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MISSISSIPPI WATERSHED MANAGEMENT ORGANIZATION

Watershed Management Plan 2021-2031

Fourth Generation Plan

MWMO Watershed Bulletin: 2021-3

Protect it. Pass it on.

MISSISSIPPI WATERSHED MANAGEMENT ORGANIZATION

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Fourth Generation Watershed Management Plan

Previous Versions

First Generation Plan: 1986
Second Generation Plan: 2000-2010
Third Generation Plan: 2011-2021

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Plan Approval and Adoption

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Front Cover

Clockwise, St Anthony Falls from the Stone Arch Bridge, Land cover in the MWMO, The River Gorge, Monitoring outfalls discharging to the Mississippi River. *Photograph by B. Jastram, Mississippi Watershed Management Organization. Courtesy of the MWMO Museum of Natural History*

Watershed Management Plan 2021-2031

Mississippi Watershed Management Organization

Abstract

The Mississippi Watershed Management Organization (MWMO) is committed to protecting, managing, and improving the water resources within its boundaries. This plan has been developed to guide the MWMO Board and staff in the implementation of watershed goals. When the original Watershed Management Plan was adopted in 2000, the MWMO established its own offices and added new staff members to develop the programmatic areas needed to successfully implement goals established within the Plan. Over the next decade, the MWMO further established its role in leading data gathering initiatives related to the water quality, quantity, and stormwater best management practice (BMP) performance. Through implementation of the 2010 Plan, the MWMO continued to find success partnering with its member organizations on capital projects achieving the organization's goals of water quality, quantity, and habitat improvement. These successes include implementation of Capital Improvement Projects (e.g. the Towerside District Stormwater Reuse System, Edison Green Campus, Minneapolis Sculpture Garden, and Hall's Island reconstruction), the continued development and implementation of the Stewardship Fund Grant program, engagement of youth through guided job experience and training, an investigation of the impact of the Upper Saint Anthony Falls lock closure on the Mississippi River, and the establishment and continued growth of a remote, real-time monitoring network for the watershed.

Through this Fourth Generation Plan, the MWMO lays out an implementation schedule that requires the continued growth and leadership of the organization to achieve its stated goals. The Plan sets out goals and strategies based on studies and data on the status of the water and natural resources of the watershed. MWMO staff and Board use the Plan to guide watershed management decisions based on the established goals and strategies, the land and water resource inventories, and any new information gathered through science-based studies. Additionally, the MWMO staff and Board use the Plan to assist in the development of annual work plans based on the outlined implementation actions in concert with the goals and strategies.

Member organizations will find the Plan of use in developing local surface water management plans and stormwater ordinances. Additionally, member organizations may use the MWMO implementation plan to assist in scheduling and coordinating capital improvements and programs.

Residents, businesses, and other organizations within the watershed may use the Plan to learn more about the natural and water resources within the watershed and to be aware of the projects, work areas, and operations of the MWMO.

MWMO Watershed Bulletin: 2021-3
Prepared for the MWMO by: Staff at the MWMO, Houston Engineering, Inc., Barr Engineering, and Kimley Horn

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Glossary

Aeration	The addition of air to a waterbody in order to increase the oxygen content of the water to benefit the health of the living organisms within the waterbody
Abstraction	The permanent retention of runoff on a site through structures and practices such as infiltration, evapotranspiration, and capture and reuse.
Bacteria	Microorganisms that can live in a variety of conditions, some types can cause illness in humans. The quantity of *E. coli*, a specific type of bacteria, is used as a metric to evaluate potential fecal contamination in surface water resources.
Benthic/Benthic zone	Ecological region at the lowest level of a body of water such as a lake or river, including the sediment surface and some sub-surface layers.
Biochemical Oxygen Demand (BOD)	The oxygen used by microorganisms that decompose organic matter such as dead algae, leaves, and waste. It is used as a measure of water quality because it is linked to the level of dissolved oxygen in the water, a compound needed to sustain fish and other organisms.
Capacity	The total amount of a certain characteristic, e.g., total volume of water stored or total ability to provide water-related education.
Chloride	A chemical used as a water quality metric. Chloride is a component of many common road salts used for deicing in the winter.
Climate change	A long-term change in climate measures such as temperature and rainfall. Changes in climate have a large impact on water quality as well as lake and wetland water levels and stream and river flows.
Converted lands	Land areas that are no longer covered with native vegetation.
Design Guidelines	Any document adopted by the MWMO to provide non-regulatory guidance for development activities occurring in the watershed to protect, manage, and restore water and natural resources. MWMO grant recipients must meet adopted guidelines to receive funding.
Development	Any land disturbance that alters or creates impervious surface and any redevelopment creating/replacing impervious surface, including but not limited to, road and/or parking lot construction or reconstruction; see also Redevelopment.
District Systems	The integrated development and management of stormwater, traffic and parking, public utilities, street construction, energy and open space. At a scale that generates a more efficient system overall than if each part was developed and managed independently

Drainageway	A route for the transport of stormwater, e.g., ditch, channel, swale, pipe.
Disturbance area	The area of a site, impacted by land disturbing activities.
Ecological integrity	The quality of the plant community compared to a representative plant community for the local area. Higher quality communities have a higher ecological integrity.
Ecosystem	The group of all living organisms in a certain area that are expected to interact within the same habitat.
Floodplain	The land adjacent to a waterbody that is expected to be inundated with water after a large rainfall event of a specific size. For example, flood insurance rate maps typically depict the floodplains for 100-year and 500-year events.
Fully reconstructed impervious surfaces	Areas where impervious surfaces have been removed down to the underlying soils. Activities such as structure renovation, mill and overlay projects, and other pavement rehabilitation projects that do not alter the underlying soil material beneath the structure or pavement are not considered full reconstruction. In addition, other maintenance activities such as catch basin and pipe repair/replacement, lighting, and pedestrian ramp improvements shall not be considered fully reconstructed impervious surfaces. Reusing an existing building foundation and re-roofing an existing building are not considered fully reconstructed.
Greenway system	Interconnected areas of vegetated open space. Greenways may include built features as well as natural or vegetated areas.
Green infrastructure	The design of infrastructure systems, such as roadways and building sites, to maintain key existing soils and vegetated areas and to incorporate vegetated approaches for stormwater management.
Groundwater	Water located below ground in the spaces present in soil and bedrock.
Groundwater recharge	Water moving through the soil surface and deeper underground to become groundwater.
Historic condition	A term used in the MWMO Standards to refer to the condition of the land in the past based on the MWMO study *Historic Waters of the MWMO (*MWMO, 2011). The study evaluated the historic soil and vegetation condition of the MWMO. The results of this analysis are used as an upper level goal for water and runoff management within MWMO.
Hydrology	The movement of water. Often used in reference to water movement as runoff over the soil after a rainfall event as it contributes to surface waterbodies.
Impervious surface	Means a surface that impedes the infiltration of rainfall and results in an increased volume of surface runoff.

Infiltration	The movement or passage of water into the soil.
Innovation	Innovation involves deliberate application of information, imagination, and initiative in deriving greater or different values from resources. It includes all processes by which new ideas are generated and converted into infrastructure improvements that increase public benefits.
Land Disturbance	Any activity that results in a change or alteration in the existing ground cover (both vegetative and non-vegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to, development, redevelopment, demolition, construction, reconstruction, clearing, grading, filling, stockpiling, excavating, and creating borrow pits. Routine vegetation management—and mill and overlay/resurfacing activities that do not alter the soil material beneath the pavement base—are not considered land disturbance. In addition, other maintenance activities such as catch basin and pipe repair/replacement, lighting, and pedestrian ramp improvements shall not be considered land disturbance for the purposes of determining permanent stormwater management requirements.
Macro-invertebrates	Aquatic insects used as a metric of water quality. Different macroinvertebrates will live in water with poor water quality than live in water with high water quality. The different types of macroinvertebrates present are an indication of the quality of the water.
Members	The municipalities and organizations that make up the MWMO, including: City of Columbia Heights, City of Hilltop, City of Fridley, City of Lauderdale, City of Minneapolis, Minneapolis Park and Recreation Board, City of Saint Anthony Village, and the City of Saint Paul.
Mercury	A metal that recycles between land, air, and water. The primary source of mercury in waterbodies is air pollution. Mercury accumulates in fish and often results in fish consumption advisories for lakes and rivers. Mercury can have toxic effects on the nervous system of animals, including humans, who eat large quantities of fish.
Multi-functional corridors	Interconnected areas serving a number of functions, e.g., stormwater treatment as well as habitat, recreation, and transit.
Native plants	Plant species that developed or occurred naturally in Minnesota prior to approximately the 1850s.
Natural areas	An area or site mostly unaltered by modern human activity that contains native plants and habitat. Natural areas may include areas such as wetlands, forests, prairie, shoreland, and bluffs.

Natural resources	Living and non-living systems that provide benefits to humans and wildlife. In this plan the term refers primarily to water-based systems such as wetlands, rivers, and streams as well as the upland areas that sustain the quality of water in these resources.
Natural waterbodies	Any waterbody, including wetlands, that was not human-made for the explicit purpose of managing stormwater.
Nonpoint sources	Waterbody pollution originating from diffuse sources.
Nutrients	A group of chemicals needed for the growth of an organism. Within surface water systems, nutrients such as phosphorus and nitrogen can lead to the excessive growth of algae.
Official Controls	As defined in MN Statute 473.852, as amended: ordinances and rules that control the physical development of a city, county, or town or any part thereof or any detail thereof and implement the general objectives of the comprehensive plan. Official controls may include ordinances that establish zoning, subdivision controls, site plan regulations, sanitary codes, building codes, and official maps.
Open Space	Land areas that are primarily vegetated and are maintained for public benefits such as recreation, wildlife habitat, water quality, water and natural resource protection, and stormwater management.
Performance standards	A set of criteria or definitions for the implementation and function of management practices and stormwater management systems.
Pesticides	A substance intended to prevent, repel, or destroy a pest (insects, mice, bacteria, etc.).
Pipeshed	A smaller geographic section within a larger watershed unit that drains through a system of pipes to a single outfall.
Point sources	Waterbody pollution originating from an identifiable location, such as an industrial facility or stormsewer system.
Pollutant loadings	The total amount of a pollutant entering a waterbody over a certain time period.
Polychlorinated biphyenyls (PCBs)	A compound historically used in coolants, transformers, and other uses. They are highly persistent in the environment and are suspected to be detrimental to human health.
Pre-development	Is defined as the runoff conditions resulting from open space in fair condition.
Public	Residents, citizens, and community groups within the MWMO.

Quaternary	Quaternary period is the geologic time beginning about 1.5 million years ago to present. The term is often used with respect to geologic deposits: unconsolidated soils deposited during the Quaternary geologic period.
Recodification	Renumbering or reorganizing the Plan without altering content.
Redevelopment	The reconstruction or significant alteration or renovation of existing structures, roadways, or other permanent constructed features. See Development.
Resource-based standards	A specific form of performance standards focusing on protection or restoration of the downstream resource.
Restorative development	Distributed and integrated infrastructure and governance; circular resource management, characterized by synergistic values, integration and equity generation.
Re-suspend	Putting back into suspension particles that had previously settled to the bottom of a waterbody or stormwater management device.
Riparian	The interface between land and a waterbody such as a stream or river.
Source water assessment area	The area surrounding a public water supply source that contributes water to the supply within a given timeframe. This is the area to be evaluated for susceptibility to contamination. The source water assessment may lead to a protection plan, either through a source water protection plan for surface water, or through a wellhead protection plan for groundwater.
Source water protection plan	A plan to address surface water supply sources from contaminants that could impact human health, to establish protection measures, and to reduce pollution.
Stormwater hotspots	Point source potential pollution generating land uses such as gas stations, chemical storage facilities, industrial facilities, etc.
Stormwater management practices	Techniques, methods, or structural controls used within a given set of conditions to control the speed and total amount of stormwater that flows off a site after a rainstorm. Also used to improve the quality of the runoff water.
Stormwater/ Stormwater runoff	Water that is generated by rainfall or snowmelt that runs off the land and may be routed into drain systems for treatment or conveyance.
Subwatershed	A smaller geographic section within a larger watershed unit with a drainage area of typically between 2 and 15 square miles and whose boundaries include all the land area draining to a specified point.

Support	Providing financial contribution, technical resources, or in-kind contributions to a certain project or initiative.
Surficial geology	The material starting at approximately 3 feet below the surface and mapped at 1:100,000 scale. Note the level of accuracy of data does not account for up to 20 feet of fill in urban areas.
Streamlining of a procedure	Altering a procedure or process to make it more efficient.
Total maximum daily loads (TMDLs)	The total amount of a pollutant that a waterbody can receive and still meet state water quality standards. TMDL also refers to the process of allocating pollutant loadings among point and nonpoint sources.
Total phosphorus	The total amount of the nutrient phosphorus present in a water sample. Increased phosphorus is a key factor leading to decreased water quality.
Water reuse	The use of water more than once in a building or in a landscape prior to discharge. This may include greywater use, storage of rainwater for irrigation, and other methods.
Water supply	A source of potable or non-potable water for human use.

Watershed Management Plan 2021-2031

1.0 Introduction

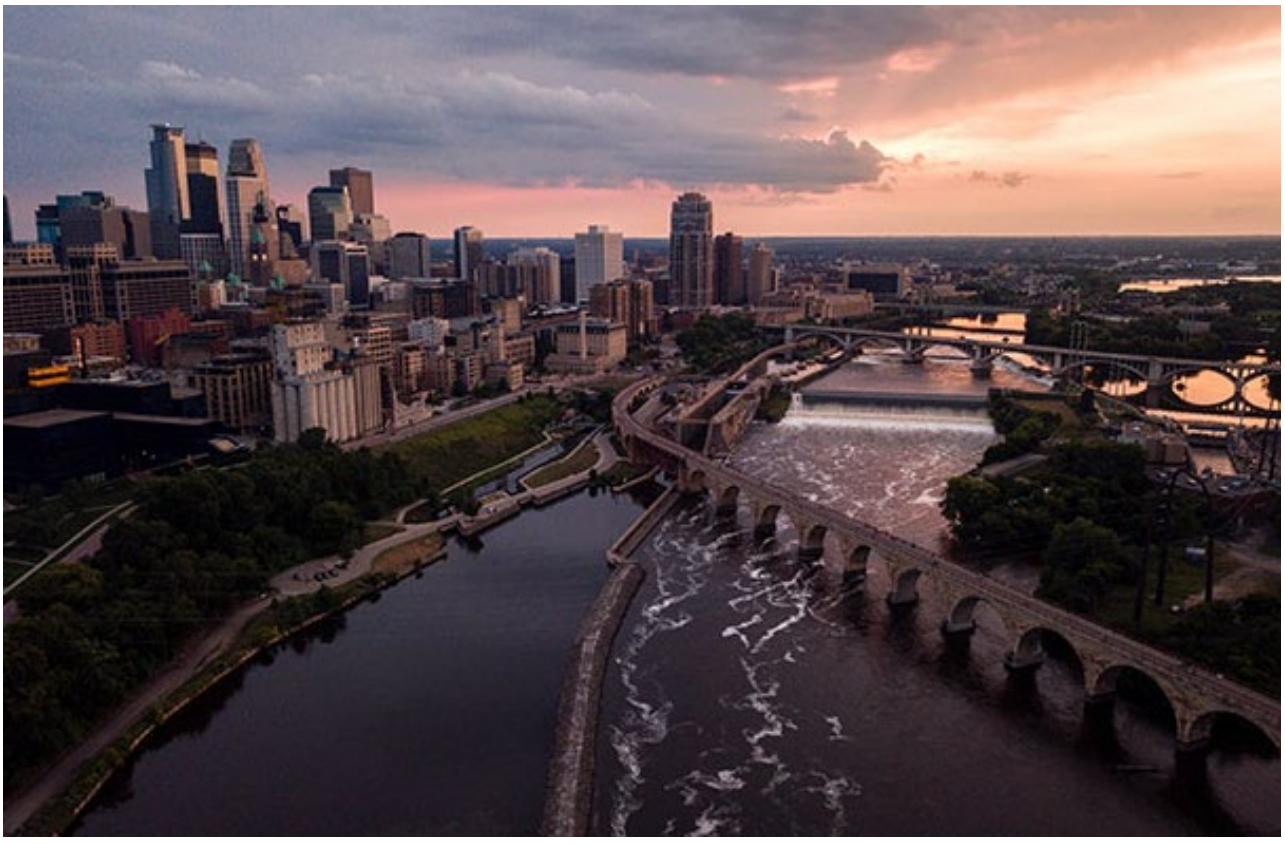
The Mississippi Watershed Management Organization (MWMO) is committed to protecting, managing, and improving the water resources within its boundaries. The MWMO Board of Commissioners has directed staff to lead efforts to accomplish the mission by assisting, educating, supporting, and cooperating with its member organizations, other units of government, nonprofit agencies, and a variety of community groups to achieve a diverse, functional urban river ecosystem.

Mission Statement articulates why the organization exists:

To lead, and to foster stewardship of the watershed and its waters with actions that promote civic ownership and responsibility and through measures that achieve diverse and functional upland and river ecosystems.

Vision statement describes what the organization hopes to achieve by 2031:

To lead, to inspire, to act, to educate, and to create a shared vision for a river system with ecological integrity.



2.0 Executive Summary

2.1 History

Today's organization began as the Middle Mississippi River Watershed Management Organization in 1985 with a joint powers agreement executed by the cities of Minneapolis, Saint Paul, Lauderdale, Falcon Heights, Saint Anthony Village, the Minneapolis Park and Recreation Board, and the University of Minnesota. For business purposes, the organization shortened its name to the Mississippi Watershed Management Organization. The current joint cooperative agreement, bylaws, and legal description are included in Appendix A. The members now include the cities of Columbia Heights, Fridley, Hilltop, Lauderdale, Minneapolis, Saint Anthony Village, Saint Paul, and the Minneapolis Park and Recreation Board.

History of MWMO's Watershed Management Plans

The First Generation Watershed Management Plan (Plan), published in December of 1986, was never officially approved, resulting in no projects being implemented. In January 1997, the University of Minnesota left the organization and a Second Generation planning effort was initiated. In 1998, the Capitol Region Watershed District (CRWD) was formed adjacent to the MWMO. As part of the creation of CRWD, a small geographic area of Falcon Heights was removed from the MWMO. In 2000, the Bassett Creek Watershed Management Commission (BCWMC), MWMO, and the City of Minneapolis entered into a joint and cooperative agreement, which resulted in a boundary change that transferred 1,002 acres from the BCWMC to the MWMO. The agreement defines the responsibilities of the MWMO and the BCWMC with respect to the new and old tunnel. For example, the agreement requires the MWMO to coordinate with the City of Minneapolis regarding flows from Bassett Creek that exceed the 50 cubic feet per second (cfs) overflow that the Old Tunnel must accommodate. The agreement also requires written approval of the BCWMC for changes in the area tributary to the new tunnel, or increases in the rate of runoff to the new tunnel by either the City of Minneapolis or the MWMO. A copy of the agreement is attached as Appendix F.

In 2000, the MWMO Second Generation Plan was approved. In 2006, the Plan was amended to add the Greening Program and clarify existing programmatic efforts. The MWMO's Third Generation Plan was adopted by the MWMO Board of Commissioners on May 10, 2011.

An intentional amendment process every 2 -3 years was built into the MWMO's Third Generation Plan. This process has allowed the MWMO to maintain a "living plan" that is updated regularly to respond to changing conditions in the watershed and better align with our member cities' capital improvement schedules. The first amendment added member cities' projects to the Plan's Capital Improvement Schedule; it was adopted by the MWMO Board of Commissioners on May 8, 2012.

In 2011 the six-city WMO was dissolved. By August 21, 2012, portions or all of the cities of Columbia Heights, Fridley, and Hilltop became members of the MWMO. On July 7, 2013, the MWMO Board of Commissioners approved a Plan amendment related to these new member

cities. Items added included an updated joint cooperative agreement, a revised legal boundary, and additional stormwater management projects in MWMO's Capital Improvement Schedule.

May 12, 2015, the MWMO Board of Commissioners approved a third Plan amendment that modified the MWMO's standards, added the MWMO's Design Sequence flow chart, and integrated projects, mapping and assessments from our new member cities of Columbia Heights, Fridley, and Hilltop into the MWMO's Watershed Management Plan.

In 2016, there were two final amendments to the Plan. The first added the new 8410 amendment process to the Plan, and updated Section 3.2, which provides our member cities guidance on local water plan content requirements. A notification of the changes made was sent out to statutory reviewers. The second was approved by the MWMO's Board of Commissioners on November 16, 2016. This amendment updated the MWMO's Capital Improvement Schedule to ready it for upcoming 2017 projects. Updates to the Capital Improvement Schedule included 6 new projects; 2 modified projects; and 11 completed projects removed from the schedule, with a final budget of $21,600,000 from 2016 through 2021.

Where We Have Been and Where We Are Going

Over the course of the last 10-year plan there have been a number of significant changes that influenced the MWMO's work between 2011 and 2021 and will continue to influence it moving ahead.

In 2014, The MWMO Board altered its existing policy regarding the use of capital project funds to include redevelopment projects on private land. This opened up all land within the watershed for projects and allows staff to recommend the projects that offer the greatest public benefits in terms of protection and improvement of water quality, habitat and natural resources.

Continuous research, assessments and feasibility studies have improved the MWMO's understanding of the watershed. This creates a process to better inform project selection with relevant science, history, engineering, planning, and design needed to succeed in improving water quality, rate control and habitat within the watershed. The MWMO has invested significant funding and staff expertise in developing hydrologic and hydraulic, ecologic and water quality models throughout the watershed, allowing us to better understand impact of climate on the watershed and our member cities.

In 2016, the Minnesota Department of Health's took the initiative to develop comprehensive statewide guidance or policy on water reuse to ensure that projects are safe and sustainable. Currently, they are assessing data to determine a standard reuse of stormwater depending on the end use and source of the stormwater.

The MWMO has been and will continue to be a leader in reuse of stormwater. The MWMO views stormwater as a valued resource rather than a waste product. Climate trends over the prior decade have shown that we can expect and need to plan for elongated droughts, dwindling

aquifers, and water shortages around the U.S. Governmental and private sector entities want to have the ability to reuse stormwater for multiple uses prior to discharging it back into aquifers or surface waters. This growing movement and awareness that stormwater has value has led to many more innovative projects in the watershed.

Due to significant reductions in lake levels on White Bear Lake, landowners sued the MN DNR in 2012. As a result, there has been an increased focus by the MN DNR on the management of groundwater supplies and surficial and groundwater interactions in the Metro Area.

The MWMO has put a significant amount of time and resources into understanding surface and groundwater interactions in the watershed. In 2011, we completed a historic study of the watershed to inform its planning and water resource management efforts. Results from this study were intended to provide a better understanding of the presettlement hydrology and ecology of the MWMO jurisdictional area and how alterations to the present-day urban landscape have affected and are affected by natural features. Included in this report is a review of all pre-settlement water features identifying if they were discharge or recharge areas or both. Research studies such as the Historic Waters of the MWMO, groundwater field studies, and future studies like MN DNR's Ground Water Atlas - Part B will help us continue to better determine the viability of infiltration within the watershed.

In 2013, the MPCA released its Minimal Impact Design Standards (MIDS). This guidance emphasized keeping the raindrop where it falls in order to minimize stormwater runoff and address multiple pollutants beyond just total suspended solids (TSS) and total phosphorus (TP). MIDS is intended to mimic a site's natural hydrology as redevelopment occurs in order to preserve and protect environmentally sensitive site features. The MWMO contributed a study that compared the effectiveness of urban stormwater standards to their work; in 2016, we worked with our member cities to adopt a new standard based on MIDS into our Watershed Management Plan. Between 2017 and 2019, we secured a commitment by each of our member cities to adopt the new standard as a part of their local water plan approval by the MWMO Board. The MWMO will continue to review the effectiveness of our standards and modify them as needed in the future.

In 2016, the MPCA finalized a Chloride Total Maximum Daily Load (TMDL) with the approval of the Twin Cities Metropolitan Area Chloride Management Plan. The MWMO has a long history of hosting and supporting the development of training materials for public and private sector winter snow plow and maintenance workers. The effort aims to reduce the amount of chlorides being used on sidewalks, parking lots, and roads. These adaptive management approaches have led to both improvements in water quality and a cost savings due to less materials used annually. We plan to continue these efforts and others like them over the next 10 years.

In 2012, the Prospect Park Partnership, which later became the Minneapolis - St Paul Towerside Innovation District, was established. Over the years, this partnership has provided the vision and capacity to create a district where innovation in systems thinking and design allows for integration of energy, streets, parking, stormwater, parks, habitat, buildings, and transportation

for the benefit of the larger surrounding community. Early on, Towerside project partners encouraged the City of Minneapolis to sign a resolution supporting the creation of innovation districts within the City of Minneapolis. The approved resolution and language in the City's 2040 comprehensive plan are opening up opportunities and places to address today's significant social, economic and environmental issues. At the same time, St Paul created a master planning process tied to a city council resolution that allows District systems with multiple public benefits to advance at the pace of redevelopment wherever the best sites present themselves city-wide.

The MWMO has worked closely over the years with the Towerside Innovation District, the City of Minneapolis and St. Paul to establish district stormwater systems that improve water quality, habitat, and emphasize reusing stormwater as a valued resource instead of a nuisance to be disposed of quickly. The MWMO will continue this work over the next 10 years finding ways to bring greater value to our member cities projects.

These environmental initiatives alone would be enough for any organization to take on, but we must also acknowledge we face more than just environmental issues. All governmental entities are being asked to take on deep systemic racism, cultivate diversity, promote equity and foster inclusion, and address aging stormwater infrastructure systems as well continue to develop and pay for new systems needed for future growth. As we move ahead, we are committing ourselves to finding a more restorative path forward that takes into consideration all the above issues.

Following the approval of this 10 year Plan, the MWMO will begin a more thorough planning process that results in equity and climate change plans or policy guidance that encompass all aspects of our organization. This planning process will invite those who would be impacted by the plans to participate in the process of developing them.

A history of systemic racism coupled with continued present-day infrastructure, land use and operations and maintenance patterns have brought to the forefront unresolved social, economic, and environmental issues of climate change. The inequities have had greater impacts on the black, indigenous, and people of color (BIPOC) communities in the watershed.

Site by site regulatory standards for redevelopment and the separation of public and private infrastructure systems to support it has unwittingly contributed to today's issues of climate change, inequity, and infrastructure debt. The MWMO will continue to work with its member cities on new district, regional and restorative infrastructure patterns. The MWMO will continue to pursue urban ecologic system improvements including enhancement of habitat corridors and reestablishment of native vegetation to better manage stormwater throughout the watershed.

Studies and work completed by the MWMO indicates that these extensive green and blue infrastructure corridors in public spaces may have multiple benefits including reduced crime rates, improved physical and mental health, cooling of the urban heat island, improved work place productivity, increased access to healthy food sources, improved social cohesion and community resilience, absorption of carbon emissions and other air pollutants, regained environmental and economic equity for neighborhoods, and lower long term maintenance costs.

The MWMO does not take on the long term operations and maintenance of the capital projects funded by the MWMO but not owned by MWMO. However, the MWMO will work with our partners to develop a future strategy that improves long term operations and maintenance of these projects. The MWMO has an interest in assuring that all projects, large or small, are maintained long term to acheive or exceed their designed performance for the lifecycle of the BMP's installed.

The MWMO is continuing with two significant initiatives to address existing inequities in the watershed: The Restorative Development Feasibility study and Community Conversations throughout the watershed.

The MWMO will continue to participate in a partnership established to undertake a Restorative Development Feasibility study. The intent of this partnership is to develop strategy to for the future built environment where wastes are seen as valued inputs, and infrastructure sets the stage for a new redevelopment paradigm that results in equitable social, economic, and environmental outcomes in communities.

Recently, the MWMO started the first of a series of watershed-wide Community Conversations in North Minneapolis. We are reaching out and building relationships around water systems and green infrastructure. This campaign is the initial outreach start-up approach to get people interested, to begin to ask questions, explore precedent examples, and build momentum around a community input driven process. We are looking to build off prior efforts to engage the community around the idea of green and blue infrastructure, and our intent is to continue these efforts ***at the speed of trust***. We believe this is necessary if these are to be community led conversations.

Plan Comment and Review Opportunities

The MWMO is in the middle of a public engagement and statutory reviewer process that is estimated to be finalized in the late Fall of 2021. Comments received from the public (Appendix G) during the 10-year plan update are the basis for the focus areas and focus statements, which continue to guide the development and implementation of MWMO's goals and strategies. Comments received from statutory reviewers (Appendix H) align MWMO's goals and strategies with the needs of our member organizations, agencies, counties, and other watershed entities. These comments will either be integrated into the plan or it will be clarified where they already exist in the plan or that the MWMO is not positioned to or does not intend to take on the issue. Both the general public, MWMO Citizen Advisory Committee (CAC), and statutory reviewers have the opportunity to participate in the 60-day review period of this 10-year plan update as well as the public hearing in July.

Public comments were gathered through an extensive watershed survey effort. Through this effort, the MWMO sought to identify any changes needed in the existing focus statements and corresponding goals and strategies for the management of the water and natural resources in the watershed. The survey was redistributed multiple times over one year through various efforts

such as outreach events, direct requests to neighborhood organizations, gov-delivery distribution, the MWMO newsletter, and the MWMO website. The survey consisted of a series of questions around demographics, outdoor recreation, and environmental issues, asking citizens what the MWMO should do about each topic. Comments from the survey were used in a Content Analysis, where they were coded for specific references or issues relative to the content, and then summarized to quantify top responses. Summarized and tabulated responses are shown at the bottom of Appendix G.

The MWMO set aside a two-week pre-draft review period and the 60-day review period to meet with statutory reviewers on an individual basis to ensure reviewers have as much time as needed to clarify any questions or resolve any priority issues. The MWMO used a process similar to this with member cities as they were updating their local water plans. It allowed for the dialogue and time needed to talk through the needs of each organization and come to an agreement on changes to be made.

2.2 Accomplishments

When the 2000 Watershed Management Plan (Plan) was adopted, the MWMO consisted of a five-member Board with staffing provided by the City of Minneapolis Environmental Services. In the fall of 2002, the MWMO Board hired an administrator and program manager to build an organization capable of implementing the goals and activities outlined in the 2000 Plan. Since then, the MWMO has established its own offices and added new staff members to develop the initiatives needed to successfully implement goals and strategies found in the plan. A few early successes include the Heritage Park Capital Improvement Project, the creation of the Stewardship Grant Fund, the Hmong Community Project, and a study on the Historic Waters of the MWMO.

MWMO now has a full complement of staff (15 full-time employees) and many additional initiatives have been taken on to achieve the implementation of plan goals. A sampling of the initiatives is described below.

Developer-Led Stormwater Innovation (Partners: City of Minneapolis and Towerside)
The MWMO worked with the City of Minneapolis and a land development team at Towerside to incorporate new and innovative stormwater management practices into a developer-led, neighborhood-supported redevelopment project. This was the MWMO's first effort within the watershed to demonstrate the multiple public and private benefits that a District-scale, integrated stormwater management effort can make in a land use redevelopment project. The practices sought to provide water quality and quantity improvement at less cost, while enhancing quality of life and environmental benefits.

Youth Employment and Training (Partner: Minneapolis Parks & Recreation Board)
For over ten years, the MWMO and the Minneapolis Park & Recreation Board (MPRB) have led a youth employment and training program, with Green Team members coming from North and Northeast Minneapolis. Typical daily activities include working to prevent water pollution, removing invasive species, building raingardens, planting trees and prairie plants, and assisting

in citizen science projects. Youth have the chance to participate in the Mississippi River Green Team for two years, and after those two years, they are a part of a supportive network that works with them to help secure jobs to expand their skills and prepare them for the future.

Outreach Activities

The MWMO's Outreach team have continued to implement a number of initiatives including the Stewardship Fund, trainings for public and private land management employees on winter and summer maintenance activities impacting our water resources, and citizen support. For example, Minnesota Water Stewards are certified and supported to prevent water pollution and educate community members to conserve and protect our water resources. The Outreach team is also investigating ways the MWMO might engage these constituents in better managing and maintaining green infrastructure. This will be a critical skill if the MWMO is to maintain stormwater practices.

With the addition of professional communications staff, the MWMO has been able to better tell the story of watershed management and protection. The communication team has updated the watershed's website, social media, and blogs while leading the effort to inform public and partners of activities as capital projects and program initiatives are implemented.

Watershed Assessment and Monitoring Network

The MWMO continues to partner with its member organizations to build a robust watershed assessment and monitoring network. The MWMO currently monitors the water quality entering the river at multiple locations. Due to the closure of the locks at St. Anthony Falls, the team now monitors the river bathymetry to track the impact of no dredging on river morphology. Current monitoring and assessment initiatives also include outfitting some stormwater best management practices with monitoring equipment to assess their performance. The MWMO has continued to build a comprehensive monitoring network that will provide the MWMO and its partners the data needed to evaluate its progress in managing the water resources within the watershed. Over the last five years, the MWMO completed several hydraulic and hydrologic studies of pipesheds in the watershed. Nearly 80% of the watershed has now been modeled for water quantity and water quality parameters.

Through these and other accomplishments, the MWMO has proven to be an effective, motivated, and proactive organization. Through this Fourth Generation Plan, the MWMO lays out an implementation schedule that requires the continued growth and leadership of the organization to achieve its stated goals.

The MWMO received an excellent Performance Review and Assistance Program rating from Board of Water and Soil Resources for effectively carrying out the MWMO's 2011 - 2021 Watershed Management Plan. That said, the MWMO will continue its work in a number of ongoing core initiatives identified in the 2011 - 2021 Plan by carrying them forward into this 2021 -2031 Plan. In addition to continuing this essential work, the MWMO will start new initiatives that address current events, emerging issues, and long-term systemic issues. The MWMO is planning to focus more of our resources on the following: developing an organizational equity strategy,

reducing the impacts of climate change, supporting restorative systems-based design approaches for developments, prioritizing projects that support District- and regional-scale infrastructure improvements, providing green infrastructure training, supporting youth engagement programs, longitudinal and latitudinal mixing of the Mississippi River, and conducting monitoring to support city needs, such as meeting TMDLs and implementing BMPs.

2.3 Statutory Background

The 1972 Federal Clean Water Act authorized the US Environmental Protection Agency (EPA) to "protect . . . rights of States to prevent, reduce, and eliminate pollution of . . . land and water resources" (Sec 101, b). The EPA transferred portions of this authority to state legislative bodies. In 1982, the legislature approved the Metropolitan Surface Water Management Act. It was later recodified as M.S. 103B. Additional clarification and requirements were included in MN Rules 8410 and its updates.

Since passage of the act, all local units of government in the seven-county metropolitan area have been involved in the preparation and implementation of comprehensive surface water management plans through membership in one or more watershed management organizations based on natural watershed boundaries.

These first plans resulted in two key advances in comprehensive surface water resource management. First, the plans required the adoption, amendment, or update of a variety of local controls to reduce erosion and sedimentation, establish stormwater design standards, and protect wetlands. Second, during the planning and implementation of the plans, communities within the watersheds developed stronger working relationships.

In 1992, the Board of Water and Soil Resources developed rules (Minnesota Rules Chapter 8410) for plan content. WMOs use these rules in plan revisions, which are required every 5 to 10 years. The rules require, among other items, more specificity in citizen participation, control of erosion and sedimentation, wetland assessment, and the design of new stormwater conveyance and treatment systems.

The Metropolitan Surface Water Management Act lists a number of responsibilities watershed management organizations can elect to accept and carry out.

The MWMO has the authority to:

- protect, to preserve, and to improve surface and groundwater systems
- establish more uniform local policies and official controls for surface and groundwater management
- prevent erosion of soil
- protect and enhance fish and wildlife habitat and water recreational facilities.

These responsibilities affect more than just water resource management; they impact land use, habitat and ecosystem planning, and management connected to water resources.

Additionally, in 2001, the legislature granted the authority of a Special Purpose Taxing District under Minnesota Statute Section 275.066 to the MWMO. This authority continues to be vital to implementing plans and goals of the MWMO.

2.4 Present Day Jurisdictional Area

The MWMO's jurisdictional area includes portions of the cities of Columbia Heights, Fridley, Hilltop, Lauderdale, Minneapolis, Saint Anthony Village, and Saint Paul as well as lands owned by the Minneapolis Park and Recreation Board. The MWMO's current (as of 2020) legal boundary is shown in **Figure 1**.

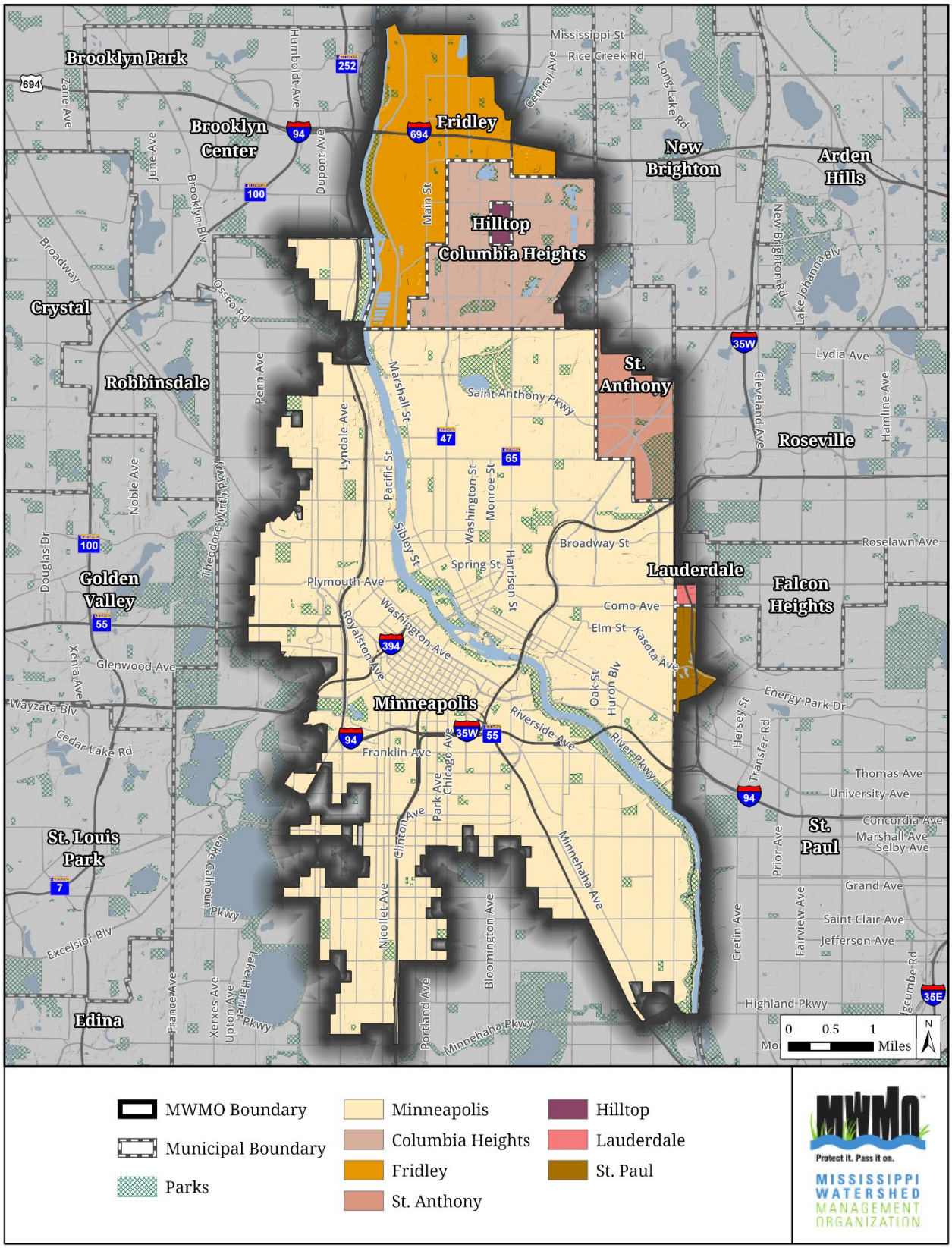


Figure 1: MWMO Legal Boundary and Location of Cities and Parks

Table 1: Percent Coverage of Member Organizations within the MWMO

Municipality	Percent Area of MWMO	Acres within MWMO	Square Miles
Columbia Heights	7.92%	2,025.04	3.16
Fridley	9.51%	2,431.89	3.80
Hilltop	0.32%	81.57	0.13
Lauderdale	0.16%	40.46	0.06
Minneapolis	73.26%	18,729.70	29.27
MPRB*	5.42%	1,386.50	2.17
Saint Anthony Village	2.55%	653.13	1.02
Saint Paul	0.85%	217.34	0.34
Totals	100.00%	25,565.63	39.95

*The MPRB's landholdings are within the Cities of Minneapolis and Saint Anthony Village

2.5 Board of Commissioners

The MWMO's governing Board of Commissioners consists of seven commissioners. There is one commissioner appointed by each member organization, with the exception of a shared seat for the cities of Columbia Heights and Hilltop.

Table 2: 2020 Board of Commissioners of the MWMO*

Member	Position	Member Community
Kevin Reich	Chair	City of Minneapolis
Jeff Dains	Vice-chair	City of Lauderdale
Donna Schmitt	Treasurer	City of Columbia Heights/Hilltop
Chris Meyer	Commissioner	Minneapolis Park and Recreation Board
Randy Stille	Commissioner	City of Saint Anthony Village
Vacant	Commissioner	City of Saint Paul
Steve Eggert	Commissioner	City of Fridley

* Visit www.mwmo.org for a current list of commissioners and alternates.

2.6 Committees

The Citizen Advisory Committee (CAC) meets at the request of the MWMO Board of Commissioners to assist in managing the water resources of the MWMO. The CAC reviews MWMO's annual budget and Stewardship Fund grant applications and makes recommendations to the Board. The committee also participates in strategic planning for the watershed: http://www.mwmo.org/about/citizen-advisory-committee/.

A Technical Advisory Committee also meets at the request of the MWMO Board of Commissioners to assist in managing the water resources of the MWMO. This committee does not have a standing membership; rather, a panel of experts is assembled based on specific project or program needs.

2.7 Focus Areas

The following focus areas were derived from public comments to guide the development and implementation of goals and strategies that advance the MWMO's mission.

Based on over 430 the public comments received between 2019 and 2021, the existing focus statements remain relevant. Rather than narrowing the broader issues of equity and climate change into a single focus area, the MWMO sees these issues permeating throughout all aspects of the MWMO's organization and the work we do.

The mix of sources and manner in which the input was gathered does not lead to a prioritization of the focus areas in of themselves. Rather, it provides us insight into key issues and people's values in the watershed. The focus areas are outlined in further detail in **Section 5** and **Section 6.2**, **Table 27**.

Water Quality Focus Area (WQ)

- WQ 1- Protect and improve the water bodies of the MWMO
- WQ 2- Account for water quality conditions upstream that impact the MWMO
- WQ 3- Participate in the development and implementation of TMDLs
- WQ 4- Identify the role the MWMO will take in addressing soil contamination and groundwater quality

Water Rate and Volume Focus Area

- WRV 1- Manage the causes and reduce the effects of flooding that impact the watershed
- WRV 2- Manage the causes and reduce the effects of drought that impact the watershed

Monitoring & Data Assessment Focus Area

- MD 1-Make decisions based on science and best available data

Communications and Outreach Focus Area

- CO 1- Provide resources and opportunities to build capacity and leadership and promote responsible stewardship of water and natural resources
- CO 2- Create communication and outreach connections within MWMO programs
- CO 3- Enhance communications between MWMO and constituents

Ecosystem Health Focus Area

- EH 1- Find ways to protect, create, and enhance vegetated areas, native plant communities, habitat, open space, green infrastructure and natural resources
- EH 2- Protect land that significantly impacts surface water and groundwater resources

Regulations & Enforcement Focus Area

- RE 1- Promote consistency in rules, regulations, standards, and enforcement across jurisdictions
- RE 2- Improve compliance and enforcement of regulations related to water and natural resources

Urban Stormwater Management Focus Area

- USM 1- Promote unique and innovative solutions for stormwater management in highly developed urban areas

Emergency Preparedness & Response Focus Area

- ER 1- Protect natural resources when natural disasters and emergencies occur

Emerging Issues Focus Area

- EI 1- Develop new approaches that protect water and natural resources as conditions change and emerging issues arise

Financial Responsibilities and Strategies Focus Area

- FRS 1- Maintain a comprehensive financial framework to implement goals, strategies, and actions of the plan
- FRS 2- Maintain a funding strategy that is effective, efficient, and transparent

The plan identifies several work areas and implementation actions to address each of the focus areas. Work areas are described in in **Section 7.1** and implementation actions are outlined in **Section 6.2**. The MWMO's work areas are:

- Capital Projects
- Outreach
- Stewardship Grant
- Communications
- Monitoring
- Planning
- Watershed Assessment

2.8 Using the Plan

This plan is developed to guide the MWMO Board and staff in the implementation of watershed goals. The plan sets out goals and strategies based on studies and data on the status of the water and natural resources of the watershed. The MWMO Board and staff use the plan to guide watershed management decisions and to assist in the development of annual work plans based on the outlined work areas in concert with goals and strategies.

Member organizations will find the plan useful in developing local surface water management plans and local ordinances through the land and water resource information and by reviewing the requirements for local plans outlined in the Member Authorities and Responsibilities section. Additionally, member organizations may use the MWMO implementation plan to assist in scheduling and coordinating capital improvements and programs.

Residents, businesses, and other organizations within the watershed may use the Plan to learn more about the natural and water resources within the watershed and to be aware of how the can partner with the MWMO on projects. For individual MWMO studies, content, and resources beyond this Plan, please see our website at https://www.mwmo.org/.

2.9 General Content of Local Plans

The required content of local plans is specified further in Section 3.3 and generally includes:

- Water, Natural Resources, and Land Use Goals and Policies
- Infrastructure Assessments and Programs
- MWMO Standards
- Surface Water Appropriations
- Evaluation

3.0 Member Authorities and Responsibilities

The MWMO will work with member organizations and other water-related authorities to implement the goals and strategies of this plan. Coordination between the MWMO and member organizations requires that each organization has a clear role. This section of the plan clarifies these roles by describing the MWMO's understanding and expectations of each authority in the areas of MWMO's standards, members' local water plans, all water-related authorities in the MWMO, and MWMO funding.

3.1 Adopting MWMO's Standards

The MWMO recognizes that the control and determination of appropriate land uses is the responsibility of the local units of government. Our members and partners understand the MWMO is responsible for the protection and management of surface and groundwater systems. In this role, it is well equipped to develop resource-based standards (MWMO Standards) that will best address the impact of the surrounding land use on the quality of the surface and groundwater systems. The MWMO does not issue permits or provide approval letters for construction projects; rather, it relies on the existing permitting and enforcement bodies of its member organizations. To continue this efficiency in government, the MWMO prefers to have member organizations integrate the implementation and enforcement of MWMO Standards into their existing regulatory departments (see Appendix B). The MWMO assists its member organizations by providing additional staff expertise and funding for the writing of these standards into ordinance. The following standards have been written with the acknowledgement that cities may need to add more details to the final ordinances.

3.1.1 Volume Control in Urban Areas

The MWMO's highly urban setting and non-native soils present limitations to implementing volume controls in the watershed. The MWMO acknowledges these limitations and thinks the Design Sequence Flow Chart developed through the Minnesota Pollution Control Agency's Minimal Impact Design Standards process adequately addresses these limitations by providing suitable alternatives to volume control on difficult sites.

Volume controls are a proactive approach to watershed management and are necessary to maintain a viable ecosystem within the challenging urban environment of the watershed. The MWMO's volume control standards reduce the loading of pollutants entering receiving waters, improve consistency with adjacent watersheds' rules, and are consistent with the Minnesota Pollution Control Agency's Construction Stormwater Permit volume control requirements. The standards may also help maintain the longevity of the pipeshed system, promote groundwater recharge, and contribute to river baseflow.

Infiltration practices are used to implement a volume control standard. Among stormwater best management practices, those practices that infiltrate stormwater (thereby reducing volume) have the highest efficiency in removal of pollutants and remove the greatest numbers of pollutants. As

a result of these characteristics, infiltration practices save time, money, land, and other scarce resources because they proactively manage for future pollutants not yet identified and regulated. In addition, onsite infiltration practices replicate as close as possible a watershed's natural hydrologic cycle, limiting pollutant concentrations, and preventing higher downstream cleanup costs. Infiltration practices may attenuate 2-year, 24-hour storm event flows, i.e., the maximum rate of discharge for smaller storm events for which volume practices are size and reduce long-term wear and maintenance costs on the pipeshed. The adoption of a volume control standard, by the MWMO is promoting a consistent approach to achieving water quality goals across much of the Twin Cities. Developers who work across the Twin Cities repeatedly spoke up during the Minimal Impact Design Standards process in favor of more consistent standards among jurisdictions.

Although triggers vary, the MWMO is surrounded by watershed organizations that require retaining approximately the first 1 inch of runoff onsite. These currently include the Capitol Region Watershed District, the Minnehaha Creek Watershed District, the Rice Creek Watershed District, the Coon Creek Watershed District, the Shingle Creek Watershed Management Commission, and the Bassett Creek Watershed Management Commission. In addition, the MWMO's volume standard is in line with the Minnesota Pollution Control Agency's current Construction Stormwater Permit requirements of retaining 1-inch volume onsite. This is a requirement that all MS4s must meet.

3.1.2 Limiting Costs of Stormwater Treatment

Initially, stormwater management practices were designed to meet conditions found in new growth areas, outside of urban cores, where there were few limiting conditions to site development. However, in highly urbanized areas, where a property may have experienced multiple land uses and been redeveloped many times, there is a greater likelihood that there will be factors limiting certain types of stormwater management practices on the site. Thus, when the same stormwater management practices are fitted to the urban core, the costs may rise significantly due to site conditions such as higher land values, polluted soil conditions, inappropriate fill, or placement of existing infrastructure. Therefore, the MWMO may seek to limit the cost of stormwater treatment any site incurs in complying with the MWMO's Standards. A limit of the stormwater costs is needed to balance the environmental and financial tradeoffs to the public and private sectors to achieve the protection and restoration of the water quality and quantity in the watershed.

On occasion, the limiting conditions on urban sites may inflate the cost of site stormwater treatment to a level that exceeds what is reasonable to expect, so the MWMO will consider shifting the treatment to the next best site opportunity elsewhere in the watershed or further upstream. When this shift occurs, the opportunity is lost to manage stormwater as close as possible to its source. Source management of stormwater is the preferred option for replicating a watershed's natural hydrologic characteristics, limiting pollutant concentrations, and preventing downstream cleanup costs.

3.1.3 The MWMO's Standards Language

1. Stormwater Management Standards
Any project creating greater than one acre of land disturbance is subject to the standards below:

a. The MWMO's Standards, or higher, must be adopted by local units of government and incorporated into their stormwater ordinance or other regulatory control.
b. In order to reduce regulatory complexity, a member may request the MWMO to allow stormwater rules set forth by adjacent watershed management organizations to govern development so long as they can be shown to be substantially equal to or greater than the level of protection afforded by the MWMO Standards.
c. Road mill and overlay project activities need only to comply with MWMO erosion and sediment control standards.
d. See the land disturbance definition for activities that shall not be considered land disturbance for the purposes of determining permanent stormwater management requirements.

2. Rate Control

Runoff rates for the proposed activity shall meet the member cities and MS4s runoff rate control requirements, using the member cities' and MS4s' required critical storm events (as defined by Atlas 14 Volume 8 and/or subsequent revisions). Runoff rates for the proposed activity and pre-development shall be determined using an Atlas 14-based (nested, regional, state) rainfall distribution using NRCS-approved methodology.

All area contributing to the practice shall be accounted for in the design of the rate control practice. This includes areas offsite and beyond the public right-of-way that will be contributing to the practice.

3. Water Quality/Volume Control

a. For nonlinear projects, without limitations, that disturb one or more acre of land, 1.1 inches of runoff from the new and fully reconstructed impervious surfaces shall be captured and retained onsite.
b. For linear projects, on sites without limitations, that disturb one or more acre of land, the larger of the following shall be captured and retained onsite:
    i. 0.55 inches of runoff from the new and fully reconstructed impervious surfaces
    ii. 1.1 inches of runoff from the net increase in impervious area
c. For projects on sites with limitations, the MWMO Design Sequence Flow Chart (Appendix I) or a MWMO-approved alternative shall be used to identify a path to compliance through Flexible Treatment Options.
    i. The MWMO will develop a memorandum of understanding (MOU) with individual member cities and MS4s to address flexible treatment option #3 offsite mitigation conditions.

Volume Control Guidance (recommended procedures for volume control projects)

a. Infiltration volumes and facility sizes shall be calculated using the appropriate hydrologic soil group classification, ASTM Unified Soil Class Symbol, and design infiltration rate from **Table 4**. Select the design infiltration rate from **Table 4** based on the least permeable soil horizon within the first five feet below the bottom elevation of the proposed infiltration management practice. The information provided in **Table 4** is intended to be used in the following manner:

    i. For preliminary design purposes, refer to the Natural Resources Conservation System (NRCS) soil survey to identify the hydrologic soil groups found onsite. This information provides a preliminary indication of the infiltration capacity of the underlying soils.
    ii. After volume control/infiltration practices have been located on the grading plans, perform soil borings in the exact location of the proposed practices and in the quantity as described in the Minnesota Stormwater Manual Wiki (Minnesota Pollution Control Agency, 2014) as amended. Soil borings should be logged using the United States Department of Agriculture (USDA) Soil Textural Classification System and the ASTM Unified Soil Class Symbol.
    iii. The combination of all the aforementioned information will allow the designer to identify the appropriate design infiltration rate. As the Minnesota Stormwater Manual States, "these infiltration rates represent the long-term infiltration capacity of a constructed infiltration practice and are not meant to exhibit the capacity of the soils in the natural state". A permit applicant can submit field measurements and revised rates, using the correction factors provided in the Minnesota Stormwater Manual if there is reason to believe the long-term infiltration rates will be other than the design infiltration rates provided in **Table 4**.

b. A geotechnical investigation shall be performed in the location of the proposed volume control practices to confirm or determine underlying soil types, the depth to the seasonally high groundwater table, and the depth to bedrock or other impermeable layer.
c. Infiltration BMPs shall drawdown in the time specified in the Minnesota Stormwater Manual Wiki for that BMP, or less if required by another entity with jurisdiction. Drawdown time and maximum ponding depths are defined in the Minnesota Stormwater Manual Wiki.
d. Infiltration stormwater management practices must be designed to include adequate pretreatment measures before discharge of runoff to the primary infiltration area, consistent with the Minnesota Stormwater Manual Wiki.
e. Design and placement of infiltration stormwater management practices shall be done in accordance with the Minnesota Department of Health guidance called "Evaluating Proposed Stormwater Infiltration Projects in Vulnerable Wellhead Protection Areas." (Most recent version to govern)
f. Specific site conditions may make infiltration difficult, undesirable, or impossible. Some of these conditions are listed in **Table 3**. A more comprehensive list is provided in the MWMO Design Sequence Flow Chart in Appendix I.

Table 3: Site Conditions Considered Undesirable for Infiltration Stormwater Management Practices

Type	Specific Site Conditions	Submittal Requirements
Potential Contamination	Potential Stormwater Hotspots (PSHs)	PSH locations and flow paths, Remediation Alternatives Considered
	Contaminated Soils	State Permitted Brownfield Documentation, Soil Borings, Remediation Alternatives Considered, Site design alternatives considered
Physical Limitations	Low Permeability (Type D Soils)	Soil Borings
	High Permeability (soils infiltrating greater than 8.3 inches/hour)	Soil Borings
	Bedrock within 5 vertical feet of bottom of infiltration area	Soil Borings
	Potential Adverse Hydrologic Impacts (e.g., impacting perched wetland)	Documentation of Potential Adverse Hydrologic Impacts
	Seasonal High Groundwater within 5 vertical feet of bottom of infiltration area	Soil Borings
	Karst Areas	Soil Borings
	Steep Slopes	Steep Slope Determination
Land Use Limitations	Utility Locations	Site Map, Alternatives considered
	Zoning or Land Use Limitations (Parking, Density, Setbacks, etc.)	Alternatives considered, Documentation of Infeasibility
	Adjacent Wells within 200 feet or inside Wellhead Protection Area or Drinking Water Supply Management Areas (DWSMA)	Well Locations or DWSMA
	Building Foundation	Ten (10) feet

Source: Modified from Minnesota Pollution Control Agency Minimal Impact Design Standards Design Sequence Flow Chart, December 5, 2013

Note: the most recent version of the Minnesota Stormwater Manual should be used; **Table 3** is provided as optional guidance to the cities

Table 4: Design Infiltration Rates

Hydrologic Soil Group	Soil Textures[1]	ASTM Unified Soil Class Symbols	Rate Per Hour
A	Gravel, sandy gravel, silty gravel	GW, GP, GM, SW	1.63 in
	Sand, loamy sand, sandy loam	SP	0.80 in

Hydrologic Soil Group	Soil Textures[1]	ASTM Unified Soil Class Symbols	Rate Per Hour
B	Loam, silt loam	SM	0.45 in
		MH	0.30 in
C	Sandy clay loam	ML	0.20 in
D	Clay, clay loam, silty clay loam, sandy clay, silty clay	CL, CH, OH, OL, GC, SC	0.06 in

Source: Minnesota Stormwater Manual Wiki, October 2014

Note: Design infiltration rates from the most recent version of the Minnesota Stormwater Manual should be used

1 Adapted from the U.S. Department of Agriculture, Natural Resources Conservation Services, 2005. National Soil Survey Handbook, title 430-VI.

Maintenance

- Practices must continue to perform as approved. Owners must follow an inspection and maintenance schedule that has been approved by the permitting entity and correct any post-construction performance issues that arise.
- All stormwater management structures and facilities, including volume reduction stormwater management practices, shall be maintained to ensure that the structures and facilities function as originally designed. The maintenance responsibilities must be assumed by either the municipality's acceptance of the required easements dedicated to stormwater management purposes, by the applicant executing and recording a maintenance agreement, or by another enforceable means acceptable to the local government unit (LGU). If used, the recordable executed agreement must be submitted to the municipality before project approval is issued from the city. Public developments will require a maintenance agreement in the form of a Memorandum of Agreement, an approved Local Water Management Plan, or be in compliance with an MS4 Permit that details the methods, schedule, and responsible parties for maintenance of stormwater management facilities for permitted development. A single Memorandum of Agreement for each LGU may be used to cover all stormwater management structures and facilities required herein, including volume reductions management practices, within the LGU's jurisdiction. This maintenance plan shall address snow management.

Drainage Alterations

No person shall alter stormwater flows (resulting in an increase in stormwater flows or a change in existing flow route) at a property boundary by changing land contours, diverting or obstructing surface or channel flow, or creating a basin outlet, without first obtaining any necessary permits from the city.

Bounce and Duration Control

- The project must meet hydroperiod standards adapted from "Stormwater and Wetlands Planning and Evaluation Guidelines for Addressing Potential Impacts of

Urban Stormwater and Snowmelt Runoff on Wetlands," (Minnesota Stormwater Advisory Group, June 1997), as follows:

i. **Wetland Susceptibility Class** = Highly Susceptible;
Permit Storm Bounce = Existing;
Inundation Period for 2-Year event = Existing;
Inundation Period for 10-year or Greater Event = Existing
ii. **Wetland Susceptibility Class** = Moderately Susceptible;
Permit Storm Bounce = Existing plus 0.5 feet;
Inundation Period for 2-Year event = Existing plus 1 days;
Inundation Period for 10-year or Greater Event = Existing plus 7 days
iii. **Wetland Susceptibility Class** = Slightly Susceptible;
Permit Storm Bounce = Existing plus 1.0 feet;
Inundation Period for 2-Year event = Existing plus 2 days;
Inundation Period for 10-year or Greater Event = Existing plus 14 days
iv. **Wetland Susceptibility Class** = Least Susceptible;
Permit Storm Bounce = No Limit;
Inundation Period for 2-Year event = Existing plus 7 days;
Inundation Period for 10-year or Greater Event = Existing plus 21 days

Flood Control

Flood control for the proposed activity shall meet the member cities or MS4's flood control requirements. Member cities and MS4's flood control requirements should minimize property damage due to excess water.

Erosion and Sediment Control

- Erosion and sediment control measures shall meet the standards for the General Permit Authorization to Discharge Stormwater Associated with Construction Activity Under the National Pollutant Discharge Elimination System/State Disposal System Permit Program, Permit MN R100001 (NPDES General Construction Permit), issued by the Minnesota Pollution Control Agency, except where more specific requirements are required.
- Activity shall be phased to minimize disturbed areas subject to erosion at any one time.
- All construction site waste—such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at the construction site—shall be properly managed and disposed of so they will not have an adverse impact on water quality.
- If silt fence is installed, it shall conform to sections 3886.1 and 3886.2, Standard Specifications for Construction, Minnesota Department of Transportation (MnDOT) (2005 ed.), as it may be amended.

3.1.4 Implementation of the MWMO's Standards

With respect to the financial impact of these standards, the MWMO does not foresee a significant increase in administrative, permitting, and enforcement costs for LGUs adopting these standards. However, studies conducted by the MWMO demonstrated that it will cost more to meet the Minimal Impact Design Standard (MIDS) than the existing cities standards. Yet, when it comes to linear projects the MWMO's new MIDS based standard is anticipated to be less costly than MWMO's previous 90% total suspended solids (TSS) standard.

As required by statute, each member organization shall amend their local water plans and adopt local ordinances and/or official or local controls that are consistent with the MWMO Standards in this plan. The MWMO is committed to ensuring the implementation of its standards in cooperation with member organizations. To promote consistency in application of the MWMO Standards, the MWMO recommends members adopt its ordinance-ready MWMO Standards language into their local ordinances and/or their official or local controls. In addition, the MWMO may provide training for local staff to ensure their familiarity with the standards. The MWMO may also provide funding or staff to assist local inspection and enforcement efforts.

The MWMO may allow a member community to comply with the rules and regulations of another watershed if the MWMO deems the standards of the other watershed management organization to be comparable to MWMO Standards set forth in this plan. The MWMO Board of Commissioners reserves the right to review and comment on site alteration plans that affect the quality and quantity of water within and across its watershed and subwatershed boundaries. If this action is taken, a process will be coordinated with the subject city's development review approval timelines.

To ensure ongoing improvement of the standards and their enforcement, the MWMO plans to convene meetings, on an as needed basis, with member organizations and adjacent watersheds to review implementation of the standards and enforcement procedures. Based on the results of these meetings, the MWMO may revise the MWMO Standards and/or work with the cities to design more efficient and effective implementation and enforcement processes that ensure the protection of natural and water resources in the MWMO.

If the MWMO determines that a member organization is not adequately carrying out the adoption, implementation and enforcement of the (stormwater-related) local controls then, the MWMO may pursue all actions necessary to ensure the MWMO's standards are being efficiently adopted, and effectively implemented and enforced. During this period of time the MWMO may withhold project funding or services from the entity and or the jurisdictional area that is not in compliance with the MWMO's Standards.

Evaluation of the effectiveness of MWMO's Standards and enforcement will be based in part on monitoring the water resources and installed practices in the MWMO. The MWMO may also conduct periodic onsite reviews of permitted activities within member organizations' jurisdictions.

3.2 Local Water Plans and Local/Official Controls: Adoption Timeline

Member organizations are responsible for preparing and adopting a local water plan that is consistent with the MWMO Plan. The local water plan must include information on land use, stormwater runoff, stormwater storage, water quality, and implementation methods to protect local resources. The specific content requirements of local water plans are found in sections 3.2, 3.3, 3.4 of this plan; defined in Minnesota Statue 103B.235; and defined in Minnesota Rule 8410 (the MWMO will follow the most recent versions of these documents).

To comply with the 8410 Rules (revised in 2015) all local water plans are required to be adopted during a two-year window prior to their next comprehensive plan update deadline. As such, the MWMO recommends cities set up a local water plan pre-draft meeting 6 months before the beginning of this two-year window to discuss MWMO's content requirements, schedule future preliminary reviews, and schedule the future 60-Day draft review period. See **Table 5** for deadlines to be scheduled with each city prior to the final submittal deadline of their local water plan.

The local water plans must be consistent with all the watershed management plans that fall within the municipal boundary. Each local water plan shall be adopted not more than two years before the local comprehensive plan is due. Extensions of local comprehensive plan due dates do not alter the local water plan schedule. Each local water plan must be adopted and implemented in accordance with the time requirements of Minnesota Statutes, section 103B.235, subdivision 4 as summarized below.

The updated local water plan must be submitted for review to the MWMO, County, and Metropolitan Council. The County and Metropolitan Council have 45 days to review and provide comment on the updated plan. The MWMO has 60 days to complete its review and approve or disapprove the local water plan or parts of the local water plan. The review by Metropolitan Council, County, and the MWMO runs concurrently. If the Metropolitan Council fails to complete its review and make comments to the MWMO within the 45-day period, the MWMO will conclude its own review. If the MWMO fails to complete its review within the prescribed 60-day period, the local water plan shall be deemed approved unless an extension is agreed to by the city.

After approval of the local water plan by the MWMO, the local government unit shall adopt and implement its local water plan within 120 days and shall amend its official controls accordingly within 180 days. Each city must notify MWMO and the Metropolitan Council within 30 days of adoption and implementation of the local water plan or local water plan amendment, including the adoption of necessary official controls.

Table 5: Local Water Plan and Local/Official Controls Review, Approval and Adoption Schedule

Year - Month	Task
2026 - June / July	Discuss Local Water Plan Content Requirements and set Schedule for any Previews of Preliminary Drafts and MWMO's 60 Day Review and Comment Period

Year - Month	Task
2026 - August / Varies by City	Previews of Preliminary Drafts or Meetings with the MWMO[1]
When Draft is Ready Start 60-Day Review Period	Submittal of Local Water Plans to MWMO, County, and Metropolitan Council
When Draft is Ready Start 60-Day Review Period	Submittal of Member Organizations Preliminary Local/Official Controls[2]
Within the 60-Day Review Period	MWMO Approves or Denies Local Water Plans and Local/Official Controls or Member Organizations Agree to Extension
Within the Extension Review Period	Extended Deadline for Local Water Plan and Local/Official Controls Approval or Denial by MWMO
120 Days After Approval of Local Water Plan	Deadline for Member Organizations to Adopt Local Water Plans if Approved by MWMO
180 Days After approval of Local/Official Controls	Member Organizations Adopt, Implement and Enforce Local/Official Controls

[1]MWMO is requesting a preview of preliminary drafts from our larger member cities of Minneapolis and St Paul.
[2]MWMO will require Local/Official Controls and all other supporting documentation for the local water plan to be to be available for review with the local water plan.

