Water Supply Planning Atlas for the Twin Cities Metropolitan Area

Subregional information for sustainable water resource planning

METROPOLITAN COUNCIL

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“Sustainable water management in Minnesota is not just about the environment, it’s about finding the intersection of economic needs, social needs, and environmental needs.”

- Deb Swackhamer (2016)

Glossary

Aquifer
An in-ground source of water supply. Aquifers may be relatively shallow sedimentary deposits or deeper bedrock units. In state statute, aquifer means a stratum of saturated, permeable bedrock or unconsolidated material having a recognizable water table or potentiometric surface which is capable of producing water to supply a well.

Bee lawn
A lawn that combines grass species and plants that offer habitat for pollinators. Bee lawn species need to tolerate being mowed, flower at low heights, provide food for pollinators, compete with turfgrass, and have a perennial life cycle.

Blue space
Lakes, rivers, streams, ponds, wetlands and other water features. Blue space (or blue infrastructure) is a general term used in land use planning and urban design to describe areas dominated by water.

Chloride
Chloride refers to chloride salts in the environment. Sodium, magnesium, and potassium chloride are examples. These salts can be naturally occurring in rocks and soils; however, much of the chloride in the metro region environments comes primarily from de-icing (road) salts, water softening, and some fertilizer applications.

One teaspoon of salt pollutes 5 gallons of water. Once salt enters surface or groundwater, there is no feasible way to remove it. Excess salt affects the taste and health of drinking water. High amounts of chloride are toxic to fish, aquatic organisms, amphibians, and aquatic vegetation. Salt also inhibits turnover (mixing) of water in lakes.

Drawdown
The lowering of aquifer levels from groundwater pumping.

DWSMA (DWSMAs)
Drinking Water Supply Management Area(s). Per MDH: An area or areas containing the wellhead protection area but outlined by clear boundaries, like roads or property lines. The DWSMA is managed in a wellhead protection plan, usually by a city. In state statute, “drinking water supply management area” means the surface and subsurface area surrounding a public water supply well, including the wellhead protection area, that must be managed by the entity identified in a wellhead protection plan. The boundaries of the drinking water supply management area are:

- center lines of highways, streets, roads, or railroad rights-of-way
- section, half-section, quarter-section, quarter-quarter-section, or other fractional section lines of the United States public land surveyproperty or fence lines
- the center of public drainage systems
- public utility service lines or political boundaries.

Efficiency
Refers to using water without excess; using only what is needed without waste.

Firm capacity
A water supply system design standard that generally refers to the ability of a water supply system to provide water, including fire suppression, with its largest pump (well or intake) out of service. Firm capacity can refer to an entire system or a part of a water supply delivery system that may contained separate treatment, storage, and delivery systems. The reliability and redundancy of a water treatment plant’s equipment and process units are integral to the plant’s firm capacity.

Gallons per capita per day (residential and total)
The number of gallons delivered by a municipal/public water supplier divided by the number of people served by that water supplier divided by the number of days in the year. Total per capita usage differs from residential in that it uses the total gallons delivered value instead of the residential. Total gallons delivered includes businesses, industrial, and commercial customers, as well as any metered institutional water usage.

Green space
Natural areas, forests, grasslands, parks, gardens, athletic fields and other vegetated spaces. Green space (or green infrastructure) is a general term used in land use planning and urban design to describe open spaces.

Groundwater
Water contained within the ground. Generally refers to the water at or beneath the water table. Groundwater may be expressed at the surface in certain surface waters like calcareous fens, trout streams, or springs.

In state statute, groundwater means water contained below the surface of the earth in the saturated zone including, without limitation, all waters — whether under confined, unconfined, or perched conditions, in near-surface unconsolidated sediment or regolith, or in rock formations deeper underground.

Impervious surface
Any part of the land surface that prohibits water infiltration such as concrete structures, roadways, parking lots, homes, and buildings.

Indoor use
The water used inside of homes, businesses, and institutional buildings.

Interconnection
Any water supply infrastructure connection between municipalities or governments. An interconnection may be used for emergency water supply service or for everyday water deliveries from one municipality to another or to individual customers.

Irrigation audit
A process that uses several methods to measure the efficiency and effectiveness of irrigation systems. Home irrigation audits examine residential systems, checking for equipment malfunctions and other system issues.

Karst
A landscape formed and influenced by the dissolution of soluble bedrock, usually carbonate rocks like limestone or dolomite. In Minnesota, there are three karst landscape classifications: active, transitional, and covered. Active karst areas are primarily found in the Southeastern portion of the state along the Minnesota, St. Croix, and Mississippi rivers. Water moves easily from the surface through fractured and porous bedrock in these areas, making them susceptible to groundwater contamination and sinkhole formation.

Metro region / metro area
Refers to the seven-county metropolitan region. Includes Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington counties and associated communities.

Nitrate
Nitrate is a naturally occurring chemical compound. Nitrate aids plant growth and is contained in many crop, lawn, and golf course fertilizers. However, runoff from fertilized areas and leakage through soils means nitrate can easily get into surface and groundwaters. Nitrate also enters the environment from uncontained sewage and animal wastes. Nitrate in drinking water is a health concern for infants and other at-risk populations. Too much nitrogen in the environment can cause excessive growth of aquatic plants and algae that block light and consume oxygen as they decompose. This process can kill fish and disrupt the biologic function of surface waters.

Outdoor use
The amount of water used during the warmer months of the year that differs from the amount of water used during the colder months. The amount of water pumped during May through October minus the amount of water pumped during November through April.

Palmer Hydrological Drought Index
One of several indices that provide a measure of drought intensity or severity. There is no single definition of drought and different aspects of the water cycle, and society will be affected by different intensities and durations of drought. The PHDI is used here because it attempts to account for drought impacts that include groundwater and other slower cycling waters. Per NOAA, PHDI measures hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) which take longer to develop and longer to recover from. This long-term drought index was developed to quantify these hydrological effects, and it responds more slowly to changing conditions than the Palmer Drought Severity Index (PDSI).

Peak (Max) Day Demand
The day of the year with the highest water demand for municipal/public water suppliers.

Peaking factor / Peak day to average day ratio
The amount of water pumped on the max day compared to the average pumping for all days of the year.

PFAS
PFAS are a group of widely used manufactured chemicals that resist grease, oil, heat, and water. They were first introduced in the 1940s and are contained in many everyday products like non-stick cookware, water-resistant clothing and fabrics, personal care products, and firefighting foam. Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS) are two of the most common and studied chemicals in the PFAS group and have been replaced with other PFAS in the U.S. PFAS are extremely long-lived in the environment, meaning that once they enter the environment, they are difficult to breakdown and remove, and they accumulate in living organisms. Current peer reviewed scientific studies have shown that certain levels of PFAS may lead to:

- Reproductive effects such as decreased fertility or increased high blood pressure in pregnant women. Developmental effects or delays in children, including low birth weight, accelerated puberty, bone variations, or behavioral changes.
- Increased risk of some cancers, including prostate, kidney, and testicular cancers.
- Reduced ability of the body's immune system to fight infections, including reduced vaccine response.
- Interference with the body's natural hormones.
- Increased cholesterol levels and/or risk of obesity.

Population served (serviced)
The number of people (residents) that receive water supply service from a municipal/public water supplier. These include single-family and multi-family residential customers.

Public / municipal water supply
Water suppliers with MN DNR permits categorized as municipal/public water supply. Most public water suppliers in the metro are municipalities with few exceptions including Shakopee Public Utilities Commission and the Joint Water Commission for Crystal, Golden Valley, and New Hope.

Rebound
The recovery of aquifer levels post-pumping or additional inputs.

Glossary

Recharge The process by which precipitation and surface water percolate through soils and sediments to replenish groundwater. In Minnesota recharge tends to occur during the spring and fall when the ground is no longer frozen, water is available, evaporation is minimal, and plants are not yet growing or have stopped growing for the year.

Residential use The amount of water used by the residential customers of municipal/public water suppliers.

Resiliency Water resources and infrastructure can withstand stress and quickly recover when stressed.

Smart irrigation controller Irrigation system controllers that use sensors, real-time weather data, or a combination of both, along with local site condition information, to accurately control the amount of water needed for lawns, landscaping, athletic fields, or other irrigated sites.

Subregion A group of neighboring communities within the metro region designated for regional water planning purposes.

Summer use The amount of water used during the months of June, July, and August.

Summer-to-winter pumping ratio The amount of water pumped during June through August divided by the amount of water pumped during January through March.

Surface water Water that is at or on the land surface. Generally refers to visible water like lakes, streams, and rivers. Stormwater is also an example. In state statute, “surface waters” means waters of the state excluding groundwater. “Waters of the state” means all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, which are contained within, flow through, or border upon the state or any portion thereof.

Sustainability The water needs of current generations are fulfilled without compromising the needs of future generations, while ensuring a balance between economic, environmental, and social well-being.

Turfgrass Grass species for lawns, athletic fields, residential properties, and other high-traffic areas.

WHPA (WHPAs) Wellhead Protection Area(s). Per MDH: Areas surrounding public water supply wells that contribute groundwater to the well. In these areas, contamination on the land surface or in water can affect the drinking water supply. In state statute, wellhead protection area means the surface and subsurface area surrounding a well or well field that supplies a public water system, through which contaminants are likely to move toward and reach the well or well field. Technical criteria are required to delineate a WHPA, including time of travel (at least 10 years), flow boundaries, daily volumes for each water supply well, groundwater flow fields, and aquifer transmissivity.

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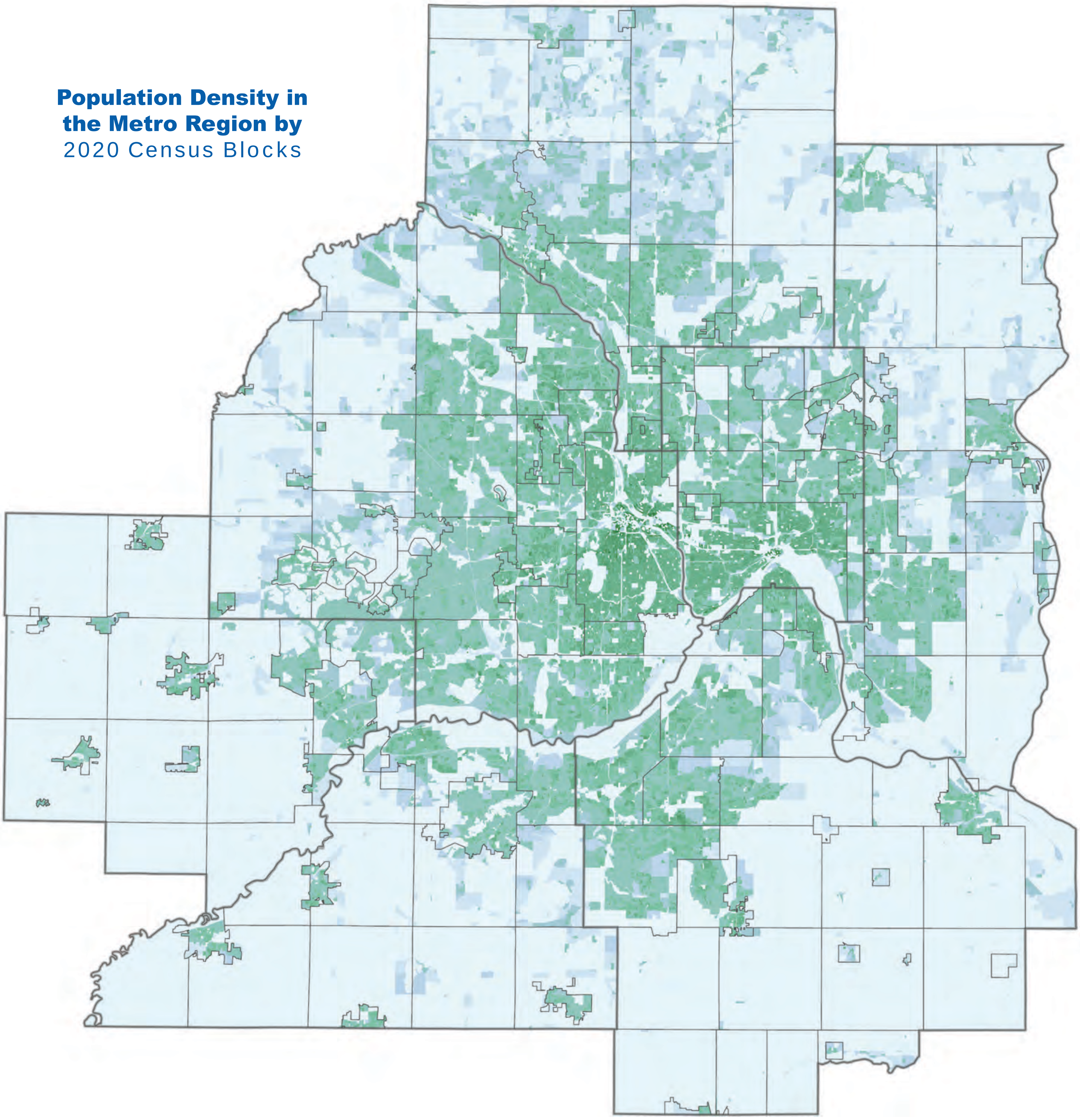
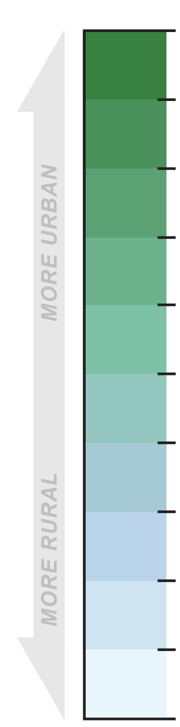
REGIONAL SETTING

Population Density in the Metro Region by
2020 Census Blocks



People per acre



The Twin Cities metropolitan region (metro) consists of the seven counties that surround the Minnesota's two largest cities of Minneapolis and Saint Paul. About 58% of the state's population lives, works, and recreates in the 182 communities that make up the region. The nearly 3,000 square miles (2 million acres) that comprise the region are diverse in land uses, economies, populations, and densities. Much of the region's population is concentrated in Minneapolis, Saint Paul, and larger suburban communities. Moving toward the edges of the metro, the landscape becomes sparsely populated, with agriculture taking up much of the land area.

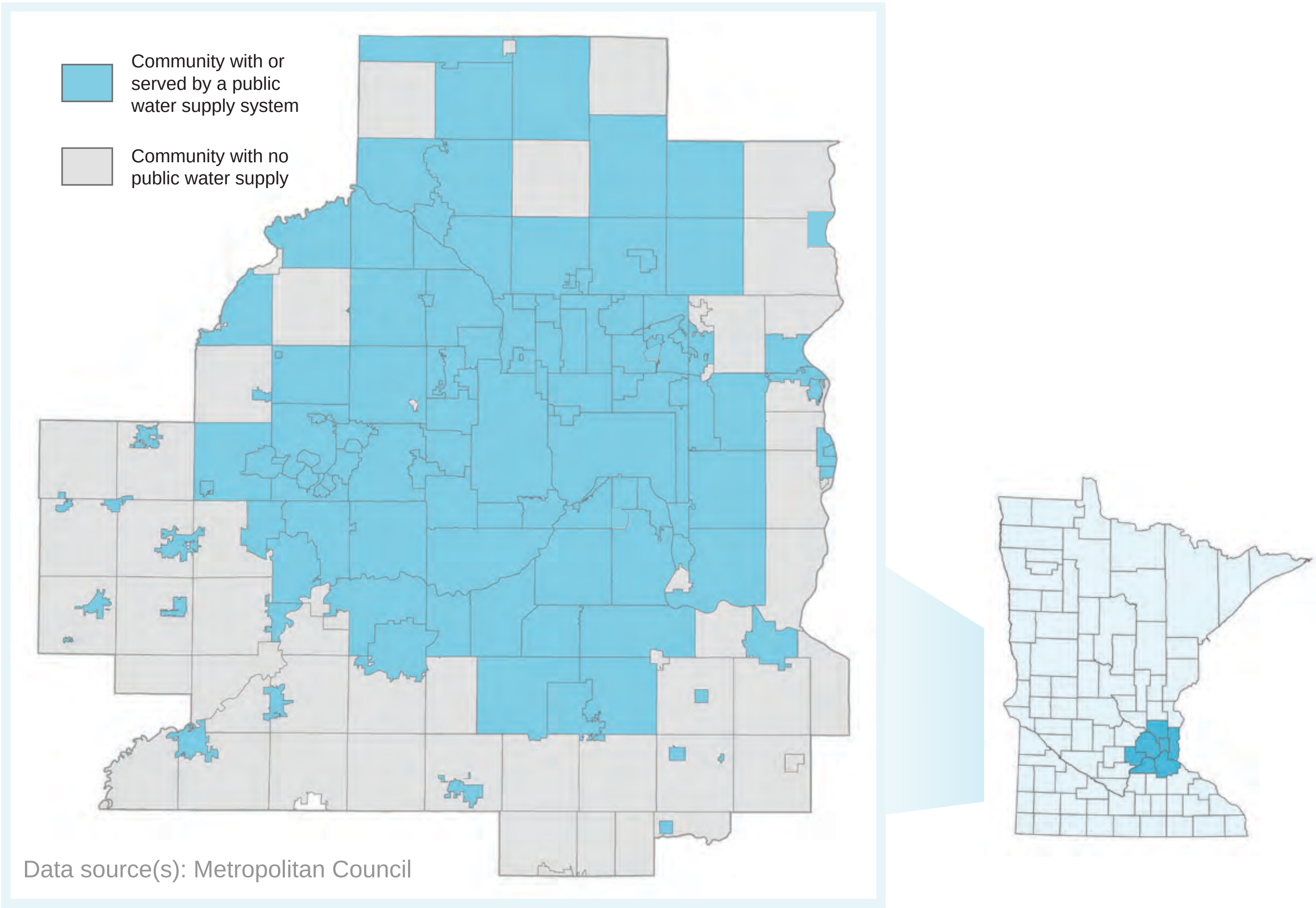
Drinking water in the metro is supplied by a combination of municipal or public water suppliers and private wells. Industries, businesses, agricultural producers, and a variety of institutions also rely on the same groundwater and surface water sources used for drinking water supply.

Data source(s): US Census

Water Supply in the Twin Cities Metropolitan Region

Communities served by public water supplies

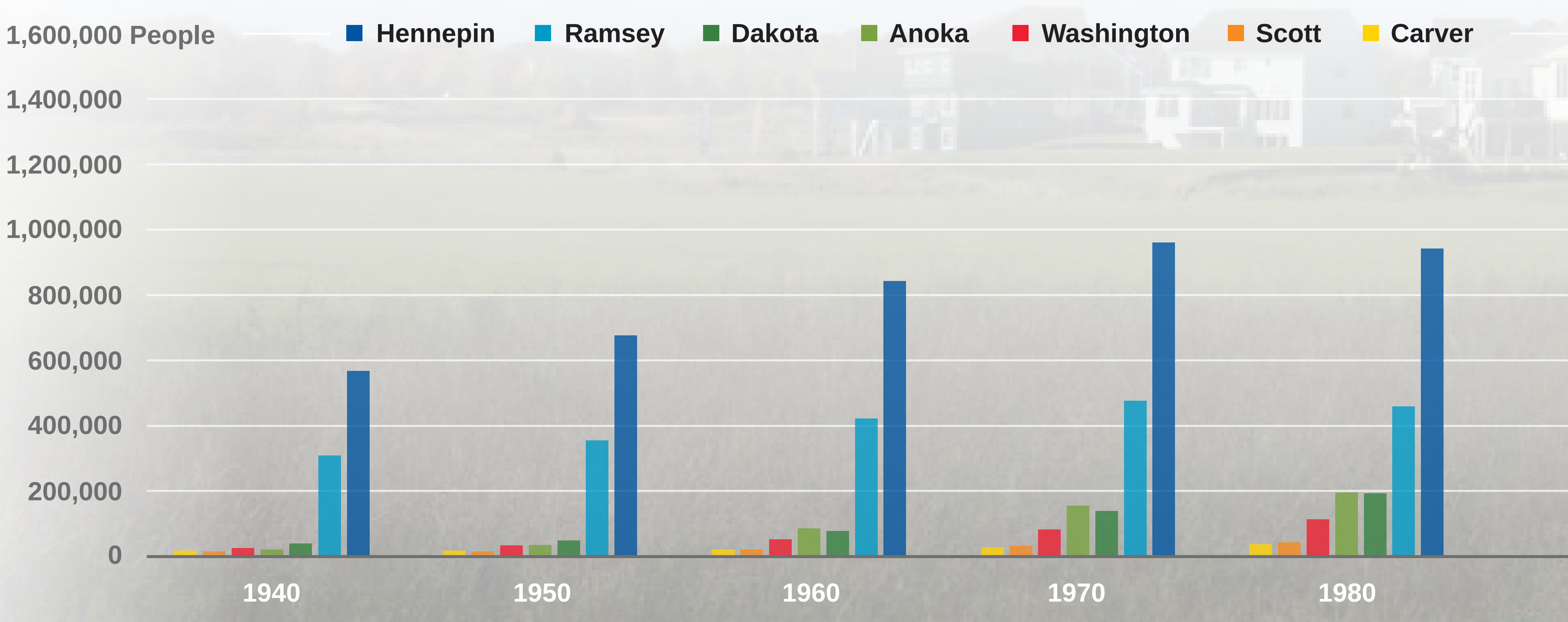
Municipal or public water supply systems provide water to all or part of 126 communities. Residents and businesses not served by municipal/public water suppliers rely on private wells for their drinking water. Farms, businesses, industries, parks, and golf courses rely on the same water sources that provide drinking water.

