WATER QUALITY

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Acronyms and abbreviations

Environmental Services – Metropolitan Council Environmental Services
EPA – United States Environmental Protection Agency
Metro region – Seven County Twin Cities Metropolitan Area
Met Council – Metropolitan Council
MPCA – Minnesota Pollution Control Agency
NPDES – National Pollutant Discharge Elimination System
PCE – Perchloroethylene
PFAS – Per- and polyfluoroalkyl substances
PFOA – Perfluorooctanoic acid
PFOS – Perfluorooctanesulfonic acid
TCE – Trichloroethylene

Policy research approach

The Metropolitan Council (Met Council) is charged by state statute to develop plans for the growth and economic development of the seven-county Twin Cities metropolitan area (metro region). Publications like the metropolitan development guide (***Thrive MSP 2040***) and associated system plans, including the ***Water Resources Policy Plan***, are the primary vehicle for us to share our vision and goals for the region. They are updated every ten years but have a twenty five-year planning horizon to allow for long-term development of the region. Each iteration of regional planning builds upon the previous effort, while adjusting our actions, policies, and vision to address current issues, mitigate future risks, and optimize regional opportunities.

The 2050 Water Resources Policy Plan, like the 2040 plan before it, will be an integrated plan that supports our core mission to operate and manage the regional wastewater system, provide water supply planning, and provide surface water planning and management throughout the region. It will serve as our guide to address issues affecting our waters, and to protect these resources for future generations.

This research paper is part of a series investigating current and future water concerns for the metro region. Together, these papers will inform our 2050 Water Resources Policy Plan. The paper topics are:

- Protecting source water areas
- Rural water concerns
- Water and climate
- Water availability, access, and use
- Water reuse
- Water quality
- Wastewater concerns

The project intent is to share our current understanding of issues, identify current policy connections or gaps, and to propose future policies and strategies to ensure sustainable water resources. Not all the recommendations included in the papers will move forward for inclusion into the Water Resources Policy Plan, and conversely, the Water Resources Policy Plan may include policies not discussed in these papers. The intent is to begin to develop a shared understanding and conversation about topics that are connected to all aspects of our core services.

Research paper topics were investigated using three core principles:

- **One Water, integrated water management:** The metro region is water-rich, and that water holds immense value. Integrated water management, also known as "One Water", addresses water as it moves from water supply, through wastewater systems and into surface waters. The ultimate goal of integrated water management is sustainable, high-quality water in the region.
- **Use existing systems:** The metro region has a robust water planning and wastewater operations system with many actors – community water and wastewater utilities, watershed management organizations, and regional, county, state, and federal agencies. Coordination and collaboration between these groups is necessary to protect our water for future generations.
- **Metric-based policies:** It is hard to quantify policy success without accountability. We will provide policy options with associated metrics and measurable outcomes where possible, to demonstrate the effectiveness of our water policies and actions.

Introduction and background

Water has always defined this region. From the glaciers that shaped the land, to the cultures that thrive along its lakes, rivers, and streams. From the very beginning, water has held great significance to the people of the region. The name Minnesota is derived from the name the Dakota people gave this land, Mni Sóta Maḳoce – meaning 'the land where waters reflect the skies' (Roper, 2021).

With almost 1,000 lakes and hundreds of miles of rivers and streams, the landscape of the metro region (**Figure 1**) is underlain by surficial sand and gravel aquifers, and deeper bedrock aquifers (**Figure 2**) that provide nearly 70% of the drinking water for the metro region (Met Council, 2022). Throughout time, the people of the area have used the regional waters to gain sustenance, spiritual solace, recreational enjoyment, transportation of goods and people, and to harness industrial power. The metro region has been and is continually shaped by the water that moves through it - without our abundant regional waters, much of our identity would be lost.

As the region developed, natural resources were utilized in the name of progress. Unfortunately, progress came with unintended consequences, and pollution and exploitation of resources resulted in harm to ecosystem and public health (**Figure 3**). In the metro region specifically, the construction of Lock and Dam #1 caused the backup of raw sewage that previously flowed with the Mississippi River currents. This created a public health emergency, as residents were sickened with cholera and other contact diseases. The Minnesota State Board of Health declared the Mississippi River a "public health nuisance," which eventually triggered the creation of the Minneapolis-St. Paul Sanitary District in 1933 and the construction of the Metropolitan Wastewater Treatment Plant in 1938 (Minnesota Department of Health [MDH], 2018). The harmful environmental outcomes of progress rose to national awareness in the 1960's, and motivated policy makers to create regulations to protect our waters, air, land, and health (e.g., Clean Water Act (1972); Safe Drinking Water Act (1974)). We at the Met Council protect water quality as designated under Section 208 of the Clean Water Act. We provide wastewater treatment and urban stormwater management, and we monitor and assess the water quality of regional lakes, rivers, and streams to track our impact from wastewater treatment and the impact of regional development on our region's waters.

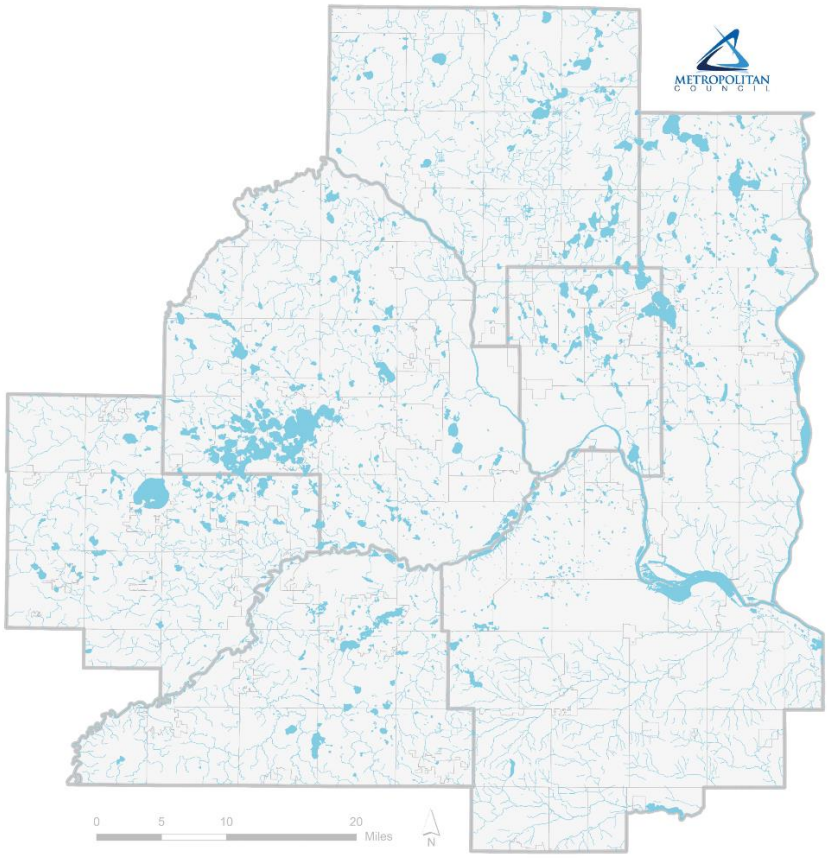


Figure 1: Regional rivers, lakes, and streams

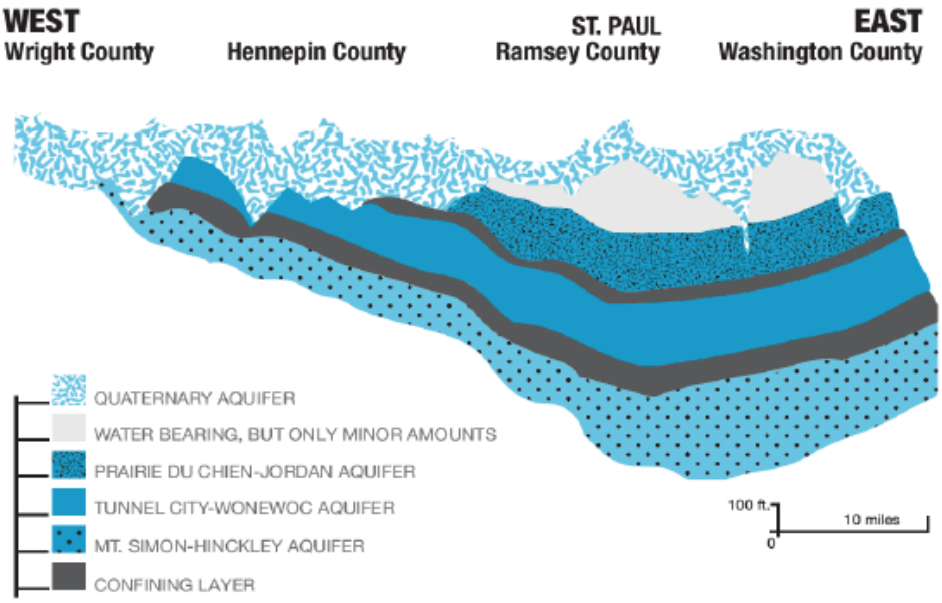


Figure 2: Regionally significant aquifers

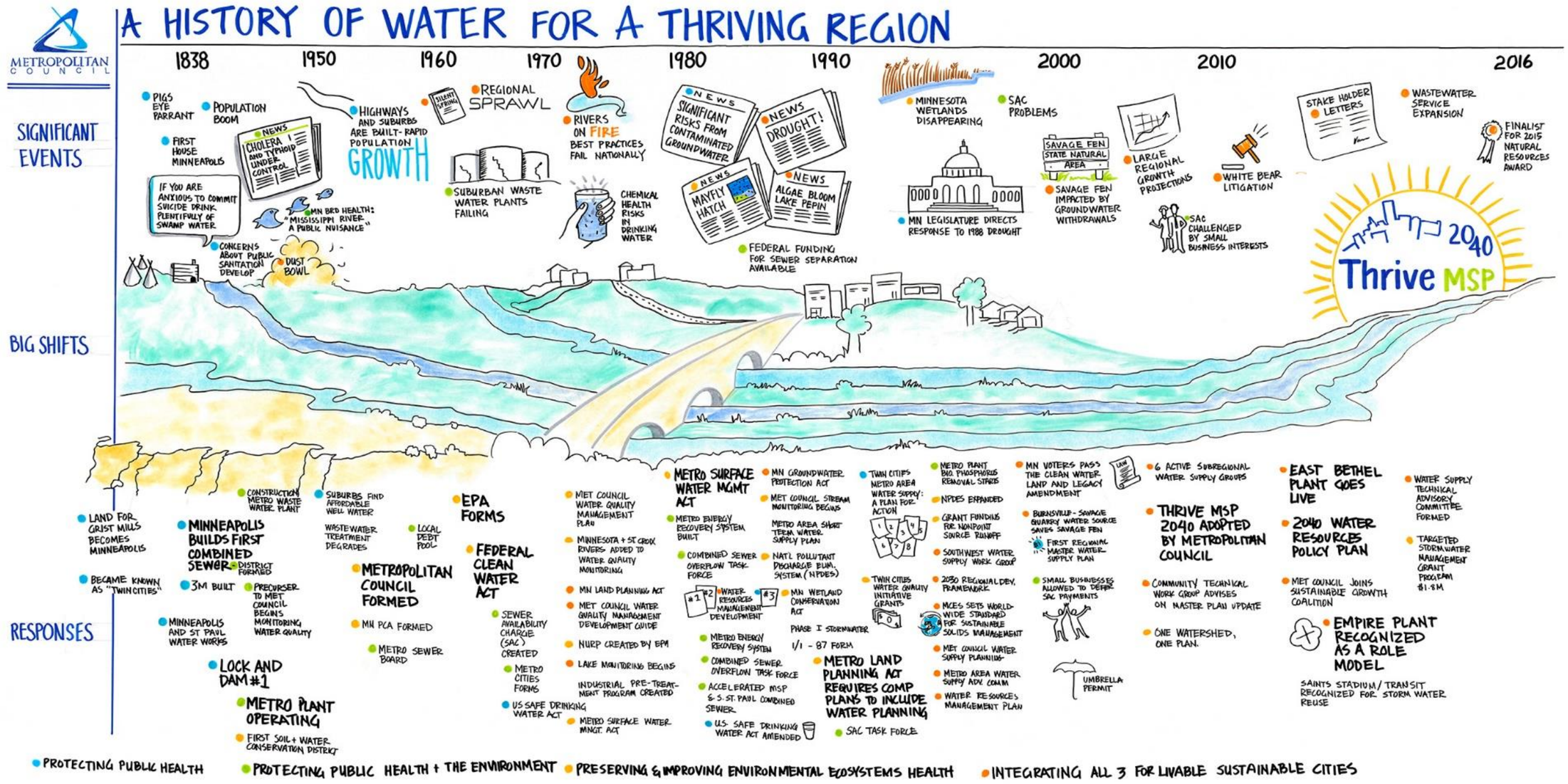


Figure 3: Twin Cities water history

Impaired waters

Federal and state water protection laws significantly reduced the amount of pollution in rivers, lakes, and streams nationwide since the passage of the Clean Water Act (Keiser & Shapiro, 2018). However, the country has not met the ambitious Clean Water Act goal of all waters being "drinkable, swimmable, and fishable." In Minnesota, the waters that do not meet state water quality standards are tracked on the Minnesota's Impaired Waters List. Usually, waterbodies are added due to persistent pollution, increased monitoring, or new, emerging contaminants. Unfortunately, waterbodies are listed faster than they are removed. Currently, there are 751 water quality impairments in 438 river sections, lakes, or stream reaches in the metro region (**Figure 4**), with many waters having more than one impairment (Minnesota Pollution Control Agency [MPCA], 2022a).