Over time, the MWMO will determine the effectiveness of stormwater management efforts in the watershed by correlating the intended impacts of stormwater management practices installed in a given subwatershed with changes in pollutant concentrations found in that subwatershed. In this manner, monitoring data on the end of the pipe concentrations discharging to the river will be used to adjust management efforts over the long term. The MWMO will also collect in-stream Mississippi River data and review the long-term cumulative impact occurring from all pipes discharging into the Mississippi River within the MWMO. Ultimately these findings will guide decisions on whether the MWMO's Standards are sufficient to achieve the goals of the MWMO and its members.

If the MWMO determines that a member organization is not taking the necessary steps to complete, within the timeframe provided in **Table 5**, one or more of the following actions will be taken:

- Amending its local water plan
- Adopting local controls
- Enforcement/implementing enacted local controls.

The MWMO will pursue all actions necessary to ensure the MWMO's standards are being efficiently adopted, and effectively implemented and enforced. During this period, the MWMO

may withhold project funding or services from the entity or jurisdictional area which is not in compliance with the MWMO's Standards.

3.3. Local Water Plans: Content Requirements

Minnesota Statutes, section 103B.235 and Minnesota Rule 8410, discuss the particular requirements and format of a local water plan (see most recent version of MN Statutes and Rules). The MWMO is especially interested in problems identified in the local water plan and corrective actions that affect the MWMO concerns stated in this plan or that may require MWMO collaboration.

Member organizations may adopt by reference all, or part, of this plan. If a member organization does not adopt the plan, their local water plan must meet the requirements outlined in Minnesota Statutes, section 103B.235 and Minnesota Rule 8410 as well as the content in the MWMO's **Table 6**. If a member organization partially adopts the MWMO Plan, then any requirements in the MWMO Plan not adopted must be completed and included in their local water plan, along with the content described in **Table 6**. Member organizations that adopt by reference all of the MWMO Plan into their local water plan also need to complete and include content elements found in **Table 6** in their local water plan.

Cities should use information currently available to complete **Table 6** requirements. No new studies are required to provide the information requested in **Table 6**. Organizations only need to cite the source of information requested in **Table 6** if it is already a part of another organizational document. The table may require content that goes beyond what is requested by other agencies. However, if there is a conflict between another agency's requirements and **Table 6** the MWMO will defer to the agency's requirement. If available, each local water plan must contain the following information regarding the management of its water and natural resources.

Table 6: Local Water Plan Content Requirements

Water, Natural Resources, and Land Use Goals and Policies
1. Include an executive summary that summarizes the highlights of the local water plan. Highlights may include local water plan goals, policies and implementation programs that address problems identified in the MWMO's Plan (Focus Statements in Section 2.7); corrective actions that affect these MWMO concerns; and any actions requiring MWMO's collaboration.
2. Provide a citation and brief description of (Annotated bibliography) water resource management-related agreements that have been entered into by the community, including joint powers agreements related to water management that the LGU may be party to between itself and watershed management organizations, adjoining communities, or private parties.
3. Describe the city's current water resource and ecosystem health-related problems and any problems that are expected to worsen or emerge over the next 10 years given the projected changes in the city's growth and land use. Identify how MWMO can help address these problems through: implementation programs; monitoring or research

Water, Natural Resources, and Land Use Goals and Policies
needs; temporary maintenance activities associated with innovative projects; capital improvement programs; or where MWMO funding, technical expertise, project management assistance is desired.
4. As a part of the Local Water Plan and City Comprehensive Plan development process, LGUs should carefully examine how water resources and ecosystems management and protection can be integrated into land use planning and development. The MWMO will look for each local plan to do the following:
a. Describe how decisions on land use, regional water and natural resource needs are being reconciled to secure the greatest degree of long-term water resource and ecosystem protection (see 2.7 e.g. water quality and ecosystem health focus areas)
b. Address the order of authority between city: planning, policies, ordinances, permitting (e.g. city: policy, comprehensive plan, permitting, zoning ordinances).
c. The MWMO is interested in increasing opportunities for stormwater infrastructure that treats runoff from multiple parcels. In particular, we are interested in opportunities that provide increased greening, habitat potential and options for stormwater reuse. Note any modifications to ordinances or best practices that could improve these opportunities. Consider how ordinances can better accommodate the co-location of stormwater treatment for multiple sites or provide more flexibility in locating stormwater treatment when limitations are present due to the soil type, geology, slope, groundwater and contaminated soils. Some example ordinances and best practices to review are as follows: zoning ordinances related to parcel combination, setbacks and parking requirements etc…; subdivision ordinance design standards for large lots; building code; ordinances related to stormwater, street sweeping, sanitary, potable supply systems, etc...; ordinances related to groundwater, protection of natural features, the critical area, shoreline protection, etc..
d. Identify a future amendment process and schedule for reassessing ordinances that impact water resources and ecosystem protection.
e. Describe efforts to integrate Safe Drinking Water Act and other wellhead protection plans, as well as the protection of sensitive surface- and groundwater resources, into the local zoning code.
f. Describe how water resource and ecosystem protection priorities will be integrated into local parks, open space, recreation and land acquisition plans.
g. Describe how local authority to require land or easement dedication as a part of redevelopment regulation is being used for water resource and ecosystem protection purposes
Infrastructure Assessments and Programs
5. Include a local implementation program that covers the term of the local water plan. The local implementation program must describe nonstructural, programmatic, and structural solutions to existing or potential water resource and ecosystem health-related problems identified by the city. The local implementation program shall include:
a. Describe the existing and proposed physical environment and land use. Include wetlands, natural resources, and land conservation areas identified by the municipality

Water, Natural Resources, and Land Use Goals and Policies
b. Define drainage areas and the volumes, rates, and paths of stormwater runoff, including a map of the stormwater system.
c. Include a stormwater system map that shows ponds, streams, lakes and wetlands that are part of your system; structural pollution control devices (grit chambers, separators, etc.) that are part of your system; pipes and pipe sizes and other conveyances in your system; and outfalls and all other points of discharge from your system that are outlets.
d. Include a table that briefly describes each component of the implementation program and clearly details the schedule, estimated cost, and funding sources for each component including annual budget totals;
e. Include a table for a capital improvement program that sets forth, by year, details of each contemplated capital improvement that includes the schedule, estimated cost, funding source and a description of the water quality protection methods used to meet the MWMO's Standards (Section 3.13).
f. Provide a schedule and annual process for assessing the need for water resource-related capital improvement programs or projects in the city
g. Clearly define the responsibilities of the local government unit from that of the MWMO and other entities for carrying out the implementation program components
6. Explain interdepartmental coordination of water and natural resource issues in the city:
a. Identify a communications process the city uses to coordinate activities between departments making policy, planning or regulatory decisions that impact surface and groundwater resources, stormwater and sanitary sewer systems. How is coordination between city council initiatives and policies; land use planning; management and planning of parks; development reviews; construction site inspections, permitting, and enforcement; operations and maintenance of city streets and infrastructure carried out? Explain what the city is does to avoid inconsistency and inefficiencies between the departments' activities. Identify a staff position/s contact in each department. (e.g. Representatives from the Mayor's Office, Parks & Recreation Department, Planning & Economic Development, Public Works, Regional Water Services, and Safety & Inspection Department)
b. Provide a description of the interdepartmental city process that facilitates the approval and installation of innovative stormwater management facilities (a liaison and roadmap for navigating
7. Provide a summary of the member organization's Storm Water Pollution Prevention Program and conformance with the requirements of the Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) for municipal separate storm sewer systems (MS4s) or summarize relevant plans and programs of the member organization that address:
a. Inspection and maintenance plans (wet ponds, infiltration basins, raingardens, stormsewer systems, etc.)
b. Street sweeping, right-of-way maintenance, road icing, salt storage, snow plowing, and snow storage programs

Water, Natural Resources, and Land Use Goals and Policies
c. Spill response and containment plans d. Identify who (e.g. private, city, state entities) is responsible for inspection, operation, and maintenance of all storm water infrastructure, public works facilities, and natural and artificial watercourses within in the MWMO's city boundaries.
MWMO Standards and Agency Regulations 8. Describe your permitting process for land and wetland alteration work 9. Identify city ordinances that address permitting, site review and enforcement processes for implementing MWMO Standards 10. Describe how the city will comply with County groundwater plan requirements 11. List any lakes within the city that are on the Metropolitan Council's priority lake list
12. List any lakes within the city that are on MPCA's list of impaired waters
13. Summarize all Total Maximum Daily Load (TMDL) compliance requirements for the city
14. Summarize all current activities completed to date to comply with TMDL requirements
Surface Water Appropriations
15. Identify city administration of appropriations from small watercourses in accordance with MS 103B.211 Subd. 4
Evaluation
16. Identify how protections and improvements to water and natural resources will be measured through implementation of the local water plan

The member organizations should determine if other management programs are necessary to meet their local water plan goals and the goals of this plan.

The MWMO will discuss with each member organization the options that address its circumstances and will collaboratively determine the most practical approach to meeting the requirements of this plan and Minnesota Rules Chapter 8410. The MWMO understands the need to be sensitive to consistency with adjacent watershed districts and water management organizations. Coordination is required to successfully implement watershed standards and projects and maintain the integrity of the MWMO's goals. The MWMO will work closely with cities as needed in local water plan preparation, review, and implementation. The MWMO will apply its goals, objectives, and policies to its review of local water plans.

3.4 General Compliance Requirements

1. Make Local Water Plans available at city offices and provide the MWMO an office reference copy.
2. The MWMO requires member cities to have a Department of Natural Resources-approved Floodplain Ordinance and a Department of Natural Resources approved Shoreline Ordinance. If no ordinance is applicable, the MWMO requires that there be no encroachment on floodways that results in reduced capacities or expedited flood flows. The only structures allowed in the flood zone are those that have been flood proofed and approved by the Department of Natural Resources.

3. Member cities are required to comply with TMDL requirements as required by their respective MS4 permits.
4. Member cities are required to address the following stormwater management and stormwater maintenance standards in a manner consistent with MWMO Standards, applicable TMDL, and NPDES standards for MS4s:
    - Target pollutant loads
    - Maximum allowable runoff rates (MWMO standard)
    - Design criteria for stormwater facilities to address target pollutant loads
    - Schedule for street sweeping, stormwater facility inspection, and maintenance
    - Spill containment and clean-up plan
5. Member cities are required to notify the MWMO of all pre-development plans requesting a variance from the MWMO's Standards.
6. Member cities in Anoka, Hennepin, and Ramsey counties are required to carry out administration of appropriations from small watercourses in accordance with MS 103B.211 Subd. 4. unless an alternative agreement was established with the MWMO.

3.5 MWMO and All Water-Related Authorities

The MWMO members pursuant to Minnesota Statutes, Section 471.59 to jointly and cooperatively by agreement exercise powers common to the contracting bodies have formed a Joint Powers Agreement for the management of water resources pursuant to Minnesota Statutes, Section 103B.201 to 103B.253. Joint Powers Agreements may have a narrowing or broadening effect on the authorities allotted to watershed management organizations by Minnesota Statute Section 103B. Authorities held in common by all member cities may be transferred to the Watershed Management Organization, with the exception of revenue-related authorities. The MWMO's current Joint Powers (Cooperative) Agreement does not narrow or expand the authorities allotted by Minnesota Statute Section 103B.

The Water Resource-Related Activities of MWMO Member Organizations (included as Appendix C) identifies the water resource-related activities of each member organization and the MWMO. The Wetland Conservation Act authority held in common by the cities is an example of an authority that could be wholly or partially transferred to the MWMO. This table may also be used to identify partnership opportunities that generate synergies and efficiencies in managing water resources in the watershed.

Appendix C is organized by the "regulated water feature" (e.g. wetland, surface waters, navigable waters, and so on). These water categories were chosen because they often have a spatial dimension and they reflect common areas for water resource laws and regulations. Within each water category there are related subtopic areas.

This information is from a more extensive study the MWMO completed to identify all the entities with water-related jurisdictional authorities and responsibilities operating within the MWMO. Contact the MWMO to request a copy of this study.

3.6 MWMO Capital Project Funding

The goal of MWMO Capital Improvement Projects (CIPs) is to support implementation of water and natural resource infrastructure to improve water quality, reduce flooding, and improve habitat. MWMO prefers capital projects designed through a systems-based approach leading to multiple public benefits.

MWMO's staff expertise and funding is available to assist with development and implementation of projects and program efforts. Projects need to align with MWMO goals to qualify for funding. Member organizations and others seeking funding will need to seek out and propose high value, innovative projects to cost-effectively improve water quality and habitat.

To streamline the funding of capital improvement projects, members' implementation schedules for water resource-related capital improvement projects should align with the MWMO's planning and annual budget processes. Applicants seeking capital project funding are encouraged to involve MWMO staff early in the project's schematic design process. To ensure sufficient time for final design and bidding to be completed before a MWMO budget cycle, it is recommended that applicants provide a one-year funding request notice, preferably in the spring. For example, the funding application period starting in the spring of 2021 will close in the spring of 2022, and approved projects from that round would be included in the MWMO's 2023 budget cycle.

In addition to the CIPs included within the Plan, there are also capital project grants described on MWMO's website. These grants have up to two application cycles per year. A feasibility study including design alternatives, cost estimates, and pollution reduction estimates should be completed prior to the start of a capital project grant.

All CIPs proposed to the MWMO will be assessed by the MWMO's CIP selection considerations. Stormwater projects must meet or exceed the MWMO's Standards (or alternative design sequence if site conditions do not allow for meeting Standards). Project components that go above and beyond stormwater requirements may be eligible for funding if it is shown that the project would provide a public benefit (i.e. aligns with MWMO's mission and watershed management goals (as seen below). Project components required by regulatory authorities cannot be funded by MWMO.

In addition to the criteria MWMO has used, we will now also consider such things as systemic racism, present-day land use practices and patterns, historic infrastructure condition and standards, and operations and maintenance needs when assessing a projects viability for funding. Climate change impacts have brought to the forefront unresolved social, economic, and environmental issues. Climate change impacts are generating greater inequity within communities of black, indigenous, and people of color. When developing plans for equity and climate change the MWMO will be evaluating what additional considerations, if any, will be used to prioritize MWMO's CIP selection. This may include minimum requirements for community engagement, restoring equity in communities, increasing the watershed's resilience to climate change, and improving habitat in the watershed.

The list of capital improvement project selection considerations below will be used to help determine MWMO funding awards. Please contact staff or see the MWMO's website for the most recent CIPs approved for funding by the MWMO Board.

MWMO will look for alignment with its mission, plan goals and standards. These include such items as: improved water quality, surface water rate and volume control, increase habitat connectivity and restoration of natural areas, stabilization of eroding riverbanks, and improvement of riparian habitat using bio-engineering techniques. Additionally, project timeliness is important; generally, projects that cannot be completed within three years of applying are not likely to be funded.

Types of projects not eligible for MWMO funding include: paving (impervious roads, trails), maintaining or replacing pipes or other gray infrastructure, road-reconstruction projects with status-quo stormwater design, or projects under $50,000 (projects under $50,000 may potentially be referred to the Stewardship Fund grant program) If the project is not eligible, the CIP selection process ends for the applicant.

Projects passing through the first general review will be asked to submit information to provide MWMO with enough data and design to fund the project. These submittals will include some of the following depending on the type and scope of the project.

Project Location:

- Is the project on public land within a MWMO member community (all else being equal, MWMO will give public CIPs higher priority than projects on private land)?
- Does it provide a measurable, demonstrable public benefit?
- Can it provide stormwater treatment for connected parcels and areas of land (district treatment) or for offsite parcels and areas of land (regional treatment)?
- Does it consider and provide synergistic benefits with other infrastructure and land uses (i.e., the sum of the whole is greater than its parts)?
- Does it offer high visibility and educational or research value?

Design:

MWMO is interested in stormwater projects with:

- long life spans (at least 20 years)
- replicable in other locations
- offers innovative stormwater control technology

- ideally offers potential for significant pollutant removal
- habitat or water conservation
- climate resiliency
- measure and produce net positive for environmental, social, and economic outcomes
- engage black, indigenous, and people of color communities

Natural Resource-Oriented Land Management and Ecological Restoration:

The MWMO wants to support the restoration of diverse and functional natural landscapes, enhance areas of biological significance, and protect rare or endangered species. The MWMO seeks projects that are aligned with long-term planning and management efforts to create more connected landscapes, reduce habitat fragmentation, and enhance habitat complexity.

Public Support and Partnerships:

The watershed does not own property except for the MWMO facility at the Stormwater Park and Learning Center. The MWMO needs to find partners to implement the vast majority of its projects. The MWMO is looking for strong partnerships and/or community support, including neighborhood involvement, matching funds and/or in-kind commitments and educational components to enhance learning and awareness for all projects.

Opportunity and Timing:

Projects with completed preliminary investigation (e.g. soil analysis, surveys, and title work) or projects with opportunity costs related to not participating may be given extra consideration. For example, if we wait, we miss our chance to retrofit the site's stormwater features; e.g., a road reconstruction corridor with known flooded sites in the corridor.

Operations and Maintenance Plan:

Maintenance and operations are an increasingly important part of the MWMO's decision-making. With the costs of projects consistently on the rise the MWMO needs to build and maintain efficient and effective projects to achieve goals.

The MWMO does not take on the long-term operations and maintenance of the capital projects funded. As such, we work with landowners to establish a design, and long-term maintenance plan that reflects the abilities of our partners to maintain the long-term performance of the BMP's installed throughout their lifecycle. This typically requires a 20-year maintenance or habitat management plan and estimated life-cycle costs. MWMO will also need access to inspect and monitor the project's performance.

“But-for” Test:

The MWMO has long applied the “But-for” test. For example, “But-for MWMO’s funding and guidance, a project that is highly beneficial to the public would not happen.”

Finally, if the project envisioned is less than $50,000 then the MWMO’s Stewardship Fund Grant program is the best place to start.

The Stewardship Fund Grant program is separate for the Capital Grant program. Stewardship Fund Grants support public efforts to manage stormwater, control pollution, and improve water quality and habitat. For more information on funding assistance for projects under $50,000, please see the Stewardship Fund grant program website.

3.7 Financial Impact of This Plan on Member Organizations

This plan lays out requirements for local water plans, sets standards to be implemented by the member organizations, and outlines MWMO partnership and funding opportunities for member organizations. The plan does not outline specific capital improvements or other projects for member organizations. Costs to member organizations associated with the implementation of the requirements of this plan will include the development or revision of local water plans, the development or revision of ordinances to address MWMO standards, the implementation of standards in member organization projects, and the completion of project reviews based on adopted standards. The MWMO may assist member organizations in paying for capital improvement projects that meet the goals and standards of the MWMO. MWMO also provides expertise to assist with planning, monitoring, science, assessments, communications, and outreach activities.

The most recent version of member organizations’, counties, and agencies Capital Improvement Programs/Projects (CIPs) or similar documents will be used to guide future MWMO funding requests. In addition, the MWMO will reference planning documents that identify implementation actions and capital projects related to flooding, water quality, and habitat improvements.

4.0 MWMO Resources Inventory

4.1 Introduction

The MWMO resource section reviews land, water, and human resources within the MWMO boundaries and assesses the need for management of these resources based on the current knowledge of the watershed. This resource assessment section influences what, why, when, where, and how the public comments and issues in Appendix G of this Plan are addressed.

The Physical Environment section includes information on topography and geomorphology, geology, and soils. The Biological Environment section includes information on vegetation and wildlife. The Human Environment section includes information on land use and growth patterns, population dynamics, recreation, and potential environmental hazards. The Hydrologic System section includes information on climate, precipitation, surface water resources, groundwater resources, water quantity, water quality, impaired waters, and surface water appropriations.

4.2 Physical Environment

4.2.1 Potential Limitations to Infiltration

A map of potential limitations to infiltration is shown in **Figure 2**. Information from this resource inventory was used to better understand where infiltration limitations may exist in the watershed. While helpful from a planning level perspective, any information required for development purposes requires a site scale review. **Table 7** provides more information on limitations analyzed and the data sources.

Table 7: Infiltration Limitations and Data Sources

Limitation[1]	**Data Source**	**Data Source Confidence Interval**	**Year of Data Source**
Rough terrain may exist where slopes are steeper than 20%	Light Detection and Ranging	+/- 6 inches	2011
Hotspots and groundwater contamination may exist	Minnesota Pollution Control Agency "What's in my backyard"	See Note 6	2014
Shallow groundwater may exist between ground level and a depth of 20 feet[2]	Minnesota Department of Health Well Data	+/- 5 feet vertical accuracy Horizontal Accuracy[5]	2014
The Minnesota Department of Health recommends no infiltration within the 1-year 3travel zone (Emergency Response Area) of Drinking	Minnesota Department of Health Source Water Protection Unit	Minimum scale requirement for data and/or maps is 1:24,000.	2014

Limitation[1]	Data Source	Data Source Confidence Interval	Year of Data Source
Water Supply Management Area (DWSMA)[4]			
A minimum of a 50-foot setback is required from water supply wells[3]	Minnesota Department of Health Well Data	+/- 5 feet vertical accuracy Horizontal Accuracy[5]	2014
Karst conditions may exist between ground level and a depth of 20 feet	Minnesota Department of Health Well Data	+/- 5 feet vertical accuracy Horizontal Accuracy[5]	2014
Low infiltration potential may exist due to hydrologic soil group D consisting of clay, silt and organics with an infiltration rate of < 0.2 in/hr.	Natural Resources Conservation Service County Soil Survey and Minnesota Geological Survey[7]	Minnesota Geological Survey shows the material expected to be encountered approximately 3-feet below the surface; however, the level of accuracy of data does not account for up to 20-feet of fill in urban areas and is mapped at 1:100,000 scale[8]. County Soil Survey applicable to the first 6-feet of soil and is mapped at 1:24,000.	2006 – Soils Data 2007 – Geology Data
Shallow bedrock may exist between ground level and a depth of 20 feet[2]	Minnesota Department of Health Well Data	+/- 5 feet vertical accuracy Horizontal Accuracy[5]	2014

1) Based on Minnesota Pollution Control Agency limitations to meeting Minimum Impact Design Standards
2) National Pollution Discharge Elimination System Construction General Permit requires 3-feet minimum separation. 20' used as buffer to account for site grading
3) Per Minnesota Rule 4725.4350
4) Minnesota Department of Health recommends no infiltration within 1-year travel zone of DWSMA and limited infiltration within 10-year travel zone
5) Horizontal Accuracy depends on the location method for each well
Accuracy of each well location can be viewed in the GCM_CODE - Geographic Method Code (identifies location accuracy).
*A = Digitized - scale 1:24,000 or larger
*B = Digitized - scale 1:100,000 to 1:24,000
*DN1 = Digitization (screen) - Map (1:24,000) - NOT Field checked
*DN2 = Digitization (screen) - Map (1:12,000) - NOT Field checked
*DS1 = Digitization (Screen) - Map (1:24,000)
*DS2 = Digitization (Screen) - Map (1:12,000)
*G3 = GPS Code Measurements (Pseudo Range) Differentially Corrected
*G6A = GPS Code Measurements (Pseudo Range) Standard Positioning Service Selective Availability On (averaged)
*G6O = GPS Code Measurements (Pseudo Range) Standard Positioning Service Selective Availability Off (averaged)

*I = GPS; accuracy 3 to 12 meters (+6 to 40 feet)
*PQ6 = Public Land Survey - QQQQQQ Section
6) Coordinates for these features were collected using a variety of methods of varying accuracy. The 'COORD_METH' column in the attribute table describes the method used to determine the coordinate for each feature.
7) In areas that show up as urban fill on the Soil Survey (approximately 50% of the MWMO) the Geological Survey was used to determine
the soil characteristics.
8) Scale refers to the frequency of sampling. The larger the second number, the larger the ground area and less detail. For instance, 1:12,000 scale depicts a sample taken
approximately every 1/4 acre. Whereas a 1:100,000 scale depicts a sample taken every 2 acres.

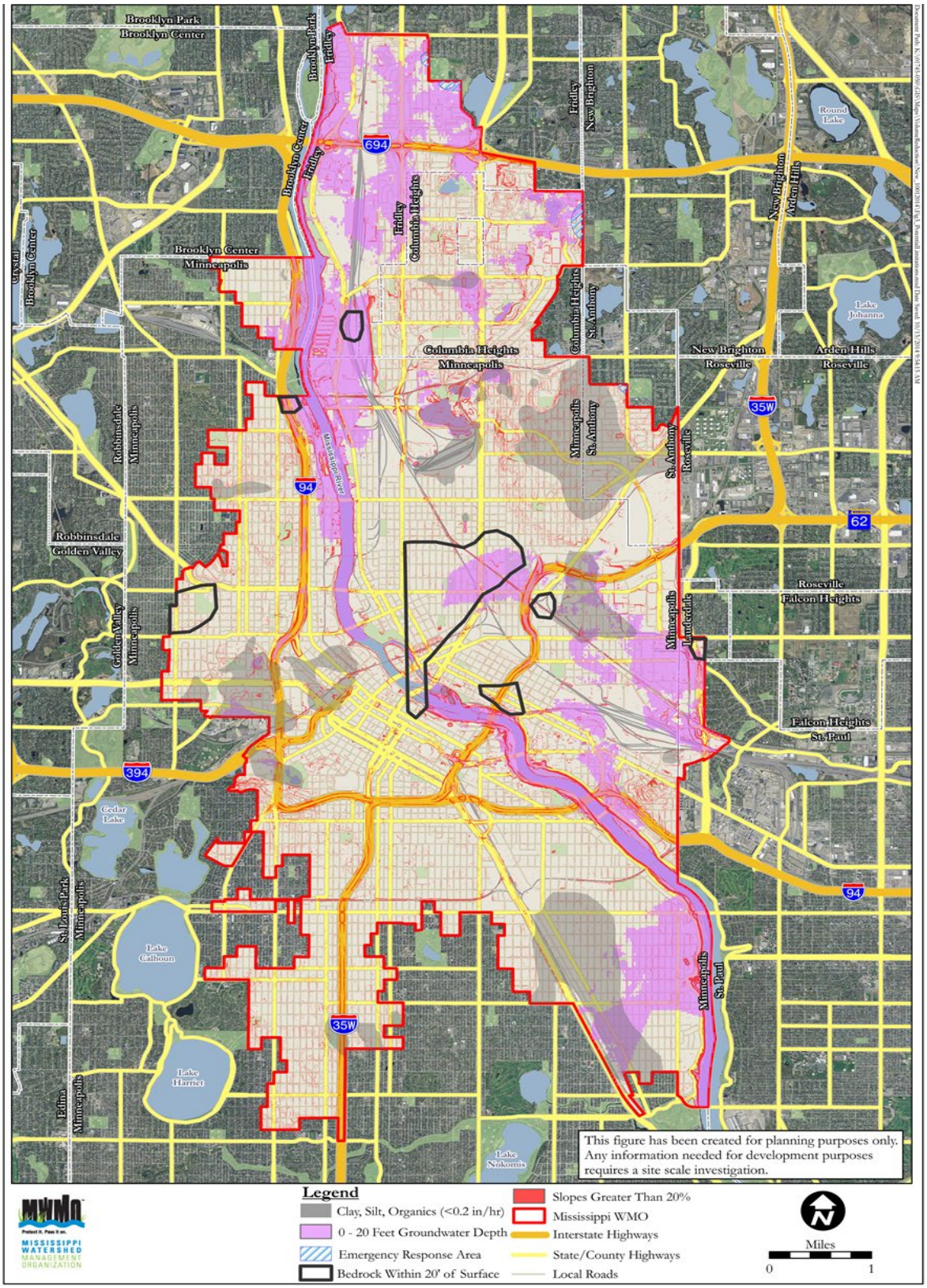


Figure 2: Potential Limitations to Infiltration

4.2.2 Topography and Geomorphology

The topography of the MWMO influences the way resources respond to events such as precipitation and urban development. The topography of the MWMO varies greatly, from rolling terrain at higher elevations distant from the Mississippi River to nearly flat terraces close to the river. Total relief in the MWMO is roughly 300 feet from high points in the Saint Anthony Village area, which has an elevation of 1,020 feet above sea level, to low points of 725 feet along the shores of the Mississippi River (**Figure 3**).

Geomorphology is the study of landform and the processes that lead to varying landform shapes. The topography of the MWMO was created by geomorphic processes such as glaciation, fluvial transport (sediment transport by water), eolian processes (sediment transport by wind), mass wasting (gravity-driven sediment transport), and weathering. These processes created nearly all the current landscapes visible throughout the watershed. In addition to geologic processes, influences from humankind have drastically shaped the landform of the MWMO. Significant grading has flattened rolling hills for the creation of flat roadbeds and building pads. In addition, some portions of the MWMO that were peat-filled wetlands prior to European settlement in the Twin Cities Metropolitan Area have since been artificially filled to promote the development of these areas.

Figure 3 illustrates the topography of the MWMO. Four prominent colors are visible as elevations above mean sea level. These prominent regions are due to the geomorphic processes that shaped these areas. Topographically high regions—visible as brown/red in Saint Anthony Village and west of I-94—are glacial depositional highs formed by the advancement of the Des Moines lobe glaciation. These depositional highs are above 900 feet and consist of clay rich till. Adjacent tan/yellow hues located at lower elevations toward the Mississippi River, between 850 and 900 feet, are terrace deposits known as the Richfield Terrace. Terraces are platforms of land created by past higher levels of the Mississippi River. As the Mississippi River down cuts, removing material and lowering the river bed, these flat areas become prominent past indicators of river floodplain elevations. Terrace deposits are typically sequences of sand and silt. Green/blue hues located at an even lower elevation toward the Mississippi River, between 800 and 850 feet, represent a different and younger terrace known as the Langdon Terrace. Finally, the reddish-tan color prominent west of 35-W and in the vicinity of Lyndale Ave and 46th Street in Minneapolis represents an area formed by glacial outwash. This area was formed by sand and gravel deposited by melting along a glacier's ice margin.

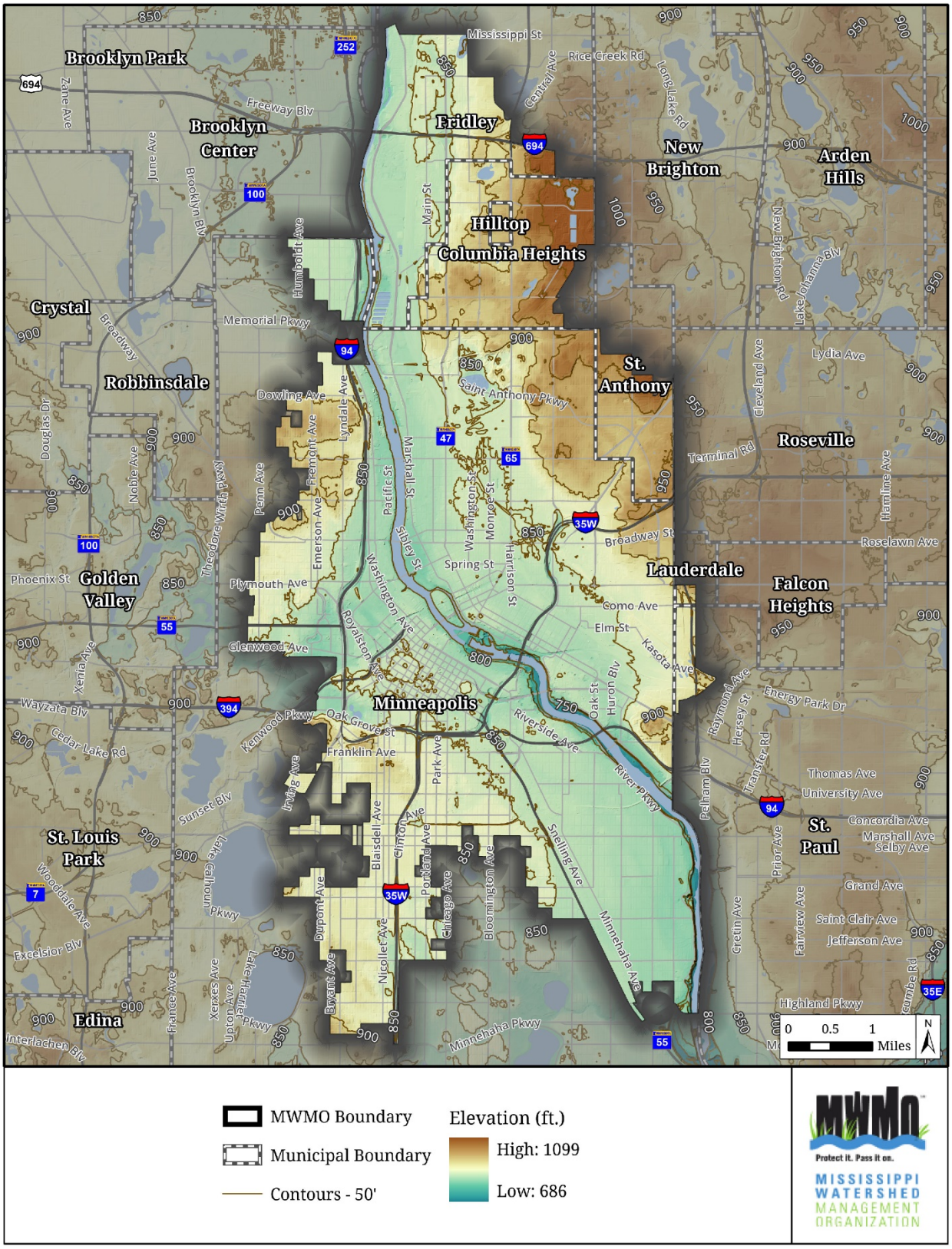


Figure 3: Topography of the MWMO

The landscape topography and the geomorphic domain of regions within the MWMO influences water quality and quantity by affecting the dynamics of the hydrologic cycle. Influences of these factors include:

- Topography directly affects the direction and rate of water flow, and the retention of water
- Geologic strata influence characteristics of MWMO soils and groundwater flow through the subsurface
- Soil type determines the ability of subsurface materials to attenuate pollutants
- Together topography and geology affect detention and retention of water, runoff rates, and infiltration rates
- Infiltration rates, aquifer properties, and groundwater flow paths influence flow of pollution from a spill site and throughout aquifers once pollution has reached the water table

Understanding the dynamics of these factors assists resource managers in identifying sites that are appropriate for infiltration practices or water storage as well as understanding sites that are sensitive to disturbances like construction.

It is important to note that soil structure is irreplaceable, and damaging it reduces soil function including infiltration. Decompaction techniques only have a short-term effect and cannot restore soil structure. In addition to soil texture classification, soil structure should be assessed and/or an infiltration test should be performed to verify design infiltration rates to prevent infiltration basin failure. In an urban watershed, where much of the developed areas have brought in fill, the MWMO uses monitoring instrumentation like an infiltrometer to gather site specific data to help determine if infiltration can occur.

4.2.3 Geology

The geology of the MWMO influences the watershed greatly. Unconsolidated geologic material deposited by glaciation and subsequent processes created the landforms visible in the watershed. Chemical and physical weathering of the geologic materials deposited influences soil type, soil properties, and shallow groundwater storage and movement. Consolidated geologic material, known as bedrock, acts as either aquitards (geological formations that are not capable of transmitting significant quantities of groundwater under normal hydraulic gradients) or aquifers (underground beds or layers of earth, gravel, or porous stone that yield water) depending on whether or not water is easily transmitted through the rock.

Aquifers are specific types of bedrock units which, because of their unique properties, are used for drinking water and industrial water use. These aquifers are important to member organizations and industries located in and near the MWMO. Understanding the properties and lateral distribution of the unconsolidated and bedrock geology of the watershed is imperative to identifying areas where there is potential for contamination, where infiltration may be a viable stormwater management practice, and where unique groundwater-dependent plant communities

could be present or restored. Maintaining groundwater recharge areas in this highly impervious watershed is important to protect groundwater baseflow to surface waters.

The surficial geology (or uppermost geologic formations) within the MWMO consists of Quaternary deposits associated with the Des Moines Lobe (Grantsburg Sublobe) and Superior Lobe of the Wisconsin Glaciation, and also with terrace deposits and post-glacial stream and peat deposits (**Figure 4**). The distribution of the surficial deposits varies dependent upon the source of the original material and the erosional and depositional processes affecting them. Directly along the Mississippi River are stream deposits (alluvial fan deposits and floodplain alluvium) and one area of exposed bedrock. Depth to bedrock along the tops of the bluffs lining the Mississippi River is typically 10 feet or less. Two relatively flat platforms, the Langdon and Richfield river terrace deposits, are at separate elevations above sea level bordering each side of the Mississippi River. The river deposits and terrace consist of sand and gravel with some silty deposits.

Moving further away from the Mississippi River and above the terrace deposits are regions of glacial outwash and till. The southwest portion of the watershed includes the outwash deposits and the northeast and northwest portions include loamy till. There are also sand faces in the northern portion of the watershed. Surficial deposits vary in depth throughout the MWMO, from less than 10 feet along the Mississippi River bluffs to about 200 feet over areas where the Prairie du Chien is the first encountered bedrock.

Bedrock geologic units underlie the surficial deposits of the MWMO. The bedrock geologic units are of early Paleozoic age (525 – 400 million years old) and were originally deposited as marine sedimentary rocks (Mossler and Blomgren, 1990). Shallow seas covered southeastern Minnesota and parts of adjacent states during most of this period. The five bedrock groups of the watershed which outcrop (are exposed directly at the surface) or subcrop (are exposed in the subsurface directly below surficial sediments) are, from youngest to oldest, the Decorah shale, Platteville-Glenwood Formation, Saint Peter Sandstone, and the Prairie du Chien Group (**Figure 5**). See **Figure 6** for a schematic of all the bedrock groups of the region.

The uppermost bedrock unit underlying the Quaternary deposits is the Decorah Shale. This unit is discontinuous through the watershed. Where it is present, it acts as a confining layer, protecting lower units from contamination. The Decorah Shale is green calcareous shale with thin limestone interbeds. This unit crops out along the bluffs of the Mississippi River.

The Platteville and Glenwood Formations underlie the Decorah Shale. The Platteville consists of fine-grained dolostone and limestone. The Glenwood consists of thin green sandy shale (3-5.5 feet thick). This formation also crops out along the Mississippi River bluff line and is discontinuous throughout the watershed.

The Saint Peter Sandstone underlies the Platteville and Glenwood Formations. The Saint Peter is divided into two parts in this area of the metro. The upper two-thirds consists of fine- to medium-grained quartz sandstone. The lower third is known as the basal Saint Peter and acts as a

confining unit where present. It consists of mudstone, siltstone, and shale with interbeds of coarse sandstone. This formation is exposed in areas along the Mississippi River bluffs.

The Saint Peter is underlain by the Prairie du Chien Group. The upper two-thirds is sandy with thin bedded dolostone and often fractured. The lower part consists of massive or thick bedded dolostone. The Prairie du Chien is present continuously within the MWMO and exhibits solution enhanced flow characteristics where fractures and joints are present.

Below the Prairie du Chien Group are the Jordan Sandstone, Saint Lawrence Formation, Franconia Formation, Ironton-Galesville Sandstone, Eau Claire Formation, and the Mount Simon Sandstone. These bedrock units are regionally important aquifers and confining layers.

Also visible in **Figure 5** are the trends of deep buried bedrock valleys. Deep valleys were cut into the bedrock of the watershed by erosional processes related to glaciation. Scouring and weathering of bedrock surfaces by glaciers and glacier meltwater created deep and broad bedrock valleys that cut deep through the top of the bedrock surface. These valleys were subsequently filled in by sediments from later glacial activity. Although they are not visible at the surface, they influence groundwater flow patterns in some regions of the Twin Cities Metropolitan Area. The most prominent of these valleys runs in a northeast-southwest trend in Minneapolis and Columbia Heights.

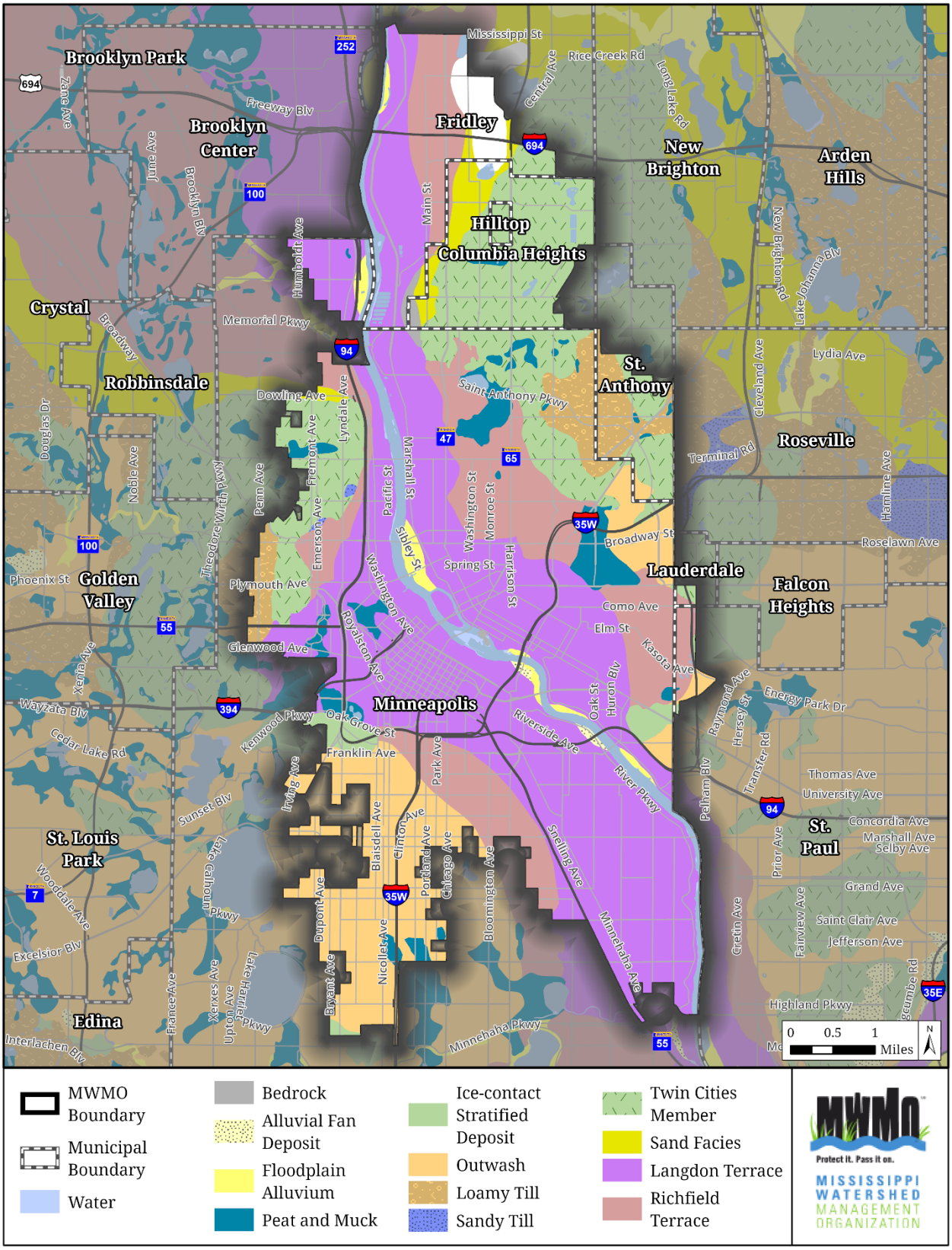


Figure 4: Surficial Geology of the MWMO

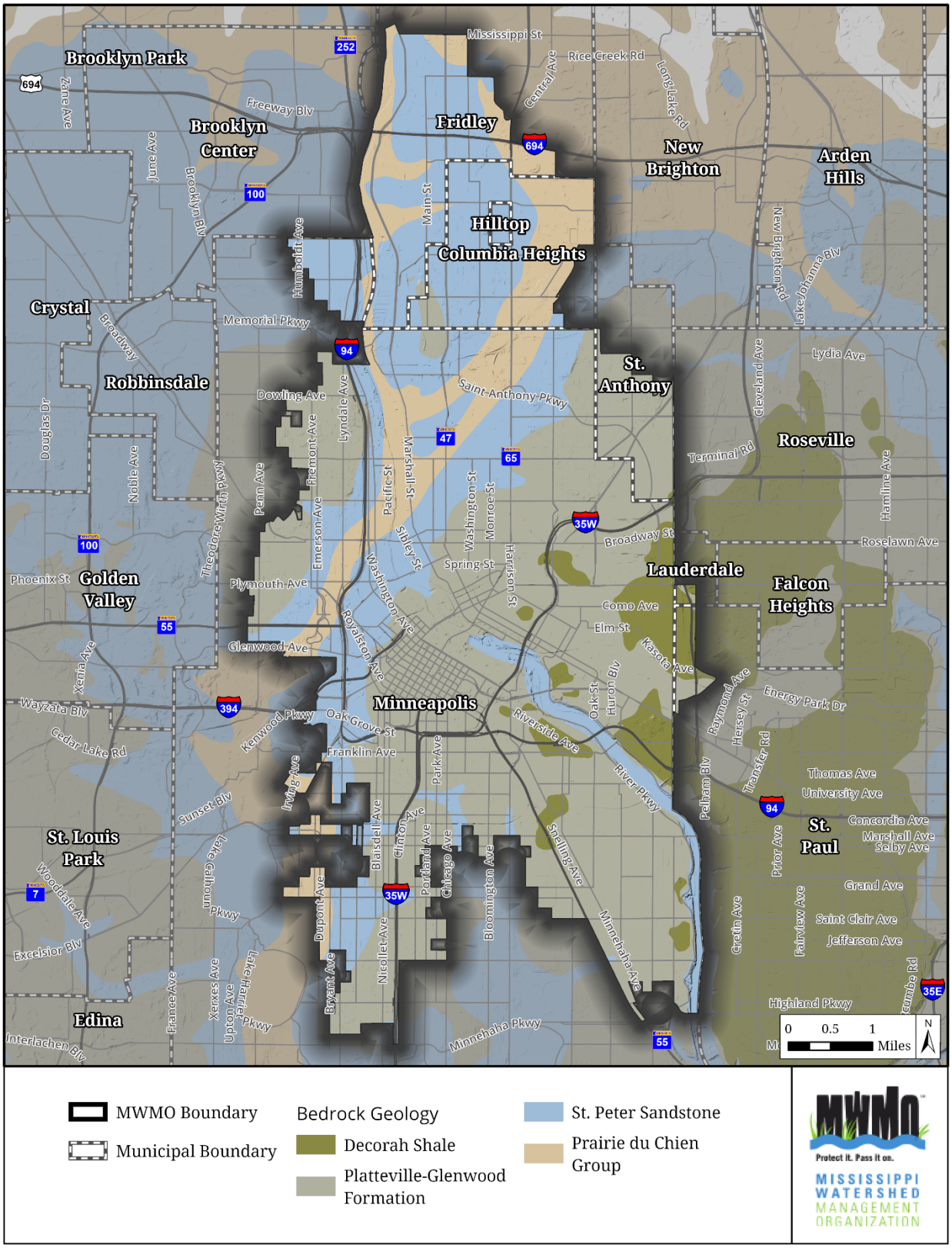


Figure 5: Bedrock Geology of the MWMO

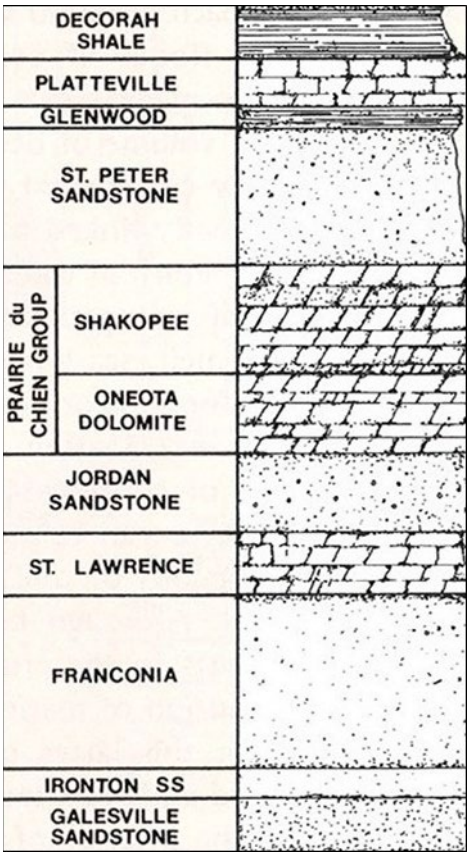


Figure 6: Bedrock units (Ojakangas and Marsh, 1982)

4.2.4 Soils

The properties of soils in the MWMO impact the water and natural resources of the watershed in a variety of ways. Soil properties impact the capacity for growth of vegetation, the likelihood for erosion to occur, the feasibility for rainfall to recharge groundwater, the potential for contaminants to move through the soil, and the possibility of transport of soil-bound nutrients and other pollutants to waterbodies.

As stated in the *Historic Waters of the MWMO (*MWMO, 2011), soil characteristics are the result of physical, chemical, and biological interactions that take place over time. Natural soils are influenced by the weathering of parent material—the biological, chemical, and mechanical activity that takes place in the oxygen-rich environment of the earth's surface. The characteristics of soils, by extension, reflect the interaction between climate, plant, and animal community life, surface and subsurface hydrology, and the base parent materials of the underlying geologic formations.

The soils of the MWMO project area are largely a reflection of the previously discussed surficial geology and the formative processes of the ancient Mississippi River Valley. Additionally, the soils of the MWMO reflect plant community relationships with the physical world since the retreat of

the glacial epoch approximately 10,000 years before the present. During the current epoch, soils have developed in conjunction with advancing and retreating vegetation communities. The establishment, disruption, reestablishment, and shifting of vegetation communities in concert with the physical landscape provide the underlying basis of the pre-settlement Twin Cities landscape.

Soil composition played a significant role in the development of the Twin Cities Metropolitan Area. This region lies at the interface between major continental biomes, each with a different set of ecological characteristics and soil qualities. The economic growth of the Twin Cities was first and foremost based on the presence of the Mississippi River. Secondly, the Twin Cities had a vast supply of timber to supply its own growth and drive the growing national economic booms of the 19th Century. Following the establishment of the Twin Cities based on timber, the vast prairies with deep rich soils provided the basis for the ongoing economic growth based on agriculture. In each case, regional soils based on the presence of post-glacial shifting vegetation communities provide an additional pathway to reconstructing the pre-European settlement landscape. Without these diverse pre-settlement vegetation and soil types, the Twin Cities may not have remained the continuously thriving metropolis that it has over the past century and a half.

As in most urbanized areas, soil mapping in the MWMO area has been seriously affected by the early and rapid urbanization of the area. Soils surveys were published for Ramsey County in 1916 and for Hennepin County in 1929. These maps have been georeferenced from the original soil surveys and are shown in **Figure 7**. Soil surveys are based on field data collection of soil plots and mapped with a taxonomic description developed by the Natural Resources Conservation Service (NRCS). NRCS soil surveys were, historically, created primarily to identify suitable soils for agricultural uses, and urbanized lands were typically lumped into categories that reflected the disturbed nature of the land. To a significant degree, the urban soils of the MWMO have been largely disrupted and moved to accommodate development and industry.

Though developed largely as a tool for agriculture and protection against overuse, soils maps today are used for a range of applications, from mineral extraction, wetland identification, buildability, and climate analysis among others. In 1916, Ramsey County was rapidly developing, but large areas of native soils remained intact, and the soil survey was quite extensive, providing mapping units for nearly the entire county. Unfortunately, only a very limited area of the MWMO lies within the Ramsey County survey area. By the time the first Hennepin County Soil Survey was published in 1929, the Minneapolis urban core was largely built-out, so most of the central portion of the MWMO area was labeled “unclassified”. Mapped exceptions in the 1929 survey are confined largely to the extremities of the MWMO area, where roads had been developed, but lot scale build-out was not fully complete. By the 1974 publication of the soils surveys for Hennepin and Ramsey Counties, urban lands dominated virtually all polygons within the MWMO boundary.

At first glance, the 2008 soil survey of the MWMO project area continues to describe the soils of the urban core as “Urban Land” since much of the land has been moved, and soils disrupted. The most recent (modern) soil surveys for Hennepin and Ramsey Counties have reincorporated more refined data into the urban mapped areas. **Figure 8** shows the extent to which the NRCS has

determined the MWMO area to be predominantly urban or disturbed soils. Very few areas are mapped to the natural soil series level. The NRCS recommends that, in these disturbed soils where soil analysis for site-based work is required, borings and soils tests are required, as it is assumed that the natural soil properties may no longer be present.

As **Figure 8** (Map 15A, MWMO, 2011) depicts, the majority of soils in the watershed are disturbed and classified as "Urban Land." Updates to the 2007 NRCS Soil Survey now include data collected in the urban core to provide soil "complexes" (Appendix D) within the predominant (often "urban") soil types. A soil complex is a mapped soil unit with a mix of soil series: in this case, areas with a predominant urban matrix with substantial "inclusions" of natural soils. According to the Hennepin County NRCS, where urban soils have been mapped as a complex with other soil series these can be read as an interpretation by the NRCS of the likely dominant series prior to disruption (telephone conversation with NRCS office staff). Using the interpretation of the most prevalent soil within an urban complex as the likely pre-settlement matrix, soil attributes that assist in understanding general landscape characteristics provide additional insight into pre-settlement conditions.

Figure 9 (Map 15B, MWMO, 2011) shows areas in the most recent surveys where "urban lands" are mapped as soil complexes (light green). Where map units are described as urban lands and udorthents (undifferentiated soil fill) with a more in-depth description (complex or substratum), new fields have been added to the GIS layers to piece together an interpretation of possible pre-settlement conditions. In addition, many of the soils mapped as "urban land" in the MWMO area are associated with a more detailed "soil complex". Soil complexes are mapped units that contain two or more recognizable units. In urban soils settings, the author has made the assumption that highest level natural soil in the complex was considered by the author of the Soil Survey as the dominant pre-settlement soil, confirmed by the Hennepin County NRCS (Telephone conversation with NRCS office staff). Using this methodology, soils descriptions can be used to assist in piecing together pre-settlement vegetation, wetlands, and drainage class among other characteristics. While this information may not be useful on a site-specific scale, it can be used to develop pre-settlement baseline conditions on a neighborhood or regional level. This new mapping provides the potential for more refined landscape scale interpretations of pre-settlement vegetation and hydrological characteristics than previously available.

Figure 10 shows the combined historic and modern data available for the MWMO area. Only those areas depicted in gray contain no information on natural soil characteristics.

Combining the attributes from different mapping periods, **Figure 11** (Map 15D, MWMO, 2011) shows the synthesis of soil series data. Where a modern soil complex is described for a soil map unit, the most common inclusion is shown, presuming the pre-settlement soil matrix. In the northeastern portion of the MWMO, the large area of Hayden soils mapped in 1929 is shown within boundaries of the modern soil survey units. Within the northeast portion of the MWMO, Udorthents with a wet substratum are shown as such, but were described as either peat or Webster silty loam in the 1929 survey. Appendix D, excerpted from the *Historic Waters of the MWMO (*MWMO, 2011), provides detailed NRCS soil series descriptions of soils shown on

Figure 11 (Map 15D, MWMO, 2011). For descriptions of the Hayden and Webster soils from the 1929 Hennepin County Soil Survey, see the *Historic Waters of the MWMO (*MWMO, 2011).

Using the synthesized data described above, **Figure 12**, **Figure 13**, and **Figure 14** (Maps 16A, 16B and 16C, consecutively, MWMO, 2011) provide a synthesis of data provided in modern and historic soils survey to assist in establishing an image of the pre-settlement landscape of the MWMO.

Figure 12 (Map 16A, MWMO, 2011) shows the soil orders associated with the map units in **Figure 11** (Map 15D, MWMO, 2011). Soil orders are the major categories of soil types largely defined by large scale landscape characteristics where these soils formed. The formative soils of the MWMO fall into four major orders, each typical of distinct vegetation communities that formed at the surface. The four major orders of the MWMO are described briefly here, and shown on **Figure 12**:

- **Mollisols** - This order of soils covers a large area of western Minnesota and provides the deep rich soils of the agricultural regions of the state. Most significantly, these soils have a nutrient rich surface layer of dark colored thick material occurring throughout the grassland pre-settlement prairie regions of the state. These soils typically have a surface layer that is low density and loose.
- **Alfisols** - The other major order in the MWMO area, the Alfisols are typically forest soils. These soils are generally found along and east of the Mississippi River, with high accumulations of aluminum (Al) and Iron (Fe). These fertile soils formed in loam or clay. Alf is the formative element and is coined from a soil term, pedalfer. The surface layer typically has less clay than the subsurface. These soils usually also contain a leached zone of eluviation, or E horizon. This layer is typical of forest soils where this E horizon has been washed of some mineral content through the percolation of water down the horizon. These soils often remain moist throughout the year. These are the soils of Maple Basswood Forests and are found west of the MWMO area.
- **Histosols** - These soils are formed of organic materials from the remains of plants found in marshes and bogs. The soils are comprised of the dead and decaying matter of leaf and root tissue of plants growing in wet environments. The soils range from Saprists (most material is decomposed and original constituents are unrecognizable) to Hemists (moderately decomposed soils where some recognizable plant material is distinguishable) to Fibrists (plant materials remain distinguishable).
- **Entisols** - These are soils of recent origin, often developing in river bottom alluvium and sand. They are defined by the combination of being comprised of parent material not easily weathered (quartz) and being in a relatively early stage of development. The Entisols most commonly found in the MWMO area are confined to the Mississippi River floodplain, the highly urbanized downtown of Minneapolis, the area of the old Bassett Creek tunnel, and the base of steep moraine slopes in the northeast portion of the watershed.

The Soil Orders Map clearly corresponds with the Surficial Geology Glacial Phase Map presented as Map 11 in the *Historic Waters of the MWMO (*MWMO, 2011). Note the highlands of the Grantsburg Lobe in North and Northeast Minneapolis, here mapped distinctly as Alfisols. Entisols, the still-developing soils of the Mississippi River floodplain and the well-drained prairie soils of

the Mississippi River terraces, are each represented by refining the information provided in the most recent Hennepin County soil survey. Udorthents are a disturbed soil. Where these units were mapped with the "wet substratum" qualifier, these were added as wetland soils. These soils correspond very closely with the historic wet features mapping (see Map 9 in the *Historic Waters of the MWMO (*MWMO, 2011).

Figure 13 represents the vegetation communities listed as typical for each of the NRCS Soils Series Descriptions. These descriptions are provided by the NRCS for every soil series at: http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi. While these descriptions do not entirely correspond with the soil orders, they are a reflection of the mosaic of vegetation communities that would have existed at the time of settlement, and indicate shifting patterns of vegetation during the postglacial period. Of note here is the extent to which the communities described are significantly dominated by the transitional savanna community. Only in the moraine region of the northeast portion of the MWMO are soils described as fully typical of forests, and likewise, specifically prairie soils are limited mostly to the river terrace area of the Seward, Cooper, Howe, and Longfellow neighborhoods of Minneapolis.

Figure 14 (Map 16C, MWMO, 2011) shows the Hydrologic Soil Group (HSG) for the map units from the synthesized soil survey. The hydrologic soil groups presented are based on an estimate of the historic native soils in the MWMO and are used in developing the MWMO Standards to determine the hydrologic soil group. The hydrologic group designation is used to describe the runoff potential of soils and is divided into four groups (A to D). HSG A soils generally have the least runoff potential, and HSG D soils the greatest. According to the 'Urban Hydrology for Small Watersheds' published by the Engineering Division of the Natural Resource Conservation Service, United States Department of Agriculture, Technical Release–55, the soil groups are described as follows:

- **Group A** soils are sand, loamy sand, or sandy loam types of soils. They have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels, and have a high rate of water transmission.
- **Group B** soils are silt loam or loam. They have a moderate infiltration rate when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
- **Group C** soils are sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with moderately fine to fine structure and a layer that impedes downward movement of water and soils.
- **Group D** soils are clay loam, silty clay loam, sandy clay, silty clay, or clay. This HSG has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high-water table, soils with a clay pan or clay layer at or near the surface and shallow soils over nearly impervious material.