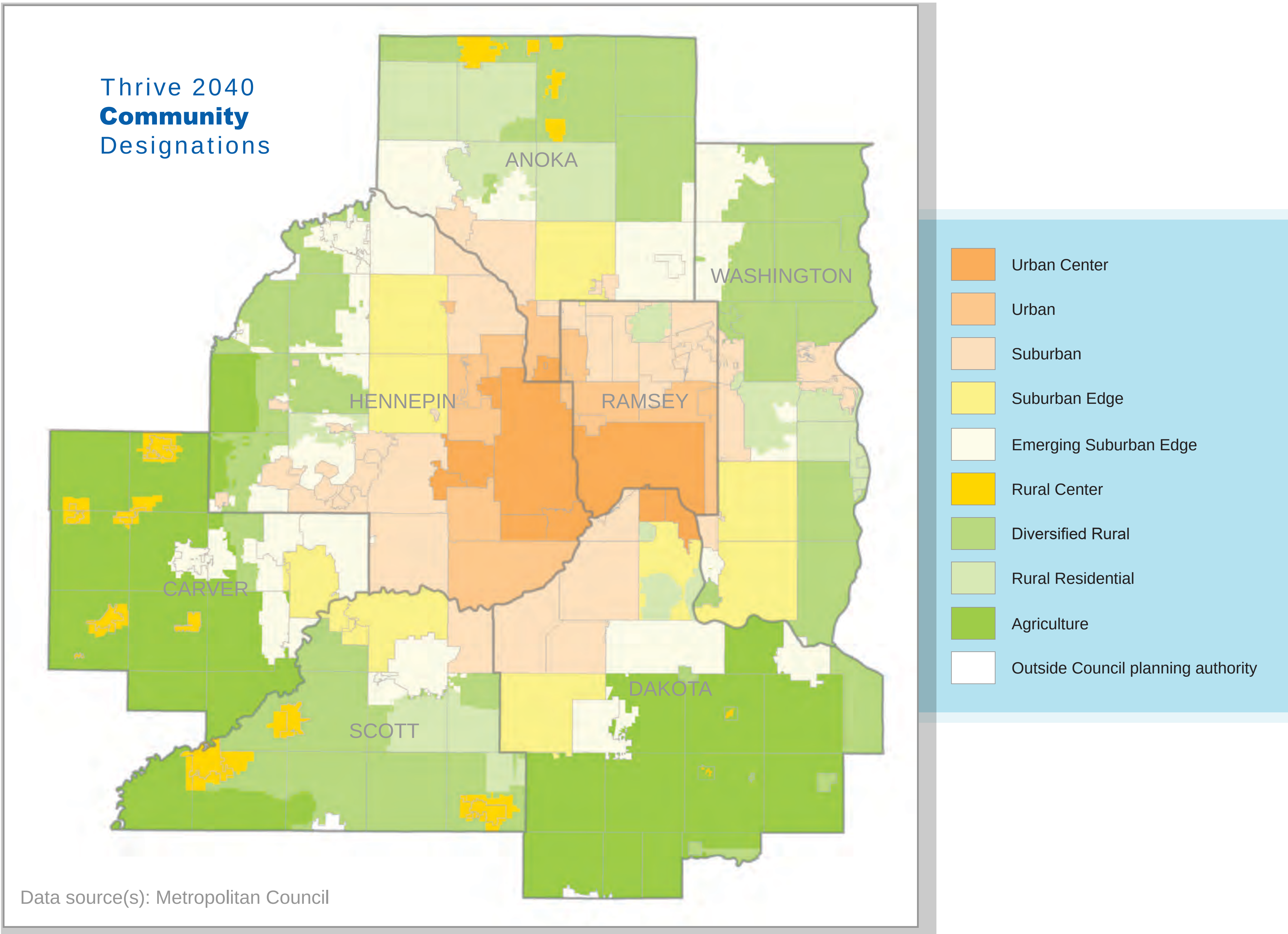


Public water supply systems are mostly operated by individual communities, although in some areas water pumped and treated by one community may be sold or delivered to another. For example, the cities of Minneapolis and St. Paul provide water to some neighboring communities. Public water suppliers are responsible for adhering to treatment standards and maintaining their systems. Private wells and those operated by commercial interests are the responsibility of the individual owner or business.

A Growing Region

The metro region continues to grow as more people choose to live, work, and recreate in the area. By 2050, the population of the region is expected to exceed four million people. More people means more development, redevelopment, and an increasing need for water. To be sustainable and prepare for the future, the region must understand the water challenges of the past and address those of the present, think holistically and invest strategically in our water supply systems, prepare for future stresses to our drinking water resources and infrastructure, and plan for the future demands on our systems within the context of a changing climate.



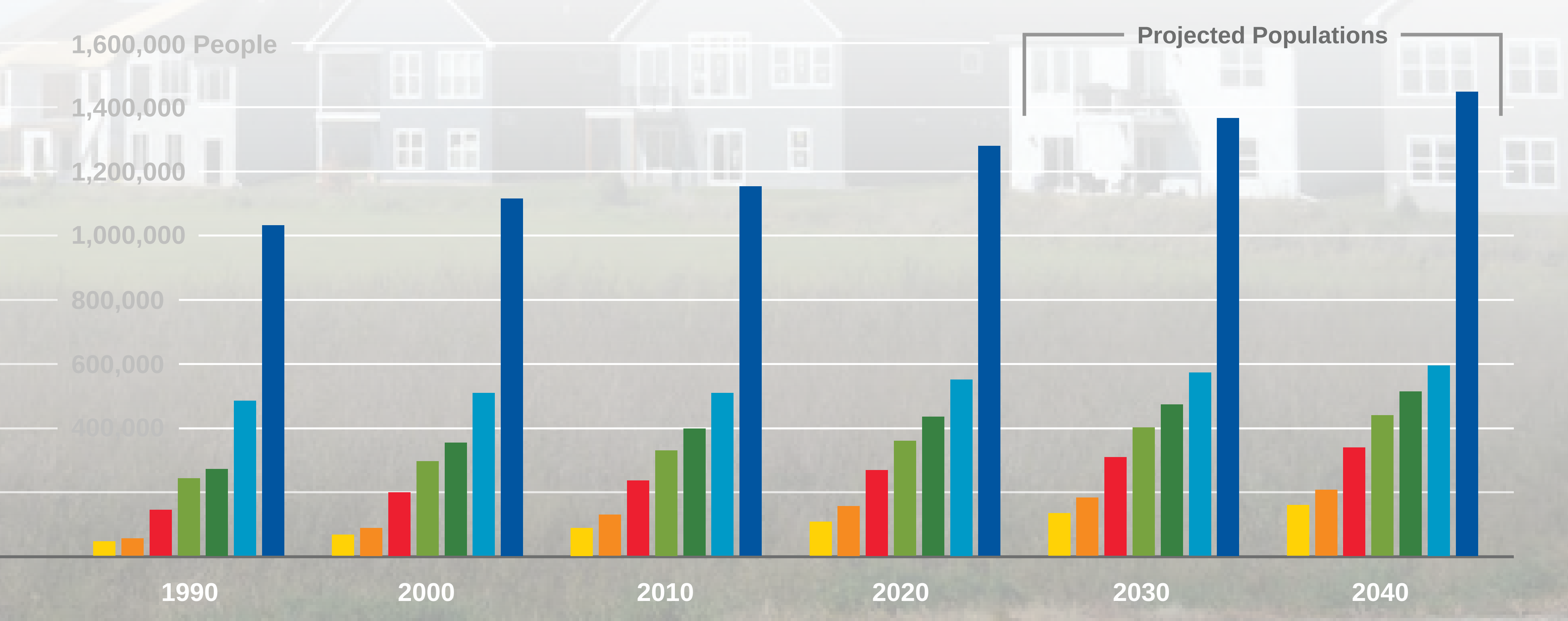


Regional Planning for Diverse Communities

The metro is made up of many different types of communities, from farming-based townships to highly developed urban areas. Recognizing that communities have diverse perspectives and individual challenges, the Council uses community designations to group areas with similar development characteristics to more effectively, equitably, and sustainably plan for the future. Preparing for the future, while addressing the challenges of the present, requires considering the connections between water resources, water systems, and water service providers. Doing so helps to ensure the needs of communities, businesses, residents, and future generations will be met.

The Met Council uses these community designations to:

- Guide regional growth and development to areas that have urban infrastructure in place and the capacity to accommodate development and redevelopment.
- Establish land use expectations, including overall densities and development patterns.
- Outline the respective roles of the Council and the individual communities for planning for forecasted growth.
- Understand how natural resources may be impacted by growth, development, and redevelopment across the diverse communities of the region.



State Water Governance

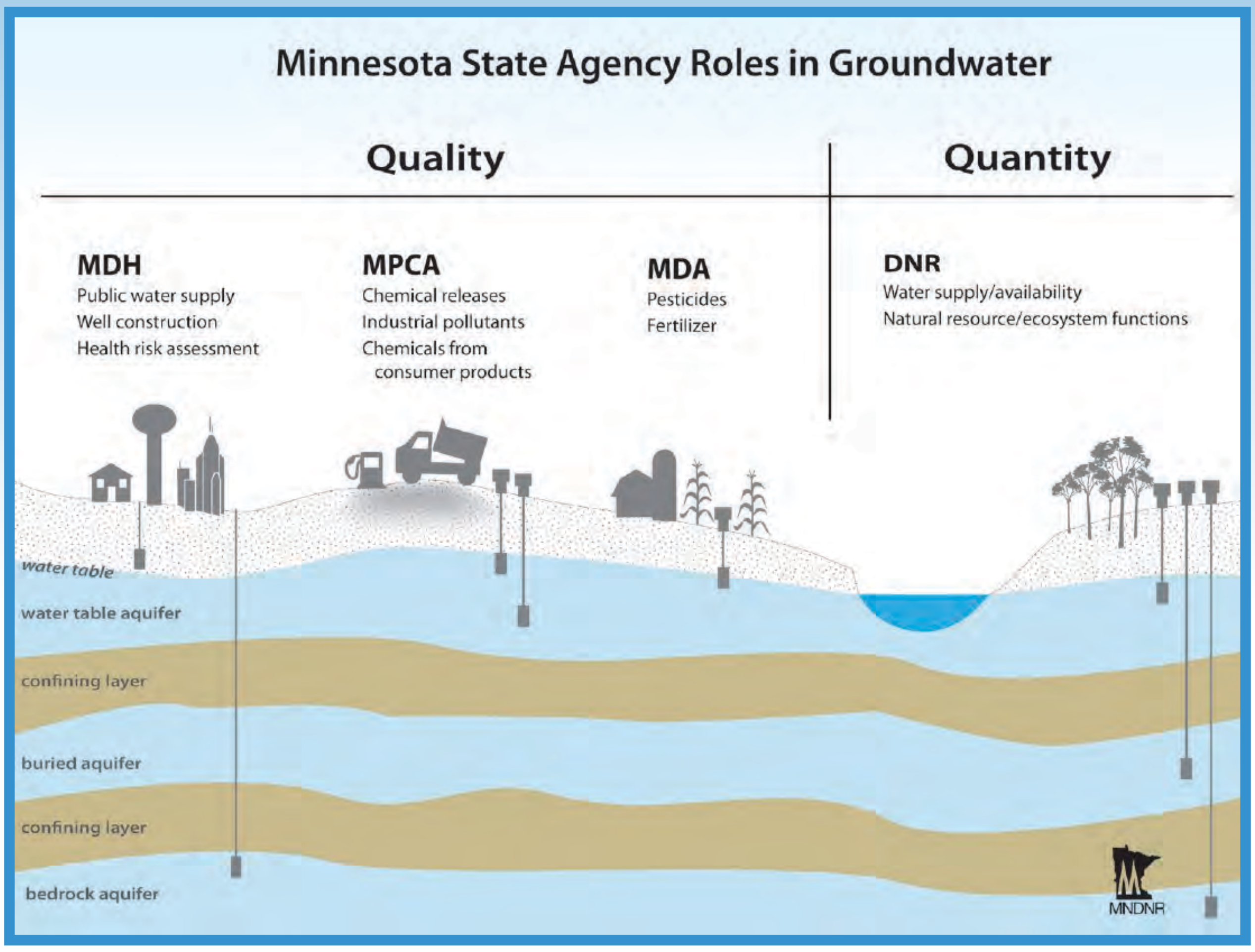
The Minnesota Department of Natural Resources (DNR) is responsible for issuing high-capacity well pumping permits and managing water resource sustainability for the state. The agency's sustainability role is focused on water availability and ecological impacts to water resources and ecosystems. The DNR monitors groundwater and surface water in the region to understand current conditions and inform water management decisions. Water appropriation permit holders report pumping, water use, monitoring, and conservation activity data to the DNR. Communities with water use permits are also required to develop local water supply plans for DNR approval. Those same plans are used as a part of community Comprehensive Plan Updates to align with regional water supply planning policies and Metro Area Water Supply Plan requirements.

The Minnesota Department of Health (MDH) is responsible for helping communities to meet state and federal drinking water requirements. The agency's source water protection and well management programs help to protect public and private drinking water supplies. MDH coordinates training and certification of water operators and administers grants to protect water supplies and infrastructure. The agency also investigates contaminants of emerging concern, climate change and public health impacts, and water reuse.

The **Minnesota Pollution Control Agency (MPCA)** protects water by setting standards for land, air, and water quality. MPCA aims to limit pollution to protect human health and the environment through watershed management plans, permitting, cleanup, and monitoring of pollutants. The agency conducts studies and develops tools to help understand, map, and prioritize restoration and remediation of the state's waters.

The Minnesota Department of Agriculture (MDA) regulates pesticide and fertilizer use in the state and has a variety of programs that fund and promote best management practices to conserve and improve the quality of water in agricultural areas. MDA conducts a variety of groundwater and drinking water protection activities, including well testing for private landowners, water quality certification for farmers, contaminant management plans, and research studies. The agency also monitors groundwater and surface water for contamination related to agricultural activities.

The **Minnesota Environmental Quality Board (EQB)** is a forum for leadership and coordination across Minnesota state agencies on complex, priority environmental issues. The Board has a responsibility to address issues affecting water, land, air, energy, and climate. In addition, EQB coordinated the long-range water resources plan for the state every ten years.



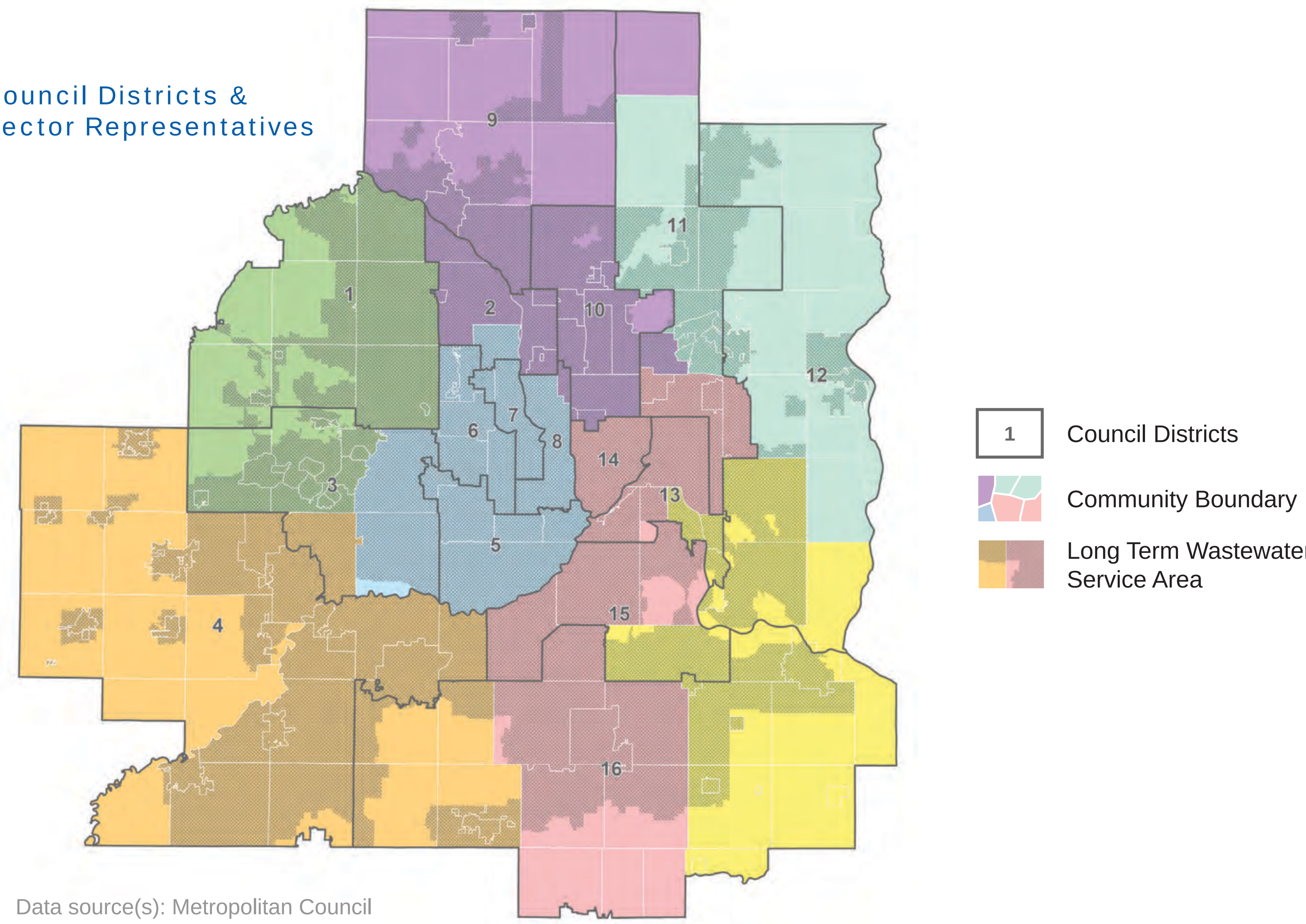
Data source(s): Minnesota Department of Natural Resources

Water Management & Regional Planning

Metropolitan Council Services and Representation

The Met Council is the regional policy-making body, planning agency, and provider of essential services for the Twin Cities metropolitan region, including transit and wastewater conveyance and treatment. The regional wastewater system provides essential ecosystem and public health services, that allow the region to grow and develop sustainably. The organization's formal role in water supply planning was created by statute in 2006.

