluding land, in 2017 dollars
Potential Funding Sources	MCWD levy, USACE Section 206, partner contributions, grants
Schedule	2020 with project monitoring activities and effectiveness evaluation to continue for 5 years past project completion.

Project	Upper and Lower Painter Marsh Restoration
Description	<p>The Upper Painter Marsh project will include construction of a swale and restoration of the streambed along the known historic channel of Painter Creek. The 65-acre wetland will be restored by scraping surrounding portions of the hybrid cattail and reed canary grass monoculture and exposing the native plant seedbank.</p> <p>The Lower Painter Marsh project includes construction of meanders along the existing channel of Painter Creek and a wetland scrape over a large area of the 430-acre wetland. Scraped material will be used to enlarge an existing island. Water levels will be controlled by the proposed replacement of the Lower Painter Marsh weir to create open water areas.</p>
Need	<p>A straightened and ditched Painter Creek stream channel causes flashy storm flows and increased erosion, sediment loads, and decreased habitat integrity. Uncontrolled agricultural runoff leads to high nutrient levels and a monoculture of hybrid cattail and reed canary grass.</p> <p>The current condition of the Lower Painter Marsh is an altered wetland with a hybrid cattail and reed canary grass monoculture. The Painter Creek stream channel has been straightened and ditched, which leads to flashy storm flows and high sediment loading.</p>
Outcome	The project will undertake a hydrologic and vegetative wetland restoration and creation of more diverse open water habitat. Returning Painter Creek to its historic stream channel will mimic the historic hydro-period, slow storm flows, settle out sediments, and provide a critical hydraulic balance to upstream and downstream project components. Deeper water areas will provide vital habitat during dry and low flow conditions.
Estimated Cost	Capital costs: \$2,800,000, excluding land, in 2017 dollars
Potential Funding Sources	MCWD levy, USACE Section 206, partner contributions, grants
Schedule	2021 with project monitoring activities and effectiveness evaluation to continue for 5 years past project completion.

Project	South Katrina Marsh Restoration
Description	The South Katrina Marsh project includes replacement of the existing weir to create open water areas. The existing stream channel will be converted into a swale and an additional swale will be created to direct flows to the south of the marsh into deeper water. Flows will eventually move from deeper pools to a level spreader distributing water throughout the wetland. Excavated material will be used to create two islands approximately 1-2 feet above the weir elevation. The total wetland restoration area is 134 acres.
Need	The current condition of South Katrina Marsh is an altered wetland with a hybrid cattail and reed canary grass monoculture.
Outcome	The project will provide a hydrologic and vegetative wetland restoration and creation of more diverse open and shallow water habitats. The deeper pools and level spreaders will slow flow, settle out sediments, and create greater habitat diversity. Construction of swales and scraping of cattail and reed canary grass biomass will decrease the monoculture, expose the native plant seedbed, and increase plant diversity.
Estimated Cost	Capital costs: \$1,270,000
Potential Funding Sources	MCWD levy, USACE Section 206, partner contributions, grants
Schedule	2022 with project monitoring activities and effectiveness evaluation to continue for 5 years past project completion.

Project	Wetland Restoration and Channel/Streambank Restoration
Description	The District will undertake wetland and channel/streambank restoration projects complementary to identified USACE Section 206 projects. Reaches of the Painter Creek channel that were ditched in the early 1900's will be restored by realigning to the natural channel configuration, bio-engineering banks, and establishing a more diverse vegetative cover. Hydrology and vegetation will be restored and managed within wetlands contiguous to ditched sections of Painter Creek.
Need	The Section 206 projects present opportunities for expansion or enhancement of the identified projects or construction of additional projects creating a stronger corridor link between established and identified project sites. The hydrology of this wetland system is highly degraded with ditched and straightened stream sections creating flashy, nutrient-laden flows eventually contributing to high phosphorus in Jennings Bay. Water levels and nutrient levels lead to invasive species monocultures. MCWD concluded that significant reduction of nutrient transport will be possible only by first restoring some of the ditched wetland and straightened Painter Creek channel accompanied by projects to reduce nutrient concentrations in the water.
Outcome	Complementary projects will enhance and strengthen the planned or existing projects and create a stronger corridor connection. The stream restoration work will restore some of the natural hydrology, create open water areas, and increase wetland and habitat diversity along approximately 6,200 lineal feet of ditched channel. Wetland restoration will restore natural hydrology, increase wetland flora diversity, de-channelize flow, and improve habitat diversity.



Estimated Cost	Wetland Restoration Capital Cost: \$330,000, excluding land, in 2017 dollars. Channel/Streambank Restoration Capital Cost: \$2,990,000, excluding land, in 2017 dollars.
Potential Funding Sources	MCWD levy, partner contributions, grants
Schedule	2018-2027

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Painter Creek, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Painter Creek has long been known to be a significant transporter of nutrient loading to Jennings Bay and the West Arm of Lake Minnetonka contributing to an excess nutrient impairment of these basins. Annual nutrient loads range in the thousands of pounds per year. Some likely reasons for high sediment and nutrient transport are ditching of wetlands and channel straightening, historical and current agricultural land use, and runoff. Stormwater from agricultural land is a significant source, along with decades of discharges from the Maple Plain Treatment Plant (1951 to 1986) into the Painter Creek subwatershed. Discharge from the plant was measured by MPCA at .24 MGD with an effluent phosphorus load in 1969/70 of 4,130 pounds.
Outcome	Reduction of pollutant loading to Painter Creek and downstream Jennings Bay; reduction of stormwater runoff volume and rate and associated impacts; protection and enhancement of groundwater recharge, stream base flow, and wetland hydrology.
Estimated Cost	Capital Cost: \$980,000
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

3.9.10 SCHUTZ LAKE SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Schutz Lake Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

Schutz Lake is a 1.5 square mile (969 acre) subwatershed located in the southwestern portion of the MCWD. Land within this geography is entirely within the City of Victoria. The subwatershed is generally characterized by parks and open spaces (25%), low density development (24%), agricultural uses (15%), institutional uses (12%), water (11%), and undeveloped land (7%). The Carver Park Reserve abuts the northwesterly portion of the lake, the Southwest Hennepin LRT Regional Trail crosses the subwatershed, and portions of the southern subwatershed belong to the University of Minnesota Horticultural Research Center and Landscape Arboretum.

In one area on the west side of the subwatershed (within the Carver Park Reserve), there is a large patch of maple-basswood forest that has been designated a high-value native plant community by the Minnesota Biological Survey. The larger area within Carver Park Reserve has been designated by the DNR as a regionally significant ecological area within the Metro area.

Schutz Lake is the primary receiving water within the subwatershed. The upper watershed drains north through Schutz Creek via a series of culverts, under Highway 5 to Schutz Lake.

Schutz Lake subwatershed has several issues relating to water quality, water quantity and ecological integrity. Water quality in Schutz Lake meets state standards, but chlorophyll-a, a measure of algae, is increasing. Schutz Creek has elevated levels of total phosphorus. Schutz Creek's annual water yield also appears to be increasing, and modeling predicts that flooding may occur at a damaged culvert during large rain events. Overall, the system has somewhat degraded ecological integrity. Schutz Lake has degraded fish and aquatic vegetation communities and Schutz

Creek has degraded macroinvertebrate communities and low connectivity. However, the Schutz Creek corridor includes wetlands that with restoration could improve vegetative diversity and provide connected habitat for the subwatershed.

Management strategies within the Schutz Lake subwatershed will focus on promoting stormwater management to reduce runoff volumes and pollutant loads, stabilizing stream channels, and improving and protecting ecological integrity. The District will collaborate on these management strategies with local and state government, developers, lake associations, citizens' groups and other parties to implement. This is summarized in the Implementation Plan.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity, and ecologic integrity. Condition information was compiled from community input, monitoring data, special studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), Minnehaha Creek and Upper Watershed Stream Assessments, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Schutz Lake subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality Lakes and Streams

The Schutz Lake subwatershed has one major lake, one major stream, and a few riparian wetlands. While Schutz Lake is not listed as an Impaired Water for nutrients, a trend analysis suggests that algal blooms are becoming more frequent, as there has been a statistically significant increase in summer average chlorophyll-a concentration.

While Schutz Creek does not exceed state eutrophication standards, it has elevated levels of total phosphorus that exceed the nutrient component of the state eutrophication standard.

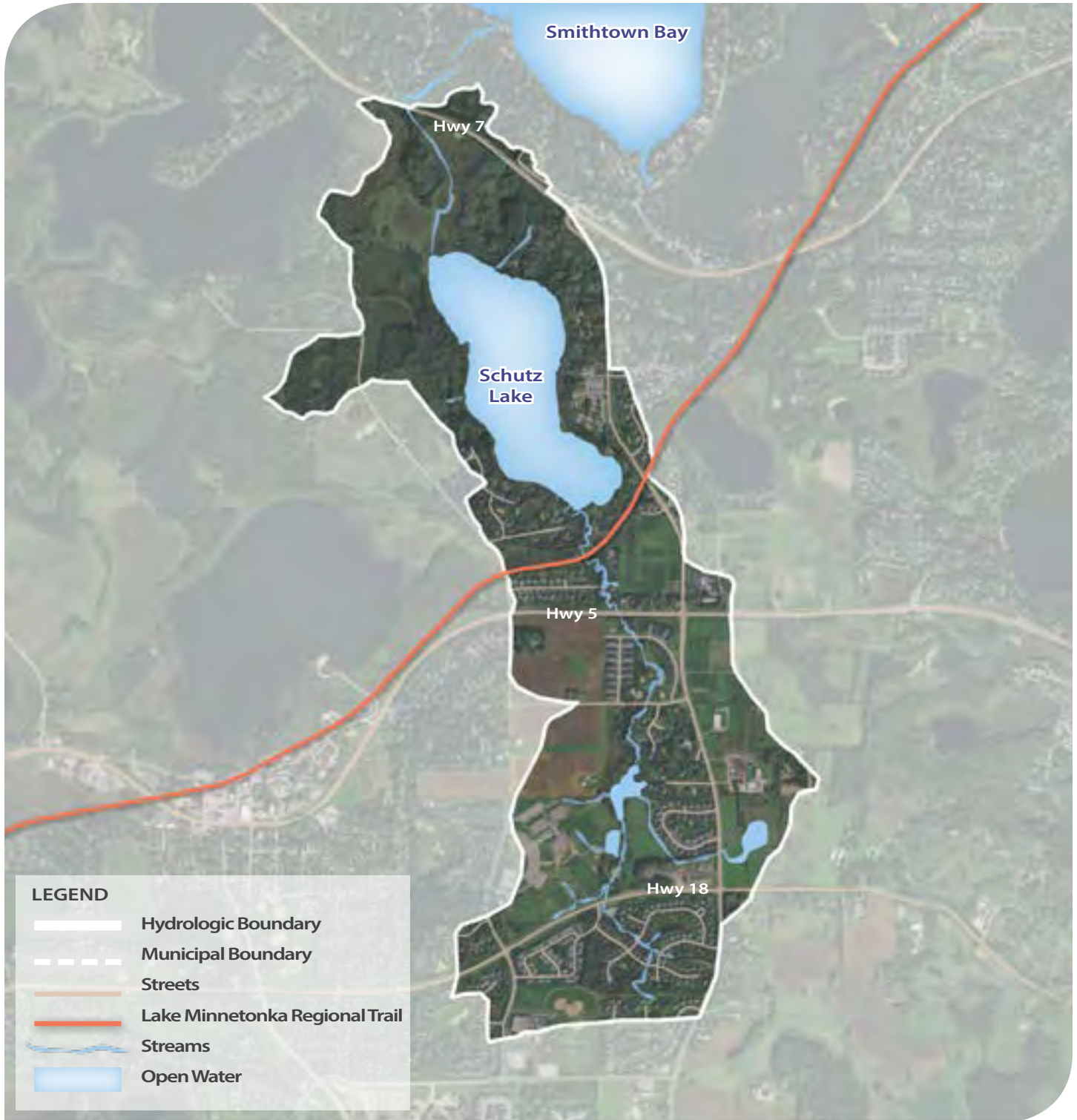


Figure 3.38 Schutz Lake Base map



Wetlands

As outlined by the District's Functional Assessment of Wetlands, the subwatershed contains some large, Preserve classification wetlands that provide a high level of water quality protection for downstream waterbodies such as Schutz Lake. Several wetlands with moderate restoration potential exist within the central drainage area of the geography and may have the potential to be improved to provide enhanced ecological value and water quality treatment. Wetlands in the subwatershed are sensitive to the quality of stormwater inputs.

Groundwater

There are areas of moderate to high aquifer sensitivity in the subwatershed. As development occurs and infiltration is proposed to meet water quality and volume control standards, special attention should be paid in areas of aquifer sensitivity and wellhead protection areas.

Water Quantity

Annual water yield from the subwatershed into Schutz Lake Creek may be increasing, as a trend analysis on streamflow data in Schutz Creek showed a statistically significant increase in annual water yield.

Water quantity has caused erosion within the channels and culverts that convey flow through the system. A damaged culvert under a minor drive off Highway 7 may overtop during large rain events, according to the District's hydrologic model.

There are wetlands and streams in the subwatershed that rely on steady inflow from surficial groundwater.

Ecological Integrity

Lakes and Streams

Schutz Lake has degraded fish and aquatic vegetation communities. The fish community shows obvious signs of disturbance compared to other similar lakes, which may be due to the presence of common carp. The vegetation community has very low species richness and is infested with Eurasian watermilfoil.

Schutz Creek has a degraded macroinvertebrate community, which lacks certain classes of organisms and consists primarily of pollution-tolerant species. The creek also has low

connectivity due the presence of culverts at Highway 5 and at the trail crossing.

Wetlands

The Schutz Creek corridor includes wetlands with vegetative communities that range in quality. Those of poor quality are heavily infested with buckthorn, reed canary grass, and Canadian wood-nettle, and those of better quality provide fish habitat and should be protected. Restoration of many of these wetlands could improve vegetative diversity and provide connected habitat for the subwatershed.

Uplands and Natural Corridors

Within the Carver Park Reserve on the west side of the lake is a large patch of maple-basswood forest that has been designated on the Minnesota Biological Survey as being a high-value native plant community. The larger area within Carver Park Reserve has been designated by the DNR as a regionally significant ecological area within the Metro area. In addition, the southern subwatershed contains part of the University of Minnesota Horticultural Research Center and Landscape Arboretum.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Schutz Lake subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Schutz Lake subwatershed are:

Water Quality

- » Excess nutrients

Water Quantity

- » Increasing annual volume from the upper subwatershed



Ecological Integrity

- » Degraded stream macroinvertebrate community
- » Degraded fish and aquatic vegetation communities

These issues are primarily the result of the following drivers:

- » Altered wetlands
- » Common carp
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading

Altered Wetlands

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater.

These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

There are few wetlands in the Schutz Lake subwatershed. There is a large wetland complex that serves as the headwaters to Schutz Creek. This wetland has low to moderate vegetative diversity, which may be a legacy of historical agricultural runoff. Water quality monitoring shows elevated concentrations of total phosphorus in Schutz Creek, and elevated chlorophyll-a, indicating elevated levels of algae, in Schutz Lake. Wetland alteration may be a source of phosphorus to Schutz Creek.

Carp

Invasive common carp negatively impact water quality and ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse state, and is often characterized by a significant loss of natural vegetation, harmful algal blooms, and the release of phosphorus



Schutz Lake

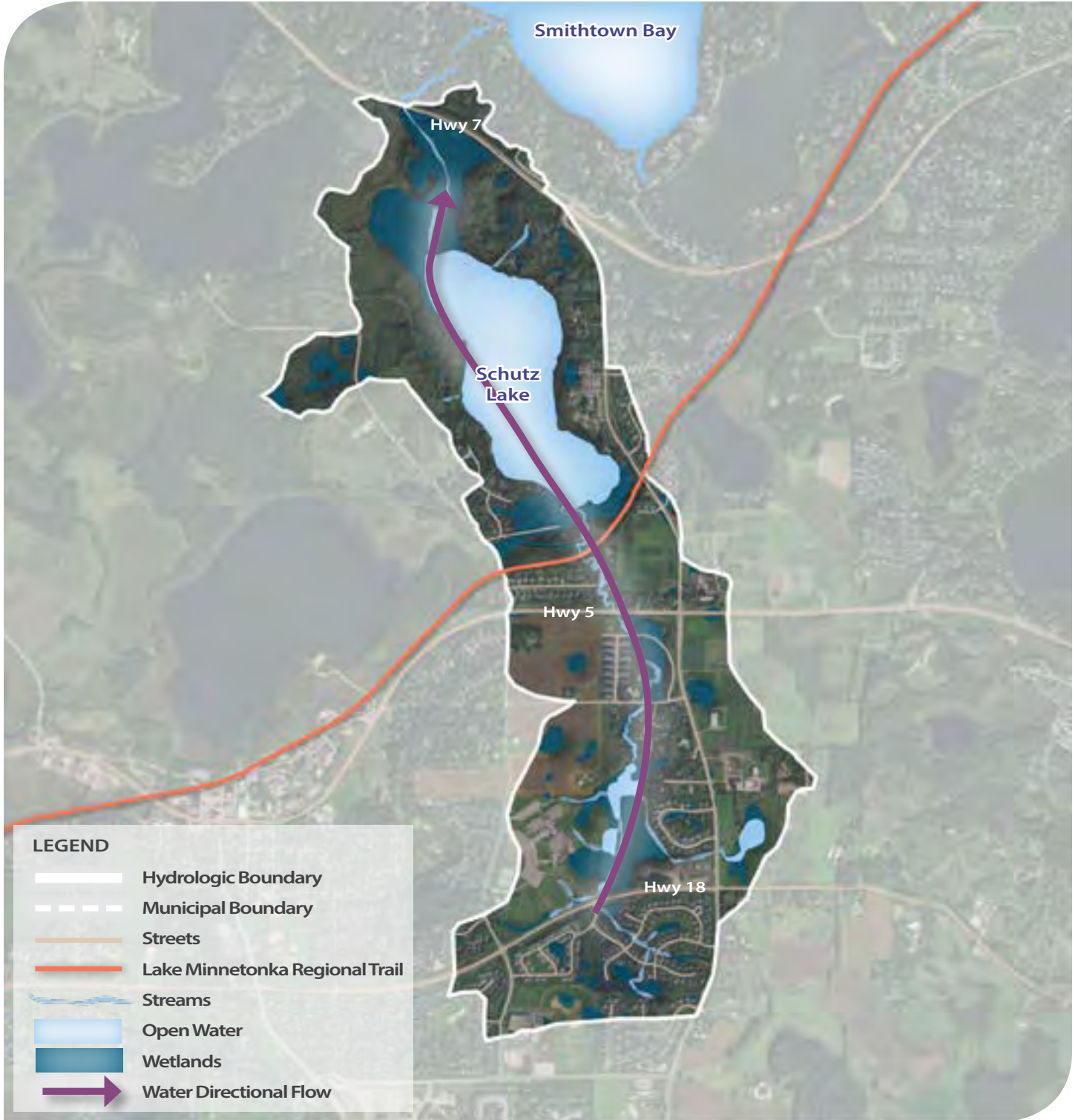


Figure 3.39 Schutz Lake Water Resources map





Schutz Creek



Schutz Lake



Schutz Lake

from resuspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

Schutz Lake has signs of potential carp impact, with its degraded aquatic plant and fish community. The status of carp in the lake is unknown, and assessing the population would be the first step towards determining the impact carp may be having on the lake.

Stormwater Runoff

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally, as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

Schutz Creek has elevated levels of total phosphorus and Schutz Lake has elevated concentrations of chlorophyll-a, a proxy for algae. Runoff from lawns and streets in the subwatershed conveys nutrients and sediment to surface waters. Monitoring data in Schutz Creek show a statistically significant increase in

annual runoff volume conveyed from the developing upper subwatershed. Runoff from the subwatershed is a likely source of phosphorus to Schutz Creek and Lake, which can cause algae blooms.

Altered Channels

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Schutz Creek runs through culverts at Highway 5 and at the trail crossing, impairing connectivity in the creek. The creek was also likely channelized at some point. Schutz Creek has a degraded macroinvertebrate community and elevated total phosphorus concentrations. A stream assessment found that there were multiple types of habitat present and the stream morphology was rich, indicating that the poor water quality may be the primary stressor on aquatic life in the Creek.