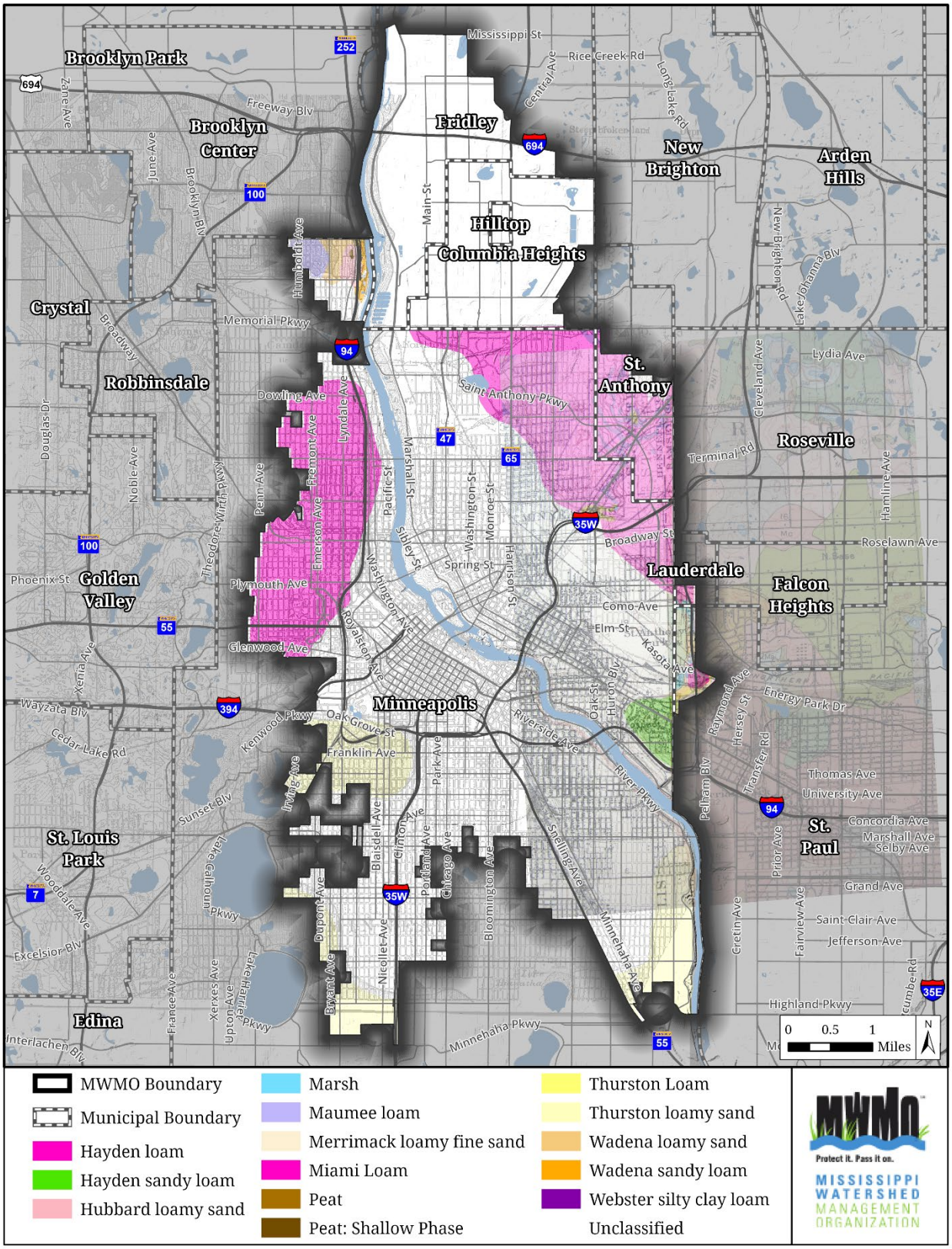


Figure 7: Historic Soils Orders of the MWMO

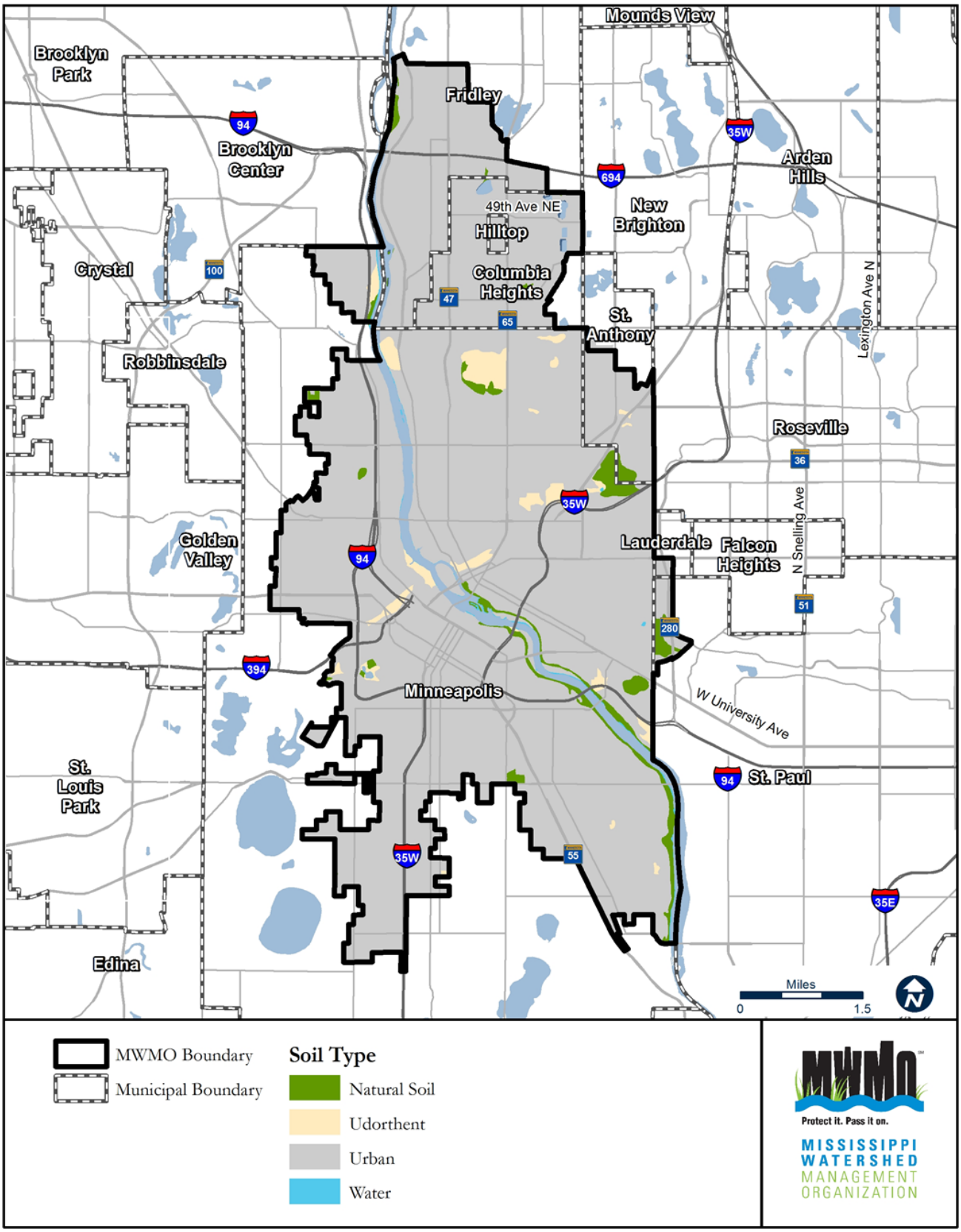


Figure 8: Present Day Urban Soils

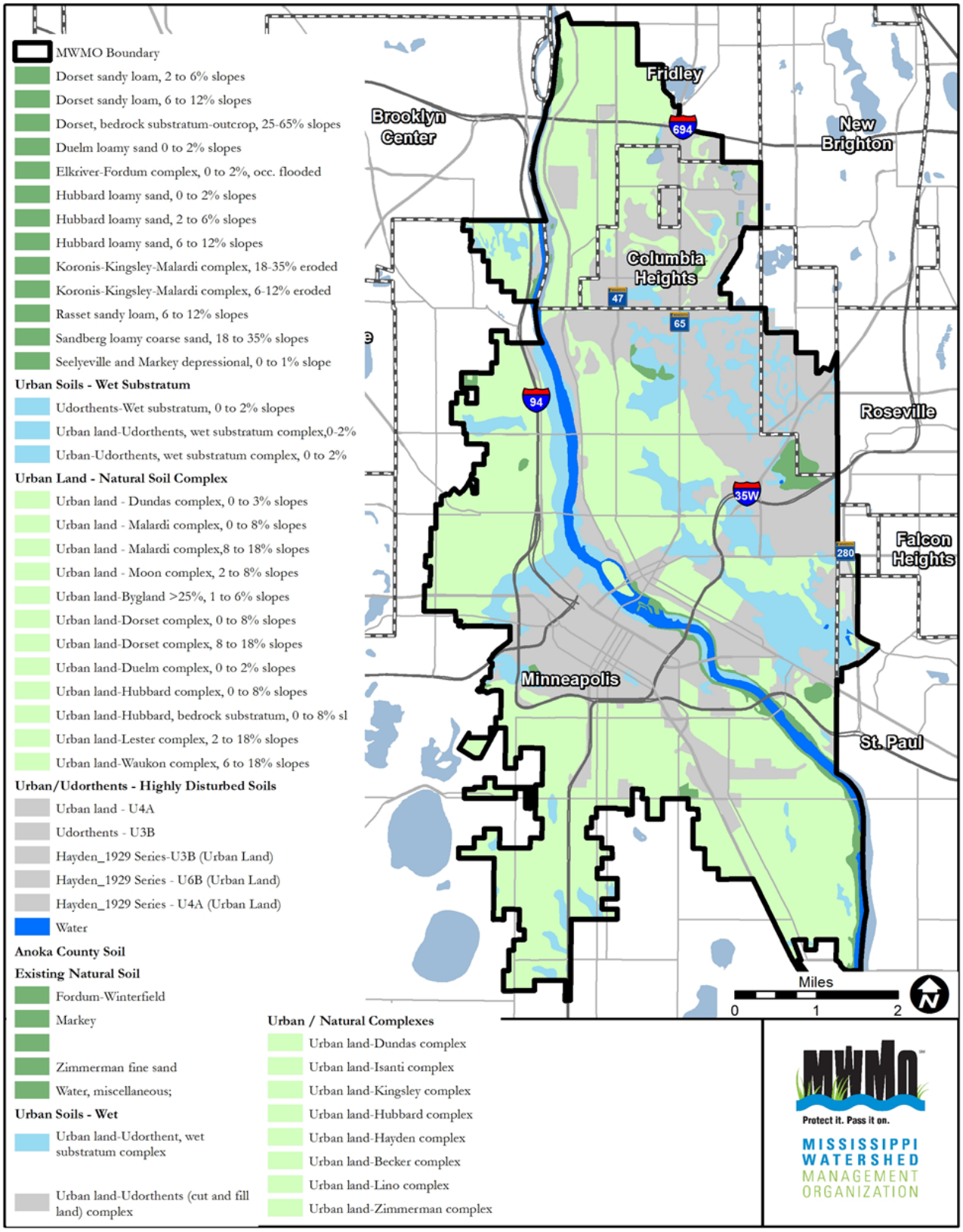


Figure 9: Modern Secondary Soil Information

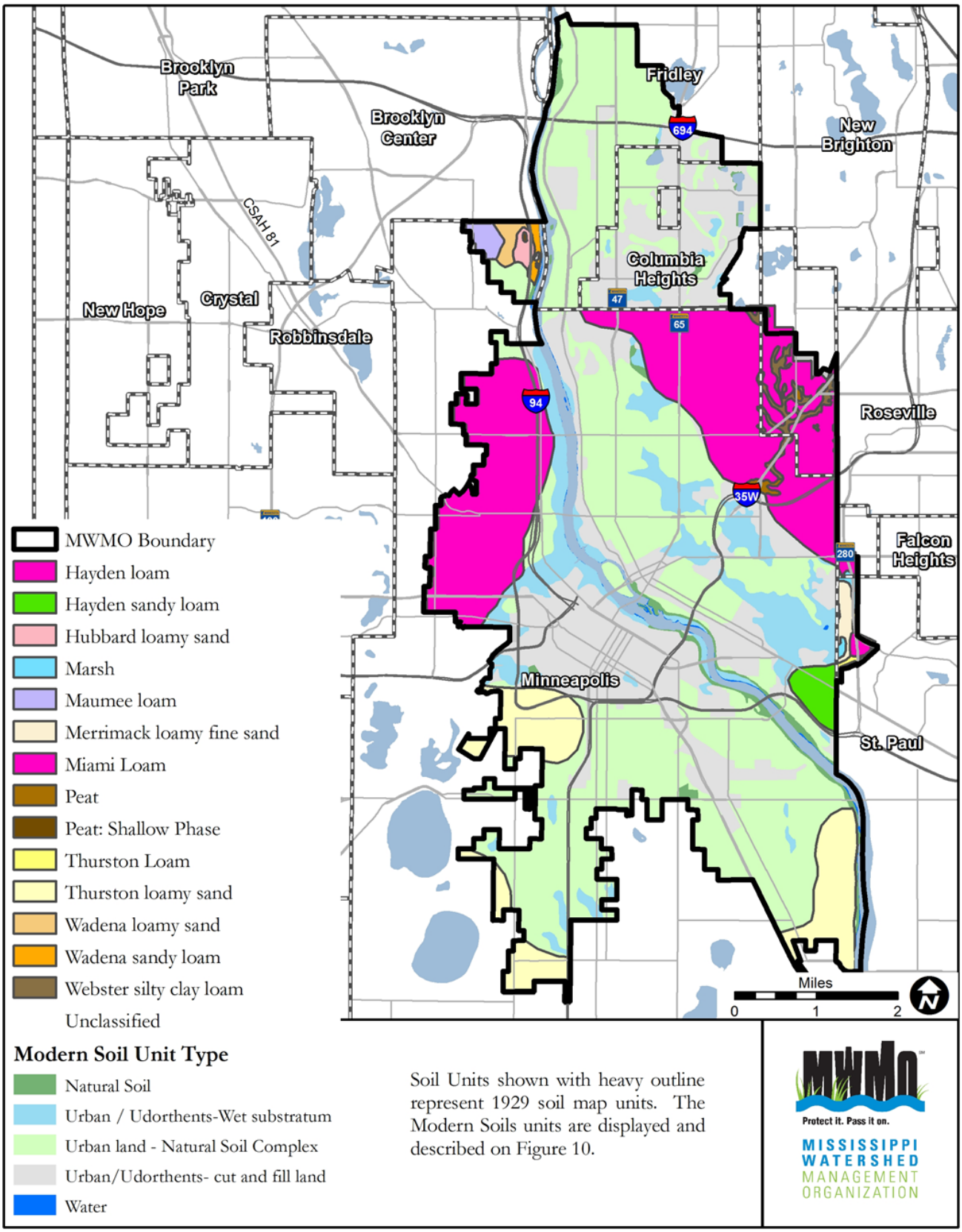


Figure 10: Combined Historic and Modern Soil Information

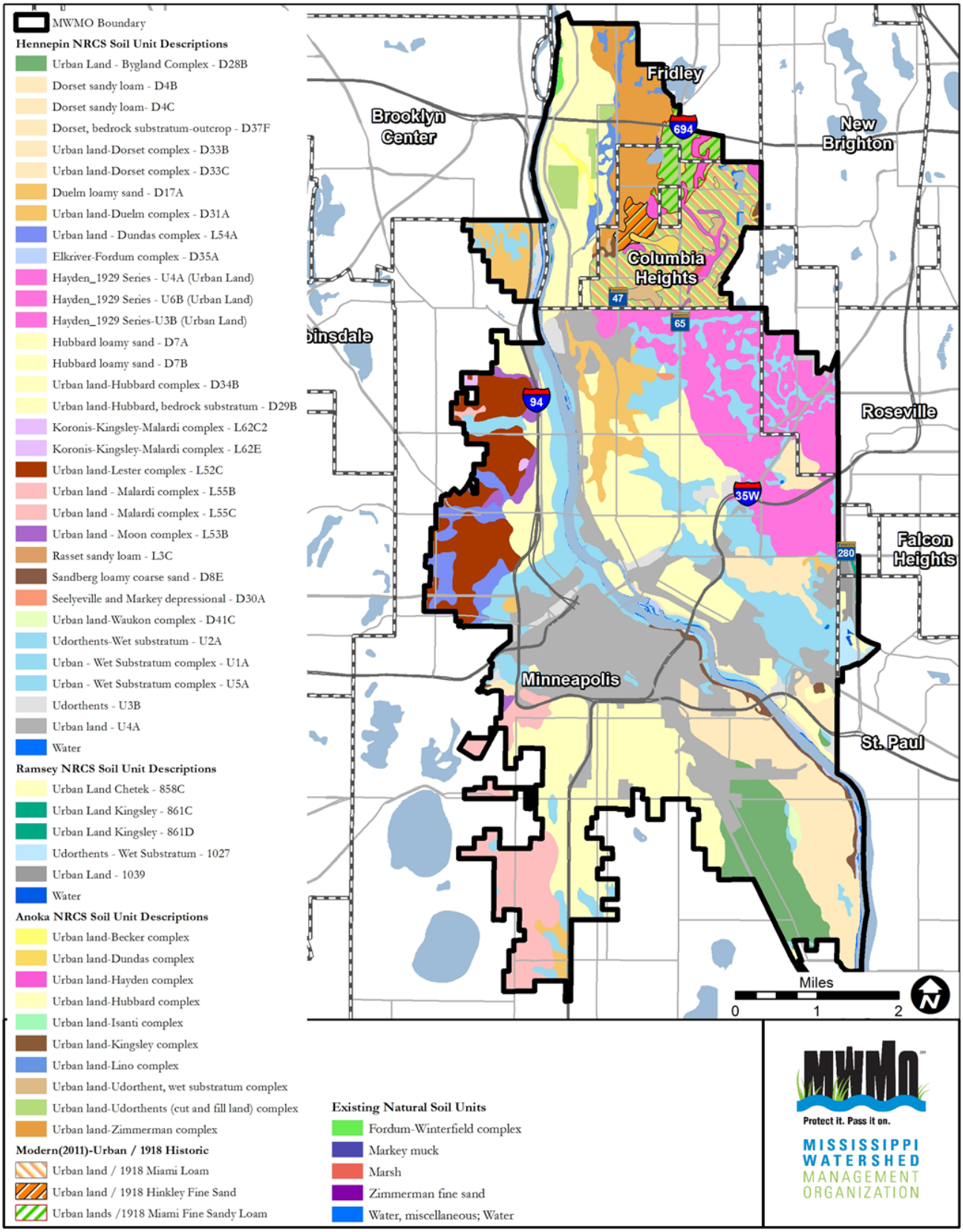


Figure 11: Soil Series

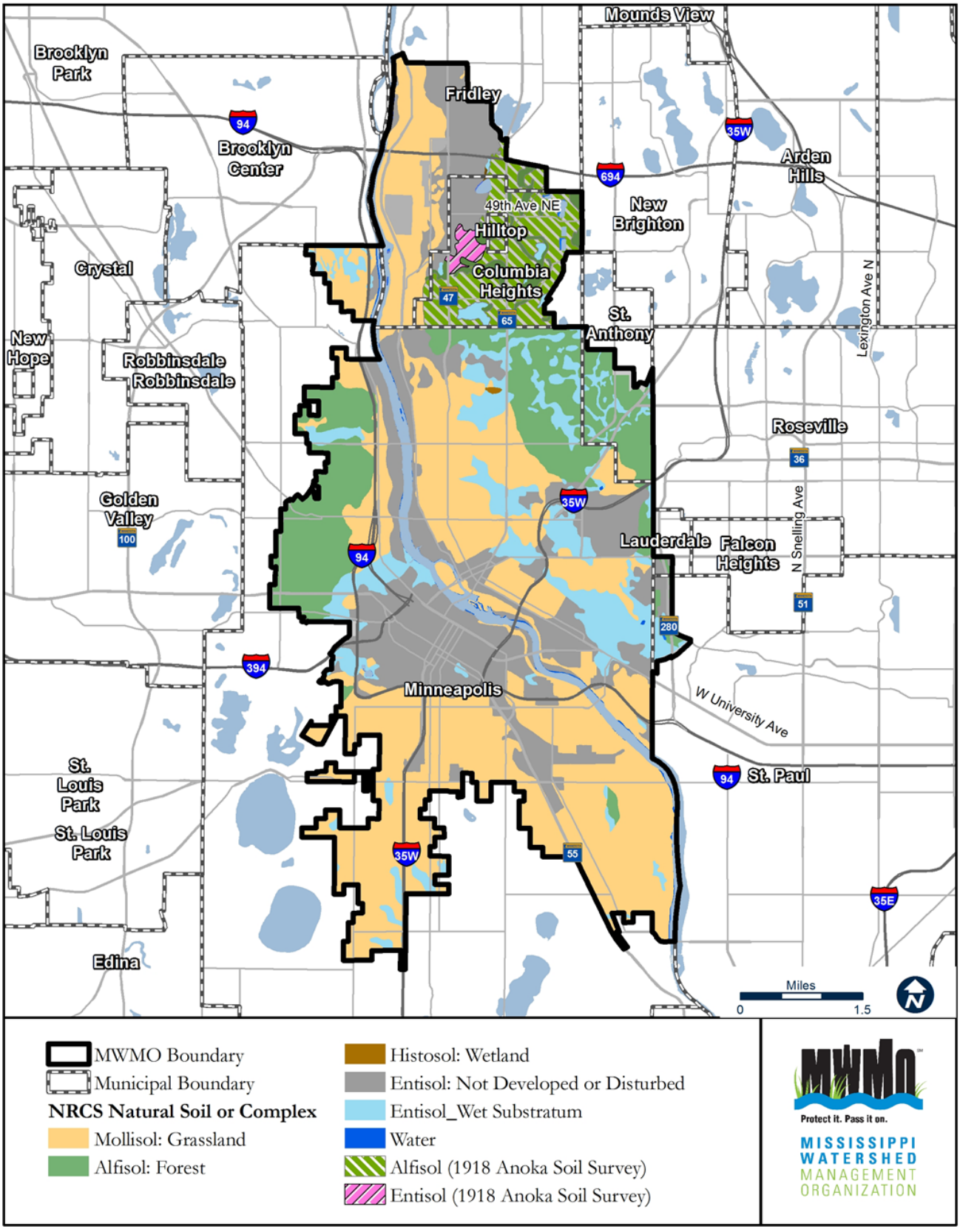


Figure 12: Soil Orders

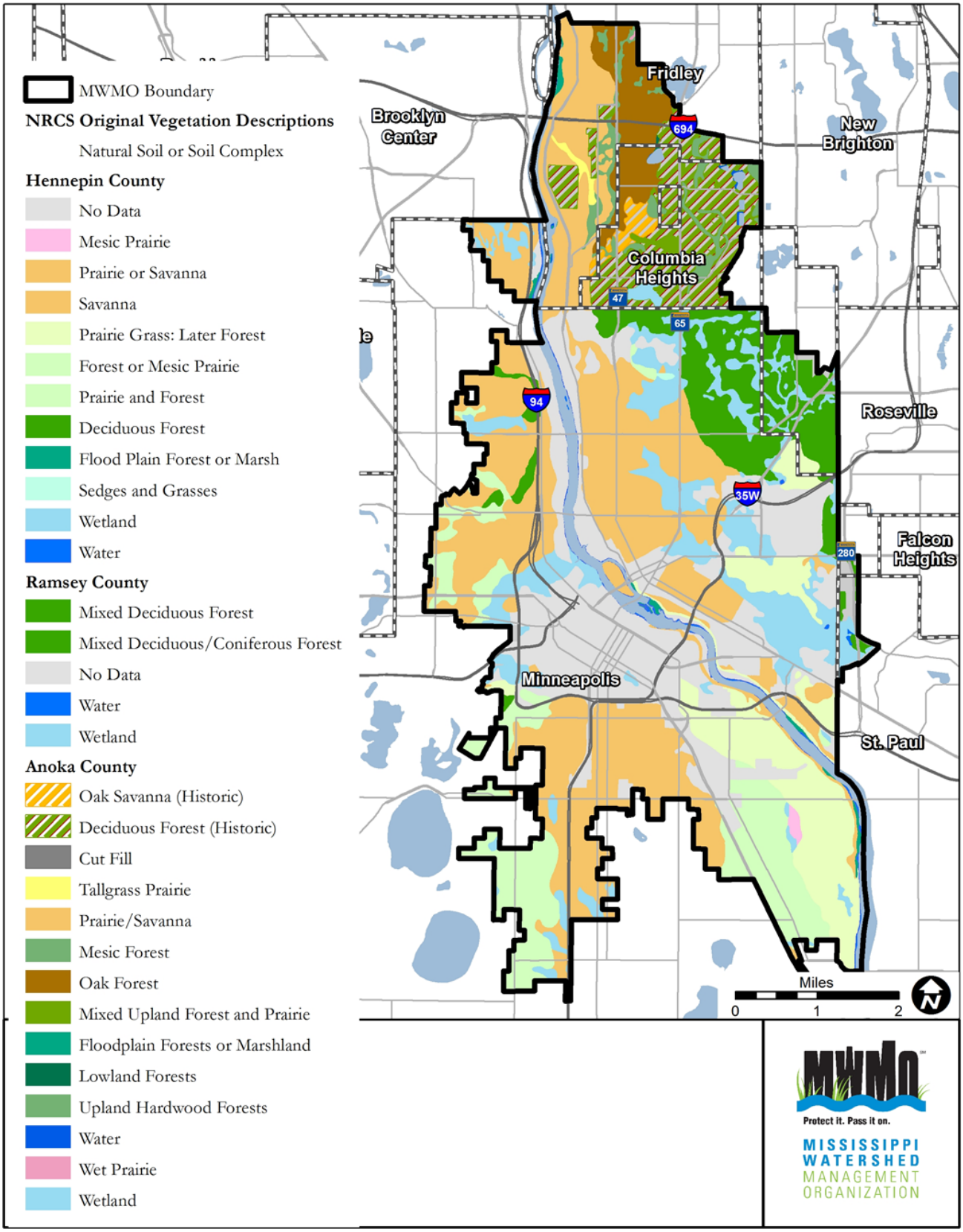


Figure 13: NRCS Based Vegetation

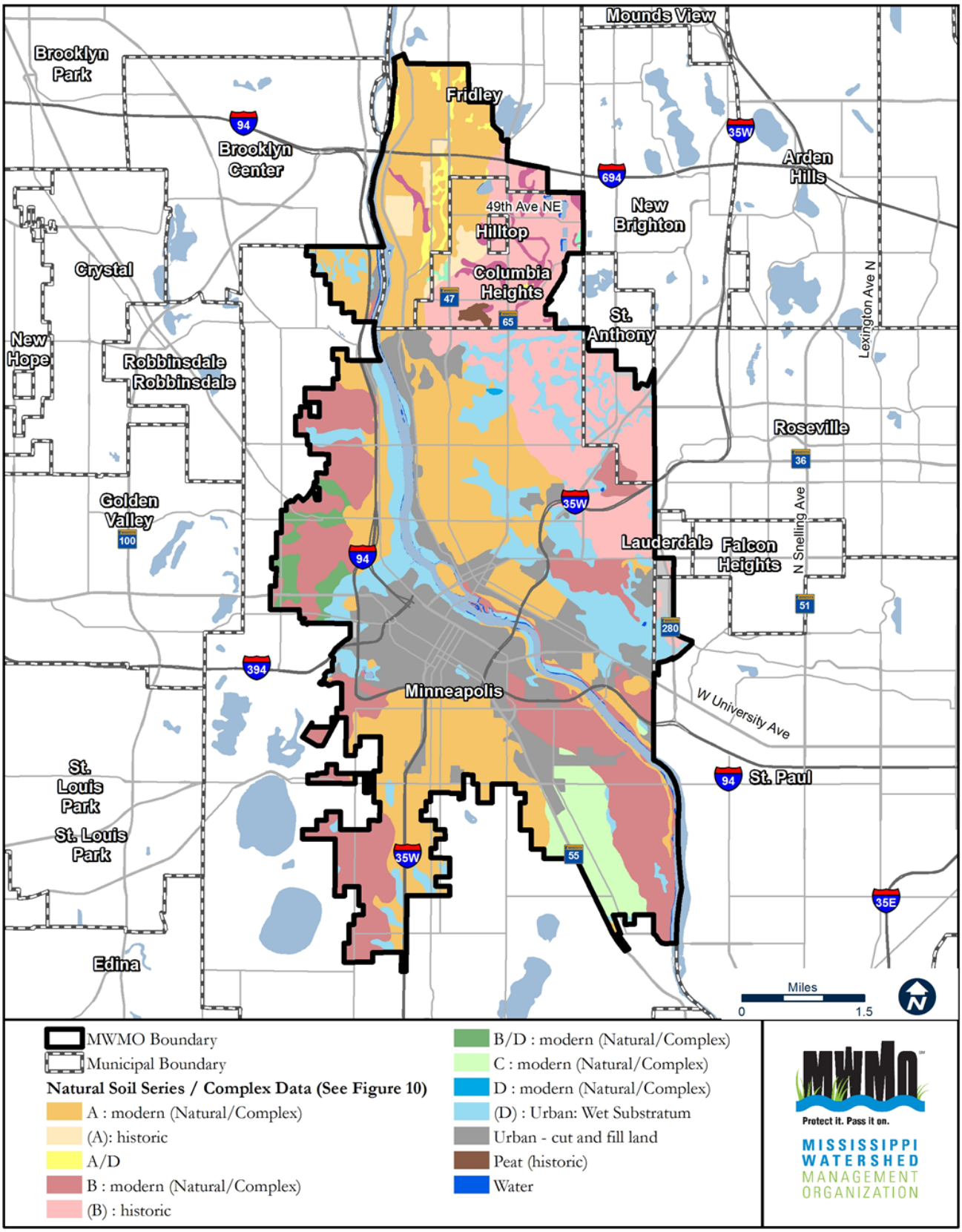


Figure 14: A Historic Estimate of Soil Hydrologic Group

4.2.5 Unique Features and Scenic Areas

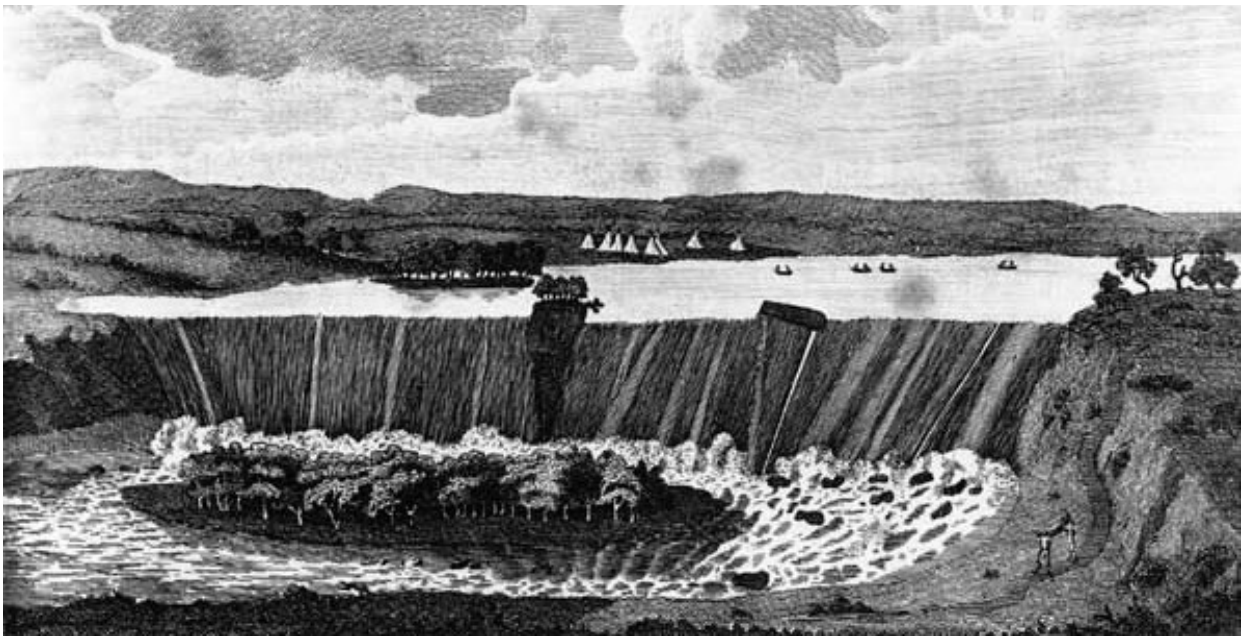
The watershed contains many scenic areas and unique features. The regional and municipal parks located within the watershed have preserved scenic views of the Mississippi River Valley and other water resources within the watershed. These parks and open spaces often allow recreational access to these resources.

As a result, many of the metropolitan area's cultural features are found within the watershed. Some of these features within the City of Minneapolis include:

- Hall's Island: an island located just north of the Plymouth Avenue North bridge on the Mississippi River. It was destroyed by industrial development in the 1960s and reconstructed with funding support from MWMO in 2018; the site was excavated to create a new back channel that re-separated the island from the mainland. The riverfront property was formerly owned by Scherer Brother Lumber Company and purchased by the MPRB in 2010.
- Mill City Museum: a museum built in the ruins of the Washburn "A" Mill on the west bank of the Mississippi River by St. Anthony Falls focusing on the history of flour milling and other industries using hydropower
- Minneapolis Institute of Art: a free museum, opened in 1915 and expanded in 1974, south of downtown Minneapolis on 3rd Avenue South across from the Washburn Fair Oaks Park
- Mississippi River Gorge: runs approximately eight miles from Saint Anthony Falls in downtown Minneapolis to the Minnesota River confluence in Mendota, Minnesota. It is the only true gorge along the Mississippi's entire 2,350-mile length. Geologic layers of the gorge include Glacial Till (soil), Plateville Limestone, the Glenwood Formation (shale), and Saint Peter Sandstone. From 45,000 to 12,000 years ago, during the last ice age, glaciers advanced and retreated many times over this area to slough away all the younger or top layers of rock formations. The glaciers melted 12,000 years ago, leaving a large amount of water. Saint Anthony Falls was formed 12,000 years ago near what is now downtown Saint Paul. The estimated size was nearly 200 feet high and a mile across. Year after year, the waterfall cut a path through layers of sedimentary bedrock. As soft, underlying Saint Peter Sandstone eroded beneath the force of falling water, the limestone caprock was undermined and crumbled. The falls receded upstream about 6.8 miles to their current location near downtown Minneapolis (Brewer 1998). The River Gorge is important for birds, fish, and native plants. Stressors include invasive species, erosion caused by foot and bike traffic, and stormwater pollution.
- Nicollet Island: an island crossed by the Hennepin Avenue Bridge in the Mississippi River north of St. Anthony Falls
- Saint Anthony Falls: the only major waterfall on the entirety of the Mississippi, these falls were once a major gathering place and landmark to the native tribes who frequented the area. The area holds cultural, spiritual, and political significance today to the Dakota and Ojibwe. The falls no longer retain their natural appearance as an immense waterfall with limestone bedrock covering soft sandstone. With the development of power extraction for the mills via diversion of upper-level water into waterwheel-equipped vertical shafts, the migration of St. Anthony Falls accelerated quickly. A concrete overflow spillway was installed after the falls partially collapsed in

1869. The river was dammed several times (with the Upper St. Anthony Falls dam completed in 1963 by the USACE) for power and navigation purposes.

- Stone Arch Bridge: a former railroad bridge, now open to pedestrians and cyclists, crossing the Mississippi River and offering views of St. Anthony Falls
- University of Minnesota Campus: a public research university with campuses in Minneapolis (both east and west bank of the Mississippi River within blocks of I-35W and I-94) and St. Paul
- Walker Art Center and Sculpture Garden: an art center and sculpture garden park (a partnership between the Walker and the MPRB) west of Loring Park and the Basilica of Saint Mary



Artistic rendition of the falls, prior to damming (brittanica.com)

The Mississippi River through the metropolitan area was designated a Critical Area by the State of Minnesota in 1979 and was designated the Mississippi National River and Recreation Area (MNRRA) of the National Park Service in 1988 by the United States Congress. In addition, the Mississippi River from Minnesota to Missouri was designated as an American Heritage River in 1998 allowing greater coordination of river-related efforts. The cities of Minneapolis and Saint Paul have developed Critical Area Plans and management plans to protect the natural, cultural, historic, commercial, and recreational values of the corridor.

4.2.6 Discussion of Challenges, Gaps, and Next Steps

The MWMO will continue to partner with the City of Fridley, the City of Minneapolis, the Minneapolis Park and Recreation Board, and the National Park Service in maintaining the water quality, habitat, and natural aesthetics of the Mississippi River and Critical Area.

Many studies done on natural resources by federal, state, and local levels of government pass over urbanized areas. As such, MWMO started with a scant amount of information on the characteristics and quality of water and natural resources in the watershed. This is problematic because effective watershed management is based on a thorough scientific understanding of the unique physical characteristics and complex ecosystems that make up a watershed. In addition, plants, soils, water, and air are a part of natural systems that do not acknowledge political boundaries. So, when managing natural resources, organizations many times need to consider a scale that goes beyond their individual city or watershed area. Thus, the MWMO will continue to conduct appropriately-scaled studies that inventory, characterize, and assess the condition of water resources and related natural and human resources within the watershed.

4.3 Biological Environment

4.3.1 Natural Communities

The majority of the MWMO has been developed for commercial, industrial, or residential uses and covered in impervious surfaces. However, some areas of natural and semi-natural vegetation remain (**Figure 15**). Most natural and semi-naturals areas are located within close proximity of the Mississippi River. **Table 8** summarizes the acreage of remaining natural and semi-natural areas within the watershed.

Table 8: Natural and Semi-natural Areas of the MWMO Planning Area

Natural and Semi Natural Areas	Acres	% Watershed Area
Disturbed Forested Wetlands	243.90	0.955%
Disturbed Forests	0.56	0.002%
Disturbed Grasslands	239.92	0.939%
Disturbed Shrublands	11.16	0.044%
Disturbed Woodlands	6.09	0.024%
Native Forested Wetlands	175.70	0.688%
Native Forests	73.24	0.287%
Native Grasslands	41.72	0.163%
Sparse Vegetation	1.21	0.005%
Water	907.40	3.552%
Totals	**1,700.90**	**6.659%**

Source: MnDNR Natural and Semi-Natural Areas dataset

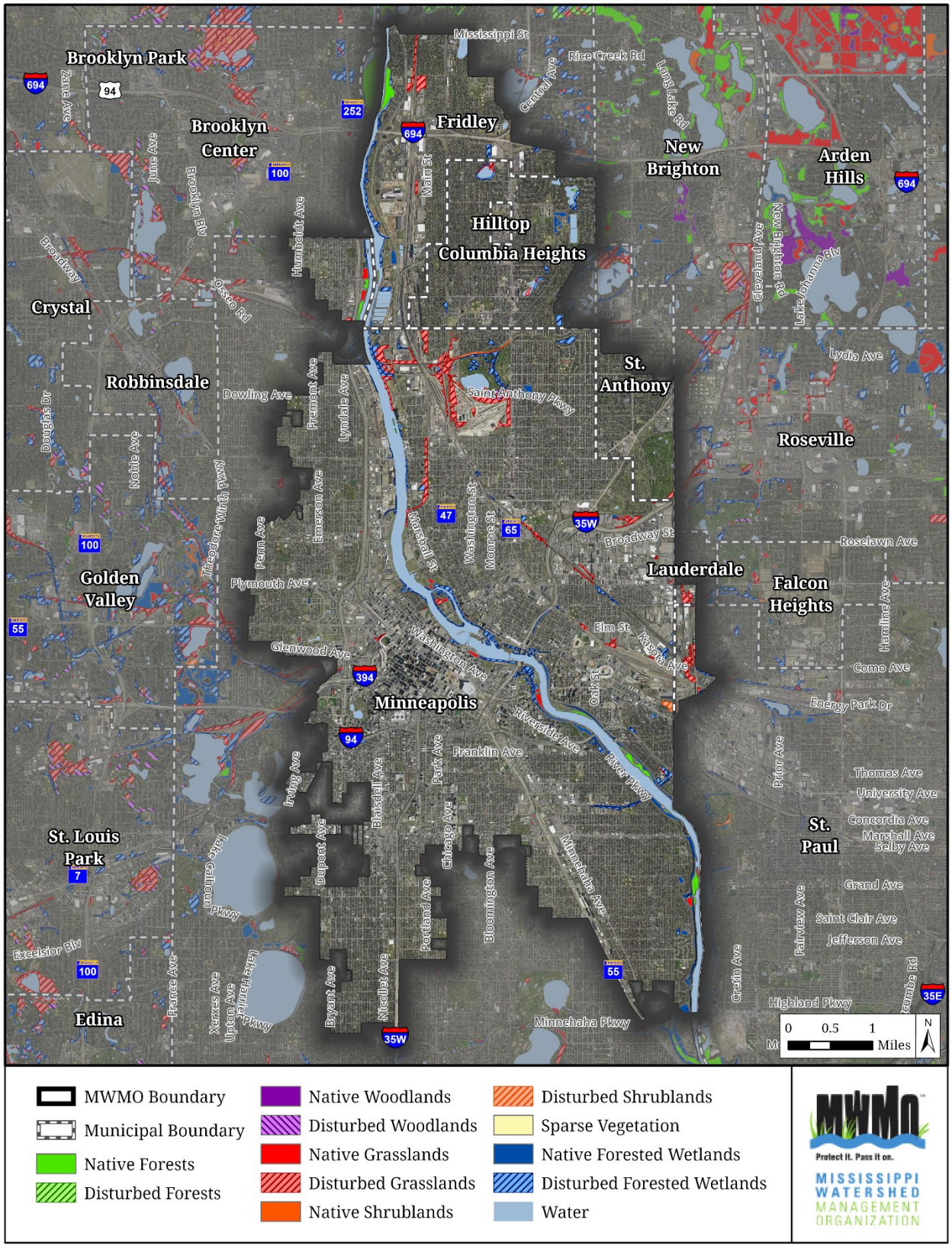


Figure 15: Natural and Semi-natural Area of the MWMO

4.3.2 Rare Biological Features

The Minnesota County Biological Survey identifies significant native plant communities throughout the State of Minnesota. Native plant communities typically appear where there is little alteration by humans and development. Native plant communities are named for the characteristic plant species within them or for characteristic environmental features. The Minnesota County Biological Survey program completed a survey of remaining areas of natural vegetation in Hennepin County from 1995-1997 and in Ramsey County from 1989-1990, identifying several intact native plant communities. The native plant communities identified in the survey are located along the Mississippi River and include Mesic prairie, Red oak/sugar maple/basswood forest, and Silver maple floodplain forest.

The Minnesota Department of Natural Resources queried the Minnesota Natural Heritage Information System Rare Features Database to find all records of rare species and other significant natural features within one mile of the watershed. **Table 9** summarizes the records of federal- and state-listed species—plants or animals that are listed as Endangered, Threatened, or Special Concern status in the State of Minnesota Department of Natural Resources Natural Heritage Program. The habitats where these species have been located need to be protected and potentially enhanced. The MWMO will give special consideration and protection to these areas during planning.

Because these rare features data are not based on a comprehensive inventory, there may be additional rare or otherwise significant natural feature occurrences in the MWMO that were not reported and therefore not entered into the database or the table below. Additional information on rare species can be found on the Minnesota Department of Natural Resources website's Rare Species Guide at http://www.dnr.state.mn.us/rsg/index.html. The index report of rare features and additional information on Blanding's Turtles can be found in Appendix E.

Table 9: Rare, Sensitive, and Endangered Species within the MWMO

Common Name	Genus and Species	Status
A Species of Fungus	*Psathyrella rhodospora*	Minnesota - Endangered
Acadian Flycatcher	*Empidonax virescens*	Minnesota - Special Concern
American Burying Beetle	*Nicrophorus americanus*	Minnesota - Watchlist
Autumn Fimbry	*Fimbristylis autumnalis*	Minnesota - Special Concern
Beach Heather	*Hudsonia tomentosa*	Minnesota - Threatened
Black Huckleberry	*Gaylussacia baccata*	Minnesota - Threatened
Black Sandshell	*Ligumia recta*	Minnesota - Special Concern
Blanding's Turtle	*Emydoidea blandingii*	Minnesota - Threatened
Eastern Hognose Snake	*Heterodon platirhinos*	Minnesota - Watchlist
Fawnsfoot	*Truncilla donaciformis*	Minnesota - Threatened
Ghost Tiger Beetle	*Cicindela lepida*	Minnesota - Threatened
Handsome Sedge	*Carex formosa*	Minnesota - Endangered
Higgins Eye	*Lampsilis higginsii*	Federal - Endangered

Common Name	Genus and Species	Status
		Minnesota - Endangered
Kentucky Coffee Tree	*Gymnocladus dioica*	Minnesota - Special Concern
Lance-leaf Violet	*Viola lanceolata var. lanceolata*	Minnesota - Threatened
Late Hawthorn	*Crataegus calpodendron*	Minnesota - Special Concern
Leadplant Flower Moth	*Schinia lucens*	Minnesota - Special Concern
Mucket	*Actinonaias ligamentina*	Minnesota - Threatened
Mudpuppy	*Necturus maculosus*	Minnesota - Special Concern
Peregrine Falcon	*Falco peregrinus*	Minnesota - Special Concern
Plains Hog-nosed Snake	*Heterodon nasicus*	Minnesota - Special Concern
Prairie Vole	*Microtus ochrogaster*	Minnesota - Special Concern
Rusty-patched Bumble Bee	*Bombus affinis*	Federal - Endangered Minnesota - Watchlist
Slender Naiad	*Najas gracillima*	Minnesota - Special Concern
Spike	*Eurynia dilatata*	Minnesota - Threatened
Swamp White Oak	*Quercus bicolor*	Minnesota - Special Concern
Tall Nutrush	*Scleria triglomerata*	Minnesota - Endangered
Tricolored Bat	*Perimyotis subflavus*	Minnesota - Special Concern
Wartyback	*Quadrula nodulata*	Minnesota - Threatened

Source: MDNR Natural Heritage Information System: Rare Features Database

4.3.3 Fish and Wildlife

The MWMO is a highly developed watershed with limited viable fish and wildlife habitat. The areas within the watershed that do foster fish and wildlife populations are important to preserve, monitor, and enhance. These areas provide economic, aesthetic, and recreational benefits. In addition, natural systems directly impact water quality. Preserving aquatic, riparian, and upland wildlife habitats can increase the overall ecological integrity of the watershed. While most of the upland areas of the MWMO are developed, habitat patches also help preserve remnants of local ecosystems and improve water quality. For example, residents in many neighborhoods have transformed their yards and boulevards to create better habitat for pollinators by installing native plant gardens, bee lawns, and infiltrative stormwater management practices like rain gardens. The following section introduces Mississippi River fish and wildlife.

Fish and Invertebrates

The Mississippi River is the major source of viable fish and wildlife habitat in the watershed. Approximately 123 fish species were historically found downstream of Saint Anthony Falls and 63 above the falls, which served as a natural migration barrier (Eddy et al., 1963). Dam construction, land use changes, and sewage and industrial contamination, led to dramatic fish species declines. By 1926, fish survey data found only two living fish between St. Anthony Falls and Hastings (Weller and Russell, 2016). Periphyton densities generally increased from upstream to downstream, whereas benthic invertebrate densities decreased from upstream to downstream in

the upper Mississippi River as urban and agricultural land use became more prevalent. Upstream of the twin cities metropolitan area (TCMA), the Mississippi River contains more diverse habitat including riffles, runs, and pools; the channel then becomes wider, warmer, and deeper with slower velocities and fine-grained substrate. Due to a series of impoundments for navigation within and downstream of the TCMA, the river is more lentic (lake-like). The result is conditions favoring lake species and larger river species that prefer deep-water habitat (ZumBerge et al., 2003). Restoration of boulder and cobble bed substrate, reestablishment of sediment transport via a free-flowing river, and restoration of native plant communities and in-channel features such as islands, sandbars, and mudflats have been identified as strategies to restore the Mississippi River Gorge. Most fish and mussels are blocked from reaching their historic spawning/nesting grounds and the substrate is buried with sediment (Lenhart, 2012). Improvements in wastewater management, particularly following the passage of the Clean Water Act in 1972, have helped fish populations recover. It is estimated that 129 or more species of fish (120 native, nine introduced) inhabit the Mississippi River up to St. Anthony Falls and 86 species above the falls (Weller and Russell, 2016). Within the MWMO watershed, biological monitoring data available from the MPCA Surface Water Data Access tool reflects impaired conditions. For example, Station 13UM001 adjacent to Boom Island Park has 2013 data indicating an index of biological integrity (IBI) rating of 26 (poor) for fish and 31 (fair) for invertebrates; fish species with the highest counts included smallmouth bass, common carp, and black darter (tolerant of pools and still water). Invasive Asian carp are also a growing concern; although not known to be currently reproducing in Minnesota, two silver carp were caught between the Hastings Dam and Dam No 1 in 2014. The health and dispersal ability of the Mississippi River's native fish populations is key to the success of mussel populations, since mussels reproduce by releasing larvae that attach to a host, usually fish. However, removal of fish migration barriers must be coordinated with efforts to prevent the spread of Asian carp (Weller and Russell, 2016).

An estimated 30 native fish species remain in the Mississippi River gorge, which extends from the original mouth of the Minnesota River at Fort Snelling to the upper Saint Anthony Falls Lock and Dam. Konrad Schmidt compiled a list based on literature, stream survey reports, specimens at the James Ford Bell Museum of Natural History, and communication with Minnesota DNR fisheries biologists. A total of 74 species representing 19 families were historically reported in the gorge. This includes 72 native species, two introduced (exotic), one threatened and three special concern species (Schmidt, 2005).

Freshwater mussels are highly sensitive to water quality impairments (e.g. low dissolved oxygen, altered flow regimes, chemical contaminants, and increased siltation) and their populations have fluctuated due to these environmental disturbances in the metro area. Historically, 41 native species of mussels were documented within the MNRRA corridor. However, populations were nearly wiped out in the early 1900s due to pollution, particularly the discharge of untreated waste, and no live species found above Lock and Dam No 1 to just above the St. Anthony Falls (Fuller 1980). Mussel populations have begun to recover due to improvements to sewage treatment, including the separation of storm sewers from sanitary sewers, and other water quality improvement efforts. A 2002 report documented 15 species within Pool 1 (extending from

Dam No 1 upstream to St. Anthony Falls) including the Wartyback (*Quadrula nodulata*), a threatened species in Minnesota described as being fairly common in Pool 1. Mussels were also found to be expanding their range above St. Anthony Falls (historically a dispersal barrier), with 16 species collected in the St. Anthony Falls pool, 10 of which had not been previously reported including the round pigtoe (*Pleurobema sintoxia*), a threatened species in Minnesota (Kelner and Davis, 2002). Upstream of St. Anthony Falls, there are now 18 reported native mussel species (Weller and Russell, 2016). Native mussels are highly sensitive to exotic invasive species invasions such as zebra mussels. Although the invasive zebra mussel was not found within Pool 1, they were noted to likely be present as they had been observed within the lock chambers at St. Anthony Falls (Kelna and Davis, 2002). The entire stretch of the Mississippi River within the watershed is designated by the MN DNR as infested with Eurasian watermilfoil, zebra mussels, or both (MN DNR, 2017). Boaters can play a key role in helping prevent the spread of invasive species. Boat launches, such as at the University of Minnesota launch at East River flats and at Boom Island Park, have zebra mussel exotic species alert signs.

Birds

Migratory, resident, and breeding birds reply upon the diverse habitats provided by the Mississippi River corridor. Millions of migratory birds travel along the Mississippi Flyway during spring and fall migrations; this corridor is used by 40 percent of North America's waterfowl and shorebirds. A total of 298 bird species are known to regularly occur within the Twin Cities metro area, 163 of which are breeders or permanent residents; the others are migrants or winter/summer visitors (Audubon Minnesota, 2012). Protected and managed areas within highly developed areas provide important habitat. For example, a list of observations by Dave Zumeta compiled between May 1998 and July 2020 includes 191 species of birds along the west side of the Mississippi River Gorge, 58 of which are confirmed or likely breeding species (Zumeta, 2020). Many American Bald Eagles also utilize the Mississippi River for nesting and fishing; the metro River has about 55 active nesting sites (Weller and Russell, 2016).

The metro area is recognized as being critical to the conservation of resident and migratory birds. The Audubon designated Mississippi River Twin Cities Important Bird Area (IBA) includes the River and its floodplain forest and upland habitat extending 38 river miles from Minneapolis to Hastings. Given the densely populated and urban nature of the IBA, conserving and managing the remaining native plant communities along the shoreline, wetlands, and adjacent upland areas is key to conservation success. The areas adjacent to the River provide vegetative cover for birds to nest and feed. Recognizing the need for conservation of bird habitat within the metro area, Minneapolis and St. Paul were recognized in July 2011 as members of the Urban Conservation Treaty for Migratory Birds (Urban Bird Treaty Program) developed by the United States Fish and Wildlife Service. Efforts under the treaty include habitat restoration (emphasizing native plants), invasive species management, and development of educational materials to support conservation of birds spending a portion of their lifecycle within the metropolitan area (Audubon Minnesota, 2012).

Mammals

The Mississippi National River and Recreation Area corridor is home to aquatic or semi-aquatic mammals including the American Beaver, River Otter, mink, and muskrat (Lafrancois et al., 2007). Within the MNRRA, natural sign surveys found otter in the corridor after decades of being absent. However, no reliable data or estimates of local river otter abundance or population size currently exist. There are seven species of bats within the MNRRA corridor, including big and little brown, northern myotis, tri-colored, eastern red, hoary, and silver-haired. Bats use natural and manmade caves along the River. While there is no evidence of white-nose syndrome in the corridor yet, it is thought to likely be on its way (National Park Service, 2013).

Amphibians and Reptiles

Lists by The National Park Service Great Lakes Inventory and Monitoring Network as of March 2006 include 14 frog and salamander species (present or probably present), 8 turtle species, and the Northern Water Snake within the MNRRA (Nerodia sipedon sipedon) (Lafrancois et al., 2007). Frog populations are currently low because breeding habitat within the MNRRA corridor is scarce with few wetlands. While toads and chorus frogs are doing fairly well within the corridor, other species such as leopard frogs are declining due to Batrachochytrium dendrobatidis fungus, pollutants and other stressors. Salamanders are also struggling. Turtle populations in MNRRA are stable but at much lower numbers than in pools immediately below the boundary (National Park Service, 2013). Spiny softshell turtles were observed by MWMO staff in June 2020 sunning themselves on logs at the reconstructed Hall's Island.

4.3.4 Discussion of Challenges, Gaps, and Next Steps

As discussed above, natural plant communities and wildlife are scarcer in the terrestrial upland areas of the MWMO, while the Mississippi River corridor is the major source of viable fish and wildlife habitat in the watershed. Yet all these fish and wildlife resources provide economic, ecological, and social benefits for residents living in the watershed. The MWMO can use this information to guide its restoration, land conservation, and multifunctional corridor planning efforts to improve native plant diversity and wildlife habitat.

4.4 Human Environment

4.4.1 Demographics

Population and demographic data can impact the reach and effectiveness of MWMO's projects and programs. To maximize its impact, the MWMO considers such data in its approach to water and natural resource management and the design and implementation of specific projects and programs.

The MWMO is an urban watershed with high population density. **Figure 16** presents population density within the MWMO based on Census Bureau block data from 2014-2018 maintained by the

Metropolitan Council. Population density for census blocks wholly or partially within the MWMO averages approximately 11 people/acre (7,200 people per square mile), but varies widely across the watershed and between neighborhoods (**Figure 16**). The total population of census blocks within the MWMO is approximately 330,000; population is broken down by community in **Table 10**. The Metropolitan Council forecasts population growth within all MWMO cities between 2020 and 2040 (**Table 10**). Increased population within the MWMO may lead to increased high-density redevelopment opportunities and challenges within the watershed. Additional population data is available in the 2040 Comprehensive Plan of each city.

Table 10: Population projections for cities within the MWMO

City	2014-2018 Population[1]	2010 Population[2]	2020-2040 Forecast Population Growth[3]
Columbia Heights	18,154	17,867	12.7%
Fridley	8,312	8,407	10.9%
Hilltop	862	744	29.8%
Lauderdale	350	344	18.5%
Minneapolis	250,997	226,050	11.2%
Saint Anthony Village	3,747	3,464	2.0%
Saint Paul	740	969	9.2%
Totals	283,162	257,844	--

(1) Based on 2014-2018 US Census Block Group and the percent area within MWMO (this does not distinguish between residential and non-residential areas).
(2) Based on 2010 US Census Block Group and the percent area within MWMO (this does not distinguish between residential and non-residential areas).
(3) Based on Metropolitan Council Thrive 2040 forecasts (this does not distinguish between areas within or outside the MWMO).

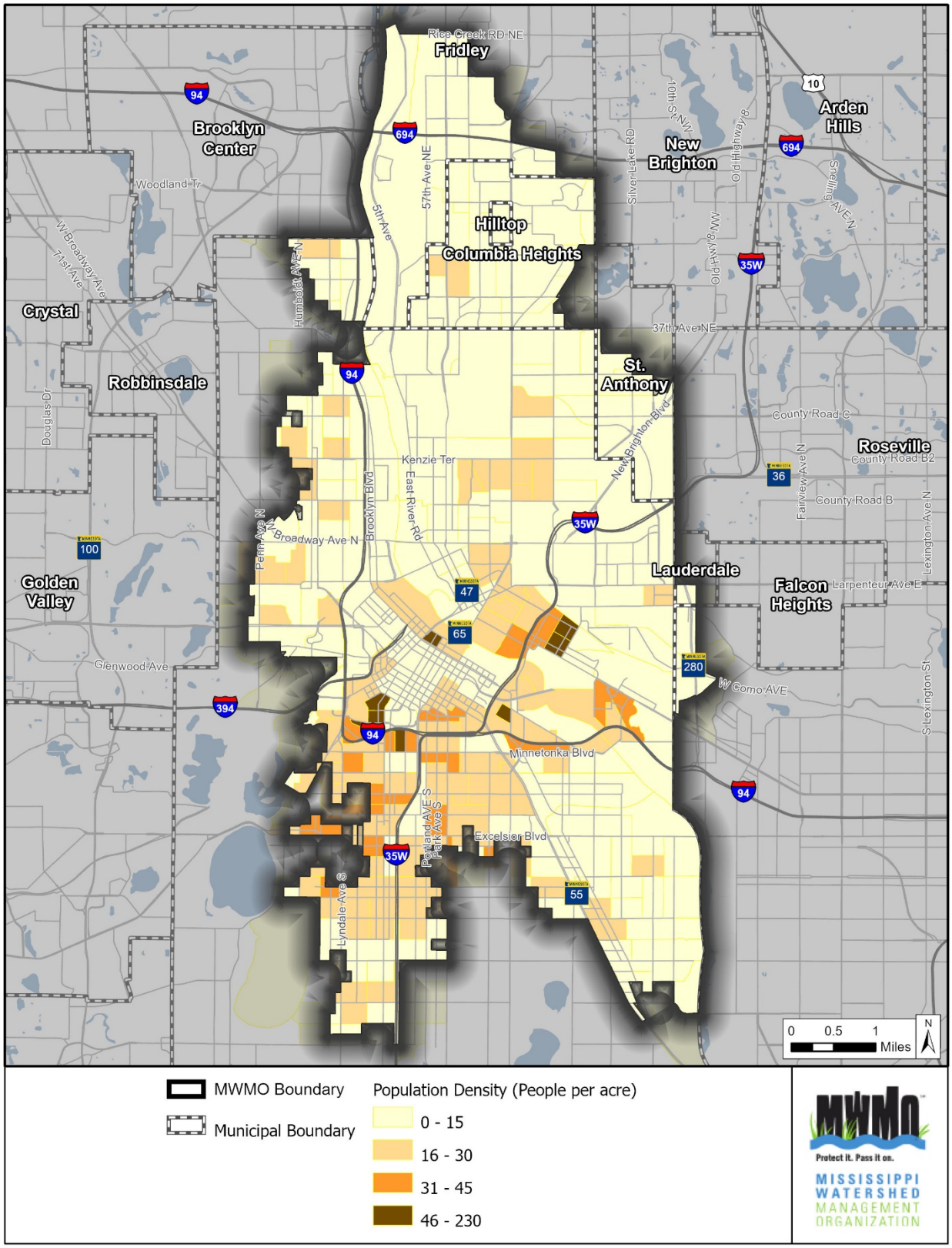


Figure 16: Population density in the MWMO

The communities within the MWMO are diverse in many ways. MWMO understands that recognizing this diversity is key to engaging populations of residents with differing values and ideas about water and natural resources, and varying capacity for action. For example, the MWMO and the City of Minneapolis Department of Public Works developed with Katherine Barton the *Hmong Water Research Project (Kev Cob Qhia Zej Tsoom Hmoob Txog Dej): Assessing Attitudes, Perception and Behavior about Water in Minnesota's Hmong Community* (Barton, 2007). The *Hmong Water Research Project* takes an important look at the Hmong community to learn and understand how the community communicates and receives information, its knowledge, behavior, and attitudes about water issues, and its worldview and cultural context. The Hmong community served as a pilot group for this thorough cultural analysis with respect to water resources management. The information in the report informs the design and implementation of focused stewardship campaigns about water. The MWMO and its partners may repeat and adapt this approach for other communities in the MWMO.

Over time, the MWMO's population has grown more racially and ethnically diverse. Over 40% of residents within the MWMO are non-white (2014-2018 Census Block data). Minneapolis has the largest urban population of Native Americans in the United States. Recent increases in diversity are due to new residents from Mexico, Latin America, and Asia, as well as African countries like Somalia and Ethiopia (Minneapolis has the largest Somali population of any city in the United States). Many of these new residents are children and working-age adults. In fact, the city boasts that over 90 languages are spoken in its households. While Minneapolis was once a major source of diversity in the MWMO, such diversity is now observed across most MWMO cities (**Table 11**).

Table 11: Race and ethnicity within the MWMO

Race or Ethnicity (percent of population identifying as)[1]									
	Person of Color	**Hispanic**	**Black**	**American Indian**	**Asian**	**White**	**Pacific Islander**	**Other**	**Multi-racial**
Totals	44.9%	10.4%	21.8%	1.3%	7.0%	55.1%	0.0%	0.2%	4.1%
Columbia Heights	40.0%	10.8%	17.2%	0.8%	6.0%	60.0%	0.1%	0.9%	4.2%
Fridley	42.0%	10.4%	20.3%	1.0%	7.5%	58.0%	0.0%	0.1%	2.7%
Hilltop	68.6%	45.1%	10.1%	2.7%	2.6%	31.4%	0.0%	0.0%	8.1%
Lauderdale	48.6%	2.4%	17.2%	2.6%	23.7%	51.4%	0.0%	1.4%	1.5%
Minneapolis	45.8%	10.4%	22.6%	1.4%	7.1%	54.2%	0.0%	0.2%	4.1%
Saint Anthony Village	14.5%	4.9%	1.4%	2.2%	2.1%	85.5%	0.0%	0.2%	3.7%
Saint Paul	15.6%	2.3%	0.8%	0.0%	10.8%	84.4%	0.0%	0.4%	1.3%
(1) Based on 2014-2018 Census Block data and percent area within MWMO.									

Beyond race and ethnicity, demographic factors such as age, education level, and language can impact a community's interest and ability to engage in water and natural resources stewardship

actions. **Table 12** and **Table 13** present breakdowns of age and education level within the MWMO, respectively. In addition, income disparity and economic stress can be a significant barrier by limiting one's financial ability to implement practices, time available to become aware of and participate in stewardship practices or MWMO programs, and property ownership that is often critical for siting BMPs.

Table 12: Age groups for cities within the MWMO

Percent of population in MWMO[1]				
	Under 18 years	**18-39 years**	**40-64 years**	**Over 65 years**
Totals	18.9%	46.8%	24.8%	9.5%
Columbia Heights	21.5%	32.2%	31.0%	15.3%
Fridley	20.4%	37.3%	29.0%	13.3%
Hilltop	28.2%	34.1%	30.6%	7.1%
Lauderdale	16.2%	59.5%	15.8%	8.5%
Minneapolis	18.6%	48.6%	24.0%	8.8%
Saint Anthony Village	23.0%	22.3%	32.1%	22.5%
Saint Paul	20.7%	36.5%	27.0%	15.9%
(1) Based on 2014-2018 Census Block data and percent area within MWMO.				

Table 13: Highest education level achieved for cities within the MWMO

Race or Ethnicity (percent of population identifying as)[1]						
	Less than High School	**High School**	**Some College**	**Associate's Degree**	**Bachelor's Degree**	**Graduate Degree**
Totals	13.5%	18.8%	18.8%	7.1%	25.4%	16.4%
Columbia Heights	11.2%	32.1%	21.6%	11.3%	16.8%	6.9%
Fridley	11.4%	32.0%	20.1%	10.1%	18.8%	7.6%
Hilltop	27.9%	40.9%	17.6%	4.0%	8.7%	0.9%
Lauderdale	6.0%	9.2%	9.8%	4.5%	34.8%	35.8%
Minneapolis	13.9%	17.4%	18.5%	6.7%	26.2%	17.3%
Saint Anthony Village	3.9%	17.6%	21.2%	6.7%	28.5%	22.1%
Saint Paul	4.4%	12.9%	15.3%	2.4%	33.4%	31.7%
(1) Based on 2014-2018 Census Block data and percent area within MWMO.						

The Metropolitan Council has identified Areas of Concentrated Poverty (ACP) – census tracts where at least 40% of the residents live below 185% of the federal poverty guideline – as well as areas of concentrated affluence (ACA) (**Figure 17**). The Metropolitan Council has further identified areas where this income disparity disproportionately impacts communities of color (i.e., greater than 50% of residents are people of color) (**Figure 17**). The Metropolitan Council maintains additional datasets that provide more information about the root causes of concentrated poverty and income inequality. The Minneapolis 2040 Comprehensive Plan also

contains detailed information about income disparity and economic stress within the city. The datasets contain more information about housing and transportation to identify more specific needs of neighborhoods. The MWMO considers these datasets to promote the equitable delivery of programs and projects across the watershed. Additional context about the ACP and ACP50 datasets is available from the Metropolitan Council at: https://storymaps.arcgis.com/stories/e61c8e0e54e24485b956601fdc80b63e

Understanding the diverse nature of the population within the watershed will help MWMO staff design, target, and implement relevant infrastructure projects, information, and stewardship campaigns for its different populations, and promote equitable distribution of services across all communities.

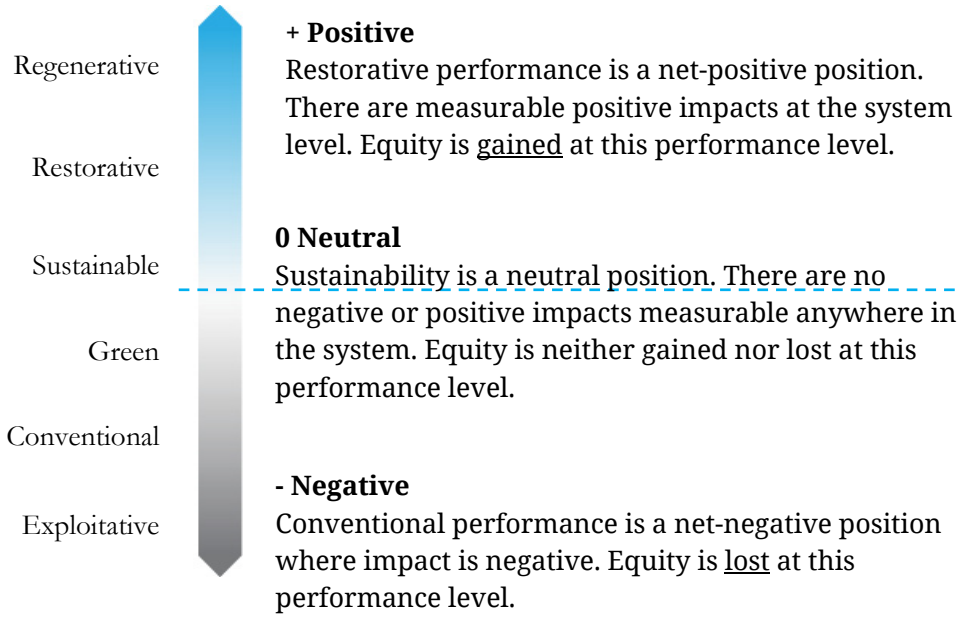
In an effort to improve equity within the watershed the MWMO is continuing an initiative started 2016 to study how restorative development design could lead to more equitable social, environmental, and economic outcomes within the watershed. The premise of a restorative approach is to assure that infrastructure supporting redevelopment sites is designed in a manner that it contributes to a net positive social, environmental, and economic outcome for the community it is in. This a part of a larger systems-based strategy where cities start to manage their waste streams as material inputs for other goods and services in the city.

Restorative development magnifies the benefits of green infrastructure work the MWMO is doing by tying improvements in air, water and soils to social needs related to food, housing, jobs and energy. In 2019, a Restorative Development Partnership was established to begin a Minneapolis wide feasibility study that will assess the viability of piloting a restorative development concept in Minneapolis.

The scale depicted below illustrates the shift that will need to occur in urban redevelopment to support climate change and equity goals sought within the watershed. As a member of the Restorative Development Partnership, the MWMO is learning how to model, measure, and track equity gained or lost from proposed developments and the infrastructure supporting them.

As shown below, the midpoint on the restorative development scale is the zero point, above which a development effort yields net positive equity, and below which it has net negative equity. The levels on the restorative development scale are: Regenerative, restorative, sustainable, green, conventional, and exploitative.