Council Districts & Sector Representatives



Data source(s): Metropolitan Council

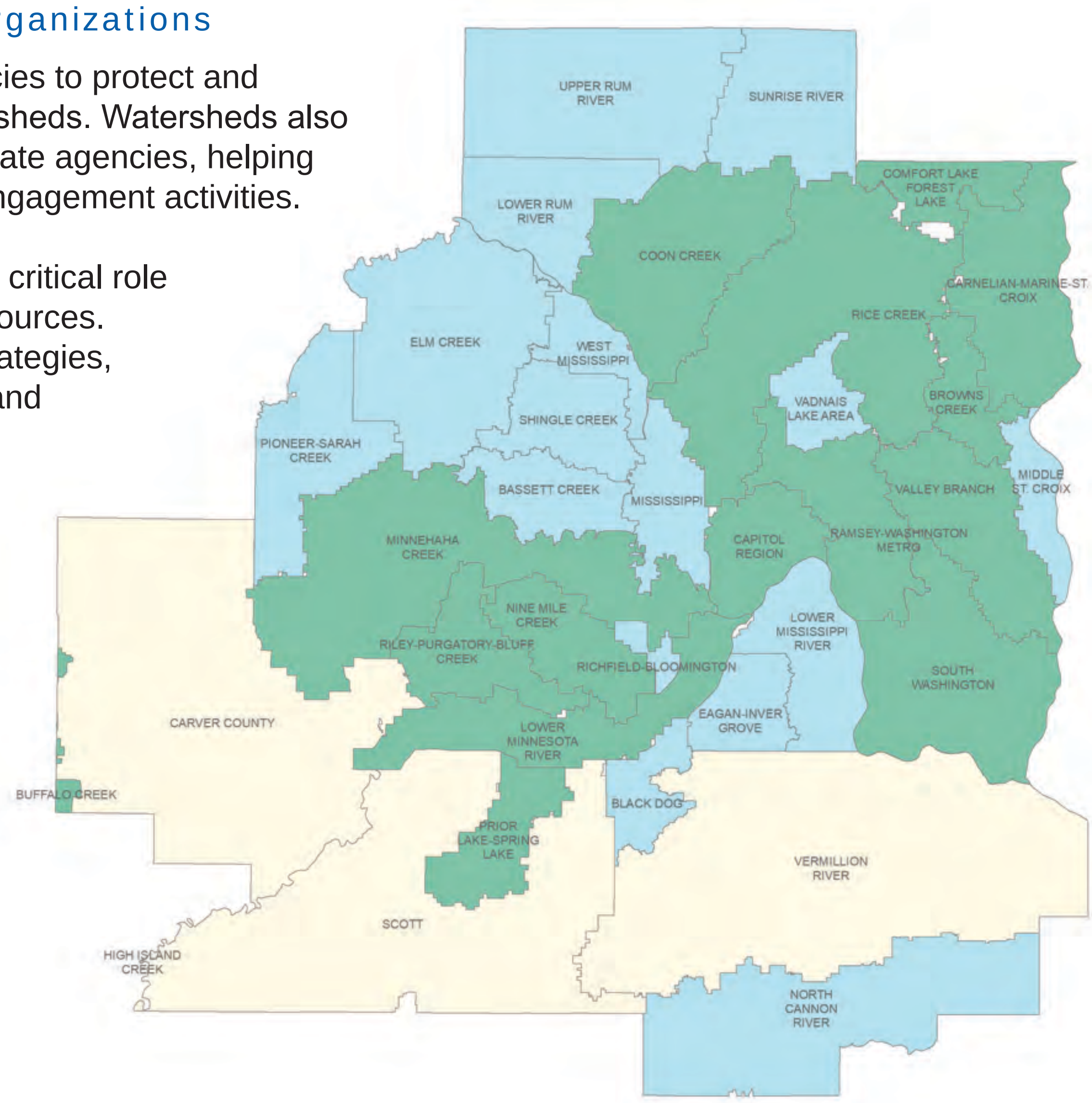
District 1: Judy Johnson
District 2: Reva Chamblis
District 3: Dr. Tyronne Carter
District 4: Deb Barber
District 5: Anjuli Cameron
District 6: John Pacheco Jr.
District 7: Robert Lilligren
District 8: Yassin Osman
District 9: Diego Morales
District 10: Peter Lindstrom
District 11: Susan Vento
District 12: Dr. Gail Cederberg
District 13: Chai Lee
District 14: W. Toni Carter
District 15: Tenzin Dolkar
District 16: Wendy Wulff

Watershed Districts and Management Organizations

These groups monitor, manage, and develop policies to protect and enhance water resources for 33 metro area watersheds. Watersheds also serve a collaborative role with communities and state agencies, helping to coordinate resource management and public engagement activities.

County water resources departments also serve a critical role in monitoring, managing, and protecting water resources. Counties develop water plans that set policies, strategies, and goals for sustainable resource management and may also develop regulations.

In more rural areas of the metro and greater Minnesota, the Bureau of Soil and Water Resources (BWSR), soil and water conservation districts (SWCD), and a variety of local associations aid communities, agricultural practitioners, and residents with resource management and planning.



County Administered Planning

Watershed District

Watershed Management Organization

Data source(s): Board of Water and Soil Resources

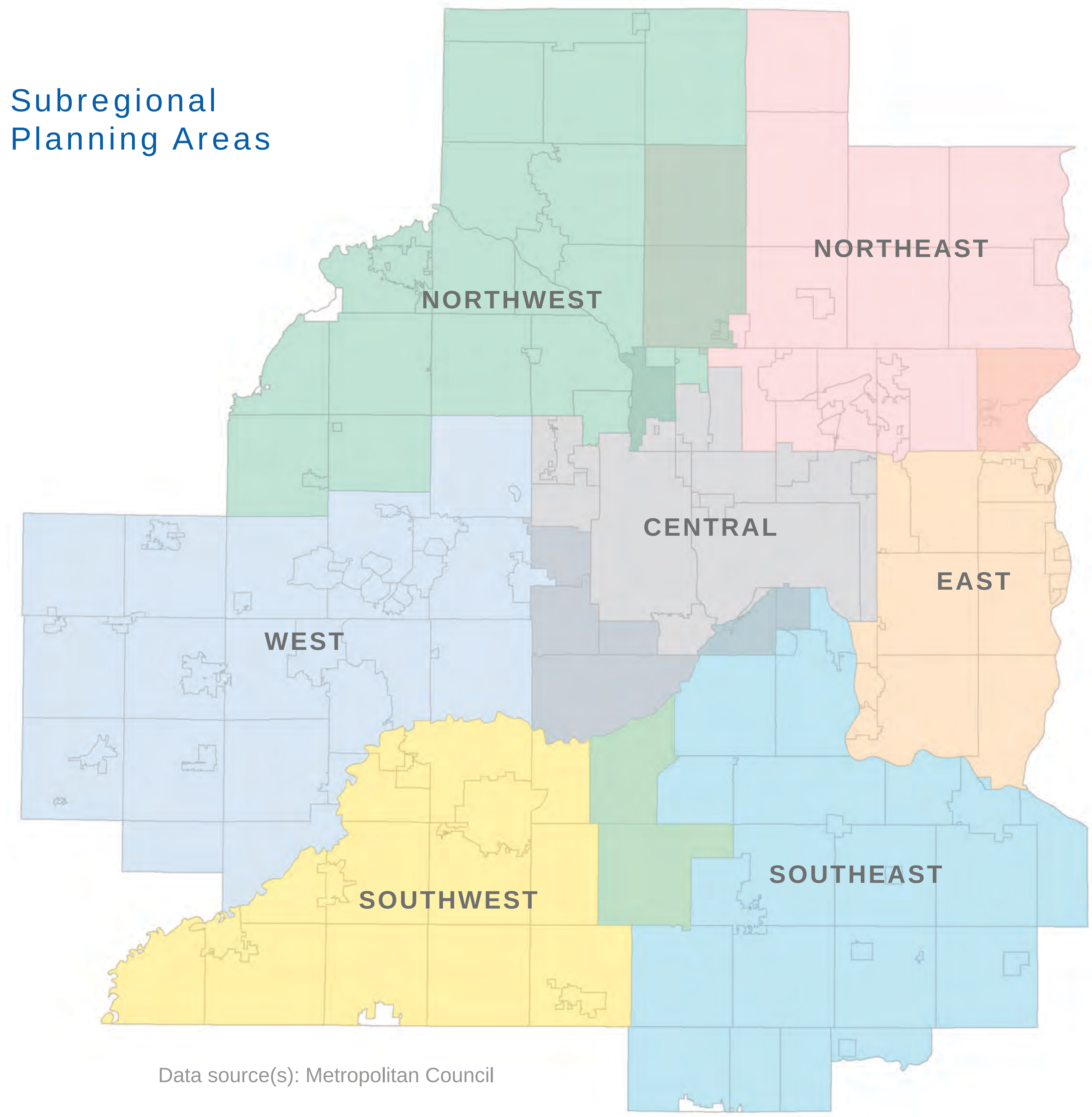
Water Supply Planning

Regional Water Supply Planning

The Met Council works with communities and technical experts to ensure the sustainability of drinking water resources and water supply systems in the metro. Every ten years, the Council works with partners to develop a regional Water Policy Plan (WPP). The Metropolitan Area Water Supply Plan (MAWSP) is part of the WPP plan, which identifies regional water policies and integrated water planning and management strategies for the region.

Tasked by the legislature with "maintaining a base of technical information," the Council conducts technical studies and research to advance the sustainability of the region's water supplies and aid water supplier services. The water supply planning unit facilitates coordinated technical planning and policy advisory groups that inform projects and the regional water supply plan. To build a regional plan, the Council compiles and develops water supply information that is shared with communities. Communities inform the regional plan by sharing their local perspectives and challenges.

Communities with public water supplies are required to develop a Local Water Supply Plan (LWSP) by the DNR. The Council works with the DNR to align regional planning goals and requirements with those of the state. LWSPs are approved by the DNR and reviewed by the Council for regional policy alignment as part of community comprehensive plan updates.

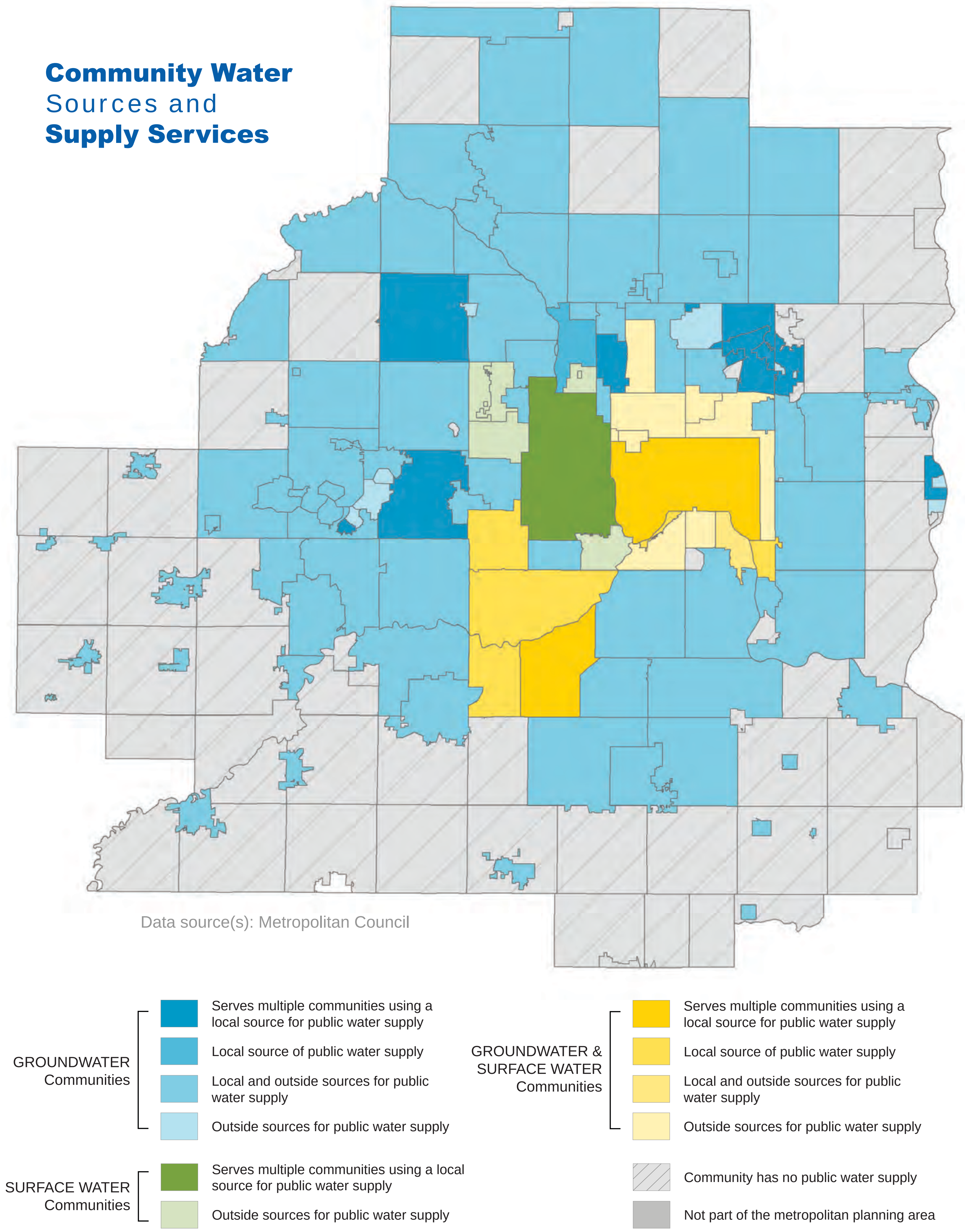


Subregional planning groups support local planning and collaborative problem solving. Water supply needs and challenges are not the same for every community nor are the potential solutions. Regional water policies and goals need to reflect local conditions and challenges to ensure implementable strategies are developed and the needs of the region are reflected. As the region continues to develop, water suppliers, users, regulators, and planners will need to work together to find creative solutions to address emerging challenges.

This atlas provides information for each subregional planning area to help communities communicate, collaborate, and better connect with regional plans, policies, and goals. Local water planning, supported by subregional and regional partners, can help communities meet their water supply system and resource needs, while positively affecting their neighbors and water sustainability across the region.

Local Water Supply Planning

Communities plan for and mange water supply systems and water resources. Water suppliers provide the essential service of safe and reliable drinking water to their customers. They also carefully monitor and manage their water supply systems and source waters to ensure water use is sustainable and protect public and ecosystem health. Communities often work together to share knowledge and information to help their neighbors address shared water challenges. All communities include local water supply, drinking water, and water resource information in their long-term, comprehensive plans.

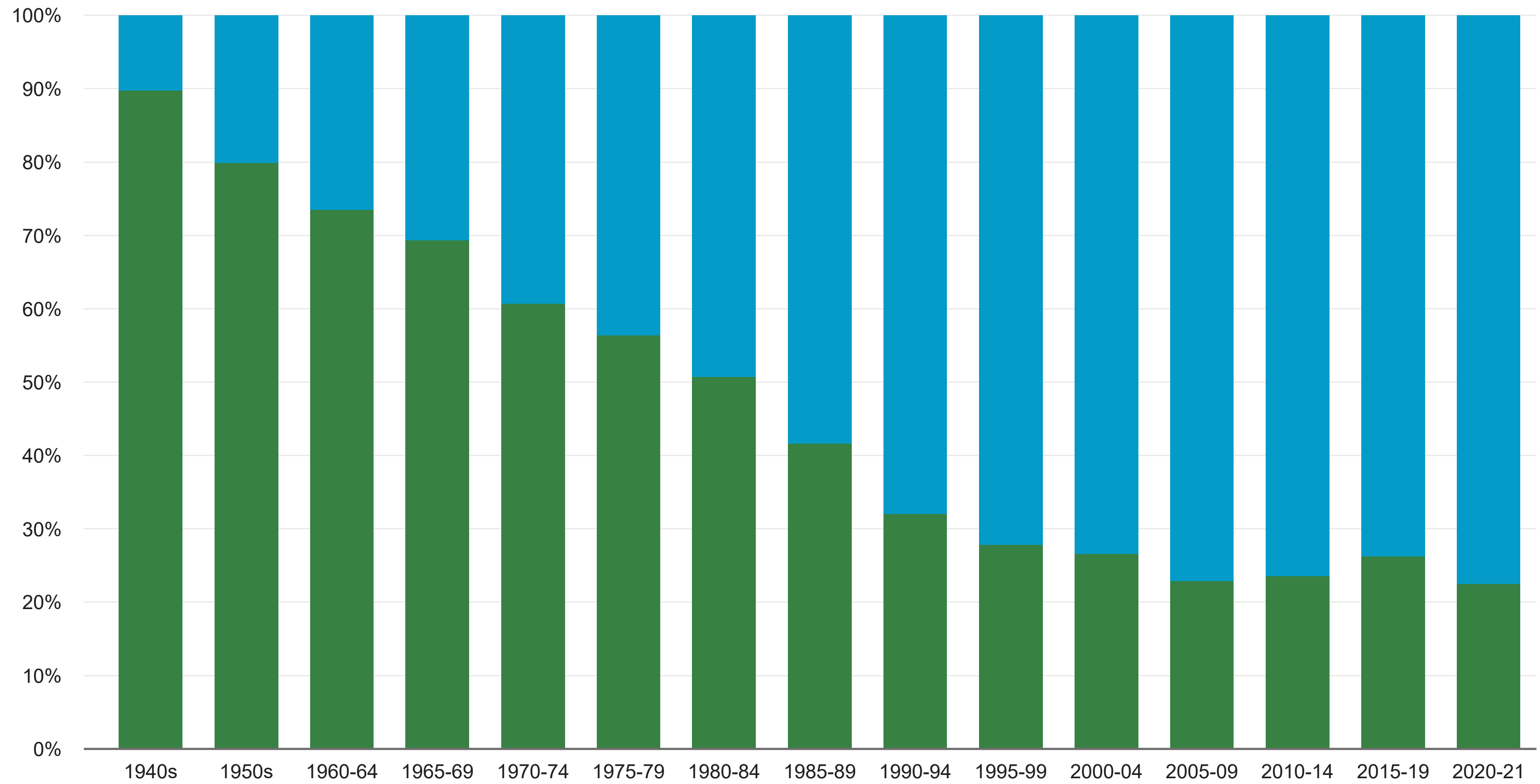


In the Twin Cities, the oldest and most developed part of the metro, surface water from the Mississippi River and a series of lakes North of Saint Paul are the primary water sources, while the townships, rural, and suburban communities surrounding the central cities mostly rely on groundwater aquifers. However, these water sources don't conform to municipal boundaries, requiring water users and managers to work with their neighbors and surrounding communities to protect and maintain high-quality water resources.

Water Resources

Municipal/Public Water Sources and Use Trends

Groundwater pumping drives regional water use trends over recent decades. In the early 1980s, as more suburban communities developed and built water treatment facilities to serve their residents, more groundwater than surface water was pumped for the first time. That trend has continued over the past 40 years as the suburban areas of the metro have continued to grow.

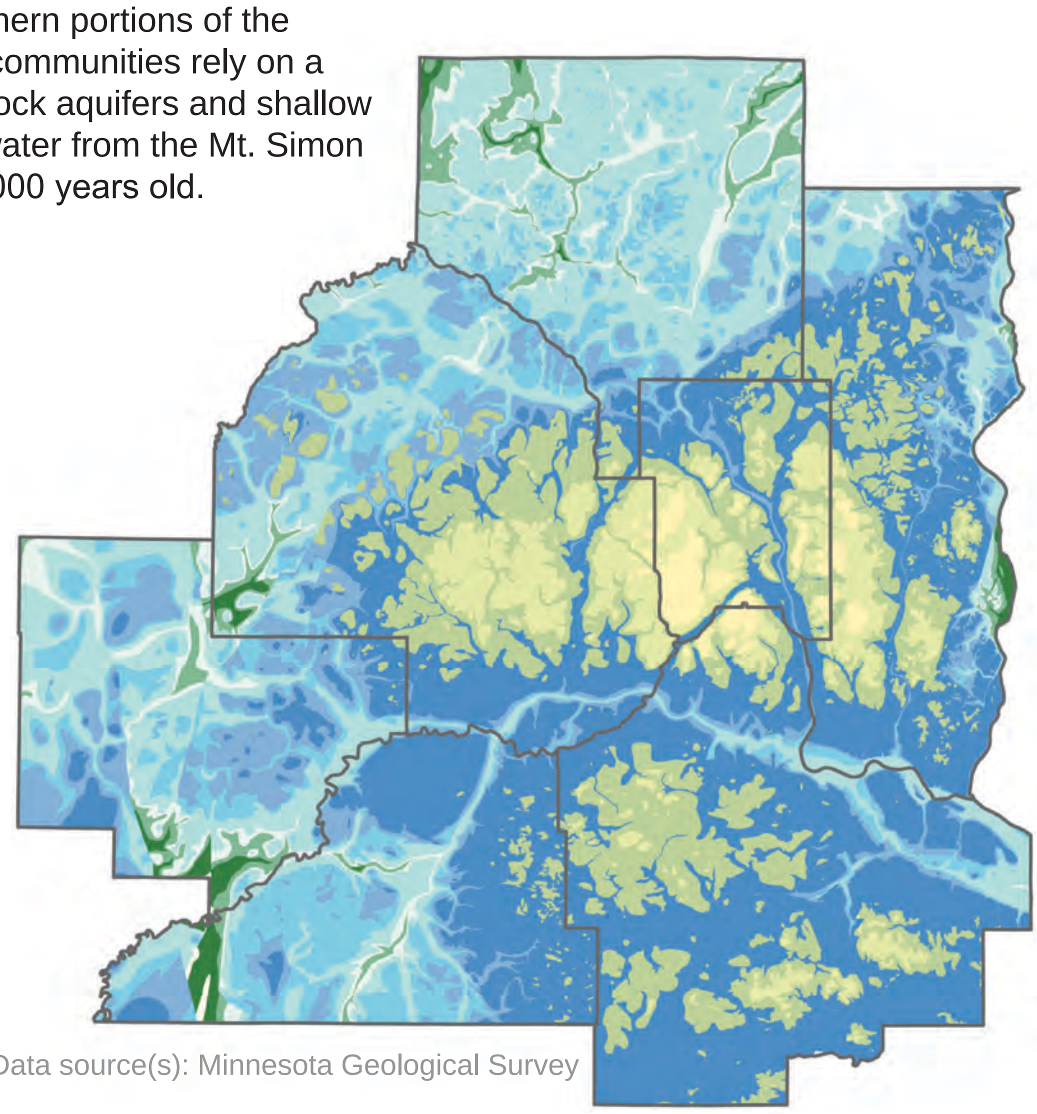


Data source(s): Minnesota Department of Natural Resources water permitting and reporting system (MPARS), United States Geological Survey

Bedrock Geology

Groundwater aquifers are often used as the source for public water supplies, as well as industrial, commercial, and agricultural uses outside of the urban center. Private drinking water wells are usually in shallow sediments deposited when continental ice sheets retreated 18,000 years ago.