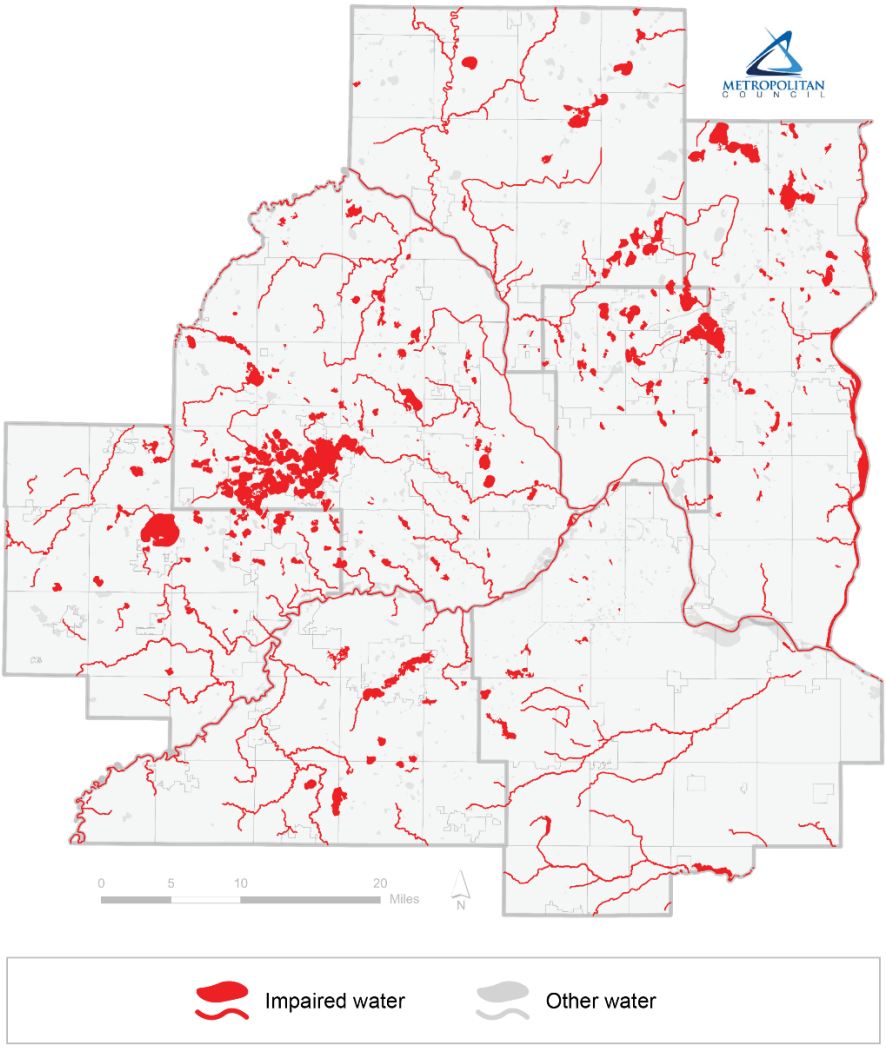


Figure 4: Regional impaired waters (303d Impaired Waters List [MPCA, 2022a])

Contamination consequences

The quality and quantity of water has direct effects on our ecosystems, health, agriculture, and infrastructure. The severity and type of contamination impacts how Minnesotans use and value the state's waters. The sources of contamination are both natural and caused by human activities. For example, elevated levels of manganese in drinking water are from groundwater weathering the soil and bedrock. Whereas elevated nitrate levels in drinking water (>10 mg/L) are usually caused by fertilizer and other nonpoint sources of pollution infiltrating drinking water sources. Regardless of the type, both natural and human-caused drinking water contamination causes negative health outcomes, especially for vulnerable groups like infants/small children and the elderly.

The consequences of water quality contamination are not isolated to drinking waters. Contaminated surface waters can also be harmful to humans and ecosystems. They can cause illness, alter food webs, and shift natural system structure. Wastewater treatment plants remove many pollutants but are not designed to remove all contaminants. Chloride, pharmaceuticals, and microplastics are still conveyed through wastewater treatment plants, and all have detrimental impacts on the ecosystems of the receiving waters. Additional examples of contamination concerns are shown in **Table 1** below.

Table 1: Example contaminants and concerns

Water type	Example contaminants	Concerns
Drinking water	• Chloride • *E. coli* bacteria • Elevated levels of manganese (or other metals) • Nitrate • Per- and polyfluoroalkyl substances (PFAS) • Dioxane • Trichloroethylene (TCE)	• Negative health impacts • Corrosion of infrastructure • Taste, color, and smell • Discoloration of clothing, appliances
Surface water	• Chloride • *E. coli* bacteria • Gas/oils • Nutrients (phosphorus & nitrate) • PFAS • Temperature	• Human and animal sickness/death from contact, inhalation, or ingestion of waters • Toxicity to wildlife, fish, and plants • Eutrophication (too many nutrients) • Fish kills • Harmful algal blooms • Plant and animal community shifts • Aquatic Invasive Species ○ (i.e., curly pond leaf, zebra mussels, spiny water flea)
Wastewater	• Chloride • PFAS • Pharmaceuticals • Microplastics	• Corrosion of infrastructure • Health impacts to wildlife, fish and plants • Accumulation of contaminants in animal tissue • Drug resistant bacteria

Issue statement

Water quality contamination and its consequences impacts public health, ecosystem function, and affects regional economic competitiveness. The metro region is experiencing increased pollutant-loaded runoff, a growing list of water impairments, contaminated drinking water supplies, and high utility treatment costs. Uncertainty around emerging contaminants, regulatory changes, and climate change intensifies these issues, and complicates how to address water contamination. Strong, regional water policies are necessary to restore and protect the quality of our waters and to ensure their resiliency to known and future contamination threats.

Our role

As the regional wastewater system operator and wastewater, surface water, and water supply planning agency for the seven-county metro area, we strive to ensure sustainable water resources through intentional planning and operations. Our wastewater treatment plants continually meet National Pollutant Discharge Elimination System (NPDES) Permit requirements. Our wastewater, surface water and water supply planning functions work to promote sustainable water resources while addressing the pollution and other factors that impacts those resources. Clean water for drinking, recreating, and treated by our wastewater treatment plants all are important parts of the region's livability and prosperity. We work with our partners, our regional influence, and perform our statutory responsibilities to protect and preserve our water.

We have three primary water planning focuses supported by state and federal statute.

- **Wastewater:** We prepare a comprehensive development guide consisting of policy statements, goals, standards, programs, and maps prescribing guides for the orderly and economical development of the region. The regional wastewater collection and treatment system one of the four regional systems included in this effort (Minn. Stat. § 473.145).

- **Water Resources Management:** State and federal law requires us to adopt a water resources plan and federal requirements for a regional management plan to address pollution from point sources, such as treatment plant discharges, and nonpoint sources, such as stormwater runoff (Minn. Stat. § 473.157; 33 U.S.C. §1288).

- **Water Supply Planning:** We are required to create plans to address regional water supply needs, including the regional Master Water Supply Plan, developing and maintaining technical information related to water supply issues and concerns, providing assistance to communities in the development of their local water supply plans, and identifying approaches for emerging water supply issues (Minn. Stat. § 473.1565).

As a part of our statutory authority, we are required to review and comment on Local Comprehensive Sewer, Local Surface Water Management, and Local Water Supply Plans (as described in Minn. Stat. § 103G.291, subd. 3) to ensure that they are in conformance and compliance with the regional plans.

The metro region has several levels of water governance with municipal, county, watershed, regional, state, and federal agencies all having a role. Cross-agency coordination and partnerships are key to successfully managing the region's waters (**Figure 5**). These partnerships

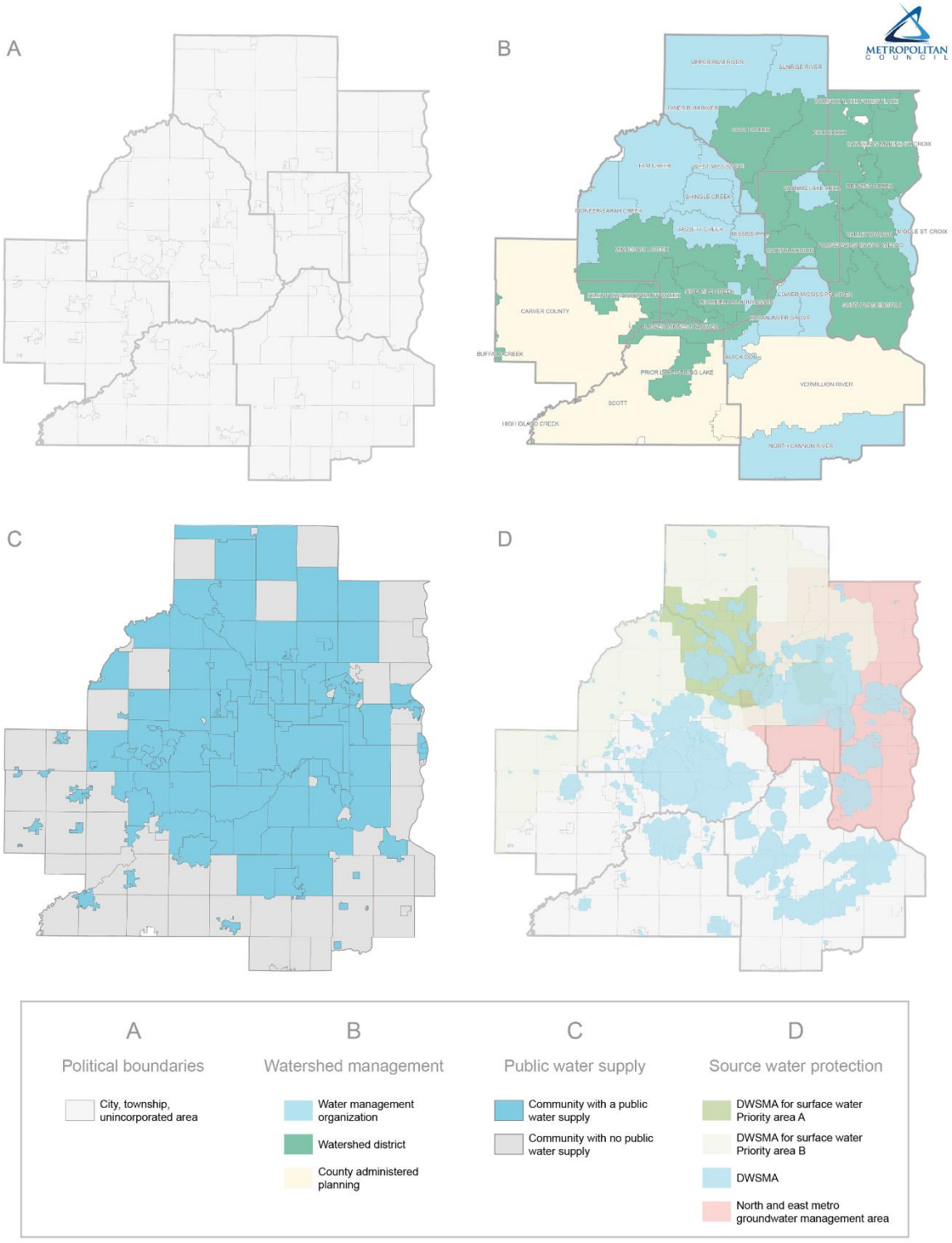


Figure 5: Water planning boundaries

Political boundaries (A), watershed boundaries (B), public water supply (C), and drinking water supply management area boundaries (D).

broaden our reach and influence to achieve regional water goals. For example, we adaptively manage water resources in partnership with watershed organizations and communities by:

- Monitoring regional river, lake, and stream water quality.
- Collecting and assessing data to understand surface water and groundwater conditions.
- Providing technical guidance on surface water management and drinking water protection through research, advisory committees, plan reviews, and other activities to cities, townships, counties, and watershed organizations.
- Assisting communities through grants to implement water efficiency, stormwater, and inflow and infiltration (I/I) programs.

We have used our resources and influence to establish contaminant investigation task forces. These task forces define the scale and scope of the challenge and develop regional solutions. Most recently, Environmental Services formed internal teams to address chloride and PFAS risks to metro water resources and the regional wastewater system. This process can and should be replicated as water challenges continue to emerge but, as they become increasingly complex, they cannot always be addressed by internal taskforces alone. Most require multiple perspectives from throughout the region to fully grasp the breadth of the issue. It is important that we convene regional water stakeholders (e.g., federal, state, and local agencies, non-profits, academia, professional organizations) to share knowledge, develop expectations, and collaborate on improving our region's waters.

Crucial concerns

In order to improve water quality, we need to highlight the challenges we face in the process. In this section, we address the primary drivers that influence water contamination, contaminants that are of key concern to the metro region, and the important connection between regional water quality and equity. These are the most crucial components to understand and are the basis of our policy recommendations.

Primary drivers

Water contamination is categorized as either point source pollution or non-point source pollution. Point sources are finite locations, usually where the end of a pipe discharges pollutants to water. By definition, point sources are easily identified and can typically be addressed through permitting and regulation. Non-point sources of pollution do not come from a single location. Instead, they are caused by rain and snowmelt washing pollutants off the landscape into rivers, lakes, streams, wetlands, and groundwater. Non-point sources of pollution are the largest cause of water contamination in the country (United States Environmental Protection Agency [EPA], 2021a). Non-point source pollution is a product of the number of people in the area, their behavior and interaction with water, land use and development patterns, and the frequency and amount of precipitation.

Population growth

The metro region's population has grown significantly since the creation of the Met Council. The population has doubled from 1960 to 2020 (**Figure 6**), climbing from 1.5 million residents to 3.2

million residents, and it is forecast to continue to increase to slightly over 4 million by 2050. Without careful planning and best management practices, this growing population can place significant stress on water availability and quality (Damania, 2019). This is a crucial concern for us, as we support regional growth and ensure sustainable water resources. Policies, planning, and investment will be needed to prevent conflicts between these goals.