Table 14: Shift in Urban Redevelopment Scale Needed to Address Climate Change and Equity Goals



Source: Yorth Group 2020: Benchmarking Sustainability

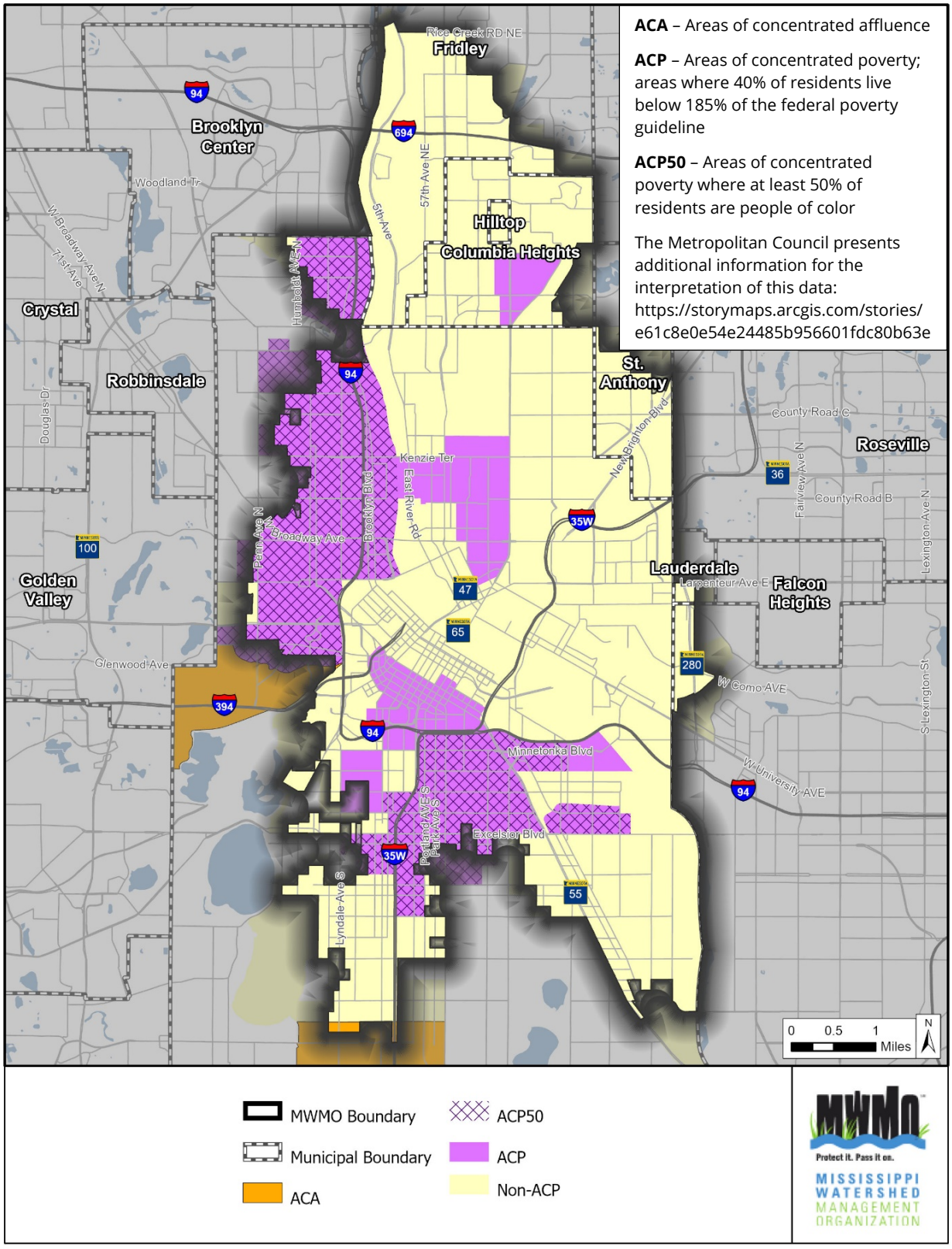


Figure 17: Areas of Concentrated Poverty and Affluence in the MWMO

Current population and population trends inform the direction of MWMO's natural resource management toward any use or combination of the following: preservation, protection, restoration, recreation, or acquisition. Population density in the MWMO in the year 2010 census is found in **Figure 18**. Each of the neighborhoods within the MWMO is identified in **Figure 19**. The population of the watershed based on the 2010 census is estimated at 257,844 people (**Table 15**). The Metropolitan Council has shown notable population growth in the Urban Center and Suburban Edge communities (Metropolitan Council, 2018). The Twin Cities Regional Forecast to 2040 (2019 update) indicates continued expected growth as well as major demographic shifts, towards a population that is more racially and ethnically diverse, older, and more likely to live alone or in larger households that may include extended family and multigenerational living arrangements (Metropolitan Council, 2019). Based on Metropolitan Council demographic forecasts as of May 28, 2014, it is projected that the overall population of cities within the MWMO will increase by 2040. The anticipated population growth indicates that higher density redevelopment within the already urbanized watershed is likely to occur.

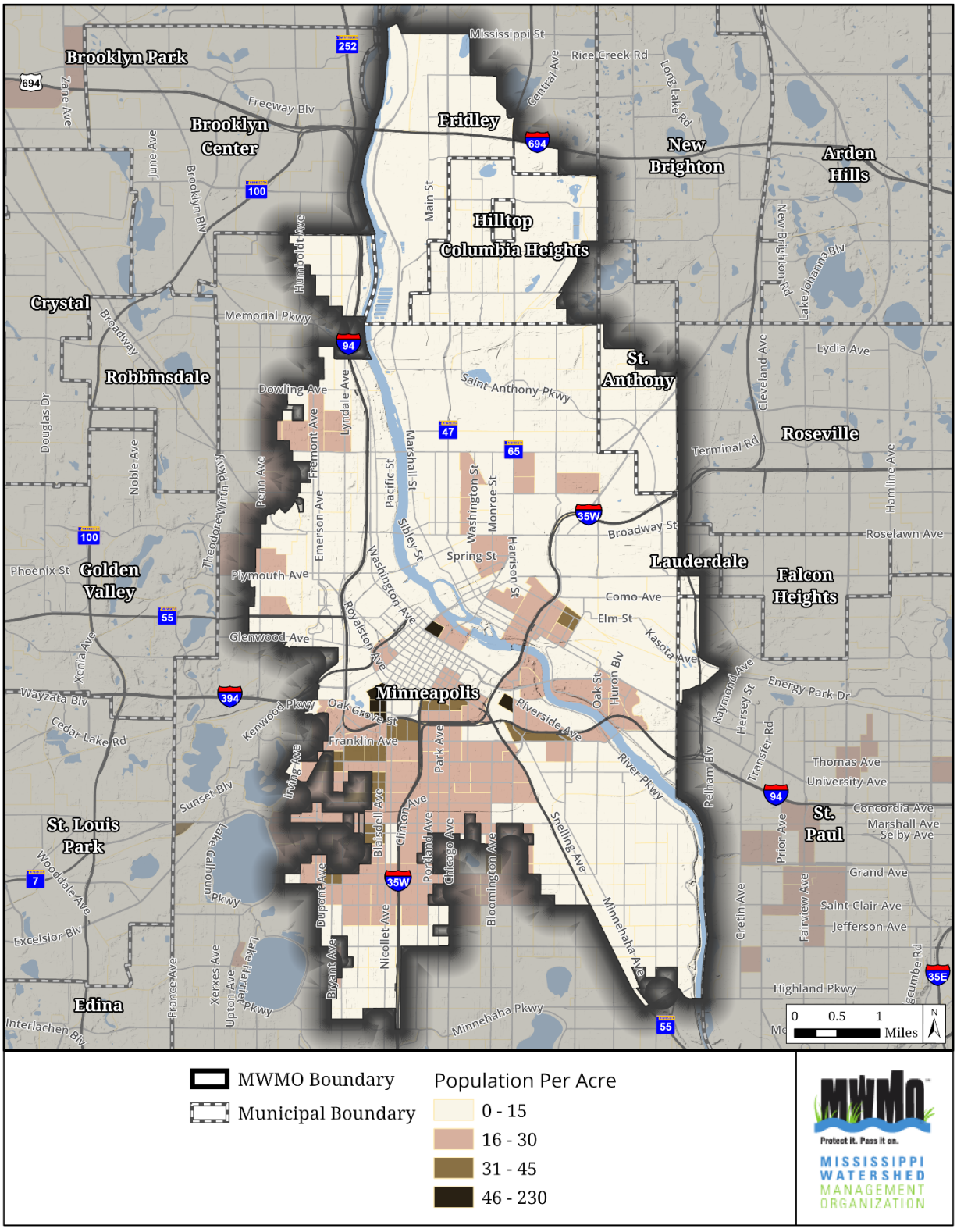


Figure 18: Population Density of the MWMO Based on the 2010 Census

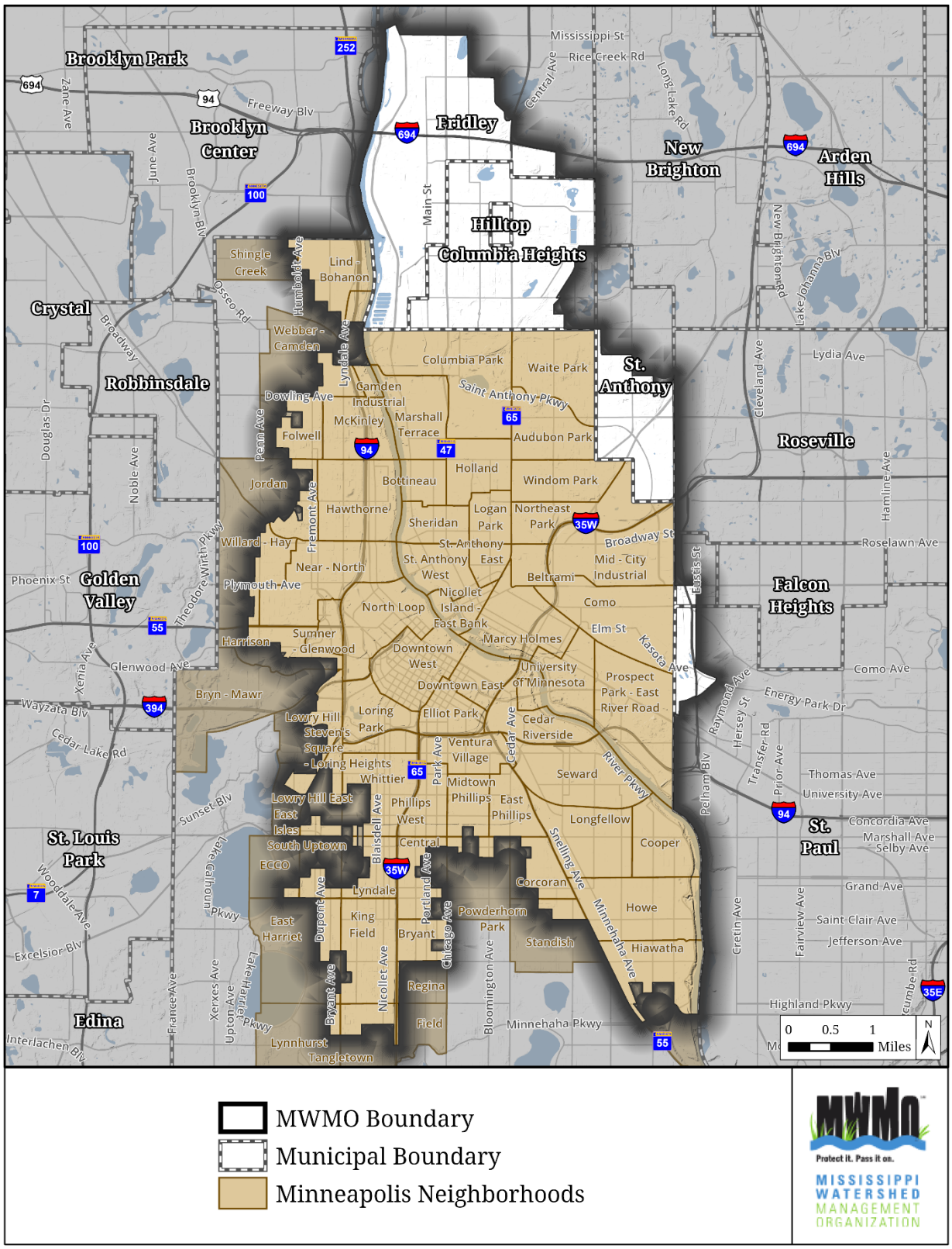


Figure 19: Minneapolis Neighborhoods in the MWMO

Table 15: Population Projections for Cities within the MWMO

City	2010 Population*	2019 Forecast**	2040 Forecast**
Columbia Heights	17,867	19,496	21,700
Fridley	8,407	27,208	29,400
Hilltop	744	744	1,100
Minneapolis	226,050	382,578	466,400
Saint Anthony Village	3,464	3,070	4,300
Saint Paul	969	285,068	334,700
Lauderdale	344	2,379	2,400
Totals:	**257,844**	**720,543**	**860,000**

Source: (Metropolitan Council Thrive MSP 2040 Forecasts, Metropolitan Council, 2014)

*Based on 2010 US Census Block Group. For the portion of the city that is within the MWMO.

** With the exception of Saint Anthony Village, Population forecasts are for the full city as estimated by Metropolitan Council, (2014) rather than the portion of the city's population that is within the MWMO. Population estimates do not differentiate among residential and non-residential areas.

The City of Minneapolis is a source of significant diversity within the MWMO. **Table 16** summarizes the estimated population within the City for seven major categories of race. In 1950, only 1.6% of the City was non-white; by 2006, the City was 36% non-white. Minneapolis has the largest urban population of Native Americans in the United States. Recent increases in diversity are due to new residents from Mexico, Latin America, and Asia, as well as African countries like Somalia and Ethiopia. Many of these new residents are children and working-age adults. In fact, the city boasts that over 90 languages are spoken in its households.

Table 16: Minneapolis 2006 Population by Race

Race	Estimated % of Total Population
White	64 %
Black or African American	18 %
Hispanic or Latino (of any race)	9 %
Asian and Native Hawaiian	5 %
Two or more races	3 %
American Indian and Alaska Native	1 %
Some other race	0 %
Total	**100%**

4.4.2 Historical Land Use

Understanding the effects of human settlement on MWMO resources is important for understanding water quality trends and guiding water resource management. The historic landscape of the MWMO consisted of a mosaic of streams, lakes, wetlands, and plant community types as a result of areas of shallow groundwater flow, soil characteristics, hydrology, and varying sun exposure. Dramatic springs and waterfalls were common.

Urbanization of the region resulted in filled, buried, drained, dammed, or otherwise altered water resources. In order to make way for development, surface waters were confined into a series of pipes and tunnels to convey streams, wetlands, and stormwater into the Mississippi River. Early planning led to some river corridor areas being left undeveloped. For example, Landscape Designer H.W.S. Cleveland created a vision in 1883 for a network of roads and parks linked to drives along both sides of the Mississippi River and presented this plan to the cities of Saint Paul and Minneapolis. Footpaths, such as the Winchell Trail on the west bank of the River between Franklin Avenue and 44th Street allow visitors close access to the River and undeveloped park space. However, the few areas that have not been developed along the River are often overgrown with invasive species like European buckthorn and have been altered by historic logging, aggregate and bedrock mining, and manmade access points. Fire sensitive maples, elms, and basswood were able to establish along the River (Brewer 1998). Despite these impacts, areas such as the Mississippi Gorge Regional Park (extending south of Bridge No. 9 to the north edge of Minnehaha Regional Park) help retain a semi-wild character along the River and showcase hardwood forests and prairie on steep limestone bluffs with bottomlands. The only true gorge along the Mississippi River, it was formed as St. Anthony Falls migrated slowly upriver and eroded a steep channel. Sections of the Mississippi Gorge Regional Park, such as the "Oak Savanna," containing remnant prairie at 36th Street and West River Parkway, have been carefully maintained and managed by MPRB staff, partnering organizations, and local volunteer groups.

The banks and bed of the Mississippi River were altered over time by filling and dredging activities. Subwatersheds in the region that were previously defined by topography are now defined by extensive underground stormwater tunnel and pipe networks. Historic subwatersheds, as identified in the *Historic Waters of the MWMO* report (MWMO, 2011), are shown in **Figure 20**. In the *Historic Waters of the MWMO* report *(*MWMO, 2011), these historic subwatersheds were aggregated into six Historic Planning Areas based on hydrologic association (also in **Figure 20**). Each Historic Planning Area is described by landscape, historic water features, pre-settlement vegetation, and major landscape alterations. In some instances, the historic hydrology of the watershed still affects land use today. With the addition of portions of three new cities to the MWMO, two additional planning areas have been added (see **Figure 20**).

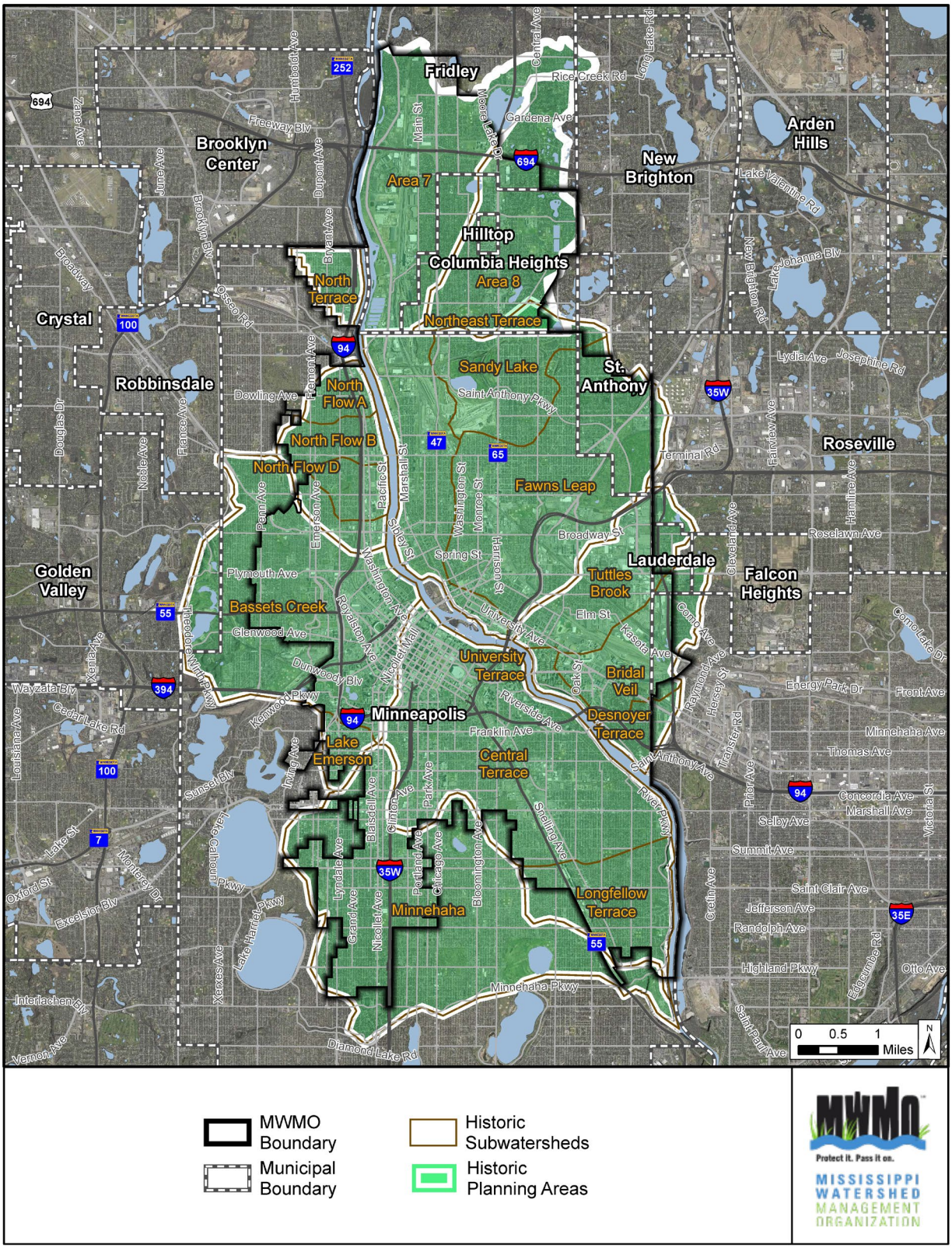


Figure 20: Historic Subwatersheds and Planning Areas of the MWMO

4.4.3 Present Land Use

The watershed is entirely developed and contains the central business district of Minneapolis (**Figure 21**). The dominant land use is single family residential, covering approximately 39.5% of the watershed. Commercial and multi-family land uses are concentrated near downtown Minneapolis and along major roadways. Industrial land uses are generally located along major transportation routes: roadways, railways, and along the Mississippi River. Parks are distributed throughout the watershed and range in size from small neighborhood parks to large regional parks located along the Mississippi River. **Table 17** summarizes acreage of the various land uses found in the watershed. The entire watershed is within the Metropolitan Urban Service Area. The Metropolitan Urban Service Area is the area in which the Metropolitan Council ensures that regional services and facilities, such as sewers and major highways, are planned and provided.

Table 17: Present Land Use of the MWMO

Land Use	Acres	% Watershed Area
Agricultural	17.6	0.1%
Golf Course	360.0	1.4%
Industrial and Utility	3,165.4	12.4%
Institutional	2,127.6	8.3%
Major Highway	1,311.2	5.1%
Major Railway	760.9	3.0%
Manufactured Housing Parks	39.4	0.2%
Mixed Use Commercial	177.6	0.7%
Mixed Use Industrial	293.5	1.1%
Mixed Use Residential	255.2	1.0%
Multifamily	1,674.4	6.6%
Office	530.2	2.1%
Open Water	879.2	3.4%
Park, Recreational, or Preserve	1,567.5	6.1%
Retail or Other Commercial	1,498.4	5.9%
Seasonal/Vacation	0.0	0.0%
Single Family Attached	1,880.6	7.4%
Single Family Detached	8,180.4	32.0%
Undeveloped	823.9	3.2%

Land Use	Acres	% Watershed Area
Totals	**25,543.2**	**100%**

Source: Metropolitan Council, Generalized Land Use Data

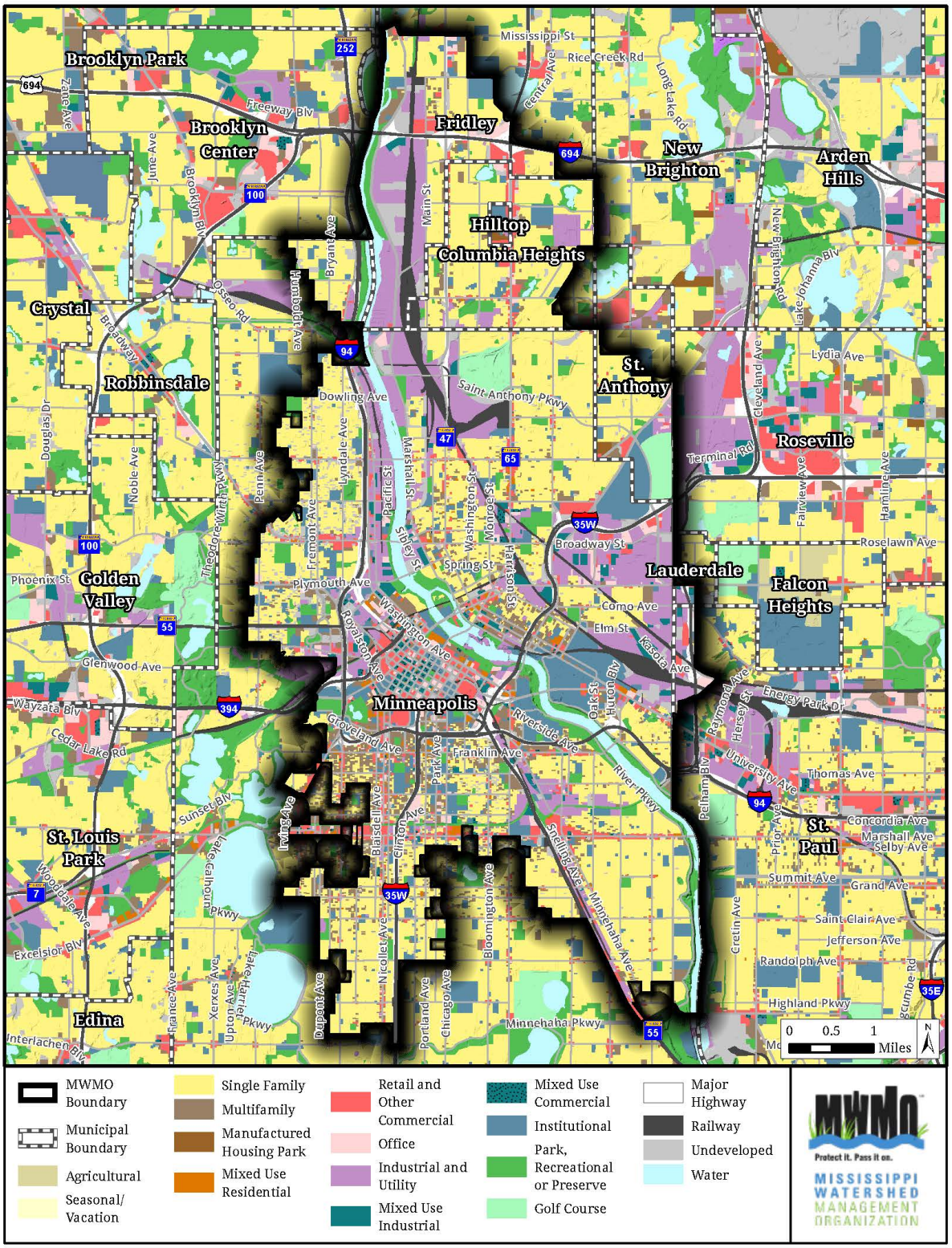


Figure 21: Present Land Use of the MWMO

4.4.4 2040 Land Use

Based on the cities' 2040 land use plans, a few major changes in land use are expected in the watershed. These include some large areas of redevelopment due to closure of Upper Saint Anthony Falls Lock, under developed areas within the watershed transitioning from warehouse to multistory and a significant shift of single-family housing to multifamily. **Table 18** summarizes acreage of the various land use forecast for the year 2040. Future land use as reported by Metropolitan Council is shown in **Figure 22**.

Table 18: Future Land Use of the MWMO

Land Use	**Acres**	**% Watershed Area**
Commercial	330.9	1.3%
Industrial	2,388.4	9.4%
Institutional	1,747.5	6.8%
Mixed Use	490.2	1.9%
Multi-Optional Development	5,921.7	23.2%
Multifamily Residential	1,895.2	7.4%
Open Water	887.2	3.5%
Parks and Recreation	2,127.7	8.3%
Railway (including Light Rail Transit)	728.6	2.9%
Rights-of-Way (i.e. Roads)	1,205.6	4.7%
Single Family Residential	7,820.2	30.6%
Totals	**25,543.2**	**100%**

Source: Metropolitan Council Regional Planned Land Use

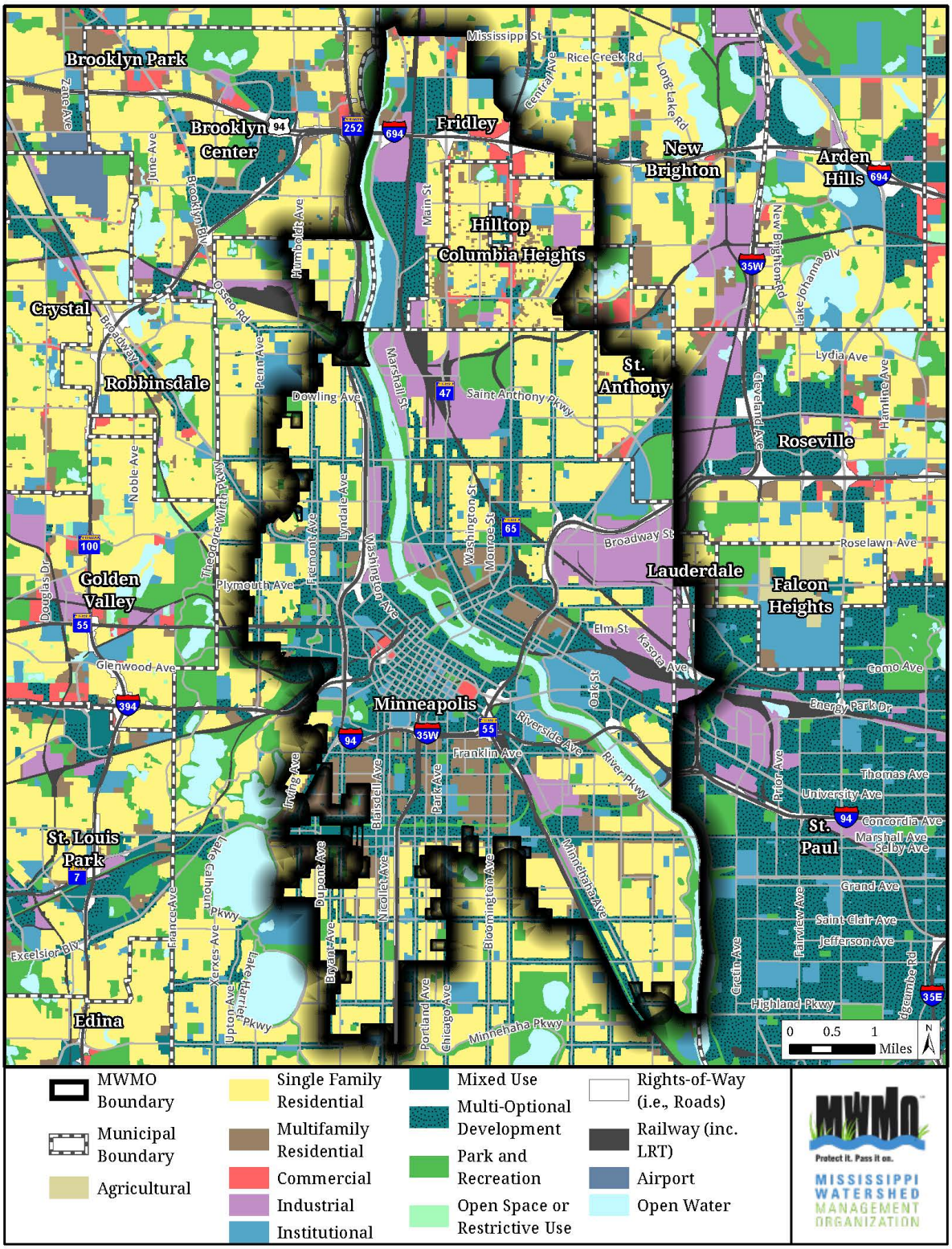


Figure 22: 2040 Future Land Use of the MWMO

4.4.5 Redevelopment Opportunities

During recent local water planning processes, the MWMO worked with its member cities to identify locations where significant shifts in the future land use is being shown. These areas of redevelopment over the next 10 years are opportunities for the cities to collaborate with the MWMO on district or regional stormwater systems, corridor planning, environmentally sensitive development techniques, or communication and outreach activities. The MWMO is willing to be a part of the early on planning and design stages of these redevelopment areas. Assisting the cities or developers with setting a green infrastructure framework for the development that will benefit both the public and private sector.

To prioritize and track these projects internally the MWMO is developing a watershed planning tool that we can utilize in house to identify where layered social, environmental, and economic benefits intersect. This will help us prioritize areas in the watershed where we will prefer to work on projects when redevelopment opportunities arise. All upcoming project areas are discussed with member cities during annual project check-ins. They also come to our attention as we work with staff and Board members from our member organizations on other planning and other project initiatives. Keeping in touch with the planning and economic development departments of member cities as well other neighborhood level organizations set up to track development is another great source of information. Regardless of the source, our goal is to meet with the landowner as soon as land is purchased or a landowner signals they are considering initial plans for redevelopment. For a current list of MWMO's capital projects see **Section 6.1 Capital Improvement Schedule**.

4.4.6 Surface and Groundwater Appropriations

Minnesota Department of Natural Resources Division of Ecological and Water Resources (EWR) regulates surface and groundwater appropriations based on daily and yearly withdrawal volumes. This management affects water supply for domestic, agricultural, fish and wildlife, recreational, power, navigation, and quality control purposes. A permit through the Water Appropriation Permit Program is required for all users withdrawing more than 10,000 gallons per day or 1 million gallons per year for consumptive or nonconsumptive use. A consumptive use is characterized by withdrawal of water that is not directly returned to its original source. All groundwater withdrawals are consumptive unless the water is returned directly to the aquifer from which it came. If surface water withdrawals are not directly returned to the source such that it is available for immediate further use, it is also considered consumptive. Currently there is not permitting in place for appropriations that draw less than 10,000 gallons per day or 1 million gallons per year.

Permit exemptions apply to certain domestic users, test pumping, water reuse from a permitted municipal source, and certain agricultural drainage systems. Permit exemptions may also apply to the demand from hydro-facilities. In certain cases where a hydro-facility does not take the water from its natural setting and the use is non-consumptive, the hydro-facility does not need an appropriation permit. As a result, these appropriations would not be on record with the

Minnesota Department of Natural Resources. Minnesota law also requires the Department of Natural Resources to limit appropriations during low flow conditions for the benefit of high priority downstream water users.

Figure 23 shows the locations and water source of the surface and groundwater appropriations within the MWMO. All the five main water use categories are currently found within the MWMO: power generation, industrial processing, public supply, irrigation, and additional uses categorized as *other*. *Other* appropriations include water withdrawn for air conditioning, water level maintenance, pollution confinement, or construction dewatering. A general permit authorizing temporary water appropriations might also include dust control, landscaping, and hydrostatic testing of pipelines, tanks, and wastewater ponds.

Three power generation appropriations are within the MWMO. Power generation appropriations typically withdraw surface water sources for cooling water resulting in non-consumptive use. Industrial processing is a water use category typically applicable to mining activities, paper mill operations, and food processing. Usually, withdrawals are from surface water sources. Many of the industrial processing appropriations are located along the Mississippi River as are public supply appropriations. Irrigation water can be withdrawn from either surface water or groundwater sources and is almost always a consumptive use. The other water use categories currently found in the MWMO include air conditioning, water level maintenance, and pollution confinement. Other withdrawals found in downtown Minneapolis are mostly for air conditioning. Other withdrawals in industrial areas are primarily for pollution confinement.

4.4.7 Open Space and Recreational Systems

Recreation is promoted by the MWMO through public involvement in land and water resource stewardship. Water-based recreation is an especially important part of the Minnesota lifestyle. The MWMO manages water quality to improve water-based recreation experiences and discourage water-based recreation that degrades water quality and surrounding habitat.

Multiple government entities and planning efforts have conducted open space, park, and recreational area mapping including the following: City Local Surface Water Management Plans and Comprehensive Plans, the Minneapolis Park and Recreation Board and its Comprehensive Plan, the National Park Service, Hennepin County, the State of Minnesota, and the Minnesota Department of Transportation. To the extent that mapping is available in report-size scale and format, **Figure 24** through **Figure 39** identify the open space, park, and recreational areas in the MWMO.

City parks, National Recreation Areas, State and County bicycle trails, and City greenways are just a few of the many open space and recreational offerings in the MWMO. In general, parks and open space in the MWMO are either associated with the Mississippi River corridor or are designated parcels within residential neighborhoods that serve as community centers with sports fields and play equipment.

The extensive network of parks in this highly urbanized watershed, specifically in Minneapolis, is the creation and activity of the Minneapolis Park and Recreation Board (MPRB). Established by an act of the Minnesota State Legislation and a vote of Minneapolis residents in 1883, it is an independently-elected, semi-autonomous body that governs, maintains, and develops the Minneapolis park system. The MPRB develops master plans to set a vision for long-term development and improvements of its parks or groups of parks, guide stewardship, ensure financial and ecological sustainability, and engage stakeholders. For example, MPRB worked with multiple stakeholders to develop a plan for the Mississippi River above Saint Anthony Falls in a report called *Above The Falls: A Master Plan for the Upper River in Minneapolis* (BRW et al., 1999). This plan was updated in 2013 (City of Minneapolis, 2013). The updated plan details a new implementation strategy to achieve the original vision for establishing a regional park along both sides of the Mississippi River all the way the City of Minneapolis' northern limits and supporting compatible new development in the northern part of the City. The plan incorporates the Minneapolis Park and Recreation Board's RiverFirst Vision for the development of parks and trails within the Above the Falls Regional Park (Tom Leader Studio et al., 2011).

Efforts were focused in North and Northeast Minneapolis for many reasons, including the increasing conflict between heavy industry and the adjacent neighborhoods striving to provide environmental quality that attracts new investment, and the fact that the Upper River is the best potential large-scale amenity awaiting development in the City of Minneapolis (and the MWMO).

The Upper River Master Plan ultimately seeks to provide the following:

- 98.6 acres of new park
- 3.9 miles of bike and pedestrian trails
- 3.4 miles of restored riverbank
- 2 miles of parkway and boulevard
- Over 1,000 housing units in new riverfront neighborhoods
- Over 3,000 net additional jobs
- Over $10 million in additional annual tax revenue

Since the original plan was written, most of the Phase I priorities have been completed:

- Upper River Development Corporation: The Minneapolis Riverfront Partnership was formed and is generally tasked with plan implementation
- Grain Belt redevelopment: located in the Sheridan Neighborhood of Northeast Minneapolis and includes the Grainbelt Brewery Complex and a varied mix of land uses such as commercial services, residential uses, arts related uses (e.g. galleries and studios), and improvements at a public riverfront attraction, Sheridan Memorial Park
- Trails along both banks of the river between Plymouth Avenue and the Burlington Northern Bridge
- West River Road North trail extension to 26th Avenue North: provides an important link from North Minneapolis to the riverfront, and specifically to the West River Road connection to Downtown

- Development projects, e.g. Standard Heating and Air Conditioning and Stremel Manufacturing (acquired by Chandler Industries), in the North Washington Industrial Park located along Washington Avenue in the warehouse district

The MPRB has undergone many additional planning efforts in addition to the Upper River Master Plan. The MPRB also developed a Park Master Plan for the Central Mississippi Riverfront Regional Park, which includes 350 acres of riverfront along the River and runs through the historic Mill District and the Downtown Minneapolis core (MPRB, 2016a). Beyond Park Master Plans, the MPRB also develops Service Area Master Plans, such as for East of the River, encompassing the Northeast/Southeast service area (MPRB, 2019a), North, covering parks north of I-394 and west of the Mississippi River (MPRB, 2019c), South, including parks south of downtown and east of I-35W (MPRB, 2016b), Downtown (MPRB, 2017), and Southwest (covering parks south of I-394 and west of I-35W). The MPRB also develops system-wide plans such as an Ecological System Plan, which was written in conjunction with the MWMO and addresses how MPRB approaches the quality, improvement, and continued protection of water, air, land and life within the Minneapolis park system (MPRB, 2020).

Recreational opportunities within the watershed include activities like boating, fishing, hiking, and biking, among others. There are four public sites to access the Mississippi River in the MWMO:

- Mississippi River Boat Ramp / Camden Boat Ramp: located on the west side of the River on Soo Avenue North in North Minneapolis (immediately west of the MWMO's boundary in the Shingle Creek watershed).
- Boom Island Park: boat dock on the east side of the River.
- Mississippi River Access, University of Minnesota: launch near the boathouse at the east end of the MPRB's East River Flats Park near the Irene Claudia Kroll boathouse. Signage indicates that this is an emergency boat launch only.
- Anoka County Riverfront Regional Park: boat launch with parking area located immediately south of Interstate 694.

There is an extensive network of bike trails through the watershed, including the Mississippi River Regional Trail in Anoka County and the Grand Rounds Scenic Byway, which nearly circumscribes the City of Minneapolis.

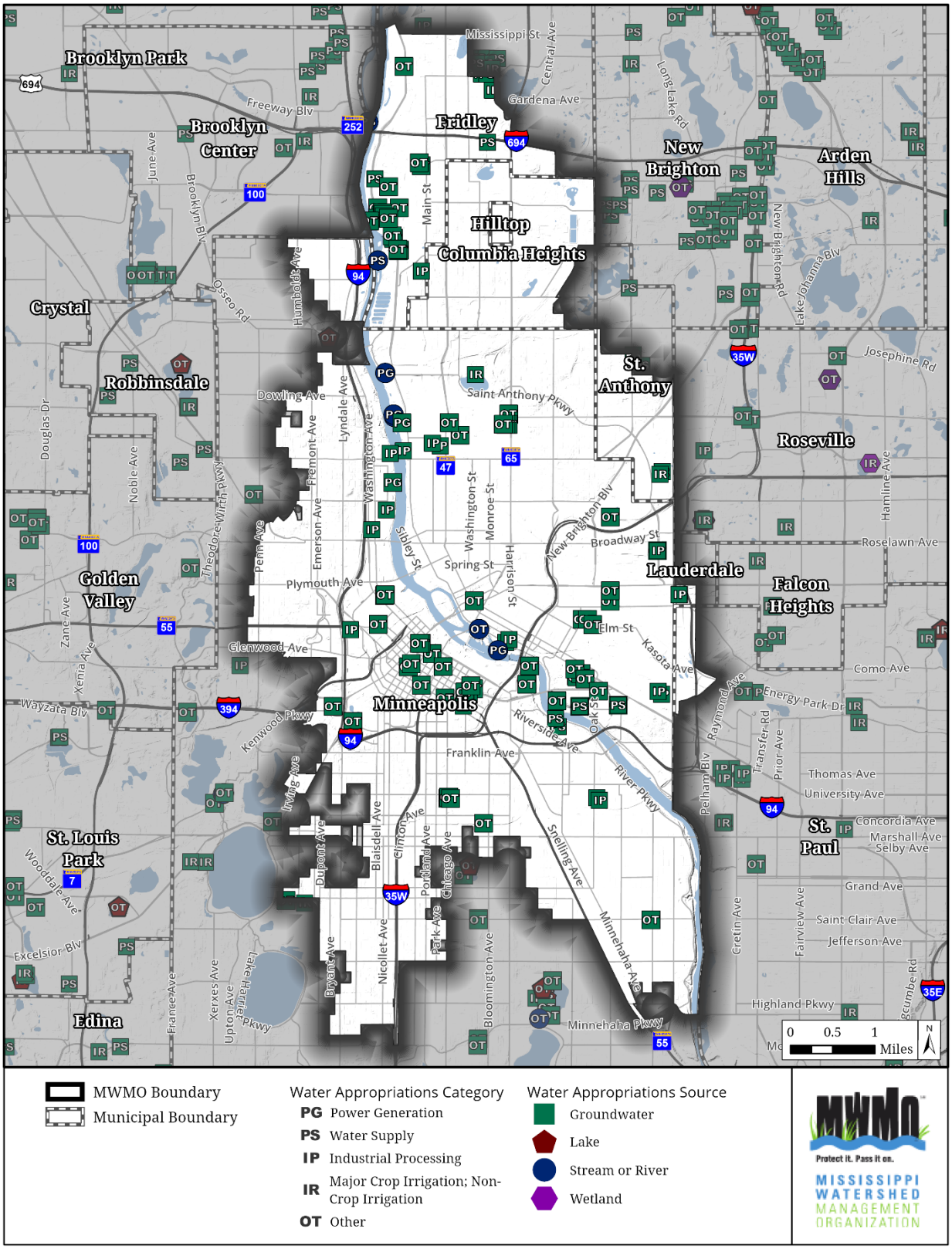


Figure 23: Surface and Ground Water Appropriations in the MWMO

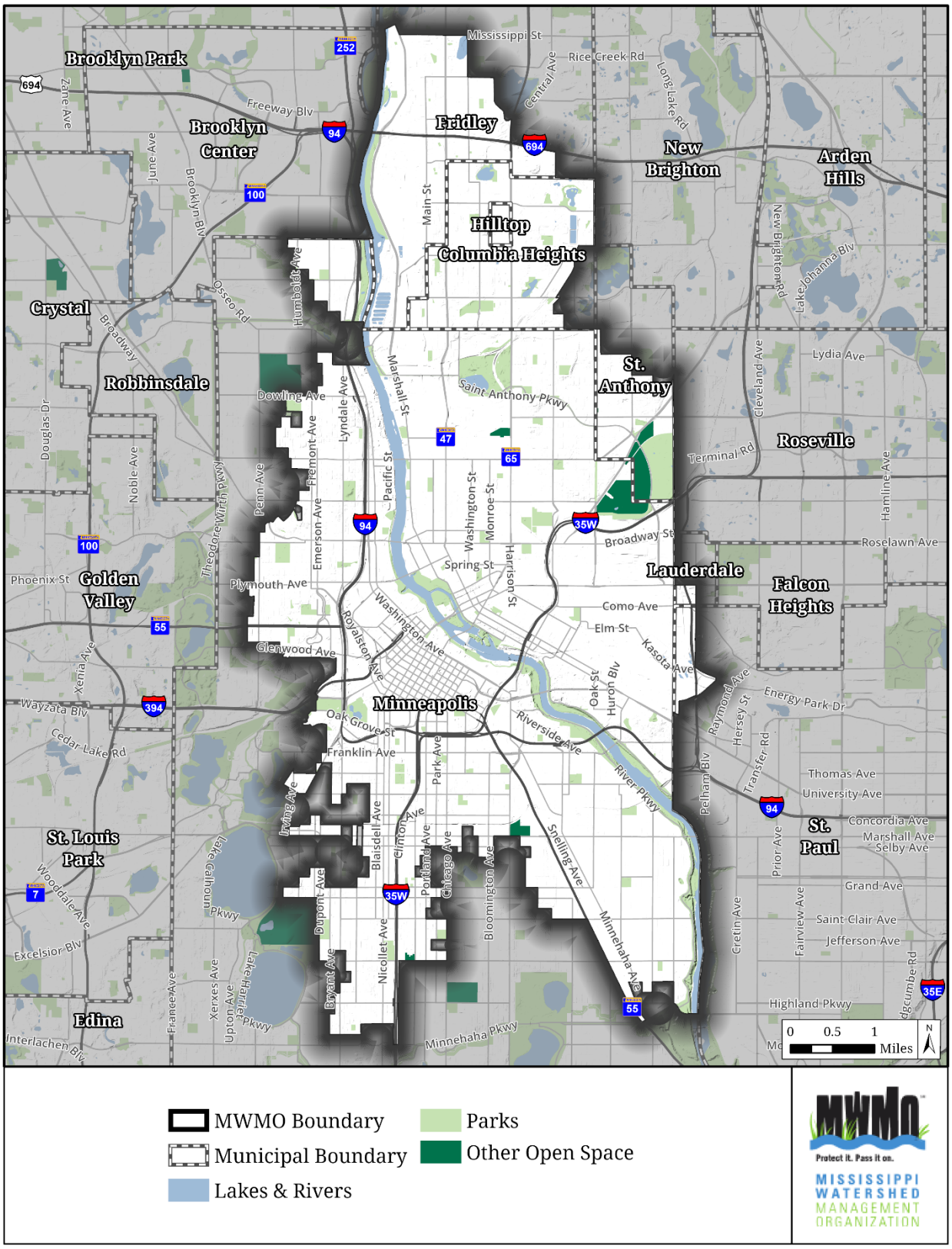


Figure 24: Parks and Open Space

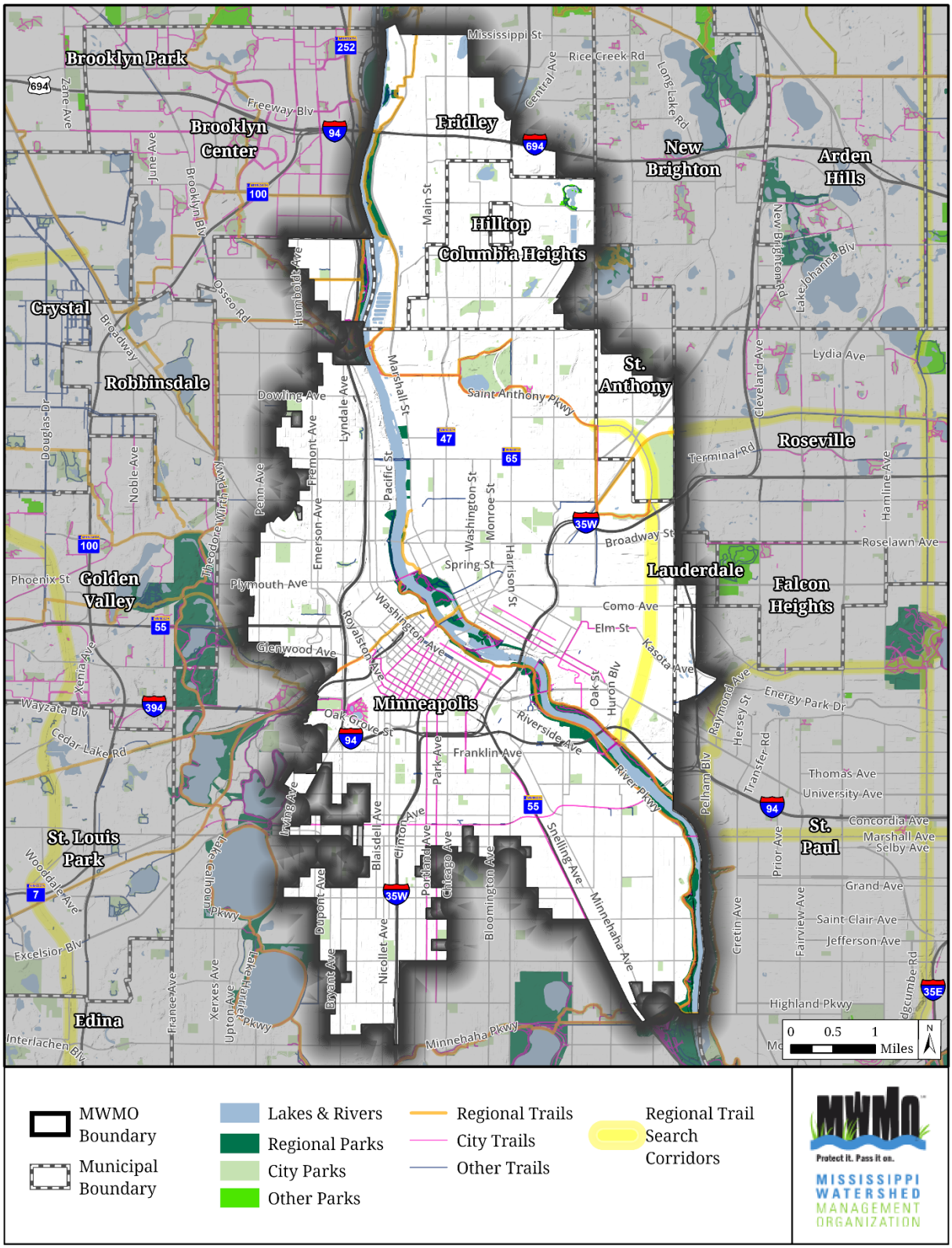


Figure 25: Regional Parks and Trails

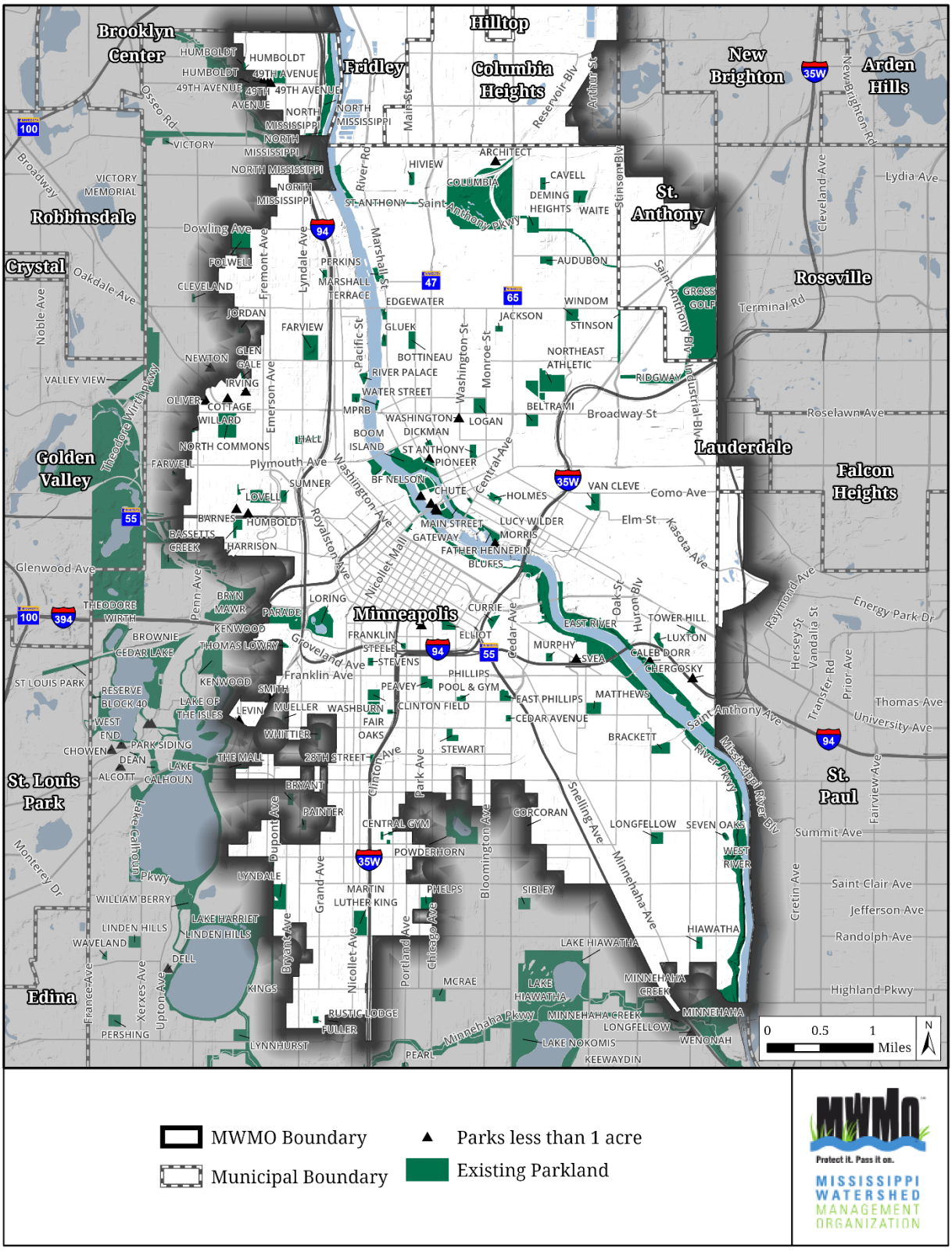


Figure 26: Existing Minneapolis Park System Map from Minneapolis Park and Recreation Board Comprehensive Plan (MPRB, 2015)

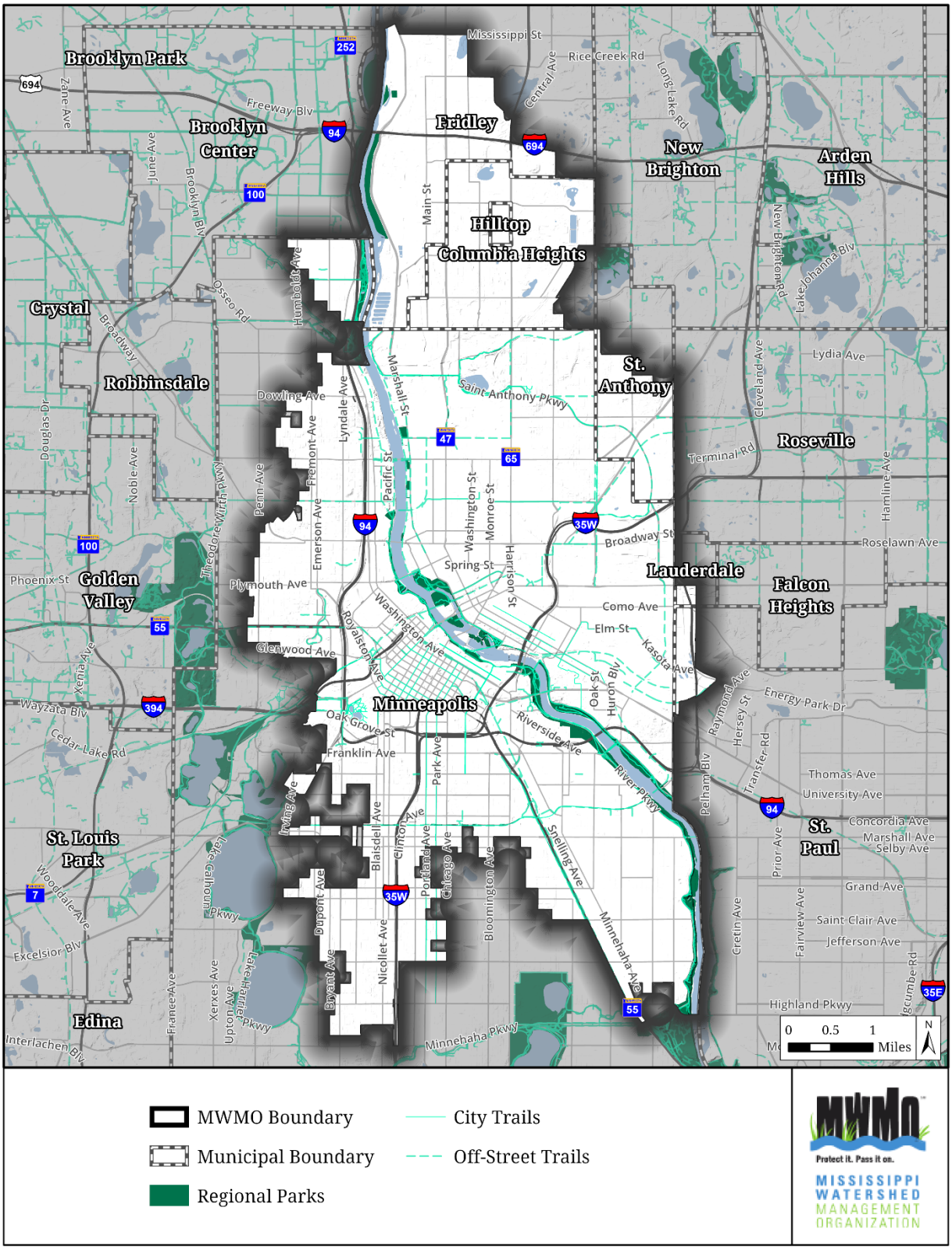


Figure 27: Minneapolis Trail System Map from Minneapolis Park and Recreation Board Comprehensive Plan (MPRB, 2015)

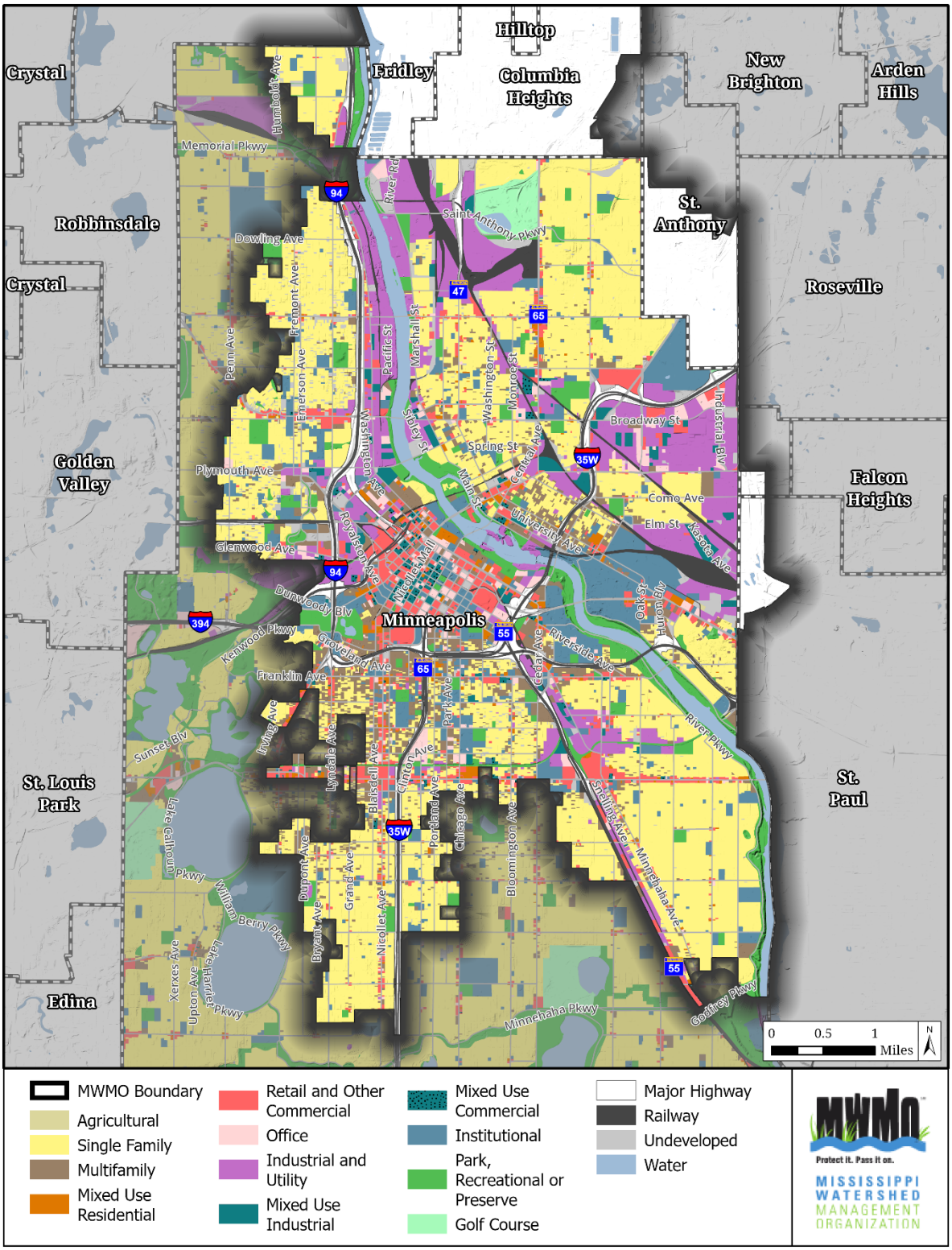


Figure 28: City of Minneapolis Existing Land Use Map from The Minneapolis Plan for Sustainable Growth (City of Minneapolis, 2017)

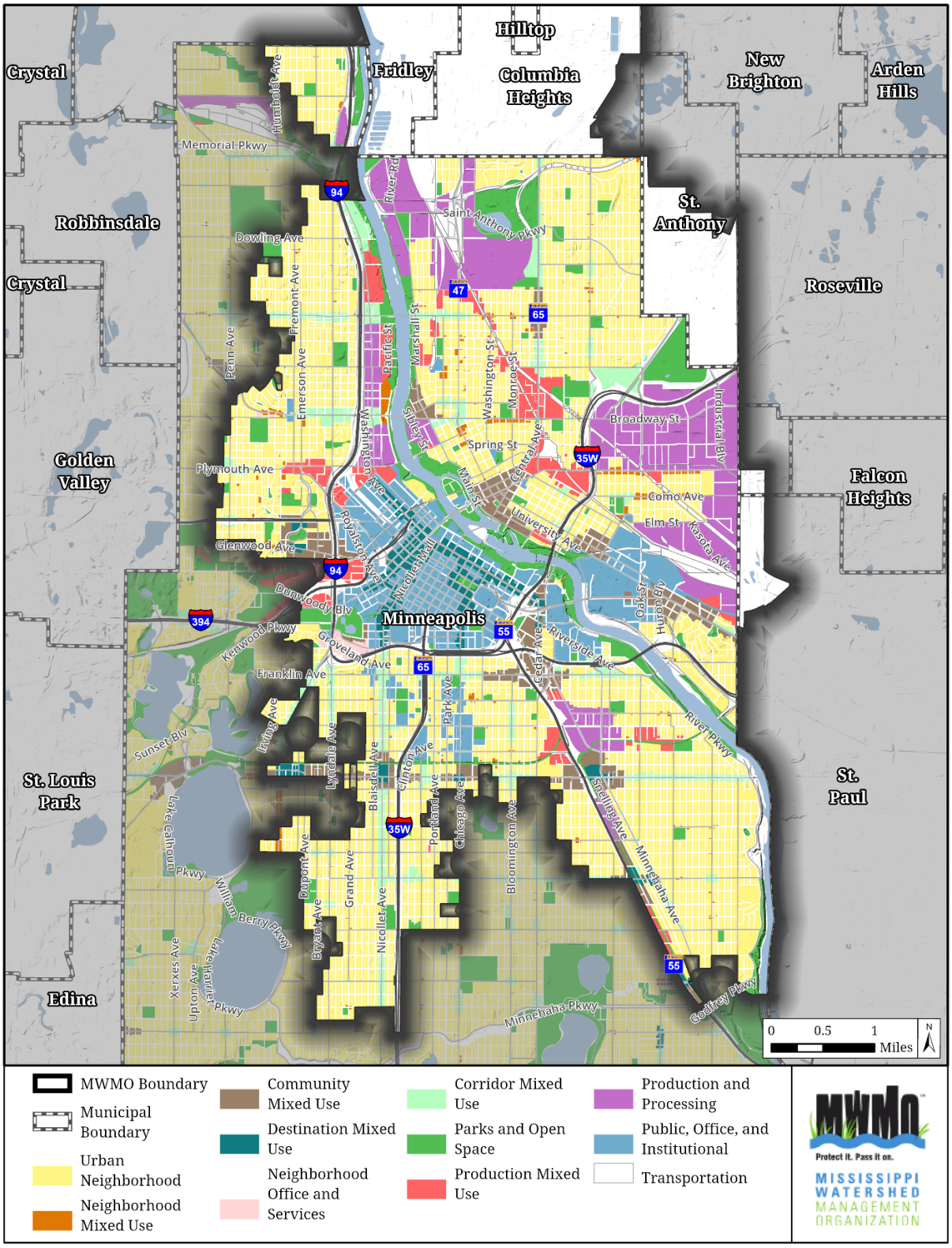


Figure 29: City of Minneapolis Future Land Use Map from The Minneapolis Plan for Sustainable Growth (City of Minneapolis, 2019)

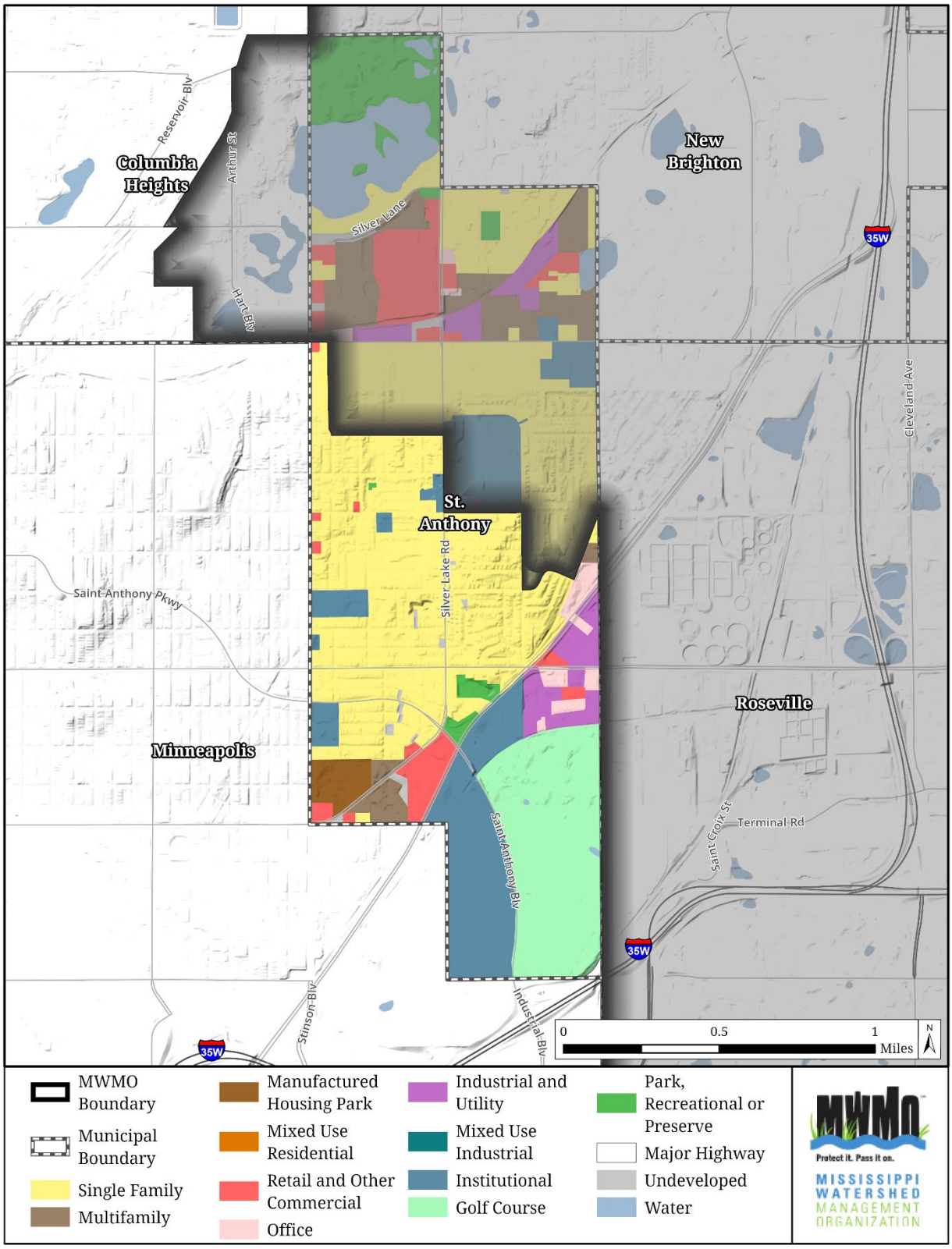


Figure 30: City of St. Anthony Village Existing Land Use Map (City of St. Anthony, 2010)