The Prairie du Chien and Jordan bedrock aquifers are highly productive water sources and cover much of the Central, East and Southern portions of the metro. In the Western and Northern part of the metro, communities rely on a combination of deeper Tunnel City and Wonewoc bedrock aquifers and shallow sandy (sedimentary) aquifers. The deepest wells pull water from the Mt. Simon aquifer, whose water has been dated to be 6,000 - 30,000 years old.



Data source(s): Minnesota Geological Survey

Water Supply Sources

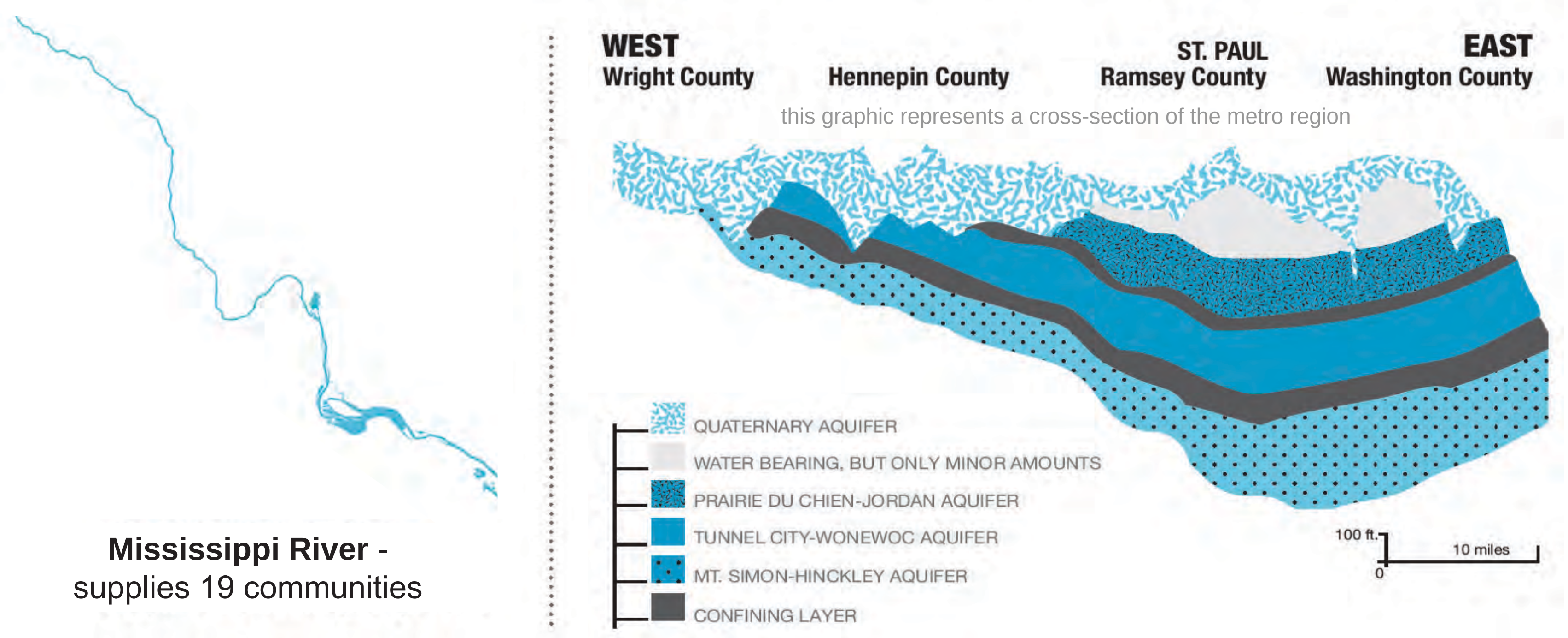
The large cities of Minneapolis and Saint Paul, and communities they provide water to, rely on the Mississippi River for their water supply. In the case of Saint Paul, water from the river is pumped to a series of lakes north of the city before it is treated and delivered to customers. Deep groundwater aquifers are often used as the water source for public water supplies outside of the urban center, and for industrial, commercial, and agricultural uses.

Quaternary - supplies 24 communities

Prairie du Chien-Jordan - supplies 83 communities

Tunnel City-Wonewoc - supplies 30 communities

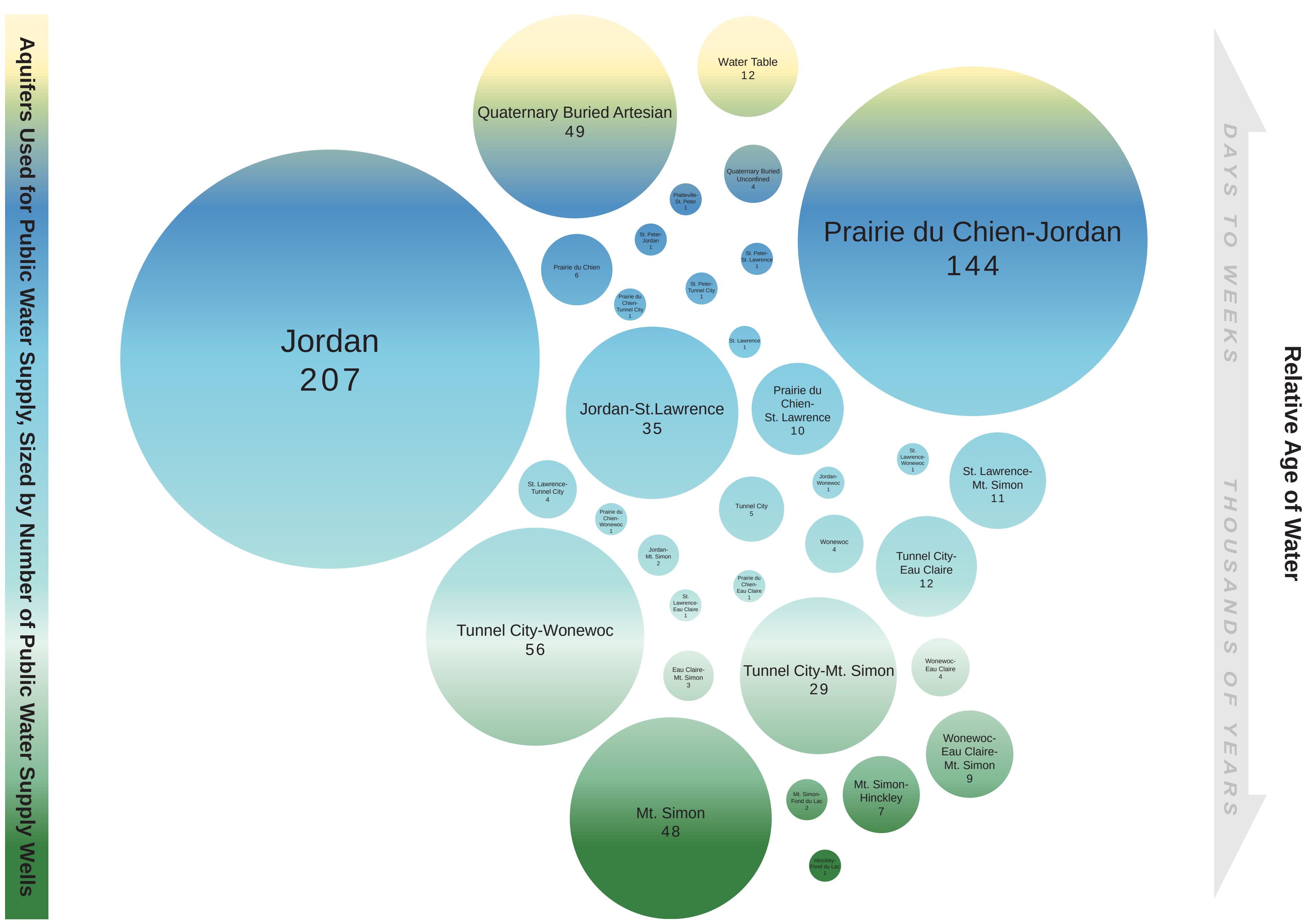
Mt. Simon-Hinckley - supplies 35 communities



Data source(s): Metropolitan Council

Many communities, farms, and residents with private drinking water wells rely on water found in shallow sandy sediments to meet their water supply needs. Water suppliers also use these shallow groundwater sources in communities where productive aquifers are more difficult to access. Because those water sources are near the land surface, they may be the first to be impacted by pollution or during periods of drought.

Number of Public Water Supply Wells by Aquifer



The Prairie du Chien and Jordan bedrock aquifers are the most heavily used in the metro. Communities that have access to these aquifers don't have to drill as deep as some other communities to access productive aquifers. However, because those aquifers are closer to the surface and used by many communities, these sources may be more easily stressed during periods of high use and more susceptible to pollution. Many high-capacity wells are open to (span) multiple aquifers. Movement of water through the ground is complicated. However, in general, the deeper the source of water, the older that water is.

Data source(s): Minnesota Department of Natural Resources water permitting and reporting system (MPARS)

Water Uses & Demand

Since the middle of the 20th century the amount of water used has continued to grow with development, mostly in expanding urban and suburban communities. A growing population requires more water for drinking, homes, and business uses. Other factors like changing climate and weather, appliance efficiency and plumbing code changes, also influence the demand for water over shorter and longer timespans. In the future the region will continue to need more water. Efficient water use practices and equipment, water reuse and exploring enhanced recharge opportunities, and identifying alternative water sources helps to ensure water systems and sources are resilient and sustainable.

MUNICIPAL WATER UTILITIES: 100+

PRIVATE WELLS: 60,000+

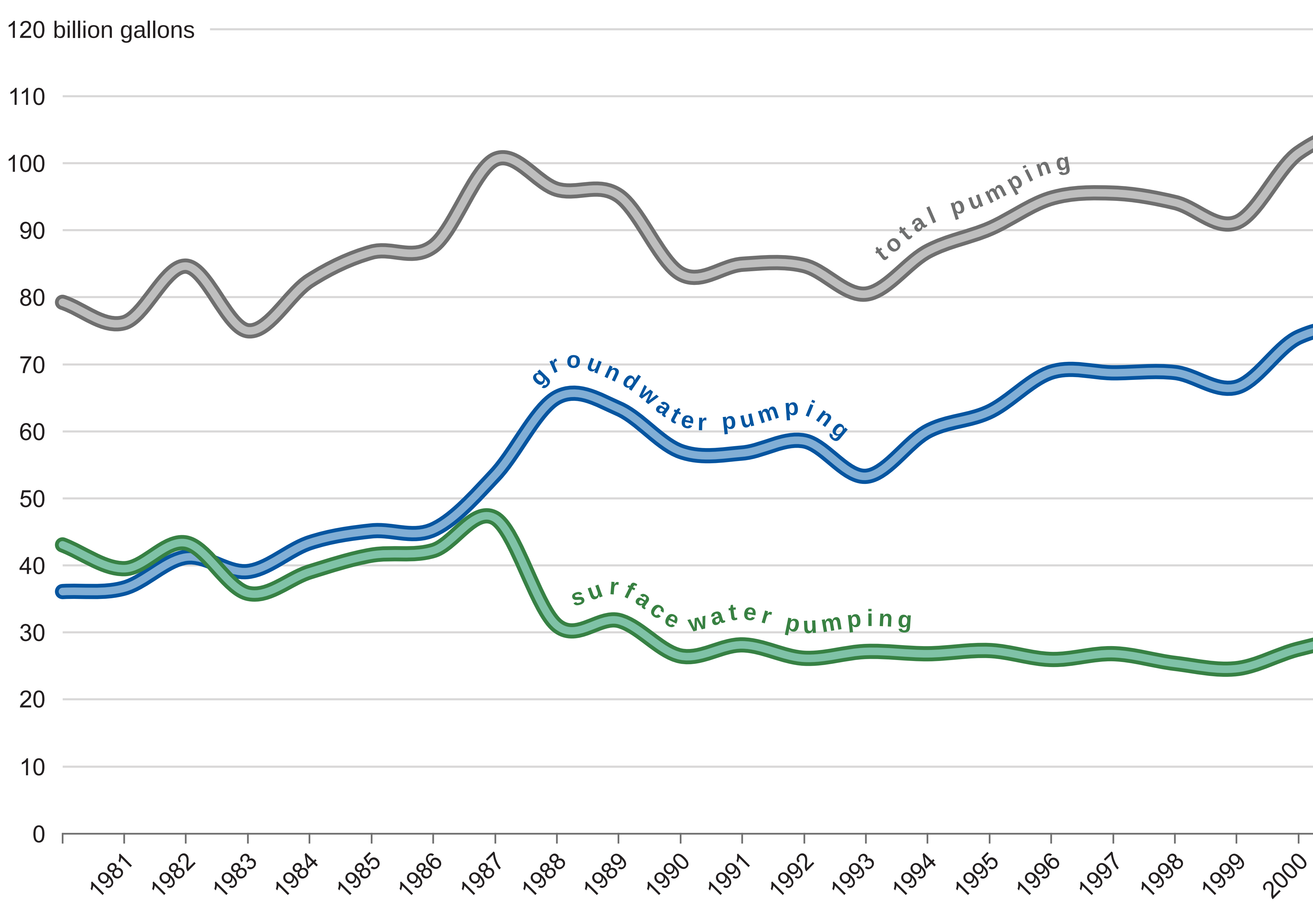
DISTRIBUTION PIPES: 10,000+ MILES

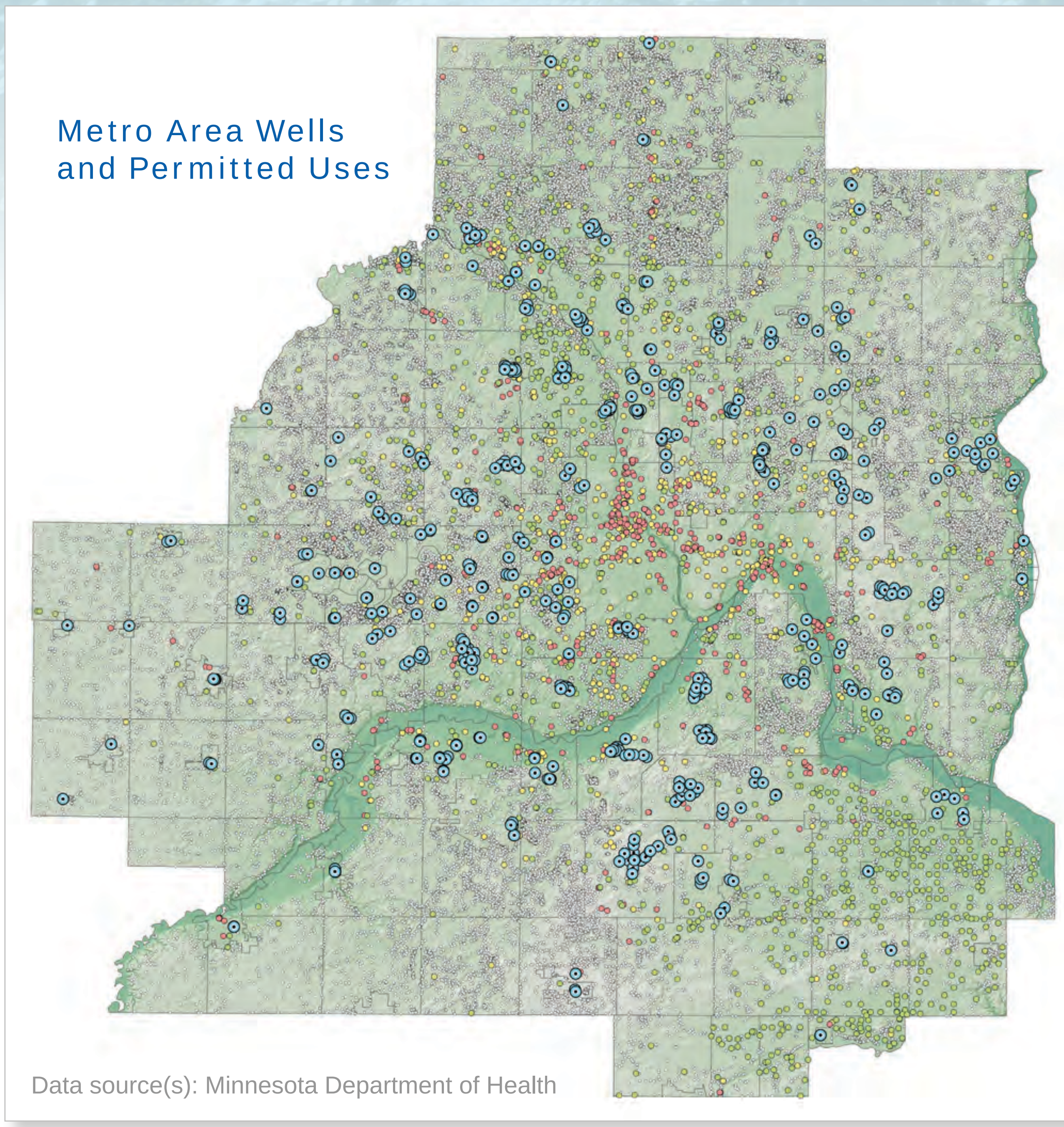
About **200** Million Gallons **per day** were pumped **by municipal** suppliers in 2020.