Internal Sediment Phosphorus Loading

Long term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

No sediment release data are available for Schutz Lake, but based on historical agriculture in this area, there may be pools of phosphorus in the sediments and available for release. An increasing trend in algal blooms could be related to these legacy impacts, or to the increased nutrient loading from the subwatershed. Additional sediment release, aquatic vegetation, and fish data are necessary to determine the probable role of each in internal loading and the appropriate course of action.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Schutz Lake subwatershed. These strategies are both short- and long-term, and establish a framework for the Schutz Lake subwatershed Implementation Plan programs and projects.

Wetland Restoration

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration, which transform and release phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

The wetland complex at the headwaters of Schutz Creek should be evaluated for potential nutrient export. Numerous wetlands within the subwatershed have high or moderate restoration potential, and if restored, could improve vegetative diversity and provide connected habitat.

Carp Management

Historically, carp management focused on removal of carp populations from impacted water bodies without any consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable



Figure 3.40 Schutz Lake Park, Trails, and Open Space map



control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

Schutz Lake has signs of potential carp impact, with its degraded aquatic plant and fish community. The status of carp in the lake is unknown, and assessing the population would be the first step towards determining the impact carp may be having on the lake. If carp are found to be impacting the system, given the small size of the subwatershed, a simple assessment could be performed that would inform management strategies.

Stormwater Management

Stormwater management will focus on reducing runoff volumes and rates, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

In the Schutz Lake subwatershed, the focus will be on installing stormwater management practices that reduce the volume and pollutant load being delivered from the upper watershed, primarily south of Highway 5.

Stream Channel Restoration

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and re-aeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Schutz Creek may be investigated for restoration potential to address bank erosion and issues surrounding the culverts that serve as part of the conveyance system. A partial stream assessment did not reveal significant issues and noted that there

was robust habitat available. Given the elevated phosphorus levels in the stream, the entire length would benefit from assessment to determine need and opportunity for streambank stabilization, buffer enhancement, and habitat improvement.

Internal Sediment Phosphorus Control

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Not enough data are available to determine if internal sediment phosphorus load requires management. Sediment cores would assist in assessing potential sediment release rates. Aquatic vegetation and fish surveys would also provide valuable data to determine what role biological management would play in controlling internal load.

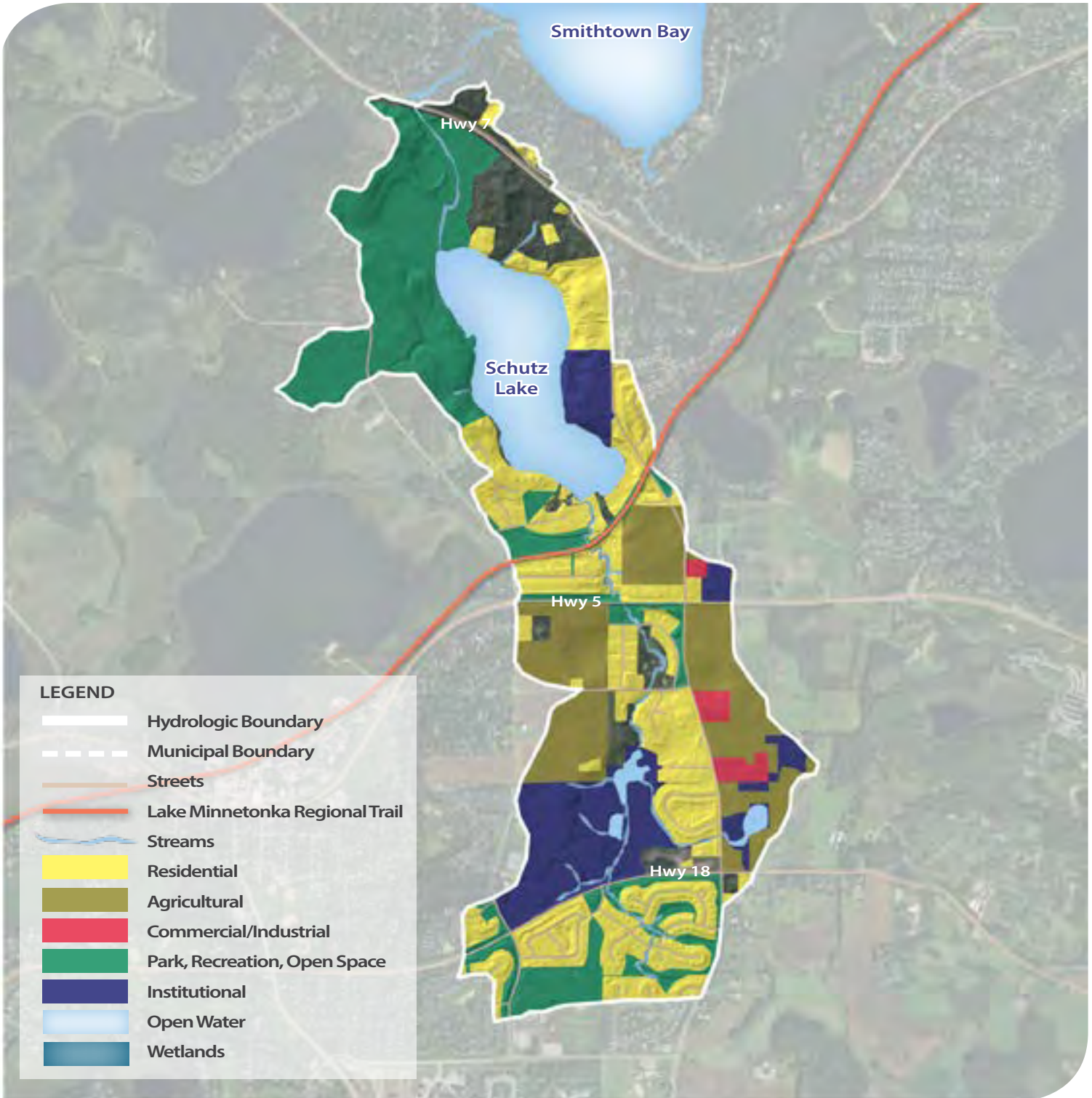
LAND USE

EXISTING CONDITIONS

The subwatershed includes a portion of the city of Victoria. Land use in the subwatershed is generally characterized by parks and open spaces (25%), low density development (24%), agricultural uses (15%), institutional uses (12%), water (11%), and undeveloped land (7%). The Carver Park Reserve abuts the northwesterly portion of the lake, the Southwest Hennepin LRT Regional Trail crosses the subwatershed, and portions of the southern subwatershed belong to the University of Minnesota Horticultural Research Center and Landscape Arboretum.

LOCAL PLANS AND PRIORITIES

As described in the District's goals (Sections 3.3), the District strives to implement its clean water objectives in ways that meaningfully contribute to the development of thriving communities. This is achieved through collaboration and integrated planning with public and private partners.



LEGEND

- Hydrologic Boundary
- Municipal Boundary
- Streets
- Lake Minnetonka Regional Trail
- Streams
- Residential
- Agricultural
- Commercial/Industrial
- Park, Recreation, Open Space
- Institutional
- Open Water
- Wetlands

Figure 3.41 Schutz Lake Land Use map



As part of the development of this plan, the District reached out to its communities to gather information on local goals, plans, and priorities for 2018-2027 (see Appendix B for details on the public input process). This information was used to broadly characterize opportunities, and to inform the development of the District's implementation plans. The information received was used only as a guide during the development of this Plan to inform the District of opportunities for partnership on the near term horizon, and was not intended to be exhaustive or restrict future collaborative efforts.

As discussed in Section 3.6, the District intends to cultivate a framework for two-directional coordination with communities on an ongoing basis, to stay apprised of emerging needs at a local level, and to identify and evaluate opportunities to implement management strategies outlined in this Plan over the next ten years. The District recognizes that local needs, opportunities and priorities may shift over time. Therefore, this Plan does not intend to capture or prescribe opportunities for partnership over a ten-year term.

Long term goals, growth and private development, and public investment in infrastructure differ across each community – and therefore, frameworks for ongoing coordination will be custom tailored based on the individual needs of each community. Coordination may occur at varying levels, through various means, with communities across the following areas:

- » Regulation of, and partnership with, private development
- » Collaboration on public planning and investment (e.g. parks, roads, utilities)
- » MS4 compliance
- » Development and implementation of TMDLs

There is an active lake association for Schutz Lake that has expressed interest in working with the City of Victoria and the District to address the issues outlined in this plan. The City of Victoria will be working pro-actively with the District to identify opportunities to manage stormwater volumes and pollutant loads, stabilize erosion within the stream and stormwater conveyance system, and to develop funding strategies to implement feasible solutions.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward the conservation and improvement of water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

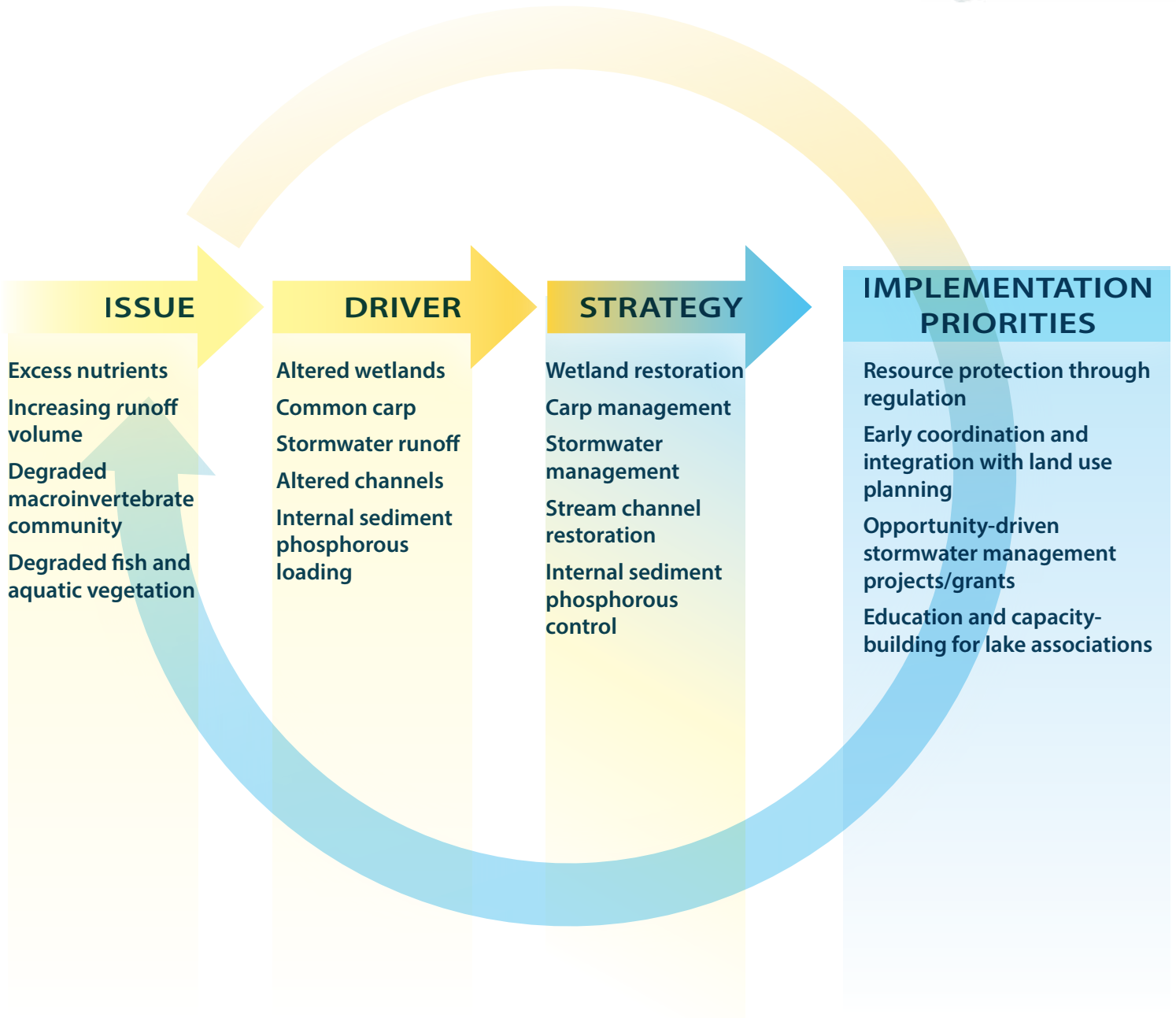
IMPLEMENTATION PRIORITIES

As described in previous sections, Schutz Lake is not impaired but does exhibit a trend of increasing concentrations of chlorophyll-a, and increasing annual water yields – likely due to development that has occurred in the last ten years. Increased quantities of water may also be causing erosion within the channel and around culverts which convey water through the system. These issues may be combining with the potential for internal loading, possibly exacerbated by the presence of common carp, to continue stressing Schutz Lake.

Based on these conditions, management strategies within the subwatershed will focus primarily on stormwater management to reduce runoff volumes and pollutant loads, assessing and stabilizing erosion within the stream channel and conveyance system, and evaluating and managing the presence and impact of common carp.

The Schutz Lake subwatershed is relatively small and little near-term development or infrastructure investment is anticipated, so opportunities from land use change may be limited. However, the Plan establishes a coordination framework through which the District will seek to maintain current knowledge of land use and capital planning by its LGUs, and of potential land use development and redevelopment activity.

As opportunities arise, the District will evaluate them against the resource needs and priorities defined throughout this plan and determine the appropriate response. The District has a wide range of services it can mobilize to address resource needs and support partner efforts, including data collection and diagnostics, technical and planning assistance, permitting



assistance, education and capacity building, grants, and capital projects.

The District will pro-actively coordinate the permitting of future land use change with the City of Victoria to explore opportunities to create public-private partnerships to address stormwater management goals in ways that exceed regulatory requirements. The District will continue working with the Lake Association to identify local resident led implementation opportunities that align with this subwatershed plan.

To allow the District the flexibility to respond to opportunities identified by the cities or other partners, or that may arise through land-use change, the capital improvement plan for this subwatershed includes a project for stormwater management. In the future, should the District or a partner determine that a larger or more concentrated scale of capital and program implementation may be needed, a discrete subwatershed planning process may be initiated to:

- » Provide high resolution diagnostic of watershed issues and drivers
- » Map current projected land use and infrastructure changes

- » Define a detailed and integrated capital and program implementation plan
- » Outline a funding strategy including program costs and sources

The details of such a plan would provide the information needed for the District to pursue a plan amendment under MN Rules 8410, thereby updating specific subwatershed components of this Plan.

CAPITAL IMPROVEMENT PLAN

The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District's scope and priorities for its capital work over the planning period. A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other policy considerations before a formal decision to proceed to construction is made. Section 3.5.5 describes the development and evaluation steps that will occur before the District will commit resources to a project.



Schutz Creek



Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures.

expenditures will be refined during project development and budgeting, and among other things will reflect the District's intent to complement its ad valorem funds with other funding sources.

A critical component of any project will be the development of a funding strategy that identifies the sources, uses, and timing of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District's public and private partners as capital projects are advanced. Therefore, any costs identified within this Plan are projections. Intended



Schutz Lake

Table 3.14 Schutz Lake Subwatershed CIP

Project	Stormwater Volume and Pollutant Load Reduction
Description	Implementation of opportunities to reduce stormwater volumes and nutrient loading to Schutz Lake, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	While Schutz Lake is not currently impaired for excess nutrients, total phosphorus concentrations are very near state water quality standards. Schutz Lake receives stormwater runoff from a developing area south of the Lake via Schutz Lake Creek where further phosphorus load reductions are needed to protect water quality.
Outcome	Reduction of pollutant loading to Schutz Lake; reduction of stormwater runoff volume and rate and associated impacts; protection and enhancement of groundwater recharge, stream base flow, and wetland hydrology.
Estimated Cost	Capital costs: \$250,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

3.9.11 SIX MILE-HALSTED BAY SUBWATERSHED PLAN

INTRODUCTION

This subwatershed plan contains information specific to the Six Mile Creek-Halsted Bay Subwatershed, including existing conditions and issues, drivers, management strategies, land use information, and an implementation plan. Information regarding the District's philosophy, goals, and implementation approach can be found in Sections 3.2-3.4 and should be reviewed first to provide context for the following subwatershed plan.

EXECUTIVE SUMMARY

The Six Mile Creek-Halsted Bay Subwatershed spans 27 square miles on the western edge of the Minnehaha Creek Watershed District. Within this large subwatershed are numerous jurisdictions and public agencies, including the Cities of St. Bonifacius, Waconia, Victoria, and Minnetrista, Laketown Township, both Hennepin and Carver Counties, and Three Rivers Park District, which owns Carver Park Reserve, a 3,700 acre park within the subwatershed.

The subwatershed is characterized by abundant and interconnected water resources, flat topography, and planned land use conversion from agriculture to suburban residential. The principal land uses within the Six Mile Creek-Halsted Bay Subwatershed are parks and open space (25%), agriculture (24%), undeveloped land (22%), water (14%), and low density development (12%).

Large areas of undisturbed or minimally disturbed forest and grassland are located within Carver Park Reserve. A majority of the land within Carver Park Reserve is designated by the DNR as a "regionally significant ecological area", as are other corridors around the large lake and wetland systems outside of the park. Areas designated as having high biodiversity significance by the Minnesota County Biological Survey include several wetland complexes in and adjacent to Carver Park.

The Six Mile Creek-Halsted Bay Subwatershed contains approximately 14 lakes and hundreds of acres of wetlands, all connected by Six Mile Creek, which has been heavily ditched and modified. The system begins at Pierson Lake in Laketown Township, and moves towards Victoria through Wassermann Lake, then through a large wetland complex into East Auburn

Lake, which is partially within Carver Park Reserve. Carver Park Reserve contains six lakes and numerous marshes, all of which drain into North Lundsten Lake then through a water control structure into Parley Lake. Water then flows through Parley and Mud Lakes, and finally through the large Six Mile Marsh complex into Halsted Bay of Lake Minnetonka.

The system has six lakes that do not meet state water quality standards for nutrients. The receiving water, Halsted Bay, requires the largest phosphorus load reduction in the District. Other water bodies have high phosphorus levels without being listed as impaired, either because they exhibit fluctuation around state standards or they have been designated as wetlands by the Minnesota Pollution Control Agency, which designates impaired water bodies and allocates required load reductions.

Degraded water quality and ecological integrity within this system are driven by both historical land use and ongoing system stressors. Many waterbodies with elevated phosphorus are driven at least in part by internal sediment release of phosphorus stored in the lake bed. This sediment phosphorus release may be exacerbated by the presence of invasive common carp, which are abundant throughout the system. The principal source of watershed nutrient loading throughout most of the system is degraded wetlands that export phosphorus due to historic hydrologic modification. Stormwater from both agricultural and developed land uses also drives some water quality issues, though proportionately less than other sources in the watershed.

Management strategies will include carp control, wetland restoration, internal load management, and coordination with public infrastructure investment to improve stormwater management. The location and timing of the implementation of these management strategies will be driven by resource need, opportunity cost, partner support, and available land and financing.