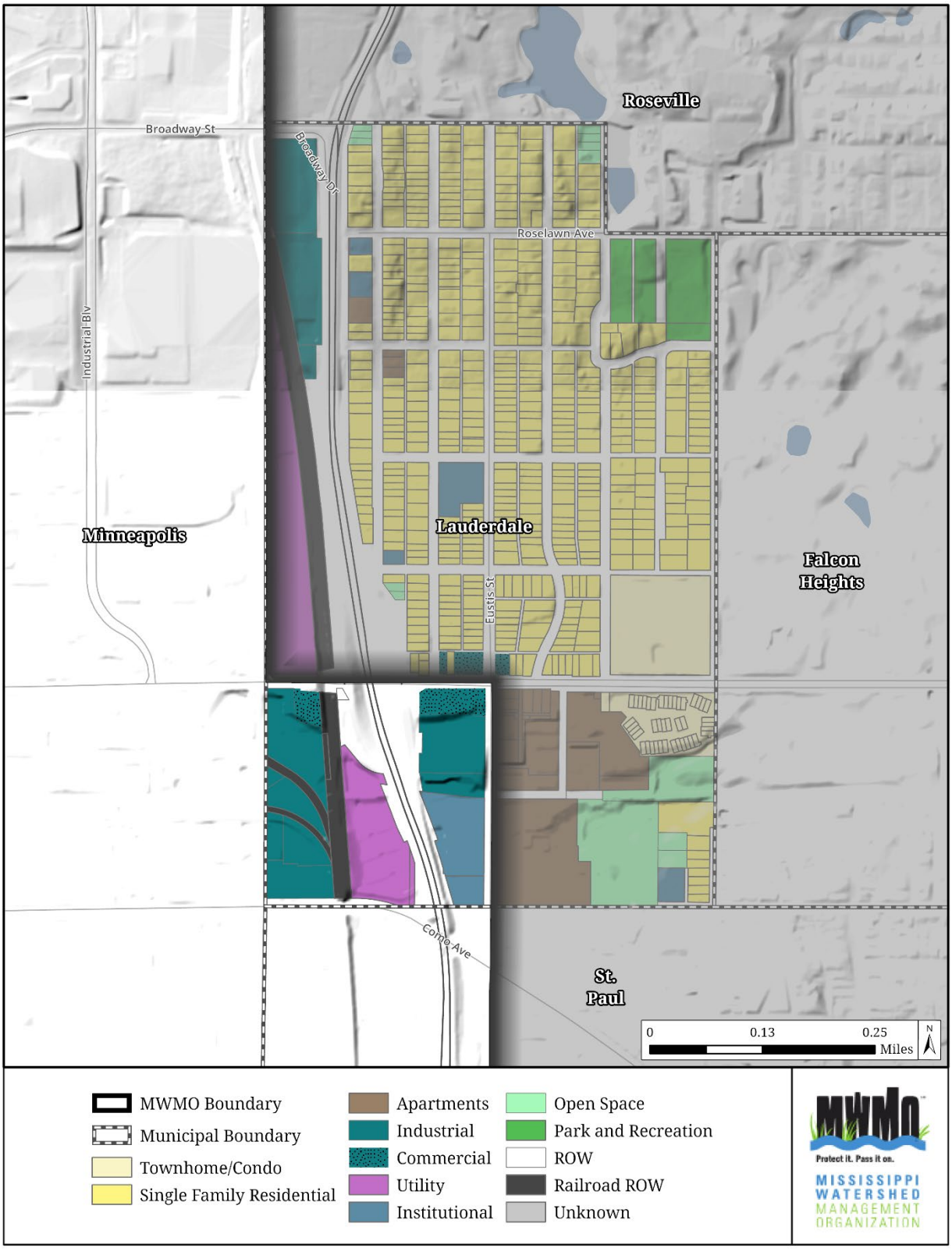


Figure 31: City of Lauderdale Existing Land Use Map from the City of Lauderdale Draft Comprehensive Plan (City of Lauderdale, 2016)

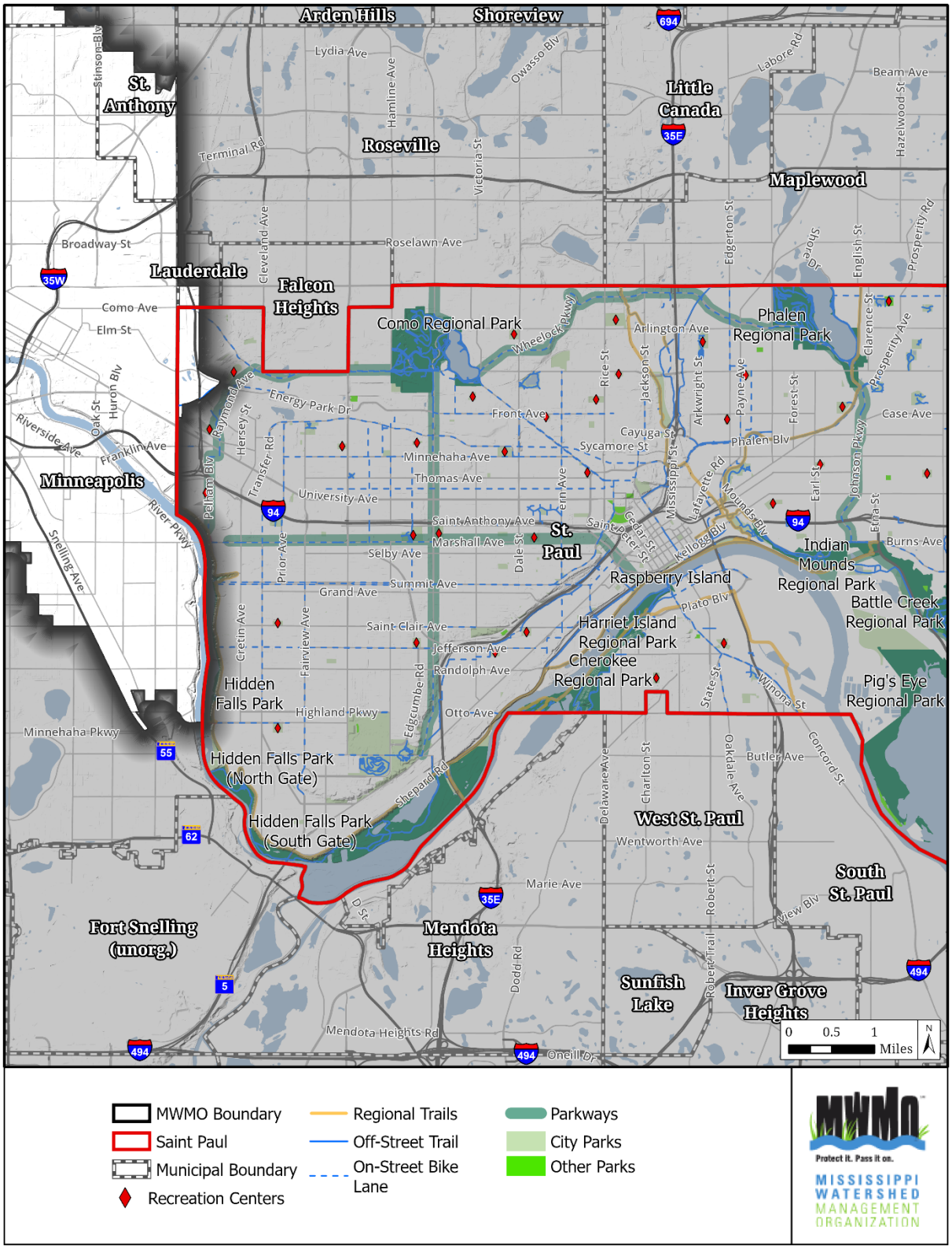


Figure 32: City of St. Paul Park System Map (Met Council, 2020)

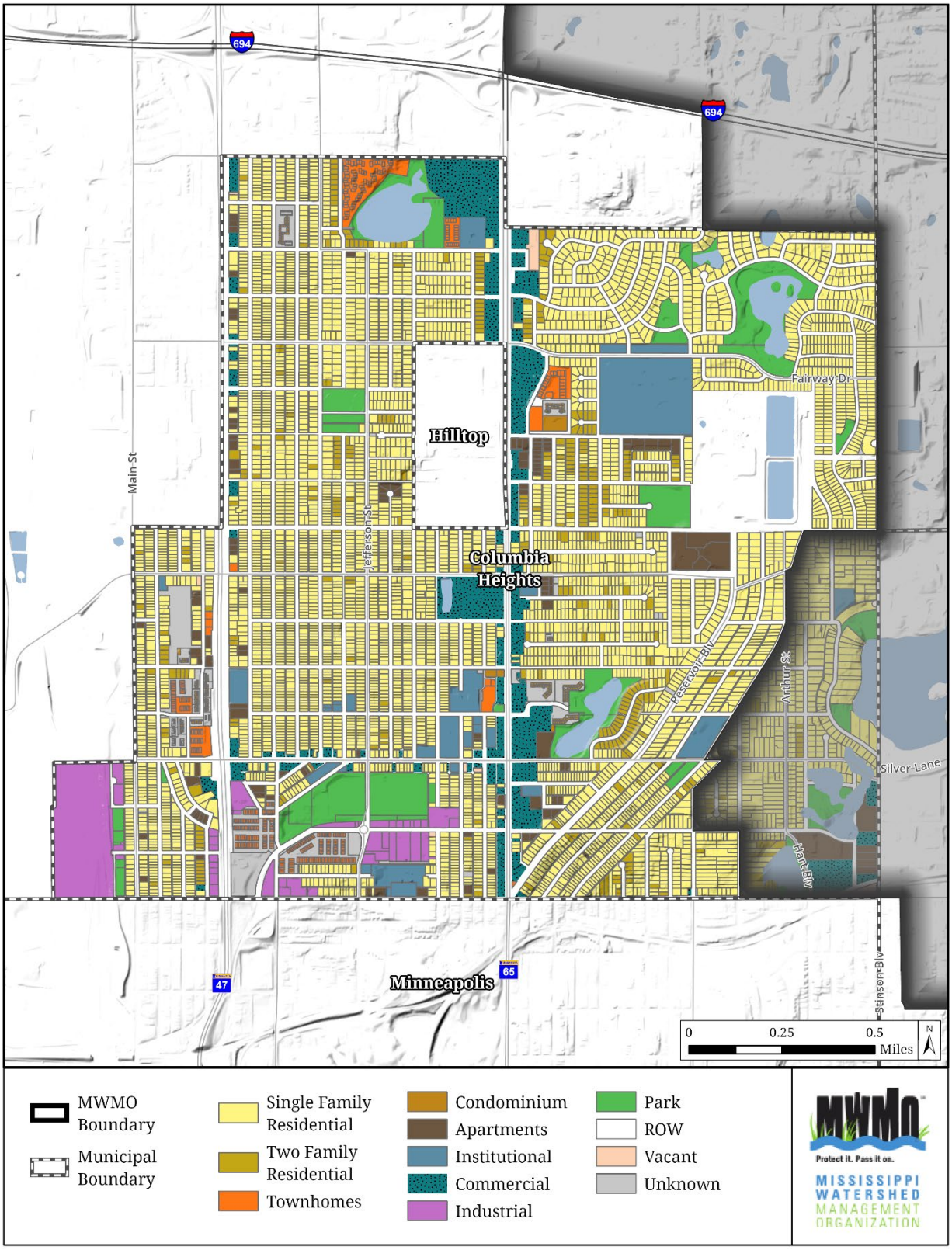


Figure 33: Columbia Heights 2020 Existing Land Use from City's Parcel Dataset (City of Columbia Heights, 2020)

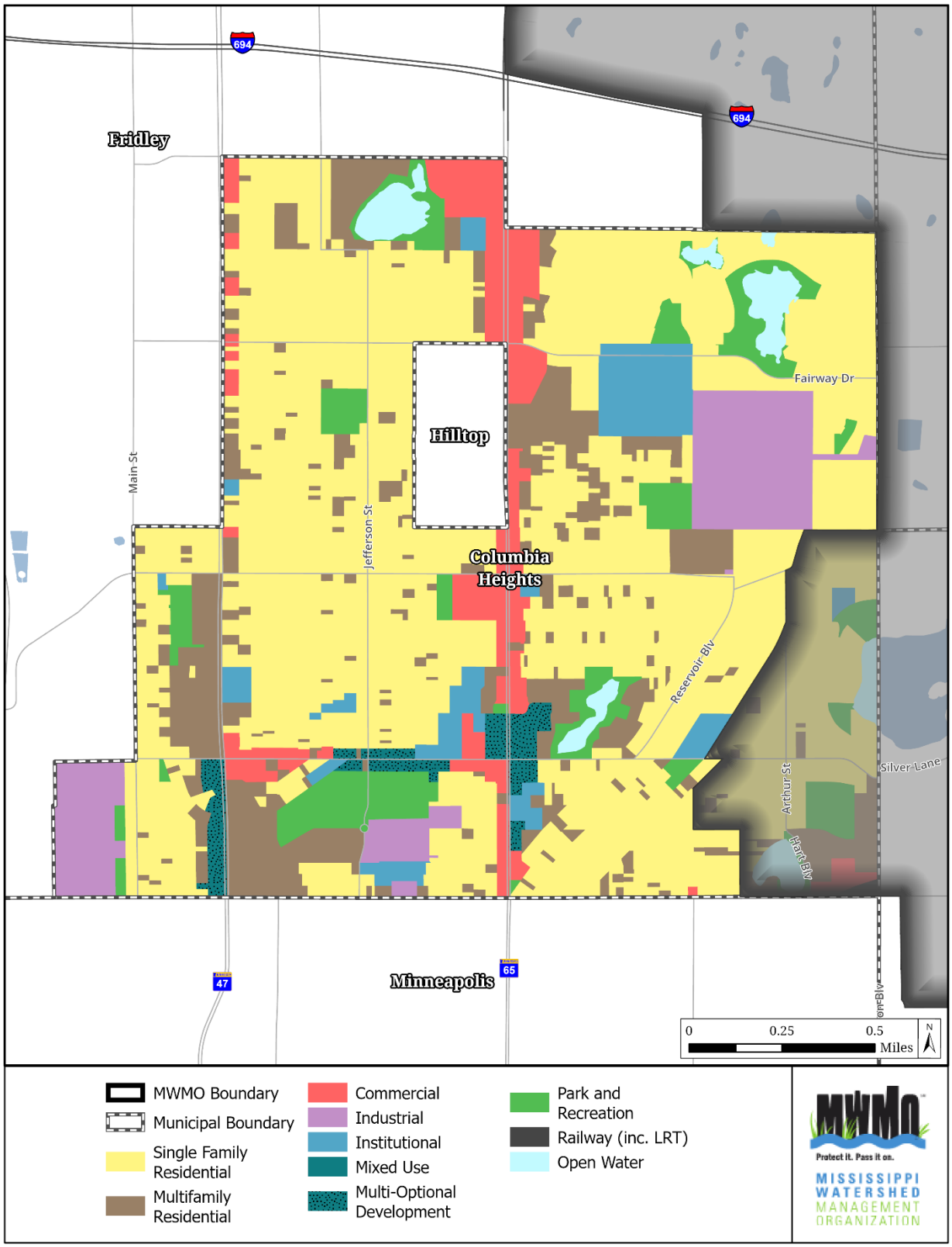


Figure 34: Columbia Heights Future Land Use from 2040 Comprehensive Plan

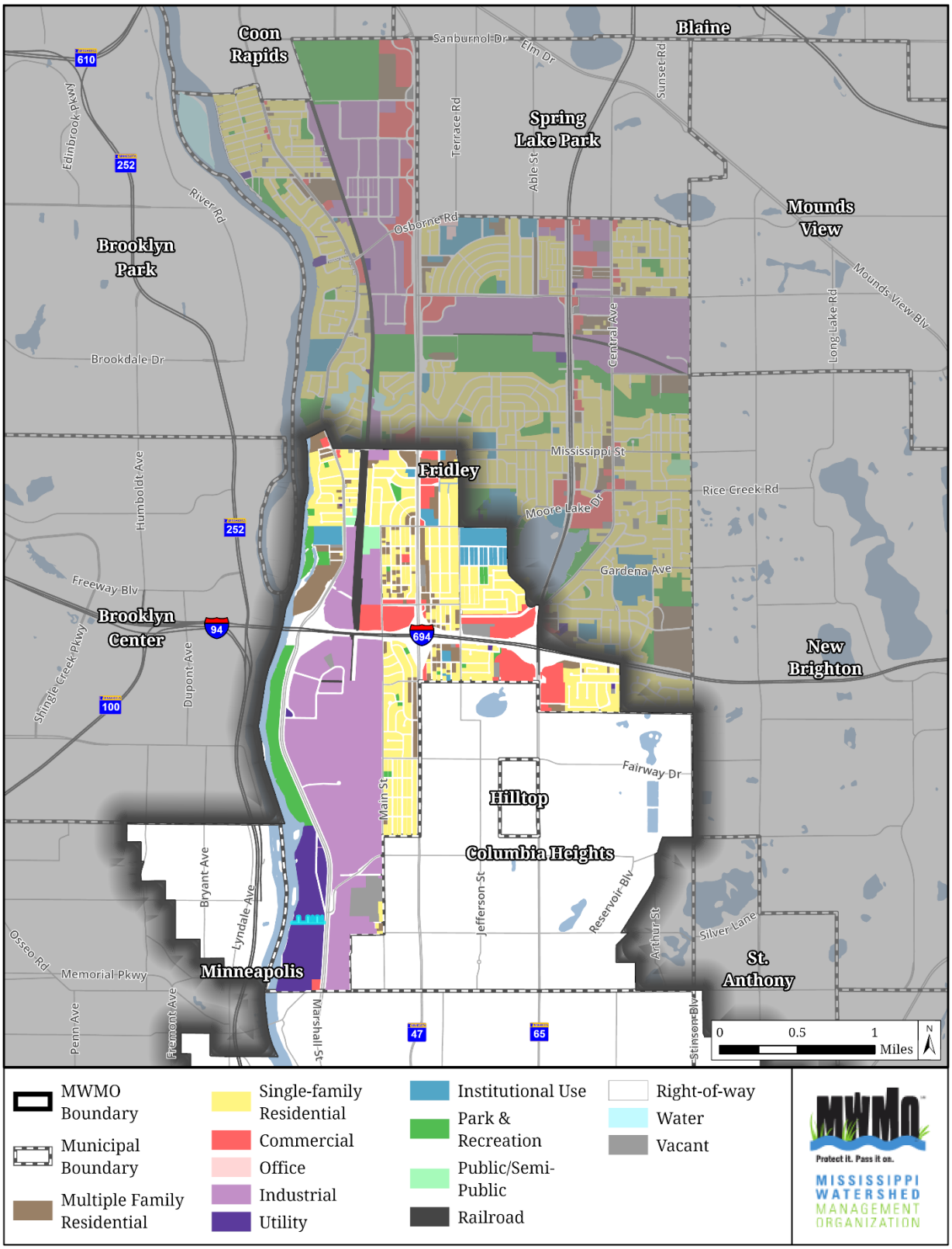


Figure 35: City of Fridley 2020 Existing Land Use from City's Parcel Dataset (City of Fridley, 2020)

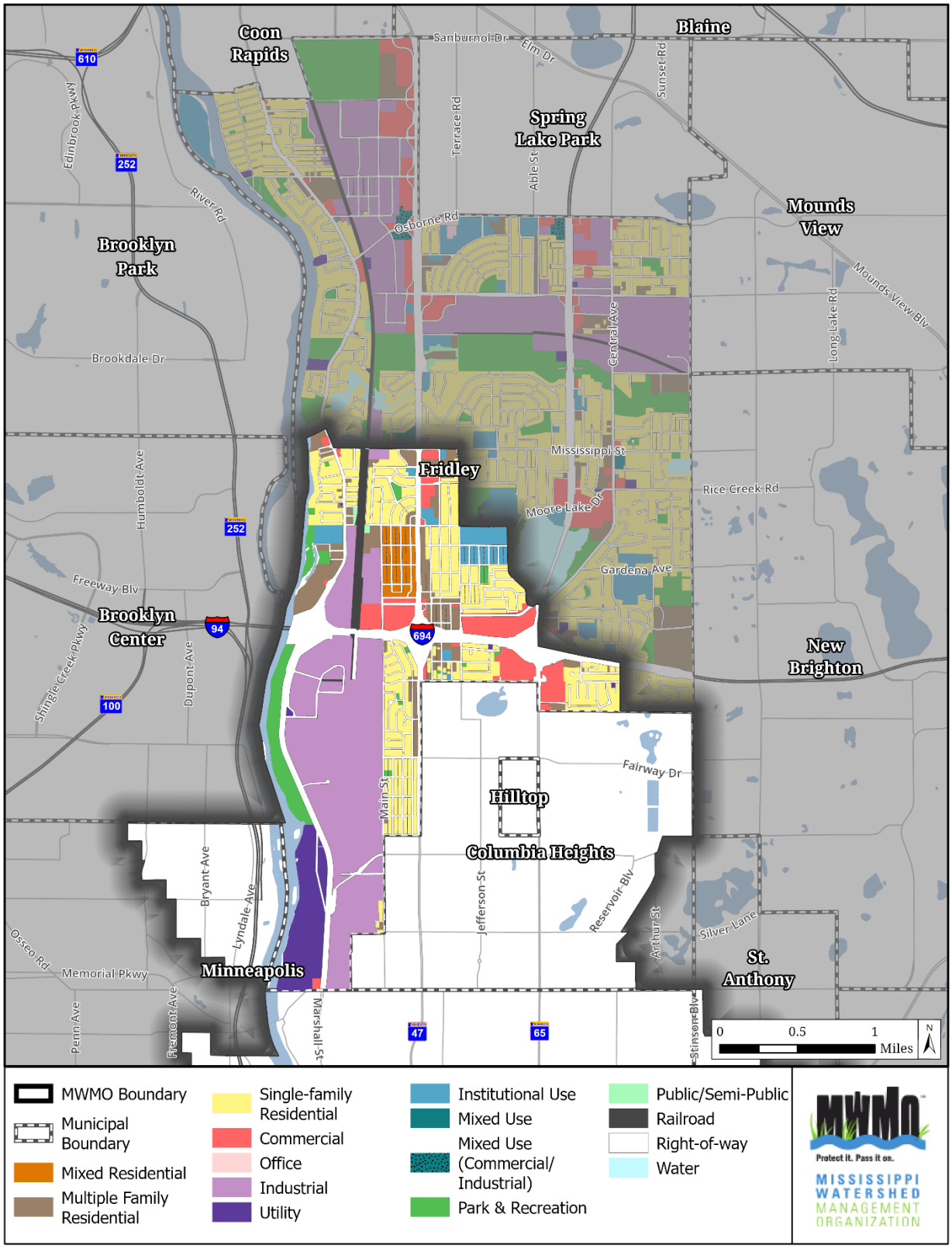


Figure 36: City of Fridley 2040 Future Land Use from 2040 Comprehensive Plan (City of Fridley, 2020)

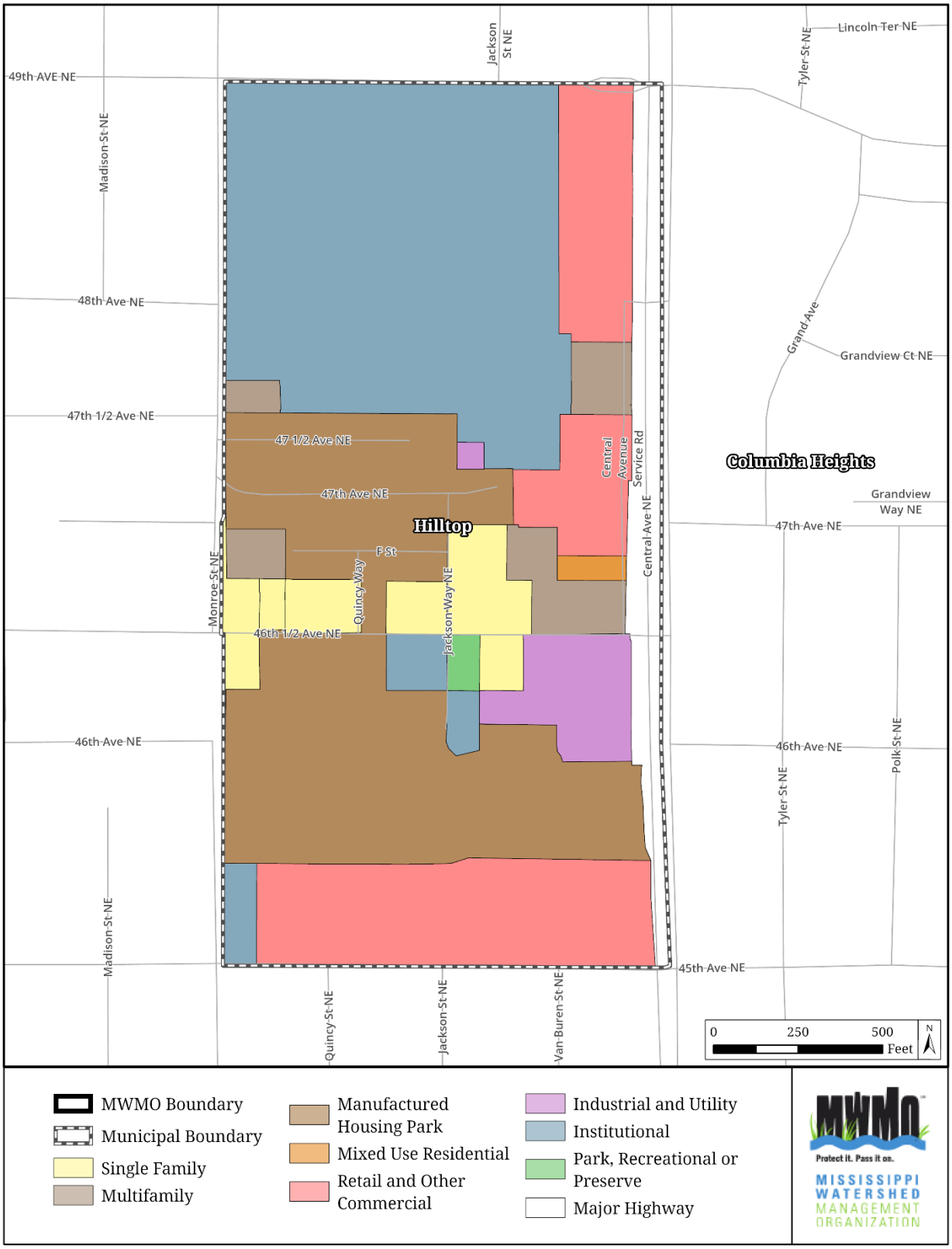


Figure 37: City of Hilltop Existing Land Use from The 2016 Generalized Land Use Inventory (Metropolitan Council, 2017)

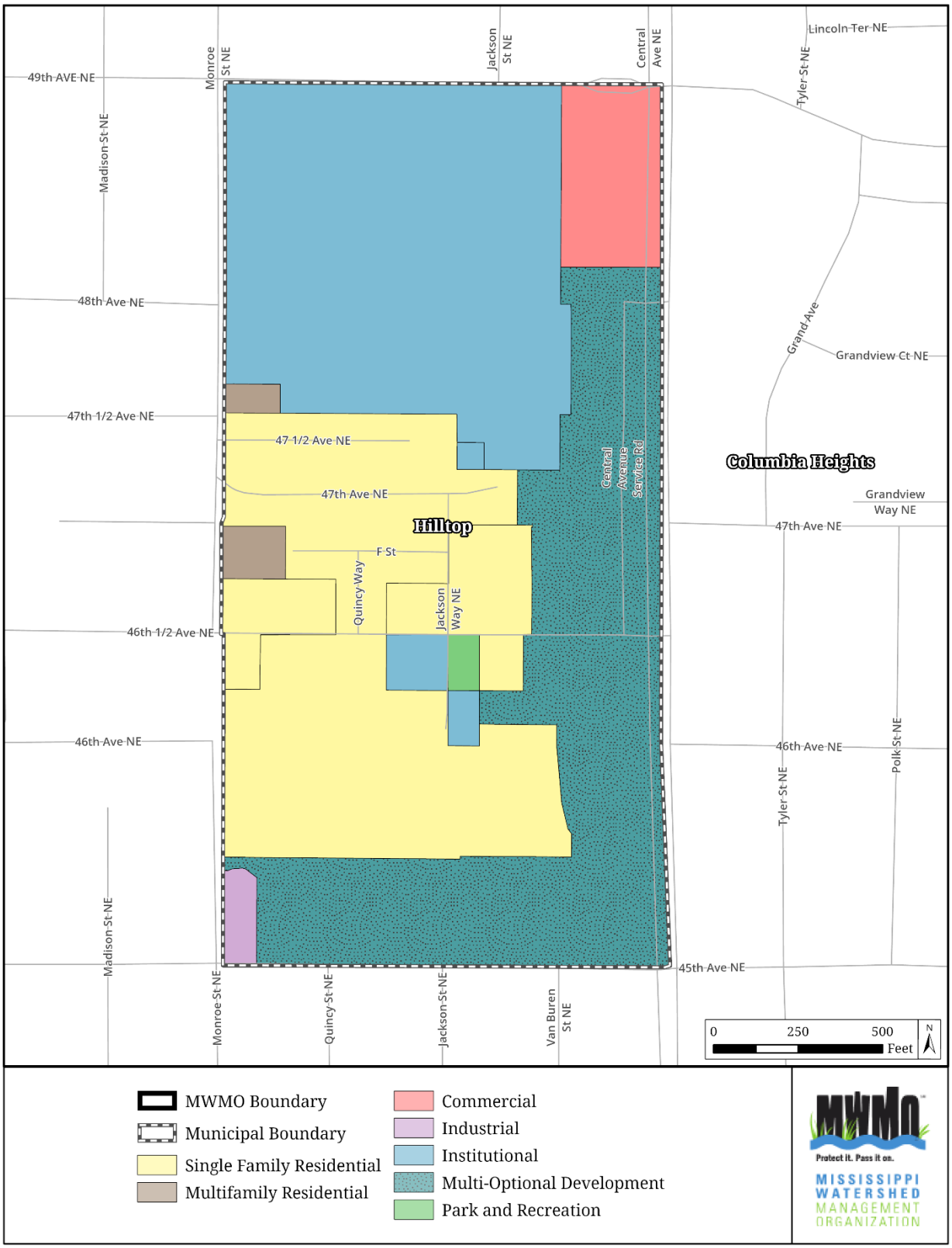


Figure 38: City of Hilltop 2030 Future Land Use from 2030 Comprehensive Plan

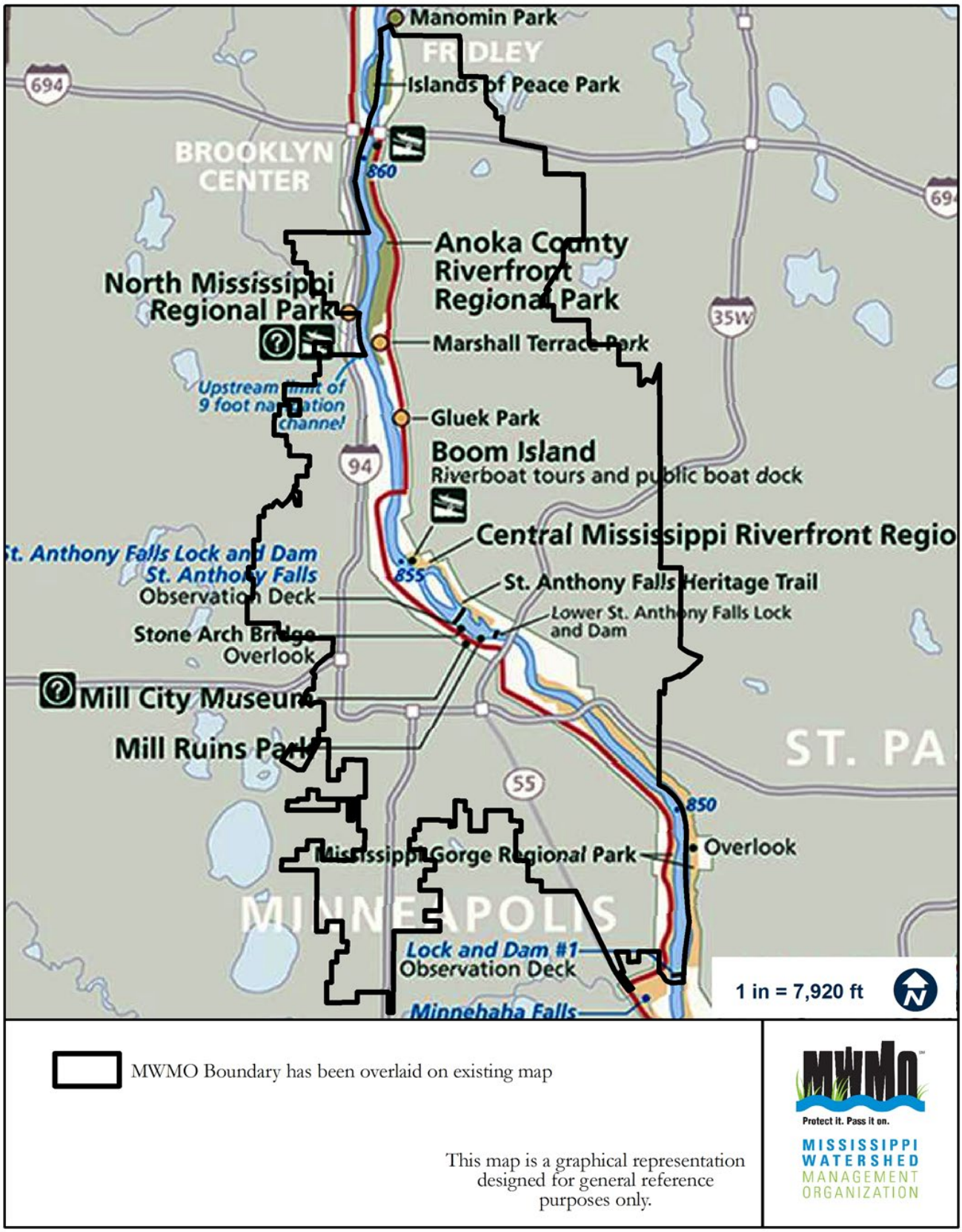


Figure 39: Mississippi National River and Recreation Map

4.4.8 Potential Environmental Hazards

Permitted Pollutant Sources

Municipal Separate Storm Sewer System (MS4) Stormwater

MS4s are defined by the Minnesota Pollution Control Agency (MPCA) as conveyance systems owned or operated by an entity such as a state, city, town, county, district, or other public body having jurisdiction over disposal of stormwater or other authorized non-stormwater discharges. A conveyance system includes ditches, roads, storm sewers, stormwater ponds, and so on. The goal of the MS4 Stormwater Program is to "reduce the amount of sediment and pollution that enters surface and groundwater from storm sewer systems to the maximum extent practicable." The MS4 stormwater discharges are regulated by National Pollutant Discharge Elimination System/State Disposal System permits administered by the Minnesota Pollution Control Agency.

Phase I of the MS4 Stormwater Program identified Minneapolis and Saint Paul as large MS4s, and each city has an individual National Pollutant Discharge Elimination System/State Disposal System permit. Under Phase II of the program, MS4s outside of urbanized areas with populations greater than 10,000 (or greater than 5,000 if they are located within 0.5 mile of an outstanding value resource or impaired water) were classified as small designated MS4s. MS4s within urbanized areas and with a population of at least 50,000 and a density of 1,000 people per square mile are classified as small mandatory MS4s. As a requirement of the permit, MS4s must develop a Stormwater Pollution Prevention Plan which outlines a plan to reduce pollutant discharge, protect water quality, and satisfy water quality requirements in the Clean Water Act. A report is submitted each year by the municipality documenting the implementation of the Stormwater Pollution Prevention Plan.

Within the MWMO, there are a number of member organizations and road authorities that are mandatory and designated MS4s, as well as Saint Paul and Minneapolis, Phase 1 Large MS4s (**Table 19**).

Table 19: Municipal Separate Stormwater Sewer Systems within MWMO

Permit Holder	Type of MS4	Permit ID
Anoka County	Mandatory Phase II	MW400066
Columbia Heights	Mandatory Phase II	MS400010
Fridley	Mandatory Phase II	MS400019
Hennepin County	Mandatory Phase II	MS400138
Hilltop	Mandatory Phase II	MS400023
Lauderdale	Mandatory Phase II	MS400026
Minneapolis	Phase I Large MS4	MN0061018

Permit Holder	Type of MS4	Permit ID
Minneapolis Community and Technical College	Mandatory Phase II	MS400207
Minnesota Department of Transportation	Mandatory Phase II	MS400170
Ramsey County Public Works	Mandatory Phase II	MS400191
Saint Anthony Village	Mandatory Phase II	MS400051
Saint Paul	Phase I Large MS4	MN0061263
University of Minnesota – Twin Cities	Mandatory Phase II	MS400212

Source: MN Geospatial Commons: MS4 Boundaries in Minnesota

Construction Stormwater

Construction sites can contribute substantial amounts of sediment to stormwater runoff. The National Pollutant Discharge Elimination System/State Disposal System Construction Stormwater Permit administered by the Minnesota Pollution Control Agency requires that all construction activity disturbing areas equal to or greater than one acre of land must obtain a permit and create a Stormwater Pollution Prevention Plan that outlines how runoff pollution from the construction site will be minimized during and after construction. Construction stormwater permits cover construction sites throughout the duration of the construction activities through final stabilization of the site. The Minnesota Pollution Control Agency Data Desk can be contacted to obtain an updated list with location information on all permitted construction sites in the MWMO.

Industrial Stormwater

The National Pollutant Discharge Elimination System/State Disposal System Industrial Stormwater Multi-Sector General Permit applies to 29 sectors of industrial activity each having the risk of exposing significant materials to stormwater. Significant materials include any material handled, used, processed, or generated that contains pollutants to surface or groundwater resources. Facilities that can demonstrate that no significant materials are exposed to stormwater can apply for the No Exposure exclusion instead of the permit. Permit requirements entail development and implementation of a Stormwater Pollution Prevention Plan (SWPPP), quarterly monitoring of site stormwater runoff, and updates or revisions to the SWPPP if monitored constituent concentrations do not meet sector-specific benchmarks established in the permit. The SWPPP entails a description of both structural and non-structural stormwater management practices implemented to prevent contact of stormwater with significant materials. The Minnesota Pollution Control Agency re-issued an Industrial Stormwater Multi-Sector General Permit in April

2010, as an update to the former, expired permit. **Figure 40** shows the approximate locations of the permitted industrial stormwater sites within the MWMO. The industrial stormwater discharge sites are often associated with a zip code rather than an exact location.

Feedlots

There are no feedlot operations within the boundary of the MWMO.

Municipal and Industrial Wastewater

Several facilities within the MWMO are permitted by the Minnesota Pollution Control Agency to discharge water, such as wastewater treatment plants, commercial sites with noncontact cooling water discharge, and manufacturing facilities. For any discharge to a surface water, ground surface or subsurface, a National Pollutant Discharge Elimination System and/or a State Disposal System permit is required and administered by the Minnesota Pollution Control Agency. **Figure 40** shows the approximate locations of permitted discharge sites within the MWMO as of 2014.

Chloride Prevention

The MWMO will continue to support our member cities through our outreach and training initiatives related to reducing the use of chlorides in the watershed.

Household water softeners are an important point source of chloride. Minnesota generally has groundwater with high levels of calcium and magnesium that must be removed through softening to improve taste and prevent lime scale buildup in appliances, pipes and water fixtures. The majority of home water softeners use sodium chloride (NaCl) in a softening process that replaces calcium and magnesium ions with sodium, while the chloride ions are discharged in the wastewater and eventually end up in the environment.

Use of salt on sidewalks, roads, and parking lots are a significant source of chlorides that discharge to surface waters in the watershed.

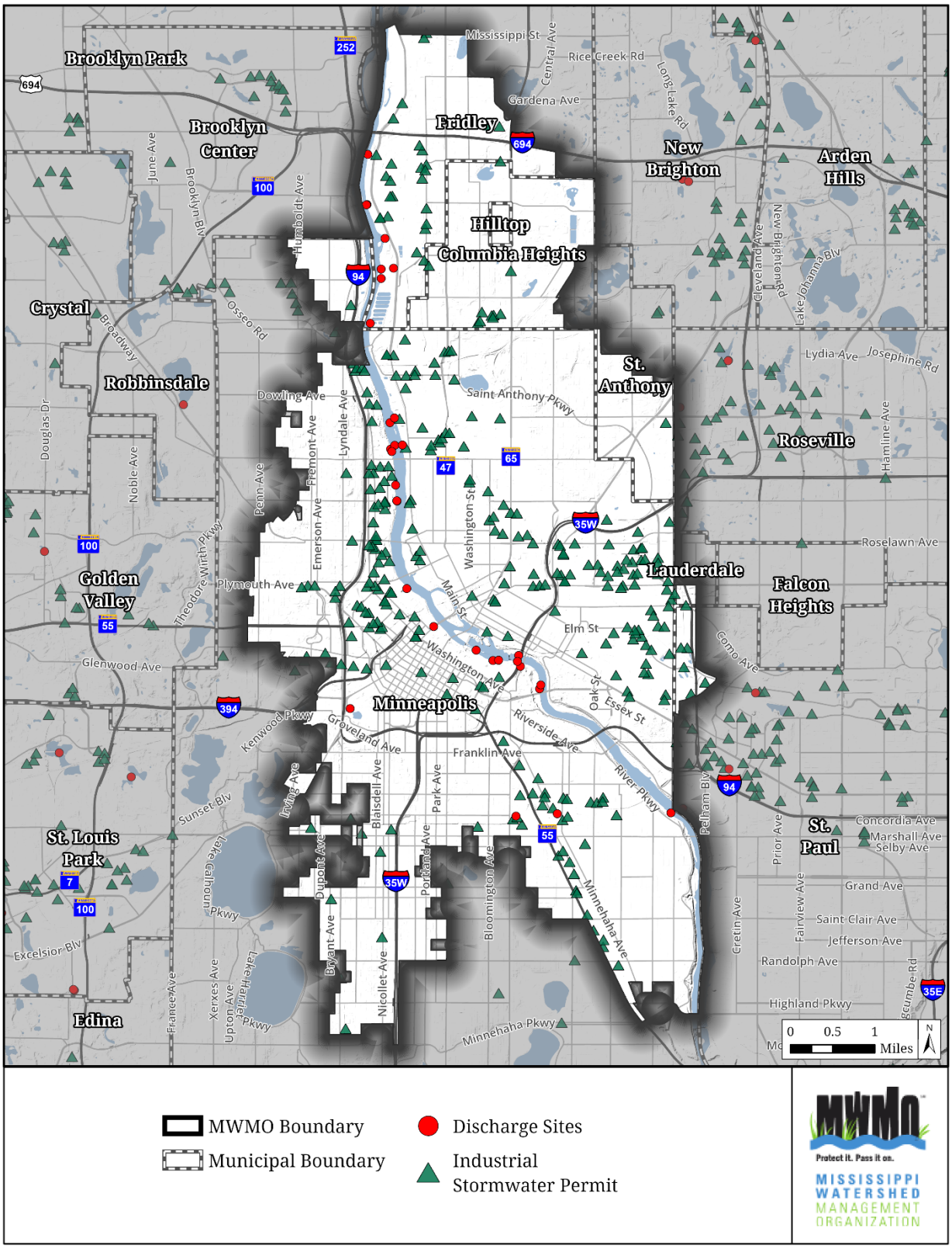


Figure 40: Permitted Discharge and Industrial Stormwater Sites within MWMO

Potentially Contaminated Sites

Sites identified by the Minnesota Pollution Control Agency as potentially contaminated within the watershed are shown on **Figure 41**. The Minnesota Pollution Control Agency has maintained a database of potentially contaminated properties since the early 1980s. The database includes properties that have already been investigated and cleaned up, properties currently enrolled in Minnesota Pollution Control Agency cleanup programs, and properties that were suspected to be contaminated but after investigation turned out to be clean. The types of potentially contaminated sites included in the database are operating and abandoned landfills, dumps, and solid waste sites, among others. Discharges at these sites may contain harmful substances that have the potential to contaminate both groundwater and surface water.

Leaking Above- and Below-Ground Storage Tanks

The Minnesota Pollution Control Agency investigates and cleans up releases from petroleum tanks. Approximately 660 releases from leaking above- and below-ground storage tanks have been reported in the watershed; their locations are shown in **Figure 42**.

Wells

Wells from the County Well Index are shown in **Figure 42**. The County Well Index includes information on the location and characteristics of water wells installed in the State of Minnesota since 1974. Wells can serve as a connection between different aquifers and can serve as a pathway for groundwater contamination. Some of the wells included in the index may have been properly sealed when abandoned, but those still in use and those abandoned but not properly sealed may provide a pathway for contamination to spread between aquifers.

4.4.9 Discussion of Challenges, Gaps, and Next Steps

While the MWMO provides similar services to the public as other watersheds in Minnesota, the complex human and built environment it operates within presents unique resource management challenges. A fully built-out and urbanized area like the MWMO has a long history of population growth, redevelopment of land, changing land use patterns, and water use patterns.

Population growth resulted in a large mix of cultures and languages spoken in the MWMO. Education and knowledge transfer are most effective when it occurs within the framework of individuals' language and culture. The extensive spectrum of ethnic groups present in the watershed means the MWMO will need to continue to develop communication networks, tools, and messaging that go beyond an English-speaking audience. With a forecasted increase in population, the MWMO will need to focus its limited education resources on key messengers and groups that have broader networks and the ability to affect change. As such, the MWMO will continue to educate and connect water resource issues to the daily activities of students, professionals, policy-makers, and community leaders in the MWMO.

With more people, more land uses need to be layered on what once was a single use parcel of land. For example, a historically forested parcel may now serve multiple functions as a corridor for water treatment, buried and overhead utilities, street or rail transportation, and pedestrian pathways. In order to inform multifunctional corridor planning and management efforts, the MWMO will continue to compile and assess shared land use opportunities in all open space, park, and recreational areas maps.

Over time, as growth and redevelopment occur, patterns of land use and water use also shift around on the landscape and waters of the MWMO. Redevelopment of individual building sites as well as transportation corridors (streets, highways, railways, and waterways) are opportunities to incorporate new water management systems into the current built-out landscape. The need to align projects with the pace of infrastructure redevelopment places some of the MWMO's goals on a twenty-five, fifty- or hundred-year timeline depending on the infrastructure being replaced. The MWMO will continue to plan for incorporating new water management systems to the watershed as a part of ongoing redevelopment activities.

As stated prior, Minnesota Department of Natural Resources Division of Ecological and Water Resources (EWR) regulates surface and groundwater appropriations based on daily and yearly withdrawal volumes. This management affects water supply for domestic, agricultural, fish and wildlife, recreational, power, navigation, and quality control purposes. A permit through the Water Appropriation Permit Program is required for all users withdrawing more than 10,000 gallons per day or 1 million gallons per year for consumptive or nonconsumptive use. Under Minnesota Statute 103B.211, subdivision 4. appropriations from small watercourses, states that: appropriations that draw less than 10,000 gallons per day or 1 million gallons per year are prohibited unless a permitted by the MWMO. In addition, member cites are required to enforce subdivision 4 when an appropriation occurs within their jurisdiction. To date the MWMO has not established a permitting program nor are they aware of any member city permitting or enforcement programs related to MS 103B.211, subdivision 4. To maximize efficiencies in government the MWMO will request that member cities add the development and enforcement of this permitting requirement to their current regulatory duties. In addition, the MWMO will work with the member cities to determine and approve an appropriate permit fee to be paid to the cities.

As built today, cities and industries in the watershed rely on the surface and groundwater resources to provide a water supply for many different functions such as drinking water, irrigation, and industrial cooling water. A primary function of surface water is the assimilation of waste streams such as stormwater runoff from streets, effluent from wastewater treatment plants, and industrial discharges. Use of the river as a final stage of treatment is straining its ecosystem, i.e. endocrine disruptors and their effect on fish populations downstream of wastewater treatment plants. The river has a finite capacity to serve in this function until its ecosystem is damaged and our society loses the basic benefits that a clean river ecosystem has to offer: swimming, fishing, waterfowl, migratory riparian birds, prime adjacent real estate, and parks. This strain on the river can be eased if there is development of new technologies and

systems that utilize today's pollutant waste streams as inputs into tomorrow's new products and services.

Wellhead and source water protection zones assure surface and groundwater quality and available volume is maintained for cities and industries in the watershed. Permitted industrial and wastewater treatment plant discharges attempt to manage the downstream impacts on ground and surface water resources. This system works well with a first generation of development. However, in long standing urban areas natural hydrologic conditions have been altered, land use has changed, and redevelopment has occurred many times over. As a result, the likelihood of a site having water-soluble contaminated soils or groundwater contamination from one of these historic changes is high. Thus, it is critical that the MWMO evaluates historic and present-day groundwater hydrology and contamination whenever it installs stormwater management practices or systems. In addition, the MWMO will stay abreast of emerging water quality, rate, and volume issues affecting the Mississippi River and in turn source water protection and waste stream discharge activities.

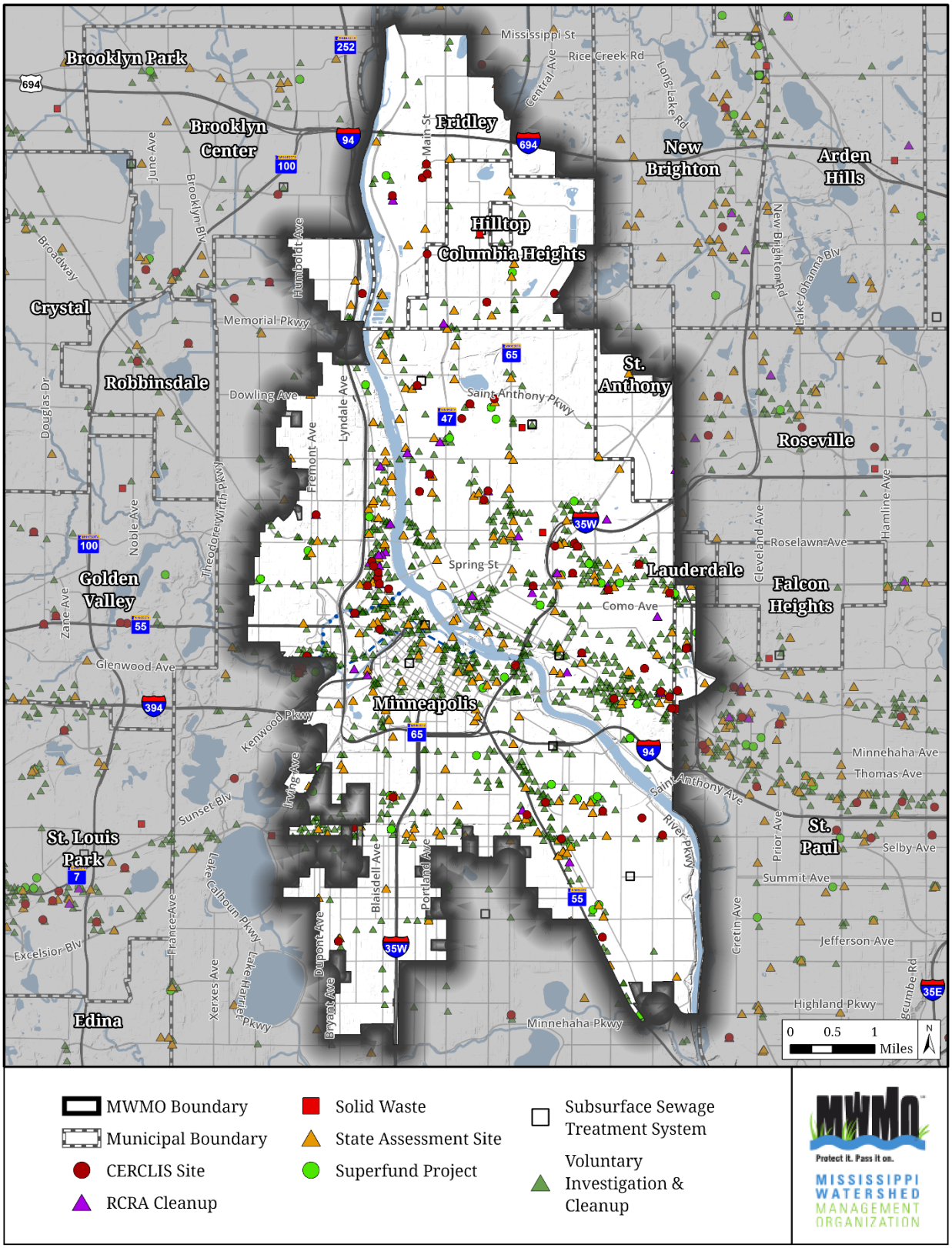


Figure 41: Known and Potential Sources of Soil and Groundwater Contamination

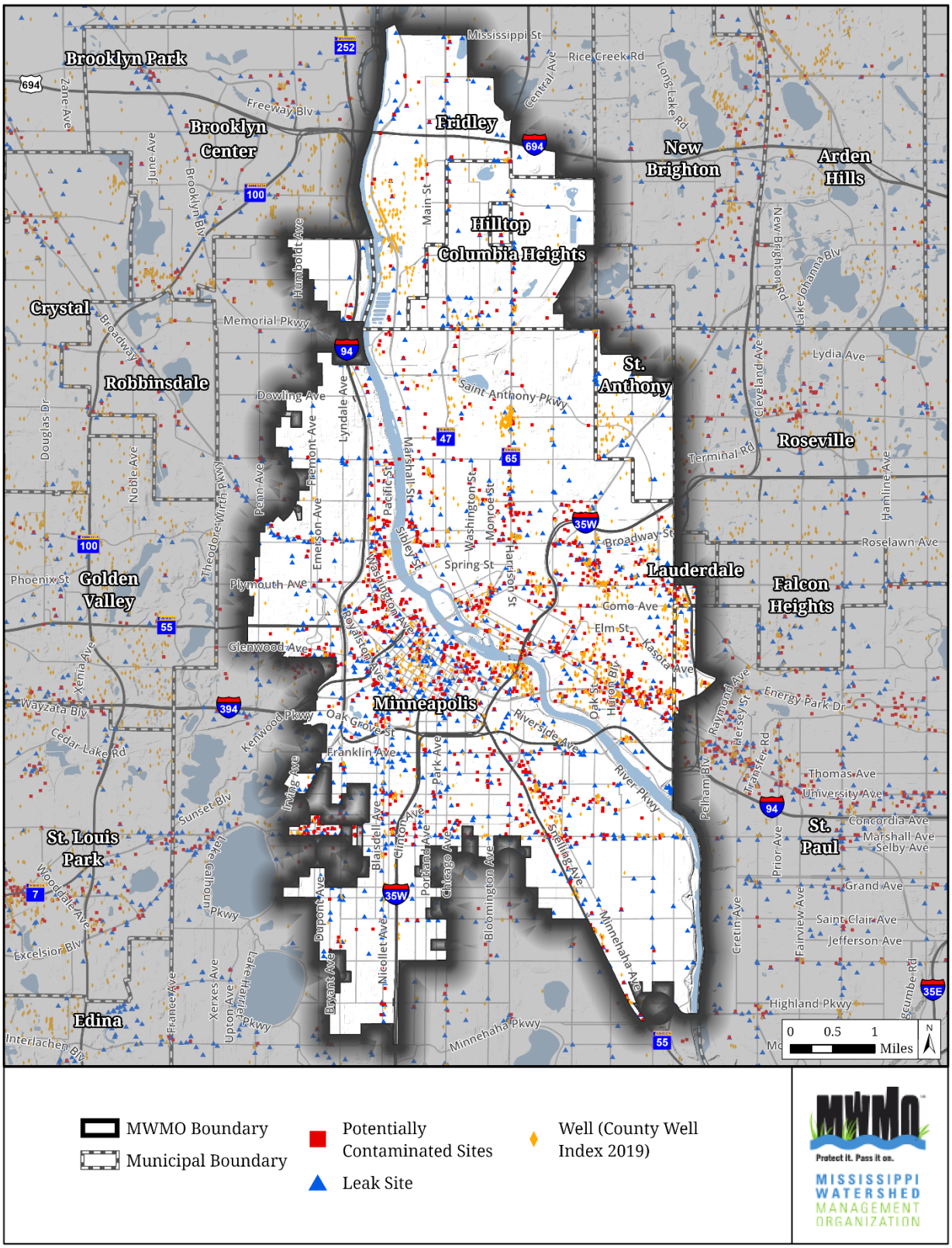


Figure 42: Environmental Hazards in the MWMO

4.5 Hydrologic System

4.5.1 Climate and Precipitation

Rainfall duration, intensity, and distribution are all factors that affect the MWMO's water quality with respect to erosion sedimentation loads, pollutant runoff, and groundwater recharge. Knowledge of their effects on the watershed help watershed managers determine hydrologic designs to mitigate water quality and quantity problems.

The climate within the MWMO is similar to the overall seven-county metropolitan area. The seven-county metropolitan area exhibits the typical characteristics of continental climates. Areas with continental climates have winters with at least one month below 32° F and at least three months of temperatures above 50° F. Regions with continental climates are characterized by winter temperatures cold enough to support snow cover from late fall to early spring, and relatively moderate precipitation that occurs mostly in the summer months.

Monthly averages for precipitation, snowfall, and temperature for the period 1981-2010 are presented in **Table 20**. Data was collected by the National Weather Service Cooperative at the Minneapolis-St. Paul International Airport (Station 215435). The average annual temperature is 46.2 degrees F. Average annual precipitation is 30.61 inches, including approximately 54.4 inches of snowfall.

Table 20: Monthly Climate Averages for the Period 1981-2010

Mean Monthly Precipitation, 1981 - 2010	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Annual**
Precipitation (inches)	0.90	0.77	1.89	2.66	3.36	4.25	4.04	4.30	3.08	2.43	1.77	1.16	30.61
Mean Monthly Snowfall, 1981 - 2010	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Annual**
Snowfall (inches)	12.2	7.7	10.3	2.4	-	-	-	-	-	0.6	9.3	11.9	54.4
Mean Temperature, 1981 - 2010	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Annual**
Max °F	23.7	28.9	41.3	57.8	69.4	78.8	83.4	80.5	71.7	58.0	41.2	27.1	55.2
Min °F	7.5	12.8	24.3	37.2	48.9	58.8	64.1	61.8	52.4	39.7	26.2	12.3	37.2
Mean °F	15.6	20.8	32.8	47.5	59.1	68.8	73.8	71.2	62.0	48.9	33.7	19.7	46.2

Design Storms

Table 21 illustrates the probability of a rainfall event occurring in any given year at the centroid of the MWMO. The probability of exceedance and the return period are measures of the probability of occurrence of the storm event. For example, a 24-hour rainfall event of 7.44 inches has a 1% probability of occurring in any given year which is expressed as once in every 100 years. A 3.56 inch, 24-hour rainfall event has a 20% probability of occurring in any given year which is expressed as once in every 5 years.

The standard accepted practice is to use National Oceanographic and Atmospheric Administration's (NOAA) Atlas 14, Volume 8, Version 2 (Atlas 14), released in 2013, on which **Table 21** is based. Atlas 14 supersedes NOAA's Technical Paper No. 40 (written in 1961), which was previously the standard accepted source of precipitation depths for selected return periods. Atlas 14 data for Minnesota is available on NOAA's website at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=mn.

Table 21: Storm Event Precipitation (inches) for the centroid of the MWMO, Atlas 14.

Probability of Exceedance	**Return Period**	**Duration of Storm Event**							
		24-hour	12-hour	6-hour	3-hour	2-hour	1-hour	30-min.	15-min.
100%	1-year	2.47	2.14	1.89	1.61	1.44	1.17	0.89	0.63
50%	2-year	2.85	2.51	2.20	1.88	1.70	1.38	1.06	0.75
20%	5-year	3.56	3.23	2.82	2.42	2.18	1.76	1.35	0.94
10%	10-year	4.26	3.92	3.44	2.93	2.62	2.11	1.60	1.11
4%	25-year	5.38	5.01	4.44	3.76	3.32	2.64	1.96	1.36
2%	50-year	6.36	5.97	5.34	4.48	3.91	3.08	2.24	1.56
1%	100-year	7.44	7.02	6.34	5.29	4.56	3.55	2.53	1.76

Source: National Oceanographic and Atmospheric Administration's (NOAA) Atlas 14, Volume 8, Version 2 (Atlas 14), released in 2013

Climate Change

Over the next 50 years, the approach to watershed management could shift because of climate change. Watershed managers are likely to go from monitoring and evaluating the effects of climate change to mitigating and finally adapting to climate change.

What impacts could climate change have on precipitation in the State of Minnesota? As the earth warms, the intensity of precipitation increases in two ways: (1) increasing the temperature of the land and oceans causes water to evaporate faster; and (2) increasing air temperature enables the atmosphere to hold more water vapor. These factors combine to make clouds richer with moisture, making heavy downpours or snowstorms more likely. The State of Minnesota is predicted to see a total increase in annual precipitation.

Seasonal precipitation could change as follows: precipitation may increase in winter by 15-50 percent and decrease in summer by up to 15 percent. While the frequency of heavy rainstorms (both the 24-hour and the multi-day) may increase, droughts are likely to be more common as the rainfall cannot compensate for the drying effects of a warmer climate. These predictions or trends have already been established: a review of approximately 3,500 National Oceanic and Atmospheric Administration weather stations indicates that Minnesota has already seen a 24 percent increase in the frequency of extreme precipitation events from 1948 to 2006 (Madsen and Figdor, 2007). In the Twin Cities Metropolitan Area, this increase was as large as 47 percent. Other changes expected in the State of Minnesota include a shorter winter season with less snow, more ice, winter rains, earlier ice-out dates, and more rapid spring snowmelt events. **Table 22** summarizes the impacts possible in the State of Minnesota because of climate change.

Table 22: Expected Impacts of Climate Change in Minnesota

Impact to Water Resource	Description	Indicators
Increases in Water Pollution Problems	Warmer air temperatures results in warmer waters	• Warmer waters hold less dissolved oxygen (DO) making instances of low DO and hypoxia more likely • Increased frequency of algal blooms
	Increased flooding increases water-borne diseases and sediment transport	• Increased stormwater runoff washes sediments (erosion) and other contaminants into waterbodies • Overloading of stormwater and stormsewer systems transports contaminants into waterbodies
	Changes in snowfall patterns	• More ice during the winter requires application of more chemicals • Less ice coverage results in greater evaporation of surface waters during winter and lower surface water levels, concentrating pollutant loads
More Extreme Water-Related Events	Heavier precipitation during rainfall events	• Increased risk of flooding • Increased variability of streamflows • Increased velocity of water during high flow periods • Taxes existing infrastructure systems (e.g. levees, sewer pipes, wastewater treatment plans, and so on)

Impact to Water Resource	Description	Indicators
Changes to Availability of Drinking Water Supplies	Changing patterns of precipitation and snowmelt	• Increased drought conditions place higher demands on drinking water supplies • Increased water loss due to higher evaporation (as a result of warmer air temperatures)
	Air temperature	• Places higher demands on community water supplies • Increased water needs for agriculture and industry • Increased need for energy production (e.g. air conditioning)
Water Boundary Movement and Displacement	Size of wetlands and lakes will change	• Changing water flow to lakes/streams • Increased evaporation • Changes in precipitation impacts wetland hydrology (bounce and duration)
	Increased stream channel instability	• Increase in channel-forming flows (bank-full flows) leads to increased sediment transport potential and channel instability
	Decreased Groundwater Recharge	• Rain from extreme events falls too quickly to be absorbed into the ground • Reduced summer water levels diminish recharge of groundwater • Earlier snow melt reduces ability of snow to recharge aquifers
	Increased Erosion	• Due to altered buffer/shoreline

Impact to Water Resource	Description	Indicators
		areas
Changing Aquatic Biology	Warmer water temperatures	• Loss of fisheries habitats as aquatic life replaced by other species better adapted to warmer waters • Interruption of breeding cycles • Increase in invasive species

4.5.2 Surface Water/Water Resources

Surface waters of the MWMO are sources of drinking water, recreation, wildlife habitat, and navigation. Each serves a different function based on size, hydrologic characteristics, and location. Surface waters can also be a source of (or a control for) flooding, depending on surface water management practices. Surface waters can physically divide communities or facilitate intercommunity activity and purpose. The surface waters of the MWMO are described below and shown in **Figure 43**.

Mississippi River

The Mississippi River at the MWMO receives drainage from approximately 19,680 square miles (USACE, 2004). Much of this drainage area is rural woodland and agriculture with large urban communities of St. Cloud, Minneapolis, and surrounding communities. From upstream areas down to the MWMO border, the percentage of agricultural lands, forest, and wetlands decreases, while the percentage of residential, commercial, industrial, and turf lands increases (MDH, 2001). The Mississippi River is part of the MWMO water monitoring program (see **Section 4.5.8**).