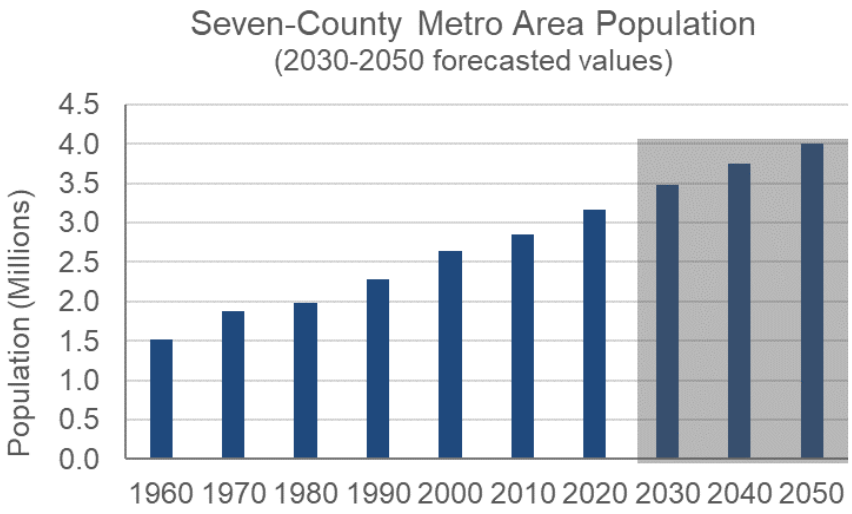


Figure 6:Seven-county metro region population and forecasts, 1960-2050

Land use change

As more people located to the metro region, the land use changed. Centralized development expanded across the seven counties (**Figure 7**). In the process, land surfaces changed from farm fields, woodlands, and open spaces to roads, parking lots, and buildings. There was a 56% reduction in agricultural, woodland, or undeveloped areas from 1968 to 2020. These increases affected the amount of environmental pollution, modified the ways water infiltrated and moved across the landscape, and reduced the potential for groundwater recharge – all factors influencing the quality and quantity of water in the urban areas of the metro.

Change was not isolated to the urban areas. Rural land use also changed as areas with active farming declined between 1968 to 2020. Although there is less land in agricultural production, technological improvements have increased crop yields. From 1968 to 2020, corn (grain) increased from 76.4 bushels per acre (bu/ac) to 188.3 bu/ac and soy increased from 20.3 bu/ac to 53.8 bu/ac (National Agricultural Statistics Service, n.d.). Farmers were now producing more on less land, but these agricultural improvements like hybrid and modified crops, tile drainage, and synthetic fertilizer can have negative water quality impacts without good management practices (UEPA, 2021b; University of Minnesota Extension, 2018).

Land use and water quality recommendations

- Metropolitan Council staff will create resources and tools to promote best land use practices for communities and watersheds across the metro. Examples:
    - Encourage bee-lawns and other no-mow, anti-erosion, low fertilizer lawn alternatives
    - Connect developers and watershed organizations early in the development process to plan proactively around water
    - Proactively create regional stormwater treatment and storage up front for phased redevelopment plans (like Allianz Field)
    - Encourage communities to adopt stormwater requirements for redevelopment of single-family properties (some communities exempt single-family redevelopment from doing any stormwater management)
- Metropolitan Council should consider supporting or investing in innovative urban planning research and design to encourage growth without placing additional stress on water resources.
    - Nature-based stormwater infrastructure
    - Low road salt development design - new or redevelopment approaches that naturally need less salt for winter maintenance
    - Porous pavements
    - Solar pavement
    - Narrower streets
    - Preservation of wellhead protection areas
- Metropolitan Council will work towards securing funds to offer targeted grants promoting protection of Priority Waters and Critical Watersheds, urban stormwater management, and agricultural best management practices.

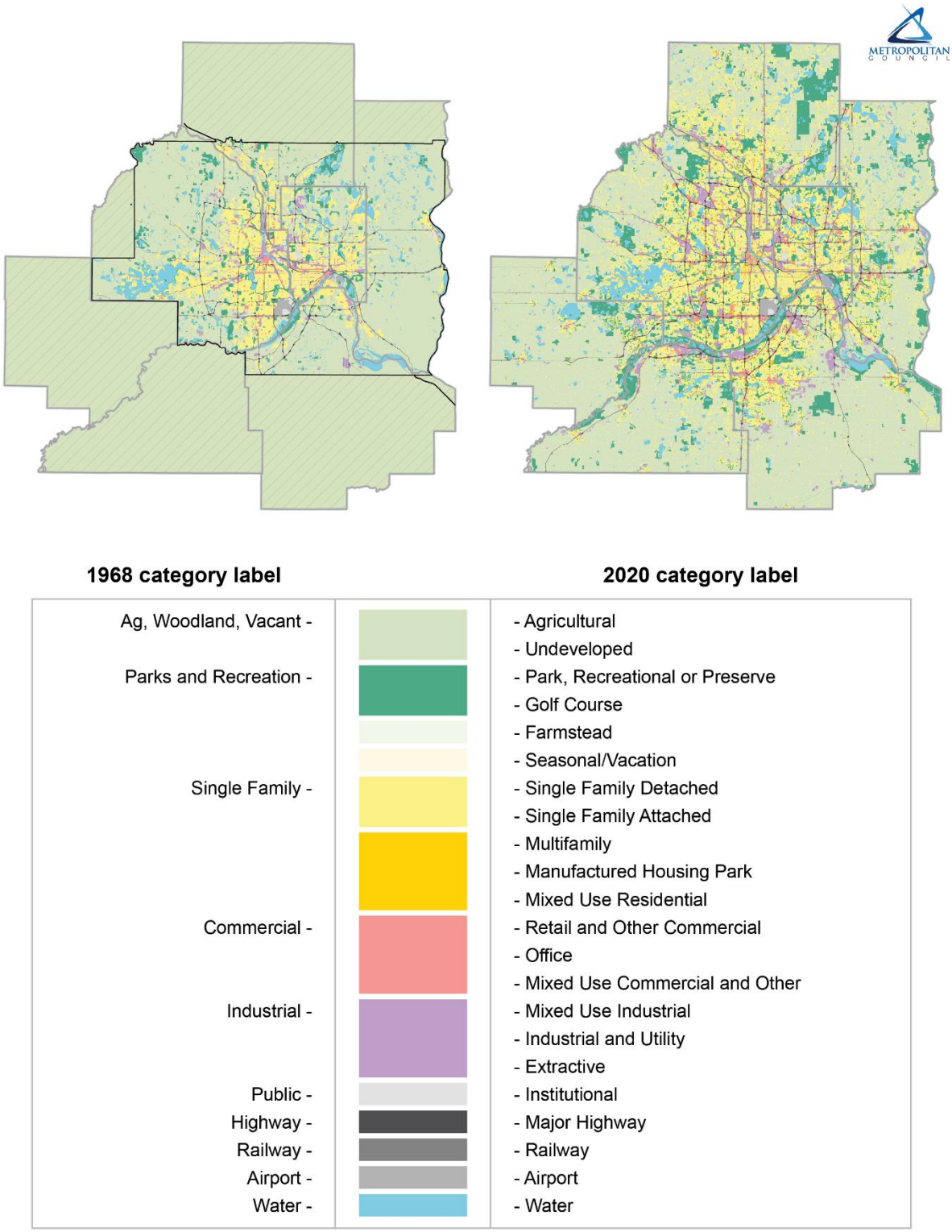


Figure 7: Metro region land use, 1968 and 2020.

Metro region land use in 1968 was identified at the time within the black outline. The 2020 metro region land use was identified across the entire 7-county area. Comparisons were only made between areas with data and not extrapolated.

Current and future climate

The metro region has a typical northern midcontinental climate pattern – summers are warm and humid, winters are cold and snowfall is common, and rainfall can occur during the spring, summer, and fall (**Figure 8**). This precipitation pattern results in water contamination events primarily in the spring through fall, with large non-point source pollution spikes during snowmelt and large storms.

Figure 8: Minneapolis-Saint Paul Airport monthly precipitation and snow normals, 1991-2020 (National Oceanic and Atmospheric Administration [NOAA], n.d.)

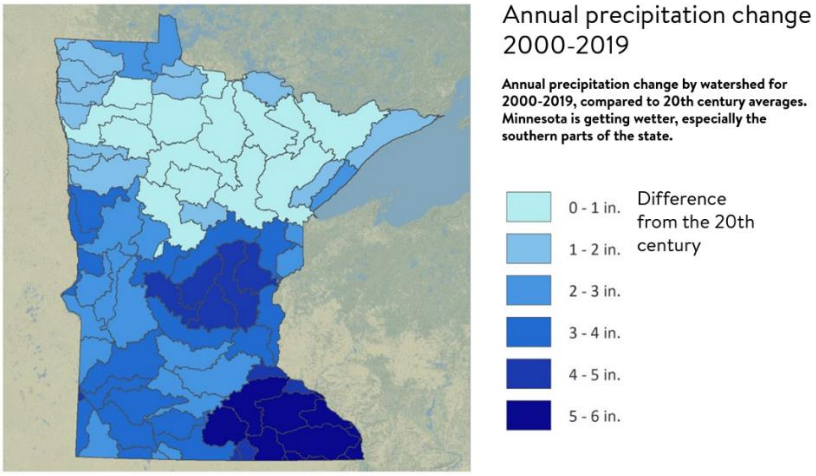


Figure 9: Annual precipitation change, 2000-2019 (Our Minnesota Climate, 2022)

Precipitation amounts have and are expected to continue increasing due to climate change. The timing of the precipitation is not shifting, the storm events have and will still occur spring through fall, but the intensity and amount of precipitation has changed. The metro region is already experiencing 3-4 inches more precipitation annually than the 20th century average (**Figure 9**). More frequent and intense storms will move more pollution into the region's waters, increasing contamination in rivers, lakes, streams, wetlands, and groundwaters. For more information about our specific climate concerns and recommended policies, please see the Water and Climate research paper.

Climate and water quality recommendations

- Metropolitan Council staff will implement and promote the use of nature-based, green infrastructure solutions on our properties where feasible.
    - Develop internal infrastructure design and placement guidelines based on the latest scientific and engineering knowledge to reduce their climate-risk on longevity.
- Metropolitan Council will provide data, information, and planning tools to assist local governments in resilient water resources and infrastructure planning and decision-making for a changing climate:
    - Monitor and assess regional Priority Waters for the impacts of climate
    - Lead and partner on regional climate scenario modeling and interpretation
    - Landscape assessments to identify areas prone to climate-risk (highly erodible soils, steep slopes, etc.)
    - Partner and develop onsite and remote sensing harmful algal bloom assessments to assist the DNR and watershed organizations

Water quality standards and regulation

Minnesota's state water quality standards are set by the Minnesota Pollution Control Agency (MPCA). They are intended to protect the waters of the state, identify waters that are impaired, and regulate point sources that discharge to the waters. The MPCA uses technical analysis, peer review, and public comment periods to revise or develop these water quality standards, and reviews them every three years.

As the regional wastewater system operator, we are one of the largest regulated point source dischargers in Minnesota. The system serves over half of the population of the state and treats 250 million gallons of wastewater daily. As of 2022, the nine wastewater treatment plants within our system have delivered a combined 126 years of excellence in regulatory compliance, often producing effluent that is cleaner than the receiving rivers.

We support the MPCA's water quality standard process through our metro water monitoring programs and by providing input to the process through a technical advisory role. Every major watershed in the state is monitored by the MPCA on a ten-year cycle. We, along with our partners, monitor the major rivers, major tributary streams, and selected lakes every year, which results in a more robust dataset and understanding of water quality dynamics within the metro region. When the MPCA does monitor regional waterbodies, we coordinate to ensure we are not duplicating efforts and we provide our data and assessments to assist in their development of the water quality standards.

Regulation and water quality recommendations

- Metropolitan Council will partner proactively in NPDES effluent permitting and water quality standards creation and review.
- Metropolitan Council will work with local, state, and federal water organizations to ensure all Priority Waters are monitored for nutrients, chlorides, and other contaminants of concern, and that data is shared at a frequency to allow assessment by MPCA against water quality standards.

Costs and benefits

The investment in good, clean waters is foundational to support our mission to foster efficient and economic growth for a prosperous region. The cost to improve and protect water quality through our facilities, infrastructure, and programs is expensive, but it is difficult to place a price on clean water. It has been estimated that the United States has invested $140 per person per year in water quality improvements since the passage of the Clean Water Act (Keiser & Shapiro, 2019). Beyond the obvious benefit of maintaining life, the additional benefits of improving water quality are vast, from the tangible: avoidance of future costs, increased property values, and protection of human health; to the intangible: aesthetic and cultural value, ecosystem services, and sustainable water resources for future generations (MPCA, 2022c).

Funding and water quality recommendations

- Metropolitan Council will seek out available funding sources to help offset the cost of clean water, and advocate for continuing these funding sources into the future. Examples of funding sources are:
    - Council levy funds
    - Council wastewater fees
    - Clean Water Fund / Clean Water, Land, and Legacy Amendment
    - Legislative-Citizen Commission on Minnesota Resources grants
    - Water Infrastructure Finance and Innovation Act funding
    - Clean Water State Revolving Fund
    - Additional state or federal programs

Emerging contaminants

Emerging contaminants are human-made, chemical compounds detected at low levels in water that have a detrimental impact on public health and aquatic life. The following emerging contaminants are just some examples of those impacting our water quality.

Microplastics are tiny pieces of plastic from a variety of sources (e.g., litter and fishing gear breaking down in surface water, and microfibers from laundered synthetic fabric). Because plastics degrade slowly over time and because of their small size, microplastics can be consumed and accumulate in animals like mussels, fish, and birds. This can seriously impact their health and the role they play in the ecosystem.

Pharmaceuticals enter the wastewater system through human excretion and by drugs flushed down the toilet. Today's treatment processes cannot remove them. Pharmaceuticals can negatively affect the health and behavior of wildlife like insects, fish, and birds.

New emerging contaminants are being identified as public health risks, and water professionals are learning more about how chemicals impact human health and the environment. There will always be "unknown unknown" contaminants, and we need to have tools and processes ready to tackle these challenges as they arise. Protecting the region's public health and water is the basis of our mission. We need to have strong policies and procedures in place to continue our regional responsibility and better prepare for the future.

Emerging contaminants recommendations

- The Metropolitan Council will adopt an adaptive management approach ("plan-do-study-check") to ensure our water policies are prioritized, targeted, measurable, and effective at improving the region's water quality.
- Metropolitan Council staff may lead regional, integrated water investigatory task forces to explore and address regionally significant contaminants of emerging concern, as necessary. They could establish a process to track emerging contaminants, assess their likely threat to waters in our region, develop a decision tree of when to initiate monitoring and assessments of these contaminants, and complete follow up actions:
    - Include watershed organization and city/township staff on the taskforce to provide the local perspective.
    - Establish current understanding and provide recommendations for next steps.
    - Create regional outreach and education to share with local units of government to modify behaviors towards pollutant generation, as appropriate.
    - Partner with local entities to reduce the prevalence of contaminant (alternative chemicals, legislative solutions, etc.).
- The Metropolitan Council will invest in new technology to improve water quality outcomes.
- The Metropolitan Council will partner with professional associations or research institutions to test and develop best water resources management practices or water treatment technological improvements.