Given the subwatershed scale, abundance of natural resources, complexity of the geography, interconnected water resource issues, and existing partnerships in the area, the subwatershed was adopted in 2015 by the MCWD Board of Managers as a priority for planning and implementation. The implementation

SIX MILE-HALSTED BAY SUBWATERSHED

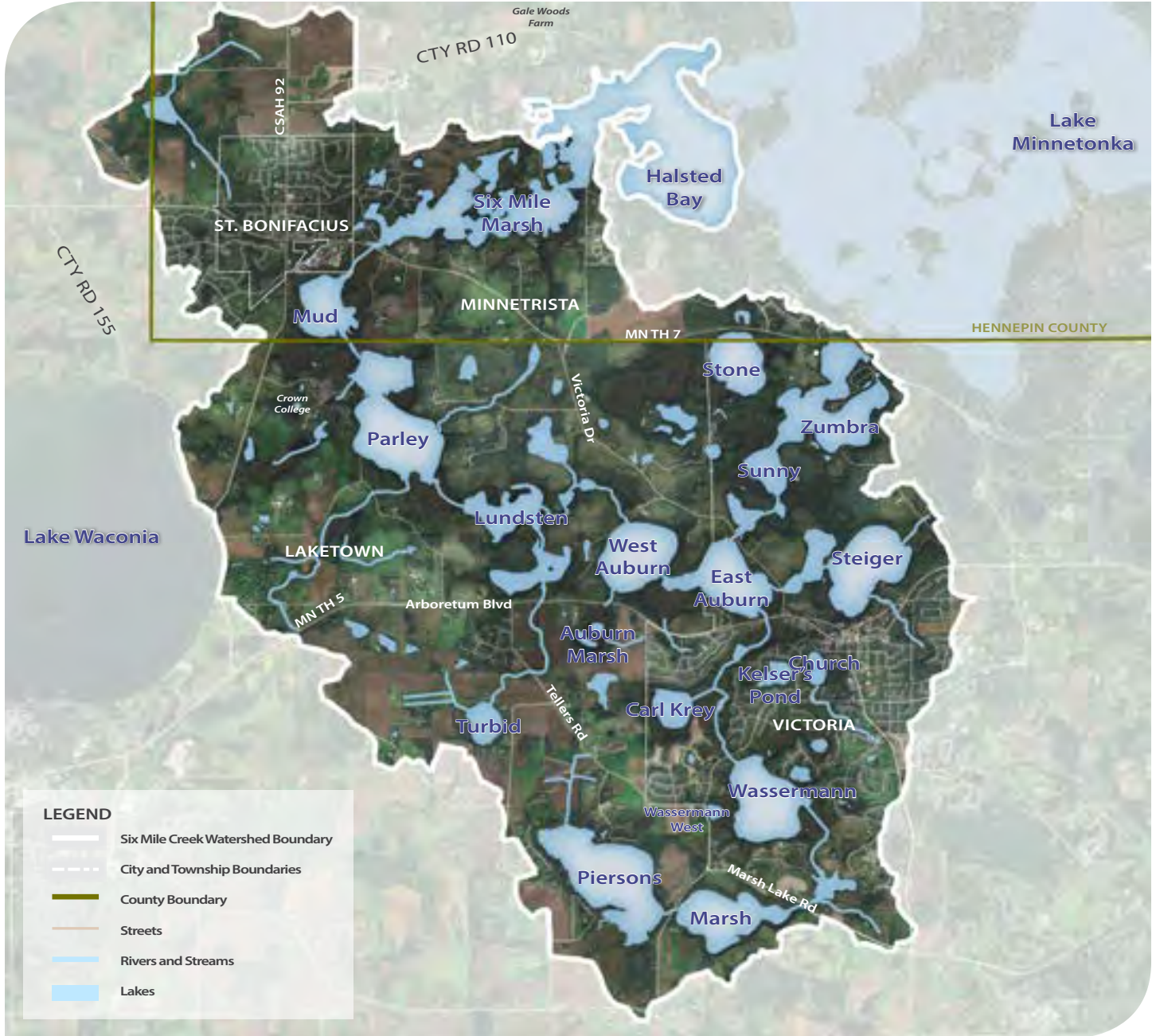
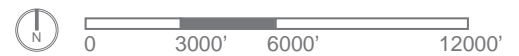


Figure 3.42 Six Mile-Halsted Bay Base map



plan for this subwatershed has been developed in coordination with the Six Mile Creek-Halsted Bay Planning Partnership, composed of policy makers and staff from the public agencies within the geography including:

- » City of Victoria
- » City of Minnerista
- » City of St. Bonifacius
- » City of Waconia
- » Laketown Township
- » Carver County
- » Hennepin County
- » Three Rivers Park District

MCWD first convened the Partnership to develop a coordinated, multi-jurisdictional plan to address complex and interconnected water resource issues in the geography. The plan integrates natural resource improvements into other, non-water public investments including parks and recreation, growth and development, and infrastructure investment. The goal of the plan is to not only improve water resource outcomes directly, but also generate secondary benefits that address local planning priorities.

The Partnership will continue to work together to guide and prioritize implementation after this plan has been adopted. The District will routinely convene the Partnership to evaluate implementation progress and provide updates on projects and opportunities the District intends on pursuing. The District will seek support from the Partnership as it pursues external funding sources such as grants and financing. The District will also support members of the Partnership as they develop their own comprehensive plans, land use ordinances, investment strategies, and other local initiatives.

RESOURCE NEEDS

EXISTING CONDITIONS AND ISSUES

This section of the Plan outlines existing conditions and water resource issues, categorized by water quality, water quantity,



Rural landscape



Six Mile Creek



Lake Wasserman, looking west, Erdahl Aerial Photos

SIX MILE-HALSTED BAY SUBWATERSHED

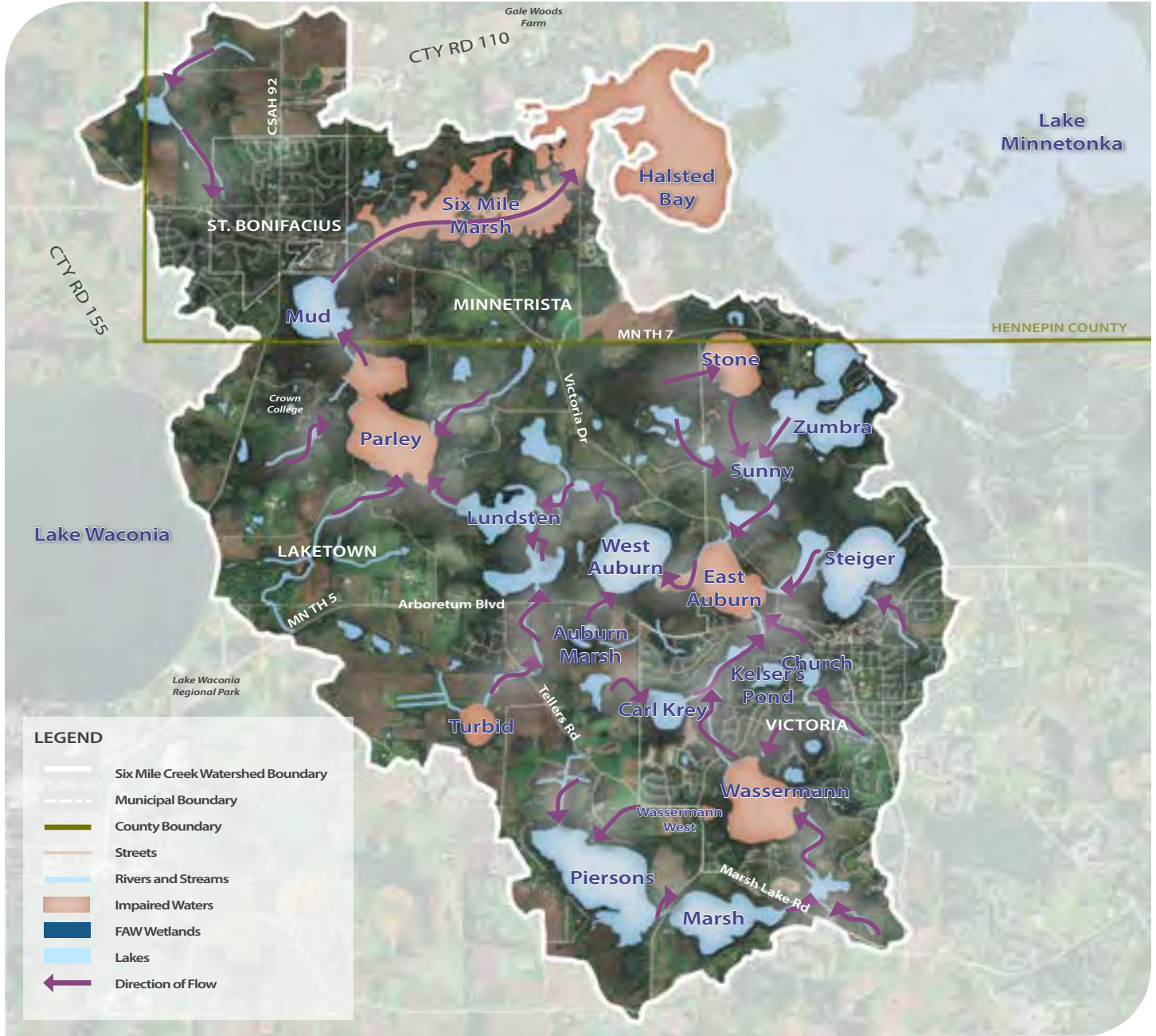
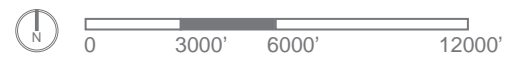


Figure 3.43 Six Mile-Halsted Bay Water Resources map



and ecologic integrity. Condition information was compiled from community input, monitoring data, specialized studies, the Hydrologic and Hydraulic Pollutant Loading Study (HHPLS), the Six Mile Diagnostic Study, the Six Mile Creek Carp Assessment, the Functional Assessment of Wetlands (FAW), Total Maximum Daily Load (TMDL) studies, and state and regional land use and land cover data. A review of these conditions and data revealed several issues and concerns that may require action on the part of the District or its partners. More detailed information about the Six Mile Creek-Halsted Bay subwatershed may be found in Volume 2: Land and Natural Resources Inventory.

Water Quality **Lakes and Streams**

East Auburn, Parley, Stone, Turbid and Wasserman Lakes are impaired for excessive nutrients, requiring load reductions under approved TMDLs. Mud Lake and South Lundsten have high nutrient concentrations but are classified as wetlands, so the state standards for lakes do not apply. Several other waterbodies within the system fluctuate around state standards for water quality and clarity but remain unlisted.

In Six Mile Creek, the reach between Mud Lake and Halsted Bay is listed as an impaired water for excess nutrients with a TMDL forthcoming. Dissolved oxygen levels frequently fall below the 5 mg/L necessary to sustain aquatic life.

Wetlands

Abundant and interconnected wetland complexes are characteristic of the Six Mile Creek-Halsted Bay geography. While many provide crucial ecosystem services, altered hydrology and monotypic vegetation communities lead many others to be exporters of phosphorus. These wetlands are driving degrading water quality in some of the largest lakes within the geography, including East Auburn, Wassermann, and Parley.

Groundwater

There are areas of high and very high aquifer sensitivity throughout the watershed, some of which correspond to anticipated development areas.

Water Quantity **Lakes and Streams**

The Six Mile Creek-Halsted Bay subwatershed is characterized by its flat topography and extensive water resources. The lack of

gradation between waterbodies generates backflow conditions between certain waterbodies when the flow pattern reverses direction, causing flooding and pollutant loading concerns.

Lakes and streams within the subwatershed have altered hydrology. Changes to inlet and outlet structures, altered rates of overland flow and recharge, and modification to stream alignment and shoreland zones generate secondary impacts to water quality and ecological integrity by modifying stream flow regime and lake levels.

Wetlands

The MCWD Functional Assessment of Wetlands (FAW) found that wetlands within the Six Mile Creek-Halsted Bay system generally function well for flood storage capacity and maintenance of hydrologic regime, with some exception for flood storage in the less developed areas in and around Minnetrista. However, the flow regime of many of the wetlands has been modified, driving symptoms that impact both the water quality and ecological integrity indicators for wetlands.

Groundwater

A majority of the wetlands within the Six Mile Creek-Halsted Bay system rely, at least in part, on recharge from surficial groundwater sources, rendering them sensitive to changes in groundwater supply.

Ecological Integrity **Lakes and Stream**

Many of the lakes within the subwatershed have shallow lake characteristics, including large littoral areas. These characteristics can drive dense vegetation, both native and non-native. Aquatic vegetation supports habitat for aquatic species, food web interactions, and nutrient cycling, but can have adverse impacts, particularly when non-native species are present.

Aquatic plant biodiversity and habitat diversity range across the lakes in the subwatershed. These ecosystem services were recently assessed through the District's E-Grade Program, and while plant communities in some lakes provided for good conditions, several others were classified as poor or degraded. Eurasian watermilfoil and Curlyleaf pondweed are present in most lakes, but at varying abundances.



Marsh Lake, Erdahl Aerial Photos



Six Mile Marsh prairie restoration



Six Mile Creek

The fish communities in the numerous lakes also were assessed through the District's E-Grade Program, and most were classified as poor to degraded communities.

Shoreline integrity varies widely across the subwatershed. Shoreline within the Carver Park system is largely intact given the public ownership by a natural resources agency, but private development in the City and Township areas can impact the continuity of buffering along the shoreline, which protects lakes from erosion and preserves habitat.

Six Mile Creek is heavily altered, having been ditched and widened over time. The stream generally lacks biodiversity and has degraded habitat characteristics.

Wetlands

With 5,127 acres of wetlands within the geography, a range of vegetative and biodiversity conditions exist within this system. Wetland assessments have identified many with low vegetative diversity and non-native species. Much of the wetland acreage still provides moderate support to wildlife and fisheries. There are a number of high- and moderate-quality wetlands in the subwatershed, many of which are situated in a nearly continuous natural corridor that provides significant functions and values such as runoff storage and water quality treatment as well as habitat and natural resources values, and should be prioritized for protection.

Upland and Natural Corridors

The Three Rivers Park District's Carver Park Reserve covers much of the central subwatershed, preserving not only numerous lakes and wetlands, but also large swaths of forest and prairie. Large areas of undisturbed or minimally disturbed forest and wetland in the subwatershed have been designated Regionally Significant Ecological Areas by the DNR, including nearly all of the Carver Park Reserve. The Minnesota Biological Survey (MBS) identified several areas of moderate or high biodiversity significance both within and outside of the regional park. The MBS also identified both terrestrial and aquatic locations in the watershed with intact native plant communities. The Metropolitan Council has identified large areas within the subwatershed as important conservation corridors.

DRIVERS

A driver of water quality, water quantity, or ecological integrity is a driving force or stressor that causes a biological community or physical structure to change. Some example drivers include increased phosphorus loading, increased impervious areas, straightened channels, and drained wetlands. Some drivers are natural, such as storm events. Most are human-caused, either directly or as a side effect of some other change such as a land use change or removal of natural land cover. This section of the Plan outlines the main drivers of water quality, water quantity, and ecological integrity issues within the Six Mile Creek-Halsted Bay subwatershed.

The principal water quality, water quantity, and ecological integrity issues within the Minnehaha Creek subwatershed are:

- » Water Quality
- » Excess nutrients
- » Low dissolved oxygen
- » Phosphorus export wetlands

Water Quantity

- » Modified hydrology
- » Localized flooding

Ecological Integrity

- » Degraded fish community
- » Degraded macroinvertebrate community
- » Degraded and disconnected wetland and terrestrial corridors

The issues are driven primarily by the following factors

- » Common carp
- » Altered wetlands
- » Water quality from upstream waterbodies
- » Stormwater runoff
- » Altered channels
- » Internal sediment phosphorus loading

Common Carp

Invasive common carp negatively impact water quality and ecological conditions in surface waters when carp dominate fish communities. Carp impact aquatic systems by their bottom feeding behavior which uproots aquatic plants, re-suspends bottom sediments, and releases nutrients into the water column. This leads to decreased water clarity and a switch to a water state dominated by algae in shallow lakes and wetlands. This turbid water condition is the least ecologically diverse state, and is often characterized by a significant loss of natural vegetation, harmful algal blooms, and the release of phosphorus from resuspended sediments, all of which contribute to water quality impairments and the loss of fish and wildlife habitat.

For most lakes, carp densities need to be kept below 100 kg/ha to prevent declining water quality and ecological integrity. The 2016 University of Minnesota Six-Mile Creek Subwatershed Carp Assessment provides a detailed assessment of carp populations in the Six Mile system, with many waterbodies greatly exceeding the damaging threshold.

Altered Wetlands

On a watershed scale, wetlands can act as sinks, sources, or transformers (particulate to dissolved) for nutrients like phosphorus. Historically, wetlands acted as nutrient sinks within a watershed, capturing and retaining nutrients, even as nutrient loads to the wetland were increased as land use intensified. However, as wetlands were ditched and drained to facilitate watershed drainage and land use change, they often converted from a sink for nutrients to sources, by increasing the breakdown of wetland soil and the conveyance of stormwater. These processes within altered wetlands can release large pools of stored nutrients, causing nutrient impairments in downstream surface waters.

In the Six Mile Creek-Halsted Bay Subwatershed, altered wetlands are a principal driver of degraded water quality for Wassermann, Turbid, East Auburn, South Lundsten, Parley, and Mud Lakes and Halsted Bay. Altered wetlands also reduce available habitat for migratory waterfowl and other bird species within the area.

Upstream Waterbodies

Headwater streams, lakes and wetlands contribute water and nutrients to downstream receiving waters impacting the quality

SIX MILE-HALSTED BAY SUBWATERSHED

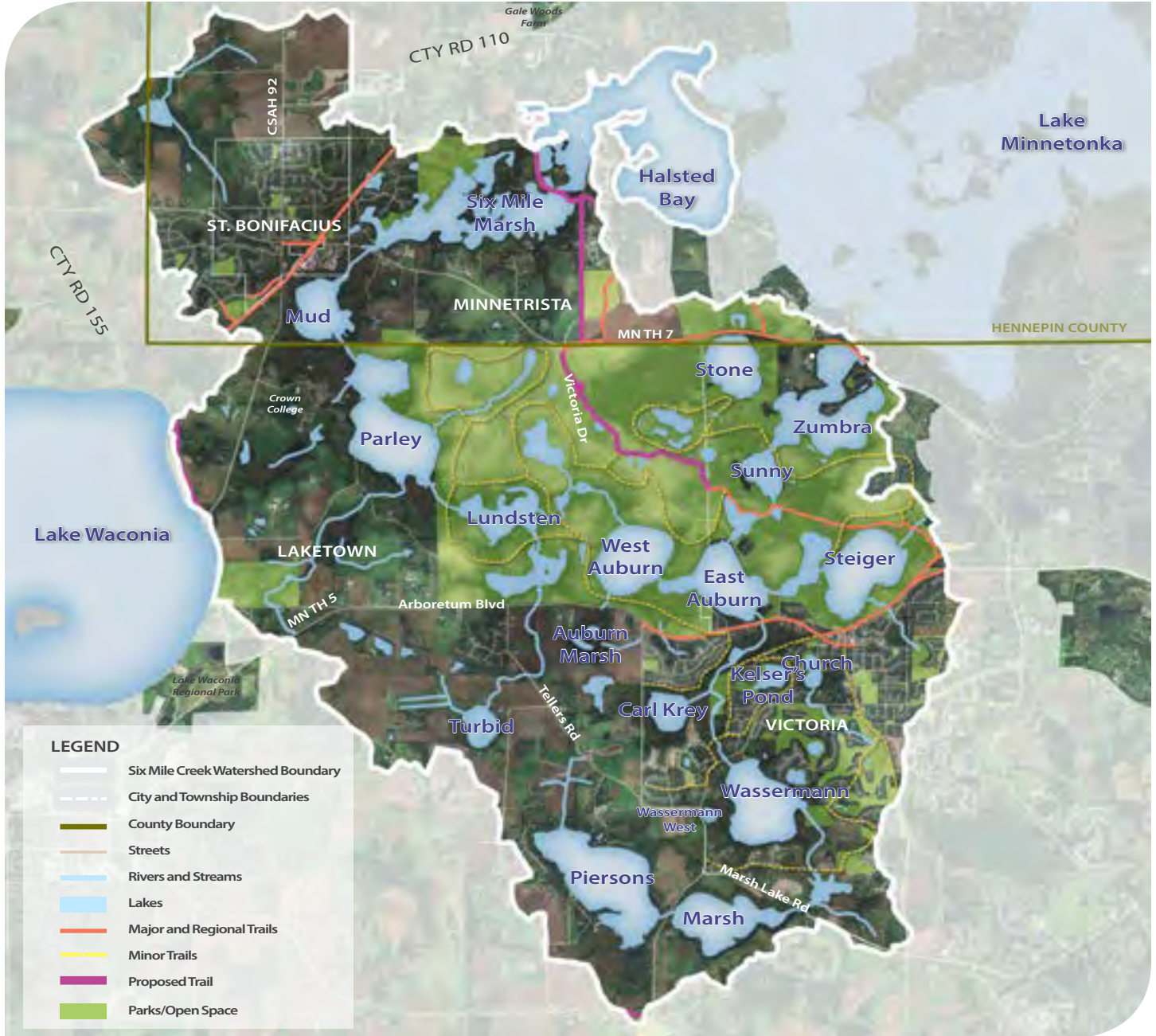
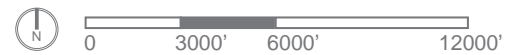


Figure 3.44 Six Mile-Halsted Bay Parks, Trails, and Open Space map



of these water bodies. Lakes and wetlands with poor water quality ultimately contribute nutrients to downstream waters that can lead to eutrophication. Consequently, restoration of upstream water bodies is often a critical component of improving downstream water quality on a watershed scale.