The headwaters of the Mississippi River above Anoka, Minnesota are designated as an Outstanding Resource Value Water and a Wild, Scenic, and Recreational River by the State of Minnesota. In addition, the MWMO reach of the river is part of the National Park Service Mississippi National River and Recreational Area. Minnesota Rules 7050.0470 lists the water use classifications for all waters of Minnesota, and the Mississippi River within the MWMO has multiple designations.

As a source of public potable water, the Mississippi River has been studied through the Source Water Assessment Program, administered by the Minnesota Department of Health, as an area for protection from contamination sources. The Minnesota Department of Health develops source water assessments for all public water supplies within the state under the federal Safe Drinking Water Act. A source water assessment area is typically mapped to show the land area over which protection measures should be taken to protect the water supply from contamination. A source water protection plan has been developed by St. Cloud, Minneapolis, and the St. Paul Regional Water Services, along with other local units of government through the Upper Mississippi River

Source Water Protection Project. The Source Water Protection Plans include a delineated source water protection area, an inventory of potential point and non-point contaminant sources within the area, and a description of management strategies and objectives for implementation. The plans and other information about the project can be found at the Upper Mississippi River Source Water Protection Project website: www.umrswpp.com.

The Mississippi River is considered one of the few federally navigable waters in Minnesota. This means that the State of Minnesota actually owns the bed of the Mississippi River, below the low water mark. The beds of most other public waters in Minnesota are either privately owned or are held in trust for the riparian owners by the State.

The Mississippi River Corridor Critical Area (MRCCA) includes the Mississippi corridor within the MWMO. The MRCCA consists of 72 miles of river and 54,000 acres of surrounding land from Anoka to the confluence of the Saint Croix River. The land was designated in 1976 under the Critical Areas Act passed by the State Legislature three years prior. The MRCCA Minnesota Critical Areas Program is housed under the Environmental Quality Board, and the Minnesota Department of Natural Resources administers the MRCCA. The purpose is to protect and preserve the unique natural, recreational, transportation, and cultural features of the section of the Mississippi River flowing through the Minneapolis-Saint Paul Metropolitan Area. The corridor's designation gives the state oversight in local land use decisions and a tool for managing development within the corridor. Partners in the protection and preservation of this area include the Environmental Quality Board, the Metropolitan Council, and the National Park Service. For communities that have adopted new MRCCA zoning regulations consistent with the 2017 rules, MRCCA districts determine structure setbacks from the Mississippi River and bluffs as well as height limits. As of February 1, 2020, the old MRCCA districts and standards still apply to Fridley, Minneapolis, and St. Paul.

According to the Upper Mississippi River Water Quality Assessment Report (EPA, 2002), water quality of the Upper Mississippi River is most influenced by nonpoint source inputs from tributary streams, major point source discharges, and river flows. The Twin Cities Metropolitan Area has a noticeable negative effect on the river's quality. Implementation of point source pollutant controls in the 1980s have reduced ammonia nitrogen concentrations and increased dissolved oxygen concentrations below the metropolitan area. Nitrification as a wastewater treatment technology and increased nonpoint source runoff from agricultural watersheds in the 1990s is a potential cause of increasing nitrite and nitrate-nitrogen concentrations.

Overall water quality trends were assessed for the 2006-2007 water year based on data from as early as 1953 to the present in the Minnesota Pollution Control Agency's 2008 Report to Congress (MPCA, 2008b). Just above Saint Anthony Falls, data indicate an increasing trend for nitrite/nitrate and decreasing trends for biochemical oxygen demand (BOD), total phosphorus (TP), unionized ammonia and fecal coliform. Downstream of the MWMO, in Pool 2 (upstream of Lock and Dam No. 2), data indicate the same findings except for no trend found for TP and an additional increasing trend for total suspended solids (TSS).

Combined Sewer Overflow

To address degrading Mississippi River water quality because of combined sewer overflows, the cities of Minneapolis, Saint Paul, and South Saint Paul together with the Metropolitan Council were involved in a ten-year sewer separation project, the Minneapolis Combined Sewer Overflow Program - Phase I (1986-1995). The Metropolitan Council monitored results from the project and data indicated a reduction by half in fecal coliform bacteria levels. In 1986, an estimated 4,651.3 acres of runoff from street inflow connections were served by combined sewers (City of Minneapolis, 2006). By 2000, 98.5% of street drainage was separated, leaving approximately 69 acres that are still served by combined sewers. Each year the City identifies additional connected acreage. For example, in 2010 additional acres have been identified through continuous flow monitoring, smoke testing, and investigation.

The City's former National Pollutant Discharge Elimination System (NPDES) permit (Permit No. MN0046744, held jointly with the Metropolitan Council) required elimination of combined sewer overflows by its expiration in 2001. Since this goal was not fully achieved, a documented approach for the elimination of combined sewer overflows was required for permit renewal. The Metropolitan Council Environmental Services and the City of Minneapolis jointly conducted a combined sewer overflow study, completed in April 2002. Based on study results, the Minneapolis Tier II Comprehensive Sewer Plan was approved by Metropolitan Council Environmental Services in January 2003 and constitutes the Minneapolis Combined Sewer Overflow Program - Phase II for the five-year period 2003-2007.

Based on the study, the Combined Sewer Overflow (CSO) Program requires the removal of both public and private stormwater inflows to the sanitary sewer system. Minneapolis has worked to eliminate major sources of clear water discharges to the sanitary sewers in an effort to minimize the occurrence of CSO events. To-date, this program has been successful with no measured CSO events since 2010. CSO controls remain in the system to prevent sewage backups into or onto streets and/or into basements during a major precipitation event, and to protect sanitary sewer infrastructure from failures caused by excessive pressure. The EPA continues to regulate CSO systems through the NPDES permit program, which is administered in Minnesota by the MPCA.

Efforts to eliminate stormwater runoff connections to the sanitary sewers will persist as the City continues to identify catch basin and other sources of clear water to the sanitary sewers.

In March 2018, the City and the Metropolitan Council executed another MOU to direct their future efforts to coordinate the study of and investment in their connected sanitary sewer infrastructure. Consistent with the MOU, the City and the Metropolitan Council are initiating a comprehensive study of the City and the Metropolitan Council sanitary systems. The goals of that study, which will be completed during multiple phases, include identifying areas in the City with high inflow and infiltration (I/I) that contribute to increased risk of CSO events and highlighting how these areas related to areas where the Metropolitan Council's system is capacity limited. Areas identified as having I/I that contributes to risk of CSO and limited capacity will be prioritized for future investment by the City and the Metropolitan Council. Additionally, the study

will evaluate the cost/benefit of alternatives to reduce the risk of CSOs, reduce I/I, and increase capacity. Alternatives to be studies include making potential changes to the remaining regulators in the City.

Metropolitan Council Surcharge Program

In 2016, the Metropolitan Council appointed the third Task Force of local community representatives to discuss and identify areas of improvement for the existing Metropolitan Council Environmental Services (MCES) Ongoing Inflow and Infiltration Program (Ongoing I/I Program) and the potential for future inflow and infiltration mitigation strategies for both public and private infrastructure. The Ongoing I/I Program aims to provide resources to communities to address excessive I/I by monitoring and informing communities about excessive flows, developing work plans to address those flows, and administering grants through State Bond funds. In 2014/2015, for every $1 in grant funding, the communities completed over $8 in construction projects. The grant program and the I/I program have incentivized over $180 million in community investment in local infrastructure since 2004. Recent studies show that communities that invest in reducing I/I have reduced peak flows by 20% or more. This reduction saves the communities from investing in larger infrastructure and keeps wastewater fees low.

In 2002, Minneapolis initiated the rain leader inspection program seeking to eliminate direct connection of roof drains to sanitary sewer. The Combined Sewer Overflow Program incorporates the rain leader inspection program. A new ordinance was approved effective August 1, 2003: Chapter 56, Prohibited Discharges to Sanitary Sewer System. It prohibits property owners from discharging rooftop rain leaders and private surface drainage to sanitary sewer and requires redirection to either the public stormdrain system or to side yards.

Dams

The Mississippi River has been molded (straightened) and maintained for navigation since 1930 such that today the River consists of a series of locks and dams and an uninterrupted navigation channel. The Upper Mississippi River has a maintained navigation channel depth of at least 9 feet. The Saint Paul District of the United States Army Corps of Engineers (USACE) operates and maintains 13 locks and dams, beginning at Upper Saint Anthony Falls in downtown Minneapolis and ending at Lock and Dam 10 in Guttenberg, Iowa. The USACE was required by law to close the Upper Saint Anthony Falls Lock to all navigation traffic on June 10, 2015. The lock is now only operated for upstream flood mitigation.

There are three dams with navigation locks within the watershed. Upper Saint Anthony Falls Lock and Dam and Lower Saint Anthony Falls Lock and Dam, completed in 1963 and 1956, respectively, are owned by Xcel Energy Center, which operates a hydroelectric plant. Construction was completed in 1963 and 1956, respectively. Upper Saint Anthony Falls Lock and Dam is the uppermost lock and dam along the River. Lock and Dam No. 1, also referred to as the Ford Dam, was formerly owned by Ford Motor Company, Inc., which operated an automobile assembly plant nearby. Due to plans to close, Ford Motor Company's hydroelectric power project was acquired and operated by Brookfield Renewable Power Inc. in 2008. Lock and Dam No. 2 superseded the

role of Lock and Dam No. 2, known today as the Meeker Island Lock and Dam, built by the USACE north of the Lake Street-Marshall Bridge and in operation only from 1907 to 1912 before being closed and demolished. Caught in debates about river navigation and hydroelectric power as well as Minneapolis and St. Paul Rivalry, the ruins of the Meeker Island facility are now only visible on the east side of the River during periods of low water. The Meeker Dam was seen as having insignificant potential for hydroelectric power and no longer necessary for getting steamboats to St. Anthony and Minneapolis. Construction of Lock and Dam No. 1 was completed in 1917 but it underwent reconstruction in 1929. The main lock was not completed until 1932, and the last major rehabilitation took place from was as recent as 1978 to 1983. The locks of all three dams are 56 feet wide by 400 feet long. Lock and Dam No. 1 has two locks of this size, making it the only dam with twin locks in the Saint Paul District of the USACE.

The USACE is conducting Minneapolis locks disposition studies to examine the costs and benefits of continuing to operate federal projects which are no longer serving their authorized purpose (i.e. river navigation). If the dams were to be removed, the hydroelectric facilities would close because they depend on dams to keep the flow of water steady in wet or dry weather. The lower gorge area (generally between Lake Street and the Ford Dam) of the Mississippi Gorge Regional Park, is anticipated to change greatly with dam removal, leading to opportunities for new floodplain islands and floodplain habitat restoration as well as challenges to existing recreation such as rowing. If the Lower St. Anthony Falls Lock and Dam and Lock and Dam No. 1 are not removed, the gorge will remain in its current state as an impounded river and the impoundments will continue to fill with sediment (MPRB, 2019).

Loring Park Pond

Loring Park Pond (sometimes referred to as Loring Lake) is within Loring Park, originally named Central Park, on the southwest edge of downtown Minneapolis, east of the 90-degree bend of Interstate 94. Designated a Type 5 (open water) wetland (Cowardin et al., 1979), it is an eight-acre eutrophic lake that receives strictly urban surface runoff and ultimately discharges to the Mississippi River (see **Figure 43**). Loring Pond was created by connecting Jewett Lake and Johnson's Pond, two small bodies of water. The Minneapolis Park and Recreation Board acquired the lake in 1883, excavated Johnson's Pond to remove a floating bog, and filled the surrounding marsh. The pond was dredged again in 1976.

In 1997-1998 the Minneapolis Park and Recreation Board enhanced the aesthetic value of Loring Park Pond by improving both water level stability and water quality. A liner consisting of a layer of clay and several sequential soil layers was installed to minimize seepage and reduce or eliminate groundwater pumping to maintain pond levels. The pond was buffered with a vegetative strip to prevent Canadian Geese from accessing the pond and to protect the shoreline from erosion, filter pollutants, and create wildlife habitat. In addition, an aeration system was installed to help prevent oxygen depletion during the summer months. The lake has been stocked annually by the Department of Natural Resources with bluegill and black crappie since 2003 and channel catfish since 2005. Native wetland and upland plantings have helped protect water quality for the stocked fish.

In March 2007, accumulated sediments in the north basin of Loring Park Pond were dredged to restore deeper water levels and improve habitat. Dredging made the island in the north basin a distinguishable feature by deepening water levels under the bridge. Dewatering the northern basin and lowering the water level of the southern basin to dredge sediments had the unintended consequence of stimulating hybrid and narrow-leaf cattail growth, which the MPRB began removing in 2013 and replanting with native aquatic emergent vegetation. A significant amount of native emergent plants (notably sweet flag) installed as part of a 1999 planting were found to be doing well after the cattails were removed. An additional 5,000 plugs of a variety of native aquatic emergent plants were planted into Loring Pond in July 2016 (MPRB, 2016).

According to the 305(b) lake assessment, the south basin of Loring Park Pond has insufficient information to determine whether it supports aquatic recreation. Since 1992 the Environmental Operations Section of the Minneapolis Park and Recreation Board has monitored the Pond as part of a diagnostic study for the Chain of Lakes Clean Water Partnership. The 2017 trophic status index (TSI) score for Loring Pond was 63, which falls between the 50th and 25th percentile for lakes in the Northern Central Hardwood Forest ecoregion. There was no significant trend in TSI from 1992-2017 in Loring Pond ($p > 0.05$). Dredging projects from 1997-1998 and the summer of 2007 had large influence in water quality. Water levels were also manipulated from 2013-2016, with a large quantity of groundwater pumped into the lake in 2016, which may have improved the score (MPRB, 2017). From 1992 to 1996, the TSI was on an increasing trend. After stabilization of pond improvements, the TSI shifted to a decreasing trend, indicating steady improvement in water quality (MPRB, 2006). For 2019, The Lake Aesthetic and User Recreation Index gives Loring Park Pond an *excellent* for aesthetics (color and odor of water, garbage and debris), a *good* for water clarity, and a *poor* for habitat quality (aquatic plant and fish diversity) and recreational access. Loring Pond does not have a swimming beach and was therefore not scored for public health.

The Kasota Ponds, Including Mallard Marsh

The Kasota Ponds, including Mallard Marsh (referred to as Kasota Pond East), are located in St. Paul along either side of Kasota Avenue and to the west side of its intersection with Hwy 280. Mallard Marsh is approximately 1 mile south of Larpenteur Avenue on the south side of Kasota Avenue and to the west of Highway 280 among the Kasota Ponds (Cowardin et al., 1979). This deep freshwater marsh is 2.5 acres in size and is not meandered. The ponds treat stormwater runoff from the Bridal Veil Creek subwatershed during storm events and then slowly release that stormwater into the storm sewer system. Groundwater recharge and discharge occurs in the Kasota area, including Skonard Spring, and discharges into one of the ponds. Mallard Marsh and the Kasota Ponds are a remnant of a much larger 100-acre wetland and pond complex.

Saint Anthony Park Community Council (SAPCC) sponsors annual cleanups around Mallard Marsh to remove discarded trash in shoreline areas. Volunteer turnout usually reaches 50-60. Historical volunteer efforts have included tree planting, nesting box installation, buckthorn clearing, turtle habitat creation, and pollutant removal. Saint Anthony Park Community Council volunteers have monitored Mallard Marsh, including three surrounding ponds, for at least 15 years. They have

recorded water quality indicators such as observations, temperature, pH, and conductivity. Besides water quality monitoring, a basic wetland inventory was done by SAPCC and University of Minnesota faculty and students in 1999-2000. The inventory included three turtle species, vegetation, fish and other wildlife including reptiles, amphibians, birds, and mammals. Fathead Minnows, Brook Stickleback, crayfish, and salamanders have also been found in Mallard Marsh and surrounding ponds (MWMO, 2006).

MWMO staff have been monitoring the area since 2008. Biological sampling was conducted in 2011 and 2016 to develop an IBI. The results indicated all three monitored wetlands are in poor health based on aquatic plant communities. Receiving runoff from various impervious surfaces including Highway 280, the wetlands were listed on the Federal Clean Water Act's Section 303(d) list of impaired waters in 2014 for chloride and were part of the Minnesota Pollution Control Agency's TCMA Chloride Total Maximum Daily Load Study and TCMA Chloride Management Plan (MWMO, 2019). A basic wetland inventory was done by Saint Anthony Park Community Council and University of Minnesota faculty and students in 1999-2000. In 2015 Saint Anthony Park Community Council received a grant with the Minnesota Conservation Corps to remove buckthorn and to restore and stabilize shoreline areas around Mallard Marsh and three surrounding ponds. In 2018 MWMO monitoring staff prepared a report to summarize 10 years of water quality and Biological Sampling. Again in 2019, Saint Anthony Park Community Council received a MWMO stewardship funds mini grant to remove buckthorn and to restore and stabilize shoreline areas around Mallard Marsh and three surrounding ponds.

Bridal Veil Creek

Bridal Veil Creek was originally a small creek or gully flowing southwesterly and draining a large, wooded swampy area covering about 1,177 acres before plunging into the Mississippi River gorge. Beginning in the mid-1800s with the growth of railroad yards, commercial areas, and residential areas, the creek was enclosed in a piecemeal fashion within culverts. The current pipeshed drains about 740 acres and lies entirely west of Highway 280. The creek is visible at its confluence with the Mississippi River just north of the Franklin Avenue Bridge and west of East River Parkway in Minneapolis. Once dramatically spilling over the bluffs into the Mississippi River, Bridal Veil Falls now have very little water and flows over a manmade tiered wall into a stony creek bed before emptying into the Mississippi River. The creek is visible via a path and viewing platform accessible by stairs north of Franklin Avenue.

During subsequent residential development, some of the stormwater runoff was diverted into sanitary sewers and discharged directly into the river. During the mid-1930s, the interceptor system was built to collect the sanitary flows, but not the stormwater runoff, which was allowed to mix with the sanitary sewage and permitted to overflow into the river in large rain events. The construction of commercial buildings, paved streets, driveways, sidewalks, and homes increased the amount of stormwater conveyed by Bridal Veil Creek. The size of the stormdrain pipes increased with time, from a 27-inch to a 72-inch pipe following construction of I-94.

After the construction of Highway 280 (built between 1954 and 1957), the City of Saint Paul Public Works noted that projected developments in the Bridal Veil Creek subwatershed would eventually exceed the design capacity of the storm sewer system. In 1995, the City of Saint Paul completed the Eustis Tunnel, separating Saint Paul runoff from the Minneapolis storm sewer system to correct capacity problems and shared management issues. The Cities of Lauderdale and Falcon Heights, formerly connected to the Bridal Veil sewer system, began draining to the Eustis Tunnel (MWMO, 2006).

The Bridal Veil Open Space, a 6.6-acre site bordered by Kasota Avenue to the south, a Burlington Northern Railroad line to the north, and industrial properties, is downstream from a Superfund site (the only one in the MWMO) to the northeast where a wood treatment facility operated from 1908 until 1962. This facility treated wooden telephone poles with creosote and pentachlorophenol (PCP) preservative. Waste product was discharged from the treatment area of the Valentine Clark site into a channel connecting to Bridal Veil Creek and southward beneath the railroad tracks to the Bridal Veil Open Space. The Open Space included Bridal Veil Pond, which was created in 1970 by the city of Minneapolis to serve as a storm water detention pond. Much of the ground adjacent to the Superfund site, including Bridal Veil Pond and the surrounding Bridal Veil Open Space, was polluted by chemical runoff from the site as well as runoff from Hwy 280, which is located directly over the lowest portions of the Bridal Veil stream valley. The pond was stocked with fish by the Minnesota Department of Natural Resources from 1976 to 1991, but ducks and fish were killed when upstream dredging of Bridal Veil Creek released contaminants in December 1990. Contaminants of concern include polyaromatic hydrocarbons (PAH), PCP, and dioxins.

Local community groups, such as Southeast Como Improvement Association and the SAPCC, have made the Bridal Veil Creek Watershed a high priority. In the winter of 2007-2008, Minneapolis Public Works and the Minnesota Pollution Control Agency remediated Bridal Veil Open Space and Bridal Veil Pond within it. Remediation activities included removal of four feet of contaminated soil over the entire Bridal Veil Open Space and replacement with clean soil, filling of the previous Bridal Veil Pond and conversion to a wetland area reseeded with native vegetation, and creation of a shallow, rocky meandering stream within the wetland to promote natural bioremediation of contaminants. In addition, the project involved extension of the storm sewer from the railroad tracks to a new outfall by the pond, limited removal of contaminated sediment from the creek, and installation of sedimentation basins to decrease the potential for contaminated sediments to migrate into the new wetland area.

Bassett Creek

Bassett Creek flows through the MWMO by way of a tunnel which was built in phases and completed in 1992. The new Bassett Creek Tunnel is in an entirely different alignment than Old Bassett Creek Tunnel (OBCT). The new tunnel was routed through downtown Minneapolis and its outfall is just downstream from Upper St. Anthony Falls dam; the outfall carries the majority of the flow of Bassett Creek (MPRB, 2016a). Although OBCT no longer carries Bassett Creek flow from portions of Minneapolis and eight upstream cities, it remains in-place to convey local flows from

its remaining drainage area of 870 acres within the Central and Near North Communities of North Minneapolis. A study was completed by Barr Engineering for the MWMO and City of Minneapolis to understand the structural condition of OBCT and develop a plan to remove accumulated sediment and debris (Barr Engineering Co., 2017). A boundary change between the BCWMC and the MWMO transferred the area encompassing both tunnels to the MWMO. In 2000, the BCWMC, MWMO, and the City of Minneapolis entered into a joint and cooperative agreement, which resulted in a boundary change that transferred 1,002 acres from the BCWMC to the MWMO. The agreement defines the responsibilities of the MWMO and the BCWMC with respect to the new and old tunnel. For example, the agreement requires accommodation of a 50 cfs overflow from Bassett Creek to OBCT during a 100-year storm event. The agreement also requires written approval of the BCWMC for changes in the area tributary to the new tunnel, or increases in the rate of runoff to the new tunnel by either the City of Minneapolis or the MWMO. A copy of the agreement is attached as Appendix F.

Sullivan Lake

Sullivan Lake is located in Columbia Heights along 51st Avenue, east of Central Avenue. According to the City of Columbia Heights' Comprehensive Plan (2010), Sullivan Lake serves as a detention area for stormwater. Its drainage basin is 0.73 square miles and the surface area is 15.3 acres at the normal water level of 880.3. A gated outlet structure controls outflow from the lake. The lake is surrounded by the largest park in Columbia Heights, with trails around the lake. The MWMO contracted Anoka Conservation District to complete a stormwater retrofit analysis (SRA) for the purpose of identifying and ranking water quality improvement projects to address TP and TSS throughout the drainage areas to of Sullivan as well as Highland Lake described below (Anoka Conservation District, 2019). MWMO monitoring staff have been partnering with Anoka Conservation District. Water quality monitoring is conducted on 3 year rotation while lake levels are monitored on an annual basis. MWMO water quality monitoring team has also collected bathymetric data on Sullivan Lake.

Highland Lake

Highland Lake is located in Kordiak County Park in the northeast portion of Columbia Heights. The City of Columbia Heights' Comprehensive Plan (2010) states that Highland Lake has six stormwater drains discharging to it and serves as a stormwater detention area. The drainage basin is 0.32 square miles and the surface area is 15.7 acres at a water elevation level of 996.1 feet above sea level. MWMO monitoring staff have been monitoring the water quality of Sullivan Lake by partnering with Anoka Conservation District. Water quality monitoring is conducted on 3 year rotation while lake levels are monitored on an annual basis. MWMO water quality monitoring team has also collected bathymetric data on Highland Lake.

Public Waters and Wetlands

The Minnesota Department of Natural Resources identifies the entire stretch of the Mississippi River, Loring Pond, Mallard Marsh, Sullivan (Sandy) Lake, and Highland (Unnamed) Lake as the

only public waters within the watershed (see **Figure 43**). Public waters include, but are not limited to, those where there is publicly owned and controlled access, waters of the state determined to be public waters by court jurisdiction, watercourses with a drainage area greater than two square miles, and water basins surrounded by publicly owned lands. Public waters wetlands are types 3, 4, or 5 wetlands (Cowardin et al., 1979) that are at least two and one-half acres in surface area. Minnesota's public waters and wetlands have been inventoried by the Minnesota Department of Natural Resources. Minnesota Department of Natural Resources public waters and wetlands maps for Hennepin and Ramsey Counties are adopted by reference and are available from Minnesota Department of Natural Resources.

The Minnesota Department of Natural Resources provides waterbody size, ordinary high water levels, and normal water levels for most public waters and wetlands. Current records of water levels are available from the MWMO office, the regional hydrologist of the Minnesota Department of Natural Resources, and the Hennepin and Ramsey Counties Public Works Departments.

National Wetlands Inventory

The United States Fish and Wildlife Service has inventoried wetlands using the Cowardin system of wetland designation (see Cowardin et al., 1979). These maps are known as the National Wetland Inventory Maps. National Wetlands Inventory wetlands are inventoried for the United States Geological Survey (USGS) quadrangle maps: Minneapolis North, Minneapolis South, New Brighton, and Saint Paul West. The jurisdictional limit of any wetland, however, must be determined by trained wetland delineators based on field review.

Figure 43 also identifies the National Wetlands Inventory wetlands within the MWMO including three systems: riverine, lacustrine, and palustrine. Riverine systems are those wetlands or deepwater habitats contained within a channel that is not dammed nor dominated by trees or emergent vegetation. Lacustrine systems are those wetlands or deepwater habitats in a depression or in a dammed river channel that have less than 30% coverage of vegetation (e.g. trees and persistent emergent varieties) and total at least 20 acres in surface area. Palustrine systems are all nontidal wetlands that are dominated by vegetation (e.g. trees and emergent vegetation). In systems lacking such vegetation, palustrine includes areas less than 20 acres and with active bedrock shoreline features less than 6.6 feet (2m) deep. These systems can characterize some tidal areas, though they are not applicable here.

Most wetland area in the MWMO is the part of the Mississippi River affected by dams. Those wetlands not along the Mississippi River are found in pockets throughout the urban watershed. The Mississippi River, Loring Park Pond, Bridal Veil Creek, Mallard Marsh, and the Kasota Ponds are associated with National Wetlands Inventory wetlands.

The MWMO conducted a function and value assessment of any wetlands. The project used Version 3.3 of the Minnesota Routine Assessment Method for Evaluating Wetland Functions. In addition to traditional federal and state data sources, the MWMO identified potential wetland sites using soils data from its *Historic Waters of the MWMO* study (MWMO, 2011) and data gathered from its

recent Land Cover Classification and Natural Resources Inventory (MWMO, 2008). To view Minnesota Routine Assessment Method visit the Minnesota Department of Natural Resources website or go directly to the web address: http://www.bwsr.state.mn.us/wetlands/mnram/MNRAM_fulltext_9_2010.pdf.

Results of this study will be integrated in the MWMO's planning and resource management efforts.

Metropolitan Mosquito Control District Wetland Map

The Metropolitan Mosquito Control District maintains its own maps of all wet areas that provide habitat for larval mosquitoes in the seven-county metropolitan area. Areas as small as 400 square feet that occasionally hold water for seven days are mapped in **Figure 44**. In addition to lakes and ponds, the maps include cattail marshes, grassy ditches or vegetative swales, and a wide array of natural or constructed water holding areas. Each wetland is classified into wetland types using the US Fish and Wildlife Service Circular 39 system. This wetland inventory is updated every five years by field inspection. The wetland inventory maps are available for review at the offices of MWMO and Metropolitan Mosquito Control District.

Impaired Waters

Previous development and redevelopment in the watershed have placed a significant burden on the health and sustainability of the MWMO's water resources due to increasing impervious surfaces generating polluted stormwater runoff. Section 303(d) of the Federal Clean Water Act requires that states establish total maximum daily loads (TMDLs) of pollutants to waterbodies that do not meet water quality standards. The loading limits are to be calculated such that, if achieved, the waterbody would meet the applicable water quality standard. To comply with the Clean Water Act, the Minnesota Pollution Control Agency assesses the state's waters, lists those waterbodies that are impaired (i.e. do not meet water quality standards), and conducts studies to determine the pollutant loading limits for the impaired waterbodies. These studies are known as Total Maximum Daily Load studies.

The Minnesota Pollution Control Agency sets target start and completion dates for individual Total Maximum Daily Load studies. Studies are usually funded by either the Minnesota Pollution Control Agency or by local units of government. Each Total Maximum Daily Load study describes the impairment, identifies the relevant pollutant(s), inventories the pollutant sources, calculates the assimilative capacity of the waterbody, allocates the allowable loads to the different sources, and prescribes an implementation strategy to restore the waterbody to meet water quality standards. Within a year of completing the Total Maximum Daily Load study, the Minnesota Pollution Control Agency requires the completion of an implementation plan, which provides more specific management details than are provided in the initial Total Maximum Daily Load study.

In 2016 the Minnesota Pollution Control Agency (MPCA) approved the Twin Cities Metropolitan Area (TCMA) Chloride Management Plan. The MPCA worked with stakeholders in the Seven County Twin Cities Metropolitan Area (TCMA) to assess the level of chloride in water resources, including lakes, streams, wetlands, and groundwater. There are two primary sources of chloride to the TCMA water resources: 1) salt applied to roads, parking lots and sidewalks for deicing; and 2) water softener brine discharges to municipal wastewater treatment plants (WWTPs). The MPCA and stakeholders also worked together to develop a plan to restore and protect waters impacted by chloride. This Chloride Management Plan (CMP) incorporates water quality assessment, source identification, implementation strategies, monitoring recommendations, and measurement and tracking of results into a performance-based adaptive approach for the TCMA. The goal of this plan is to develop the framework to assist local partners in minimizing salt (chloride) use and provide safe and desirable conditions for the public. The TMDLs were developed for each of the lakes, wetlands, and streams in the TCMA impaired for chloride. Chloride impaired waters in the MWMO along with those having other impairments show up in **Table 23**.

MPCA has identified 11 non-mercury/non-toxic impaired water bodies that are completely or partially within the boundary of the MWMO sub-watershed boundary as of the 2018 EPA approved 303(d) impaired waters list. Five of these impaired waterbodies have an approved TMDL plan with the remaining six having targeted TMDL completion dates within the timeframe of this updated water plan. Nutrient/eutrophication biologic indicators, chloride, fecal coliform (E.coli), Total Suspended Solids (TSS) (South Metro Mississippi Turbidity TMDL) remain issues within some of the surface waters within the MWMO's boundaries. MWMO's listed waters and their impairments are shown in **Figure 45**, and **Table 23**. The information was taken from the 2018 MPCA Impaired Waters List and is provided only for water bodies within the MWMO.

In 2010, the MPCA began work in the Mississippi River – Twin Cities HUC-8 level watershed as part of the watershed approach to restoring and protecting water quality. The resulting monitoring and assessment report can be found at the following webpage. https://www.pca.state.mn.us/water/watersheds/mississippi-river-twin-cities . In 2020, the MPCA will revisit the Mississippi River - Twin Cities Watershed to monitor and reassess lakes and streams.

Table 23: Impaired Waters of the MWMO

Waterbody	Year Listed	Impairment	Target Completion Year or Status
Streams			
Bassett Creek - Medicine Lake to Mississippi River[1]	2010	Chloride	TMDL Approved in 2016
	2008	Fecal Coliform	TMDL Approved in 2014
	2004	Fish Bioassessment	2025
Mississippi River - Crow River to Upper St. Anthony Falls	2006	Fecal Coliform	2024
	1998	Mercury in Fish Tissue	TMDL Approved in 2007
	2016	Nutrients	2018
	2002	PCB in Fish Tissue	2020
Mississippi River - Upper St. Anthony Falls to St. Croix River	1994	Fecal Coliform	2022
	1998	Mercury in Fish Tissue	TMDL Approved in 2007
	1998	Mercury in Water Column	TMDL Approved in 2007
	2016	Nutrients	2018
	1998	PCB in Fish Tissue	2020
	2008	PFOS in Fish Tissue	2025
	2014	PFOS in Water Column	2025
	2014	TSS	TMDL Approved in 2016
Lakes			
Loring (South Bay)	2014	Chloride	TMDL Approved in 2016
Kasota Pond North	2014	Chloride	TMDL Approved in 2016
Kasota Pond West	2014	Chloride	TMDL Approved in 2016
Mallard Marsh	2014	Chloride	TMDL Approved in 2016
Sandy	2002	Nutrients	2025
Unnamed (Highland Lake)	2004	Nutrients	2025

[1] Bassett Creek is wholly contained underground within the MWMO.

PCB = Polychlorinated biphenyl

PFOS = Perfluorooctane Sulfonate

TSS = Total Suspended Solids

MPCA 2018 Impaired Waters List

Ditches

There are no public ditches within the watershed as established by Minnesota Statutes chapter 103E.

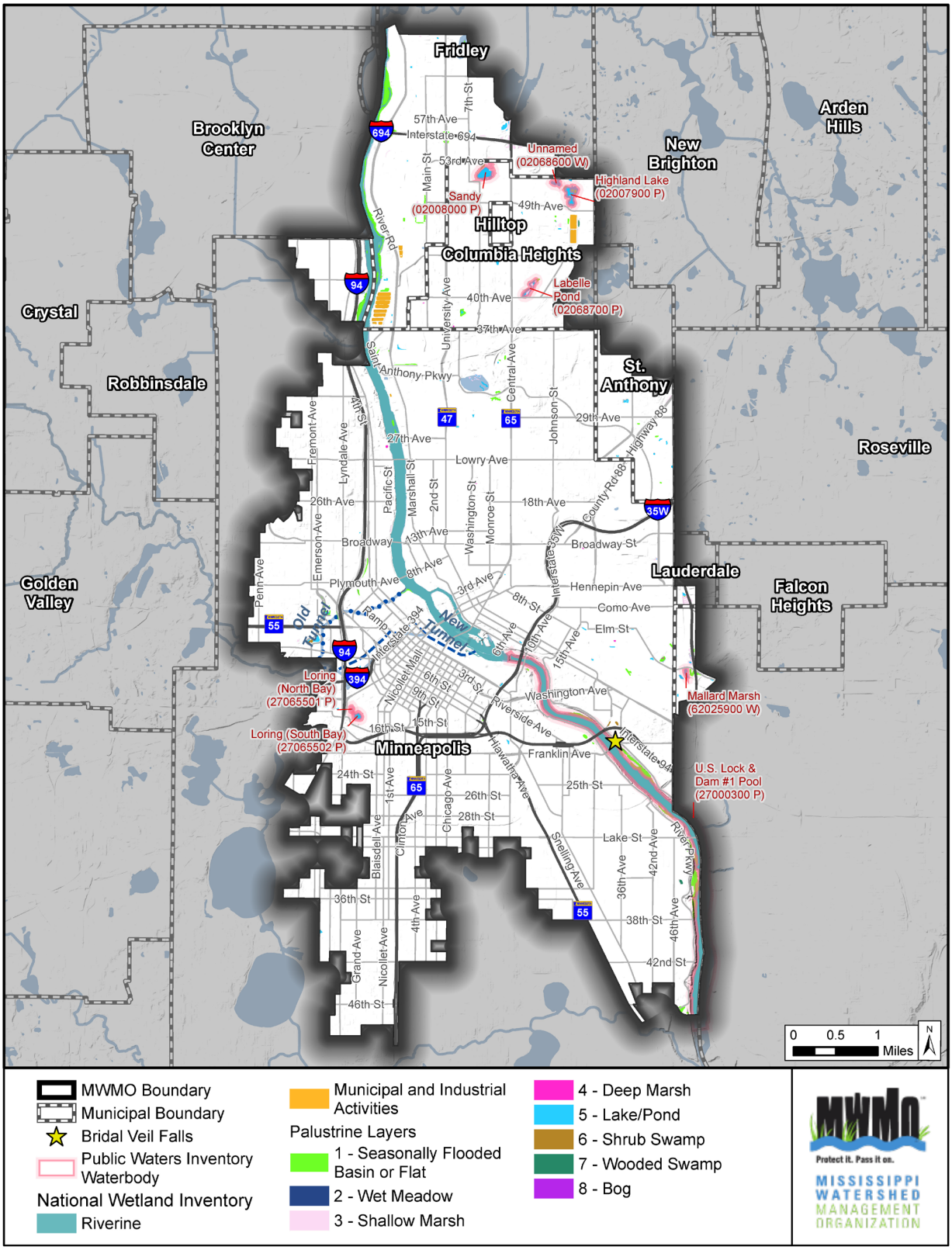


Figure 43: Surface Water Resources of the MWMO

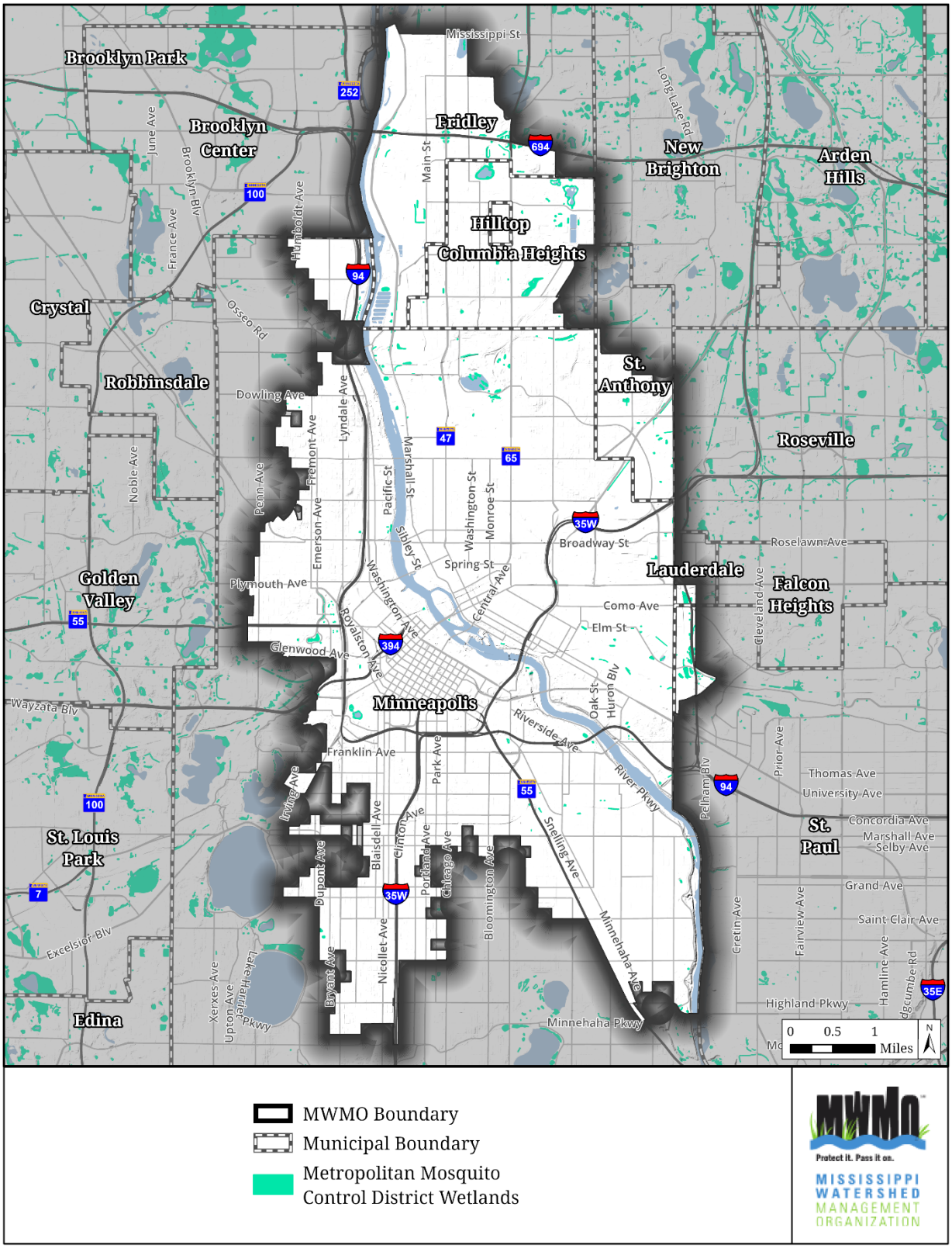


Figure 44: Metropolitan Mosquito Control District Wetland Areas in the MWMO

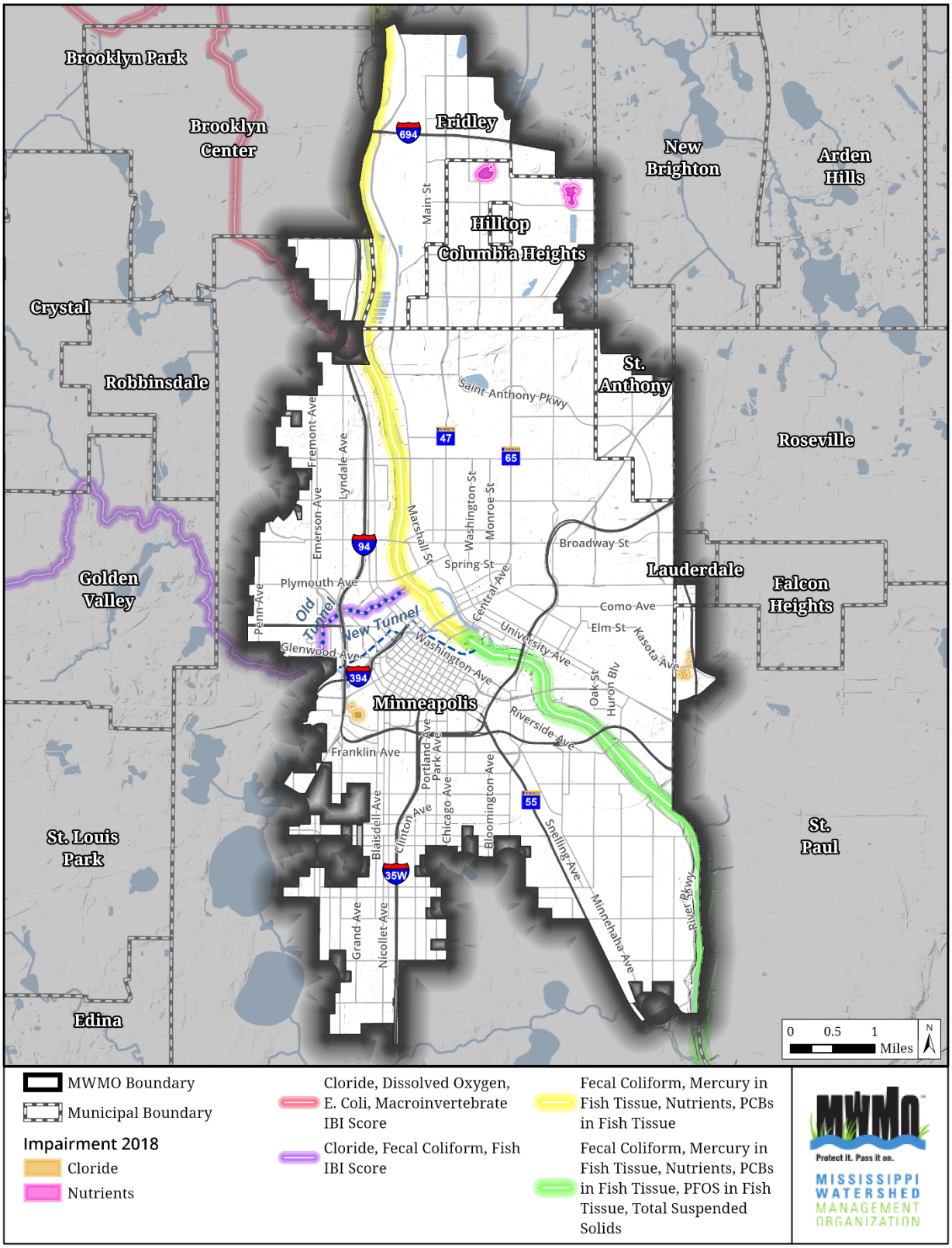


Figure 45: Impaired Waters of the MWMO

4.5.3 Stormwater System

The MWMO is highly urbanized. Many of the streams, lakes, and wetlands once found in the watershed have been buried, filled, drained, or otherwise altered as the watershed developed. As historic surface water drainageways were altered to make way for development, an extensive series of pipes and tunnels were put in place to collect and convey stormwater downstream. This conveyance system is mostly manmade—stormwater pipes and tunnels have replaced the creeks and streams that once conveyed water within the area to the Mississippi River. Understanding this extensive stormwater pipe and tunnel system is key to watershed management in the MWMO. Pipesheds throughout the MWMO can be found in **Figure 46** and the Drainage area of the Minneapolis Storm Tunnel System can be found in **Figure 49**.

The MWMO has aggregated pipesheds shown in **Figure 46** into five subwatershed management units. These subwatershed areas shown in **Figure 47** will be the management units the MWMO uses when identifying projects and assessing changes (improvements/degradation) occurring in the watershed's resources. The MWMO reserves the right to define additional areas in the future if needed. Four main criteria were used to establish the subwatershed management units: existing pipeshed boundaries, potential greenway corridors based on existing land cover, existing MWMO boundaries, and existing pervious areas.

The City of Minneapolis stormwater system receives runoff from approximately 50 square miles. The system includes main line storm pipes, deep storm tunnels (23 miles in total), catch basins, outfall control structures, pump stations, and numerous stormwater management practices including ponds, wetlands, and grit chambers (City of Minneapolis, 2008a). Cross connections between storm sewer and sanitary sewer systems still exist.

Over the past several years the City has been updating its stormdrains spatial database. Almost all of the stormdrain system has been digitized with attribute information attached. Minneapolis Park and Recreation Board stormdrain networks were incorporated into the database recently.

The major Saint Paul storm system within the MWMO is the Eustis Branch, of the Saint Anthony Park Storm Tunnel, in the Bridal Veil Creek region. The Saint Paul storm sewer network is available from the City in GIS format. The City of Lauderdale has mapped the storm sewer system throughout the city. The maps are available in Geographic Information System (GIS) format. The City of Saint Anthony Village storm sewer system is not available electronically.

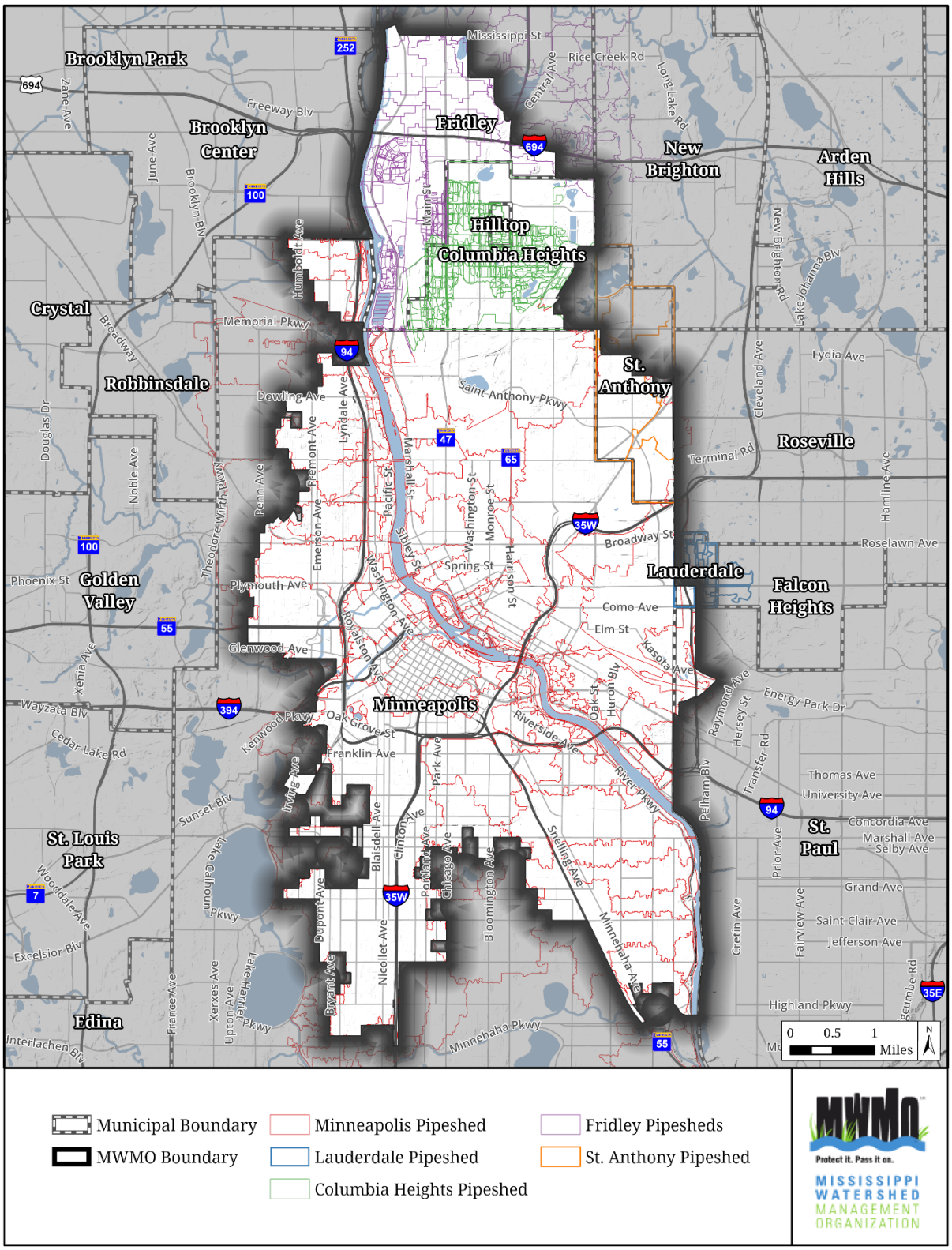


Figure 46: Pipesheds of the MWMO

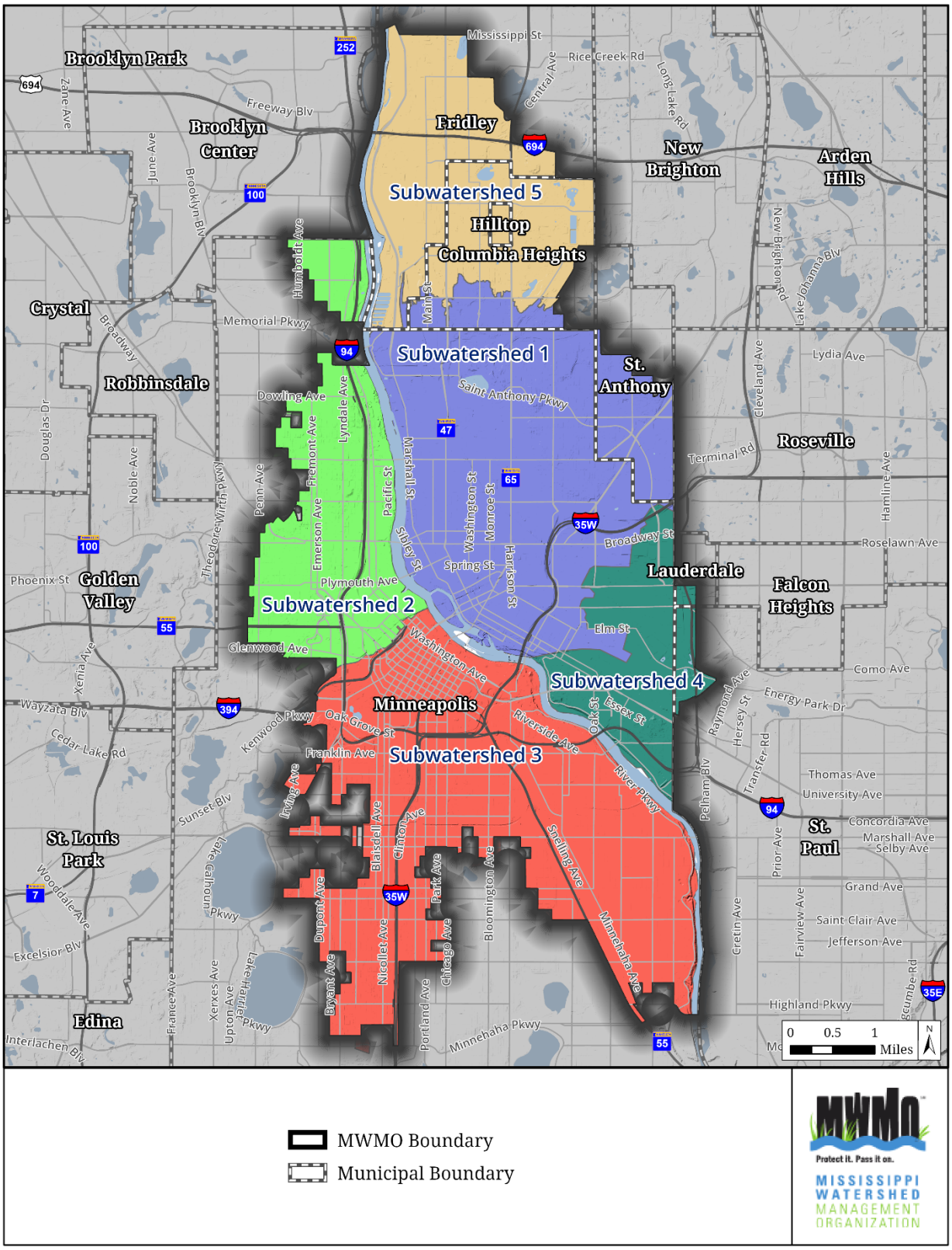


Figure 47: 2010 Subwatershed Management Areas of the MWMO

4.5.4 Flood-Prone Areas

The urbanized condition of the MWMO, coupled with a natural history that indicates this area once featured a network of streams and wetlands, now defines a landscape that is (among other things) prone to flooding. July 1997 rainfall totaled twelve inches and included five events that produced flooding complaints throughout the watershed. These five events prompted simultaneous flood control awareness and action on the part of the cities within the MWMO.

From 1998 to 2006, the City of Saint Anthony Village completed approximately $16 million in flood improvements based on recommendations from their 1997 analysis of problem areas (City of Saint Anthony Village, 1997); 7 of the 13 problem areas were located within the MWMO. The City has since identified an additional flooding problem area at Anthony Lane South in the Saint Anthony Village Industrial Park. The City is planning to undergo a feasibility study to investigate the causes and solutions for this problem. The site is within the New Brighton Boulevard Stormdrain (NBBS) subwatershed. The area of the watershed that includes the Village of Saint Anthony defines the NBBS.

In 2018, the City published an inventory in their Water Resource Management Plan of all their flood mitigation projects including designation of study areas and prioritized flood mitigation projects for implementation. This is part of the City's flood mitigation program. The program addresses localized flooding and drainage problems. The programs look at volume, load, and rate controls and aim to protect homes and businesses and improve water quality. Hydraulic and hydrologic modeling is being done citywide to determine the extent of the localized problems. When modeling is completed in 2018, flood areas will be evaluated. Areas found to be a highest risk for flooding will be subject to feasibility studies. The results of the feasibility studies will inform selection and prioritization of solutions considering constructability and costs, as well as the need to leverage other opportunities and funding. Solutions for larger-scale drainage problems may include underground storage, pipes, and ponds in combination with green infrastructure such as rain gardens, bioswales, constructed wetlands, and pervious pavements. Future projects for this funding category will be informed by the Hydrologic and Hydraulic Modeling efforts currently underway.

The City of Saint Paul made substantial flood mitigation efforts within the MWMO back in 1995, the year of completion of the Eustis Tunnel, and throughout the past few decades leading up to completion of combined sewer overflow work. The Tunnel resulted in major alleviation of potential flooding in the Bridal Veil Creek (BVC) subwatershed. The BVC subwatershed, as discussed earlier, is that area of the watershed that includes the cities of Lauderdale, Saint Paul, and east Minneapolis.

In 2003 the City of Lauderdale rebuilt city streets, the utilities under those streets (natural gas, water, sanitary sewer), and used stormwater management practices to create stormwater drainage capabilities throughout the residential portion of the city which integrated with surrounding established systems.

Since 2014, the MWMO has been working with member cities Minneapolis, Columbia Heights, Hilltop and Fridley on the development of comprehensive water quantity models (Hydrology and Hydraulic: H & H). These models are used to identify areas at risk of flooding, predict the frequency and severity of flooding, and help in the targeting and performance assessment of flood mitigation projects. The MWMO delineation and naming of these subwatersheds can be found in **Figure 48**.

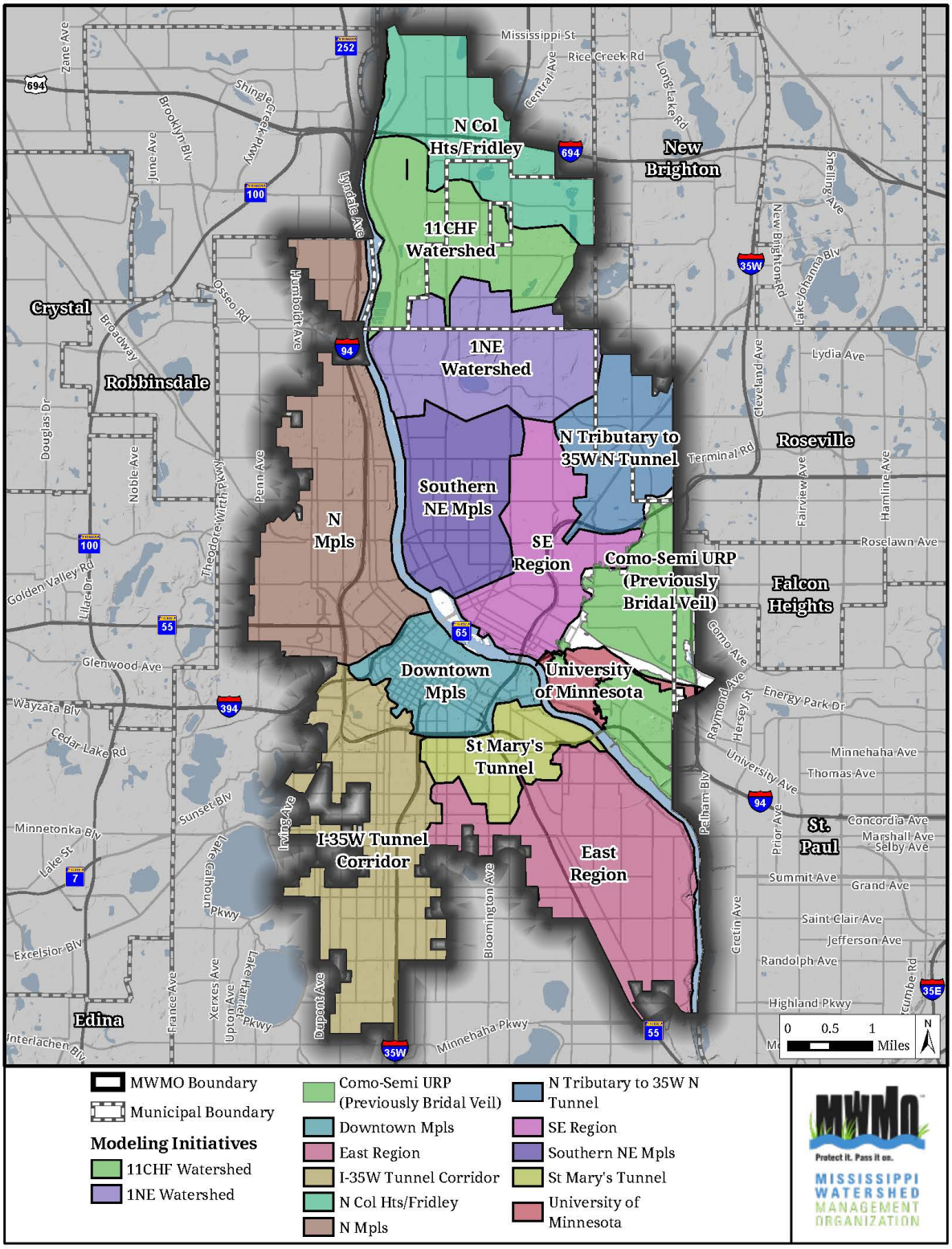


Figure 48: Map of MWMO new H&H and P8 Modeling Subwatersheds

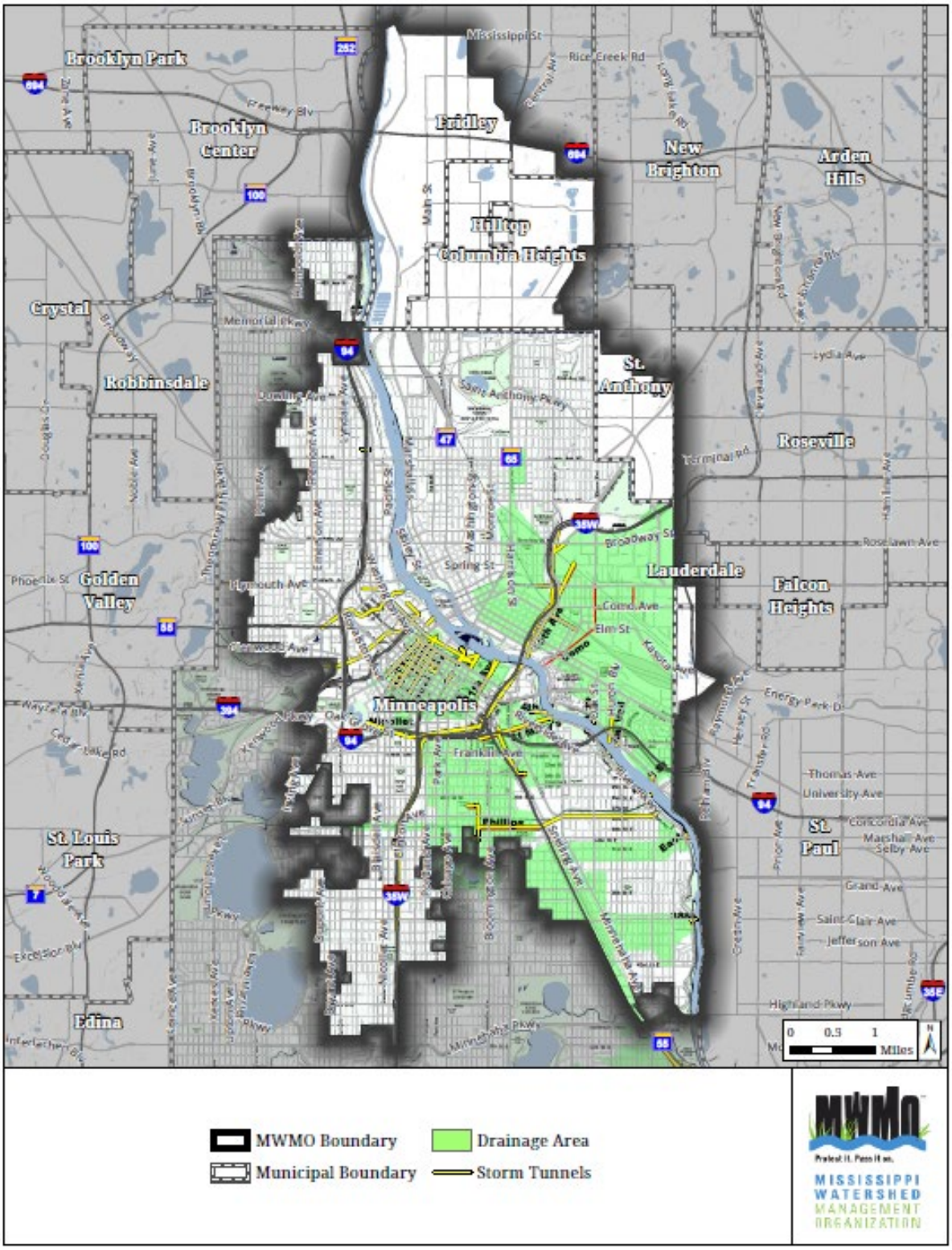


Figure 49: Minneapolis Storm Tunnel System

4.5.5 Floodplain and Shoreland

Floodplain

Most floodplains in the watershed are adjacent to the Mississippi River except for a small zone affiliated with Bassett Creek on the west side and some small areas in the City of Columbia Heights. All floodplains are within the Cities of Fridley and Minneapolis. Current 100- and 500-year floodplains are illustrated in **Figure 50**. Flood insurance studies are completed by the Federal Emergency Management Agency in compliance with the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial National Flood Insurance Program Maps for the City of Minneapolis were completed in 1974. Initial Flood Insurance Rate Maps (FIRM) were completed in 1981. The most recent FIRM update in the Twin Cities metropolitan area was 2016.

By law, Minnesota's flood-prone communities are required to adopt floodplain management regulations when adequate technical information is available to identify floodplain areas and to participate in the National Flood Insurance Program. Participation in the National Flood Insurance Program is a commitment to administering and enforcing ordinances that are intended to keep people and structures reasonably safe from flooding and enables the people of Minnesota to insure themselves from future losses through the purchase of flood insurance.

When the FEMA maps are updated, as they were in 2004, the cities participating in the National Flood Insurance Program must adopt those new maps by the effective dates or FEMA suspends them. The maps are adopted by either adopting a new floodplain management ordinance or amending an existing ordinance. State law requires that Department of Natural Resources approve the draft ordinance before they adopt it. All MWMO member cities participate in the National Flood Insurance Program and Columbia Heights, Fridley, Lauderdale, Minneapolis, Saint Paul, and Saint Anthony Village have approved floodplain ordinances.

Shoreland Ordinances

The Minnesota Department of Natural Resources (DNR) administers the Shoreland Management Program. This program requires that local governments implement, administer, and enforce shoreland management standards through their planning and zoning controls. A model shoreland ordinance was updated October 3, 2019. The model serves as a tool for local governments to develop new or amend existing shoreland ordinances. These requirements must be met within the MWMO's jurisdiction by the cities of Columbia Heights, Fridley, and Minneapolis.

The DNR completed the Rule Making process for the Mississippi River Critical Corridor Area (MRCCA) in 2017 Minn. R 6106.0010 - 6106.0180 and revised the MRCCA boundary legal description in 2018 (Minn. Rule 6106.005 Subp. 64). As a result, the cities of Fridley, Minneapolis, and St. Paul were all required to develop plans and zoning regulations that comply with state rules which were submitted to the Metropolitan Council and DNR as a part of their 2040 Comprehensive Plan approval process.