Contaminants of concern

There are numerous contaminants that can impact water quality in various ways. This section focuses on four major contaminants or groups of contaminants that are of great concern to the region's waters. Some of these contaminants have been long known (nutrients and chloride) and some are of more recent concern (PFAS). We have made initial efforts in understanding and addressing the contaminates identified in this section through monitoring, assessment, investigatory taskforces, or technical advisory. Further work is needed to fully remediate the impacts of these contaminants.

Chloride

Chloride is a growing water quality concern in Minnesota. It occurs naturally in the environment but its presence is increasing in surface and groundwater due to human use, threatening aquatic life and drinking water supply. Chloride enters surface and groundwater from a variety of sources including road salt, water softeners, and agricultural fertilizer (MPCA, 2016a).

Chloride is a permanent pollutant. Once introduced it persists in the environment. It does not change form or cycle through any natural processes. Current technology and science make the removal of chloride from contaminated water cost prohibitive. The best management practice for chloride is source control to limit the introduction of additional chloride into surface and groundwater.

Since 2018, we established two internal chloride focused teams to address increasing chloride trends in surface and groundwater, concerns about chloride in wastewater discharge, and

requests from industry and community and watershed partners to discharge chloride into our Environmental Services wastewater collection system. These cross-functional teams have worked to better understand the risks of chloride to surface water, groundwater, wastewater, and water supply systems and identify chloride management alternatives.

Chloride sources

Chloride pollution in Minnesota has multiple sources. The three largest are household water softening, synthetic fertilizer, and de-icing salt (**Figure 10**).

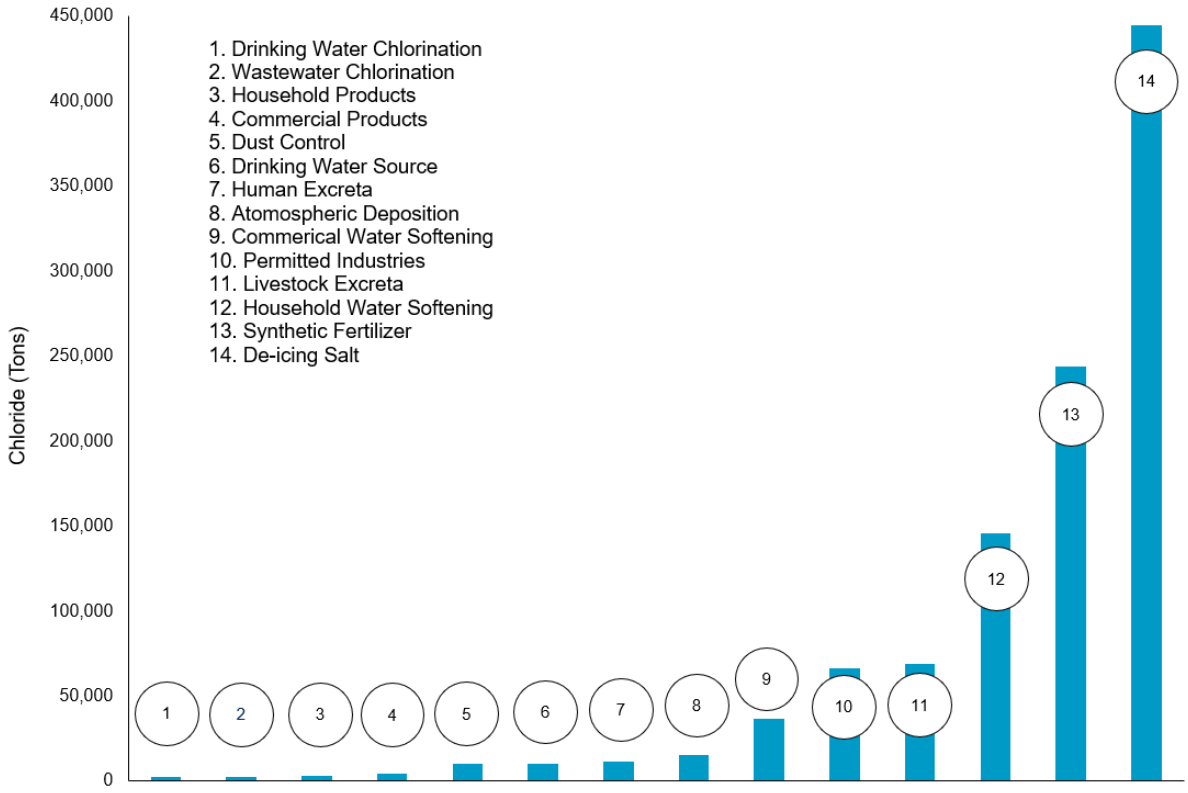


Figure 10: Major chloride sources and annual contributions to the environment in Minnesota

Water softening: More than 70% of the drinking water used in the Twin Cities comes from groundwater (Met Council, 2020) and many groundwater users soften their water with cation exchange resins (water softeners). Sodium chloride is used to periodically regenerate the resin, thereby releasing chloride as wastewater. Water softeners can provide benefits to homeowners such as increased lifespan for appliances and plumbing, and improved water quality for bathing and washing. The chloride waste from the water softening process enters surface and groundwater through wastewater treatment plants or residential subsurface sewage treatment systems (MPCA, 2020a).

Subsurface sewage treatment systems and typical municipal wastewater treatment plants cannot remove chloride with the existing treatment processes. It is estimated that roughly 65% of all chloride passing through wastewater treatment plants originates from residential/commercial water softening (MPCA, 2016a; Overbo et al, 2019).

***Fertilizer*:** Chloride is associated with macronutrients like potassium. The most common potassium source in Minnesota is potash fertilizer, which can contain potassium chloride (MPCA, 2020a). Plants consume the potassium and release the chloride into surface and groundwater. It is estimated that 220,000-260,000 tons of chloride are applied to croplands per year across the state of Minnesota through the application of certain fertilizers (MPCA, 2016a).

Additionally, tile drainage systems may be a large conveyance system of chloride from the land to surface waters. The amount of chloride concentration carried by tile drainage is variable over time and across agricultural lands.

Deicing salt: Winter maintenance provides a unique challenge since it requires public safety standards for cleared roads, sidewalks, and trails. Approximately 249,100 tons of chloride are used by cities and townships within the metro region annually in order to clear those roads (Overbo and Heger, n.d.). In the spring, the melting ice and snow carry the salt to surface and groundwater.

Commercial/private sources of chloride vary greatly since individual landowners and tenants conduct the application of salt and snow removal themselves. It is estimated commercial sources are responsible for 10%-20% of the total salt applied to paved surfaces in the metro and other urban areas (MPCA, 2016a; Wenck, 2009).

Chloride impacts

Chloride contamination has detrimental impacts on plant and animal health and ecosystem function. High concentrations of chloride can kill fish, invertebrates, and native plant species. Prolonged chloride contamination can lead to the invasion of salt tolerant plant species (MPCA, 2016b). It changes the density of water, negatively affecting a lake's ability to undergo turnover, which is important because turnover increases oxygen levels required for aquatic life, affects nutrient cycling processes, phytoplankton community composition and productivity, zooplankton community composition, and fish (MPCA, 2016b). It also affects the upland soils. Salt-laden soil can lose its ability to retain water and store nutrients. This causes the soil to be more prone to erosion and increased sediment runoff, which affects total suspended solids, phosphorous, and other nutrient pollution loading (MPCA, 2020a).

Chloride has negative impacts in the built environment as well. Water infrastructure is susceptible to elevated chloride concentrations. Chloride increases the electrical conductivity in water, which simultaneously increases its corrosivity (WHO, 2003). The chloride in the drinking water reacts with metal ions in the pipes it passes through, degrading the pipe itself and increasing metal concentrations within the drinking water (WHO, 2003). Increased salinity can also affect drinking water taste and at high levels negatively affect human health (MPCA, 2022b).

Chloride regional effects

Since 1985, chloride concentrations have been increasing in the Minnesota, St. Croix and Mississippi Rivers, and as of 2022, at least 39 streams in the seven-county metropolitan area are contaminated with excessive levels of chloride (**Figure 11**). It is estimated that only 22% to 30% of the chloride applied in the metro region was exported out of the region via streamflow in the Mississippi, Minnesota, and St. Croix Rivers, 70% to 78% of the applied chloride remains in the metro's lakes, wetlands, and groundwater, and it may also be stored in soil (Stefan *et. al*., 2008).

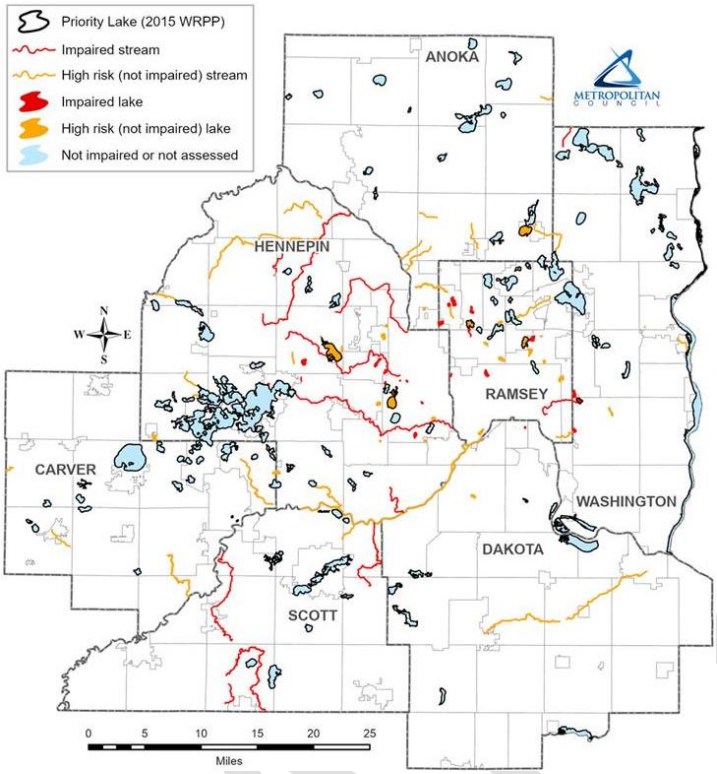


Figure 11: Waters impaired or at risk for chloride impairments within the metro region (MPCA, 2022a)

Surface waters and groundwater are interconnected. Chloride that has contaminated soils, streams, lakes, wetlands, and rivers can infiltrate into shallow groundwater increasing the chloride concentrations. Groundwater is the source of drinking water for 75% of the people in the Twin Cities metropolitan area. In 2013-2017 MPCA collected groundwater monitoring data, which found that 16% of monitoring wells tested in shallow sand and gravel aquifers in the metro region exceeded the state chronic standard of 230 mg/L (MPCA, 2016a). Waters in developed watersheds and those with hard drinking water sources are at risk for chloride impairment.

Chloride in wastewater is also a regional concern. Wastewater treatment plants are conduits for, not sources of, chloride. Less than 1% of wastewater treatment plant effluent chloride is from the plant itself. The primary sources of chloride to our treatment plants are residential water softening followed by industrial processing and commercial softening. This differs from the primary source of chloride to surface and groundwater in the metro, which is road salt. From a regulatory standpoint, chloride effluent limits for NPDES permits are not anticipated for most of the regional wastewater treatment plants in the foreseeable future. This is because the plants discharging to the Mississippi, Minnesota, and St. Croix Rivers are not likely to exceed the chloride water quality standard given current conditions. That could change if commercial and industrial discharges to the wastewater collection system change significantly.

Chloride prevention and reduction

Source control is necessary to reduce loading to already impacted waters and to protect regional water resources. Chloride persists in the environment and is economically prohibitive to treat. Currently, there are no cost effective and safe alternatives to road salt, and there are few

options for eliminating chloride in water softening and agricultural practices. The best management practices for reducing chloride are behavior modification, education, and source control (**Figure 12**).

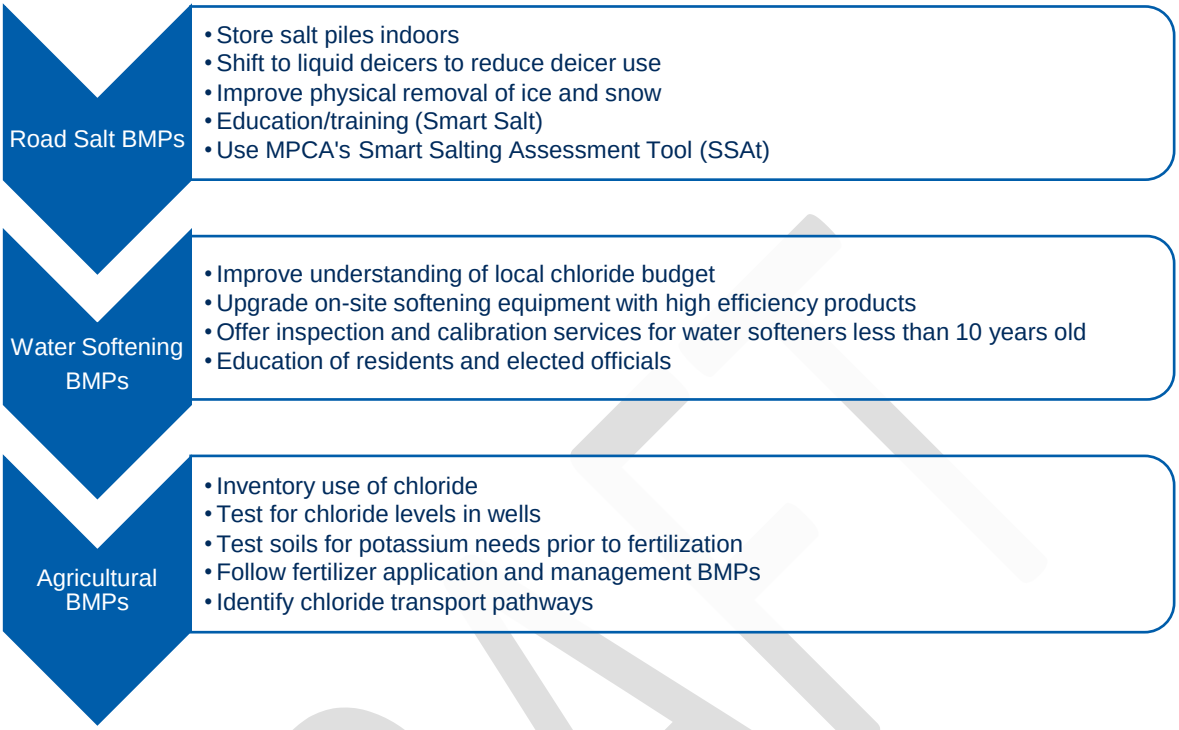


Figure 12: Chloride best management practices (BMPs) (MPCA, 2022b)

Understanding chloride dynamics through monitoring and modeling is key to identifying which waters are susceptible or resistant to chloride impairment. This will allow us to target non-point source interventions and make relevant facility plans if receiving waters are at risk of chloride impairment. We at Environmental Services and our partnering agencies/organizations monitor selected regional waters for chloride. Coordination and communication between organizations is vital to prevent duplication and optimize efforts.