Six Mile is particularly challenged in this regard because in several cases the upstream waterbodies are either not listed as impaired because they are classified as wetlands or are held to shallow water body standards which allow for higher nutrient concentrations, even if their downstream waterbodies are held to stricter standards.

Stormwater Runoff

Watershed runoff from rainfall events, or stormwater, can carry nutrients and other pollutants to surface waters leading to negative impacts in lakes, streams and wetlands. In urban and suburban areas, high proportions of impervious surfaces such as parking lots and driveways increase the volume and rate of stormwater runoff, which can cause flooding, and change stream flow in ways that negatively impact habitat for critical parts of the food-web like fish and macroinvertebrates. In rural areas drained for agriculture, the increased volume and peak

flow of stormwater runoff causes similar negative impacts.

While the increased volume and rate of stormwater runoff can negatively impact physical conditions in receiving waters, the runoff also carries with it increased loads of pollution that negatively impact the quality of lakes, streams and wetlands. In urban and suburban areas, stormwater picks up excess nutrients, bacteria such as *E. coli*, chloride from road salt, and other pollutants causing toxicity to organisms or issues with excess nutrients (eutrophication). In more rural areas, stormwater mobilizes pollutants from manure and fertilizer including excess nutrients, bacteria, herbicides and pesticides.

These impacts heavily influence the conditions of surface waters because a healthy hydrologic condition is critical to supporting a healthy lake, stream or wetland. Generally as impervious cover, altered drainage, and stormwater runoff within a watershed increases, the quality of lakes, streams and wetlands decreases.

The Six-Mile-Halsted Bay System experiences water resource issues from both developed areas and agricultural land uses. Areas of Victoria and most of St. Bonifacius were developed



Six Mile-Halsted Bay Subwatershed



before today's more rigid stormwater standards were in place and continue to drive declining water quality in receiving waterbodies.

There are several areas in the subwatershed where ongoing agricultural land use continues to drive declining water quality in receiving waterbodies. More prominently, however, are impacts still felt today from the historic agricultural land use the subwatershed, including high concentrations of phosphorus built up in waterbodies leading to internal sediment release and degraded and hydrologically altered wetland complexes that act as sources or transformers of nutrient pollution.

Altered Channels

Historically, natural channels were straightened, widened and relocated to accommodate land use change. Channel alteration to improve watershed drainage can lead to a loss of physical habitat, increased peak flow velocities and downstream flooding, decreases in dissolved oxygen, and increased sediment transport which can negatively impact fish and macroinvertebrate communities.

Six Mile Creek is classified as a public drainage system and has been heavily modified over time, principally to serve agricultural land which formerly dominated the landscape.

Internal Sediment Phosphorus Loading

Long-term excessive loading of phosphorus to lakes can lead to phosphorus buildup in the sediments of the lake bed. Ultimately, this phosphorus can be released from the sediment back into the water. Further exacerbating the problem, released phosphorus is typically dissolved which is readily available for plant uptake and contributes directly to algae blooms. Sediment phosphorus release can lead to summer algae blooms, poor water clarity and, in severe cases, summer fish kills and harmful algal blooms. Restoration of water quality in lakes often requires significantly reducing phosphorus release from sediments.

Lakes where internal sediment release is or may be a driver in the Six Mile Creek-Halsted Bay include Marsh, Wasserman, Church, North and South Lundsten, Turbid, Parley, and Mud Lakes, and Halsted Bay. In some of these lakes, internal release is proportionately small to other factors but still significant for achieving phosphorus reduction goals.

MANAGEMENT STRATEGIES

Informed by the identification and prioritization of conditions and issues in the subwatershed and an understanding of the drivers impacting its water resources, the District has developed general strategies to guide actions in the Six Mile Creek-Halsted Bay subwatershed. These strategies are both short- and long-term, and establish a framework for the programs and projects utilized in the Six Mile Creek-Halsted Bay subwatershed Implementation Plan. To best understand the strategies and efforts of the District and its partners within the Six Mile Creek-Halsted Bay subwatershed, it is important to recognize the recent work in this subwatershed and the integration and alignment of natural resource management strategies with the goals of our communities.

Focal Subwatershed Planning

As noted throughout this plan, the District's overarching organizational strategy is founded in its Balanced Urban Ecology policy. This policy was established as the District's fundamental philosophy and way of doing business – developed to guide all future planning and watershed management activities in order to achieve its mission of protecting and improving land and water.

The overarching strategy described in Balanced Urban Ecology policy is a vision of integration with government agencies, private landowners and developers, and philanthropic partners through multi-jurisdictional partnerships, emphasizing the economic and social value that natural systems generate for the built environment. It further describes how our work will be strengthened through these collaborative efforts to not only offer greater community impact, but to produce creative public-private funding opportunities that will leverage scarce resources and maximize benefits.

Following the success in applying the Balanced Urban Ecology policy in the Minnehaha Creek Subwatershed, the District turned to The Six Mile Creek-Halsted Bay Subwatershed in 2014 as the next geography in which to apply these lessons of partnership, integration, and flexibility. The Six Mile Creek-Halsted Bay was selected as an implementation priority due to its abundant natural resources, complex water resource issues that cross jurisdictional boundaries, the anticipated growth and development pressure in the coming decades, the existing support and partnerships, and the geography's connection

to Halsted Bay of Lake Minnetonka. It was also noted that the scale, complexity, and multiple jurisdictions would warrant an approach in which the District routinely convenes area partners to adaptively manage capital project implementation.

In 2013, the District conducted a comprehensive diagnostic assessment to gain a clearer picture of the issues and drivers within this geography. One of those drivers identified included invasive common carp, prompting the District to contract with the University of Minnesota to conduct an assessment of the recruitment, concentration, and movement patterns of carp in the system to inform subsequent management activities. These studies, along with other District wide studies and specialized assessments, serve as the backbone of understanding the interplay of issues, drivers, and management strategies in the Six Mile Creek-Halsted Bay subwatershed.

Beginning in early 2016, the District convened a group of public sector stakeholders in the subwatershed including the City of Victoria, City of Minnetrista, City of St. Bonifacius, City of Waconia, Laketown Township, Carver County, Carver County Soil and Water Conservation District, Hennepin County, and Three Rivers Park District to form the Six Mile Creek-Halsted Bay Subwatershed Partnership. As expressed in the resolution of support adopted by these partner agencies in March of 2017, the purpose of this Partnership is twofold:

- » Develop and adopt a subwatershed plan that identifies key water resource issues and strategies, identifies natural resource corridors, and accommodates local growth and development planning; and
- » Establish a framework for plan implementation, memorializing routine re-engagement of the Partners for the purposes of aligning plans and priorities, forecasting upcoming projects, and establishing investment strategies, including sources of external funding, to be incorporated into capital improvement plans;

Through one on one meetings with individual agencies and meetings with the whole Partnership committee, the Partnership has established a shared baseline knowledge of principal water resource issues, provided the District with an understanding of local conditions and priorities that influence each agency's role in implementation, and guided the District

in determining management strategies and how they can be implemented in synergy with local planning and development initiatives. The Partnership has established a shared vision for the subwatershed that preserves and enhances natural resources; wisely anticipates the growth and development of vibrant communities; promotes the preservation of distinctive areas; recognizes that natural systems can serve to underpin local identity and sense of place; builds strong community connections through transportation infrastructure, trails, parks, and schools; and integrates natural and built systems to enhance the long term social and economic value of communities.

With the adoption of this plan, the Partnership will continue to play a critical role in working with the District towards its implementation. The implementation plan section provides a more detailed overview of the implementation approach for Six Mile and how activities will be prioritized on a rolling basis across the subwatershed as resources allow. The District will routinely convene the Partnership to:

- » Adaptively evaluate capital project opportunities and assess them against the established goals of the Partnership;
- » Align local plans and initiatives with the goals of the District and the Partnership, including local surface water plans, comprehensive plans, and area plans;
- » Coordinate on non-District capital improvements such as transportation projects, new development, utility updates, etc. to pro-actively identify opportunities to layer in water quality and natural resource benefit; and
- » Support the District as it pursues external funding resources to support capital project implementation.

Implementation of the following management strategies within the Six Mile Creek-Halsted Bay Subwatershed will not be linear – the subwatershed is large and interconnected, and many of the drivers of natural resource degradation are highly interdependent, requiring an adaptive management approach and continual evaluation of program effectiveness. While some implementation opportunities can be well forecast, others will emerge in real time as land use changes, funding and land becomes available, and the system adjusts to the first phases of project implementation.



Lundsten and Auburn Lakes, Erdahl Aerial Photos



Rural landscape



Parley Lake, looking west, Erdahl Aerial Photos

Carp Management

Historically, carp management focused on removal of carp populations from impacted water bodies without consideration of population dynamics such as reproduction, immigration, and emigration. More recent carp management techniques focus on integrated pest management where activities focus not only on removal but also on the long-term prevention of carp reproduction and immigration into sensitive water bodies. These new techniques allow for sustainable control of carp populations to measurably improve shallow lake and wetland water quality, plant communities and overall ecological health.

Wetland Restoration

Traditional approaches to wetland restoration focus on restoring wetland channels and hydrology to support a more diverse native plant population. While this strategy addresses ecological integrity within the wetland, it often overlooks the need to alter the cycles of wetland chemistry created by historic wetland alteration that transforms and releases phosphorus to downstream waterbodies.

To address both ecological integrity and the release of phosphorus, wetland restoration must focus on modifying hydrology to support the native plant community while minimizing phosphorus export. This may include, but is not limited to, bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system.

Stormwater Management

Stormwater management will focus on reducing runoff volume and rate, as well as reducing pollutant loading from runoff producing rain events. Stormwater management in the developed or developing urban and suburban areas will focus on retrofitting low impact development techniques such as ponds, filters, infiltration techniques, and other technologies where they are applicable. In the rural and agricultural areas, stormwater management will focus on buffers, improved agricultural practices such as conservation tillage, manure management for animal agriculture and hobby farms, wetland restoration and fertilizer management.

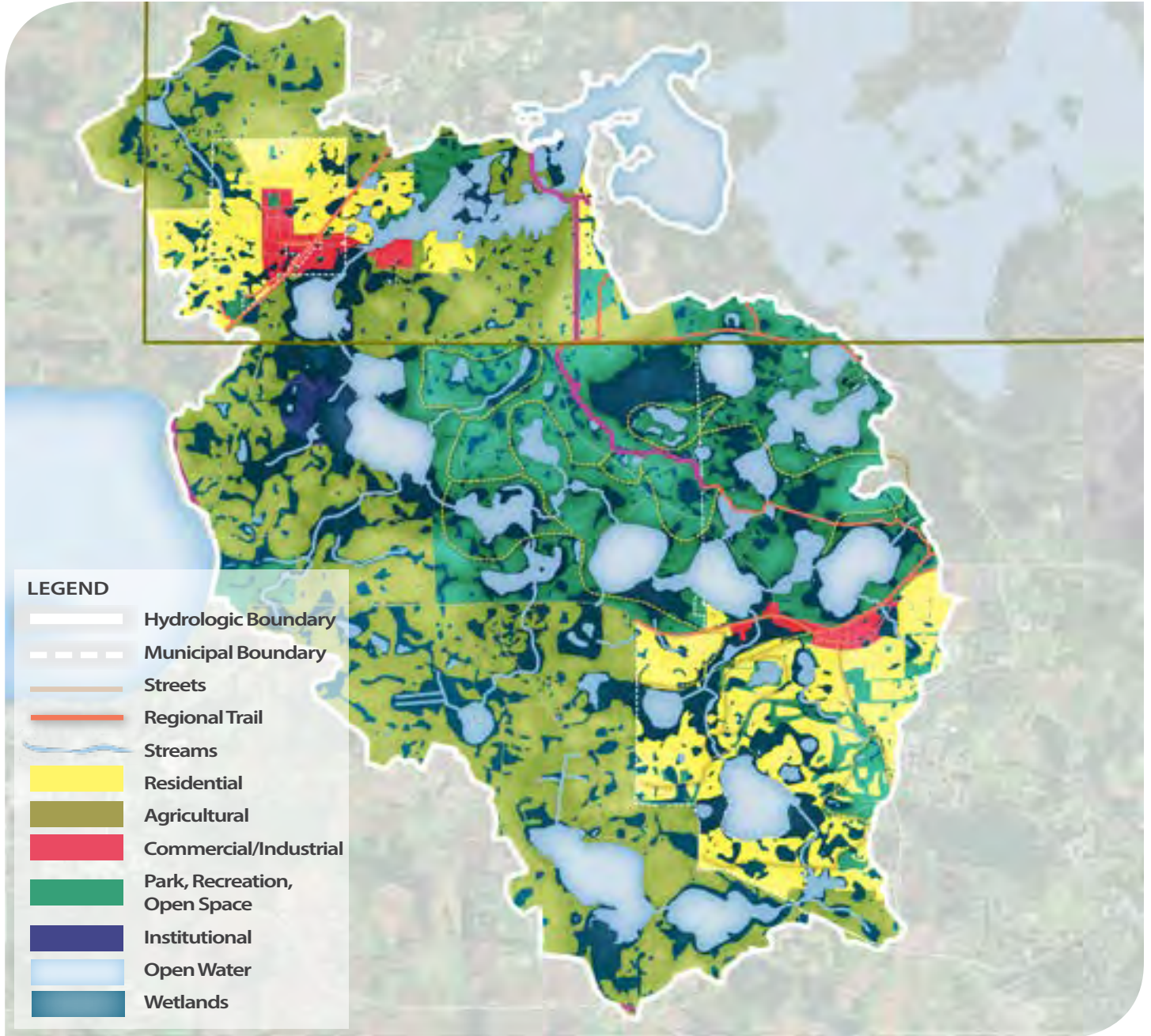


Figure 3.45 Six Mile-Halsted Bay Land Use map



Stream Channel Restoration

Stream restoration focuses on balancing stormwater conveyance to prevent flooding and channel erosion while providing high quality habitat for fish and macroinvertebrates. Restoration includes, where applicable, improving channel sinuosity, stabilizing streambanks, controlling peak flow velocities, increasing channel roughness for habitat and re-aeration, narrowing stream channels to improve wetted width and ecological baseflow, and increasing stream structure.

Internal Sediment Phosphorus Control

Reducing or eliminating phosphorus release from sediments is often essential to meet water quality standards in lakes. There are several techniques available for controlling sediment phosphorus release including sediment phosphorus inactivation using a chemical such as aluminum, oxygenation to prevent sediment anoxia, hypolimnetic aeration and iron addition to prevent phosphorus release, or hypolimnetic withdrawal. While all the techniques can be effective, the application of aluminum to sediments using aluminum sulfate (alum) or a mixture of sodium aluminate and alum is typically the most cost effective approach for reducing sediment phosphorus release.

Whole Lake Drawdown

One of the limiting factors for a healthy, diverse submersed aquatic vegetation community in shallow lakes is loose, unconsolidated sediments that are high in nutrients. During restoration of a nutrient enriched shallow lake, whole lake drawdown is often required if the plant community does not respond to nutrient and rough fish management. The goal of whole lake drawdown is to expose as many of the lakes sediments as possible during late summer to promote sediment consolidation and denitrification. During drawdown, the submersed aquatic vegetation seed bed is reinvigorated, resulting in significant sprouting and growth of submersed aquatic vegetation.

Watershed Protection

Several subwatersheds, especially in the western part of the watershed, are rapidly converting from undeveloped or rural land uses to developments which can increase impervious areas, reduce flood storage, increase pollutant loads, and eliminate or reduce biologically significant land cover. A critical strategy to maintain existing resources and critical functions is to protect

these areas by minimizing the impacts of development. This is accomplished by conserving biologically significant upland areas, protecting high value wetlands, mimicking natural watershed hydrology, maintaining stream geomorphology, protecting stream buffers and riparian areas, and protecting critical fish and wildlife corridors.

The District has a strategic interest in protecting and creating greenway corridors through the Six Mile Creek-Halsted Bay subwatershed. According to the American Planning Association, interconnected systems of parks and open space:

- » Provide a higher level of benefit for people, wildlife, and the economy than do parks in isolation
- » Help preserve essential ecological function and protect biodiversity
- » Can help shape urban form and buffer incompatible uses
- » Can reduce costs for stormwater management, flood control, transportation, and other forms of built infrastructure

The District will pro-actively evaluate opportunities to acquire, through fee or easement, properties suitable for greenway connection in coordination with City and County partners. It will also support similar efforts, through acquisition or regulation, by partners that generate new and preserve existing linkages. The District will cross reference conservation corridors developed by other agencies as properties are considered for protection.

LAND USE

EXISTING CONDITIONS

The Six Mile Creek-Halsted Bay subwatershed contains three cities – St. Bonifacius, Minnetrista, and Victoria, and Laketown Township. These communities span two counties: St. Bonifacius and Minnetrista are in Hennepin County and Victoria and Laketown Township are in Carver County. The City of Waconia is currently outside of the District boundaries, but will be annexing land currently within the Laketown Township portion of the District. Three Rivers Park District's Carver Park Reserve, at 3,700 acres, also constitutes a large portion of the land area of the subwatershed.

The principal land uses with the Six Mile Creek-Halsted Bay subwatershed are parks and open space (25%), agriculture (24%), undeveloped land (22%), water (14%), and low density development (12%).

This subwatershed is one of the least developed within the District. Historically, agriculture has been the predominant land use within the Six Mile Creek-Halsted Bay geography, principally crop (alfalfa and corn) and dairy operations. Agricultural production has driven substantial change to pre-settlement hydrology – ditching and straightening the channel through and between wetland reaches, laying drain tiles to keep agricultural fields clear of water, creating new channels to facilitate drainage, and modifying groundwater recharge while increasing withdrawals.

Beginning in the 1950s, pockets of residential development began to emerge in the landscape, particularly in and around the area that is now St. Bonifacius and in the City of Victoria. Today, the Six Mile Creek-Halsted Bay subwatershed is anticipated to be one of the fastest growing regions of the District. The Metropolitan Council 2015 system statement – which will serve as the basis for the 2040 city comprehensive plans – anticipates that the area will grow by approximately 45% in the coming decades.

The area of highest anticipated residential development is in and around the City of Victoria in what is now Laketown Township. The Cities of Victoria, Chaska, and Waconia have an orderly annexation agreement which over time will lead to the annexation of all of present day Laketown Township. Laketown will dissolve as a governmental unit when it is no longer economically viable.

The northern portion of the subwatershed will have less anticipated development in the near term. St. Bonifacius is approximately one square mile and is nearly entirely built out. The City of Minnetrista anticipates some growth but most of the area within Six Mile Creek-Halsted Bay will remain agricultural under an urban reserve classification.

Parks and Trails are a dominant feature on the Six Mile Creek-Halsted Bay landscape. The 3,700 acre Carver Park Reserve provides significant recreational opportunity while preserving

high quality ecological areas and buffering many of the lakes and wetlands from development impacts. The City of Victoria is connected from the east by the Lake Minnetonka Regional Trail, and the City has a network of local trails and bike friendly roads that spur from the regional trail's termination point. In the Northern portion of the geography, the Dakota Regional Trail, which spans from New Lester to Wayzata, runs through St. Bonifacius and Minnetrista. In addition to these existing regional corridors, Three Rivers Park District has plans for a new regional trail that would connect Carver Park to Baker Park in Maple Plain. The City of Victoria's 2030 Comprehensive Plan anticipates the extension of the Lake Minnetonka regional trail along highway 5 towards Waconia and a regional trail spur running south-east towards Chaska.

LOCAL PLANS AND PRIORITIES

City of Minnetrista

The City of Minnetrista will experience limited development within the near term planning horizon, with the exception of possible commercial development along highway 7 and some residential expansion from Woodland Cove on Halsted Bay and Hunter's Crest in the northwest Mud Lake drainage area. The City also anticipates roadway expansion and improvements, which can be critical coordination opportunities as they have the potential to trigger stormwater regulations and impact wetlands.