Minnesota's buffer law passed in 2015 establishes new perennial vegetation buffers of up to 50 feet along rivers, streams and ditches that will help filter out phosphorus, nitrogen, and sediment. The law provides flexibility and financial support for landowners to install and maintain buffers.

The DNR's role in Minnesota's buffer law is to produce and maintain a map of public waters and public ditch systems that require permanent vegetation buffers. The DNR released the buffer protection map in July 2016. The map is helping to guide the implementation of Minnesota's buffer law by landowners, with the help of the Board of Water and Soil Resources (BWSR), Soil and Water Conservation Districts (SWCDs), Drainage Authorities and other local governments. These requirements must be met within MWMO's jurisdiction by the cities of Columbia Heights, Fridley, and Minneapolis.

4.5.6 Surface Water and Water Quality & Quantity Modeling

Surface water and water quality and quantity modeling provides communities and organizations with the ability to identify flood-prone areas and test solutions, identify key areas for stormwater management practices implementation, and coordinate policy with those practices that have the most positive effect on the watershed. In addition, models create a central database of hydrologic, hydraulic, and water quality information at many possible scales, from small subwatersheds to national drainage systems like the Mississippi River.

As described in **Section 4.5.4** (Flood-Prone Areas), the MWMO is working with member cities Minneapolis, Columbia Heights, Hilltop and Fridley on comprehensive water quantity (Hydrology and Hydraulic: H & H) and associated water quality model studies for areas covering Northeast Minneapolis, and portions of Columbia Heights, Hilltop and Fridley. In the years following, the MWMO will continue partnering with its member cities to complete H&H and water quality models across the remainder of the MWMO.

In 2019-2020 Saint Paul worked with a consultant to generate a detailed Hydrologic & Hydraulic model of the Saint Anthony Park subwatershed, including areas within Saint Paul, Lauderdale, Falcon Heights, State Fair property, and University of Minnesota property. Also created was a P8 model for water quality assessments and prioritization of capital projects.

Modeling enables the MWMO and its member cities to understand and analyze stormwater as it flows through the existing infrastructure system. The completed models also assist cities with local system management and programmatic reporting. The MWMO and member cities can use the models to target locations for stormwater control measures, ecological restoration, and best practices to manage or improve water quantity and quality infrastructure, and the models also inform cost/benefit analyses used to determine which of these practices are the most effective and efficient for a given location. The models also function as the basis for probabilistic studies to understand the relative impact of changes in land use, climate, and infrastructure.

The MWMO continues to partner with the city to develop models that can be used for a variety of purposes including flood mitigation and water quality assessments and solutions. In 2004, the City

of Minneapolis initiated a Storm Water Management Model calibration and standards study for the purpose of establishing standards for future modeling efforts in the City such that all models can ultimately be integrated. The result has been higher model accuracy and greater confidence in model results. SRF Consulting developed for the City a *Development Manual for SWMM Users* (City of Minneapolis Public Works Department, 2005). The Manual includes basic modeling standards, data sources, and processing requirements to be used by a variety of professionals for all Storm Water Management Models developed for the City. To date, the City of Minneapolis has modeled each of its deep storm tunnel systems under the 100-year, 24-hour event as an effort for the 2004 Storm Tunnel System Management Plan. The main findings were that most of the tunnels operate under surcharge conditions during this extreme event.

In addition to models that simulate stormwater as it flows through the existing infrastructure system and to the Mississippi River, the MWMO has developed a hydraulic model of the Mississippi River from River Mile 860.4 (Interstate 694) down to River Mile 847.7 (the Ford Dam), as a part of the MWMO's *A Guide to Bank Restoration Options for Large River Systems* (MWMO, 2010). The study modeled shear stress and flood levels along the reach from 2-year to 500-year flood events to inform the potential for bioengineering restoration techniques along the Mississippi's riverbanks. Eventually this same modeling will be tied into stormwater discharge modeling of tunnels and pipes leading to the river.

Intercommunity Flows Analysis

79% of the MWMO's area is within Minneapolis. Roughly six square miles of drainage from Columbia Heights, Hilltop, St Anthony Village, St Paul, and Lauderdale cross over into Minneapolis and contribute to intercommunity flows. A central role for the MWMO is to understand and assist its member cities in managing the quality, rate, and volume of these intercommunity flows.

4.5.7 Groundwater Resources

Most of the residents within the MWMO obtain their drinking water from the City of Minneapolis, which uses the Mississippi River as its primary water source. However, groundwater is also used to privately supply drinking water to organizations and businesses. It is also likely that there are private wells located within the MWMO supplying groundwater for drinking water or small irrigation uses that are not identified within existing databases. There are three aquifers of significance in the MWMO including the Quaternary water table, Saint Peter, and Prairie du Chien-Jordan. The proximity of the Quaternary water table aquifer to the land surface makes the Quaternary water table aquifer susceptible to pollution, therefore it is not typically used for residential wells. However, many monitoring wells in the MWMO are set in the Quaternary water table aquifer.

Regional groundwater flow modeling (Metropolitan Council's Metro Model 3) is a tool that allows water supply planners to consider a range of potential future aquifer levels under a set of planned and alternative water demands and sources. Metro Model 3 is a planning tool, not a

regulatory tool, and it provides information to support regional planning and cooperation to ensure sustainability. Regional groundwater modeling, which simultaneously evaluates the combined impacts of all wells in the region, suggests that our current (2015) plans for water supply are likely to cause further declines in aquifer levels. Information and maps developed in conjunction with the Metro Model 3 model scenarios illustrating predicted aquifer declines under projected 2040 groundwater pumping conditions, which are expected to fall within a range 20% above or below the 2040 projection. Analysis and planning should be done to ensure that groundwater pumping does not exceed safe yield conditions, as defined in Minnesota Rules (part 6115.0630). These model results include some uncertainty. The regional groundwater flow model, along with water demand projections, provides useful information to consider as part of regional growth planning. It is the best tool available to illustrate "the big picture" pattern of aquifer decline that may occur if 2040 demand is supplied solely by currently (2015) planned sources. The MWMO will utilize the Met Council's model 3, as well as the Master Water Supply Plan to continue to inform decisions on projects that could impact groundwater within the MWMO.

Groundwater flow within the MWMO is locally toward lakes, springs, and wetlands and regionally toward the Mississippi River. Unconsolidated sediments in the MWMO can be generalized as a two-tiered system. The top tier is the unsaturated zone, sometimes referred to as the vadose zone. This zone is not continuously inundated with water. The vadose zone may become saturated after large precipitation or melting events, however the water within the zone either infiltrates to lower aquifers, moves laterally down gradient, is evaporated into the atmosphere, or is used through transpiration by plants.

The lower tier, which is fully saturated with water, is known as the saturated zone. The top of the saturated zone is the water table. Elevation of the water table fluctuates through time due to changes in climatic conditions and groundwater withdrawal. Understanding regions where the vadose zone is seasonally greater than five feet deep aids in identifying regions where infiltration is a viable stormwater management practice.

Bedrock aquifers underlying unconsolidated deposits in the MWMO are typically used as groundwater sources. These deeper units typically offer better protection from contaminates and typically offer better water yield. The Saint Peter aquifer is the first bedrock aquifer that is sometimes used in the MWMO. It is confined in some areas by the Platteville-Glenwood Formations and unconfined in areas where these confining layers have eroded away. Flow in this unit is toward the Mississippi River. This aquifer does not provide for a significant source of water in the MWMO. It is used locally for domestic supply and other low-capacity uses.

The Prairie du Chien-Jordan aquifer system, or a combination of aquifers including the Prairie du Chien-Jordan, provides for most of the groundwater uses in the MWMO. This aquifer is somewhat confined on the top by the shaley base of the Saint Peter Sandstone and on the bottom by the Saint Lawrence confining unit. This aquifer has a total thickness between 120 and 130 feet. Flow in this unit is toward the Mississippi River. The Prairie du Chien-Jordan aquifer has been subject to large withdraws by industrial, municipal, and commercial uses which have lowered the water level by almost 50 feet since the initial use of the aquifer in the 1880s.

Groundwater Sensitivity and Protection

Groundwater analysis is important for both the quality and quantity of municipally utilized water. Groundwater uses throughout the MWMO make it necessary to monitor this resource for quality and quantity.

Figure 51 shows the sensitivity of the shallow groundwater aquifers to pollution. The groundwater's susceptibility was determined by a methodology developed by the Minnesota Geological Survey. The ratings are based on the ability of the geological material to absorb contaminants, attenuate contaminants, change the contaminant to a benign substance, and the rate at which the aquifer transmits contaminated water.

Both Ramsey and Hennepin Counties have published draft county groundwater protection plans. The 2009 Draft *Ramsey County Groundwater Plan* presents a comprehensive overview of the surficial and geologic features, and it provides the county's assessment of the groundwater resources. This plan uses maps and tables to show locations of contaminated sites, wellhead protection areas, and sensitive geologic areas. Similarly, the *Draft Hennepin County Groundwater Plan* contains information on geologic features, areas of special groundwater protection needs, and strategies to protect groundwater resources that can be implemented by local government units. Anoka County has prepared a groundwater protection assessment.

Source Water Assessment and Wellhead Protection

The Source Water Assessment Program administered by the Minnesota Department of Health develops source water assessments for all public water supplies within the state. A source water assessment provides basic information regarding a public water supply, including the water supply's susceptibility to contamination, and is a requirement of the 1986 amendments to the federal Safe Drinking Water Act. A source water assessment area is typically mapped to show the land area over which wellhead protection measures should be taken to protect the water supply from contamination. There are currently no mapped source water assessment areas within the MWMO (**Figure 52**).

Some public water suppliers are required to develop a detailed wellhead protection plan; others are required to implement wellhead protection measures within a specific area surrounding their well(s). There are currently four delineated wellhead protection areas that overlap the political jurisdiction of the MWMO. These mapped areas are regions where the Cities of Fridley, New Brighton, Richfield and Saint Anthony Village's Well Head Protection Areas overlap the MWMO political jurisdiction.

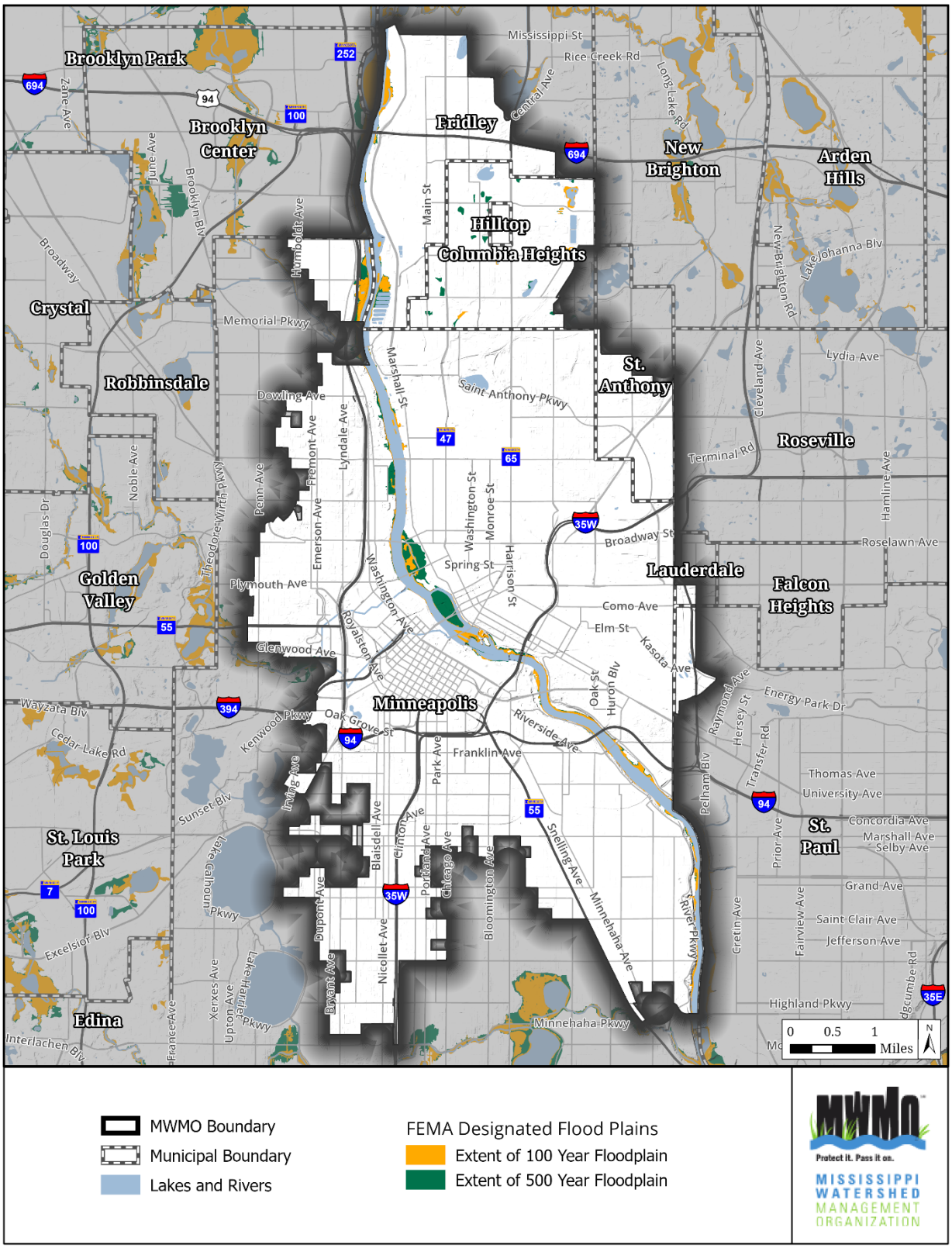


Figure 50: FEMA Designated Flood Plains in the MWMO

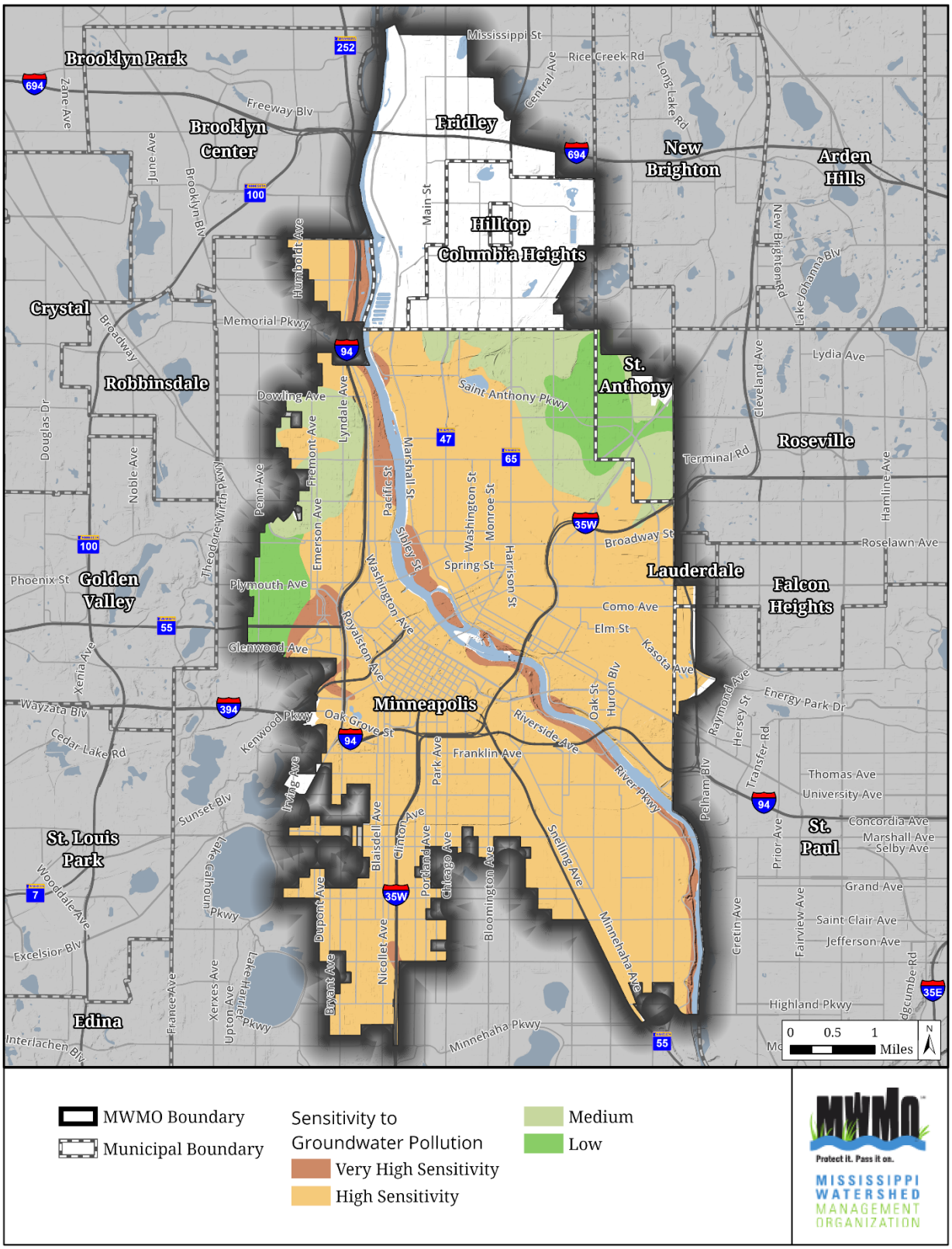


Figure 51: Groundwater Sensitivity of the MWMO

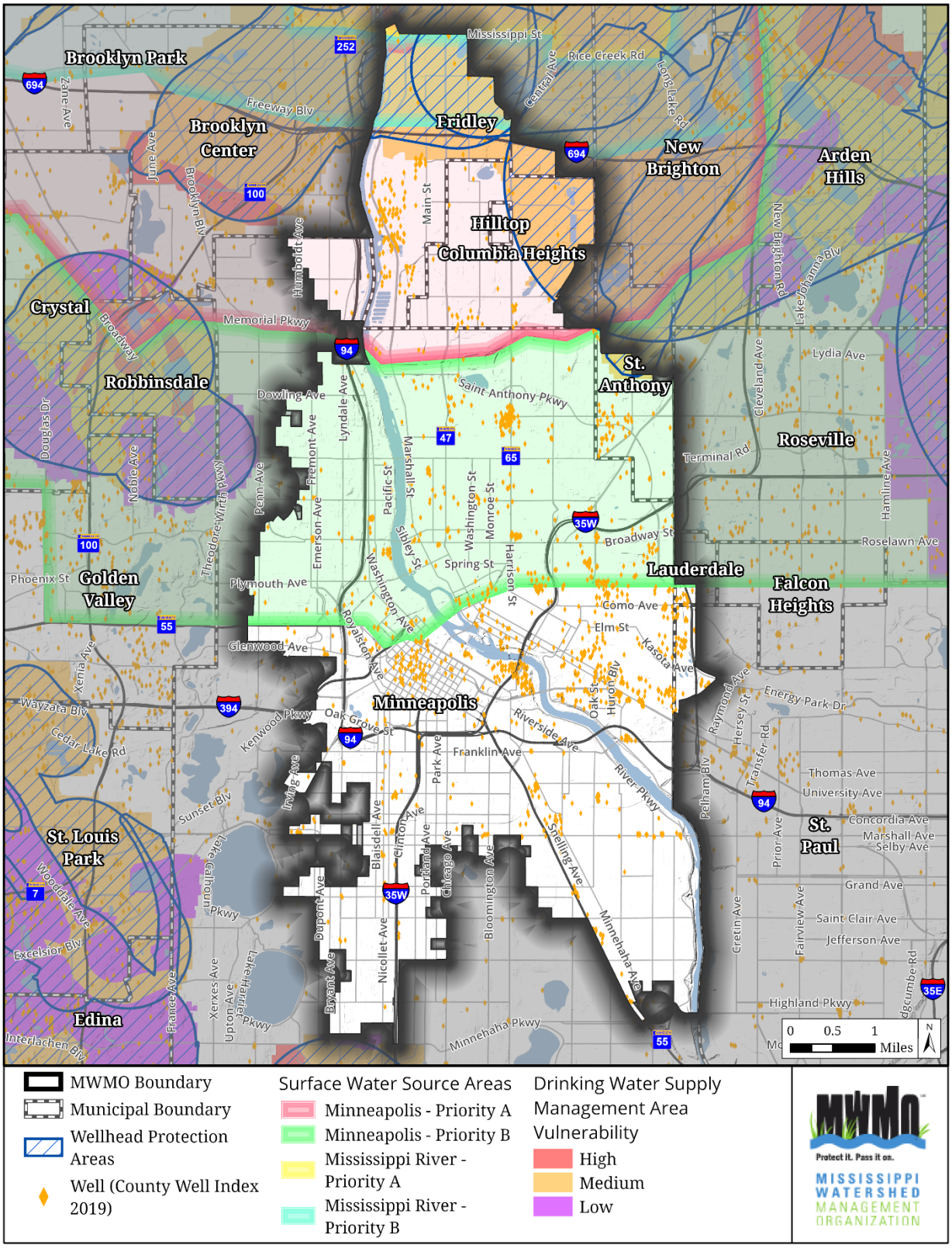


Figure 52: Groundwater Management Areas of the MWMO

4.5.8 Monitoring

One of the most important functions at the MWMO is to monitor and track changes in the water quality of the Mississippi River and in the local stormwater drainage systems. MWMO monitoring staff conduct regular, year-round sampling of both river water itself as well as the stormsewers that discharge into the river. The data collected provide a scientific basis for identifying and tracking water quality issues over time. This information is used to help guide public policies and projects designed to control pollution and improve water quality. These data are also important for hydrologic and water quality modeling in order to improve the accuracy and ultimate value of the model.

The MWMO's Monitoring Program currently includes seven sites along its portion of the Mississippi River, seven stormwater outfall sites as they discharge to the Mississippi River, one jurisdictional boundary site between Saint Anthony Village and Minneapolis, six stormwater best management practices, and the three Kasota Ponds (including Mallard Marsh). See **Figure 53** for monitoring locations.

Precipitation is recorded at two outfall sites, at the jurisdictional boundary site between Saint Anthony Village and Minneapolis, at the MWMO headquarters, and at three other locations in Northeast Minneapolis, Saint Anthony Village, and Columbia Heights. At the Mississippi River and stormwater monitoring sites, water quality data includes *E. coli*, dissolved oxygen, pH, transparency, salinity, and specific conductivity, nutrients, sediment, inorganics, organics, and metals. Continuous flow data are collected at all the stormwater monitoring sites and water flow, temperature, and conductivity are measured at four of the stormwater outfalls. Water elevation is measured at seven locations along the Mississippi River. In 2019, the MWMO published a summary report of ten years of data collected at the Kasota Ponds. Site descriptions and monitoring results can be found in Annual Monitoring Reports at https://www.mwmo.org/monitoring-and-reports/water-quality-monitoring/.

Future monitoring will expand to additional MWMO wetlands and waterbodies, jurisdictional boundaries, best management practices, and representative outfalls of each subwatershed. New Hydrology and Hydraulic models being completed will identify the subwatershed and jurisdictional boundary framework which will be used for locating future monitoring activities.

4.5.9 Discussion of Challenges, Gaps, and Next Steps

To date the MWMO has reviewed all monitoring activities occurring in the watershed and is identifying efficient ways to address gaps in monitoring, while avoiding duplication of any existing monitoring efforts. Specific partnerships and coordinated efforts include working with MPCA on Total Maximum Daily Load studies, member cities on interjurisdictional flows, and the City of Minneapolis on system-wide illicit discharge detection. The MWMO plan to continue to develop local, regional, and international partnerships that coordinate and unify multi-organization monitoring goals.

The MWMO conducted a function and value assessment of wetlands. The MWMO recognizes that member communities may place differing value and priorities on each wetland function depending on their own policies, values, and goals. As such, this assessment will be followed up with a cooperative effort among its members to classify allowable uses for each wetland identified and draft a model buffer zone ordinance.

In the future MWMO capital projects and programmatic efforts are considering subwatershed management units identified in **Figure 47** as one possible scale for managing for flooding, water quality, and habitat. To better inform member organizations' capital projects and programmatic activities the MWMO plans to leverage monitoring data and subwatershed models that can prioritize water resource project areas and contamination hot spots in the watershed.

The MWMO plans to expand its monitoring efforts to characterize loading within each subwatershed identified in **Figure 47** and to gather information on interjurisdictional flows.

MWMO needs to understand pollutant mixing on two levels for the Mississippi River. First, to adequately address public health issues around Total Maximum Daily Loads for bacteria (*E. coli*), a big river sampling methodology that accurately measures existing pollutant loads in the river needs to be developed. The MWMO has collected data from the Mississippi River to determine pollutant mixing in the river and has developed monitoring protocols using this information. However, the extent of pollutant mixing from outfalls is still unknown. The MWMO will conduct additional studies of pollutant mixing from stormwater outfalls to better understand the overall pollutant mixing of the river. The MWMO plans to seek out broader regional partnerships or funding to accomplish both of these studies. These studies exemplify the type of assessments the MWMO will need to complete to more accurately monitor and evaluate the impact specific programmatic efforts and capital improvements are having on the Mississippi River.

From its start in 2004, the MWMO's monitoring program has focused on gathering reliable flow-weighted data that can be used for long-term loading and trend analysis. Difficult site conditions and limited staffing resources have limited the growth of the program and the amount of consistent reliable data gathered. Currently, data collected is reported in the MWMO's Annual Monitoring Reports and loading analysis is underway.

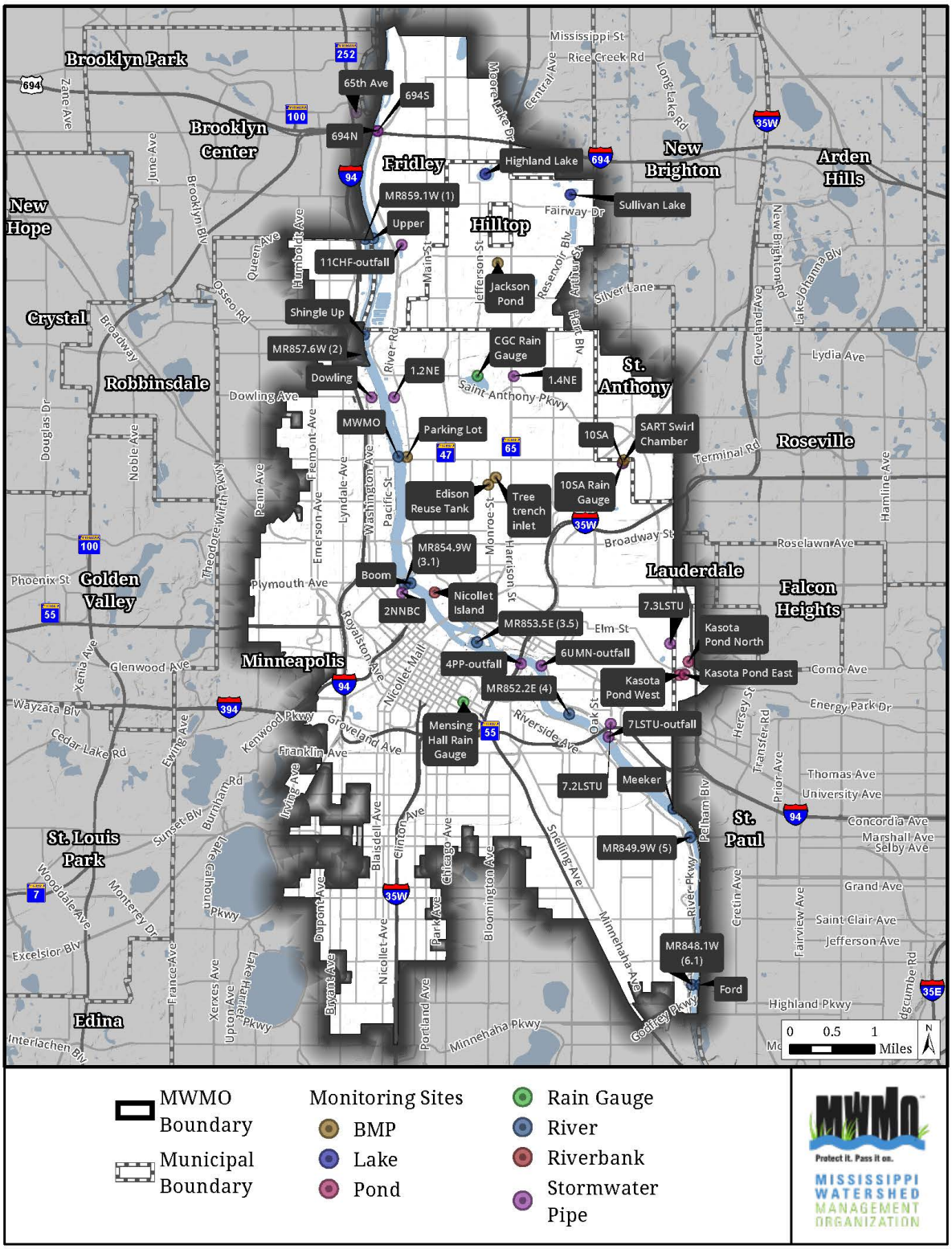


Figure 53: Monitoring Locations of the MWMO

5.0 Watershed Issues, Goals, and Strategies

This section starts with a discussion of key partnerships the MWMO will seek out to collaborate on implementation, avoid duplication, and build off what partners are doing to leverage funding and other organizational resources (**Table 24**). It then expounds upon ten Focus Areas that are the underpinnings of MWMO's goals and strategies and were derived from public input on the plan. **Section 5** is a pivotal point in the plan, informing and establishing much of the content found in **Section 6**. This includes MWMO's financials, programmatic activities, MWMO's Capital Improvement Schedule (**Table 26**), and The MWMO's Ten-Year Implementation Schedule (**Table 27**), which aligns MWMO's key strategies with lead staff work areas and ranks the strategies as a low, medium, or high priority over the next ten years.

The MWMO will seek out partners and leverage funding whenever possible to carry out the focus areas, goals, and strategies presented in MWMO's Ten-Year Implementation Schedule. Strategies in **Table 27** (the MWMO's Ten-year Implementation Schedule) were derived from MWMO staff, the public, government agencies, non-governmental organizations, and MWMO municipal partners via public meetings, and surveys (see Appendix H for details).

Partners may be member organizations, government agencies, organizations such as nonprofits, private developers and businesses, as well as residents and other stakeholders. **Table 24** outlines key partnership opportunities the MWMO has with organizations who conduct work in support of water resource issues.

Assembling diverse and collaborative partnerships are central to the MWMO's ability to carry out our work to protect and improve water quality, habitat and natural resources without causing unintended externalities. As such, our initiatives and projects are becoming more systems based in an attempt to see how the interconnectedness of the work we do environmentally affects other systems (e.g. energy, food, transportation, solid waste, cultural, social, and economic). Doing this well means working with partners outside traditional means to arrive at outcomes that benefit all.

On an annual basis the MWMO will invite partners on this list to meet and review our current capital improvement schedule, allowing them the opportunity to partner with us on existing projects or suggest new projects.

Table 24: Potential Water Resource Project Partners

Source	Agency/ Organization	Mission/Activities
Federal	Environmental Protection Agency	Implement Clean Water Act by requiring states to monitor waters, conduct TMDL studies, and regulate certain activities affecting wetlands, lakes, and rivers. Provides research assistance to state and federal agencies and requires state programs to meet or exceed federal standards. Provides water quality improvement project funding (319 Program).

Source	Agency/ Organization	Mission/Activities
Federal	Natural Resources Conservation Service	Delivers soil and water conservation programs on agricultural lands. Provides financial assistance for many conservation activities and conservation technical assistance to land-users, communities, and units of state and local government. Oversees the Resource Conservation and Development Program.
	United States Army Corps of Engineers	Oversees Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. Oversees dredging, filling, and dam maintenance activities in waters of the United States.
	United States Geological Survey	Provides water information that benefits citizens, including publications, data, maps, and applications software. Oversees and conducts research and data acquisition on ground and surface water resources.
	National Park Service	Oversees the Mississippi National River and Recreation Area.
State	Minnesota Pollution Control Agency	Protects, improves, and conserves water quality. Oversees wastewater and stormwater permitting, septic systems, impaired waters (Total Maximum Daily Load) projects, surface water monitoring, groundwater monitoring, and the state administration of the Clean Water Act mandates and state and federal water funds.
	Minnesota Department of Natural Resources	Manages the conservation and use of natural resources. Oversees public waters permits, invasive species, groundwater monitoring, water resource mapping, water appropriations, dam safety, flood damage, lake and stream hydrology, and shoreland management.
	Minnesota Department of Agriculture	Regulates fertilizers, pesticides, and soil and plant amendments, Minnesota Pesticide Control Act and Agriculture Best Management Practices Loan Program. Monitors waters for pesticides.
	Minnesota Department of Health	Prevents environmentally induced disease. Oversees the Safe Water Drinking Act, health-based standards setting and groundwater well sealing.
	Environmental Quality Board	Coordinates state water management activities and the development of broad water policy recommendations. Oversees environmental review process, conducts period water quality and quantity trends assessments and reports, coordinates overall state water policy.
	Board of Water and Soil Resources	Improves and protects Minnesota's water and soil resources. Works in partnership with local organizations on private lands. Oversees the Wetland Conservation Act. Provides watershed district and watershed management organization oversight, local water planning, erosion control and water quality cost

Source	Agency/ Organization	Mission/Activities
		share. Administers conservation easements. Evaluates outcomes and performance of local water management.
	Minnesota Geological Survey	Conducts mapping, research, and education on wells, hydrologic properties, and groundwater monitoring. Maintains statewide database on well records. Collects geophysical logs, maps ground water, identifies recharge areas, recharge rates, and sustainable yields.
Regional	Metropolitan Council	Monitors metro area lakes and rivers, provides funding to local park services and runs a Citizens Assisted Monitoring Program. In cooperation with local communities, oversees a comprehensive regional planning framework focusing on wastewater, transportation, and park systems that guides the efficient growth of the metropolitan area. The Council operates wastewater and transit services and administers housing and other grant programs.
	Counties: Hennepin, Anoka and Ramsey	General-purpose unit of government approach to water. Has a major funding role with Soil and Water Conservation Districts. Administers shoreland and land use regulations that guide property development. Manages the local water plan by identifying problems and providing for development. Regulates wetlands, manages large tracts of public lands.
Local	Park and Recreation Organizations	They govern, maintain, and develop the park systems in the watershed. Preserving, protecting, maintaining, improving, and enhancing natural resources, parkland, and recreational opportunities. They provide places and recreational opportunities for all people to gather, celebrate, contemplate, and engage in activities that promote health, well-being, community, and the environment.
	Soil and Water Conservation Districts	Political subdivisions governed by a board of elected supervisors. Work cooperatively with the public, nonprofit organizations, and governmental entities in protecting water and land resources through the use of conservation practices. Provide local leadership for the prudent use and conservation of water, soil, and associated resources.
	Watershed Management Organizations	Prepare and implement comprehensive surface water management plans and work cooperatively with each other, the state, counties, cities, and soil and water conservation districts to achieve water quality, water quantity, and natural resource preservation and improvement.
	Watershed Districts	Local government units that work to solve and prevent water-related problems. The boundaries generally follow those of watersheds and cross multiple jurisdictions. Watershed Districts

Source	Agency/ Organization	Mission/Activities
		have broad authorities including adopting rules, hiring staff and contracting with consultants, levying taxes, accepting grant funds, acquiring property and drainage systems and entering upon lands. In addition, Watershed Districts can act in coordination with each other, the state, counties, cities, and soil and water conservation districts to achieve goals.
Local	Cities: Minneapolis, Saint Paul, Fridley Columbia Heights, Hilltop, Lauderdale, and Saint Anthony Village	Water suppliers that utilize Mississippi River as at least a partial water source; owners of storm sewer systems; plan, direct, coordinate, and evaluate all planning and zoning activities. Holders of National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System permits and usually the primary implementers of Total Maximum Daily Load wasteload allocation strategies.
	Public and Private Organizations	University of Minnesota, other universities national and international, colleges, non- governmental organizations, private sector partners, organizations improving the Mississippi River upstream and downstream, individual neighborhoods working to improve their communities and to protect and improve the natural, human and cultural resources of the area.

Public Input and Focus Areas

In 2010, the MWMO tested several approaches for gathering public input on the Plan. In the end, a survey sent out to residents had the greatest impact, producing 80 – 90% of the public comments received. As such, in 2019 the MWMO decided to utilize a survey tool to gather public input on the Plan. The MWMO was able to gather over 430 survey responses from the public (Appendix G). These responses and past public input were used to develop ten focus areas that are the underpinnings of MWMO's goals and strategies.

Based on the public comments received between 2019 and 2021, the existing focus statements remain relevant, with the caveat that rather than try to narrow the more comprehensive issues of equity and climate change into a single focus area, the MWMO sees these issues permeating throughout all aspects of our organization and the work we do. As such, these topics are addressed under many of the focus areas' challenges section.

The mix of sources and manner in which the input was gathered does not lead to a prioritization of the focus areas in of themselves. Rather, it provides us insight into key issues and what citizens value in the watershed. The focus areas are outlined in further detail in **Section 6.2**, **Table 27**.

Ten watershed focus areas:

1. Water Quality (WQ)
2. Water Rate and Volume (WRV)
3. Monitoring and Data Assessment (MD)
4. Communication and Outreach (CO)
5. Ecosystem Health (EH)
6. Regulations and Enforcement (RE)
7. Urban Stormwater Management (USM)
8. Emergency Preparedness and Response (ER)
9. Emerging Issues (EI)
10. Financial Responsibilities and Strategies (FRS)

The focus statements, goals, and strategies found in MWMO's Ten-Year Implementation Schedule were developed specifically based on these ten focus areas. The MWMO will continue to develop its staff and expertise as necessary to implement activities resulting from the goals and strategies of each focus area described in this section.

5.1 Focus Area: Water Quality (WQ)

Purpose

Initiatives implemented within this focus area will protect, maintain, or improve the water quality of the Mississippi River and the other water resources within the MWMO.

Challenges

The densely urban and highly developed condition of the MWMO watershed poses a primary water quality challenge for the MWMO. The high impervious surface coverage and population density can limit opportunities for traditional water quality treatment projects, yet they also present opportunities for new and innovative approaches to water quality challenges.

The effects of climate change also pose a significant water quality challenge to the MWMO watershed. Many existing water quality improvement projects were not designed for the expected changes in surface and groundwater flows due to rainfall events of increasingly larger intensity,

leading to increased pollutant loading to the Mississippi River. The application of more green or natural infrastructure and the protection of natural areas may help limit the need for construction of larger and additional stormwater infrastructure to remove pollutants.

Being located downstream of a large urban watershed creates challenges related to riverbank erosion, which can be a substantial source of sediment and can be exasperated by more intense rainfall events due to climate change, as intense rain events on poorly vegetated landscapes can lead to significant topsoil loss. Efforts to prevent erosion along the riverbank can therefore be highly effective in protecting the water quality of the Mississippi River.

One other challenge the MWMO faces in implementing water quality improvements is the regional nature of the water quality issues facing the Mississippi River, the major water resource within the MWMO. The water quality of the Mississippi River is affected by actions far upstream of the boundaries of the MWMO, making coordination with upstream groups necessary to improve the water quality of the river.

While contaminated stormwater poses risks for everyone, some communities are at greater risk because of historic urban development decisions affecting residents of low-income and BIPOC communities. The result is that these neighborhoods are often paved-over and lacking in green spaces that could absorb stormwater and filter contaminated urban runoff. The stormwater runoff in these communities are also often exposed to dangerous levels of toxins associated with high concentration of polluting businesses, industries, and transportation corridors such as highways, freeways, and rail lines.

Target Audiences

The primary target audiences for water quality implementation initiatives are entities holding land rights, land use controls, and regulatory controls for water resources within the MWMO and their associated headwaters, as well as those partaking in any use of the land and resources within the watershed.

Indicators and Measures of Performance

Performance will be measured by using the long-term water quality trend in pollutant loading to continue toward attainment of the required pollutant reductions, the waterbody standard, and notable improvements in the aquatic ecosystem. An evaluation of the trend in water quality parameters at points of discharge into the Mississippi River will be conducted every 5 years at a minimum. For all other waterbodies, resource specific evaluations will be conducted.

5.2 Focus Area: Water Rate and Volume (WRV)

Purpose

Implementation of Water Rate and Volume initiatives will provide protection from the impacts of high stormwater runoff volumes, limit the frequency at which flood damage occurs, and help

reduce the severity and frequency of drought-like conditions. The MWMO utilizes practices such as green infrastructure, stormwater infiltration, and water harvesting for irrigation. These types of techniques collect stormwater runoff where it falls, and then infiltrates it or reuses it, thereby tempering the effects of drought-like conditions.

Challenges

The MWMO's main challenge when addressing stormwater runoff volumes, flooding, and drought concerns is how to integrate structural solutions within the watershed to protect both local and downstream communities. The impacts of climate change, such as more frequent and heavier rainfall events, will require new and innovative design approaches for stormwater infrastructure, particularly in low lying areas of the watershed. Many stormwater conveyance systems are undersized, as they were designed based on outdated precipitation records. Flooding is an increasing challenge in many neighborhoods within the MWMO watershed, threatening damage to buildings and public health. However, flooding poses a particular safety risk for many marginalized and socioeconomically disadvantaged communities, as the cost of clean-up and repairs may be exceptionally high as compared to income levels and can also cause profound disruptions to already struggling families. Chronic flooding issues can also lead to high maintenance costs, mold, and waterborne diseases that tend to disproportionately affect renters and low income homeowners.

Target Audiences

The primary target audience for Water Rate and Volume implementation initiatives are the member organizations that can implement land use controls and standards and partner on capital improvement projects in order to limit stormwater runoff volumes and reduce the occurrence of flooding and drought-related damages.

Indicators and Measures of Performance

Performance will be measured by monitoring the change in the rate of stormwater discharging into the Mississippi River and reduction in the number and extent of damages to habitat, communities, and infrastructure resulting from flooding or drought.

5.3 Focus Area: Monitoring and Data Assessment (MD)

Purpose

Implementation of Monitoring and Data Assessment initiatives continue to assemble the best scientific data to inform water resource decision making and to identify successful implementation of stormwater management practices based on water quality and quantity trends.

Challenges

Challenges include identifying monitoring methodologies and locations appropriate for the varying hydraulic and hydrologic conditions and pollutant mixing occurring within the MWMO's reach of the Mississippi River. Damaging conditions resulting from the hydraulics and size of the urban stormwater pipeshed, animals, as well as vandalism can limit available monitoring station locations and corrupt data collected. The bluff landscape along the Mississippi River also limits access to stormwater pipes, some of which are located greater than fifty feet below the land surface. Tailwater conditions during intermittent high river levels at some outfalls have also been a challenge.

Target Audiences

The target audiences for Monitoring and Data Assessment implementation initiatives are MWMO's member communities as well as local and statewide entities already conducting monitoring initiatives. The data are publicly available to all parties through the Minnesota Pollution Control Agency's "EQuIS" database.

Indicators and Measures of Performance

The measure of performance is an increasing length of accurate and usable data records. Ultimately, having sufficient data to guide water resource management indicates success. The MWMO will also consider how to make collection and use of the data more accessible. Monitoring helps inform projects both on the front-end, by understanding and assessing site conditions, as well as on the back-end (post-construction) to determine if projects are functioning as intended and addressing problems such as flooding and water quality issues. Monitoring results can inform future project design and implementation. Development of new monitoring methods or approaches can also help inform how to more efficiently collect data and cut costs so communities, neighborhood groups, and others can utilize the data.

5.4 Focus Area: Communications and Outreach (CO)

Purpose

To develop an engaged, empowered, and informed public by providing information, opportunities for engagement, training and financial support to promote connection with and responsible stewardship of water and natural resources in the watershed.

Challenges

Providing informative, inclusive, and engaging communications and outreach products and activities can be a challenge in our culturally, racially and economically diverse watershed. Finding ways to connect with and build relationships with different communities is key to finding common ground and shared values around water and environmental protection.

Target Audiences

Target audiences for communication and outreach initiatives are the policy and decision makers, residents, workers, and visitors. This includes such segments of the population as homeowners, residents, professionals, elected officials, public agency staff, large property owners, partners, youth, and educators.

Indicators and Measures of Performance

Performance indicators for outreach activities are measured by participation and engagement in various outreach activities across the MWMO as well as the degree to which different communities (culturally, racially, geographically, etc.) are represented in these activities. Additionally, the data collected from surveys, awards, grant applications and additional community interactions help staff monitor the knowledge, participation, and engagement level of target audiences in the watershed. Key performance indicators and insights gained on communication activities may come from data analytics on website traffic, social media engagement, email newsletter performance and similar online measures.

5.5. Focus Area: Ecosystem Health (EH)

Purpose

A healthy, balanced and functioning ecological system is essential to protecting water quality and quantity in the watershed and significant effort must be put into restoring, establishing, and protecting ecosystem health.

Challenges

Not only do the ecosystems existing within the MWMO watershed need to function in a highly urban setting, but increasing challenges are expected as ecosystems need to adapt to impacts of climate change. Native plants may be increasingly stressed by pests, diseases, and non-native, invasive plants, which may expand their range and have a competitive edge as winters become warmer. Existing habitat in the watershed is highly fragmented with low species diversity, making recovery more difficult. Bloom times of native plants may also shift, leading to less food availability for bats, birds, insects, and other pollinators.

Changing hydrologic conditions such as increased flooding and erosion also pose challenges to the design of habitat restoration projects to ensure their long-term function. Healthy ecosystems are critical for our heritage and culture; equity and inclusiveness in planning and implementation of projects will be key to ensuring more connected and healthier conditions for all community members.

Target Audiences

The target audiences for Ecosystem Health initiatives are citizens, community members, and landowners who can help protect and restore ecosystem health. This includes member

organizations and public land-use authorities who have jurisdiction over public lands, as well as permitting entities, private developers, and landowners who make landform and landscaping decisions.

Indicators and Measures of Performance

Urban ecology requires an understanding of the relationship between social and ecological systems. Habitat patches and corridors that connect and maintain healthy ecosystems provide essential mental, physical, and social health benefits. Increased ecosystem connectivity and an increase in key social and environmental health parameters (e.g. reduced heat stroke, lower crime rates, improved mental health, vegetation and wildlife), will indicate successful implementation.

5.6 Focus Area: Regulations and Enforcement (RE)

Purpose

Implementation of Regulations and Enforcement initiatives will promote consistency across jurisdictions in the standards, compliance and enforcement of regulations for the protection and improvement of water and natural resources.

Challenges

MWMO is predominantly a non-regulatory jurisdiction. MWMO will need to work with member organizations to be sure they have the necessary resources and controls to implement and enforce the MWMO's Standards. A variety of site conditions such as poorly drained or contaminated soils could limit the stormwater management practices available to contractors, increasing the cost of meeting the standards.

When developing plans for equity and climate change, the MWMO will evaluate if our standards could serve as a vehicle to restoring equity in communities, increase the watershed's resilience to climate change, or establish a basis for equitable community engagement.

Target Audiences

The target audience for Regulations and Enforcement initiatives include member organizations and local units of government who regulate water resources and stormwater management. Stakeholders and workgroups within the MWMO who can effectively evaluate water resources standards, rules, and regulations and associated enforcement activity are also targeted.

Indicators and Measures of Performance

One measure of performance is an increase in the consistency across jurisdictions in the application of standards and compliance and enforcement of regulations. A long-term reduction in pollutant loads entering and exiting MWMO waterbodies is another measure of performance.

5.7 Focus Area: Urban Stormwater Management (USM)

Purpose

Implementation of Urban Stormwater Management initiatives will promote unique and effective stormwater solutions to address the highly-developed urban condition of the watershed.

Challenges

The urban and highly-developed nature of the watershed demands innovation in stormwater management. The MWMO works to implement and encourage regulators to allow for innovative urban stormwater management practices, retrofit solutions to existing infrastructure, and deal with contaminated or compacted soils from historic land uses. The extent of impervious surfaces and the high population density within the watershed are simultaneously a barrier to innovation and an opportunity for gaining support and recognition for highly visible projects. Protecting communities from flooding and contaminated water, particularly in areas that have experienced a lack of investment, may include implementation of solutions such as green stormwater infrastructure and restoration of natural areas. Using data on water, health, and equity issues will be key to the future of urban stormwater management within the MWMO.

Target Audiences

The target audiences for Urban Stormwater Management initiatives are the member organizations who can modify existing land use regulations and building codes to allow for new stormwater management, and stakeholders and other entities that are willing to collaborate on the design and implementation of unique stormwater management solutions.

Indicators and Measures of Performance

Performance will be measured by the degree each project funded by the MWMO advances beyond the equivalent conventional design, policy, funding, and benefit to the public.

5.8 Focus Area: Emergency Preparedness and Response (ER)

Purpose

Implementation of Emergency Preparedness and Response initiatives will prepare the MWMO and member organizations to protect water and natural resources in the event of an emergency that threatens the health and function of these resources and assist them in alleviating damages to resources from emergencies.

Challenges

The MWMO's challenge in being prepared for emergencies is the inherent unpredictability of the type and timing of emergencies. There may also be challenges among the public and existing emergency response agencies given that these emergency preparedness and response initiatives represent a change from the historical role the MWMO has played in this arena. Examples may include emergency response to flooding and other increasing climate-related disasters.

Target Audiences

Target audiences for Emergency Preparedness and Response initiatives include MWMO staff and member organizations who can implement emergency response activities, as well as emergency response officials from local, state, and federal agencies who can effectively protect water and natural resources.

Indicators and Measures of Performance

The measure of performance is the demonstrated preparedness and response to future emergencies that threaten water and natural resources in the watershed.

5.9 Focus Area: Emerging Issues (EI)

Purpose

Implementation of Emerging Issues initiatives will develop awareness of new issues and address the related changing conditions, in order to protect water and natural resources.

Challenges

The MWMO's main challenge is the inherent newness of emerging issues. This compounds the difficulty of anticipating and identifying potential impacts to water and natural resources, and possible solutions to these impacts.

A history of systemic racism coupled with continued present-day land use patterns; infrastructure, operations, and maintenance patterns; have brought to the forefront unresolved social, economic, and environmental issues of climate change. These climate change impacts are generating greater inequity within communities of black, indigenous, and people of color.

MWMO staff need to continue to build public and private partnerships with neighborhoods, governmental and private sector partners to engage early on in planning for new redevelopment activities that bolster the watershed's resilience to climate change; regain social and environmental equity neighborhoods have lost; and reduce long term infrastructure debt.

Private site by site redevelopment and the separation of public and private infrastructure systems to support it has unwittingly contributed to today's issues of climate change, inequity, and infrastructure debt. The MWMO needs to continue to work with its member cities on new district, regional, and restorative infrastructure patterns that help resolve these issues. Staff need to

continue to help partners promote and implement systems based designs that utilize stormwater to re-establish connected habitat corridors that has multiple benefits including: reduced crime rates, improved physical and mental health, cooling of the urban heat island, improved work place productivity, increased access to healthy food sources, improved social cohesion and community resilience; absorption of carbon emissions and other air pollutants; regained environmental and economic equity for neighborhoods; more extensive public spaces, lower public infrastructure debt, and lower long-term maintenance costs.

Target Audiences

The primary target audience for emerging issues implementation initiatives is MWMO staff and stakeholders with input on key emerging issues.

Indicators and Measures of Performance

The performance measure is the retrospective evaluation of how emerging issues were handled, the ability to build awareness and build partnerships and projects that implement corrective actions, the identification of secondary effects avoided, and the perceived preparedness for future changes in conditions.

5.10 Focus Area: Financial Responsibilities and Strategies (FRS)

Purpose

The purpose of MWMO financial strategy is to effectively, efficiently, and transparently fund implementation, operation and management of MWMO projects and program initiatives to achieve the protection and improvement of the natural and water resources in the watershed. The MWMO will make every effort to utilize and leverage of grants and partner funds whenever possible. MWMO will actively maintain a financial plan.

Challenges

In the past the MWMO had a relatively scant amount of water and natural resource information on which to base its programmatic expenditures. As such, it has taken the initiative to identify gaps in this information and fund watershed assessments to further develop this base of knowledge. New knowledge about the watershed's resources may shift the focus of the MWMO's funding toward projects and activities and less on assessments and studies. Thus, one of the challenges for the MWMO is maintaining enough flexibility in funding its projects and activities to keep up with current science and information available on the watershed.

Target Audiences

The primary target audiences for financial responsibilities and strategies implementation initiatives are the MWMO itself, potential project partners who can provide in-kind or cash

contributions, and the public and member organizations who are interested in the funding process and approval of expenditures.

Indicators and Measures of Performance

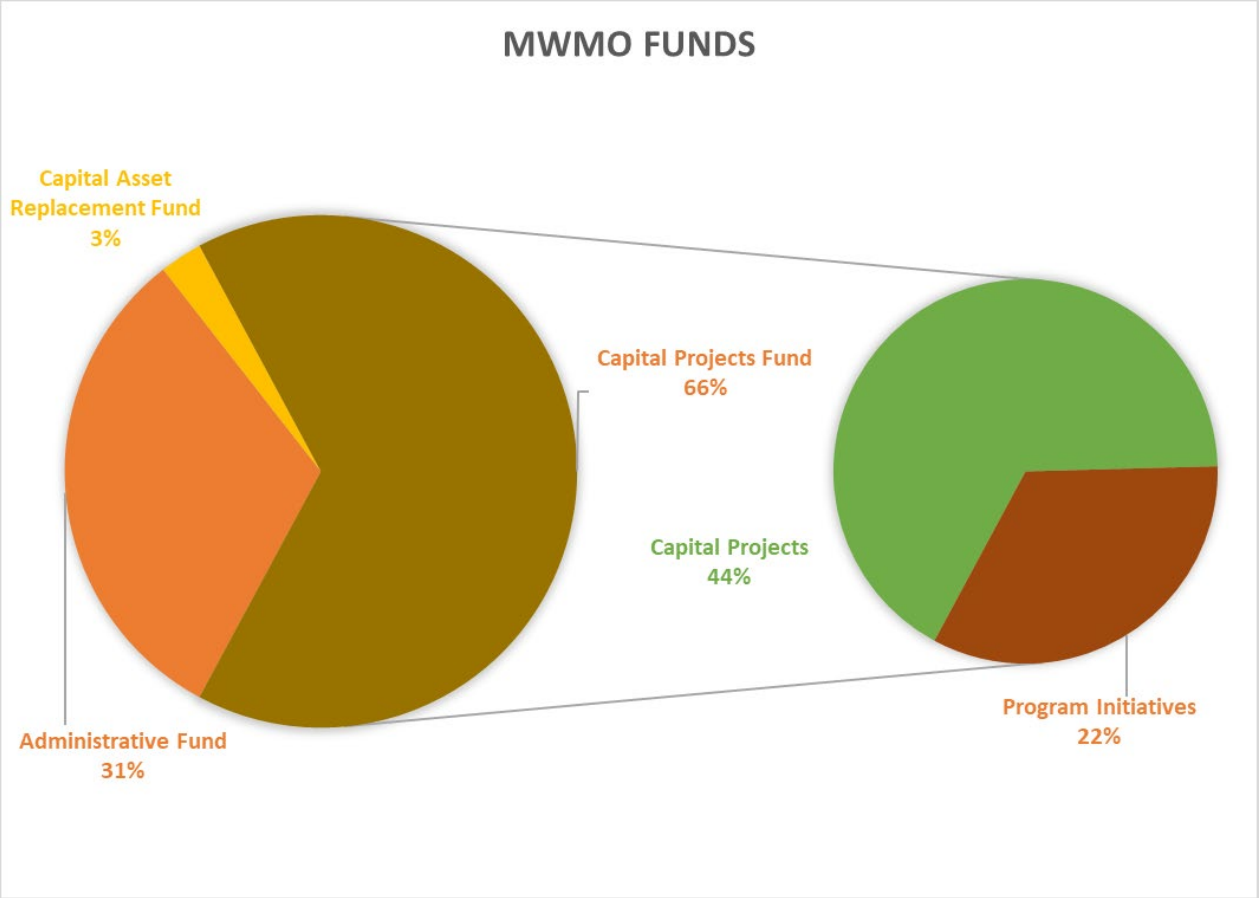
The performance measures will be the amount of leveraged funds, the extent of public benefits created by use of funds, and the number of successful activities and projects that are funded.

6.0 MWMO Financials

The MWMO is a Joint Powers Watershed Management Organization (WMO). The MWMO is listed in MS 275.066 as a Special Taxing District. The MWMO raises funds by a property tax levy to complete water management under section 103B.211 and 103B.241. This annual levy is the primary source of revenue for the MWMO.

The MWMO operates three funds to complete its work, one for all capital projects and program initiatives, one for all administrative expenses, and one for capital replacement created in 2019 for operations and maintenance activities. The average annual levy for the five-year period between 2016 and 2020 was $5.70 million. **Figure 54** represents the average percentages allocated to the three funds from 2016 through 2020. **Table 25** lists the anticipated budget for each program area from 2021 to 2031 based on administrative expenses increasing at an annual rate of 3% and capital projects and initiatives at 6%. Individual program areas are funded on an as needed basis. Thus, there are years where certain programs may receive no funding.

Over the next ten years the MWMO anticipates a slight shift of funding may occur between the various capital projects and programmatic initiatives and staffing/administrative needs of the organization; however, over the prior 20 years the MWMO has maintained 70% of its expenditures going to capital implementation or program initiatives and views this as a financial goal.



MWMO Fund	5-year Average Annual Amount	% of Average Annual Budget
Administrative Fund	$1,783,000.00	31.28 %
Capital Asset Replacement Fund	$152,000.00	2.67 %
Capital Projects and Program Fund	$3,710,000.00	65.09 %
Capital Projects	$2,475,000.00	43.42 %
Program Initiatives	$1,235,000.00	21.67 %

Approved Budgets 2016 through 2020	2016	2017	2018	2019	2020	Total 2016-2020	Average of Annual Budget	% of Total Budgeted Levy
Capital Projects	**$ 2,400,000**	**$ 2,400,000**	**$ 2,575,000**	**$ 2,500,000**	**$ 2,500,000**	**$ 12,375,000**	**$ 2,475,000**	**43.42%**
Initiatives	**$ 1,500,000**	**$ 1,425,000**	**$ 1,250,000**	**$ 1,000,000**	**$ 1,000,000**	**$ 6,175,000**	**$ 1,235,000**	**21.67%**
Communications & Outreach	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 1,250,000	$ 250,000	4.39%
Planning	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 150,000	$ 350,000	$ 70,000	1.23%
Monitoring	$ 150,000	$ 150,000	$ 200,000	$ 200,000	$ 150,000	$ 850,000	$ 170,000	2.98%

Watershed Assessments	$ 800,000	$ 775,000	$ 500,000	$ 250,000	$ 200,000	$ 2,525,000	$ 505,000	8.86%
Stewardship Grant Fund	$ 250,000	$ 200,000	$ 250,000	$ 250,000	$ 250,000	$ 1,200,000	$ 240,000	4.21%
Administration	**$ 1,645,000**	**$ 1,695,000**	**$ 1,795,000**	**$ 1,875,000**	**$ 1,905,000**	**$ 8,915,000**	**$ 1,783,000**	**31.28%**
Staff Salary & Benefits	$ 1,350,000	$ 1,400,000	$ 1,520,000	$ 1,600,000	$ 1,630,000	$ 7,500,000	$ 1,500,000	26.32%
Commissioner Expenses	$ -	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 20,000	$ 4,000	0.07%
Office Admin & Supplies	$ 110,000	$ 110,000	$ 110,000	$ 110,000	$ 70,000	$ 510,000	$ 102,000	1.79%
Legal, Eng., IT, HR, Auditor	$ 185,000	$ 180,000	$ 160,000	$ 160,000	$ 200,000	$ 885,000	$ 177,000	3.11%
Operating Reserve	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0.00%
Capital Asset Replacement Fund	**$ 100,000**	**$ 125,000**	**$25,000**	**$ 270,000**	**$ 240,000**	**$ 760,000**	**$ 152,000**	**2.67%**
Monitoring Equipment	$ 25,000			$ 15,000	$ 15,000	$ 30,000	$ 6,000	0.11%
Exhibits, Videos, Equip, Etc			$ 15,000	$ 25,000	$40,000	$ 8,000		0.14%
Building/Facility O&M	$ 25,000	$25,000	$25,000	$ 145,000	$ 100,000	$ 295,000	$ 59,000	1.04%
BMP O&M				$ 25,000	$ 25,000	$ 50,000	$ 10,000	0.18%
Office Equipment			$ 25,000	$ 25,000	$ 50,000	$ 10,000		0.18%
WS Models				$ 25,000	$ 25,000	$ 50,000	$ 10,000	0.18%
Fleet (vehicles, boats, etc.)				$ 5,000	$ 10,000	$ 15,000	$ 3,000	0.05%
Webpage				$ 15,000	$ 15,000	$ 30,000	$ 6,000	0.11%

Figure 54: Average Percentages allocated to MWMO Funds 2016 – 2020

Table 25: Budget Forecasts 2021-2031

	Average 2017-2021	2021 Budget	2022
Capital Projects	$4,475,000	$3,700,000	$3,922,000
Capital Implementation Program	$2,475,000	$2,700,000	$2,862,000
Capital Project Grants *	$1,000,000	$1,000,000	$1,000,000
Greening Grants *	$1,000,000	$1,000,000	$1,000,000
Land Acquisition *	$2,000,000	$2,000,000	$2,000,000
Initiatives	$1,235,000	$1,000,000	$1,060,000
Communications	$75,000	$75,000	$79,500
Outreach	$175,000	$175,000	$185,500
Planning	$70,000	$150,000	$79,500
Monitoring	$170,000	$150,000	$159,000
Watershed Assessments	$505,000	$200,000	$212,000
Stewardship Grant Fund *	$240,000	$250,000	$265,000
Capital Asset Replacement Fund **	$152,000	$200,000	$212,000
Building/Facility O&M	$10,000	$50,000	$53,000
BMP O&M	$10,000	$25,000	$26,500
Office Equipment	$59,000	$25,000	$26,500
Fleet (vehicles, boats, etc.)	$10,000	$10,000	$10,600
Outreach Communication (Exhibits, Videos, Etc.)	$10,000	$25,000	$26,500
Webpage	$10,000	$25,000	$26,500
Watershed Models (H & H , Wqlty, etc)	$5,000	$25,000	$26,500
Monitoring Equipment	$15,000	$15,000	$15,900
General/Administration	$1,825,000	$1,955,000	$2,013,650
Staff Salary & Benefits	$1,546,000	$1,700,000	$1,751,000
Commissioner Expenses	$5,000	$15,000	$15,450
Office Admin & Supplies	$100,000	$100,000	$103,000
Legal, Eng., IT, HR, Auditor	$174,000	$150,000	$154,500
Operating Reserve***	$800,000	$800,000	$824,000
Total	$7,687,000	$6,855,000	$7,207,650

*These are boards defined limits for the initiative or grant that we start with each year. We only levy to replace funds committed/allocated the prior year.
**The capital replacement fund will grow until we have about 15% for the total replacement need and then we'll only levy to replace funds committed/allocated the prior year.
***The operation reserve will be kept at 4-6 months of operating expenses or $ 800,000 to $ 1,200,000 and then we'll only levy to replace funds committed/allocated the prior year.

Table 25: Budget Forecasts 2021-2031 Continued**…**

	2023	2024	2025
Capital Projects	$4,157,320	$4,406,759	$4,671,165
Capital Implementation Program	$3,033,720	$3,215,743	$3,408,688
Capital Project Grants *	$1,000,000	$1,000,000	$1,000,000
Greening Grants *	$1,000,000	$1,000,000	$1,000,000
Land Acquisition *	$2,000,000	$2,000,000	$2,000,000
Initiatives	$1,123,600	$1,191,016	$1,262,477
Communications	$84,270	$89,326	$94,686
Outreach	$196,630	$208,428	$220,933
Planning	$84,270	$89,326	$94,686
Monitoring	$168,540	$178,652	$189,372
Watershed Assessments	$224,720	$238,203	$252,495
Stewardship Grant Fund *	$280,900	$297,754	$315,619
Capital Asset Replacement Fund **	$224,720	$238,203	$252,495
Building/Facility O&M	$56,180	$59,551	$63,124
BMP O&M	$28,090	$29,775	$31,562
Office Equipment	$28,090	$29,775	$31,562
Fleet (vehicles, boats, etc.)	$11,236	$11,910	$12,625
Outreach Communication (Exhibits, Video	$28,090	$29,775	$31,562
Webpage	$28,090	$29,775	$31,562
Watershed Models (H & H , Wqlty, etc)	$28,090	$29,775	$31,562
Monitoring Equipment	$16,854	$17,865	$18,937
General/Administration	$2,074,060	$2,136,281	$2,200,370
Staff Salary & Benefits	$1,803,530	$1,857,636	$1,913,365
Commissioner Expenses	$15,914	$16,391	$16,883
Office Admin & Supplies	$106,090	$109,273	$112,551
Legal, Eng., IT, HR, Auditor	$159,135	$163,909	$168,826
Operating Reserve***	$848,720	$874,182	$900,407
Total	$7,579,700	$7,972,260	$8,386,507

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Table 25: Budget Forecasts 2021-2031 Continued…

	2026	2027	2028
Capital Projects	$4,951,435	$5,248,521	$5,563,432
Capital Implementation Program	$3,613,209	$3,830,002	$4,059,802
Capital Project Grants *	$1,000,000	$1,000,000	$1,000,000
Greening Grants *	$1,000,000	$1,000,000	$1,000,000
Land Acquisition *	$2,000,000	$2,000,000	$2,000,000
Initiatives	$1,338,226	$1,418,519	$1,503,630
Communications	$100,367	$106,389	$112,772
Outreach	$234,189	$248,241	$263,135
Planning	$100,367	$106,389	$112,772
Monitoring	$200,734	$212,778	$225,545
Watershed Assessments	$267,645	$283,704	$300,726
Stewardship Grant Fund *	$334,556	$354,630	$375,908
Capital Asset Replacement Fund **	$267,645	$283,704	$300,726
Building/Facility O&M	$66,911	$70,926	$75,182
BMP O&M	$33,456	$35,463	$37,591
Office Equipment	$33,456	$35,463	$37,591
Fleet (vehicles, boats, etc.)	$13,382	$14,185	$15,036
Outreach Communication (Exhibits, Videos, Etc.)	$33,456	$35,463	$37,591
Webpage	$33,456	$35,463	$37,591
Watershed Models (H & H , Wqlty, etc)	$33,456	$35,463	$37,591
Monitoring Equipment	$20,073	$21,278	$22,554
General/Administration	$2,266,381	$2,334,372	$2,404,403
Staff Salary & Benefits	$1,970,766	$2,029,889	$2,090,786
Commissioner Expenses	$17,389	$17,911	$18,448
Office Admin & Supplies	$115,927	$119,405	$122,987
Legal, Eng., IT, HR, Auditor	$173,891	$179,108	$184,481
Operating Reserve***	$927,419	$955,242	$983,899
Total	$8,823,686	$9,285,116	$9,772,192

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***The operation reserve will be kept at 4-6 months of operating expenses or $ 800,000 to $ 1,200,000 and then we'll only levy to replace funds committed/allocated the prior year.