Coordination is also important within our monitoring programs as well. Currently, chloride monitoring data is collected for streams, lakes, rivers, permitted groundwater, and effluent sampling. These monitoring efforts could be better coordinated to understand how chloride is transported through the metro region. Integrating our five independent water quality monitoring programs will take substantial investment but will provide a better understanding of pollutant dynamics and reflect our integrated water planning perspective.

Chloride recommendations

- The Metropolitan Council will expand the Industrial Pretreatment Incentive Program to reduce chloride laden industrial sources.
- The region could reduce the source of chlorides in metro region water by supporting Limited Liability legislation to reduce salt application on private property.

- The Metropolitan Council will investigate the regional need and economic and legal viability of accepting salty stormwater discharges to our wastewater collection and treatment system allowing for the reversal of chloride impaired waters from the region.
- The Metropolitan Council will work towards securing funds to provide grants promoting water quality best management practices for residential, commercial, agricultural, and industrial purposes, and provide grants for water softener efficiency improvements.

Nutrients – Phosphorus and Nitrogen

Nutrients are a broad category of elements which are required for proper ecosystem function. The most common nutrients are nitrogen (often measured as nitrate, NO_3) and phosphorus (typically measured as total phosphorus, TP). Phosphorus and nitrogen are naturally found in all surface waters, where they are absorbed by plants, algae, and microbes (primary producers). Under pristine conditions, nutrients, primary producers, and consumers remain in balance. When ecosystems have excess nutrients, they show various signs of stress including algal blooms, lowered dissolved oxygen, and occasional fish kills.

Phosphorus

In freshwater systems, phosphorus is the primary nutrient limiting algae growth. Phosphorus attaches to soil and other particles, which are then transported to surface water through stormwater runoff. It is either absorbed by algae or the phosphorus bearing particles are deposited as sediment. The reservoir of phosphorus stored in the sediment is known as an internal load because it is cycled through the food web, water, and sediments until it is physically removed.

Rivers also store phosphorus in their sediment and banks, but the process is slightly different because phosphorus can be carried by continually flowing water through the system. Climate change, stormwater conveyance and tile drainage are increasing river flows. Increasing river flows erode and destabilize river channels, mobilizing the phosphorus bound to the sediments and soil.

In the natural environment, human activity dramatically increases phosphorus loading, but rarely does it remove phosphorus. Wastewater treatment is one exception. Beginning in early 2000, we began a major project to reduce phosphorus outputs from our wastewater treatment facilities. Excessive phosphorus caused algal blooms and nutrient problems in Lake Pepin that negatively affected the ecosystem health and limited recreational opportunities. We worked collectively with the MPCA to reduce phosphorus effluent from wastewater treatment plants to concentrations below 1 mg/L. We also installed new technology at the treatment plants that allows them to capture and remove a significant amount of phosphorus before it enters the rivers. These efforts have resulted in an 88% reduction is total phosphorus system-wide (**Figure 13**). Many other WWTP across the state are now moving towards similar reductions due to statewide 1 mg/L TP limit requirements.

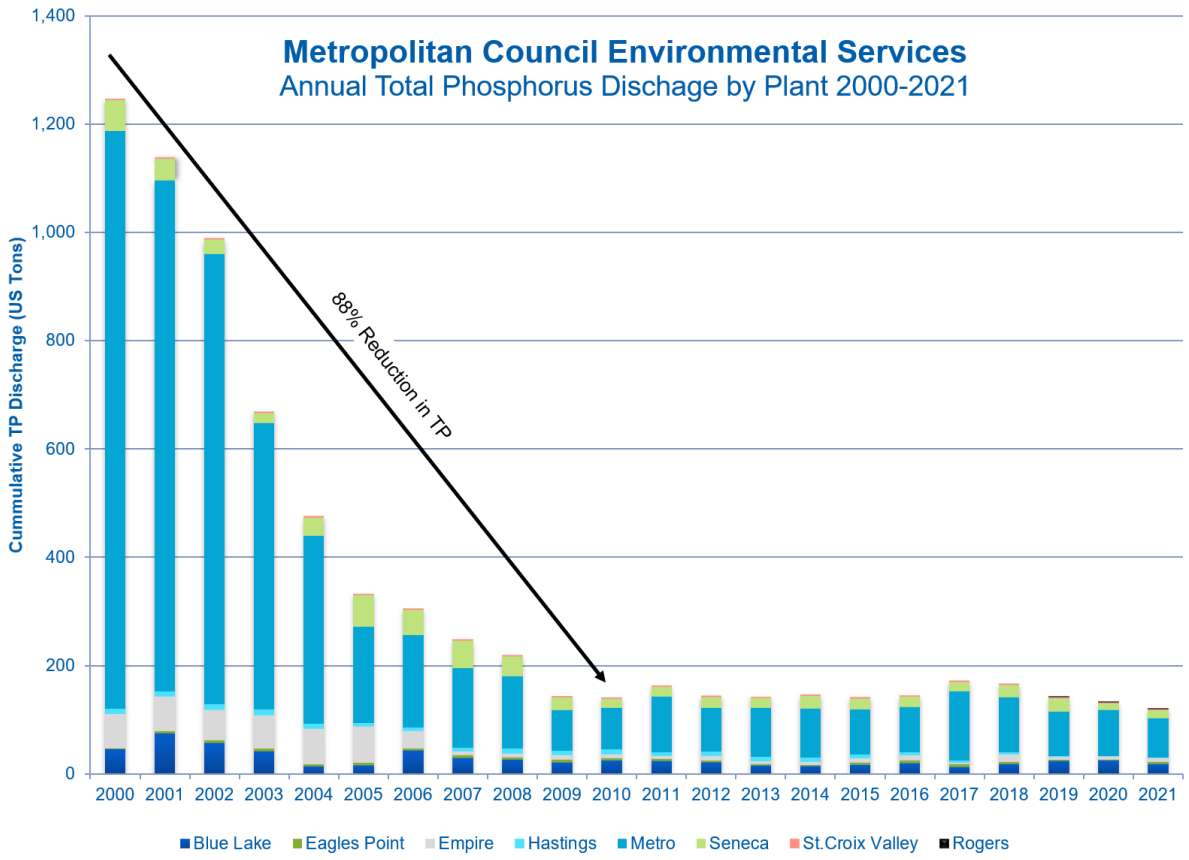


Figure 13: Environmental Services system-wide total phosphorus discharge, 2000-2021

Nitrogen

The largest pool of nitrogen is in the air as inert atmospheric nitrogen gas (N_2). It can be converted to biologically available nitrogen by nitrogen fixing bacteria, lightning, and industrial ammonia production, and is required by all living things to form proteins. When proteins break down, the nitrogen is converted to ammonia (NH_3-N). Ammonia is acutely toxic to all aquatic life. However, in surface water, ammonia is rapidly oxidized to form nitrite (NO_2) and nitrate (NO_3). Our wastewater treatment plants use aerobic secondary treatment to oxidize ammonia into nitrate.

In freshwater ecosystems, plants and bacteria use nitrate as an energy source, but nitrate concentrations usually exceed their needs. Nitrate is carried by stormwater runoff to rivers, lakes, wetlands, and streams, and it can even infiltrate groundwater supplies. Unlike phosphorus, nitrogen does not attach to soil particles. It remains dissolved and is transported with water flows. Excess nitrogen accumulates in surface and groundwater where it can pose a threat to human and animal health.

The MPCA has initiated the rulemaking process to revise the water quality standards for ammonia's impact on aquatic life in surface waters of the state. As of June 2022, the amendments will no longer include a nitrate standard, as it is still in development (MPCA, 2022d). The interplay and amount of ammonia and nitrate in our wastewater effluent may be affected by these water quality standards, and it is possible that our wastewater treatment

processes may need to be modified. Any modification will include an evaluation of regional benefit, cost, and legal viability.

Nutrient sources

Human activities accelerate nutrient cycling directly by collecting, concentrating, and applying nutrients, indirectly through landscape alterations (e.g., increasing erosion) and through point and non-point source pollution.

Non-point sources of nutrients can be both natural and human caused. Phosphorus can be introduced to natural environments through the disturbance and mobilization of soils or sediments. This includes soil loss from construction sites or other non-vegetated lands, bank erosion, or using sand for traction on ice. Stormwater runoff transports soils and sediments (and associated phosphorus) into our waterways. Both phosphorus and nitrogen can be found in organic materials such as leaves, grass clippings, and pet waste. As the material breaks down, it releases nutrients back into the environment. In a forest, leaf litter helps to recycle nutrients into the soils. In an urban environment, the leaves accumulate in streets and sewers, creating a buildup of excess nutrients in the waters.

Manufactured nitrogen fertilizer is the dominant source of total nitrate to Minnesota's rivers and regional waters (MPCA, 2014). It is estimated that 78% of the nitrogen load in the Mississippi River and 89-95% of the nitrogen load in the Minnesota River is from cropland runoff and correlates well with fertilizer application rates (MPCA, 2013). Adoption of agricultural best management practices was predicted to save money and reduce nutrient pollution, but adoption is voluntary, and has been slow as a result.

Wastewater effluent is an example of a point source of nutrients. Most wastewater treatment plants effectively remove phosphorus, however, some phosphorus and about half of the incoming nitrogen is released in treated wastewater. As of 2016, there were 333 permitted municipal wastewater discharge locations in the Upper Mississippi River watershed and 240 and 76, respectively, in the Minnesota portion of the Minnesota and St. Croix River watersheds. Most of these discharge locations are upstream of the metro region and contribute to nutrients in the incoming pollutant load.

We operate nine wastewater treatment facilities in the region treating approximately 250 million gallons of wastewater per day from 111 communities. This represents approximately 98% of all wastewater collected in the region. The remaining 2% (approximately 3.6 million gallons per day) is treated by 15 tribal or municipal wastewater treatment plants and community and private subsurface sewage treatment systems distributed through the region.

Nutrients impacts

Natural aquatic ecosystems exist over a wide range of nutrient levels from oligotrophic (low nutrient levels) to eutrophic (high nutrient levels). Natural systems change slowly and have some resilience to nutrient pollution. However, ecosystem's resilience may be increased or decreased by human-caused impacts.

When nutrient pollution overwhelms an ecosystem's resilience, the ecosystem shifts to an undesirable, but stable, state known as "hypereutrophic". This is characterized by high nutrient levels and intense algae blooms, which block sunlight from submerged aquatic plants, causing plants death and nutrient release. Without aquatic plants, nutrient rich sediments are destabilized and release even more nutrients.

Harmful algal blooms are an example of hypereutrophic conditions that have toxic impacts. They are caused by algae species that release toxins that pose acute threats to human and animal life. Eventually the algae bloom collapses, and as the algae die and decompose, they consume the dissolved oxygen. If oxygen levels drop below 5 mg/l fish begin to die. Without aerating mitigation, every winter some lakes in the region lose all their dissolved oxygen and experience a complete loss of fish or “winter kill” (Fang & Stefan, 2000).

Eutrophication is expensive and difficult to reverse. Eutrophication negatively impacts everyone in the watershed, from Lake Itasca to the Gulf of Mexico. Excess nutrients in our region’s rivers travel to the Gulf of Mexico and causes eutrophication. As the algae die and decompose, they deplete oxygen in the Gulf creating a “dead zone” which averages 5,000 square miles. Fish and other aquatic animals move further out to sea to avoid the area, reducing the number of fish, shrimp, crabs, and the animals that prey on them.

Nitrate pollution also affects drinking water supplies. Over twenty million people depend on the Mississippi River and its tributary streams as primary drinking water sources (American Rivers, 2022), and it is vital to remove nitrate pollution prior to human consumption. Pilot projects in Dakota and Washington Counties surveyed private wells to assess the frequency of nitrate contamination. Both projects found over 20% of wells exceeded the health-based nitrate limit of 10 mg/l. Nitrate pollution is increasing in groundwater and surface waters despite the current interventions.

Finally, wastewater effluent NPDES permitting is impacted when effluent-receiving waters have elevated nutrient concentrations or are close to the water quality standard. The effluent may be assessed for reasonable potential to exceed water quality standards, and the MPCA may set an NPDES permit limit. The higher water treatment costs (both for drinking and wastewater) are passed through to individuals by fees or taxes.

Nutrient prevention and reduction

Nutrient pollution is a chronic problem with severe impacts. Nutrient loading happens continuously over the entire watershed, but the negative impacts are acute. It is difficult for an individual to see how their actions impact a distant waterbody, making nutrient pollution a complex problem. Like the dead zone in the Gulf of Mexico, as watersheds become larger the disconnect between cause and effect also becomes larger and the problem becomes harder to solve.

The MPCA’s 2022 Impaired Waters List contains 189 nutrient impairments within the seven-county metro area. The Minnesota, Crow and St. Croix Rivers are designated as impaired for nutrients over their full length through the region. The Mississippi River is designated impaired for nutrients along 68 miles of the total 73 miles within the metro region, from the confluence of the Crow River to the confluence of the St. Croix River.