From a water resource perspective, the City will continue to support the identification of implementation opportunities and funding sources to address the Halsted Bay TMDL.

City of St. Bonifacius

The City of St. Bonifacius is geographically small and almost entirely built out. There is only one area with potential for new development, and otherwise the City anticipates some single parcel redevelopments, dependent upon private real estate transactions. The City has noted that the single vacant parcel would require wetland mitigation and may present a partnership opportunity with the District. The City notes that new development outside of its jurisdiction will impact traffic and potentially require infrastructure investment. The City also has interest in improving its trail and sidewalk networks.

Principal water resource concerns for the City include degraded



wetlands to the northwest and challenges associated with maintaining stormwater infrastructure.

City of Victoria

The City of Victoria is a fast growing community with substantial new development at the urban fringe as land is annexed into Victoria from Laketown Township. The City has two potential growth corridors: South of Marsh Lake Road towards Chaska, and West of highway 43 and Wassermann Lake, including the area around Carl Krey. The City will coordinate closely with the District to incorporate natural resource improvements with new development, particularly as much of the anticipated growth corridors correspond with Wassermann, Marsh, Pierson and Carl Krey. As the City develops, it will focus on connecting people to natural areas through the development of a trail system and green corridors around the lakes.

The City shares many of the identified natural resource priorities with the District, including addressing the Wassermann impairment and protecting non-impaired water bodies. Additionally, the City would like to move increasingly towards regional stormwater management within new developments, in coordination with the District.

City of Waconia

The City of Waconia does not anticipate growth within the Six

Mile Creek-Halsted Bay geography for another 15-20 years. The City of Waconia is a growing community, though the growth projections have been slowed for the upcoming planning cycle, as they have in many exurban communities. The City of Waconia prioritizes the efficient use of land and extends infrastructures service only to areas where these services can be provided in a cost effective manner. This means maintaining compact and regular growth patterns and preserving exurban farm land and natural areas. Areas outside of the current City will continue to be zoned by Carver County, but the City advises no multi-lot subdivisions should be permitted in advance of City development.

The City does not yet have specific water resource concerns within the Six Mile Creek-Halsted Bay subwatershed, but in general the City is working to identify and execute upgrades to existing older infrastructure in the City core and implement innovative water management strategies in newer developments.

Laketown Township

The Cities of Victoria, Waconia, and Chaska have an orderly annexation agreement that would result in the complete annexation of Laketown Township over time. The Laketown Board has limited authority over land use and relies on County zoning. As the land develops and is annexed, the Township



Six Mile Marsh prairie restoration, Erdahl Aerial Photos

would like to see natural resources protected and improved concurrent with or in advance of new infrastructure installation. The Township is particularly invested in protecting and improving Pierson and its drainage area, through direct capital investment and addressing potential sewerage service failures.

Three Rivers Park District

Three Rivers Park District (TRPD) is Hennepin County's regional parks authority. Carver Park Reserve is one of three parks that lies outside of Hennepin County, its taxing jurisdiction. The Property was acquired through donation. The property contains a nature center, historic farm, and extensive bike, pedestrian and equestrian trails. Many of the subwatershed's high value resources are located within the park, and the park serves an important protection role for these resources. There are no major changes to land use anticipated within the park, but TRPD does have long term plans to extend a regional trail north out of Carver Park to Baker Park in Maple Plain, which may present coordination opportunities over the coming years.

TRPD is a mission-driven organization focused on promoting environmental stewardship through recreation and education within its nature-based park system. As such, it shares many of the District's water resource priorities, including managing carp and preserving high quality natural resources within and adjacent to its parkland.

Lake Associations

There are three active lake associations within the subwatershed: Area Partnership for Pierson Lake Enhancement, Wasserman Lake Association, and Lake Zumbra-Sunny Association. The District has engaged with each of these associations on concerns specific to their respective waterbodies and will continue to engage with them through the Watershed Association Initiative and through implementation of this Subwatershed Plan.

WATER RESOURCE MANAGEMENT UNIT

Due to its size, complex drainage patterns and nutrient interactions, and mosaic of jurisdictions and authorities, the District divided the subwatershed into five management units for planning purposes. These management units reflect both

the jurisdictional boundaries and the distinguishing natural resource interactions. Each management unit discussion below walks through the issues, drivers and strategies framework in more detail and with specific reference to primary water bodies of concern and specific management strategies. Management strategies within this section were further informed by coordination with the Six Mile Creek-Halsted Bay Subwatershed Partnership.

PIERSON-MARSH-WASSERMANN

The Pierson Marsh Wassermann management unit begins in the south-western corner of the subwatershed in Laketown Township and runs through the City of Victoria, terminating near downtown Victoria at Carver Park Reserve. Pierson Lake is the headwaters of the system and has a small drainage area with agriculture and rural residential development. Pierson Lake outlets at its southern edge and runs into Marsh Lake, a shallow, natural-resource lake with no shoreline development. Marsh runs through several large wetland complexes into Wassermann Lake, which is also the edge of Victoria's current City line. Wassermann drains towards East Auburn through several large wetland and pond complexes. A separate drainage runs from Church Lake and Victoria's downtown into East Auburn.

Existing Conditions and Issues

The Pierson-Marsh Wassermann system is the headwaters of the Six Mile Creek-Halsted Bay subwatershed. Pierson Lake has good water quality and is largely a protection area. Marsh exhibits elevated phosphorus at its lake outlet, indicating possible internal release. Wassermann is impaired for nutrients and requires 62% or 470 lbs/year total phosphorus reduction to meet state deep water quality standards.

The smaller lakes along the creek north of Wassermann are generally of good water quality, with the exception of Church Lake, which has fluctuated around state standards for quality and clarity, likely associated with upstream pollutant loading.

The area contains many large wetland complexes. There are a number of complexes immediately adjacent to agricultural land use that are poor quality, likely due to altered hydrology and associated vegetation impacts. The large wetland complex

SIX MILE-HALSTED BAY SUBWATERSHED

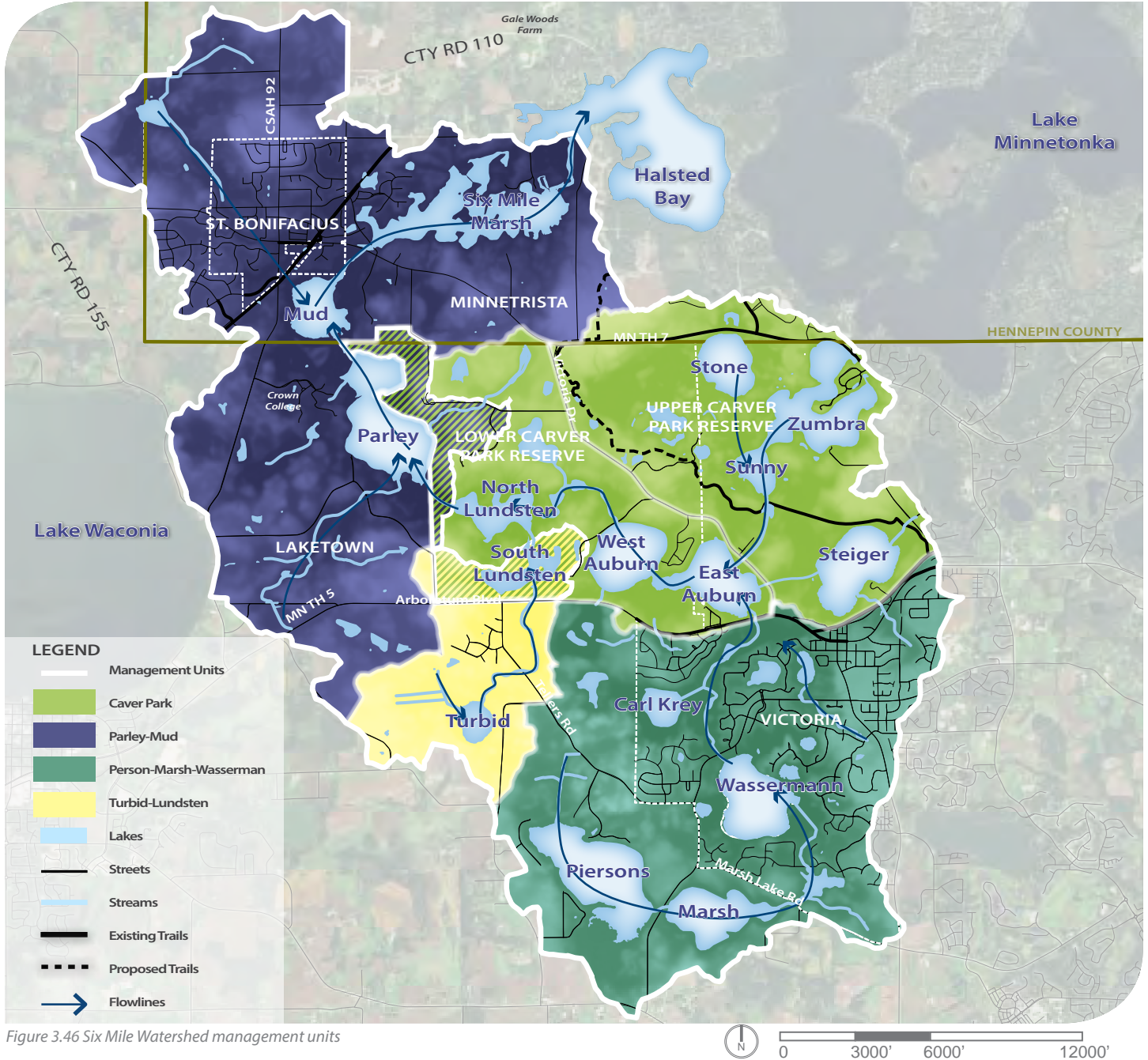


Figure 3.46 Six Mile Watershed management units



running along the creek between Wassermann north of highway 43 to highway 5 is likely a significant source of external phosphorus loading to East Auburn Lake.

Marsh is a shallow lake with 100% littoral area, resulting in abundant plant growth of both native and non-native species. Its shoreline currently is fully intact and is largely wetland fringed.

Wassermann has a degraded aquatic plant community and a poor fish community.

Anecdotal evidence suggests that Pierson Lake's fishery has improved since a 2011 carp removal effort.

Drivers

Pierson has a small subwatershed and much of the phosphorus loading is from stormwater runoff from the surrounding agricultural landscapes. The agricultural drainage has been heavily modified through the introduction of drain tiles and ditches. Carp within the lake are currently below the impact threshold but it remains connected to spawning areas and needs to therefore be monitored while carp reproduction remains active.

The elevated phosphorus levels at the outlet of Marsh Lake indicate that internal loading is the likely driver of moderately elevated phosphorus levels, which could be attributed to carp or internal release. The U of M carp assessment identified Marsh as a potential carp nursery, fueling the adult carp population in Pierson and Wassermann. The properties adjacent to Marsh will likely experience suburban development in the coming decade, including a roadway improvement to Marsh Lake Road which will likely facilitate additional residential development, potentially impacting water quality and the currently intact shoreline integrity.

Wassermann's poor water quality is driven by both internal and external phosphorus loading. The principal external sources are wetland complexes draining to the lake. Internal loading is partially driven by decades of accumulation of phosphorus-laden sediment from the surrounding drainage area, which was almost entirely agriculture and rural residential until the 1990s. The high density of carp in Wassermann further drives

the internal release of phosphorus, in addition to negatively impacting the clarity and plant vegetation.

This management unit will face significant growth pressure in the coming decades as both Waconia to the east and Victoria to the west grow in population and annex land in Laketown Township under an orderly annexation agreement, which they share with Chaska. The primary growth corridors for Victoria's 2040 Comprehensive Plan are east towards Waconia and South towards Chaska. Development in this area will present opportunities to preserve and enhance natural resources systems and enforce District rules designed to minimize the impact of new development, in some cases resulting in improved conditions over current agricultural use.

Development will be a significant factor in natural resource protection and enhancement in the coming decades. District stormwater rules can result in improved water resource outcomes, particularly when transitioning from agriculture. Development will provide opportunities to coordinate on wetland enhancements, create contiguous natural resource corridors, and generate other water quality projects. However, development can also have adverse impacts by altering natural hydrology and creating wetland fill. Some categorical exceptions to the District phosphorus rules may cause increased pollutant loading. This drainage area will experience the most land use change in the near time of any other area of the subwatershed given Victoria's projected growth and annexation.

Management Strategies

Carp Management

Carp management will be a principal strategy within this management unit. Refer to the Six Mile Carp Management Plan for a detailed overview of the carp management approach. Strategies presented in the management plan will include:

- » Aeration of Marsh Lake to prevent winterkill and reduce carp recruitment
- » Temporary barrier at the outlet of Wassermann to prevent fish from reentering Wassermann from downstream lakes during management
- » Adult biomass removal in Wassermann Lake. Piersons

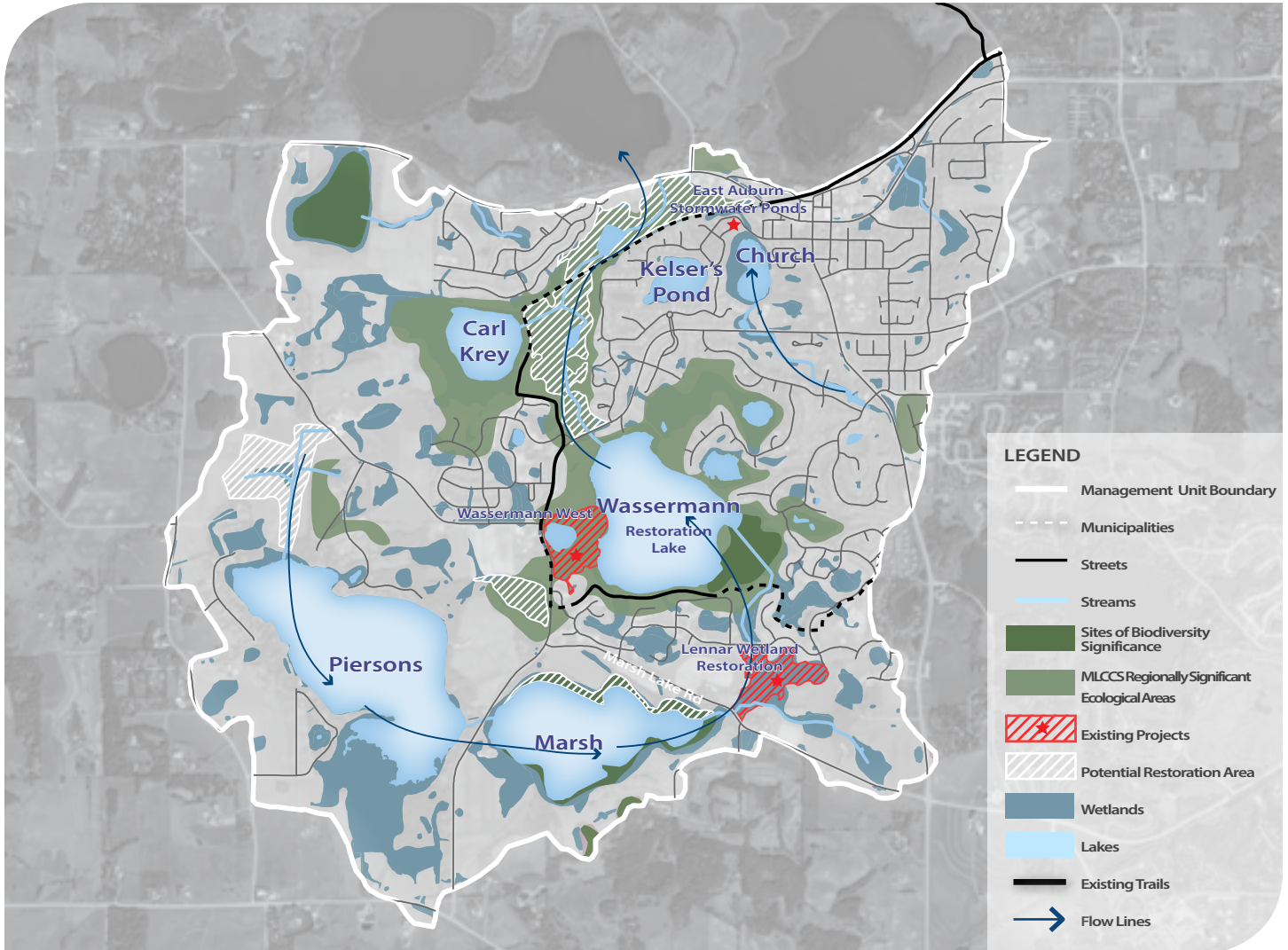


Figure 3.47 Pierson-Marsh-Wasserman Management Unit map



Lake is currently below the threshold, and should be monitored periodically, but no further action is needed at this point.

Stormwater Management

As new developments occur in the City, Victoria will increasingly work to identify regional stormwater solutions. Regional stormwater management can improve water resource outcomes over site by site management by incorporating areas that may otherwise be exempt from regulatory compliance and

by treating the entire drainage area upfront, bringing the area into compliance immediately.

In the developed areas of downtown, there may be opportunities for retrofitting or enhancing existing stormwater facilities to improve treatment capacity of stormwater above existing regulatory requirements.

The District will not employ agricultural best management practices programs as a principal strategy, but it will provide

technical support to agencies and landowners seeking to take advantage of such programs.

Wetland Restoration

There are several large wetland areas that will be targeted for phosphorus load reduction, including those north of Pierson Lake, between Marsh and Wassermann, and along the creek between highway 43 to highway 5. Strategies may include hydrologic alteration, vegetation enhancement, soil amendments, or outlet filtration. Some of the wetland complexes that are identified phosphorus export wetlands are on City-owned outlots, facilitating restoration.

Internal Sediment Phosphorus Control

Internal phosphorus loading is a significant source of nutrient pollution in Wassermann Lake. The 2013 Six Mile Diagnostic recommends alum dosing to provide internal load control. Carp tend to stir up bottom sediments in littoral areas and can reduce the effectiveness of alum, so carp control must precede alum treatment. Marsh Lake may be a target for similar internal control.

Landscape Protection and Restoration

Urban growth is anticipated to continue in this management unit. The District will evaluate opportunities on an ongoing basis for strategic acquisition in fee or conservation easement to ensure that natural resource protection and development goals are compatible. Priority landscape areas in this management unit may include:

- » Shoreline protection on Marsh and Pierson Lakes
- » Preserve wetland complexes in exurban areas
- » Degraded, hydrologically altered wetlands
- » Areas with steep slopes adjacent to water resources
- » Areas otherwise identified through District studies and evaluation (E-Grade, etc)

City of Victoria has interest in connecting people through development of trails, which can be strategically integrated into land use planning and acquisitions.



Mud Lake, looking southwest, Erdahl Aerial Photos



Lundsten Lake



Piersons Lake, Erdahl Aerial Photos



UPPER CARVER PARK RESERVE

Upper Carver Park includes Lakes Zumbra, Stone, Sunny, and Steiger. The management unit is almost entirely within Carver Park and all lakes exhibit good water quality. Both Zumbra and Stone are headwaters lakes with relatively small drainage areas that drain into Sunny Lake, Zumbra directly and Stone through a wetland complex. Sunny then flows towards East Auburn through a large wetland complex. Steiger receives drainage from downtown Victoria, then drains through a separate wetland complex, also into East Auburn. Given that the land is owned almost entirely by Three Rivers Park District as a park preserve, the water quality within this drainage area can be anticipated to remain stable.

Existing Conditions and Issues

All lakes within the subwatershed have good to excellent water quality. Though Stone was identified as exceeding state nutrient standards and has an adopted TMDL, it has improved every year since 2000 and should be considered a protection watershed. Zumbra has excellent water quality and a small watershed that keeps it well buffered from watershed loading. Steiger does have somewhat elevated phosphorus levels, but has not seen any concerning trend over the monitoring time period and continues to be in good health overall.

Phosphorus concentrations jump significantly between both Sunny and East Auburn and Steiger and East Auburn, indicating the wetlands are contributing phosphorus to surface water. These wetlands are important target areas for nutrient pollution reduction.

This drainage area experienced localized flooding associated with the 2014 high water event. Further investigation found that in heavy rain events, Sunny Lake rises faster than Zumbra and creates backwater flooding into Lake Zumbra. The District will continue to investigate possible solutions and mitigation strategies.