Table 25: Budget Forecasts 2021-2031 Continued…

	2029	2030	2031
Capital Projects	$5,897,238	$6,251,072	$6,626,136
Capital Implementation Program	$4,303,390	$4,561,593	$4,835,289
Capital Project Grants *	$1,000,000	$1,000,000	$1,000,000
Greening Grants *	$1,000,000	$1,000,000	$1,000,000
Land Acquisition *	$2,000,000	$2,000,000	$2,000,000
Initiatives	$1,593,848	$1,689,479	$1,790,848
Communications	$119,539	$126,711	$134,314
Outreach	$278,923	$295,659	$313,398
Planning	$119,539	$126,711	$134,314
Monitoring	$239,077	$253,422	$268,627
Watershed Assessments	$318,770	$337,896	$358,170
Stewardship Grant Fund *	$398,462	$422,370	$447,712
Capital Asset Replacement Fund **	$318,770	$337,896	$358,170
Building/Facility O&M	$79,692	$84,474	$89,542
BMP O&M	$39,846	$42,237	$44,771
Office Equipment	$39,846	$42,237	$44,771
Fleet (vehicles, boats, etc.)	$15,938	$16,895	$17,908
Outreach Communication (Exhibits, Videos, Etc.)	$39,846	$42,237	$44,771
Webpage	$39,846	$42,237	$44,771
Watershed Models (H & H , Wqlty, etc)	$39,846	$42,237	$44,771
Monitoring Equipment	$23,908	$25,342	$26,863
General/Administration	$2,476,536	$2,550,832	$2,627,357
Staff Salary & Benefits	$2,153,509	$2,218,114	$2,284,658
Commissioner Expenses	$19,002	$19,572	$20,159
Office Admin & Supplies	$126,677	$130,477	$134,392
Legal, Eng., IT, HR, Auditor	$190,016	$195,716	$201,587
Operating Reserve***	$1,013,416	$1,043,819	$1,075,133
Total	$10,286,391	$10,829,278	$11,402,510

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In ***The operation reserve will be kept at 4-6 months of operating expenses or $ 800,000 to $ 1,200,000 st and then we'll only levy to replace funds committed/allocated the prior year.

its members through various memorandum of understanding or joint powers agreements for IT, accounting, financial management and HR services.

The MWMO will remain stable with respect to its staff numbers in the near term. As such, fluctuations in percentages spent on individual work areas will reflect primarily the MWMO shifting between activity areas to complete tasks central to planned MWMO actions. For example, with the completion of this Fourth Generation Plan, expenses in the program initiative areas of Planning and Watershed Assessments are likely to taper back and the Capital Project expenses will grow. Reviewing the Ten-Year Implementation Schedule for the program areas exemplify these projected shifts over the next ten years, with higher priorities noted around capital project related activities.

6.1 Capital Improvement Schedule

The MWMO Capital Improvement Schedule estimates the total project costs for MWMO capital projects over the next five years. The MWMO will continue to amend our plan as new capital projects are identified with our partners, to be implemented in years 2026 –2031. Projects found in **Table 26** and described below will not be contracted for without the completion of a feasibility study.

The MWMO does not take on the long-term operations and maintenance of the capital projects funded by the MWMO but not owned by MWMO. However, the MWMO will work with our member organizations and private landowners to establish a design, and long-term maintenance plan that reflect the abilities of our partners to maintain the long-term performance of the BMP's installed throughout their lifecycle.

All projects will require an operation and maintenance plan, which must include a description of personnel implementing the plan (noting any education and staff training needed), equipment needs, maintenance resources, an inspection schedule, and a maintenance budget. In addition, post construction performance testing of stormwater management practices installed may also be required.

The MWMO evaluates the net social, environmental, and economic outcomes of a design to assure what is built results in an equitable public benefit to the community. As a result, the infrastructure the MWMO models, designs, or builds related to: stormwater, flooding, and habitat focuses on bolstering those aspects of a community where historically and present day the greatest inequity exists.

The MWMO is continually assessing priority areas within the watershed for future capital projects and will update this schedule as studies are completed. The MWMO will continue to review the Capital Improvement Program minimally every 2 years for potential amendments.

The MWMO recommends that its staff and its member's staff work with one another on shared reviews of capital projects and planning efforts. Sharing staff expertise between the organizations will strengthen the connectivity and synergy between MWMO and members' capital projects and

planning activities. Information on current and previously completed projects is available on the MWMO's website.

Columbia Heights City Hall: Heated Sidewalks along Central Ave

The City of Columbia Heights will partner with the MWMO to install heated sidewalk along Central Avenue in front of the City Hall building located at the corner of 40th Avenue NE and Central Avenue. This will eliminate the need to use salt on the sidewalk in the winter, and thus eliminate sodium chloride from entering the storm sewer along Central Avenue.

Columbia Heights: Gauvitte Park Area: Water quality improvements and flood protection

The City of Columbia Heights in partnership with the MWMO will be implementing flood control and water quality improvements in the Gauvitte Park Area. The project implemented may utilize filtration, reuse, bioretention or bioengineering practices to reduce the amount of total phosphorus and total suspended solids reaching the Mississippi River. The project is located between 42nd Ave. and 44th Ave. NE, west of University Ave.

Columbia Heights: Huset Park Area: Water reuse and water quality improvements

The City of Columbia Heights, in partnership with the MWMO, will implement water reuse and water quality improvements in Huset Park, as part of an overall park redevelopment effort. The project will be designed to optimize stormwater reuse to maximize the amount of water captured/reused and reduce the amount of total phosphorus and total suspended solids reaching the Mississippi River. Water quality improvements may include the additional of an iron enhanced sand filter to an existing pond in the park. The project is located south of 49th Ave, between University Ave and Central Ave NE.

Columbia Heights: 4300 Central Ave NE Mixed-Use Development

This 13-acre site is planned for re-development, offering both single and multi-family residential housing, a public market, and parkland. A feasibility study will be performed to explore mitigating nearby flooding and any other potential opportunities to create greater water quality improvements for the area.

Fridley/Columbia Heights: 53rd Ave NE Stormwater Improvements

The City of Fridley, in cooperation with the City of Columbia Heights, will work with the MWMO to implement above-and-beyond stormwater management as part of turnabout installation project to improve safety for vehicular traffic at the Target/Medtronic entrance on 53rd Street, between Monroe St NE and Central Ave NE (Trunk Highway 65). The project will look for opportunities to treat stormwater runoff from both public and private sources and may include stormwater treatment at the greenspace north of 53rd Street on the adjacent Target property. The cities also plan to construct a trail on the southside of 53rd Street and extend the sidewalk on the northside of 53rd Street, which presents some opportunity for linear treatment; however, this is

limited by the right-of-way. The goals of the work are to maximize pollutant removals and reduce loading into the adjacent Sullivan Lake. Practices to be considered include linear green infrastructure, ponding, or underground infiltration. Opportunities to design BMPs to expand ecological benefits of the adjacent Sullivan Lake Park will be explored. It is foreseen that the MWMO could potentially be involved with the acquisition of property to implement the stormwater practices.

Fridley: University Avenue Drainage Improvements

The City of Fridley will work with the City of Columbia Heights and MnDOT on a feasibility study to identify and implement a potential flood mitigation solution at University Avenue, near the intersection of 49th Ave NE. The project will focus on practices that reduce peak flows and improve water quality at this intersection and/or upstream of this intersection.

Fridley: 2021 Street Project 57th Ave from 7th St. to Quincy

The City of Fridley will reduce the width of 57th Avenue between 7th St NE and Quincy St NE in the Lakeview Neighborhood. The road is overly wide and represents an opportunity for a road diet (>36 feet) and enhanced stormwater management. There are no sidewalks along this road, however there may be opportunities for bump outs with tree trenches..

Fridley: Sylvan Hills Park Stormwater Improvements

The City of Fridley will work with MWMO to explore opportunities for stormwater management at Sylvan Hills Park. The park has a large open green space adjacent to the city storm sewer which continues to University Avenue and an area at risk of flooding. MWMO will work with the city on a feasibility study to explore cost effective ways to improve water quality, mitigate flooding, and restore habitat within one mile of the Mississippi River. Improvements may include curb cut raingardens or large-scale surface or underground storage and treatment system.

Minneapolis/Columbia Heights: 37th Ave NE Street Reconstruction

The Cities of Columbia Heights and Minneapolis will partner with the MWMO to implement stormwater management as part of the reconstruction of 37th Ave NE, between Central Ave and Stinson Street NE. The project will focus on implementing a road diet (reducing from four lanes to two lanes), the use of linear green infrastructure to capture and treat stormwater runoff from the roadway, adjacent trails, and the surrounding drainage areas. Improvements may include the installation of new grey infrastructure to direct water in and out of the stormwater management features. Stormwater management features will be designed to maximize water quality benefits, mitigate flooding in the down-system infrastructure, and improve pollinator habitat in the area.

Old Bassett Creek Tunnel: Water quality and water conservation improvements

This is a joint Minneapolis Public Works and MWMO project based on the findings of the 2017 Old Bassett Creek Tunnel Condition Assessment, Cleanout Plan, and Structural Integrity Study. The

project involves structural repairs and modifications to the Old Bassett Creek Tunnel (OBCT), including the addition of access shafts to increase opportunities for removal of deposited debris, sediments, and trash. The removal of this accumulated material will improve water quality of stormwater discharging to the Mississippi River. The project is being implemented in phases, as opportunities for tunnel modification become available. The MWMO will coordinate the project design with staff from the BCWMC and the City of Minneapolis to assure it meets the requirements set forth in the BCWMC-MWMO-Minneapolis Joint and Cooperative Agreement of 2000 or subsequent versions (see Appendix F).

Minneapolis: Combined Pipesheds Stormwater Project

Minneapolis will partner with the MWMO in identifying and implementing stormwater management practices across a large-scale watershed or pipeshed to provide comprehensive flood mitigation, improve water quality discharging to the Mississippi River, and enhance ecological habitat.

MPRB: Water Works Park

Water Works is an 8-acre park development project by the MPRB. It lies along the west bank of the Mississippi River, just north of the Stone Arch Bridge, and was originally envisioned as part of the RiverFirst Initiative. In addition to green infrastructure practices, the MPRB will be installing a stormwater reuse system at the site. The stormwater reuse system will collect and treat roof runoff from the existing rooftops of adjacent buildings, as well as the proposed park pavilion rooftop. This water will be used for irrigation at the Water Works site, toilet flushing in the proposed pavilion and potentially for use in one of the three water features at the site.

MPRB: Bohanon Park Naturalized Stormwater Management and Ecological Redevelopment

As part of the redevelopment of Bohanon Park in north Minneapolis, the Minneapolis Park and Recreation Board (MPRB) is planning to address historic stormwater management issues on the site and create a stormwater wetland feature, which may also be used for winter recreation activities such as skating. The preferred concept calls for new naturalized stormwater management near the building to help keep fields dry. The MWMO will partner with the MPRB to maximize the stormwater management and ecological benefits of this work, improving water quality and reducing the volume of stormwater discharging to the Mississippi River. This may include exploration of whether stormwater from off the property (e.g. 49th Avenue North street and 49th Avenue Corridor paved trail) may be treated onsite.

MPRB: Elliott Park Stormwater Management Improvements and Habitat Enhancement

As part of the redevelopment of Elliot Park in downtown Minneapolis, the MPRB will implement practices to improve stormwater management and increase habitat with native pollinator plantings and canopy trees to complement existing mature hackberry trees (MPRB, 2017). Goals of the project are to maximize water quality improvement, promote infiltration, increase pollinator habitat, and mitigate flooding in the area's stormsewer system. Opportunities may include the

installation of green infrastructure, including tree trenches, around the perimeter of the park to capture and treat stormwater that originates from both on and off-park areas. Stormwater management features may also be used to enhance the use of Elliot Avenue as a plaza space and reduce runoff from the park site into the surrounding stormsewer system.

MPRB: Mississippi Gorge Regional Park Projects – Bank Restoration, Water Quality/Habitat Improvements

As part of the restoration of the Mississippi River Gorge, the MWMO will partner with the MPRB to enhance habitat and improve water quality along the River, building off concepts developed in the Mississippi River Gorge Master Plan. Opportunities include river bank restoration, rebuilding and armoring of outfalls to prevent erosion, improved stormwater management, such as rain gardens, and habitat enhancements such as buckthorn removal and reestablishment of native riverside plant communities.

MPRB: Audubon Park Water Quality, Flood Resiliency, and Ecological Improvements

As part of renovations at Audubon Park within the Audubon Neighborhood of Minneapolis, the MPRB will implement stormwater management practices that reduce pollutant loading to the Mississippi River, increase flood resiliency, and improve ecological function within the surrounding watershed. The goal of this project is to capture and treat runoff from Audubon Park, mitigating its impact on downstream flooding and water quality issues. Improvements will be designed to address historic stormwater management issues on the park and consider innovative approaches to stormwater management. As part of the 1 NE Watershed Study, it was noted that this park could provide stormwater capture and treatment in a neighborhood in need of stormwater management improvements. The new concept includes natural flower gardens, woodland, and bee lawn and will capture all stormwater onsite. Ability to capture offsite water will also be explored.

MPRB: Hennepin Island Rehabilitation Project

Hennepin Island is the secluded park space between the Stone Arch Bridge and the East Falls below Father Hennepin Bluff. It is a riverine landscape of high potential ecological richness although the landscape integrity is currently degraded. Public access is very challenging and accomplished by stairways, only one of the original two of which is in service. The stairs link to a system of loop trails and ped bridges. The proposed project will rehabilitate all existing amenities and natural resources as well as make access and security upgrades. The natural resource work will include native landscape installation, shoreline rehabilitation, ecological interpretive features and environmental quality monitoring.

MPRB: Nicollet Island Bank Stabilization Project

The northern or upstream half of Nicollet Island's natural shoreline has been slowly eroding and receding over time. Erosion has reached a point in some locations where the Island's

infrastructure could be in jeopardy. In addition, some of the tunnels under the Island show signs of sagging or have partially collapsed and need structural stabilization. The proposed project would implement the shoreline stabilization recommendations recently formulated by the MWMO, conduct tunnel stabilization, restore native shoreline vegetation and perform environmental quality monitoring. Previous phases of work on the island included upland habitat and stabilizing erosion prone pathways down to the river, a partnership between MWMO, FMR, and MPRB. This future work will build off of the work that has already been done, as well as utilizing MWMO monitoring data to inform bank stabilization techniques.

MPRB: Nicollet Island South Loop Project

The southern part of Nicollet Island (area downstream of Hennepin Avenue Bridge) is a significant event destination with the Nicollet Island Pavilion as its hub. The grounds of the South Loop area do not match up well with its destination status. There is a unique boardwalk along a portion of shoreline but it is poorly connected to pedestrian routes. There is a small '70s-era amphitheater along the East Channel that is only barely functional. There is no perimeter trail route. The shoreline needs vegetative restoration and some stabilization.

The proposed project includes trail extension, boardwalk restoration, shoreline restoration, amphitheater rehabilitation and amenity upgrades around south loop of the Island. The natural resource work will include shoreline stabilization and native landscape rehabilitation, ecological interpretive features and environmental quality monitoring.

MPRB: Graco Park Development

MPRB is working on park designs for the Graco Park area, with construction being planned for 2022. The proposed project will include a new MPRB building and plaza along Sibley Street that will incorporate stormwater management infrastructure. The park will also build on the habitat restoration efforts of Halls Island to build ecologically resilient systems along the river with a focus on public access.

1NE Watershed System-Scale/Multiple-Benefit Stormwater BMPs (South Columbia Golf Course)

The MWMO is working with the City of Minneapolis and MPRB to implement system-scale stormwater BMPs within the 1NE Watershed. This project includes improvements along the southern half of Columbia Golf Course and will be designed to provide flood mitigation both to upstream watersheds and the golf course, remove pollutants from stormwater runoff, and restore ecological health and create habitat within the golf course.

MWMO/MPRB/Minneapolis: Upper Harbor Terminal

The Minneapolis Upper Harbor Terminal (UHT) is a 50-acre redevelopment site located along the west bank of the Mississippi River in North Minneapolis. The MWMO will seek to implement

regional and district-scale stormwater opportunities in conjunction with redevelopment at the UHT. The MWMO will work with willing landowners to evaluate the opportunity for innovative stormwater practices along the roadways, railway and utility corridors, private development sites, public right of ways, and on Minneapolis Park Board land. Stormwater designs will work to create added-value (e.g. stormwater reuse and improved ecosystem services) from the significant volume of stormwater that passes thru the UHT area from North Minneapolis. The project will utilize historic sites, complement existing and future land uses, improve ecosystem services, and provide bank and shoreline habitat restoration.

MWMO Restoration of Eroded Riverbanks Sites: Water quality and habitat improvements

The MWMO will work with its partners to consider riverbank restoration sites that contribute sediment to the MWMO's reach of the Mississippi River. Bioengineering techniques will be used to restore these and other eroded areas, improving water quality and habitat along the Mississippi River. The entity carrying out the improvements is dependent on findings of a final feasibility study and/or studies on restoration needs along the Mississippi River. The MWMO will work with its member organizations to identify eroded sites where there is a shared interest in restoration along the river. Single projects that require multi-year funding would need to be amended into the CIP schedule as stand-alone projects. The $1,000,000 is for implementation of projects that eliminate near bank erosion and improve habitat in the Mississippi River Corridor Critical Area (MRCCA) in accordance with the MWMO's Bioengineering Installation Manual.

MWMO Towerside Innovation District

The MWMO has completed a Blue/Green Framework Masterplan for the Towerside Innovation District. This framework identifies catchment areas within the pipeshed where storage of stormwater is most likely to occur. It then aligns this storage with above ground green infrastructure opportunities and water reuse opportunities such as irrigation of habitat corridors, greenspaces and community gardens. The MWMO has identified multiple project opportunities on public and private land in this area. The current project underway is the Towerside Phase II District Stormwater System (Malcom Yards). This is a 23-acre redevelopment project adjacent to the Phase I District Stormwater System. This project and others in this area will to improve water quality, create greenspace and habitat corridors, reduce runoff volumes, and manage rates of discharge. Design done in this area will also further the MWMO's understanding for how district stormwater systems can be integrated in with restorative development designs and future opportunities to blend district systems into restorative initiatives in the area.

Table 26: MWMO Capital Improvement Schedule 2021 to 2026

MWMO Capital Improvement Projects	**2021**	**2022**	**2023**	**2024**	**2025**		**Total funding**
Columbia Heights City Hall – Heated Sidewalks along Central Ave		X					$150,000
Columbia Heights: Gauvitte Park Area Water Quality Improvements and Flood Protection				X	X		$500,000
Columbia Heights: Huset Park Water Reuse and Water Quality Improvements			X	X	X		$400,000
Columbia Heights: 4300 Central Ave NE Mixed-Use Development		X	X				TBD
Fridley/Columbia Heights: 53rd Ave NE Stormwater Improvements		X	X				$400,000
Fridley: University Avenue Drainage Improvements					X		TBD
Fridley: 2021 Street Project 57th Ave from 7th St to Quincy	X	X					TBD
Fridley: Sylvan Hills Park Stormwater Improvements					X		TBD
Minneapolis/Columbia Heights: 37th Ave NE Street Reconstruction			X	X			$800,000
Mpls: Old Bassett Creek Tunnel Water Quality and Water Conservation Improvements			X	X	X		$1,711,000
Minneapolis: Near North Combined Pipesheds Stormwater Project			X	X	X		TBD
MPRB: Water Works Park	X	X	X				$100,000
MPRB: Bohanon Park Naturalized Stormwater Management and Ecological Redevelopment			X	X	X		$600,000
MPRB: Elliott Park Stormwater Management Improvements and Habitat Enhancement			X	X	X		TBD
MPRB: Mississippi River Gorge – Bank Restoration, Water Quality/Habitat Improvements			X	X	X		$2,000,000
MPRB: Audubon Park Water Quality, Flood Resiliency, and			X	X	X		$600,000

MWMO Capital Improvement Projects	2021	2022	2023	2024	2025		Total funding
Ecological Improvements							
MPRB: Hennepin Island Rehabilitation Project			X	X	X		$330,000
MPRB: Nicollet Island Bank Stabilization				X	X		$1,500,000
MPRB: Nicollet Island South Loop Project					X		$1,000,000
MPRB: Graco Park Development		X	X				$100,000
MWMO/MPRB/Minneapolis: 1NE Watershed System-Scale / Multiple-Benefit Stormwater Projects	X	X	X	X			$2,000,000
MWMO/MPRB/Mpls: Upper Harbor Terminal	X	X	X	X	X		$11,000,000
MWMO: Restoration of Eroded Riverbanks Sites. Water Quality and Habitat Improvements		X	X	X			$860,000
MWMO: Towerside Innovation District Habitat, Reuse, Water Quality, and Restorative Improvements	X	X	X	X	X		$3,600,000
Grand Total							**$28,751,000**

Note: A feasibility study of the project and the MWMO's funding guidelines will determine what aspects of the project may be funded. MWMO Board will review and approve all final project budgets and agreements.

Funding amounts for the capital improvement projects do not include diagnostic and feasibility study costs. These costs are a part of the annual budget for the Watershed Assessments. Any significant changes (15 to 25% increase) to the estimated project costs will be reported by the MWMO in their annual report to the Board of Water and Soil Resources and included in the MWMO's annual budget meeting which is open for public comment. Projects exceeding 25% of their budgeted cost will require a minor amendment. The maximum grant amount for a CIP project not on the current CIP schedule is 25% of the MMWO's annual CIP project budget or an average annual estimated total CIP project budget over the life of the Plan.

6.2 Ten-Year Implementation Schedule

The MWMO's Ten-Year Implementation Schedule is intended to be used as a guide, not a prescription, for MWMO activities over the next ten years. The MWMO will conduct an annual prioritization of goals and strategies for each year. This annual prioritization will be based on effectiveness of work performed in past years, progress toward meeting intended goals, changing resource conditions, and financial constraints.

A summary of recently approved TMDL Implementation Plans and MWMO's related activities will also be included in the MWMO's annual report to BWSR to ensure that MWMO activities and projects are supporting TMDL implementation as needed. Consistent with the MWMO Plan amendment policy in **Section 7.2**, the MWMO will incorporate needed TMDL implementation activities into the Watershed Management Plan.

Layout and Content Guidance on Table 27

The MWMO's Ten-Year Implementation Schedule is framed by ten focus areas: Water Quality, Water Rate and Volume, Monitoring and Data Assessment, Communications and Outreach, Ecosystem Health, Regulations and Enforcement, Urban Stormwater Management, Emergency Preparedness and Response, Emerging Issues, and Financial Responsibilities and Strategies. The first column of **Table 27** starts with focus area statements, goals, and finally strategies to be implemented to meet the goals. This format continues for each of the ten focus areas. All implementation is understood within the context of the goals and strategies preceding them.

Together columns two and three indicate the priority and lead staff area: Administrative (AD); Communications and Outreach (CO) or individually (C) (O); Capital Improvement Projects (CIP); Monitoring (MD); Planning (PL); and Watershed Assessments (WA) designated to carry out the strategy. In many cases there are multiple teams of staff implementing components of the annual work plan to achieve goals and strategies.

Staff within these lead work areas have prioritized the strategies in **Table 27** as low, medium, or high. The prioritization of each strategy is based on the degree to which it advances improvements in water quality, habitat, and flood reduction in the watershed. These strategies are prioritized only under the related goal and focus area not against all of the other focus areas identified. The prioritization also reflects the level of effort needed annually to implement the strategy. For example, a high priority strategy is a weekly or monthly activity within staff's work plans and is central to achieving the MWMO's mission and goals. A strategy may show up as a low priority because annually it only requires a few weeks or less of work, yet it is still seen as central to achieving the MWMO's mission and goals.

The MWMO considers equity and climate change as more comprehensive issues that will permeate throughout all aspects of the MWMO's organization and the work we do. As such, additional goals or strategies on these topics may be added to **Table 27** as staff and the MWMO Board develop the plans and policies needed to fully address these topics.

Since this plan is based on organizational, scientific, and regulatory information currently available, the MWMO reserves the right to reprioritize, add, or remove strategies indicated in order to adapt to emerging issues, priorities, and organizational growth.

Table 27: MWMO's Ten-Year Implementation Schedule Implementation Actions

MWMO's Ten-Year Implementation Schedule Implementation Actions	Priority	MWMO Lead Area
Water Quality (WQ)		
WQ 1 Protect and improve the water resources of the MWMO.		
Goal 1 Protect and improve the Mississippi River.		
Strategy 1 Quantify MWMO's contribution to pollutant loading in the Mississippi River.	High	WA
Strategy 2 Monitor the water quality of the river upstream and downstream of the MWMO's reach of the Mississippi River.	Medium	MD
Strategy 3 Eliminate water quality impacts of combined sewer overflows.	Low	WA, PL, CIP
Strategy 4 Work with appropriate agencies to limit resuspension of sediment and pollutants in the water column of the Mississippi River.	Medium	WA
Strategy 5 Partner on bank stabilization and habitat restoration within MRCCA while allowing multiple uses.	Medium	WA, CIP
Goal 2 Protect and improve the quality of lakes and wetlands in the watershed.		
Strategy 1 Quantify pollutant loading to each waterbody in the watershed.	High	MD
Strategy 2 Reduce pollutants to lakes and wetlands.	Low	WA, CIP
Strategy 3 Participate in the development, implementation and compliance of regulations, ordinances, rules and standards that impact the watershed's resources.	Medium	PL
WQ 2 Account for water quality conditions upstream that impact the MWMO.		
Goal 1 Take a leadership role in protecting the health of the Mississippi River.		
Strategy 1 Work with stakeholders within the Mississippi River basin to establish common goals to improve the health of the river.	Low	PL
Strategy 2 Share information on efforts and successes to demonstrate the feasibility of meeting standards in a highly urban watershed.	Medium	CO
Strategy 3 Partner with watersheds that manage headwaters discharging into the MWMO to help achieve the MWMO's water quality goals for the Mississippi River.	Low	PL
WQ 3 Participate in the development and implementation of TMDLs.		
Goal 1 Take an active role in Total Maximum Daily Loads (TMDLs) affecting the Mississippi River and the resources within the MWMO		
Strategy 1 Work with Minnesota Pollution Control Agency (MPCA) on TMDLs	Medium	MD, WA, PL

MWMO's Ten-Year Implementation Schedule Implementation Actions	Priority	MWMO Lead Area
Strategy 2 Participate in the development and implementation of TMDLs.	Medium	PL, MD
WQ 4 Identify the role the MWMO will take in addressing soil contamination and groundwater quality.		
Goal 1 Engage in effective watershed management that does not adversely affect groundwater.		
Strategy 1 Account for the effect of contaminated soils and groundwater when setting watershed performance standards or rules.	Low	WA
Strategy 2 Account for the effect of contaminated soils and groundwater when planning capital and infrastructure projects	Medium	CIP
Strategy 3 Monitor the quality of groundwater discharging into the Mississippi River.	Low	MD
Strategy 4 Manage areas of groundwater-surface water interaction (e.g. areas of recharge and discharge) with a heightened awareness of pollution potential between the two systems.	Medium	WA
Goal 2 Protect, improve and conserve the groundwater resources that support surface and drinking water sources.		
Strategy 1 Work with municipalities and stakeholders to promote groundwater conservation measures.	Medium	CO
Strategy 2 Quantify the interaction of groundwater and any associated contamination within the WMO's natural resources	Medium	CIP
Strategy 3 Minimize unintended impacts to the Mississippi River and the local groundwater system resulting from new policies or program initiatives.	Low	WA, PL
Water Rate and Volume (WRV)		
WRV 1 Manage the causes and reduce the effects of flooding that impact the watershed.		
Goal 1 Prevent the flooding of streets and structures due to surface water runoff.		
Strategy 1 Identify vulnerable areas and appropriate flood control projects.	Medium	WA, PL
Strategy 2 Encourage flood control projects that include water quality treatment, habitat improvement and erosion control.	High	WA, CIP
Strategy 3 Acquire and share monitoring data to inform flood control decisions.	High	MD
Strategy 4 Work with member organizations and other entities to manage drainageway routes.	Low	PL
WRV 2 Manage the causes and reduce the effects of drought that impact the watershed.		
Goal 1 Minimize the impact of drought conditions on environment, economics, infrastructure, health, and aesthetics.		

MWMO's Ten-Year Implementation Schedule Implementation Actions	Priority	MWMO Lead Area
Strategy 1 Monitor and engage in agency led water supply planning efforts.	Low	PL
Strategy 2 Promote and engage in policies, programs, and projects that encourage conserving water resources.	High	PL
Strategy 3 Restore localized storage and infiltration into the landscape.	High	CO, CIP
Monitoring & Data Assessment (MD)		
MD 1 Collect and analyze data to inform other program efforts Make decisions based on science and best available data.		
Goal 1 Assemble best scientific data.		
Strategy 1 Collaborate with stakeholders to effectively monitor watershed resources.	High	MD
Strategy 2 Monitor and compile environmental data on the watershed to make management decisions and evaluate progress.	High	MD
Strategy 3 Compile socio-economic data to inform program activities and policy decisions.	Medium	WA
Goal 2 Process data to make it usable.		
Strategy 1 Collaborate with stakeholders to analyze data.	High	MD
Strategy 2 Analyze data to make and track science-based management decisions.	High	MD
Strategy 3 Analyze socio-economic data.	Medium	WA
Goal 3 Share the data with other entities.		
Strategy 1 Provide access to data.	High	MD
Strategy 2 Use data to track and evaluate the condition of water resources.	High	PL, MD
Communications and Outreach (CO)		
CO 1 Provide resources and opportunities to build capacity and leadership and promote responsible stewardship of water and natural resources.		
Goal 1 Educate to increase the knowledge and awareness of the connections between land use and water quality		
Strategy 1 Develop and implement audience appropriate information, programs, materials and trainings for watershed constituents.	High	O
Strategy 2 Build community leadership and capacity for water education.	High	O
Strategy 3 Provide opportunities for youth to learn about and engage in watershed awareness and watershed management activities	High	O

MWMO's Ten-Year Implementation Schedule Implementation Actions	Priority	MWMO Lead Area
Goal 2 Create and support opportunities for public participation and involvement.		
Strategy 1 Provide opportunities for community-initiated projects to be realized.	Medium	O
Strategy 2 Provide opportunities for the public to be involved with MWMO projects and programs.	Medium	CO
Goal 3 Collaborate with agencies, partners and networks in developing education, outreach materials and stewardship activities to increase the reach and effectiveness of watershed education.		
Strategy 1 Leverage MWMO expertise and funding.	High	CO
Goal 4 Recognize and respond to educational needs and opportunities of the diverse communities represented in the MWMO		
Strategy 1 Customize education and outreach efforts for individual communities.	High	O
Strategy 2 Capitalize on opportunities to expand MWMOs reach into diverse communities.	High	CO
Strategy 3 Create and implement a diversity, equity and inclusion plan	High	ALL
CO 2 Create education and outreach connections within MWMO programs		
Goal 1 Integrate education into MWMO programs.		
Strategy 1 Plan and implement education as part of MWMO projects and programs	Medium	CO
Strategy 2 Create and implement an internal communications plan	High	C
CO 3 Enhance communications between MWMO and constituents.		
Goal 1 Increase awareness and knowledge of the MWMO		
Strategy 1 Increase the visibility of the MWMO by collaborating and partnering with others engaged in watershed management activities	Medium	CO, PL
Strategy 2 Document and disseminate MWMO accomplishments and activities.	High	C
Goal 2 Provide water and natural resource information and data to the public.		
Strategy 1 Document and disseminate information collected by the MWMO.	High	CO
Strategy 2 Interpret and make technical data and information available to non-technical audiences	Medium	CO, MD
Goal 3 Coordinate communication networks.		
Strategy 1 Prepare consistent communications guidelines to represent the MWMO outwardly.	Medium	C
Strategy 2 Plan for making MWMO information available to constituents from different backgrounds, income levels. etc.	High	CO
Ecosystem Health (EH)		

MWMO's Ten-Year Implementation Schedule Implementation Actions	Priority	MWMO Lead Area
EH 1 Protect, create, and enhance vegetated areas, springs, native plant communities, habitat, open space, and green infrastructure		
Goal 1 Protect and restore land- and water-based ecosystems.		
Strategy 1 Increase connectivity, improve habitat and expand functional integrity of ecosystems within the watershed through redevelopment opportunities	High	CIP, CO, WA
Strategy 2 Integrate ecosystem health throughout land use decision making processes.	High	PL, CO
EH 2 Protect more land that significantly impacts surface and groundwater resources and natural resources		
Goal 1 Identify and respond to opportunities for protecting and acquiring land.		
Strategy 1 Implement priorities and strategies for land acquisition	Low	CIP
Strategy 2 Leverage land acquisition funds to the greatest extent possible	Medium	CIP
Strategy 3 Encourage land owners to enter land into conservation easements.	Medium	CIP
Regulations & Enforcement (RE)		
RE 1 Promote consistency in rules, regulations, standards and enforcement across jurisdictions.		
Goal 1 Develop MWMO resource-based standards that maintain or improve ecosystem health for adoption by local units of government.		
Strategy 1 Work with stakeholders to reassess MWMO standards.	High	PL
RE 2 Improve compliance and enforcement of regulations related to water and natural resources.		
Goal 1 Support and empower member organizations to improve compliance with their regulations.		
Strategy 1 Evaluate level of compliance with existing regulations.	Low	PL
Goal 2 Support and empower member organizations to improve enforcement of their regulations.		
Strategy 1 Avoid duplication of existing regulatory controls.	Low	PL
Goal 3 Participate in the implementation and compliance of regulations associated with state and federal laws		
Strategy 1 Assist stakeholders in establishing and complying with regulations	Low	PL
	Medium	
Urban Stormwater Management (USM)		
USM 1 Promote unique and innovative solutions for stormwater management in highly developed urban areas.		
Goal 1 Collaborate with member organizations to incorporate stormwater management solutions		
Strategy 1 Stormwater management planning is Incorporated into member's process at the initial stage of development.	High	PL

MWMO's Ten-Year Implementation Schedule Implementation Actions	Priority	MWMO Lead Area
Strategy 2 Incorporate stormwater management into multi-functional corridors.	High	PL
Strategy 3 Be a leading knowledge organization for current and innovative stormwater management technology	High	WA
Strategy 4 Evaluate the installed performance of stormwater management practices.	Medium	WA, MD
Strategy 5 Implement innovative District redevelopment and Restorative stormwater infrastructure systems	High	PL, WA, CIP
Goal 2 Publicize the value and benefits that stormwater can provide.		
Strategy 1 Emphasize the value of stormwater as a resource in an effort to increase local stewardship efforts.	Medium	WA, PL
Emergency Preparedness & Response (ER)		
ER 1 Protect natural resources when natural disasters and emergencies occur.		
Goal 1 Prepare for and respond to emergencies impacting the MWMO's water and natural resources.		
Strategy 1 Collaborate with emergency response officials from local, state and federal agencies.	Medium	AD, CO, MD, PL
Strategy 2 Improve emergency access to the Mississippi River throughout the MWMO reach.	Low	PL, MD
Goal 2 Implement protection strategies that protect and minimize the effects of natural disasters and emergencies on water and natural resources.		
Strategy 3 Conduct and apply research and monitoring as needed.	Medium	WA, MD
Emerging Issues (EI)		
EI 1 Develop new approaches that protect water and natural resources as conditions change and emerging issues arise.		
Goal 1 Identify emerging issues related to water and natural resources		
Strategy 1 Maintain and prioritize a list of emerging issues	Medium	WA
Goal 2 Respond to emerging issues related to water and natural resources.		
Strategy 1 Fund research and development related to emerging issues and make the information available to others.	Medium	WA
Strategy 2 Keep Watershed Management Plan current to address emerging issues.	Low	PL
Goal 3 Support new policies and regulatory systems needed to manage emerging issues		
Strategy 1 Encourage the use of new and innovative infrastructure systems	High	PL, WA

MWMO's Ten-Year Implementation Schedule Implementation Actions	Priority	MWMO Lead Area
Financial Responsibilities and Strategies (FRS)		
FRS 1 Maintain a comprehensive financial framework to implement goals and strategies of the plan.		
Goal 1 Utilize funds to actively protect and improve the quality and quantity of water and natural resources.		
Strategy 1 Fund the evaluation, development, and use of new technologies and management practices.	High	CIP, WA, PL, CO
Strategy 2 Fund activities where there is demonstrated public benefit.	High	CIP
Strategy 3 Fund community-initiated stewardship activities.	High	CIP, CO
Strategy 4 Fund activities outside of the watershed that result in direct public benefits within the watershed to the water and natural resources.	Low	WA
Strategy 5 Fund capital improvement projects.	High	AD, CIP
Strategy 6 Fund land acquisition.	Low	CIP
Strategy 7 Grant funds to projects that meet or exceed MWMO standards.	High	CIP, PL
Strategy 8 Fund approaches to minimize the impact of emerging pollutants on water and natural resources.	Medium	CIP, WA
FRS 2 Maintain a funding strategy that is effective, efficient and transparent.		
Goal 1 Leverage MWMO funding and staff expertise with funds and expertise from other sources.		
Strategy 1 Collaborate with other entities to carry out program activities.	High	CIP
Goal 2 Use funds in ways that are fiscally responsible and provide public benefit.		
Strategy 1 Be accountable to the taxpayers and member organizations of the MWMO.	High	AD
Strategy 2 Involve the public and member organizations in major funding processes.	High	CO, CIP
Strategy 3 Evaluate cost benefit of MWMO project and program initiative expenditures	Medium	All
Goal 3 Expend administrative funds on activities that increase the effectiveness and efficiency of personnel		
Strategy 1 Carry out annual work planning and training for staff of the MWMO.	Medium	All

7.0 MWMO Administration/Internal Operations

The internal operations of the MWMO are designed to allow the organization to efficiently and effectively accomplish its duties. The MWMO addresses the protection and restoration of water and natural resources through planning, financing and funding processes, and a variety of projects and activities. This section of the Plan outlines the administration and internal operations of the MWMO. For a discussion on MWMO financing and funding see the implementation chapter "Financial Responsibilities and Strategies" and "MWMO Financials."

7.1 MWMO Project Expertise and Services

While the MWMO Watershed Management Plan lays out the general work flow for the organization, it does not provide the year–to-year specific planning and work detail necessary to implement the goals of the plan. In addition to the Plan, the Board periodically carries out strategic planning that must be incorporated into the annual workplan of staff. Each year, MWMO staff develops an annual workplan to present to the Board of Commissioners. The annual workplan provides a schedule and details of the projects and activities to be completed each year. The process takes place concurrently with the MWMO budget process to ensure funds are directed to priority projects and activities.

The MWMO conducts an annual prioritization and selection of projects and activities based on available funding for capital projects, planning initiatives, research and watershed studies, communication and outreach initiatives and monitoring. These projects and activities selected and implemented will advance the organization's goals and strategies while responding to changing resource conditions and financial constraints of the MWMO.

The MWMO also continues to seek out opportunities to collaborate and develop partnerships with other organizations to expand the reach of its and their activities, to leverage additional funds, and to prevent duplication of services and project efforts within the watershed (**Table 24**).

All projects undertaken and services provided will have an evaluation component. Evaluations measure the impact of the MWMO's efforts and are a critical part of improving its projects and activities. Evaluations will clearly state objectives, measure results, and serve as a valuable tool in documenting the success of the MWMO's implementation plan. The MWMO will include results of the evaluations as part of its annual report and financial summary.

MWMO brings staff and expertise to each of the following areas:

- Capital Projects
- Communications
- Outreach
- Monitoring
- Planning
- Watershed Assessment

Below are summaries of each area of expertise and the how and why of the work they do.

Capital Projects

Purpose and Justification: The MWMO builds structural solutions to address its water resource protection and improvement goals because it is often the most efficient and effective way to attain the water quality and quantity goals of the MWMO. Nutrient reduction, volume control, rate control, and drought attenuation on a district, sub-watershed, or watershed scale is where the MWMO primarily invests its capital improvement funding.

Restoration of native vegetation is also an effective tool to reduce water volume, sediment, and other pollutants of stormwater in the watershed. Trees and other vegetation help reduce the negative impacts of urbanization on water and air quality, habitat, energy use, public health, and quality of life. The strategic use of vegetation reduces the amount and cumulative impact of impervious surfaces. Structurally, vegetation also provides layers of opportunities (e.g. canopy, ground cover, roots in the ground) to intercept, use, transpire, and infiltrate stormwater before it becomes runoff. Moreover, using vegetation to mitigate urban effects is often less costly than structural engineering solutions. These projects utilize opportunities and incentives to retrofit sites to integrate vegetation to improve water quality, to integrate better building and landscape design into land use decisions and policies, and to pilot new approaches to solving resource problems.

The combination of water conservation (using less water) and reuse (using water more than once before discharge) are additional measures the MWMO utilizes to reduce the impact and demand on our water resources. Water is an increasingly scarce resource, both regionally and nationally, and growing demands are arising from an expanding population, changing lifestyles, and industrial, commercial, and agricultural uses. Even in Minnesota, a land of many waters, water is not replenished at the same rate that it is used. Reuse of water can also provide a backup to potable water supplies, creating a strategic level resilience for a community, thereby enhancing community resilience. Sustainable water management practices are an integral part of water use and planning by individuals and large water users, even in the absence of water restrictions.

Finally, through acquiring easements and purchasing land, the MWMO improves its ability to significantly protect and improve surface and groundwater resources, as well as other recreational, historical, and cultural resources. Cooperative land conservation projects and a dedicated budget enables the MWMO to participate in long-term planning and purchasing processes, as well as respond to opportunities as land becomes available. Moreover, MWMO funds will be used strategically to leverage additional partnerships and purchasing power.

Objectives:

- Encourage the use of new and innovative water management systems for energy, water supply, and stormwater and wastewater treatment and reuse
- Evaluate the effectiveness of new technologies

- Pilot innovative and visible demonstrations to showcase techniques for local conditions
- Provide technical and funding assistance for projects, programs, and policy development in the watershed that encourage conservation of water resources
- Provide leadership in surface and groundwater conservation, and reuse whenever opportunities arise
- Provide leadership, technical, and funding assistance in the watershed, to support a transition to restorative infrastructure that equitably optimizes the environmental, social and economic outcomes of redevelopment
- Promote integration of building and landscape design
- Use plants to reduce the volume, slow the rate, and treat runoff leaving the land
- Increase capacity of the watershed to intercept precipitation and infiltrate and store water
- Restore and protect habitat, native plant, and animal communities
- Work towards preserving diverse natural areas (e.g. floodplains, prairies, savannas, and forests), and creating habitat corridors crucial for wildlife movement
- Create and restore ecosystem function and structure
- Create climate resilient landscapes
- Implement best practices and apply innovative approaches to maximize native plant community health and habitat, as well as encourage the selection of plant species suitable to a changing climate
- Design water quality improvement and flood control projects resilient to climate change
- Actively seek opportunities to vegetate urban landscapes and link green spaces
- Apply hydrologic, hydraulic, and water quality science and computer simulation models in the selection of project locations providing the best opportunities to reduce flood risk and pollutants to the Mississippi River
- Create recreational opportunities related to water
- Develop partnerships between the MWMO and communities
- Reduce the pollutant load reaching the Mississippi River and other MWMO water resources
- Address localized flooding concerns by reducing the rate and volume of runoff reaching the flood area
- Work toward improvement in regional flooding concerns through reductions in the rate and volume of runoff that reaches the Mississippi River
- Provide technical and funding assistance for regional projects in the watershed
- Assist member organizations in eliminating remaining combined sewer overflows
- Leverage funding from other sources to purchase property that supports watershed planning goals
- Provide financial assistance to member organizations for responding quickly to emergencies that impact water resources
- Protect groundwater by investigating potential soil contamination and use information to inform project design

Communications

Purpose: Increase awareness and understanding of the MWMO and its role in protecting and improving water quality and habitat. Spur action and advocacy by residents and stakeholders to improve water quality and habitat and support green infrastructure projects. Support MWMO member organizations, partners, and clean-water allies by helping meet their communication needs.

Justification: The MWMO's communications staff supports the other program areas by providing professional communication services, serving as the main conduit of public information, and developing strategies and tactics to assist staff in engaging the public in ways that support the MWMO's mission and goals.

The communications area promotes and maintains MWMO brand and graphic standards, provides media relations services, and provides public information through various channels. These may include printed materials, web content, email newsletters, social media, video platforms, and various new and emerging communication technologies as they become relevant. Communications staff also ensure compliance with specific statutory requirements found in Minnesota Statutes Chapter 103B and Minnesota Rules Chapter 8410.

Communications staff work in close collaboration with the MWMO's outreach and education team. These two areas together function as the public face of the MWMO in its day-to-day operations. Communications staff also provide support to staff and residents of MWMO member communities when appropriate.

Objectives:

- Support MWMO staff, program areas, and member organizations in communications services related to stormwater management, water quality and habitat.
- Provide public information via print, web, email, social media, news media outreach and other communications channels and technologies as they become relevant.
- Maintain and promote awareness of the MWMO's graphic standards among MWMO staff and partners to ensure consistent, professional appearance in communications products.
- Support MWMO staff with communications services and coordinate communications-related contracts with outside vendors.
- Ensure compliance with state regulations regarding required communications with residents.
- Maintain the MWMO website and ensure compliance with accessibility standards.
- Provide communication services and support to MWMO member organizations to achieve shared goals around water quality and habitat.
- Promote the expertise and services that the MWMO offers partners and member organizations.
- Promote awareness and understanding of the benefits of MWMO projects through project-specific communications, including development of interpretive signage.

- Facilitate communication with all of the diverse communities in the MWMO watershed, adapting communication strategies and tactics to reach specific audiences as needed.
- Maintain and update the MWMO's Strategic Communications Plan in accordance with the strategic priorities identified by the MWMO's leadership team.
- Maintain and update the MWMO's Crisis Communications Plan and ensure that MWMO staff are informed of the plan and have appropriate media training.
- Develop an internal communications plan to facilitate effective communication between MWMO staff and program areas.

Outreach

Purpose: To develop an engaged, empowered, and informed public by providing information, opportunities for engagement, training and financial support to promote connection with and responsible stewardship of water and natural resources in the watershed.

Justification: Continuing to build community understanding about water and natural resources is at the core of a successful watershed management plan. Encouraging behaviors that positively impact water quality and habitat are key to protecting the environment and long-term health of our communities. Greater knowledge, awareness and engagement can lead to adjustments in personal, corporate, and institutional behaviors and expectations.

Since the MWMO is one of the most diverse and densely populated watersheds in the state of Minnesota, a wide variety of audiences must be identified and engaged. Doing this well requires varying strategies and must address access and barriers, particularly in underserved communities, to achieve ongoing constituent engagement.

Outreach programming and activities fulfill specific statutory requirements found in Minnesota Statutes Chapter 103B and Minnesota Rules Chapter 8410. Coordinated programming and activities may also support member cities in fulfilling the demands of NPDES permit authority and support other MWMO projects and actions to increase their impact.

Objectives:

- Support member organizations in outreach related to stormwater management, water quality and habitat.
- Collaborate with other professionals and networks to leverage funding and other resources to increase the reach and effectiveness of watershed education and engagement.
- Increase awareness and understanding of the MWMO and its role in stormwater and water quality management.
- Develop public awareness of threats to water quality and habitat and possible solutions and create opportunities for public engagement and participation.
- Develop public awareness of the causes, impacts and solutions of climate change and the role of land use decisions and green infrastructure in developing climate resilient communities.

- Empower constituents to take actions to improve water quality by increasing awareness and knowledge of stormwater issues and resources among key audiences, including homeowners/residents, elected officials, public agency staff, large property owners, partners, youth and educators. Create demonstration sites to inform and educate the watershed community
- Utilize Stormwater Park and Learning Center to promote connection, understanding and care for water and natural resources in the watershed and beyond.
- Actively work to expand audiences to include all people who work, live and recreate in the watershed through relationship building, developing partnerships and addressing inequities.
- Consider and adapt approaches to complex intersecting issues impacting local water resources and communities, including but not limited to climate change, historical land use, green infrastructure, environmental justice, and housing issues.
- Provide and promote professional training opportunities that increase understanding and competency across professional fields that have direct impact on water quality and habitat.
- Educate and engage land-use professionals and decision-makers about the relationship between land use and water quality and environmental health.
- Provide resources and opportunities to build capacity and leadership and promote responsible stewardship of water and natural resources.
- Support and promote local stewardship initiatives, community leadership, and community involvement.
- Provide opportunities for youth to learn about and engage in watershed awareness and watershed management activities.
- Develop and training programs and career pathways to encourage more people, particularly BIPOC and other under-represented populations to pursue environmental careers.

Monitoring

Purpose: Provide a scientific basis for identifying and tracking water quality and quantity issues, and to provide information to aid in the selection of projects and evaluating the success of those projects.

Justification: Minnesota Statutes Chapter 103B.201 and Minnesota Rules Chapter 8410.003 establish the principle purposes of the MWMO. Among other purposes, the MWMO is charged with protecting groundwater and surface water quality; additionally, the MWMO may address water quantity issues to correct of flooding within the watershed. Minnesota Rules Chapter 7050 requires all waterbodies comply with water quality standards.

Section 303(d) of the Federal Water Pollution Control Act (commonly known as the Clean Water Act) requires states to develop Total Maximum Daily Loads (TMDLs) for waters with impaired uses. The Mississippi River, within the MWMO's boundaries, is listed on the Environmental Protection Agency's 303(d) list of impaired waters. Water quality monitoring provides scientific data to ascertain where and how stormwater management practices can be implemented to effectively achieve TMDLs, state standards, and MWMO purposes and standards.

Objectives:

- Monitor biological, chemical, and physical parameters of surface and groundwater resources in the watershed
- Monitor water quality within the watershed
- Develop a record of baseline data to characterize water quality and identify pollutants that exceed water quality standards
- Assess pollutants listed on the Minnesota Impaired Waters list for the TMDL process
- Collect rate and volume data for the Mississippi River and key subwatersheds
- Monitor performance of stormwater management practices
- Collaborate with stakeholders to identify and apply a standardized data collection and assessment approach
- Develop partnerships and collaborate with other organizations and/or agencies both inside and outside the watershed boundaries to improve water quality in the Mississippi River
- Assess land use impacts on water quality
- Participate in the technical development and update of statewide monitoring databases
- Make data accessible to the public and public entities and to MWMO staff for use as an education tool (e.g. BMP performance data)
- Collaborate with emergency response officials in training and implementation of emergency response practices
- Develop emergency monitoring plan in case of emergencies affecting water resources

Planning

Purpose: Provide direction to the MWMO's activities. Clarify and integrate the MWMO's goals, responsibilities, and future courses of action. Coordinate implementation of MWMO Standards and goals by member organizations. Maintain involvement with Mississippi River regional working groups.

Build public and private partnerships with neighborhoods, governmental and private sector partners to engage early on in planning for new redevelopment activities that bolster the watershed's resilience to climate change; regain environmental equity neighborhoods have lost; and reduce long term infrastructure debt through public private partnerships.

Lead stormwater and habitat infrastructure planning efforts that: reduce crime rates, improve physical and mental health, cool the urban heat island, improve work place productivity, increase access to healthy food sources, improve social cohesion and community resilience, absorb carbon emissions and other air pollutants, improve social equity within neighborhoods, create extensive public spaces, and lower long-term maintenance costs.

Justification*:* Planning processes led and carried out by the MWMO transform the planning requirements of Minnesota Statutes Chapter 103B from referenced laws into a vision, mission, goals, and actions that are collectively understood and implemented by the MWMO and its member organizations. Planning for projects and activities provides the MWMO with an opportunity for coordination and to create efficiencies as to how it achieves its desired outcomes.

Objectives:

- Develop and maintain MWMO organizational identity
- Keep the MWMO's Watershed Management Plan (WMP) current to address new circumstances and changing priorities
- Develop plans for new watershed initiatives
- Review and respond to planning related activities and project proposals within the watershed to assure they are in concert with the MWMO's WMP
- Review and approve local management plans and amendments that impact water and natural resources
- Provide access to information about MWMO goals, priorities, projects, and work areas
- Encourage public participation in MWMO planning activities
- Bring together information (i.e. watershed assessments and data, public comment, staff and Board reviews) to identify MWMO planning priorities
- Integrate MWMO priorities into areas and projects
- Develop consensus among stakeholders for managing resources in the watershed
- Coordinate budget establishment process and financial evaluation of MWMO projects and activity areas
- Work with member organizations on the implementation of ordinances, standards, plans, and enforcement
- Participate in regional working groups for protection and improvement of the Mississippi River
- Develop plans for habitat and stormwater that are intended to re-connect neighborhoods to waterbodies and natural areas in the watershed Establish public and private partnerships during redevelopment that restore net positive social, environmental, and economic equity in communities

Watershed Assessment

Purpose: Develop a scientific base of knowledge that characterizes physical, chemical, cultural, historic, biological, social, economic, organizational, and political resources of the MWMO to guide planning and management decisions in the watershed.

Justification: Watershed Assessment projects and activities meet the purpose of water management programs found under Minnesota Statutes Chapter 103B.201. Assessments enable a management and prioritization of water resource issues that is scientifically based, accurate, and effective. These projects and activities support both internal and external planning initiatives and the MWMO's implementation efforts by providing information on the physical and social conditions of the watershed allowing focused and equitable planning and implementation.

Objectives:

- Provide the research, engineering, social and physical science required to understand how new redevelopment infrastructure (stormwater, rate control, and habitat) can break down and remove the historic and present-day systemic barriers that have led to the existing social inequity in communities, climate change related challenges, and growing infrastructure debt.
- Provide information needed to set and refine design and performance standards for the watershed

- Conduct basic research to enhance understanding of general water resource issues and emerging issues within and beyond the watershed's boundaries
- Conduct assessments within the watershed to define the ecological, physical, biological, cultural, social, economic, organizational, and political characteristics that comprise the MWMO
- Conduct project-based diagnostic and feasibility studies
- Provide information to support other MWMO projects and work areas
- Provide information to inform the prioritization and use of the MWMO's natural, financial, and human resources
- Provide watershed information to organizations both inside and outside the MWMO's boundaries

7.2 Plan Amendments

As a governmental entity, the MWMO levies taxes to pay for its activities. As such, it is essential that there is an opportunity for input by the community when the MWMO is amending or identifying new activities it will take on in the Plan. In addition, actions taken by the MWMO affect the activities of many other governmental and private entities. Thus, when making Plan amendments, coordination with these entities is an essential part of balancing the needs of all affected parties.

This plan will guide MWMO activities until BWSR's 10-year plan update approval in 2031 unless it is superseded by the adoption and approval of a subsequent plan within the ten-year timeframe. Many uncertainties arise when trying to align a ten-year planning horizon with the one-year capital budget cycles of the MWMO and member organizations. Thus, changes and amendments to the plan are likely to occur prior to the next scheduled update in 2031. The MWMO will follow the most recent version of Minnesota Statutes, section 103B.231 and Minnesota Rules 8410 when amending the Plan.

The more routine plan changes can be implemented through a process known as "Changes not requiring an amendment" where only a notice and the distribution of changes made is required. These draft and final changes may be sent electronically and must be distributed to member cities, agencies, counties, and watersheds who have received a copy of the MWMO's Plan. Distribution must include a version of track changes made with deleted text as stricken and new text as underlined. Final changes need to be in the form of replacement pages for the plan with each page renumbered as appropriate and each page including the effective date of the change. Changes not requiring an amendment to the plan are as follows:

- formatting or reorganization of the plan;
- revision of a procedure meant to streamline administration of the plan;
- clarification of existing plan goals or policies;
- inclusion of additional data not requiring interpretation;
- expansion of public process; or
- adjustments to how an organization will carry out program activities within its discretion.

In 2016 the MWMO routed a copy of the Plan with changes not requiring an amendment to provide member communities with timely and current information for their mandatory comprehensive plan update cycles.

The MWMO will review, revise, or amend this plan when completion of current and future studies, regulatory changes, emerging issues, or new research necessitates changes in the implementation schedule or activities of the organization. Finally, the MWMO will review, revise, or amend as necessary its long-range implementation program through the MWMO annual budget and work plan process.

The following is an abbreviated version of the current amendment process which describes: the type of amendment needed, procedural process to be followed, and oversight on the process:

When making amendments to the Plan the MWMO will adhere to the review process provided in Minnesota Statutes, section 103B.231, subdivision 11, except when the proposed amendments are determined to be minor amendments according to the following provisions:

- the Board of Water Soil Resources has either agreed that the amendments are minor or failed to act within five working days of the end of the comment period specified in item B unless an extension is mutually agreed to with the MWMO;
- the MWMO has sent copies of the amendments to the plan review authorities for review and comment allowing at least 30 days for receipt of comments, has identified the minor amendment procedure is being followed, and directed that comments be sent to the MWMO and the Board of Water Soil Resources;
- no county board has filed an objection to the amendments with the organization and the board within the comment period specified in item B unless an extension is mutually agreed upon by the county and the MWMO;
- the MWMO has held a public meeting to explain the amendments and published a legal notice of the meeting twice, at least seven days and 14 days before the date of the meeting; and
- the amendments are not necessary to make the plan consistent with an approved and adopted county groundwater plan.

Draft and final amendments may be sent electronically. A receiving entity may request to receive an amendment in paper format. Draft amendments must show deleted text as stricken and new text as underlined. Unless the entire document is redone, all final amendments adopted by the organization must be in the form of replacement pages for the plan with each page renumbered as appropriate and each page including the effective date of the amendment.

The MWMO will maintain a distribution list of member organizations, state review agencies, the Metropolitan Council, Hennepin County, Ramsey County, Anoka County, and interested parties who have received a copy of the plan. The MWMO will distribute copies of amendments to all on the distribution list and post the amendments on the organization's web site within 30 days of adoption.

Government agencies reviewing proposed amendments are encouraged to use the opportunity to balance needs and coordinate activities with the MWMO. Taxpayers of the MWMO can comment on proposed amendments by contacting the MWMO to request a copy of the amendment and providing written comment and/or by providing input at the public meeting.

7.3 Administration of Legal Boundary

The MWMO primarily conducts activities for protection and improvement of water and natural resources within its legal boundary. Due to its urban setting, the MWMO's legal boundary encompasses an interconnected drainage network of pipes passing between the cities of Minneapolis, Saint Anthony Village, Saint Paul, and Lauderdale and between the cities of Hilltop, Columbia Heights, and Fridley and discharging directly to the Mississippi River. The legal boundary follows established property lines and typically starts in places where the upstream surficial drainages and topography are routed into this network of pipes. In cases where activities occurring outside the MWMO's legal boundary are affecting the MWMO's water resources, the MWMO will work with the adjacent watershed management organizations, watershed districts, any other local unit of government or organization to address water or natural resource protection or improvement issues.

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Figures Source Information

Figure #	Name	Layer	Source	Year
1	MWMO Boundary	MWMO Boundary	MWMO	2014
2	Potential Limitations to Infiltration	Infiltration	MWMO	2014
	Location Map of Special Area Plans	Special Area Plans	MWMO	2014
3	Topography	Contours	Minnesota DNR	2011
4	Surficial Geology	Surficial Geology	Minnesota Geological Survey (M-178)	2007
5	Bedrock Geology	Bedrock Geology	MPCA Metropolitan Groundwater Model	2000
6	Bedrock Units	Bedrock Profile (not a map)	(Ojakangas and Marsh, 1982)	1982
7	Historic Hydrologic Soil Group	Hydrologic Soils	NRCS	2007
8	Present Day Urban Soils	Soil Type	Historic Waters of the MWMO Study	2011
9	Modern Secondary Soil Information	Soil Information	Historic Waters of the MWMO Study	2011
10	Combined Historic and Modern Soil Information	Modern Soil Unit	Historic Waters of the MWMO Study	2011
11	Soil Series	Hennepin NRCS Soil Units	Historic Waters of the MWMO Study	2011
12	Soil Orders	NRCS Natural Soil or Complex	Historic Waters of the MWMO Study	2011
13	NRCS Based Vegetation	NRCS Vegetation	Historic Waters of the MWMO Study	2011
14	Historic Estimate of Soil Hydrologic Group	NRCS	Historic Waters of the MWMO Study	2011
15	Natural and Semi Natural Areas	Natural and Semi Natural Areas	Minnesota DNR	2008
16	Population Density	Block Groups	U.S. Census Bureau	2010
17	Areas of Concentrated Poverty	ACP 50	Met Council	2019
18	Population Density	2010 Population	Census	2010
19	Neighborhood Boundaries	Minneapolis Neighborhoods	City of Minneapolis	2014
20	Historic Subwatersheds	Historic Subwatersheds	MWMO	2009
21	Present land use	Land Use	Metropolitan Council	2011
22	2020 Future Land Use	2020 Land Use	Metropolitan Council	2014
23	Surface and Groundwater Appropriations	Water Use Permit	Minnesota DNR	2014
24	Parks and Open Space	Map Created By City	City of Minneapolis	2008

Figure #	Name	Layer	Source	Year
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27	Minneapolis Trail System and Regional Park System	Map Created By City	Minneapolis Park and Recreation Board	2007
28	Minneapolis Existing Land Use	Map Created By City	City of Minneapolis	2009
29	Minneapolis Future Land Use	Map Created By City	City of Minneapolis	2009
30	City of Saint Anthony Village Existing Land Use	Map Created By City	City of Saint Anthony Village	2008
31	City of Lauderdale Existing Land Use	Map Created By City	City of Lauderdale	2008
32	City of Saint Paul Park System	Map Created By City	City of Saint Paul	2008
33	Columbia Heights Existing Land Use	Land Use	City of Columbia Heights	2008
34	Columbia Heights Future Land Use	2030 Land Use	City of Columbia Heights	2008
35	Fridley Existing Land Use	Land Use	City of Fridley	2007
36	Friday Future Land Use	2030 Land Use	City of Friday	2007
37	Hilltop Existing Land Use	Land Use	City of Hilltop	2009
38	Hilltop Future Land Use	2030 Land Use	City of Hilltop	2009
39	Mississippi National River and Recreation Map	Map Created By Agency	National Park Service	No Date
40	Permitted Wastewater and Industrial Stormwater Sites	Industrial Stormwater Permit	Minnesota Pollution Control Agency	2014
		Wastewater Discharge Sites	Minnesota Pollution Control Agency	2014
41	Known and Potential Sources of Soil and Groundwater Contamination	Contaminated Sites	Minnesota Pollution Control Agency	2014
42	Environmental Hazards	Potentially Contaminated Sites	Minnesota Pollution Control Agency	2014
		County Well Index	Minnesota Department of Health	2014
		Leaking Underground Storage Tanks	Minnesota Pollution Control Agency	2014
43	Surface Water Resources	Wetlands (NWI)	U.S. Fish and Wildlife Service	2007
		Bridal Veil Falls	EOR	2009
		Public Waters Inventory	Minnesota DNR	2009

Figure #	Name	Layer	Source	Year
		(PWI)		
44	Metropolitan Mosquito Control District Wetlands	MMCD Wetlands	Metropolitan Mosquito Control Distric	2014
45	Impaired Waters	Impaired Waters	Minnesota Pollution Control Agency	2014
46	Minor Pipeshed Boundaries	Minneapolis Pipesheds	City of Minneapolis	2020
		Lauderdale Pipesheds	City of Lauderdale	2008
		Saint Anthony Village Pipesheds	City of Saint Anthony Village	2008
		Saint Paul Pipesheds	City of St. Paul	No date
		City of Fridley Pipesheds	City of Fridley	2020
		Columbia Heights Pipesheds	Columbia Heights	2020
47	Subwatersheds	MWMO Subwatersheds	MWMO	2014
48	1997 Flood Areas	Map Created by Minneapolis	City of Minneapolis	1997
49	Storm Tunnel System	Map Created by Minneapolis	City of Minneapolis	No date
50	FEMA Designated Flood Plains	Floodplains	Federal Emergency Management Agen	2007
51	Sensitivity to Groundwater Pollution	Sensitivity to Goundwater Pollution	Minnesota Geological Survey	1989
52	Groundwater Management Areas	Wellhead Protection Areas	Minnesota Department of Health	2019
		Source Water Assessment Areas	Minnesota Department of Health	2014
		Drinking Water Supply Management Area Vul	Minnesota Department of Health	2014
53	Monitoring Sites	Monitoring Sites	MWMO	2014

Appendices

Appendices A – K Combined (PDF, 7 MB, 251 pages)

Appendix A MWMO Joint and Cooperative Agreement, Legal Description and Bylaws (PDF, 3 MB, 59 pages)

Appendix B MWMO Standards (PDF, 0.1 MB, 6 pages)

Appendix C Water Resource-Related Activities of Member Organizations (PDF, 0.9 MB, 82 pages)

Appendix D Soil Series Descriptions (PDF, 0.2 MB, 11 pages)

Appendix E Rare Species Index and Blanding's Turtle Information (PDF, 0.5 MB, 12 pages)

Appendix F Joint and Cooperative Agreement regarding Bassett Creek Tunnels (PDF, 1 MB, 18 pages)

Appendix G Public Comments and Issues Identification (PDF, 0.3 MB, 16 pages)

Appendix H Statutory Reviewer Comments and Responses 2020 (PDF, 0.4 MB, 20 pages)

Appendix I Design Sequence Flow Chart (PDF, 0.1 MB, 2 pages)

Appendix J MWMO 2021 WMP Data Sources and Updates (PDF, 0.4 MB, 21 pages)

Appendix K Public Hearing Comments and Responses (PDF, 0.2 MB, 2 pages)