What will water use look like in 20 years? +100

Data source(s): Metropolitan Council; Minnesota Department of Natural Resources water permitting and reporting system (MPARS)

Annual Water Pumped by Public Suppliers, in Billions of Gallons



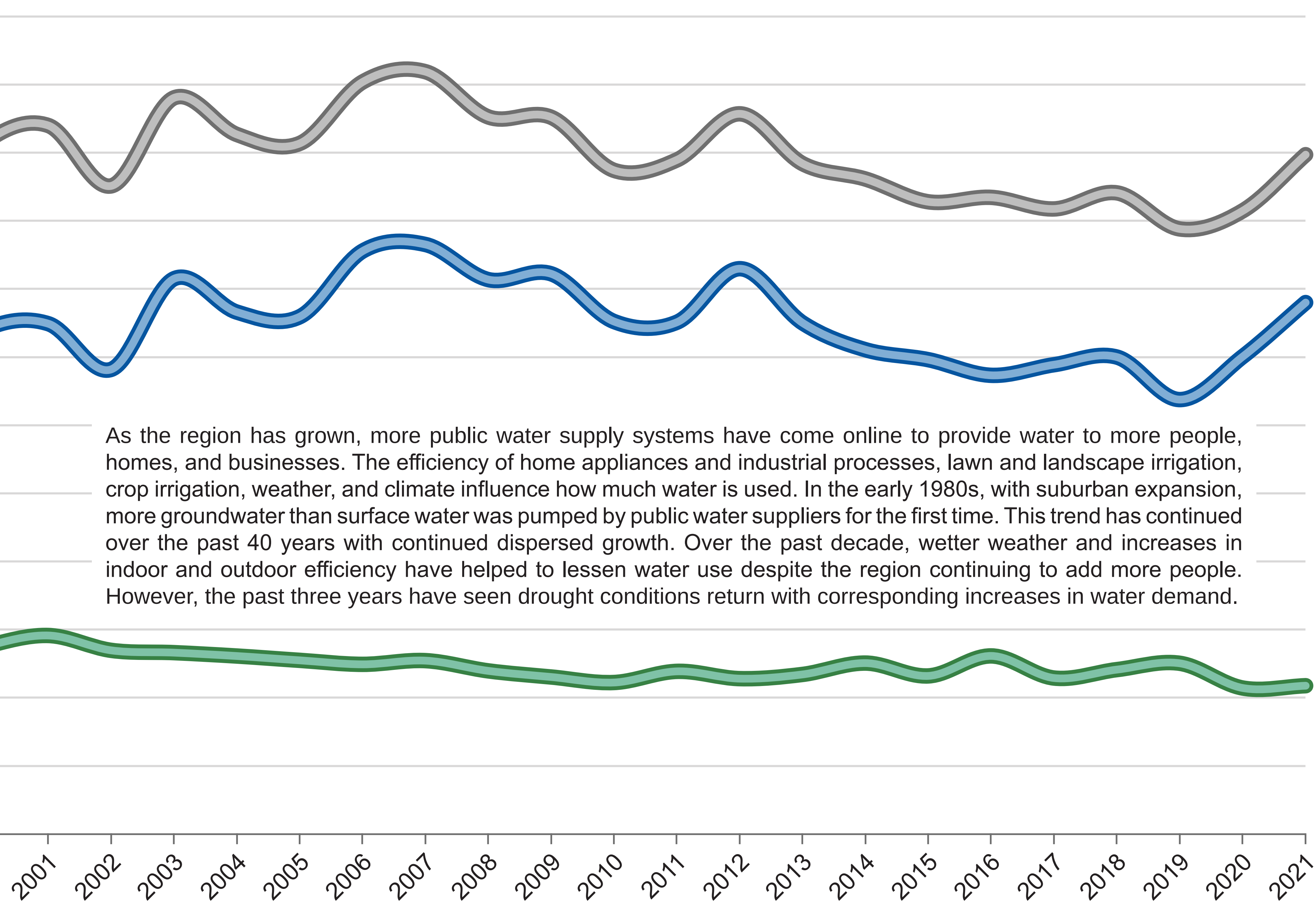


Metro Area Wells and Permitted Uses

Data source(s): Minnesota Department of Health

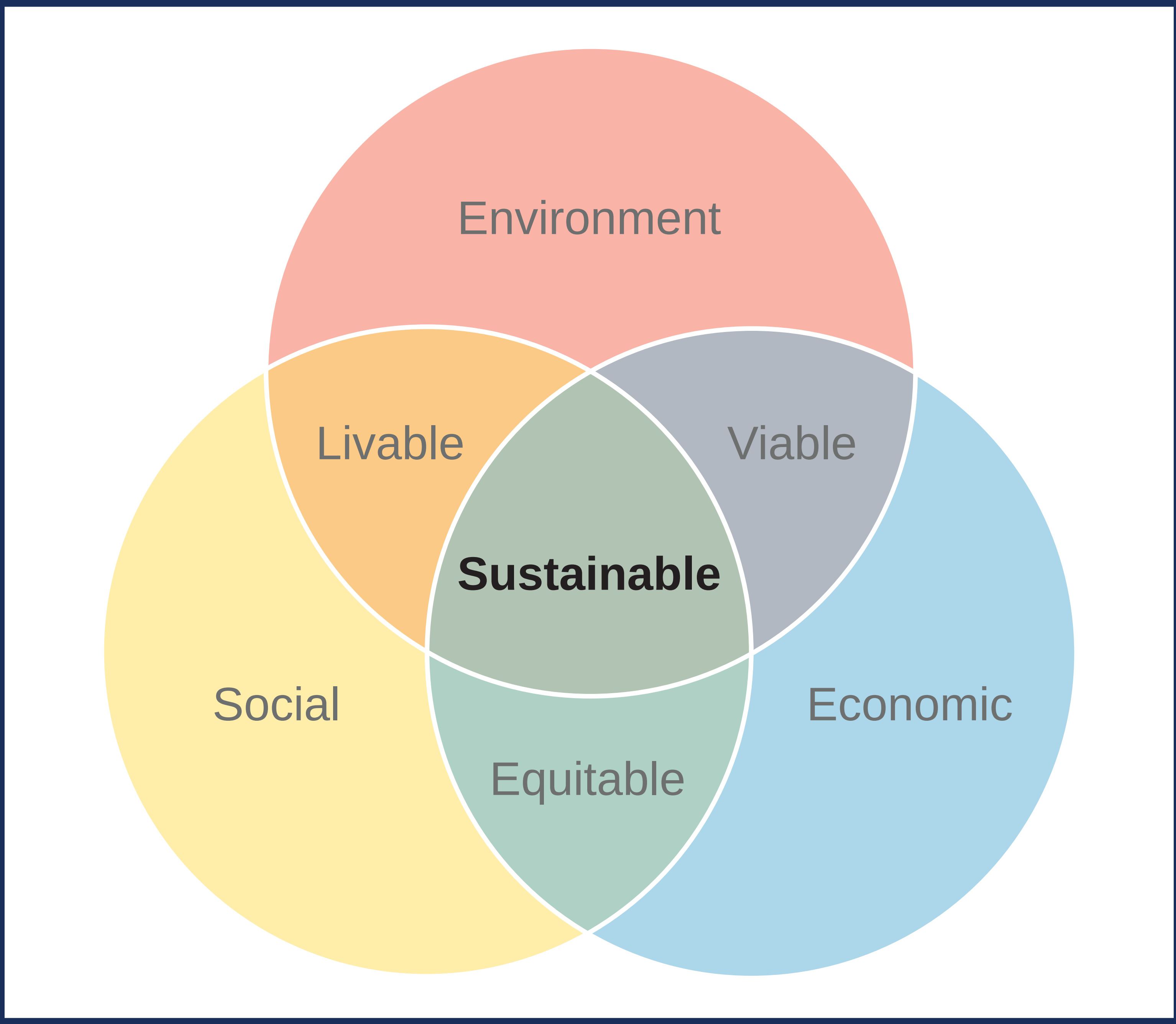
There are many different types of water supply wells. In the map, wells are classified by their associated water appropriation permit type or by domestic use for private wells. Where different types of wells are located is connected to historical development patterns in the metro region. Most irrigation wells are agricultural and are found in the more rural parts of the metro while industrial and commercial wells. Municipal/public water supply wells are connected to development and the Municipal Utility Service Area (MUSA).

More water is pumped for cooling at power generation plants than any other permitted water use in Minnesota. Almost all of this water is surface water, and this use is mostly considered non-consumptive by the Minnesota DNR because water is returned to its original source soon after it's used.



As the region has grown, more public water supply systems have come online to provide water to more people, homes, and businesses. The efficiency of home appliances and industrial processes, lawn and landscape irrigation, crop irrigation, weather, and climate influence how much water is used. In the early 1980s, with suburban expansion, more groundwater than surface water was pumped by public water suppliers for the first time. This trend has continued over the past 40 years with continued dispersed growth. Over the past decade, wetter weather and increases in indoor and outdoor efficiency have helped to lessen water use despite the region continuing to add more people. However, the past three years have seen drought conditions return with corresponding increases in water demand.

Water Sustainability



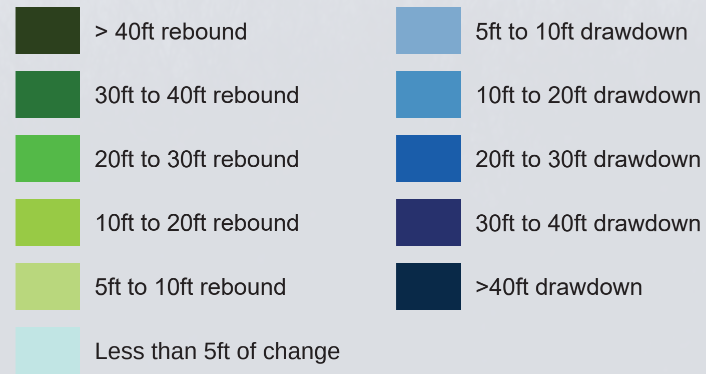
Adapted from Minnesota Water Sustainability Framework

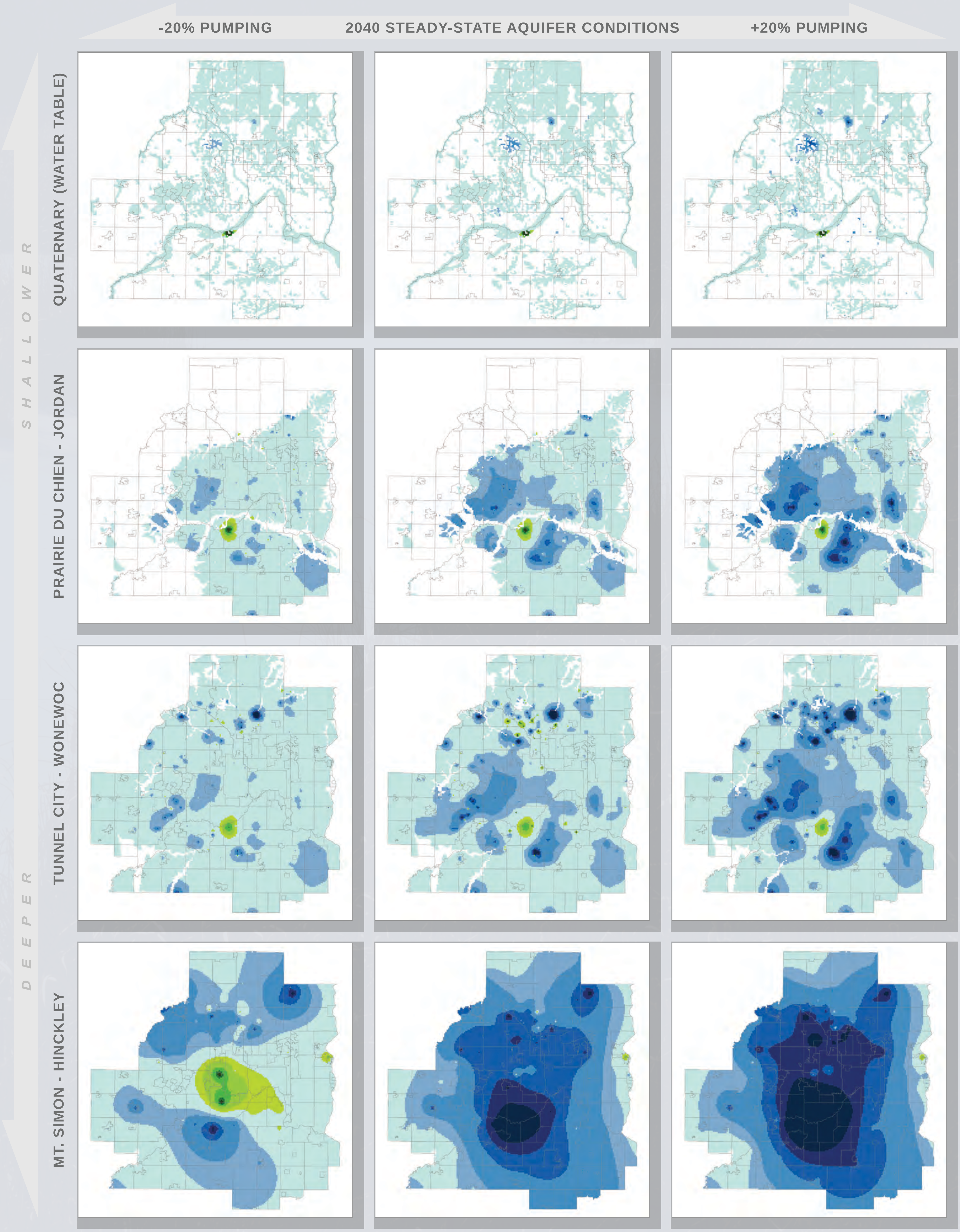
The ability of the metro region to grow and meet the needs of future generations is dependent on the sustainability of water resources and the services those resources provide to society. Without plentiful, safe, and affordable water, the region cannot grow economically, continue to develop, or meet the needs of the people who live here. Likewise, the utility systems that provide and treat water need to be sustainably operated and funded to meet those needs. Our water system is both natural and engineered, with infrastructure continually interacting with surrounding ecosystems. Water resources and utilities must be planned for holistically to address complex challenges. Considering risks and impacts to water resources and utility services in community planning and development decisions helps to ensure the region is a thriving place to live for all current and future residents.

In 2014, a regional groundwater model was developed as a planning tool to help facilitate planning discussion about the future of the region's groundwater resources. The model uses estimates of future municipal water demands and associated groundwater pumping to provide a picture of what future aquifer conditions might look like as the region continues to grow. Scenarios that increase and decrease pumping by 20% were included to provide a range of possible outcomes for water managers, regulators, and planners to consider. Over the past decade, the region has experienced additional growth and associated water demand and changing aquifer conditions. An updated regional model, using new and additional data, would likely provide a different view of the future with more data.

Regional Groundwater Modeling Estimates Future Aquifer Conditions

In general, modeling results show some amount of aquifer decline over the next 20 years, under theoretical steady-state conditions. The model does not answer whether those declines might negatively impact water resources, infrastructure, or local ecology. While these results are not predictive, they do help the region to understanding where and why water supply challenges might occur. This helps the region and individual communities prioritize areas for additional investigation, direct resources, and be proactive rather than reactive.





Data source(s): Metropolitan Council

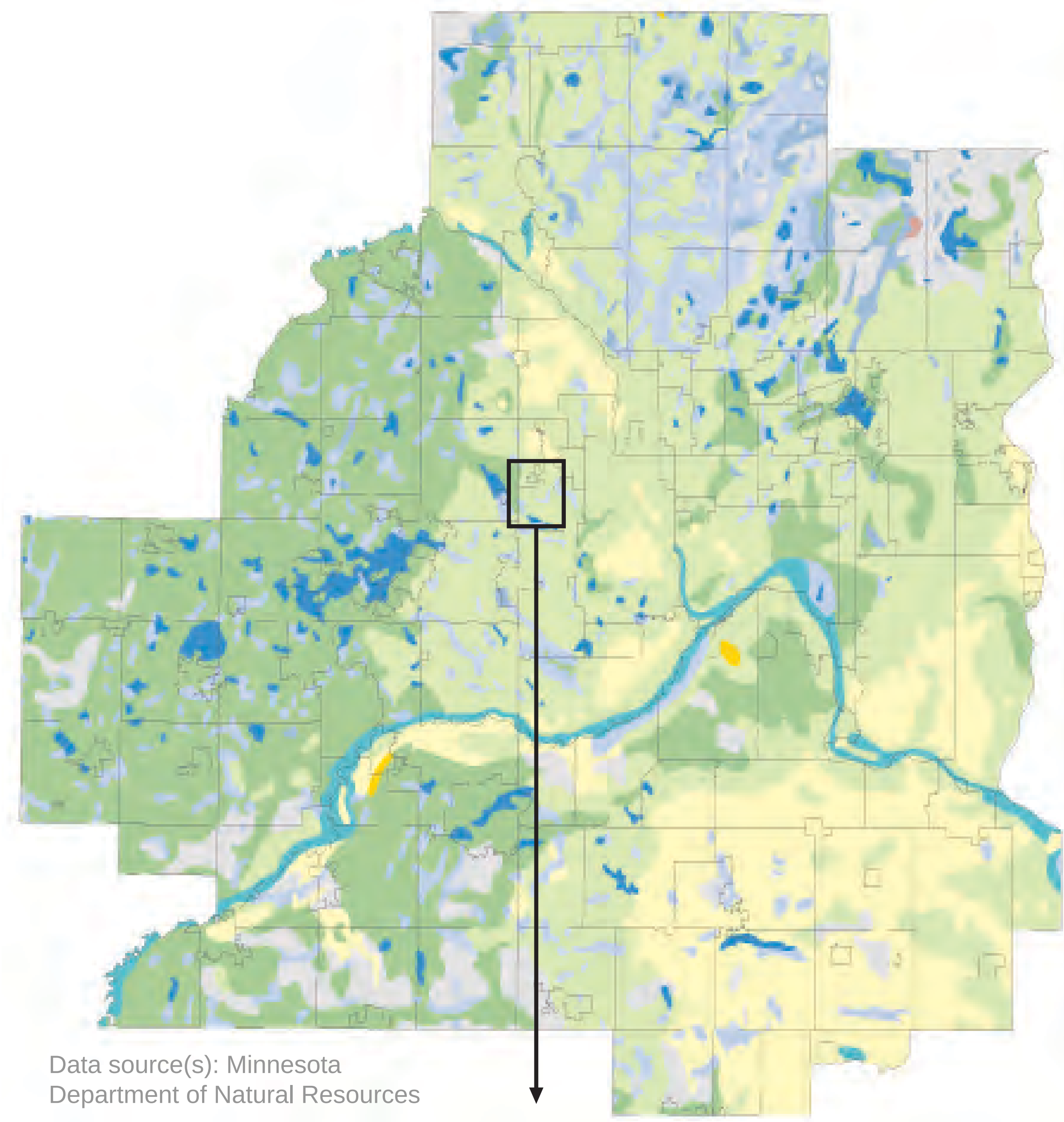
Note this assessment was completed in 2014 and is based on groundwater pumping data prior to 2012. Any future regional modeling efforts would include more recent data and provide an updated estimate of future aquifer conditions

Development, Growth, & Land Use Change

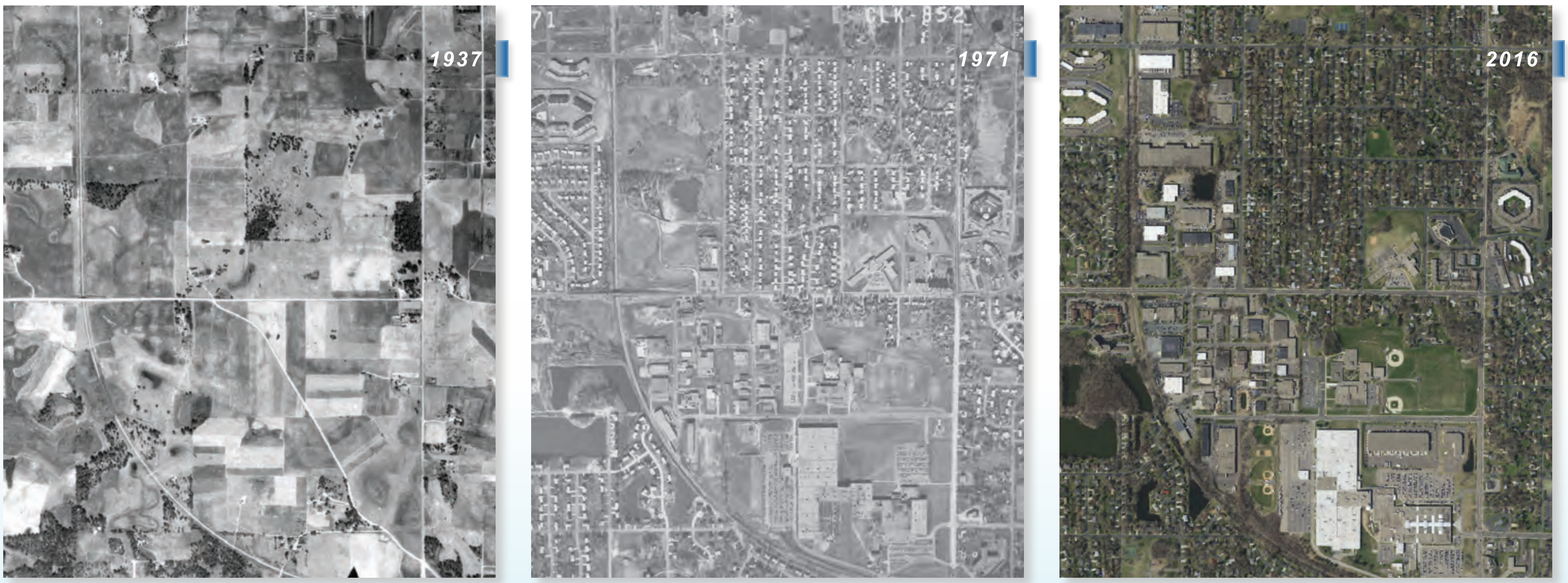
Native Vegetation 1847-1907

Land use changes have profound effects on water resources. Prior to colonization and European settlement, indigenous peoples had lived for generations in the area we currently call the metro region. Forests, wetland meadows, and prairie grasslands covered the area. Dakota and Anishinaabe peoples cared for the landscape, including the waters that we rely on today for public health, economic growth, and community well-being.

During the late 19th and early 20th centuries indigenous peoples were forcefully removed from their lands. Communities were destroyed and many lives were lost, with ongoing impacts to subsequent generations. At the same time, white settlers were employing extractive approaches to the landscape. Forests were cleared for timber, wetlands drained for development, and land plowed for new agricultural fields. The Homestead Act (1862) encouraged anyone considered a citizen to purchase land for a nominal fee as the land was "improved," meaning developed in some way. As more people began to make their homes in the region, the area became more urbanized and industrialized, bringing more people, so that by the 1960s large suburbs were beginning to form around the Twin Cities.