The aquatic plant communities in Sunny, Steiger and Stone are in poor condition, and the Fish IBI score for Steiger is classified as poor. Sunny and Stone cannot be assessed by the Fish IBI due to their size and depth. Zumbra generally has a good aquatic plant and fish community.

Though there is some private ownership within Carver Park Reserve and a few drainages to Carver lakes that enter from outside the Park proper, overall the management unit is held almost entirely by Three Rivers Park District and there are therefore no major land use issues facing the management unit. It is possible that the agricultural legacy within the Park has some impact on existing impairments, but without land use change and with Three Rivers sharing natural resource protection as foundational to its mission, land use itself will not be a significant factor in the management unit.

Drivers

For the most part, water quality within this management unit is stable and good, likely in part due to the substantial natural resource buffer the Carver Park Reserve provides.

Steiger Lake's moderate water quality is likely driven in part by stormwater runoff from downtown Victoria. This area of Victoria is fully built out, but as redevelopment occurs under more stringent stormwater rules some reduction may be achievable.

The four lakes also have relatively low carp populations. The 2016 U of M Carp Assessment confirmed that the carp populations within these lakes are largely isolated from one another due to a rather complex series of water control structures. Future changes to or replacements of these structures should consider the impact on carp populations.

Strategies

Wetland Restoration

The wetland complexes running from the outlets of Sunny and Steiger to East Auburn need to be evaluated for wetland restoration to control phosphorus export. A complementary project may be the construction of a lake outflow bypass pipe, which would circumvent the degraded wetland complex for water leaving Sunny and Steiger. However, this idea may have fish passage or wetland hydrology implications that would need to be further evaluated. There are other restorable wetlands within Carver Park Reserve that may be considered for restoration to improve habitat function and value on an opportunity driven basis.

Carp Management

Sunny Lake is a potential carp nursery location and will be

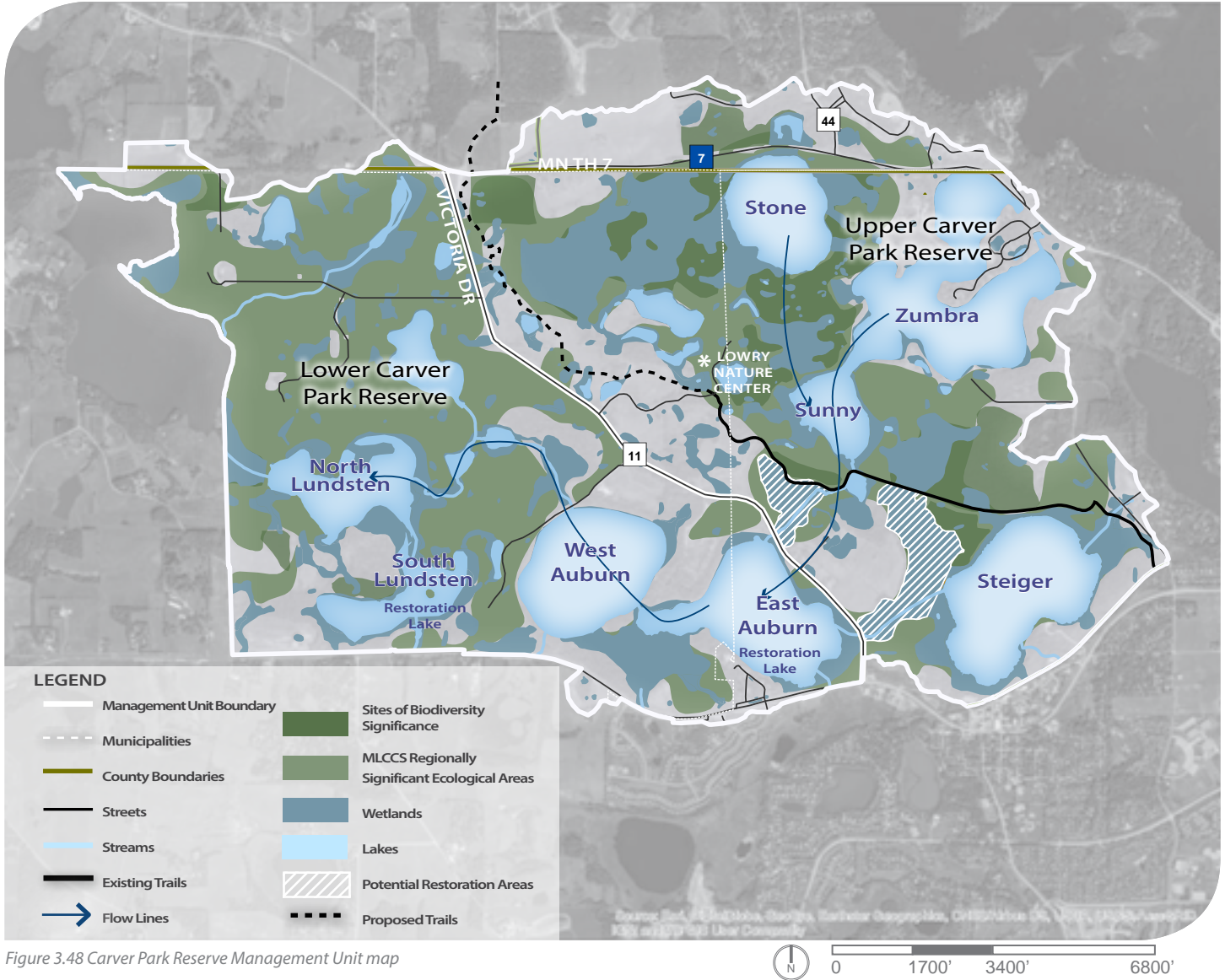


Figure 3.48 Carver Park Reserve Management Unit map

considered for winter aeration, or at least monitored annually for carp recruitment. The current barrier at the Zumbra outlet is also in need of repair, and should be fortified as it currently overtops in high water conditions. Minimal adult biomass removal is needed in Steiger, Zumbra and Sunny to bring population levels to the desired threshold. Stone Lake is already below the threshold, and requires no management actions.

Landscape Protection and Restoration

As TRPD works to acquire land to develop the regional trail connection between Carver and Baker Parks, there may be opportunities where new trail connections correspond with resources or potential project locations within the Six Mile Creek-Halsted Bay geography. The District and TRPD will coordinate acquisitions in the trail corridor to identify potentially mutually beneficial acquisition opportunities



LOWER CARVER PARK RESERVE

The lower Carver Park Reserve management unit includes East Auburn, West Auburn, and North Lundsten Lakes. East Auburn receives drainage from both the Wassermann and Upper Carver Park management units and its water quality is substantially impacted by its being a collection point for the upper watershed. North Lundsten is a very shallow lake with an average depth of 4.4 feet and a very short residence time. It receives drainage from both West Auburn and South Lundsten.

Existing Conditions and Issues

East Auburn is impaired for nutrient pollution and has an adopted TMDL requiring a load reduction of 546 lbs/year. Both West Auburn and North Lundsten demonstrate relatively good water quality, though North Lundsten has demonstrated some eutrophic indicators and elevated phosphorus levels.

Wetlands within this drainage area are generally high quality and classified as Preserve. They are well buffered from degradation given their location within Carver Park. Auburn Marsh, a wetland draining to West Auburn, is identified by the DNR biological survey as a site of biodiversity significance. Much of the drainage area has also been identified as MLCCS regionally significant ecological areas and DNR regionally significant ecological areas.

These lakes all consist of poor aquatic plant communities, and Fish IBI scores for East and West Auburn indicate a poor fish community. North Lundsten cannot be assessed with the Fish IBI tool due to its size and depth.

The drainage area is located entirely within Carver Park Reserve and there will therefore be no development or significant land use change.

Drivers

East Auburn's impairment is driven largely by the phosphorus exporting wetlands in both the Wassermann and Upper Carver Park drainage areas. Upstream lakes are also a significant factor in East Auburn's impairment, with Church and Wassermann Lakes contributing approximately 36% of the load to East Auburn. These lakes will need to meet state water quality standards for East Auburn to meet standards.

Observations of elevated phosphorus levels in North Lundsten are driven primarily by phosphorus export from South Lundsten, which is a highly eutrophic waterbody. There do appear to be different levels at the inlet and outlet of North Lundsten, which indicates some amount of internal loading driving North Lundsten's elevated phosphorus levels.



Six Mile Marsh, looking east, Erdahl Aerial Photos

Though carp do not seem to be a principal driver of water quality issues within the Lower Carver Park drainage area, carp biomass is moderately high in both West and East Auburn and North Lundsten. North Lundsten is also a potential carp recruitment area, and warrants winter aeration to prevent winterkill.

Strategies

Carp Management

Adult biomass removal will be necessary to reduce the carp density below the damaging threshold in all three lakes in this system. South Lundsten is the principal nursery for this area, along with some contribution from North Lundsten, so aeration of those lakes will need to precede removal activities. Multiple removal methods could be utilized to reduce adult carp populations in these lakes, including winter or open water seining, box-net trapping and trapping of carp in channels used for migration.

Wetland Restoration

Wetlands driving poor water quality within East Auburn are those beginning at the outlets of Wassermann, Sunny, and Steiger and draining to East Auburn. These wetland complexes will be evaluated for bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells.

Internal Load Management

The contribution of internal loading to North Lundsten's elevated phosphorus levels should be further evaluated and alum may be employed to address downstream loading concerns. Eventually, whole lake drawdown may be used to reset the shallow lake ecology following successful carp management.

Upstream Lake Improvements

Restoration of upstream lakes in the Pierson-Marsh-Wassermann corridor will be critical in addressing East Auburn's impairment, with upstream lakes contributing approximately 32% of the phosphorus load into East Auburn.

It seems that the elevated phosphorus levels in North Lundsten are driven almost entirely by the highly degraded South Lundsten, which in turn drives the impairment of Parley Lake.

Though South Lundsten is classified as a wetland and therefore not subject to lake water quality standards, its degraded state drives other impairments and therefore nutrient reductions need to be prioritized.

TURBID-SOUTH LUNDSTEN

The Turbid-South Lundsten management unit lies just west of Victoria in Laketown Township. Though Turbid and Pierson Lake are approximately one mile away from each other, they are hydrologically disconnected, with their tributaries flowing in opposite directions. This management unit is relatively small and contains only two waterbodies connected by a low gradient stream flowing through several degraded wetland complexes. A majority of the land in this management unit is in Laketown Township, though South Lundsten is entirely within Carver Park Reserve. Outside of Carver Park Reserve, the land is almost entirely agricultural with one single family subdivision, Rolling Meadows. The subwatershed is in the long-term growth trajectory of Victoria, though likely outside of the next 20 year plan cycle.

Existing Conditions and Issues

Turbid Lake is at the headwaters of the management unit. It has a large littoral area, despite being a deep lake. Turbid is impaired for nutrients and requires both internal and external load reduction. South Lundsten is a larger, shallow lake, with extremely high phosphorus concentrations. Because it is classified for TMDL purposes as a wetland there are no mandated reductions for this waterbody.

Wetlands within this drainage area are largely degraded and water quality monitoring along the creek indicates they are significant contributors to elevated phosphorus in both water bodies. Much of the land around South Lundsten and within Carver Park Reserve has been identified by DNR as having biodiversity significance or as a regionally significant ecological corridor.

The aquatic plant community in South Lundsten is considered poor, while the community in Turbid is considered degraded. Neither lake is large enough or deep enough to be assessed with the Fish IBI tool.

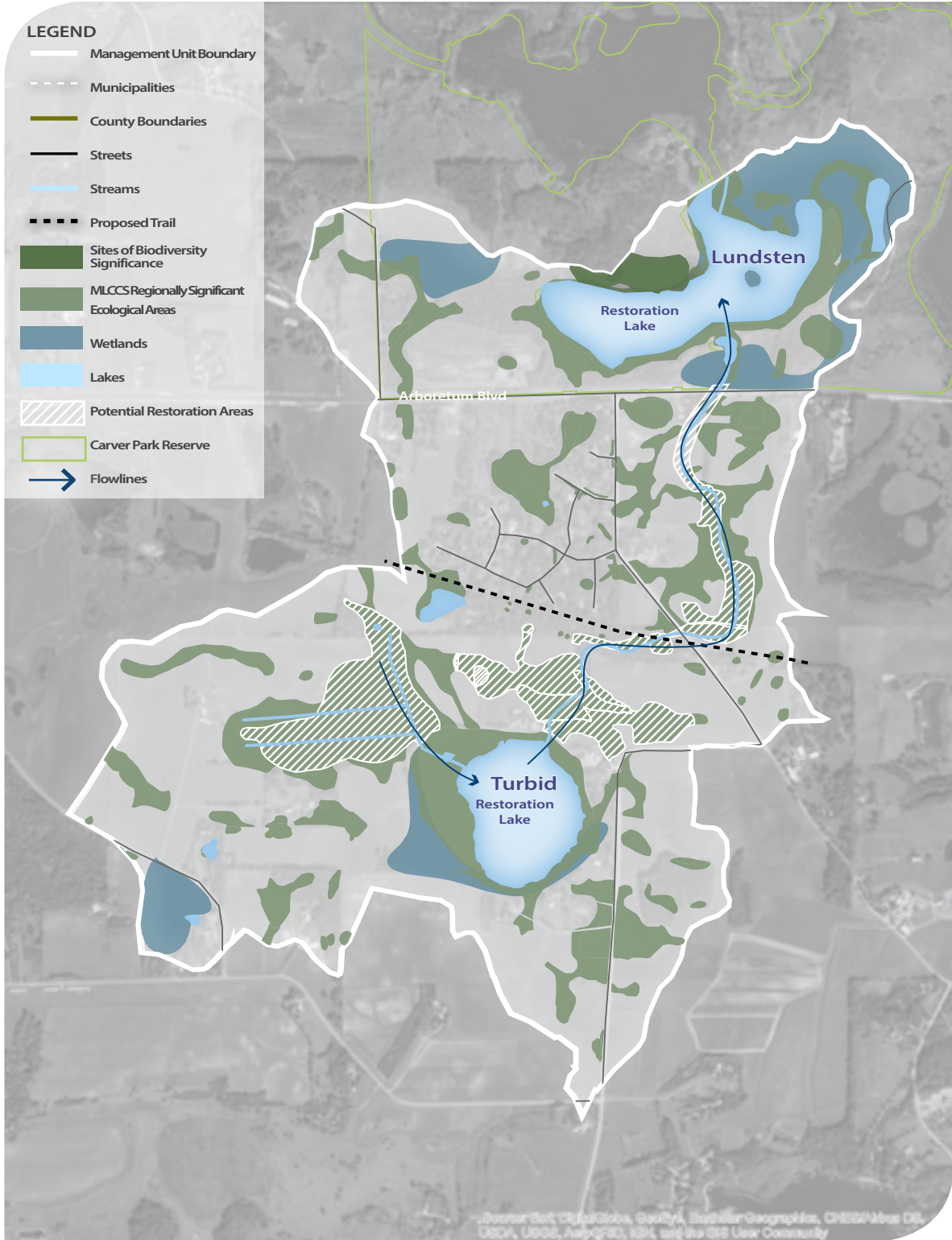


Figure 3.49 Turbid-South Lundsten Management Unit map

Land use within this management unit is agricultural and residential. The management unit is near what eventually will be the western edge of the City of Victoria, but is not anticipated to develop within the near-term. As such, implementation activities will likely precede development.

Drivers

Turbid's and South Lundsten's poor water quality are driven by similar factors. Nutrient loading to Turbid Lake is dominated by internal loading, representing 65% of the phosphorus load to the lake. Watershed loading represents the other major contribution to nutrient pollution, principally from the large wetland complex to the west of the Lake.

South Lundsten experiences an extremely high internal phosphorus release rate. Watershed loading is also quite high, though it is proportionately only 17% of the total load. Much of the watershed loading can be attributed to the degraded wetland complexes between the two waterbodies.

Carp biomass is high in Turbid and moderate in South Lundsten. Both lakes are also production areas, with South Lundsten being an active and highly productive carp nursery for the upper watershed system.

Strategies

Carp Management

The Turbid-Lundsten Corridor is high priority for near-term carp management activities. Both lakes require aeration to prevent ongoing carp recruitment. South Lundsten in particular has been identified as a principal recruitment area, with carp dispersing as far as Wassermann from this lake. Once these systems are aerated, adult removal may also be prudent.

Wetland Restoration

Two feasibility studies completed in 2010 identify a multi-phased wetland and stream restoration project to substantially reduce watershed loading to both Turbid and South Lundsten Lakes. The project includes wetland restoration and hydrologic modification in the drainage area to Turbid Lake and in the wetland and stream corridor between Turbid and South Lundsten. The project may have secondary benefits of restricting carp movements between the two waterbodies. The project may be implemented concurrent with or in advance of development reaching this area of the subwatershed.

Landscape Restoration and Preservation

The proposed wetland restoration within this subwatershed will result in changes in hydrology that will increase wetland acreage, in some cases on land that is currently within agricultural production. The District may employ its land conservation program to maximize the opportunity for this project to address downstream loading concerns. These wetland areas would eventually be deeded to the City of Victoria when this area develops, so the District would work in close coordination not only with the landowners, but also with the City, which eventually will have jurisdiction in this area.

PARLEY-MUD-HALSTED

The Parley-Mud-Halsted management unit constitutes the whole lower watershed drainage area. With a dam between North Lundsten and Parley Lakes, this management unit is hydrologically disconnected from the upper subwatershed. In this drainage, water flows from Parley into Mud, then travels approximately 3 miles through Six Mile Marsh into Halsted Bay. The drainage area is mostly within Hennepin County in Minnetrista and St. Bonifacius, but some of the Parley lakeshed is currently in Laketown Township in an area that eventually will be annexed by the City of Waconia as it grows east.

Existing Conditions and Issues

Both Parley and Mud Lakes are highly eutrophic shallow lakes with high total phosphorus concentrations. Parley Lake has an approved TMDL requiring a reduction of 1,270 lbs/ year, or a 44% reduction. Mud Lake has very high phosphorus, but is considered a wetland for TMDL development purposes. Both lakes have degraded and low diversity vegetative communities.

Halsted Bay has an approved TMDL requiring the largest phosphorus load reduction in the District. It routinely falls well above state standards for nutrient concentrations, Chlorophyll-a, and clarity. The plant community of Halsted Bay is highly degraded and dominated by Eurasian water milfoil, coontail, and Curly-leaf pondweed.

This management unit contains numerous large wetland complexes, including Six Mile Marsh, which spans the three miles from Mud Lake to Halsted Bay. There are numerous other large, degraded wetlands that likely are a significant source of phosphorus pollution into the lakes.