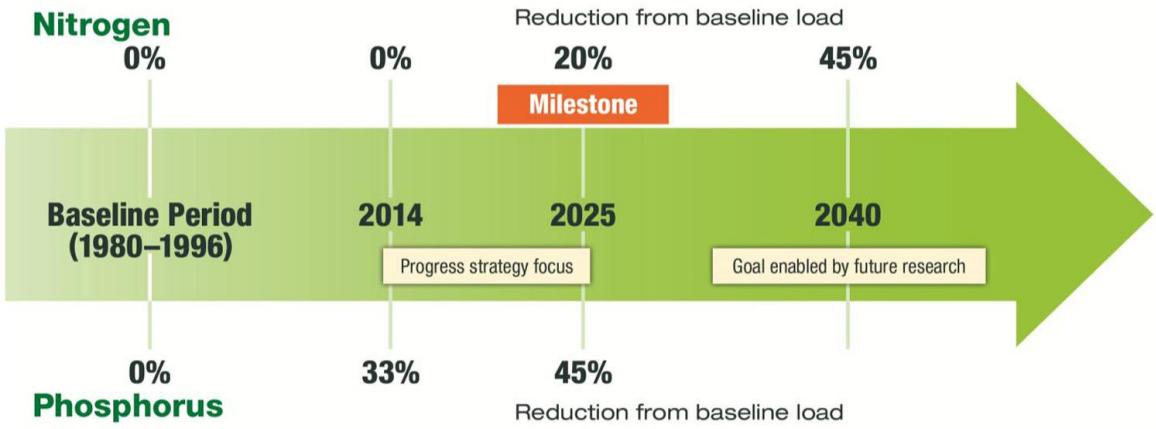


Figure 14: Nutrient reduction timeline for Mississippi River (MPCA, 2014)

The Minnesota Nutrient Reduction Strategy was formalized in 2014 to reduce excess nutrient inputs, combat Minnesota's growing list of nutrient impairments, and to lessen the state's contribution to the dead zone. The desired outcome of the plan is to see a 45% reduction in both phosphorus and nitrogen loads in the Mississippi River by the year 2040 (**Figure 14**). As of 2020, the state had made reductions in phosphorus concentrations, but the nitrate loads increased. The progress made in phosphorus concentrations was negated by the increase of storm events flushing more phosphorus into the river (MPCA, 2020b). We were involved at multiple levels in the Nutrient Reduction Strategy development. Staff provided data collection and assessment information and were members of the steering team for the final plan.

One option to reduce the amount of nitrogen in the water is to create water quality standards for nitrate. In 2010, a Minnesota law was passed giving the MPCA funding to continue rulemaking to establish water quality standards for nitrate (2010 Session Laws, Chapter 361, Article 2, Section 4, Subdivision 1). The MPCA has started the administrative rule making process to update rule 7050 and create nitrate limits, as well as refine limits for ammonia (MPCA, 2022d). The first proposed standard was 17 mg/L-N, but this proposal was not promulgated because it would have had minimal impact on nitrate reduction. The MPCA is continuing its efforts to decide on a science-based limit that will improve the waters of the state. When it is decided, this water quality standard could have an impact on Met Council wastewater treatment processes and technology. It may also affect how the Met Council interacts with agricultural producers from a water quality perspective. The concepts of pollution trading, upland source reduction, and best management practices might be reinvigorated with the codification of nitrate standards, with the end goal of improving the quality of the metro region's waters.

Nutrient recommendations

- The Metropolitan Council will partner with the MPCA to evaluate the potential for point and non-point source nutrient trading to reduce watershed nutrient loading upstream of our wastewater treatment plants.
- The Metropolitan Council will support research and monitoring on the conditions and frequency of toxic hazardous algal blooms within metro region waters.

- The Metropolitan Council will support research on conditions under which stormwater ponds become a source of phosphorus and partner with communities to develop mitigation strategies for affected stormwater ponds.
- The Metropolitan Council will work towards securing funds to provide grants promoting water quality best management practices.

PFAS

Per- and polyfluoroalkyl substances (PFAS) are a group of persistent, synthetic chemicals significantly impacting the region. Because of past manufacturing in the metro region and extensive use as water- and grease-resistant applications on consumer products and packaging, PFAS enter the environment in many ways (e.g., chemical spills, landfill leachate, residential and industrial wastewater, and biosolids). Once released, the chemicals can contaminate surface waters, drinking water supplies, and build up in the tissues of fish, wildlife, and humans.

Health concerns related to PFAS have raised concern by the public and have prompted federal and state agencies to develop plans to address PFAS. The EPA's PFAS Strategic Roadmap (EPA, 2021c) and Minnesota's PFAS Blueprint (MPCA, 2022e) seek to address understanding and quantifying PFAS risks, preventing PFAS pollution, and limiting PFAS exposure from drinking water, food, and commercial products.

To date, the federal government has not enacted maximum contaminant levels for any PFAS, although EPA has issued a Lifetime Drinking Water Health Advisory Level of 70 parts per trillion (ppt) for Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA). In its new, interim advisories, the EPA recommends that lifetime exposure to PFOA and PFOS in drinking water be no more than 0.004 ppt and 0.02 ppt, respectively (EPA, 2022a). This is a marked reduction to the EPA's 2016 guidance value of 70 ppt in total for the two. The EPA has published its Draft Recommended Aquatic Life Water Quality Criteria for PFOA and PFOS to support the protection of aquatic life from acute and chronic effects in freshwater (EPA, 2022b). Twenty-one states have either adopted the EPA health advisory or implemented health notifications, advisories, and maximum contaminant levels for various PFAS chemicals.

The Minnesota Department of Health has developed health-based guidance values to represent levels for six PFAS chemicals that are significantly higher than the EPA's drinking water advisory (MDH, 2022). MPCA has recently established site-specific water quality criteria for PFOS in Pool 2 of the Mississippi River (from Minneapolis to Hastings, MN) and several other water bodies, resulting in 19 metro waterbodies added to the state Impaired Waters List (**Figure 15**) (MPCA, n.d.). The MPCA criteria are a maximum of 0.37 nanograms of PFOS per gram (ng/g) of fish tissue and 0.05 ng/L of PFOS in water.

In 2004, PFAS was found in the drinking water supplies for 14 communities within the East Metro, covering 150 square miles and affecting 140,000 residents (**Figure 16**, MPCA 2021). The MPCA determined the contamination source was from four PFAS disposal sites used by 3M from 1950-1970.

A 2007 Consent Order negotiated by the MPCA and 3M brought three of the disposal sites under the formal Superfund process (3M Cottage Grove Chemolite site, 3M Woodbury site, and the 3M Oakdale site). The fourth site, the Washington County Landfill, is addressed

through the state Closed Landfill Program. In 2010, Minnesota's Attorney General sued 3M for damaging natural resources and water supplies in the southeast metro region. The case was settled in 2018, resulting in $850 million in funds that is being distributed to the affected communities to pay for water supply treatment and infrastructure, and the enhancement of natural resources.

PFAS is received at our wastewater plants through sewers and liquid waste receiving. Wastewater plants are conduits of PFAS, as they are discharged into the receiving water bodies along with the treated wastewater.

Existing processes at municipal wastewater treatment plants are not designed to remove PFAS. Similar to other pollutants, the most effective way to reduce PFAS concentrations at treatment plant effluents, is by reducing the sources of PFAS to the plants.

PFAS have several environmental, regulatory, and political drivers that may control how the problem manifests itself over the next 10-30 years. The PFAS plans that were recently issued by EPA and the State of Minnesota indicate PFAS regulation will be further developed within the next several years. Wastewater utilities collection of PFAS data in MPCA's PFAS monitoring program is Phase 1 of MPCA's planned steps toward development of a regulatory framework for PFAS in the state. The short-term impact is the need to consider potential PFAS regulation in any treatment plant facility plans. There are current site-specific criteria that could impact for up to four wastewater treatment plants, PFAS sampling requirements for five wastewater treatment plants, and permit required reduction planning at Empire. If additional PFAS measures are required or limits are implemented in NPDES permits, the costs to address PFAS reductions will be great and limited by current technological constraints.

Figure 15: 2022 PFOS impaired waters (MPCA, 2022)

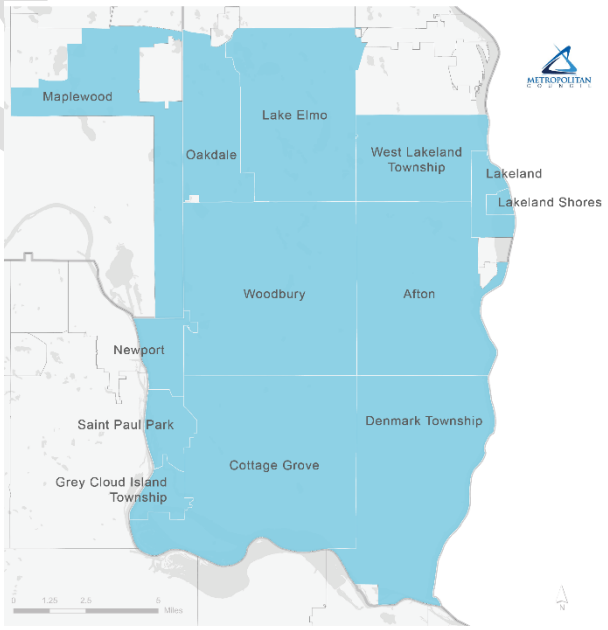


Figure 16: East metro region communities impacted by PFAS contaminated drinking waters (MPCA, 2021)

PFAS concerns

PFAS are not readily biodegradable and are susceptible to migrating from the original source through water. Since PFAS in general are not removed through conventional wastewater processes, the PFAS that enter wastewater treatment plants are discharged along various pathways as they pass through the plant. As can be seen in the PFAS Cycle, in **Figure 17**, any PFAS that come into the plants and are not removed would have pathways to:

- Receiving water bodies – through treated wastewater discharges
- Atmosphere – through air emissions
- Agricultural land – through biosolids land application
- Landfills – through incinerated and dried biosolid disposal

Additional data and information are needed to identify best opportunities for PFAS mitigation. The MPCA released a PFAS Monitoring Plan in March 2022 to address PFAS in solid waste, wastewater and stormwater facilities, hazardous waste landfills, facilities with air emissions, and sites in the Brownfield or Superfund programs.

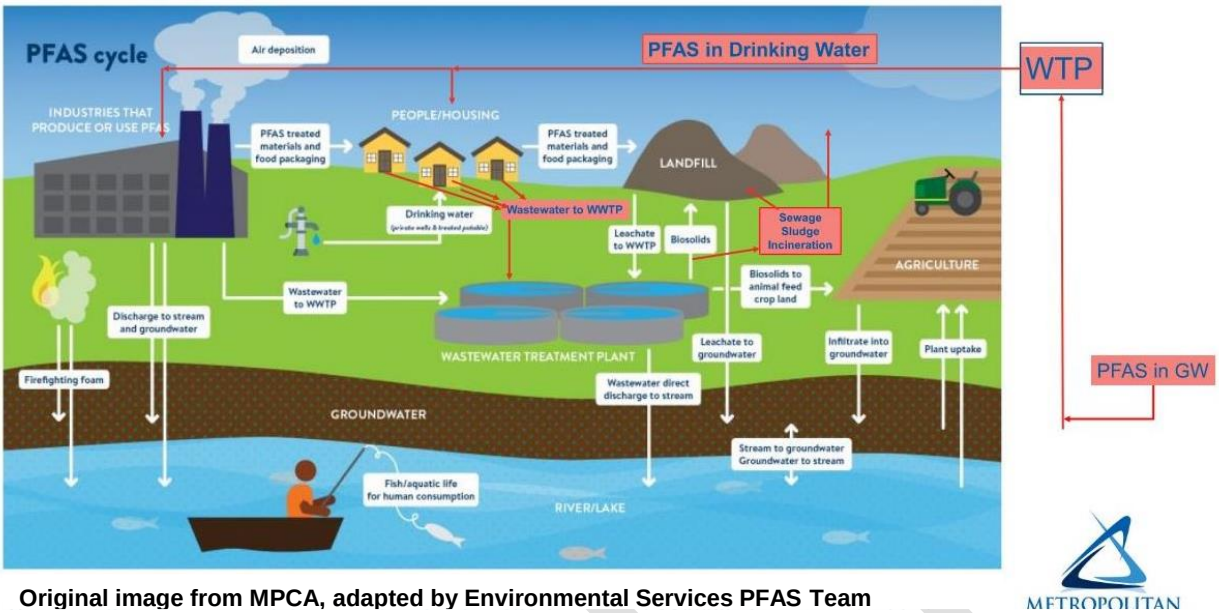
Several of our wastewater treatment plants are included in MPCA's PFAS Monitoring Plan. There are five plants (Blue Lake, East Bethel, Hastings, Seneca, and Rogers) which are included in the municipal wastewater monitoring plan. The Metro Plant is included in the air monitoring plan. The Seneca Plant has air quality PFAS reporting requirements in its most recent permit.

Phase 1 of the MPCA PFAS Monitoring Plan requires a single PFAS sample be taken on the influent to each plant during two consecutive yearly quarters. Staff at the wastewater treatment plants will continue to research and determine sources of PFAS to the plants, and implement steps to reduce PFAS in the influent. Final samples will then be taken and compared with the initial samples.

MPCA plans to use the results of this Phase 1 monitoring to establish "Response Levels". Wastewater plants with certain Response Levels during Phase 1 will likely be required to conduct additional sampling in Phase 2 of the plan. During Phase 2, additional PFAS information will be collected at multiple points throughout the wastewater treatment plants to better understand how PFAS move throughout the system.

Our Environmental Services Industrial Waste department has already conducted some PFAS analyses to understand sources of PFAS to our plants, including determining the highest concentration sources of PFAS to each plant.

Addressing PFAS will require the prevention of PFAS pollution from the source through regulation, reformulation, and the cleanup and destruction of existing PFAS contamination. We currently have limited authority to control the entry of PFAS into regional waters and the wastewater collection system, lending the need to partner with state agencies and other stakeholders to determine and implement the most cost-effective methods of addressing PFAS.



Original image from MPCA, adapted by Environmental Services PFAS Team

Figure 17: Environmental Services PFAS cycle (MPCA, 2020c).