Data source(s): Minnesota Department of Natural Resources



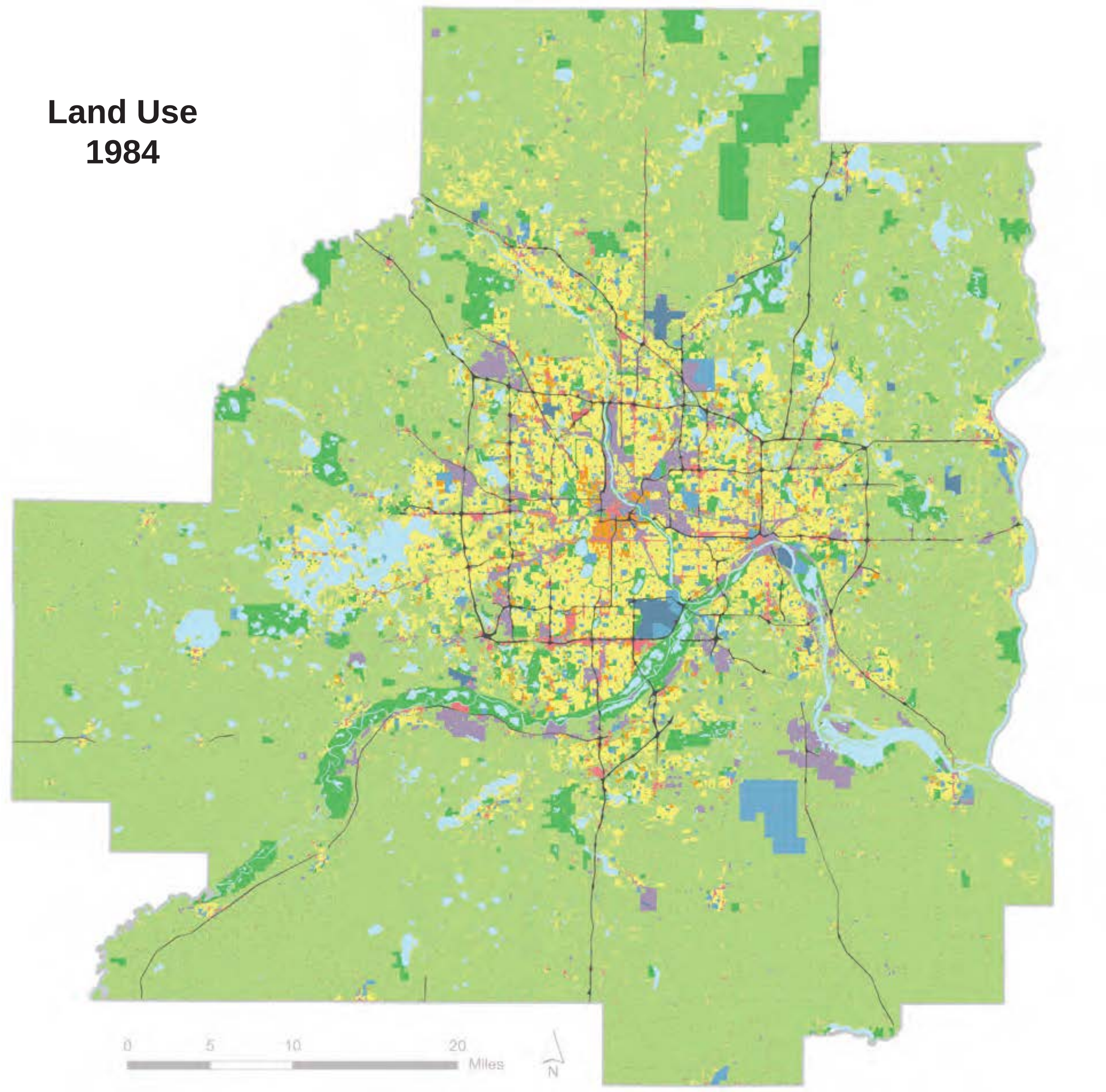
Development & Water

Landscapes change with development. What we build and how we build it influences how much water is available, how much is needed, and the potential risks to public and ecosystem health. More development requires more water infrastructure to meet the needs of society. Development and resource management practices also influence how much water can enter the ground, how groundwater and surface waters flow, and water quality. By considering how population growth and development impact water resources and utility infrastructure, communities can better identify risks and prepare for the future.

Data source(s): University of Minnesota, Metropolitan Council

color on map	1984 category label	2020 category label
	Farmstead	Farmstead
	Single family residential	Seasonal/vacation Single family detached Manufactured housing park Single family attached
	Multi-family residential	Multi-family
	Commercial	Retail and other commercial Office
	N/A	Mixed use residential Mixed use industrial Mixed use commercial/other
	Industrial Industrial parks not developed	Industrial and utility Extractive
	Public/semi-public Public/semi-public not developed	Institutional
	Parks & recreation	Park, recreational, or preserve Golf course
	Major four lane highways	Major highway
	N/A	Railway
	Airports	Airport
	Vacant/agricultural	Agricultural Undeveloped
	Open water bodies	Water

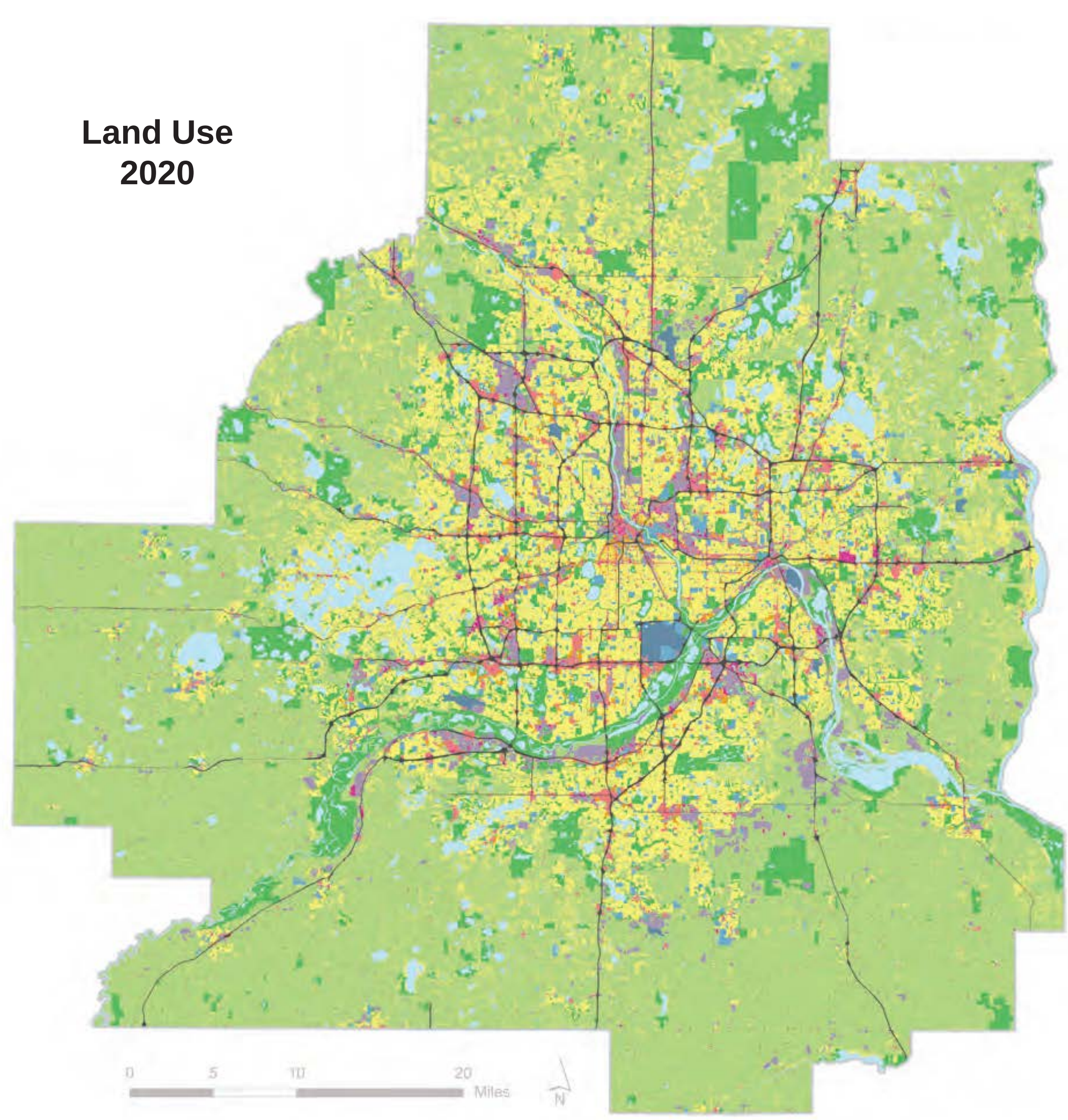
Land Use 1984



Land Use Change in a Growing Region

These depict land use types in the region nearly forty years apart. Since 1984, residential land use has expanded significantly as outer ring suburbs have developed. As suburban areas grow and new housing is built, the region's transportation network expands, and new industrial and commercial areas are sited further from the Twin Cities. Much of the region remains rural, in agricultural use or undeveloped, but those areas have shrunk since 1984. By 2050, the region is forecasted to have a population of about 4 million people. Where those people live and work will drive how the region develops, how and what land uses change, and where and how much water is needed.

Land Use 2020

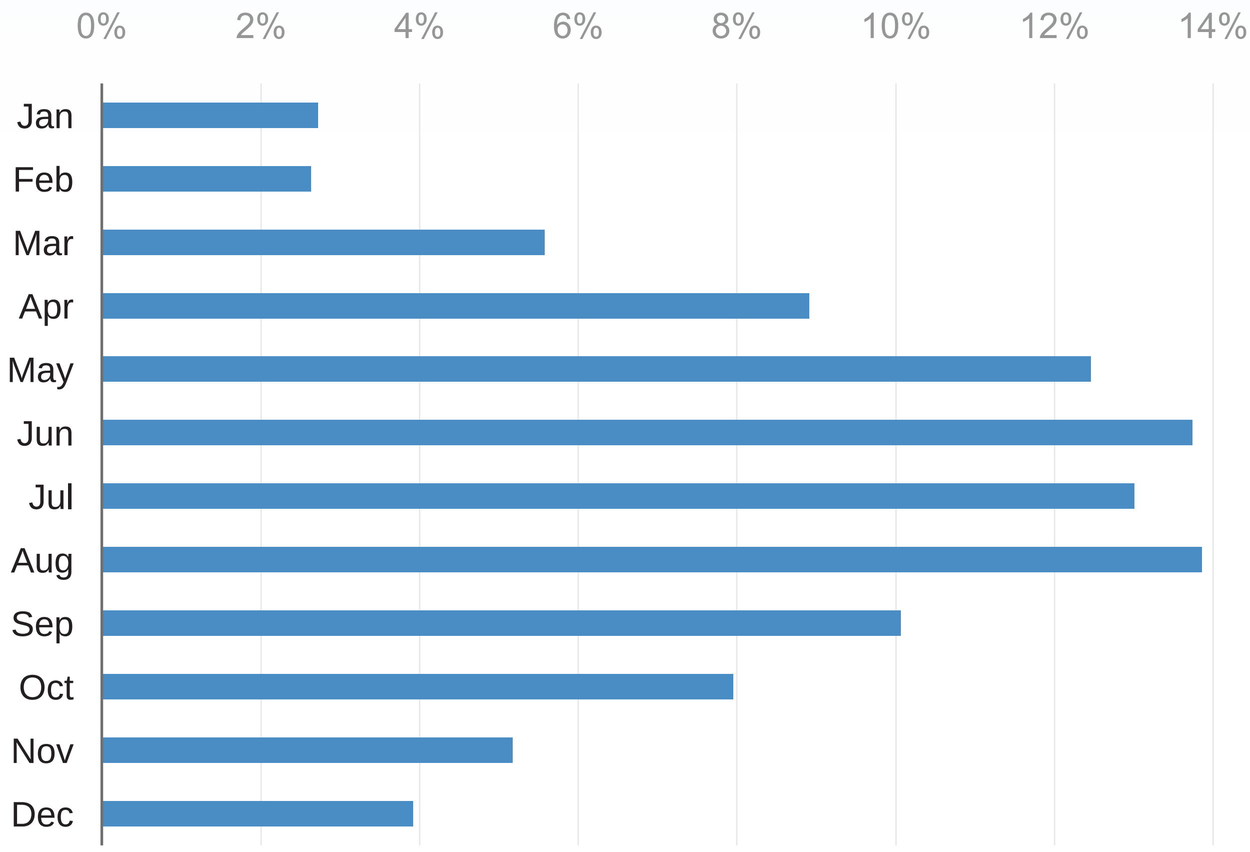


Data source(s): Metropolitan Council

Climate & Weather

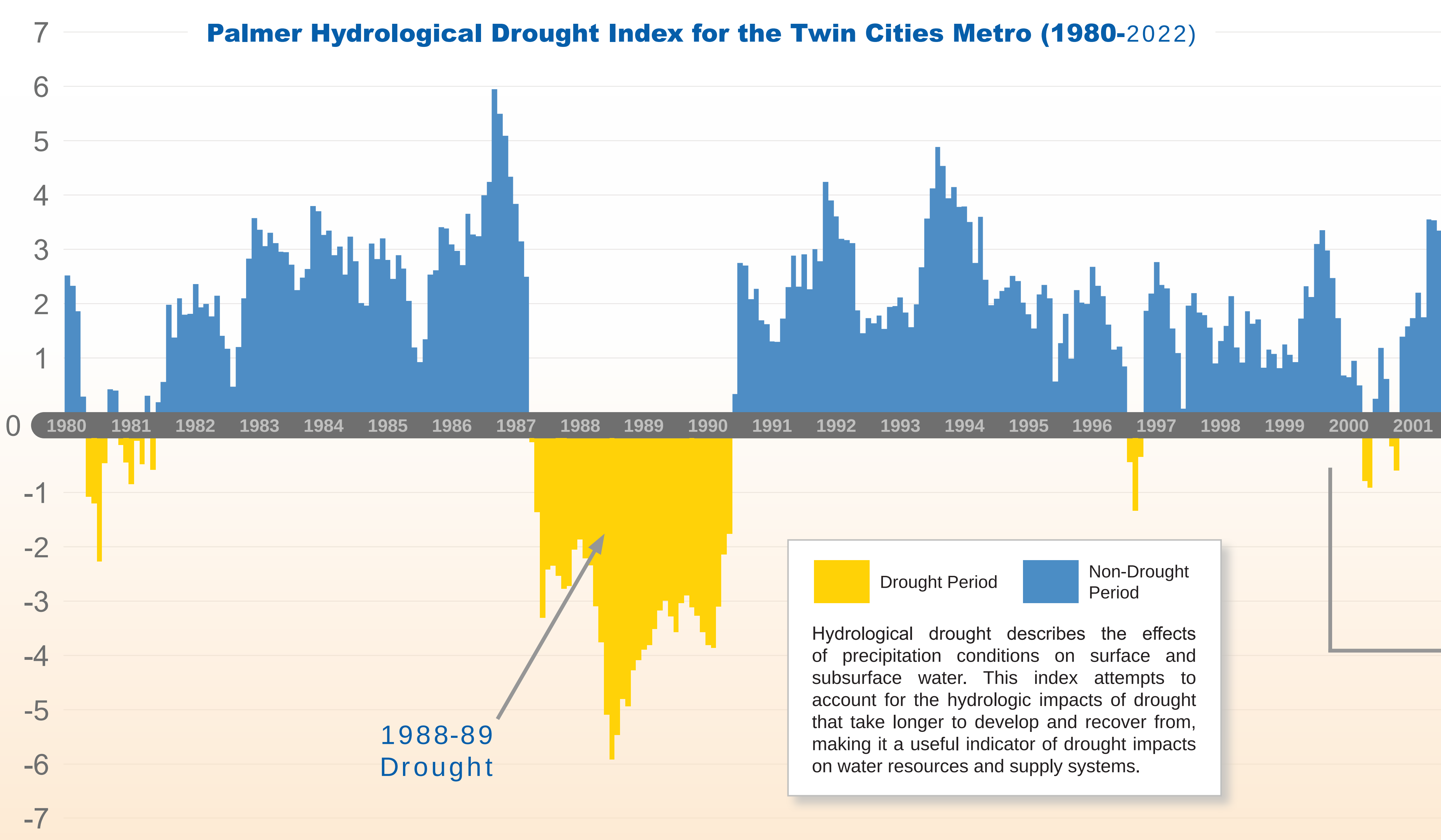
Global climate change is a complex, multifaceted issue with many downstream, equally complex challenges. The term climate describes a set of long-term weather conditions. A key component of the current global climate change challenge is the rapidity of the changes and associate impacts. When climate changes, local weather conditions change and those new conditions impact ecosystem and public health. While we don't know exactly what the future will look like, we can expect increases in temperature and longer growing seasons, intense precipitation and heat wave events, droughts, and greater weather variability. A less predictable climate increases the challenge of maintaining safe and reliable water supplies and decreases the resiliency of the infrastructure and water resources we rely on for drinking, recreation, and healthy communities and economies. Climate change is creating new challenges and exacerbating long standing water quality and availability issues. These impacts don't look the same in all communities and are likely to significantly affect vulnerable populations and communities.

Precipitation Trends



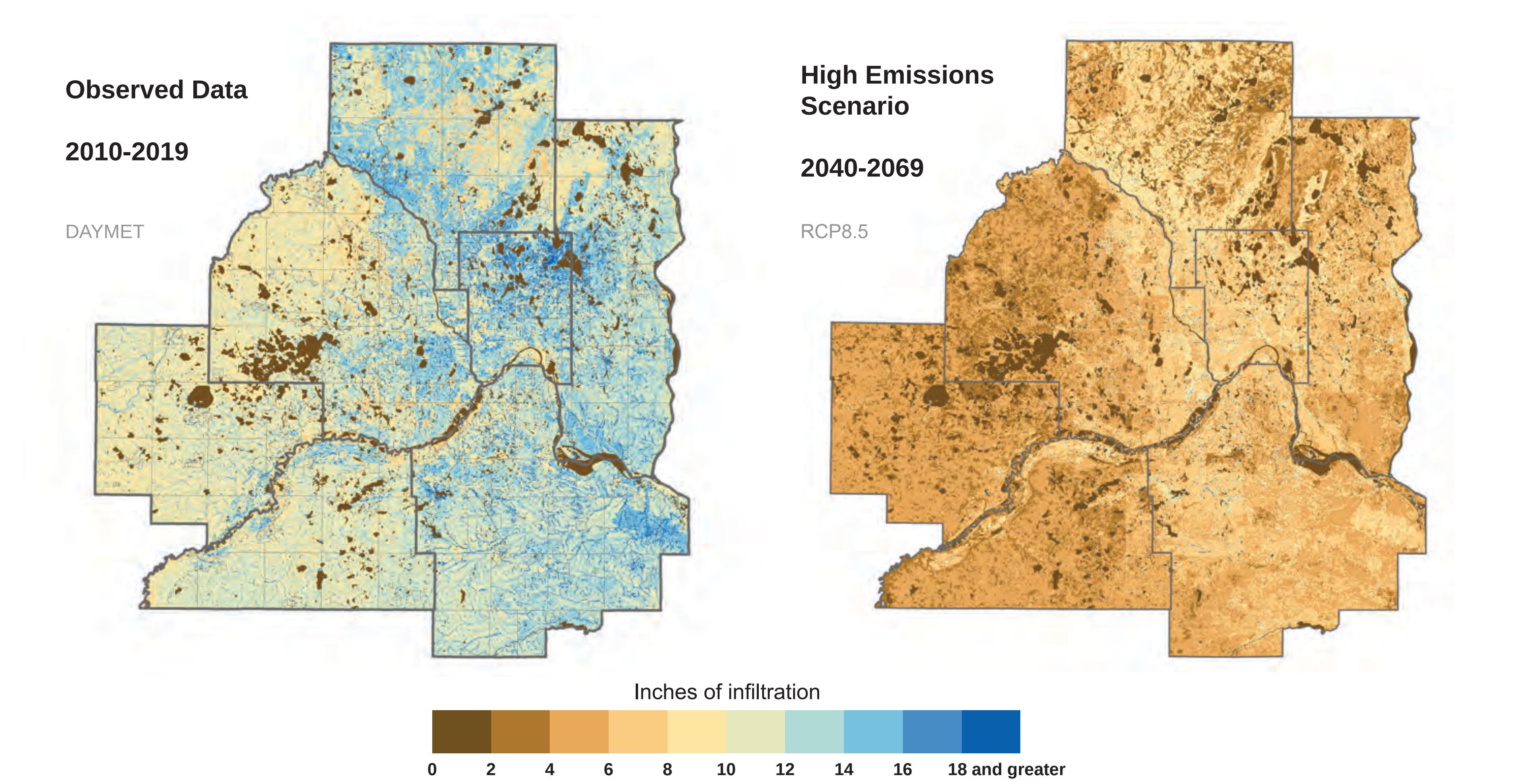
Over the past 40 years, the average precipitation in the region has been about 35 inches per year. Most precipitation runs off during winter melt when the ground is frozen or during intense storm events during the warmer months. Some water is stored temporarily in surface waters or shallow groundwater. During the growing season, much of the precipitation that makes it to the ground is used by plants or evaporates. Only about 33% of precipitation that falls annually is available to replenish groundwater aquifers. As the region has become increasingly urbanized over the past 150 years, groundwater replenishment has not kept up with use.