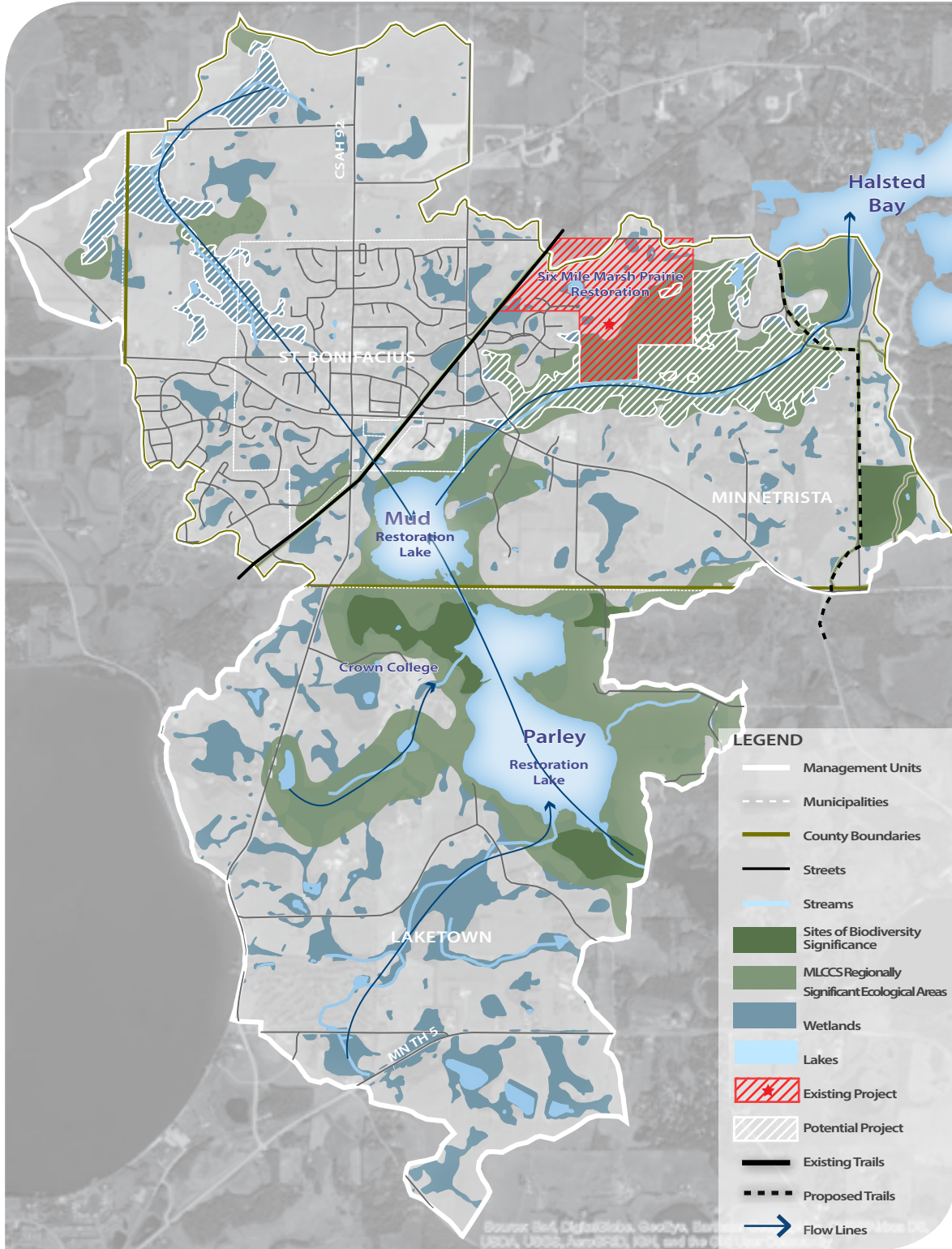


Figure 3.50 Parley-Mud-Halsted Management Unit map



Land use within this management unit is mostly rural residential and agricultural. The City of St. Bonifacius, a one square mile community just north of Mud Lake, is almost entirely built out with some redevelopment anticipated and a few remaining vacant parcels. The population center at St. Bonifacius also supports several residential developments just across the City line in Minnetrista. Little land use change is anticipated in the near term in the Minnetrista area except on some specific parcels adjacent to St. Bonifacius and along Six Mile Marsh.

Drivers

2006 monitoring observed very high levels of primarily orthophosphorus coming from the drainage directly east. Modeling of Parley Lake indicates that it is driven by internal loading (17%), loading from the direct drainage area (38%), and loading from upstream North Lundsten Lake (41%). Several wetlands in the direct drainage area have been identified as potential sources of phosphorus loading, but require additional analysis. In total, Parley requires a 44% reduction, with the greatest reduction needed being in internal loading (61%).

Mud Lake experiences elevated phosphorus levels driven by both watershed loading and inputs from upstream Parley Lake. Internal loading is proportionately small but not insubstantial.

Halsted Bay is driven principally by loading from Six Mile Creek (50%), followed by internal loading (40%). A 2017 technical evaluation provided a more in-depth analysis of the loading from Six Mile Creek to determine the respective contributions from Mud Lake itself as compared with Six Mile Marsh. The results indicate that Six Mile Marsh contributes about 4-8% of the load, which is significant for a single phosphorus source. More significantly, the analysis found the wetland to be a significant transformer of phosphorus, settling out particulate phosphorus and releasing dissolved, which is more difficult to treat.

Carp are a significant factor in this system. Carp populations are very high in all three lakes, particularly in Halsted Bay itself, where the U of M researchers found carp concentrations higher than observed anywhere else in the Center's history. Carp move freely between the three lakes. The carp assessment identified three likely recruitment areas within the management unit: Mud Lake, Big SOB, and a pond on Crown College campus. The

landowner of Big SOB has already begun aeration. Some carp are able to migrate from South Lundsten into Parley Lake, but traveling back upstream is restricted by the dam.

Strategies

Carp Management

Managing carp in this 3-lake system will require a multi-pronged and adaptive approach. The 2017 U of M Carp Assessment recommends the following approach:

- » Installation of a permanent barrier along Six Mile Marsh to create two distinct carp management units, Parley-Mud and Halsted Bay
- » Control recruitment through aeration or barriers to block access to Mud Lake, and either aeration or hydrologic separation of Crown College pond. Continue to aerate SOB Lake.
- » Adult biomass removal following successful suppression of recruitment.

Internal Load Control

Following successful reduction of the adult carp population, alum may be used to address ongoing internal phosphorus release in Mud and Parley.

Alum will also be a strategy for reduction of internal phosphorus release in Halsted Bay. While typically the recommendation would be to control carp populations first, it may be feasible in Halsted Bay to apply alum in the deep areas of the lake while carp populations are still high in the littoral zone.

Whole Lake Drawdown

Following or concurrent with reductions in the adult carp population in both Mud and Parley Lakes, whole lake drawdown may be considered to restore plant vegetation and return the lakes to a clear water state.

Wetland Restoration

Restoration of large, degraded wetlands draining to both Mud and Parley Lakes will be principal strategies for reducing watershed loading. There are several, smaller wetlands identified in the Mud Lake Drainage Assessment that will also be targeted concurrent with local development and investment.



Stormwater Management

The 2017 Mud Lake Assessment identified existing stormwater facilities in the City of St. Bonifacius that could be retrofitted with enhanced filtration facilities to increase its effectiveness at removing phosphorus pollution. Retrofitting existing facilities will be coordinated with local priorities and infrastructure investments. The Mud Lake Assessment also provides a detailed analysis of the most cost effective retrofit opportunities.

Application of agricultural best management practices will also be an important strategy within the Mud and Parley Lake drainage areas. The District will support agency partners and landowners in identifying resources to implement agricultural best practices but will not play a direct role in implementation of agricultural practices.

Alum Injection Facility

While the goal ultimately is to fully restore upstream Mud and Parley Lakes, the process for doing so will take years of implementation and require leveraging significant external funding. In 2012, the District evaluated the feasibility of a structural solution to phosphorus loading in Halsted Bay and identified the option to build an offline alum injection facility that would treat water moving through the creek before

entering Halsted Bay, substantially reducing the large load coming through Six Mile Marsh. The lifecycle of such a solution would be approximately 30 years, providing an interim solution while the upstream system is restored.

Landscape Protection and Restoration

Minimal urban and suburban growth is anticipated in this management unit which limits the implementation opportunities to leverage local development growth for greater natural resource benefit. The District will continue to leverage this approach where applicable in coordination with the Cities of St. Bonifacius, Minnetrista, and Waconia, but in the near term land acquisition will be a strategy principally applied to achieve watershed load reductions and wetland restorations as outlined above.

IMPLEMENTATION PLAN

The goals set forth in this subwatershed plan will require an integrated set of programs and projects oriented toward conserving and improving water resources within the watershed. The Implementation Priorities section generally describes the actions that the District and its partners will look to take in order to address the issues present in the



Six Mile Marsh, looking west, Erdahl Aerial Photos

subwatershed and achieve the goals as set forth in the plan. The Capital Improvement Plan (CIP) provides cost estimates and schedules for any proposed capital investments.

IMPLEMENTATION PRIORITIES

As described in previous sections, the Six Mile Creek-Halsted Bay Subwatershed is a large subwatershed, spanning 27 square miles, with an extensive lake, wetland, and stream system. It is one of the headwaters of Lake Minnetonka, the most heavily used recreation lake in the State, with Six Mile Creek terminating in Halsted Bay of Lake Minnetonka, a highly impaired Bay requiring the largest phosphorus load reduction in the District.

The system upstream of Halsted Bay is a complex network of shallow and moderately deep lakes – many of which have a large littoral area – and hydrologically altered wetlands. Five of the upstream lakes are impaired for phosphorus. Each lake impairment is driven by a complex interplay of internal load, degraded wetlands, and upstream waterbody contribution, largely driven by historic agricultural land use in the area.

Given the need to address the impairment of both Halsted Bay and the upstream lake system, the abundant and interconnected natural resources, the range of jurisdictions covered by this large geography, the pace of residential growth in the area, and the existing relationships and partnerships with public and private agencies operating in this area, the District has identified the Six Mile Creek-Halsted Bay subwatershed as a priority area to focus implementation efforts in this plan cycle. The District has convened a group of agency partners in the region to identify priorities for the development of this plan as well as moving forward with implementation of the plan.

The capital improvement plan (CIP) for the subwatershed identifies projects that have undergone some level of feasibility and are anticipated for project initiation within the next five years. These include projects identified in the last plan cycle that feasibility work now proposes to be a good investment, as well as several projects (East Auburn Stormwater Enhancement and Wassermann West) that have been initiated as plan development has been underway.



Rural landscape



The CIP also includes a number of implementation strategies – stormwater management, wetland restoration, internal sediment phosphorus control, whole lake drawdown, and stream channel restoration – that have been identified as critical components of the subwatershed’s protection and restoration but that have not yet undergone preliminary feasibility. Projects opportunities within these implementation strategies will be evaluated on an ongoing basis in coordination with the Six Mile Creek-Halsted Bay subwatershed partnership and based on factors such as available funding, land rights, opportunities to integrate the work with other agency priorities, common sense sequencing of priorities, and cost-benefit analyses.

As previously noted, Common Carp are very abundant within this system and exhibit high mobility between lakes. Carp can render other management activities for shallow lake restoration, including alum and vegetation management, ineffective, and carp management therefore needs to be a principal and near term implementation priority. Carp management is programmatic and not reflected in the CIP, but is nevertheless a critical piece of the lake restoration work to reestablish nutrient budgets and support in-lake habitat.

When carp have been brought below the ecological damage threshold of 100 kg/ha, management of internal or sediment phosphorus release will be employed. In some lakes where high phosphorus and carp activity have caused the lake to shift from a clear to turbid lake state (including Mud and Parley), whole lake drawdown may be further employed to allow for the reestablishment of lake bed vegetation critical to support game and non-game fish species.

The watershed has over 5,000 acres of wetlands, many of which are ecologically degraded and contribute nutrient pollution to downstream waterbodies. Restoration of any given wetland may be based on whether land rights need to be and can be acquired, available funding, and ecological lift and water quality benefit achieved by restoration. The District is currently developing a GIS-based tool in partnership with the US Army Corps of Engineers that will enable the District to rapidly evaluate wetlands for multiple restoration parameters to assist in this prioritization framework.

As land converts from agricultural land use to residential, stormwater regulations will, in many cases, result in improved

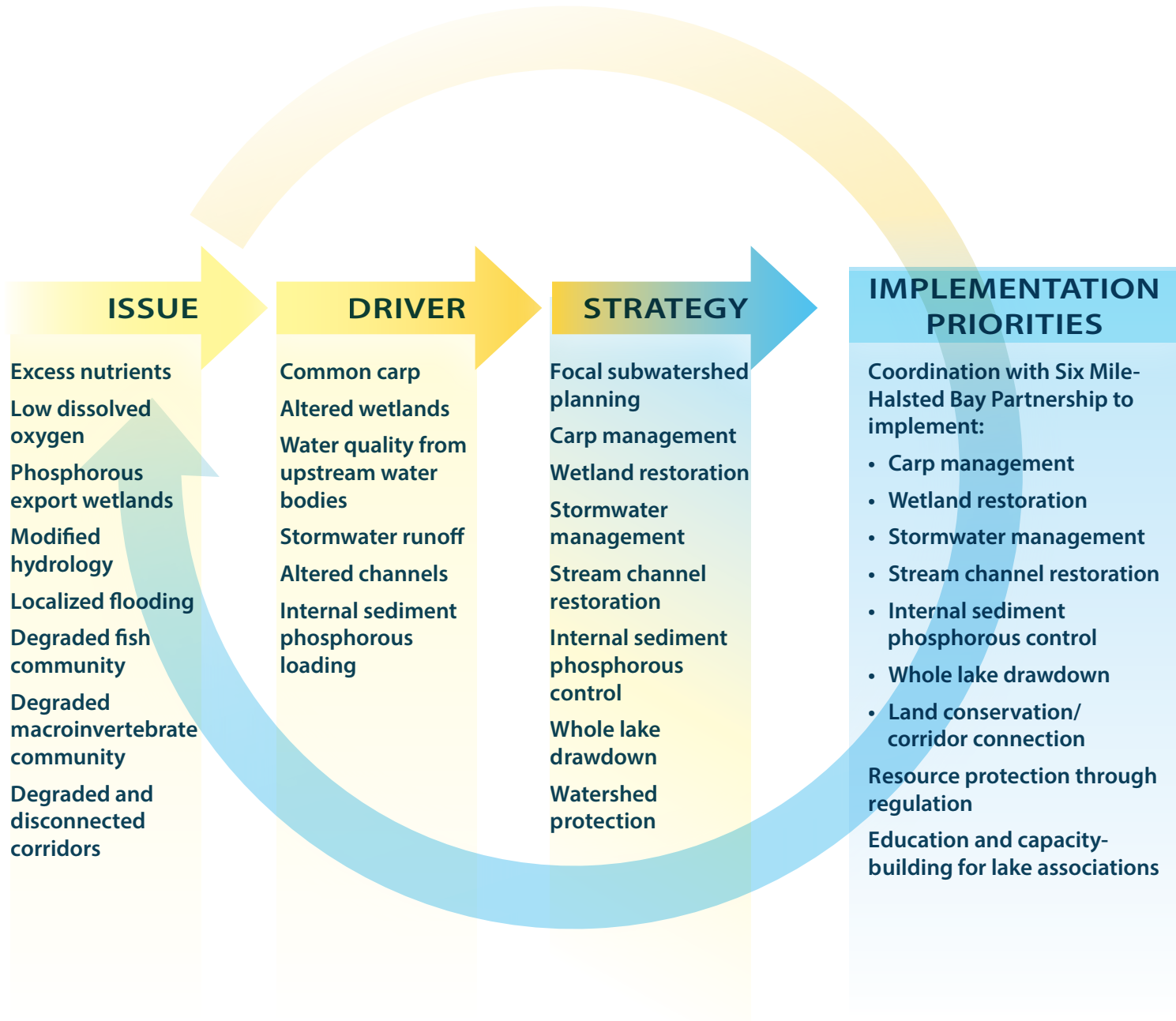
water quality over predevelopment conditions. However, the District will continue to work with its City and County partners through the development process to identify opportunities to surpass regulatory standards, particularly where it may address an existing TMDL or known water quality issues.

Many of the aforementioned strategies will be used to restore this headwater system. While this work will have immediate benefit within the Six Mile Creek subwatershed itself, long term this restoration should also address the 50% of the watershed load to Halsted Bay coming from Six Mile Creek. However, given the long term nature of this restoration and the current condition of Halsted Bay, an interim solution may be considered. The District has completed preliminary feasibility for an alum treatment system that would provide immediate water quality benefit to Halsted Bay. The alum treatment facility should be located at the terminus of Six Mile Marsh, which is responsible for transforming the particulate phosphorus leaving Mud Lake to dissolved phosphorus, which can be more difficult to remove and requires some level of chemical treatment. The implementation of the alum facility will depend on the District’s ability to secure external funding support through grants or state appropriations.

IMPLEMENTATION AND FUNDING STRATEGY

The Six Mile Creek-Halsted Bay Subwatershed was identified as a priority implementation focus for the 2018-2027 Plan cycle due, in part, to the complexity and scale of fully implementing the restoration and protection strategy outlined in this plan in order to preserve the headwaters of Lake Minnetonka. The District realized early on in shifting its focus into this geography that it would require not only support from its local public and private partners, but also a diversified funding strategy that would effectively leverage financial assistance from a variety of sources.

The District’s intent as it becomes more effective at implementing high impact natural resources projects is to diversify its funding sources. The District has historically relied on its ad valorem tax levy to support its capital improvement program, but increasingly will look to use its tax levy as one component of multi-sourced project funding. This will include leveraging grants, county financing, and partner funding for



project elements that meet their mission and goals.

Ultimately, the scope and scale of implementation within the Six Mile Creek-Halsted Bay geography will be contingent upon successfully leveraging external grant and funding resources. There are two broad categories of external grants that will be pursued by the District and its partners:

- » State and regional grants applicable for individual, site specific projects or eligible project elements
- » State and federal funding available to larger scale, programmatic implementation efforts that aggregate management strategies across the geography

As an example of the latter category, a grouping of Six Mile Creek-Halsted Bay stream and wetland restoration initiatives may be directly eligible for USACE Section 206 Habitat Restoration funds, whereas a single wetland project would not. In this instance, projects would need to be aggregated and evaluated in a way that meets the specific federal Section 206 evaluation criteria. Other identified programmatic funding opportunities include Lessard Sams Outdoor Heritage Council and the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

The District will work with the Six Mile Creek-Halsted Bay Subwatershed Partnership as it pursues external funding sources. In some cases, members of the Partnership will be stronger applicants for a given source, in which case the District will support their application. Relationships with third-

party partnership such as US Fish and Wildlife Service and the Minnesota Waterfowls Association will enhance the District's reach into pools where watershed districts have not historically been as competitive.

CAPITAL IMPROVEMENT PROGRAM

The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District's scope and priorities for its capital work over the planning period. A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other policy considerations before a formal decision to proceed to construction is made. Section 3.5.5 describes the development and evaluation steps that will occur before the District will commit resources to a project.

Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures.

Table 3.15 Six Mile-Halsted Bay Subwatershed CIP

Project	East Auburn Stormwater Enhancement Project
Description	Design and construction of stormwater enhancements to two existing ponds in the City of Victoria. Enhancements are intended to include the installation of an iron-enhanced sand filtration bench and a filtration bench.
Need	East Auburn exceeds state nutrient standards. A TMDL identified a need to reduce nutrient loading in East Auburn by 626 lbs/yr, with 200 lbs/year needing to come from upstream waterbodies.
Outcome	Reduction of nutrient export from downtown Victoria and upstream Church Lake to East Auburn Lake; native vegetative enhancements in the buffer and upland areas. The project is estimated to achieve a phosphorus reduction of 39 lbs/year. This estimate will be refined through project feasibility and design.
Estimated Cost	Capital Costs: \$170,000 in 2017 dollars.
Potential Funding Sources	BWSR Clean Water Legacy grant, City of Victoria
Schedule	2017-2018

Project	Wassermann West External Load Reduction and Landscape Restoration
Description	Design and implementation of strategies to reduce landscape phosphorus loading through the use of aluminum sulfate (alum), vegetative restoration, and/or hydrologic alternation; preservation and restoration of vegetative community in wetland and upland areas through land acquisition, development of restoration plan; programmed public access to Lake Wassermann for public use and enjoyment.
Need	Lake Wassermann exceeds state nutrient standards. An adopted TMDL requires a 470 lbs/yr reduction in phosphorus loading. This site is estimated to be responsible for 7% of the total phosphorus load at approximately 75 lbs. The site features a diversity of vegetative and wetland communities and has been recognized as a restoration priority by several agencies, including the MLCCS, MnDNR, City of Victoria, and MCWD.
Outcome	Reduction of nutrient export to Lake Wassermann; enhanced recreation access to Lake Wassermann; preservation and enhancement of shoreline, upland, and wetland buffers; vegetative wetland restoration. The project is estimated to achieve a phosphorus reduction of 64 lbs/year. This estimate will be refined through project feasibility and design.
Estimated Cost	Capital costs:\$2,250,000, excluding land, in 2017 dollars
Potential Funding Sources	District levy, City of Victoria, and/or regional, state, and federal grants
Schedule	2018-2019



Project	Pierson Lake Headwaters Restoration
Description	Removal of drain tile system; design and construction of outlet control structures; wetland establishment/restoration including site preparation, invasive species control, seeding, and maintenance; feasibility, design, and construction of stormwater management practices; stream restoration
Need	Pierson Lake is good quality, but 85% of its nutrient pollution is attributed to the drainage area north of the Lake. The area around Pierson Lake is anticipated to develop over the coming years as the City of Victoria expands into Laketown Township. This project will address the largest single source of phosphorus to a high value waterbody while protecting degraded wetlands from future development impacts.
Outcome	Reduced phosphorus loading to Pierson Lake; increased clarity in the north bay of Pierson Lake; enhanced wetland vegetative diversity creating waterfowl and non-game bird habitat; enhanced corridor connection. Phosphorus load reduction estimates will be developed during project feasibility and design.
Estimated Cost	Capital costs: \$320,000, excluding land, in 2017 dollars
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2019-2021

Project	Turbid-Lundsten Wetland Restoration
Description	Restoration of wetlands around Turbid and Lundsten Lakes through hydrologic modification, changes to storage capacity, and vegetation restoration; design and construction of soluble phosphorus filtration system; hydrologic modification to eliminate open water ditch downstream of Turbid; pond retrofit at South Lundsten inlet. Phase I will restore wetland upstream of Turbid Lake and Phase II will restore wetland and construct pond filtration downstream of Turbid Lake.
Need	Turbid Lake exceeds state nutrient standards. An adopted TMDL requires a 138 lbs/yr reduction in nutrient loading, or 55%. Though the TMDL identified internal loading as the principal driver of the impairment, a 2010 feasibility study found that reductions of 34 lb of phosphorus could be achieved through restoration upstream of Turbid Lake and 27 lb could be removed through downstream restoration to the benefit of South Lundsten. Water quality in South Lundsten is very poor and drives downstream water quality issues, including in Parley Lake which is impaired for water quality and clarity. South Lundsten is considered a wetland and therefore is not subject to lake standards but reducing its nutrient concentration is critical to downstream waterbodies that are impaired, including Parley Lake which exceeds state nutrient standards.
Outcome	Reduction of nutrient export to Turbid, South Lundsten, North Lundsten and Parley Lakes; Increase wetland biodiversity and habitat diversity, improve flood storage potential, and reduce phosphorus export; limit carp movement. These projects are estimated to achieve a phosphorus reduction of 93 lbs/year (Phase I 43 lbs, Phase II 50 lbs). These estimates will be refined through project feasibility and design.
Estimated Cost	Capital costs, phase I: \$2,870,000, excluding land, in 2017 dollars. Capital costs, phase II: \$230,000, excluding land, in 2017 dollars.