PFAS recommendations

- The Metropolitan Council will support PFAS source reduction measures including considering support for regulation, restrictions, or PFAS bans to stop the pollution at its source and work with pollution creators to prevent future contamination.
- The Metropolitan Council will support local, state, and federal water organizations to complete a metro-wide synoptic survey of surface waters to establish a baseline understanding of the extent of surface water contamination.
- The Metropolitan Council will consider more extensive PFAS study to identify PFAS through our systems to help us better understand options for addressing PFAS within the wastewater treatment process.
- The Metropolitan Council will encourage interconnection of water supply systems where economies of scale can reduce the per capita cost of treatment for PFAS in potable water.
- The Metropolitan Council will partner with universities and other research organizations in regional surface, drinking, and wastewater PFAS contamination research, as appropriate.

Local water supply concerns

Drinking water quality concerns arise from natural contamination or from human-caused pollution. An example of a natural contaminant is manganese, which occurs naturally in Minnesota groundwater and is sourced from manganese deposits in soil and bedrock. Water quality data collected from wells across the state shows that the concentration of manganese varies significantly (**Figure 18**) in the metro region. The southern and eastern portions of the metro have concentrations of less than 50 micrograms per liter (ug/L), while the western and northern portions have concentrations greater than 100 ug/L.

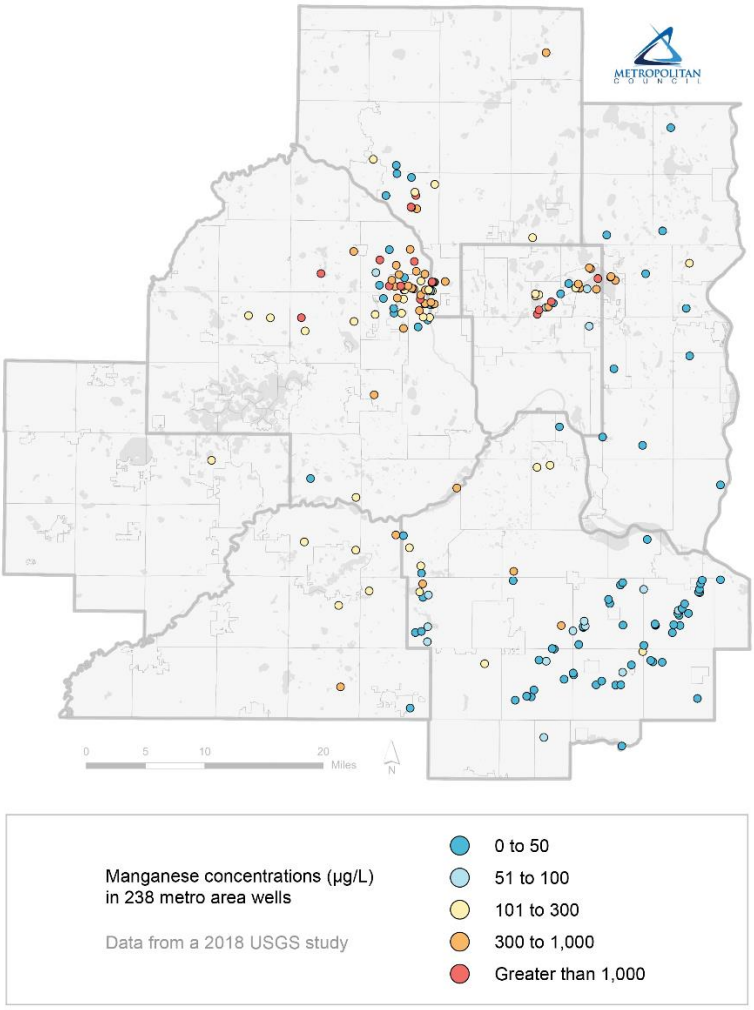


Figure 18: Manganese concentrations in Minnesota groundwater (USGS, 2018)

Manganese is a concern for two reasons. The first is aesthetic, as it can cause staining of plumbing fixtures and clothing. The second is human health. Manganese is a neurotoxin for children and adults, and for infants at low concentrations.

Children and adults who drink water with high manganese concentrations can develop problems with memory, attention, and motor skills over time. Infants can develop learning and behavioral problems.

Perchloroethylene (PCE), trichloroethylene (TCE), and dioxane are human-created volatile organic contaminants found in groundwater. PCE and TCE are chlorinated organic chemicals that are used as dry-cleaning agents and degreasers. Dioxane is a stabilizer that is added to TCE. All three of these chemicals are toxic to humans. Former disposal practices for these chemicals have led to soil and groundwater contamination in numerous areas of the region.

The State of Minnesota has created a Groundwater Contamination Atlas which provides descriptions for volatile organic contaminants affected groundwater areas (MPCA, n.d.).

The locations of PCE, TCE, and dioxane contamination in soil and groundwater are shown in **Figure 19.**

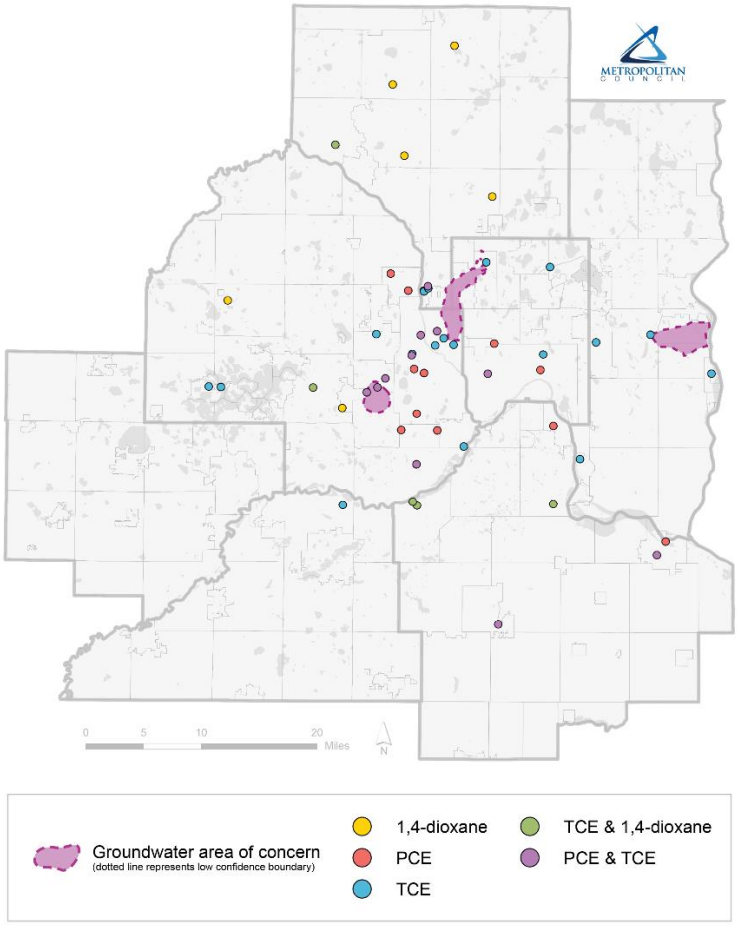


Figure 19: Metro sites contaminated with PCE/TCE/dioxane (MPCA, 2022f)

While we are not the regional water supplier for the metro region, we do have a role in providing guidance and technical assistance to the region's water suppliers. We support local control and responsibility of water systems and will continue to partner on the sustainability of our water supplies. Working collaboratively with local water suppliers, state agencies, and water- and public health-focused organizations, we can hold conversations and workshops to collectively develop data, facilitate funding for research, and provide resources to help address current and future drinking water quality concerns.

Local water supply recommendations

- The Metropolitan Council will work with the Minnesota Department of Health to understand future changes to health-based guidance for drinking water contamination concerns.

- The Metropolitan Council will work with MPCA to advance our understanding on the movement of existing groundwater contamination plumes in the metro region.
- The Metropolitan Council should support hydrogeologic studies to further knowledge on the levels of contaminants present in water supply aquifers.
- The Metropolitan Council should incorporate drinking water treatment best practices into future updates of the Metro Area Water Supply Plan.
- Where appropriate, the Metropolitan Council may support investments in water supply system interconnections.
- The Metropolitan Council will share information with subregional water supply work groups.

Equity considerations

Public policy and industry practice have produced an unequal landscape across American neighborhoods. This has caused a disproportionate burden on people of color including causing them to experience negative impacts on wealth building, health, and environmental justice issues. Discriminatory housing practices from both federal and private programs have contributed to the segregation of neighborhoods, making it possible to geographically target and withhold public investment. In 2016, the median net worth among white families was 10 times that of black families, and more than eight times that of Hispanic families (Loh et al., 2020). Impacts from these programs and practices can be seen and felt within the metro region.

Equity in relation to the environment and our water resources is important to protect all residents from environmental hazards and to provide access to environmental benefits regardless of income, race, and other characteristics (UCLA, n.d.). Environmental equity is a basic human right and includes fair treatment and meaningful involvement. Under-represented and vulnerable communities must be engaged in a manner so that outreach will not be a performative exercise, but rather an opportunity to inform and involve groups most impacted by the decision-making processes and outcomes.

Environmental justice is a core tenet of equity and is often deeply intertwined with water quality contamination issues. Environmental justice acknowledges that past harms have been committed against vulnerable communities through policies and rules across systems. Currently, we are working at the intersection of equity and our regional services, with a focus on environmental justice through our 2022 Climate Action Plan. The Climate Action Plan team created the Environmental Justice Taskforce to create a framework to assist in the development and evaluation of the Climate Action Plan with an environmental justice lens. The Taskforce's definition for environmental justice, specifically for the Met Council, is:

> *Environmental justice is the equitable engagement of policy creation for, and service delivery to, all people in the metropolitan region with the prioritization of communities of color and low-income communities. The term justice is used to acknowledge that there has been an ongoing history of harm and environmental racism towards Black, Indigenous and people of color in the state of Minnesota.*

There are environmental justice and equity concerns in the metro region regarding water quality including, but not limited to, access and impairment of waters for fishing/recreation, access to clean drinking water, affordability of wastewater treatment, and private ownership/access to 'pristine' waters.

The ability to access clean surface waters has cultural and health impacts. Different cultural groups hold numerous beliefs in which fishing plays an important role. For example, in both Dakota and Ojibwe communities, fishing plays an integral role in ceremonial traditions and creates important ties between families and individuals and their ties to the environment (Gikinoo'wizhiwe Onji Waaban [Guiding for Tomorrow], n.d; Minnesota Historical Society, 2022). This is also true for our region's immigrant groups, especially the Hmong, where the fishing tradition connects the Hmong community back to their ancestral lands of Laos, Thailand, and Vietnam (Lallensack & McKay, 2015). For lower income communities, fishing is an affordable way to incorporate fresh, healthy food into their diets – all of which could be a risk due to impaired waters affecting the safety of fish consumption.

Although the Twin Cities metro region has a regional wastewater treatment and collection system, many communities still rely on private drinking water wells and subsurface sewage treatment systems to treat wastewater. Maintenance and replacement of these systems can be extremely cost prohibitive, and failure is inevitable if they are not maintained. Failed subsurface sewage treatment systems have negative impacts on the surrounding water resources and can contaminate the resident's well and surrounding wells. While the Minnesota Department of Health offers free well testing, participation in the program is voluntary. This results in a situation where residents may not know they are drinking contaminated water. In cases where residents are aware of contamination, water filtration systems or bottled water can be expensive and therefore impossible for many. This lack of education and financial support for subsurface sewage treatment system maintenance, replacement, and water filtration can negatively impact the public health and water resources of communities of color and low-income communities.

Green infrastructure can help to address certain conditions that lead to disparities in health outcomes for low-income and marginalized communities (American Planning Association [APA], 2015). Green infrastructure is the integration of nature and ecosystem services to generate multiple benefits, including better stormwater management, improved access to greenery, and increases in habitat. Studies have shown that these communities do not have the same level of access to green infrastructure resources, such as parks and trees (APA, 2015). Lack of investment in these communities have created environmental justice issues and have impacted water quality. Green stormwater infrastructure can help reduce stormwater runoff and erosion, which then reduces the volume of pollutants entering waterways.

Traditional gray stormwater infrastructure is designed to move stormwater away from the built environment, collecting and conveying stormwater from impervious surfaces. The stormwater is then discharged, untreated, into a local water body. Low-income and marginalized communities typically have more grey infrastructure and less green infrastructure compared to their counterparts. This can lead to negative impacts on the community's water resources.

One way Minnesota is expected to experience climate change, is with an increase in the number of high-heat days. A lack of tree canopy (green infrastructure) can exacerbate heat related problems. A new mapping tool created by our Community Development division shows the inequity of tree coverage in the metro region. Neighborhoods that are whiter and wealthier tend to have more trees than their counterparts (Metropolitan Council, 2022c).

Minnesota is "the land of 10,000 lakes" and has a thriving lake and cabin culture. Those who can afford cabins, typically "escape" the metro region and are able to recreate on lakes that are considered more 'pristine' compared to lakes within the metro. Those with less resources do not have the ability to access these lakes. However, access to clean, cool urban waterbodies can provide vulnerable communities relief during high heat incidents. Improving the quality and

access to our urban water resources is vital to communities that may not have other cooling options during prolonged heat events.

Environmental water injustices exist within our region. Conversations with marginalized communities and reparative relationship efforts need to be had to better understand where they are occurring, what existing policies may still be exacerbating them, and how to best to remedy the injustice. Environmental justice work must be addressed to achieve environmental equity. All Minnesotans have the basic human right to access clean water.

Water equity recommendations

- Metropolitan Council staff will engage with different cultural communities in the metro about water equity and environmental justice through events that build relationships and trust.
- The Metropolitan Council should partner and support local organizations with a water equity focus.
- The Metropolitan Council should hold regional discussions about water equity and environmental justice concerns.
- Environmental Services will integrate equity metrics into our programs, projects, and services. Examples could be:
    - Target monitoring work to Priority Waters with high scores in the equity category (this data is already available).
    - Offer financial incentives to our Citizen Assisted Lake Monitoring Program sponsors to recruit volunteers from disadvantaged communities.
    - Complete an equity analysis of where our capital program dollars are being spent.
    - Take a larger role in addressing PFAS in drinking water in areas with disadvantaged communities.
- Environmental Services will partner with our other Met Council divisions on equity efforts that overlap regional systems. Potential projects to explore:
    - Regional Parks: Pilot projects involving water monitoring, and creating signage about blue green algae and safe swimming.
    - Transit: Pilot projects that increase access and signage to Priority Waters
    - Community Development & Housing: Pilot projects that promote low-flow fixtures and green infrastructure in disadvantaged communities without causing housing affordability concerns and environmental gentrification.
- The Metropolitan Council will work towards securing funds to provide grants promoting water equity and to address identified environmental injustices.