Most precipitation in the metro area falls during the late spring and early summer months, with May and June accounting for about 26% of the annual total. Significant periods of drought in the 1930s, '70s, '80s, and as recently as 2020-22 have had large impacts on water resources, policies, and regulatory agency requirements. During periods of drought, there is greater demand for water and less precipitation. Less water makes it into the ground to recharge the groundwater system. During wetter periods, less water is needed, and the rate of water consumption tends to decrease. However, receiving too much water too fast leads to flooding and water contamination issues.

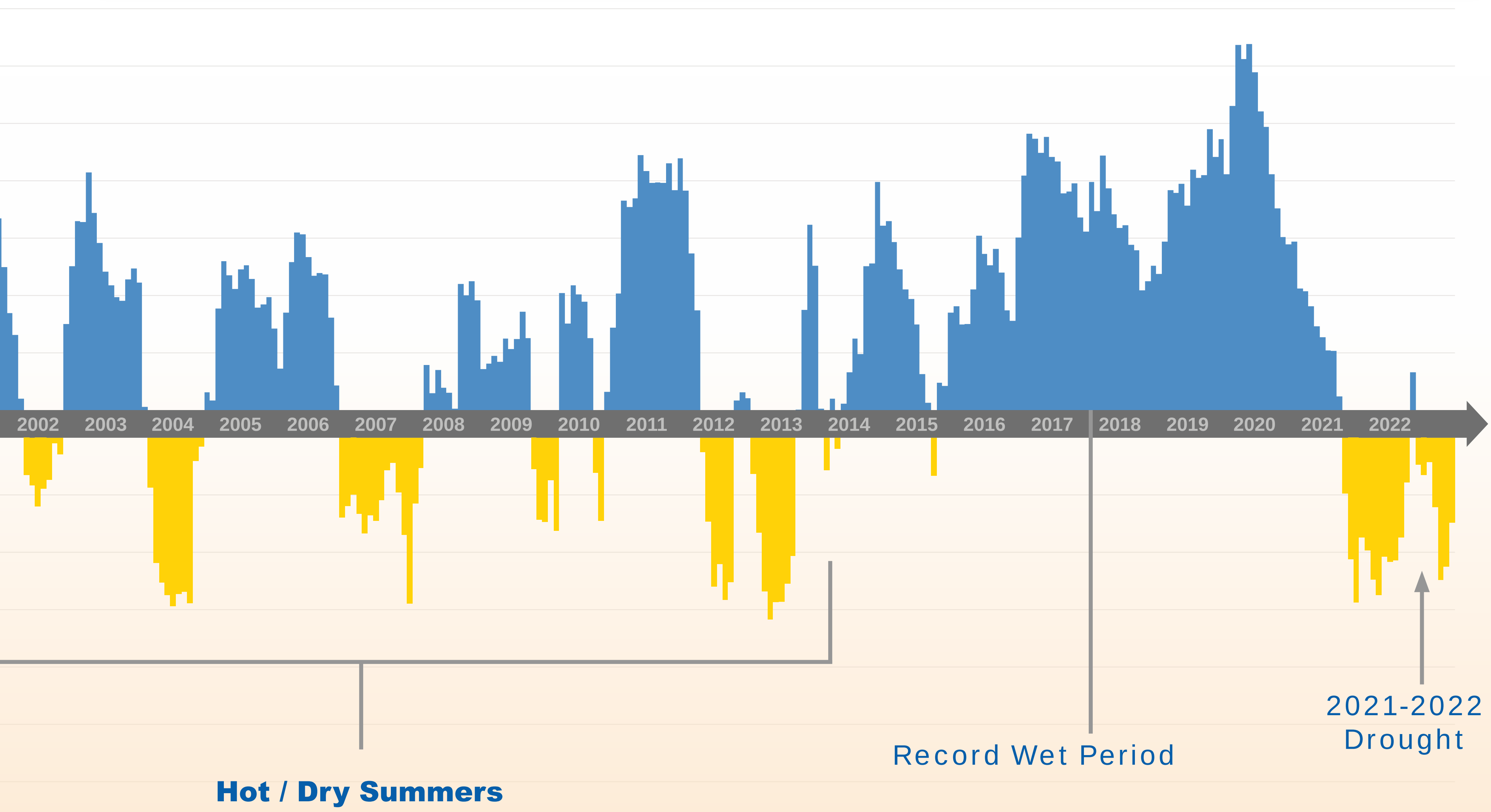


Climate Change Impacts Future Groundwater Recharge Estimates

Mathematical models of climate conditions estimate the future timing and amount of precipitation. Understanding what precipitation could look like allows helps to estimate aquifer recharge later in this century. A future with more greenhouse gasses, a warmer atmosphere, and more development with more impervious surfaces generally results in less water being available for recharge. While models cannot precisely predict the future, they do provide a reasonable picture of what the future might look like. Understanding a range of future possibilities allows planners, water resource and utility managers, and regulators to make decisions and investments now to limit negative outcomes in the future.



Data source(s): Metropolitan Council



Data source(s): Midwestern Regional Climate Center

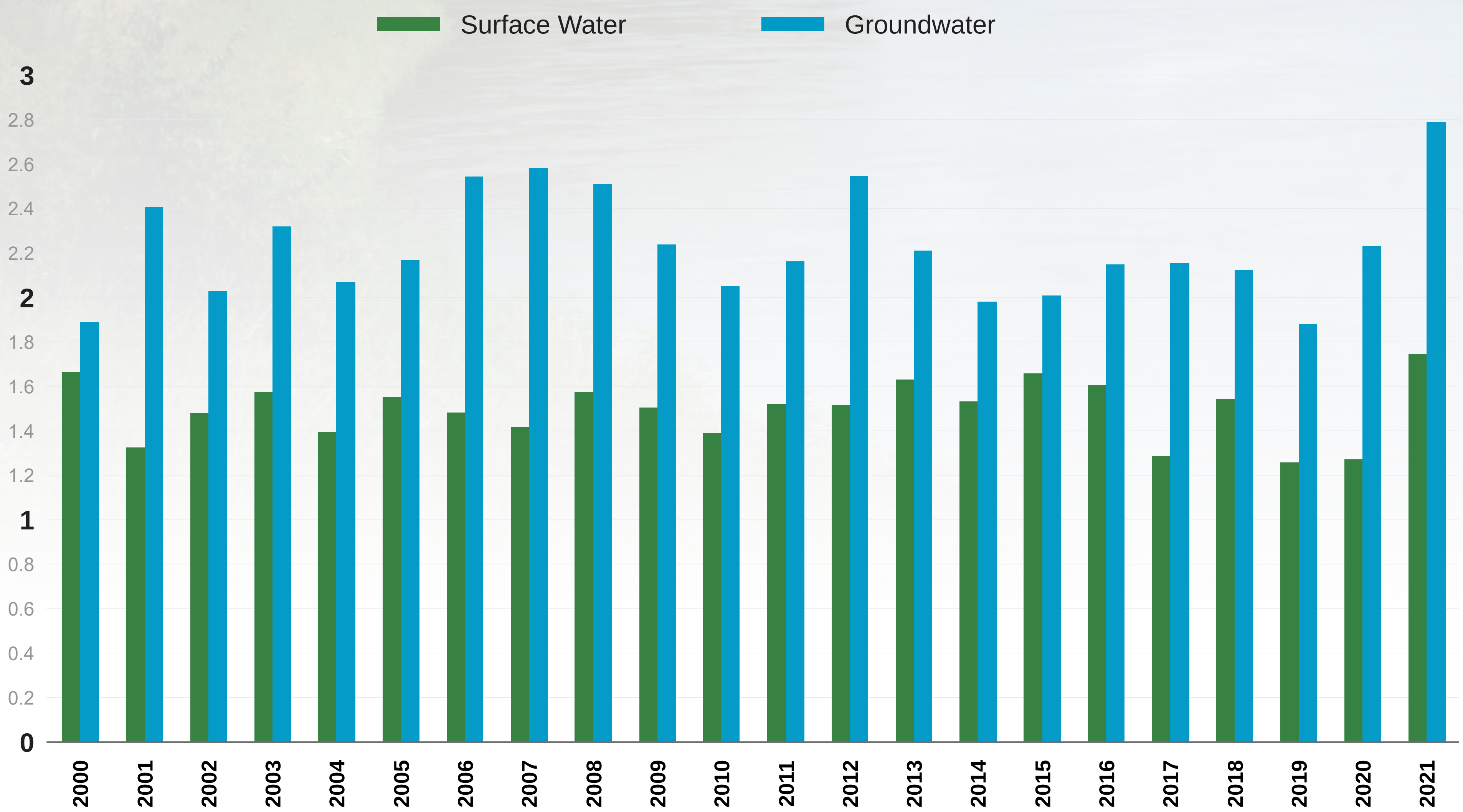
Seasonal Challenges

Water resource and supply system stresses can develop quickly or accumulate over longer periods of time. Seasonal changes in water use and associated drawdown of area aquifers can be significant particularly during hot dry summers, leading to well interferences or impacts to surface waters and other ecologically significant areas. Stream and river flows are also lower during dry periods, potentially limiting surface water sources and recreation opportunities. If the use of water exceeds the amount of water that's replenished, year after year, the amount of water available for use will be less. Monitoring of water resources and tracking water use helps us understand these impacts, and to be more resilient when big challenges (like long-term drought) arise.

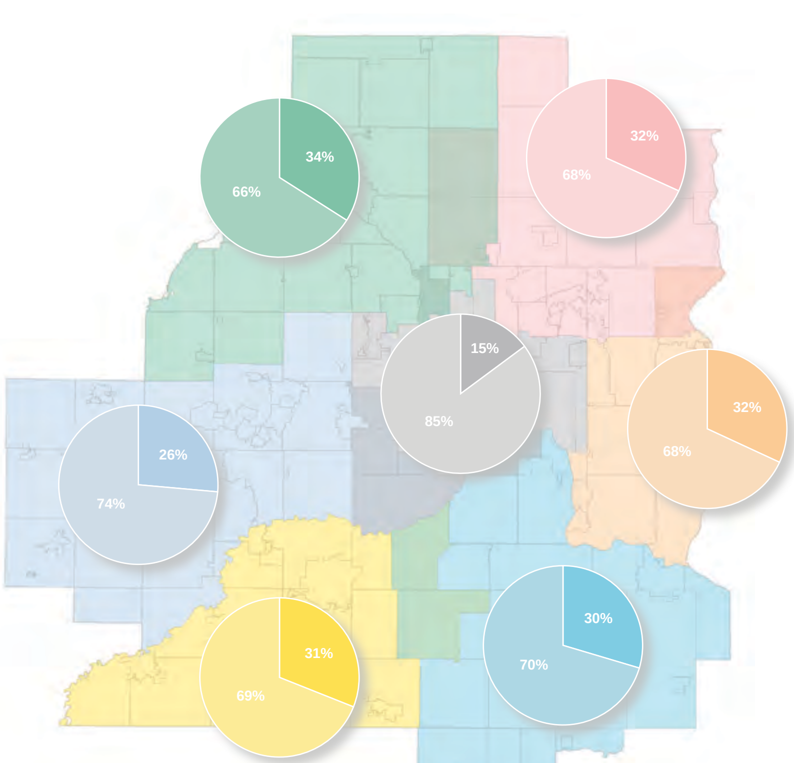
Water Demand

After a long winter, Minnesotans look forward to the warm summer months, swimming and fishing in area lakes and rivers, growing gardens and crops, and exploring the outdoors. As we take advantage of the warm growing season and longer days, we use more water. However, when we use water inefficiently during the summer months, we also increase the stress on our water resources and supply systems, driving up costs and putting our engineered and ecological water systems at risk. As stress builds, negative impacts become more likely, particularly during periods of drought when the demand for water can be extremely high.

Ratio of Summer to Winter Pumping for Public Water Suppliers by Water Source (1980-2021)



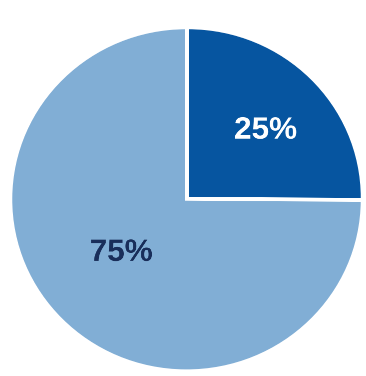
Data source(s): Minnesota Department of Natural Resources water permit appropriations databases (SWUDS, MPARS)



Outdoor vs Indoor Use by Subregion

Outdoor Use

Outdoor use is represented by darker shades on the pie charts. Lighter shades represent indoor use.

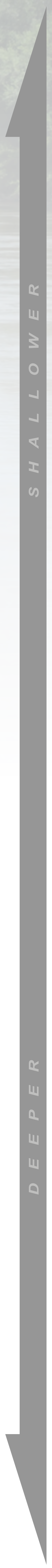


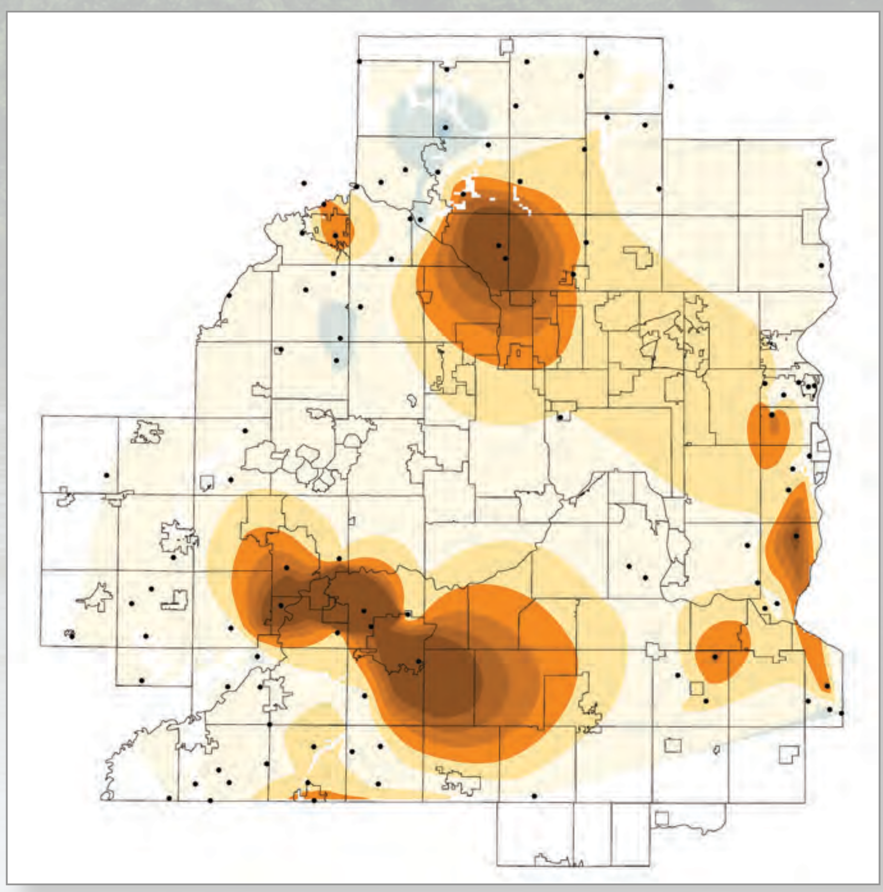
Outdoor vs Indoor Use Region-wide

We estimate the amount of municipal/public water supply used outdoors by comparing the amount of water pumped during the cool and cold months (November - April) to the water pumped during the warm and hot months (May - October). Some small amounts of water are lost during treatment processes or unaccounted for due to unmetered uses like hydrant flushing. Outdoor water uses makes up about 25% of all water used across the metro. Areas that pump groundwater tend to use a higher percentage outdoors, while more urban areas that rely on surface water sources tend to be slightly lower, likely due to smaller lots and less lawn and landscape irrigation. Using water wisely outdoors, as well as indoors, helps to limit stress on water sources and supply systems, lowering costs for water users and water suppliers.

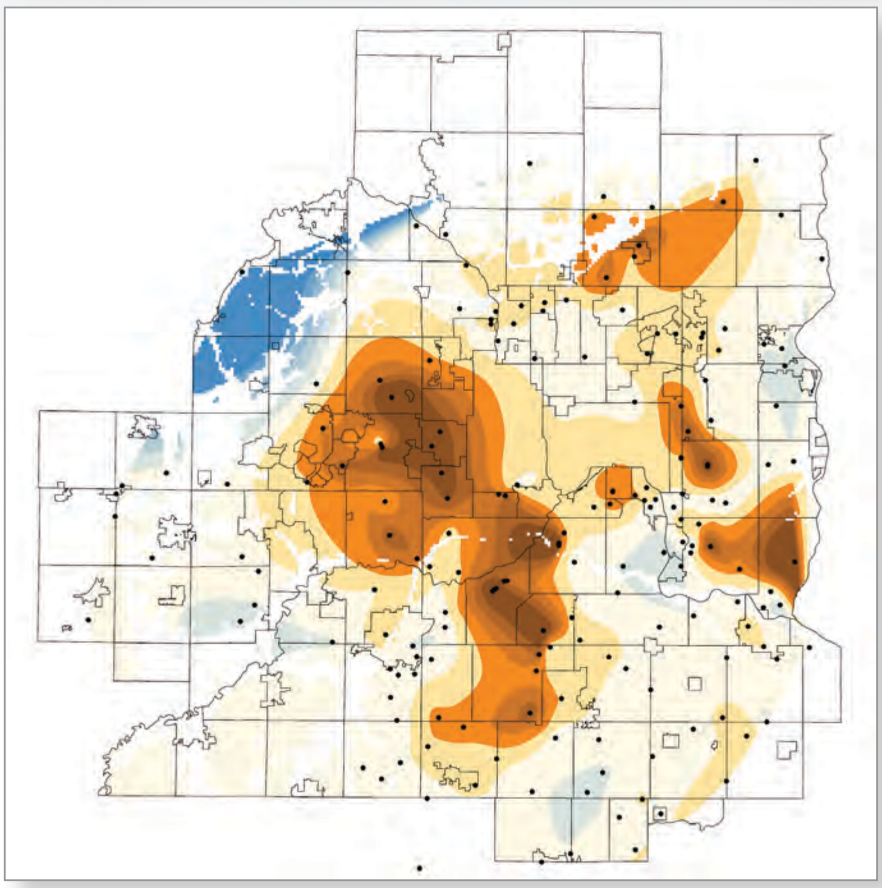
Groundwater Level Change

A study of groundwater levels in metro area wells was conducted by the USGS in partnership with the Met Council and DNR during the spring and summer of 2008. The study showed seasonal declines in aquifer water levels and decadal declines in some areas when comparing the data to previous studies. Monitoring groundwater levels in real time and tracking long term trends helps water planners, managers, and regulators understand system stresses and address issues before significant impacts occur.