Potential Funding Sources	District levy, partner contributions, grants
Schedule	2019-2021

Project	Mud Lake Watershed Load Reductions
Description	Addressing watershed nutrient load to Mud Lake through wetland restorations, regional stormwater treatment, and enhancement of existing stormwater facilities. Phosphorus sources to Mud Lake are diffuse and implementation will take place in a phased approach, targeting the most cost-effective and highest impact projects first.
Need	The 2013 Six Mile Diagnostic identified Mud Lake as having very poor water quality, driven by a combination of internal loading, upstream lake water quality, and watershed loading. Reductions between 78% and 95% (1,864 lbs/yr – 2,258 lbs/yr) from the direct watershed are needed to shift the ecological condition of Mud Lake and address downstream impacts to Halsted Bay. Though Mud Lake is classified as a wetland and therefore not required to meet lake standards for nutrient concentrations, Halsted Bay requires the largest phosphorus load reduction in the District and about half of its load comes from upstream Mud Lake. The implementation approach was developed through a BWSR Clean Water Legacy grant which sought to identify nutrient sources and the most cost-effective means to address nutrient concentrations in Mud Lake.
Outcome	Reduced nutrient loading to Mud Lake and Halsted Bay; hydraulic and vegetative wetland restoration. Phosphorus load reduction estimates will be developed during project feasibility and design.
Estimated Cost	Capital costs, phase I: \$1,120,000 excluding land, in 2017 dollars. Capital costs, phase II: \$480,000 excluding land, in 2017 dollars. Capital costs, phase III: \$1,490,000 excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2019 - 2025

Project	Wassermann Lake Internal Load Management
Description	Application of alum to sediments to inactivate sediment release
Need	Lake Wassermann exceeds state nutrient standards. An adopted TMDL requires a 470 lbs/yr reduction in phosphorus loading, with 88% coming from internal sediment release. The 2013 Six Mile Diagnostic modeled an annual internal release rate of 374/lbs year. Alum can only be applied once the carp population has been significantly reduced and the recruitment is being managed through aeration or physical barriers.
Outcome	Reduction in phosphorus load from internal sources; improved water clarity; more abundant aquatic vegetation community. Phosphorus load reduction estimates will be developed during project feasibility and design.
Estimated Cost	Capital costs: \$310,000 in 2017 dollars.



Potential Funding Sources	District levy, partner contributions, grants
Schedule	2020-2022

Project	East Auburn Wetland Restoration
Description	Restoration of up to five degraded wetland complexes draining to East Auburn from Steiger, Sunny, and Wassermann Lakes targeting nutrient reduction.
Need	East Auburn Lake exceeds state nutrient standards. An adopted TMDL requires a total reduction of 626 lb, 410 lb of which are from watershed sources. The 2013 Six Mile Diagnostic attributes 57% of the total watershed load to the drainage area, and further analysis indicates that a vast majority of the source of the drainage area loading is from these large, degraded wetland complexes. Further analysis will be required to determine the relative impact of each of the five complexes to determine the restoration priority and scope.
Outcome	Reduced nutrient loading to East Auburn; Hydrologic and vegetative wetland restoration; enhanced habitat; enhanced aesthetic value tying into a high value recreation area (Carver Park). Phosphorus load reduction estimates will be developed during project feasibility and design.
Estimated Cost	Capital costs: \$990,000, excluding land, in 2017 dollars
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2020-2021

Project	Halsted Bay Watershed Load Management
Description	Off-line alum treatment facility situated adjacent to Six Mile Marsh to treat upstream phosphorus load into Halsted Bay of Lake Minnetonka
Need	Halsted Bay of Lake Minnetonka greatly exceeds state nutrient standards. An adopted TMDL requires a 2,087 lb reduction from external sources (73%) to meet clean water standards. 50% of the total phosphorus load comes from upstream Mud Lake, driven by both watershed load and internal sediment release. Six Mile Marsh acts to transform phosphorus from particulate to dissolved, which requires chemical treatment to remove it from the water column. A 2013 feasibility study found that operating an off-line alum treatment facility would provide the most cost-effective means to reduce phosphorus loading into the Bay in the short term. Long term restoration of the upstream Parley-Mud system would allow the alum treatment facility to be brought off line at the end of its design horizon of 30 years.
Outcome	Reduced nutrient loading to Halsted Bay of Lake Minnetonka. The project is estimated to achieve a phosphorus reduction of 1,600 lbs/year. This estimate will be refined through project feasibility and design.
Estimated Cost	Capital Costs: \$13,050,000

Potential Funding Sources	District levy, partner contributions, grants, state appropriations
Schedule	2022-2025

Project	Wetland Restoration
Description	May include bypassing flow around the wetland, the addition of nutrient filters, soil engineering or augmentation to permanently sequester phosphorus, or the development of wetland treatment cells. Selected restoration options will depend on site specific wetland conditions and hydrology, and overall needs of the subwatershed system. The selection process will be facilitated by a partnership with the US Army Corps to develop a restoration prioritization tool with input from agency partners including the Six Mile Creek-Halsted Bay Subwatershed Partnership, the US Fish and Wildlife Service, and state agencies including BWSR and the DNR. The level of implementation (i.e. acres restored) will depend on the District's ability to secure external grants or other funding.
Need	The Six Mile Creek-Halsted Bay subwatershed has six lakes that exceed state nutrient standards (Wassermann, Turbid, East Auburn, Parley, Stone, and Halsted Bay), with others close to the limit of in-lake nutrient concentrations. The 2013 Six Mile Diagnostic identified hydraulically altered and degraded wetlands as a principal source of external phosphorus to waterbodies subwatershed-wide, principally in Wassermann, Turbid, East Auburn, South Lundsten, Parley, Mud, and Halsted Bay. The Six Mile Creek-Halsted Bay Subwatershed has thousands of acres of wetlands that not only play a critical role in nutrient cycling, but also provide habitat, forage, and breeding ground for the migratory and non-game bird species abundant within this subwatershed. Prioritization of wetland restoration opportunities will be based on water quality and natural resource impact, ownership (public vs. private), and available funding.
Outcome	Increased nutrient retention, enhanced vegetation diversity, supportive waterfowl and non-game bird habitat, enhanced corridor connection.
Estimated Cost	Capital costs: \$3,000,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027



Project	Stormwater Volume and Pollutant Load Reduction
Description	Regional treatment or other best management practices that augment treatment capacity and add ecosystem service value concurrent with regional growth and development, including but not limited to infiltration or filtration basins and devices, reforestation, revegetation, and stormwater detention or redirection.
Need	Six lakes exceed state nutrient standards. A TMDL identified the need to reduce external loading by 30 lbs to Wassermann (though the 2013 Six Mile Diagnostic identifies a much higher external load), 27 lbs to Parley, 33 lbs to Turbid, 420 lbs to East Auburn, and 2,087 lbs to Halsted Bay. Other waterbodies may be targeted for stormwater management as a protection measure against development impacts. The District will typically play a technical and grant assistance role in developing stormwater management projects but may be more heavily involved where the associated water quality and natural resource benefit is highest.
Outcome	Reduction of pollutant loading to subwatershed lakes; reduction of stormwater runoff volume and rate and associated impacts; protection and enhancement of groundwater recharge, stream base flow, and wetland hydrology.
Estimated Cost	Capital costs: \$2,000,000, excluding land, in 2017 dollars
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

Project	Stream Channel Restoration
Description	Stream restoration may include bank stabilization, grade control, culvert modification, and floodplain/riparian management.
Need	Six Mile Creek has been heavily ditched and modified over time. The 2012 Minnehaha Creek Stream Assessment identified a number of opportunities for stream restoration to manage sediment and nutrient loading and provide in-stream and riparian ecological benefit. Stream restoration projects may be carried out in concert with wetland restoration projects, as much of the stream acreage is associated with marsh areas.
Outcome	Reduced sediment and nutrient loading to downstream waterbodies, reconnection of stream bank to riparian marshes.
Estimated Cost	Capital costs: \$870,000, excluding land, in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

Project	Internal Load Management
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Description	Application of aluminum sulfate or similar chemicals in order to inactivate sediment phosphorus release from the lakebed
Need	The 2013 Six Mile Diagnostic identified lakes in which internal sediment phosphorus release is a significant driver of water quality issues. A TMDL identified the need to reduce internal loading by 442 lbs (88%) to Wassermann, 971 lbs (61%) to Parley, and 104 lbs (77%) to Turbid. South Lundsten also needs internal load management to address its contribution to the impairment of Parley Lake. All of these lakes currently exceed the carp population concentration where ecological damage occurs. Carp also reduce the effectiveness of alum by re-suspending bottom sediments that have been sealed by alum, so no internal load treatments can be complete until the carp population has been brought below that threshold.
Outcome	Reduced internal nutrient release; increased water clarity; reemergence of submersed aquatic vegetation.
Estimated Cost	Capital costs: \$980,000 in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027

Project	Whole Lake Drawdown
Description	Hydrologically manipulate lake levels to temporarily expose lake bed sediments to promote the growth of healthy submersed aquatic vegetation communities.
Need	South Lundsten, Parley and Mud Lakes have very high carp populations and nutrient concentrations which jointly have created turbid lake conditions wherein the lake lacks submersed aquatic vegetation, is dominated by rough fish, and is characterized by turbid water from sediment resuspension and algal production. Whole lake drawdown is needed to reestablish a biotic community supportive of a clear shallow lake state and address internal loading in all three lakes. Whole lake drawdown is the final step in a long term shallow lake management strategy and will be implemented only after other compounding issues have been addressed including carp management, reduced watershed nutrient loading, reduced loading from upstream waterbodies. Internal load management can be done concurrently or in advance, dependent upon timing of other factors.
Outcome	Reduce internal sediment and nutrient loading; reemergence of submerged aquatic vegetation; establishment of healthy fishery
Estimated Cost	Capital cost: \$770,000 in 2017 dollars.
Potential Funding Sources	District levy, partner contributions, grants
Schedule	2018-2027



3.10 IMPLEMENTATION TABLES

Table 3.16 summarizes the District's programs, their general activities, approximate annual budgets, funding sources, and schedule. More detailed descriptions for each of these programs can be found in Section 3.5. The subwatershed plans in Section 3.9 describes specific implementation actions that may be undertaken by the District and its partners.

Table 3.17 summarizes the District's Capital Improvement Plan (CIP), including the subwatershed where the project is located, project name, estimated cost, potential funding sources, and schedule. More detailed descriptions for each project can be found in the Subwatershed Plans in section 3.9. The CIP is a planning tool. It also is a means to inform partners, District residents, and other interested parties as to the District's scope and priorities for its capital work over the planning period. A project's inclusion in the CIP does not mean that the project will be constructed, only that the District has identified it as an action that may be a cost-effective way for the District to achieve identified water resource goals. A project identified in the CIP always will need further review as to technical feasibility, cost and financing, consistency with local needs, and other

policy considerations before a formal decision to proceed to construction is made. Section 3.5.5 describes the development and evaluation steps that will occur before the District will commit resources to a project.

Section 3.5.5 also describes how the District will review the CIP on an ongoing basis throughout the planning period. This review will allow the District to reassess described projects from a technical perspective, but also will involve broader policy considerations such as shifts in District priorities, decisions as to annual budget and levy levels, and the prospect of state and federal grant funds or financing. For this reason, projects may be added to and deleted from the CIP from year to year, in accordance with those procedures. A critical component of any project will be a funding strategy that identifies the sources, uses, and timing of funds needed to successfully achieve identified goals. These plans will be developed in conjunction with the District's public and private partners as capital projects are advanced. Therefore, any costs identified within this Plan are projections. Intended expenditures will be refined during project development and budgeting, and among other things will reflect the District's intent to complement its ad valorem funds with other funding sources.

Table 3.16 District program activities, budgets, funding sources, and schedule

Program Activities	Approximate Annual Budget	Funding Sources*	Schedule
Education and Communications	\$1,000,000	MCWD Levy	Ongoing
Build support for District policy, programs, and projects Engage and educate communities on water resource issues Provide knowledge and skills needed to adopt clean water practices			
Incentive Programs	\$500,000	MCWD Levy	Ongoing
Administer grants to facilitate green infrastructure projects			
Land Conservation	\$2,500,000	MCWD Levy	Ongoing
Continue proactive efforts to conserve lands of high value for water resource protection and enhancement			
Permitting	\$650,000	MCWD Levy	Ongoing
Administer permits Field inspection and compliance enforcement Identify opportunities and build partnerships			
Planning	\$1,000,000	MCWD Levy	Ongoing
Plan and implement capital projects Develop policy and coordinate with District partners Maintain internal program coordination and alignment			
Project Maintenance and Land Management (PMLM)	\$750,000	MCWD Levy	Ongoing
Maintain District capital projects, lands, and infrastructure Provide technical assistance to partners and landowners Inspect and maintain ditches under MCWD jurisdiction			
Research and Monitoring	\$1,000,000	MCWD Levy	Ongoing
Collect and analyze data to inform management efforts Carp management AIS early detection, rapid response, and support of partner efforts			
Capital Improvement Program	\$3,500,000	See Table 3.18	
See Table 3.18			

*See Section 3.4.4 for more information on funding sources



Six Mile Creek-Halsted Bay Subwatershed

Table 3.17 2018-2027 Capital Improvement Program

Subwatershed	Capital Projects	Estimated Cost
District-wide	Land Conservation	See Table 3.17
Christmas Lake	Stormwater Volume and Pollutant Load Reduction	\$200,000
Dutch Lake	Stormwater Volume and Pollutant Load Reduction	\$780,000
Gleason Lake	Stormwater Volume and Pollutant Load Reduction	\$600,000
Lake Minnetonka	Halsted Bay Internal Phosphorus Load Reduction	\$1,400,000
Lake Minnetonka	Stormwater Volume and Pollutant Load Reduction	\$1,000,000
Lake Virginia	Stormwater Volume and Pollutant Load Reduction	\$650,000
Langdon Lake	Stormwater Volume and Pollutant Load Reduction	\$230,000
Long Lake Creek	Stormwater Volume and Pollutant Load Reduction	\$1,320,000
Minnehaha Creek	Minnehaha Creek FEMA Flood Damage Repairs	\$920,000
Minnehaha Creek	325 Blake Road Regional Stormwater and Greenway	\$2,750,000
Minnehaha Creek	Meadowbrook Golf Course Ecological Restoration	\$2,200,000
Minnehaha Creek	Arden Park Stream Restoration	\$4,100,000
Minnehaha Creek	Greenway to Cedar Trail Connection and Streambank Restoration	\$510,000
Minnehaha Creek	Boone-Aquilla Floodplain	\$500,000
Minnehaha Creek	Cottageville Park Phase II Riparian Restoration	\$280,000
Minnehaha Creek	West Blake Greenway Enhancement	\$420,000
Minnehaha Creek	Meadowbrook Greenway Expansion	\$950,000
Minnehaha Creek	Hiawatha Golf Course Restoration	\$1,940,000
Minnehaha Creek	Minnehaha Parkway Stormwater Management	\$1,400,000
Minnehaha Creek	Stormwater Volume and Pollutant Load Reduction	\$2,450,000
Minnehaha Creek	Channel/Streambank Restoration	\$3,120,000
Painter Creek	Potato Marsh Restoration	\$ 870,000
Painter Creek	SOBI Marsh Restoration	\$240,000
Painter Creek	Upper and Lower Painter Marsh Restoration	\$2,800,000
Painter Creek	South Katrina Marsh Restoration	\$1,270,000
Painter Creek	Stormwater Volume and Pollutant Load Reduction	\$980,000
Painter Creek	Stream Restoration	\$2,990,000
Painter Creek	Wetland Restoration	\$330,000



Potential Funding Sources*	Proposed Implementation Year
MCWD Levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018
MCWD levy, partner contributions, grants	2018-2019
MCWD levy, partner contributions, grants	2018-2019
MCWD levy, partner contributions, grants	2018-2019
MCWD levy, partner contributions, grants	2019-2020
MCWD levy, partner contributions, grants	2019-2020
MCWD levy, partner contributions, grants	2019-2020
MCWD levy, partner contributions, grants	2020-2021
MCWD levy, partner contributions, grants	2020-2021
MCWD levy, partner contributions, grants	2020-2021
MCWD levy, partner contributions, grants	2021-2022
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, USACE Section 206, partner contributions, grants	2019
MCWD levy, USACE Section 206, partner contributions, grants	2020
MCWD levy, USACE Section 206, partner contributions, grants	2021
MCWD levy, USACE Section 206, partner contributions, grants	2022
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027

Schutz Lake	Stormwater Volume and Pollutant Load Reduction	\$250,000
Six Mile Creek-Halsted Bay	East Auburn Stormwater Enhancement Project	\$170,000
Six Mile Creek-Halsted Bay	Wassermann West External Load Reduction and Landscape Restoration	\$2,250,000
Six Mile Creek-Halsted Bay	Pierson Lake Headwaters Restoration	\$320,000
Six Mile Creek-Halsted Bay	Turbid-Lundsten Wetland Restoration	\$3,100,000
Six Mile Creek-Halsted Bay	Mud Lake Watershed Load Reductions	\$3,090,000
Six Mile Creek-Halsted Bay	Wassermann Internal Load Management	\$310,000
Six Mile Creek-Halsted Bay	East Auburn Wetland Restoration	\$990,000
Six Mile Creek-Halsted Bay	Halsted Bay Watershed Load Management	\$13,050,000
Six Mile Creek-Halsted Bay	Wetland Restoration	\$3,000,000
Six Mile Creek-Halsted Bay	Stormwater Volume and Pollutant Load Reduction	\$2,000,000
Six Mile Creek-Halsted Bay	Whole Lake Drawdown	\$770,000
Six Mile Creek-Halsted Bay	Internal Load Management	\$980,000
Six Mile Creek-Halsted Bay	Stream Restoration	\$870,000

*See Section 3.4.4 for more information on funding sources

MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018
MCWD levy, partner contributions, grants	2018-2019
MCWD levy, partner contributions, grants	2019-2021
MCWD levy, partner contributions, grants	2019-2021
MCWD levy, partner contributions, grants	2019-2025
MCWD levy, partner contributions, grants	2020-2022
MCWD levy, partner contributions, grants	2020-2021
MCWD levy, partner contributions, grants	2022-2025
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027
MCWD levy, partner contributions, grants	2018-2027