Connections to current policy

The 2040 Water Resources Policy Plan contains 11 separate policies. Six of these policies address water quality, as denoted below.

Policy on Watershed Approach
The Met Council will work with our partners to develop and implement a regional watershed-based approach that addresses both watershed restoration (improving impaired waters) and protection (maintaining water quality in unimpaired waters).

Policy on Sustainable Water Supplies
While recognizing local control and responsibility for owning, operating, and maintaining water supply systems, the Met Council will work with our partners to develop plans that meet regional needs for a reliable water supply that protects public health, critical habitat and water resources over the long-term.

Policy on Assessing and Protecting Regional Water Resources
The Met Council will continue to assess the condition of the region's lakes, rivers, streams, and aquifers to evaluate impacts on regional water resources and measure success in achieving regional water goals.

Policy on Water Conservation and Reuse
The Met Council will work with our partners to identify emerging issues and challenges for the region as we work together on solutions that may include the use of water conservation, wastewater and stormwater reuse, and low-impact development practices in order to promote a more sustainable region.

Investment Policy
The Met Council will strive to maximize regional benefits from regional investments.

Wastewater Sustainability Policy

The Met Council will provide efficient, high-quality, and environmentally sustainable regional wastewater infrastructure and services. The Met Council shall conduct its regional wastewater system operations in a sustainable manner as is economically feasible. Sustainable operations relate not only to water resources but also to increasing energy efficiency and using renewable energy sources, reducing air pollutant emissions, and reducing, reusing, and recycling solid wastes.

Draft new policy and implementation strategies

This section puts forth specific draft policies, strategies, and actions that are an integration of the Crucial concern section recommendations and our existing 2040 water quality-related policies that will be carried forward into the 2050 planning cycling. All of the below content is intended to spark discussion and ideas to help hone the policy language for the next plan. Where necessary, Met Council staff have developed new or modified policy language for consideration.

Policy on environmental justice and water equity

We will need to develop a new policy to encapsulate our strategies and actions towards water equity and environmental justice within the region. Met Council staff will work with Council Members to develop the language in 2023. Below are the recommended actions from this paper:

- Met Council staff will convene and listen to community members who have water equity and environmental justice concerns or experiences. We will work together to try to alleviate imbalances that cause the injustices and strengthen our relationship and build trust.
- Met Council staff will partner and support metro region organizations with a water equity focus.

- Environmental Services will integrate equity metrics into our programs, projects, and services.
- Target monitoring work to Priority Waters with high scores in the equity category (this data is already available).
- Investigate options for financial incentives to CAMP sponsors to recruit volunteers from disadvantaged communities.
- Complete an equity analysis of where our capital program dollars are being spent.
- Environmental Services will partner with other Met Council divisions on equity efforts that overlap regional systems. Potential projects to explore:
    - Regional Parks: Pilot projects involving monitoring in waters in certain parks/ Create signage about blue green algae/ Information about safe swimming
    - Transit: Pilot projects that increase access to Regional Priority Waters, create signage about waters
    - Community Development & Housing: Pilot projects that promote low flow fixtures and green infrastructure in disadvantaged communities without causing housing affordability concerns and environmental gentrification.
- The Met Council will work towards securing funds to provide grants promoting water equity and to address identified environmental injustices.

Environmental Services finance policy

Environmental Services may need to revisit our finance policy to incorporate funding sources to provide for work not covered by, or to augment the regional sewer fees. Met Council staff will work with Council Members to develop the language in 2023.

Policy on watershed approach

The following existing implementation strategies related to water quality under this policy:

- Work with the watershed management structure in the metro region on issues that transcend watershed organization boundaries to prepare water management plans that promote the protection and restoration of local and regional water resources (lakes, rivers, streams, wetlands and groundwater).
- Provide technical and financial assistance to local governments and other partners on water issues and water management activities.
- Facilitate discussions on regional water issues that transcend community or watershed organization boundaries.
- Provide technical information to watershed organizations on practices to use and incorporate into their plans that protect water quality for water supply sources.
- Support educational efforts through partnership opportunities with agricultural communities in the region and collar counties on watershed issues.

The following could be added under this policy:

- Met Council staff will adopt an adaptive management approach ("plan-do-study-check") to ensure our water policies are prioritized, targeted, measurable, and effective at improving the region's water quality.
- Met Council staff will lead regional task forces to help us best explore and address regionally significant contaminants of emerging concern. They could establish a process to track Emerging Contaminants, assess their likely threat to waters in our region, or develop a decision-tree of when to initiate monitoring and assessments of these contaminants and do follow up actions.
    - Include watershed organization and city/township staff on the taskforce to provide the local perspective.
    - Establish current understanding and provide recommendations for next steps.
    - Create regional outreach and education to share with local units of government to modify behaviors towards pollutant generation, as appropriate.
    - Partner with local entities to reduce the prevalence of contaminant (alternative chemicals, legislative solutions, etc.).
    - Sponsor or promote activities or events (e.g., prescription drop-off locations).
- Through the review process for comprehensive plans, local water plans, and watershed management plans, Met Council staff will make water resources management a critical part of land use decisions, planning protocols and procedures. This will ensure these plans are making progress toward achieving state and regional goals for protection and restoration of water resources.
    - Encourage pollution prevention/protection actions for Priority Waters
    - Promote stormwater best practices - including the guidance of MDH and MPCA about limiting infiltration in wellhead protection areas
    - Encourage the utilization of retrofit stormwater management in urban public areas to reduce volume
    - Protect habitat and open spaces
- The Met Council will partner with universities and other research organizations to participate in surface, drinking, and wastewater contamination research in the region's/Council's interest:
    - Contaminants of concern (PFAS, nutrients, chloride, emerging contaminants, etc.)
    - Stormwater ponds as a source of phosphorus - partner with communities to develop mitigation strategies for affected ponds.
- The Met Council will support reductions of pollutant sources (chlorides, PFAS, etc.) to metro water, including as appropriate through legislative solutions.
- The Met Council will work towards securing funds to provide targeted grants to promoting regional water quality:
    - Protection of Priority Waters and Critical Watersheds
    - Urban stormwater management
    - Agricultural best management practices
    - Chloride best management practices for residential, commercial, agricultural, and industrial purposes.
    - Improved water softener efficiency grants

- Met Council staff will create resources and tools to promote best land use practices for communities and watersheds across the metro. Such as:
    - Encourage bee-lawns and other no-mow, anti-erosion, low fertilizer lawn alternatives
    - Connect developers and watershed organizations early in the development process to plan proactively around water.
    - Encourage proactive creation of regional stormwater treatment and storage up front for phased redevelopment plans (e.g., Allianz field).
    - Encourage communities to have stormwater requirements for redevelopment of single-family properties (some communities exempt single- family redevelopment from doing any stormwater management).

Policy on sustainable water supplies

The following existing implementation strategies related to water quality under this policy:

- Collaborate with state agencies, watershed organizations, and community water suppliers to update the regional Master Water Supply Plan.
- Support community efforts to improve water supply resiliency by cooperatively identifying economically and technically feasible water supply alternatives.
- As required by Minnesota Statutes, review and comment on local water supply, wellhead protection, and county groundwater plans.
- Facilitate discussions on water supply issues that transcend community boundaries, through subregional work groups and on an ad hoc basis, as needed.
- Collaborate with partners to perform special studies as needed.

The following could be added under this policy:

The Met Council will encourage interconnection of water supply systems where economies of scale can reduce the per capita cost of treatment for contamination (PFAS, Mn, VOCs) in potable water.

The Met Council will work with MDH to understand future changes to health-based guidance for drinking water contamination concerns.

The Met Council will work with MPCA to further knowledge on the movement of existing groundwater contamination plumes in the metro region.

The Met Council will support hydrogeologic studies to further knowledge on the levels of contaminants present in water supply aquifers.

Met Council staff will new incorporate drinking water treatment best practices into future updates of the Master Water Supply Plan.

The Met Council will share information with subregional water supply work groups on developments in water treatment technologies.

Policy on assessing and protecting regional water resources

The following implementation strategies related to water quality under this policy:

- With our many partners, monitor the quality of regional lakes and rivers and the quality and flow of regional streams.
- Work with our partners to fill gaps in assessments of lake, stream, river, and groundwater data.
- Assess and evaluate long-term water quality trends for the region's lakes, streams, and rivers and identify key issues to be addressed.
- Maintain a regional database that contains easily accessible water quality, quantity and other water-related information collected as part of the Council's monitoring programs.
- Convene stakeholders and collaborate with partners to identify implementation paths for water quality improvement.

The following could be added under this policy:

- Council staff will work with local, state, and federal water organizations to ensure the monitoring of and data sharing for all Priority Waters for nutrients, chlorides, and other contaminants of concern at a frequency to allow assessment by MPCA against water quality standards.
- As new contaminant threats emerge, Met Council staff will work with local, state, and federal water organizations to complete a metro-wide synoptic survey of surface waters and well observations to establish a baseline understanding of the extent of surface and groundwaters contamination.
- Met Council staff will provide data, information, and planning tools to assist local governments in resilient water resources and infrastructure planning and decision-making for a changing climate:
    - Monitor Regional Priority Waters for the impacts of climate.
    - Lead and partner on regional climate scenario modeling and interpretation.
    - Do climate assessments with our lake, river, stream data, such as found here: https://www.pca.state.mn.us/air/view-data-climate-impacts-our-waters, on a recurring schedule.
    - Landscape assessments to identify areas prone to climate-risk (highly erodible soils, steep slopes, etc.)
    - Partner and support research, monitoring, and assessment of HABs within regional waters.

Policy on water conservation and reuse

The following implementation strategies related to water quality under this policy:

- In partnership with others, research and promote low-impact development, land use practices, agricultural best practices, and cooperative water use practices that minimize impacts on aquifers and maximize groundwater recharge, where practical.
- Provide research and guidance on best management practices for effective surface water management.
- Install and monitor innovative nonpoint-source pollution reduction practices at Council facilities and support economically feasible projects that demonstrate new technologies and their effectiveness.

Investment policy

The following implementation strategies related to water quality under this policy:

- Invest in nonpoint-source pollution control when the cost and long-term benefits are favorable compared to further upgrading wastewater treatment.
- Consider pollutant trading or off-set opportunities with nonpoint-sources of pollution when cost-effective and environmentally beneficial.
- Invest in wastewater reuse when justified by the benefits for supplementing groundwater and surface water as sources of non-potable water to support regional growth, and by the benefits for maintaining water quality.
- Potentially invest strategically to further the effectiveness of the region's nonpoint-source pollution prevention and control program and to ensure efficient investment to achieve regional water quality objectives.
- Support cost-effective investments in water supply infrastructure to promote sustainable use and protect the region's water supplies by:
    - Developing criteria to identify water supply projects with regional benefit.
    - Promoting equitable cost-sharing structures for regionally beneficial water supply development projects.
    - Supporting cost-benefit analyses of alternative water supply options.
    - Identifying funding mechanisms for regionally beneficial water supply development projects.

The following could be added under this policy:

- The Met Council will partner with the MPCA to evaluate the potential for point and non-point source nutrient trading to reduce watershed nutrient loading.
- The Met Council will consider supporting or investing in innovative urban planning research and design to encourage growth without placing additional stress on water resources.
    - Nature-based stormwater infrastructure
    - Low road salt development design - new or redevelopment approaches that naturally need less salt for winter maintenance
    - Porous or solar pavements
    - Narrower streets
- The Met Council will investigate the regional need and the economic and legal viability to accept salty stormwater discharges to our wastewater collection and treatment system allowing for the reversal of chloride impaired lakes from the region.
- Met Council staff will partner with professional associations or research institutions to test and develop best water resources management practices or WWTP technological improvements.

Wastewater sustainability policy

The following implementation strategies related to water quality under this policy:

- Provide industries with incentives to pretreat wastewater to reduce its strength and thus provide the most environmental and economical benefit for the region.

The following could be added under this policy:

- The Met Council will implement and promote the use of nature-based, green infrastructure solutions on Met Council properties where feasible.
- Met Council staff will develop internal infrastructure design and placement guidelines based on the latest scientific and engineering knowledge to reduce their climate-risk on longevity.
- Met Council staff will consider more extensive study of PFAS in our systems to help us better understand options for addressing PFAS at various points along the WWTP processes.

Next steps

This topical research paper is the first step in the process of creating regional water policies to safeguard our waters and to protect the livability and prosperity of the region (**Figure 20**). The ideas in this paper are intended to spark discussion and generate additional water-focused policy recommendations to provide the foundation of the 2050 Water Resources Policy Plan. This paper was created and reviewed by our Met Council staff. Our planned next step is to gather and include the perspectives of our partners on important policy recommendations.

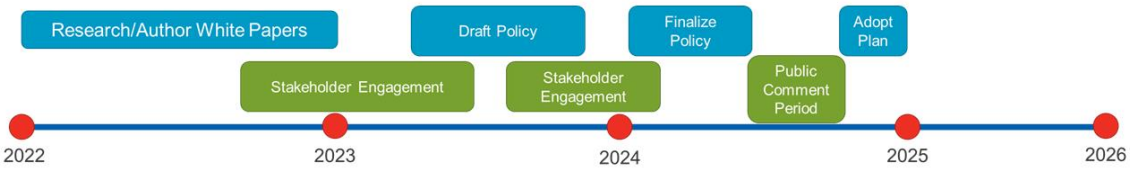


Figure 20: Water Resources Policy Plan timeline

After this additional information is gathered, we will update the draft policy recommendations through an interactive process of drafting policies, listening to stakeholder feedback, and integrating the information collected to assist our Council members in developing, evaluating, refining, and adopting these new policies. Alternating between engagement and policy creation will allow stakeholders to participate and shape plan content from the very beginning. This proposed process is an intentional attempt to bring more voices and perspectives to the table, and to help us produce polices and implementation strategies that are reflective of the region's water priorities.

If you have any questions or feedback about the content of this paper, please contact **Jennifer Kostrzewski** at ***Jennifer.kostrzewski@metc.state.mn.us***.

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