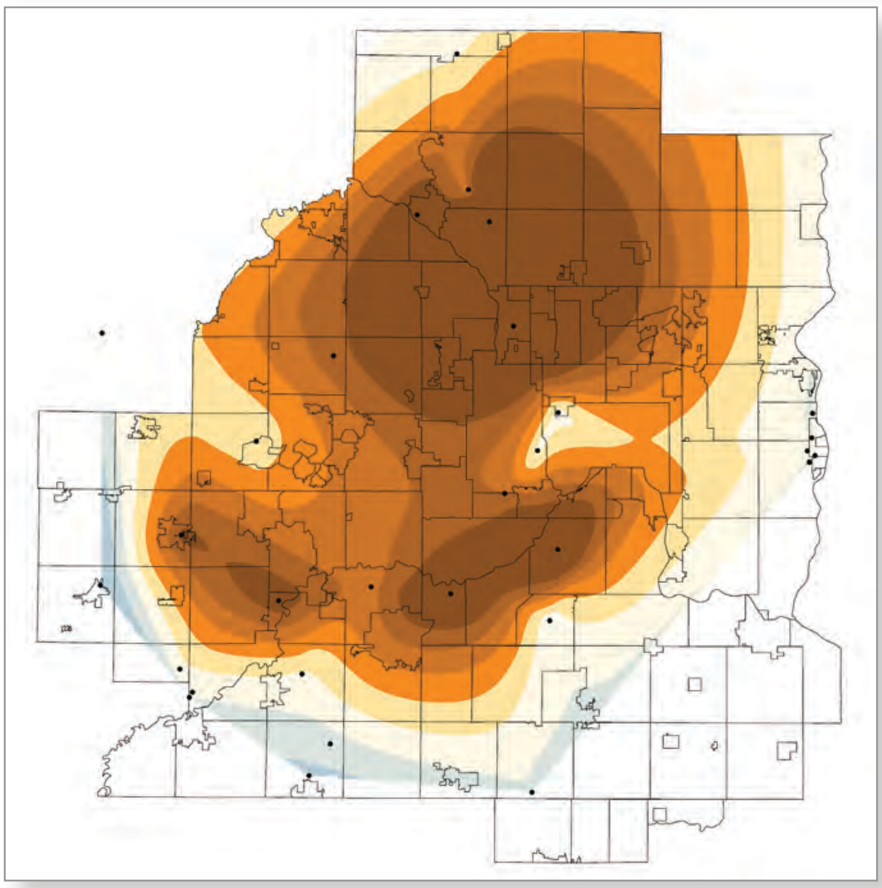




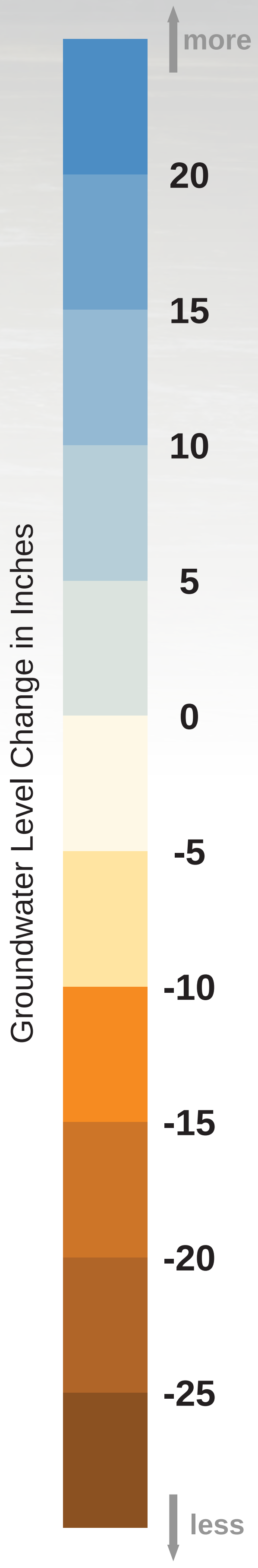
Groundwater-level changes in the **Prairie du Chien-Jordan** aquifer between March 2008 and August 2008



Groundwater-level changes in the **Tunnel City-Wonewoc** aquifer between March 2008 and August 2008



Groundwater-level changes in the **Mt. Simon-Hinckley** aquifer between March 2008 and August 2008



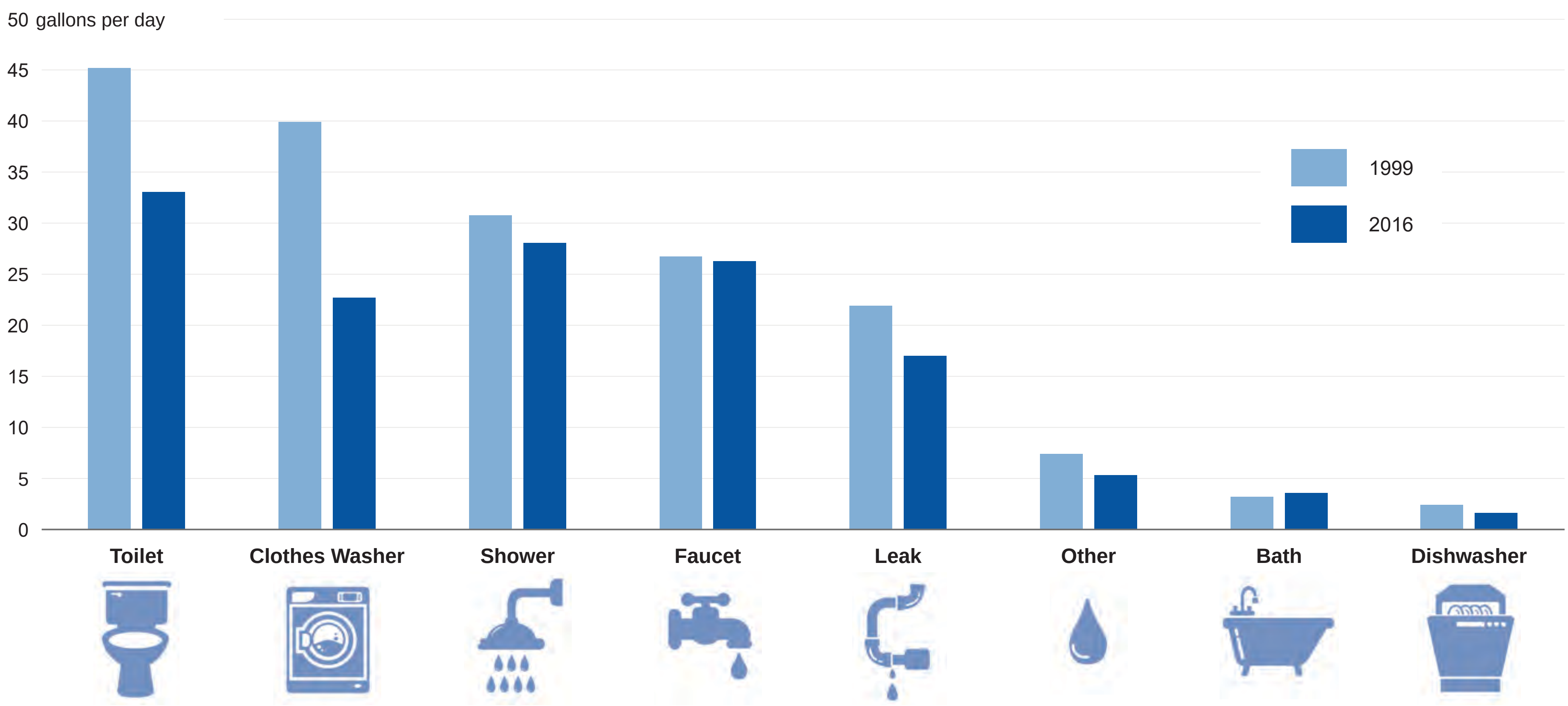
Efficient Water Use

Many factors influence when and how much water is used. Weather, home type and size, the age of infrastructure, and the number of people using water are all factors that affect water use. In many homes and industries more water is used than necessary. This inefficient use increases costs and energy use, requires additional infrastructure and water treatment, and makes our limited water resources less sustainable. Water efficiency is the combination of strategies, practices, and equipment that limit excessive water use. By implementing water efficient practices in our homes, businesses, and water utilities we can lower costs, and ensure water is available now and in the future. The Met Council supports water use efficiency through a grant program for public water systems, technical support and tool development for communities, and partnerships with the Minnesota Technical Assistance (MnTAP) and Turfgrass Science programs at the University of Minnesota.

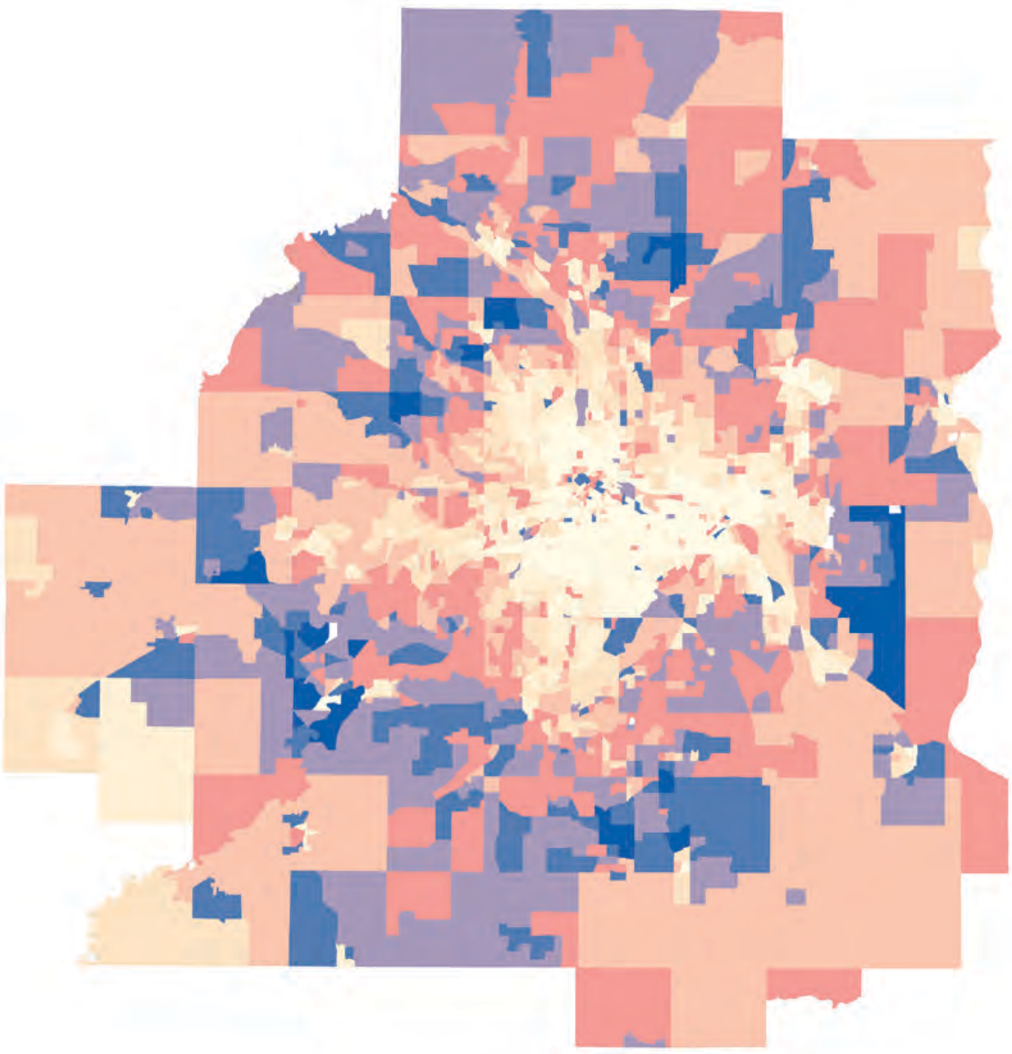
Indoor Efficiency

Average Daily Indoor Water Use by Household (National Estimate), 1999 vs 2016

chart adapted from AWWA Residential End Uses of Water, Version 2: Executive Report



In communities where efficient water use for residential homes and lawns has been promoted, more water may be conserved by helping local industries, commercial properties, and multi-unit residential facilities to be more efficient water users.



Median Home Age by Census Tract

Pre 1950	Most homes concentrated in the urban core.
1950 to 1959	
1960 to 1969	Growth of the suburbs as people settle on the edges of the cities.
1970 to 1979	
1980 to 1989	Continued suburban expansion with more groundwater than surface water use for the first time.
1990 to 1999	Code changes boost indoor efficiency. By the mid-1990s lawn irrigation systems are being widely installed.
2000 to 2009	Rapid suburban growth in the first half of the decade with increased appliance efficiency.
2010 to 2018	New EPA WaterSense guidelines and attrition of older appliances likely lead to increased indoor water efficiency.

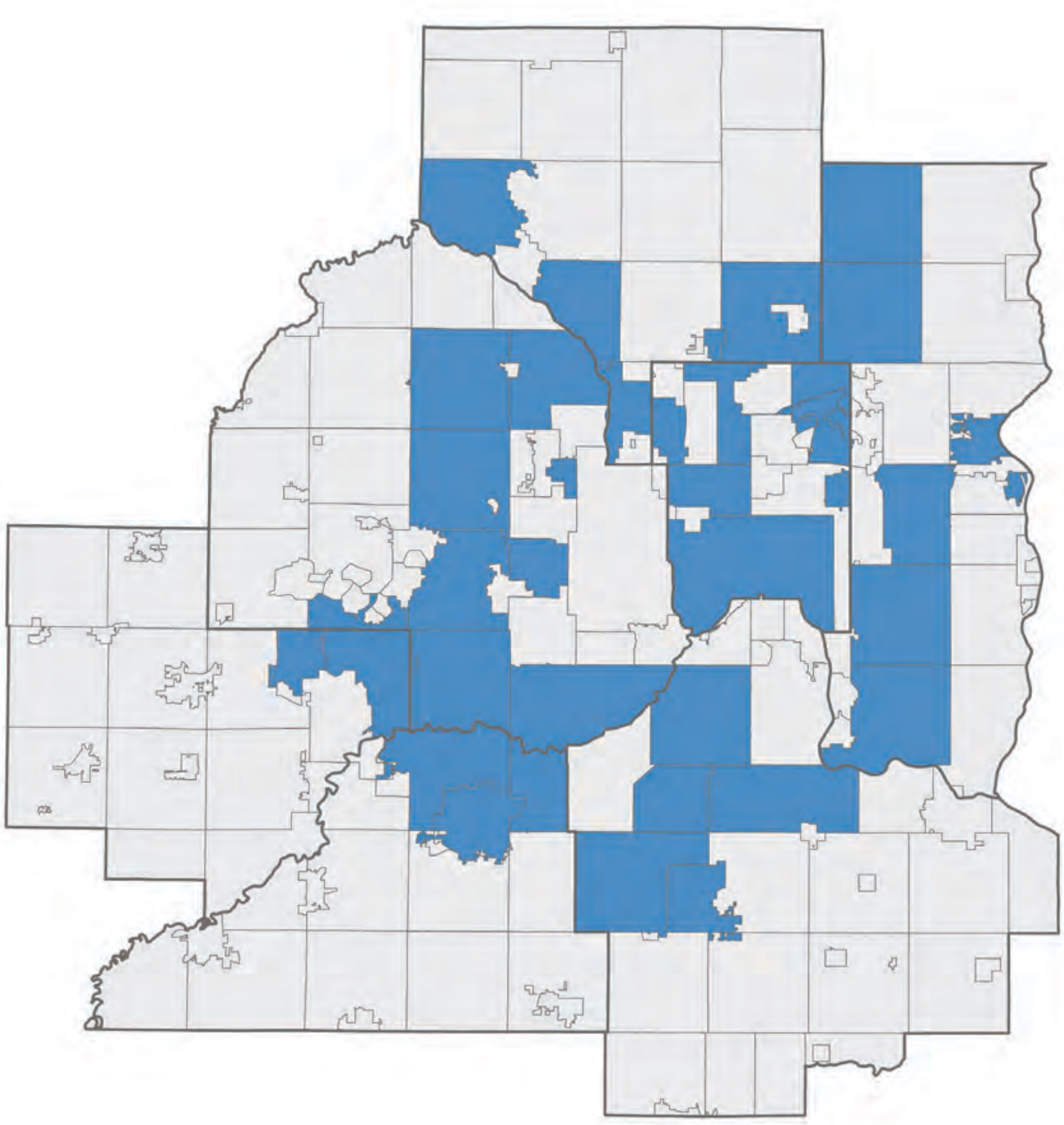
Data source(s): Metropolitan Council, US Census

Many factors influence when and how much water is used. Weather, home type and size, the age of infrastructure, and the number of people using water are all factors that affect water use. In many homes and industries more water is used than necessary. This inefficient use increases costs and energy use, requires additional infrastructure and water treatment, and makes our limited water resources less sustainable. Water efficiency is the combination of strategies, practices, and equipment that limit excessive water use. By implementing water efficient practices in our homes, businesses, and water utilities we can lower costs, and ensure water is available now and in the future. The Met Council supports water use efficiency through a grant program for public water systems, technical support and tool development for communities, and partnerships with the Minnesota Technical Assistance (MnTAP) and Turfgrass Science programs at the University of Minnesota.

MnTAP and Met Council Partnership, Cumulative Gallons Saved, 2013-2021

The Minnesota Technical Assistance Program (MnTAP) is an outreach program at the University of Minnesota. MnTAP helps Minnesota businesses develop and implement industry-tailored solutions that prevent pollution at the source, maximize efficient use of water, and reduce energy use and costs to improve public and environmental health. With funding provided through the Clean Water Fund, the Met Council supports MnTAP interns who help area businesses conserve water, energy, and save money throughout the metro area.

Met Council Grants Promote Efficient Water Use in the Region



Participating community (2022-2024)

The Water Efficiency Grant Program provides grants to metro area communities served by municipal water systems to fund the replacement of toilets, irrigation controllers, and spray sprinkler bodies with WaterSense-labeled products, as well as irrigation audits by WaterSense-certified auditors and clothes washers with Energy Star ratings, as designated by the Department of Energy. The Met Council awards grants on a competitive basis to metro area communities that manage municipal/public water supply systems. This program began in 2015 and has had several funding cycles which have saved millions of gallons around the region.

Outdoor Water Management

Municipalities, homeowners, and businesses can use less water and energy, less fertilizer, and save money, by choosing climate and location appropriate native plants or grasses for their landscapes. Lawns are nutrient intensive landscapes that lack biodiversity. However, by choosing turfgrasses that fit the use of the site and the site conditions or establishing lawn alternatives like drought tolerant prairie plants, we can have more water efficient landscapes that provide beauty, habit, and improve water quality.

Grass Type		Positives	Negatives
Kentucky Bluegrass	The most popular turfgrass in the northern US, Kentucky Bluegrass is used for lawns, golf courses, parks, and fields.	Valued for its aesthetics, recuperative ability, winter hardness, mowing quality, and seed or sod.	Shortcomings include its dormancy during drought, heat stress intolerance, generally poor shade performance, and disease susceptibility.
Perennial **Ryegrass**	Perennial Ryegrass is commonly used for home lawns, parks, and golf fairways.	Valued for its quick germination and establishment.	Shortcomings include its winter hardiness and summer stress tolerance.
Tall Fescue	First introduced in the US as a forage grass, use of Tall Fescue as turf began in the 1940s and 1950s.	Valued for its drought avoidance, wear tolerance, and disease resistance.	Shortcomings include its susceptibility to ice cover damage, leaf texture, slow green up, and perceptions.

Fine Fescues	Fine Fescues are a group of versatile grasses with greater drought tolerance and the ability to grow well in sun and shade. The two main types of Fine Fescues are bunch and rhizomatous. Common fine fescues that form bunches are Hard Fescue, Chewings Fescue, and Sheep Fescue. Rhizomatous Fine Fescues include Strong Creeping Red Fescue and Slender Creeping Red Fescue.

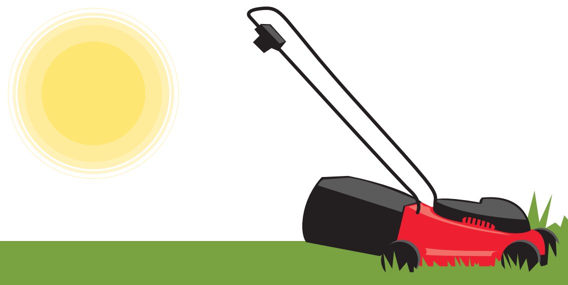
Bee Lawns

Turfgrasses are commonly used for many homeowners and businesses in Minnesota, but they require significant management and are essentially food deserts for native fauna. Bee lawns mix flowers with turfgrasses to provide important food resources to bees and other pollinators, as well as recreational space for people. Some common flowering species in bee lawns include white clover, self-heal, and creeping thyme.


University of Minnesota

Climate and Landscape Appropriate Plants

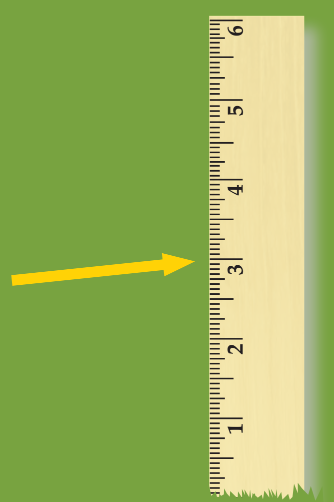
Other homes and businesses choose to move away from lawns entirely by creating communities of native plants. These plants are well-adapted to Minnesota's growing conditions. For instance, many prairie plants are very drought tolerant and provide natural habitats for insects, birds, and other creatures. Incorporating native landscapes into home, commercial, and public locations benefits water resources, provides beauty and pollinator habitat, and requires less maintenance and nutrients than turfgrass.



Mowing Affects Lawn Health

Mowing is an essential part of turfgrass maintenance. However, many people are often uneducated about proper mowing techniques and tend to mow lawns too often and too close to the ground. Regular mowing with a sharp blade, at the proper height, promotes healthy growth and lawn nutrition if grass clippings are left on the lawn.

For a typical lawn, the University of Minnesota Extension recommends maintaining a height of 3 inches or higher



- **Taller grass shades out weeds and keeps soil cooler**
- **Taller grass means longer roots and greater drought tolerance**

Irrigation Efficiency

University of Minnesota

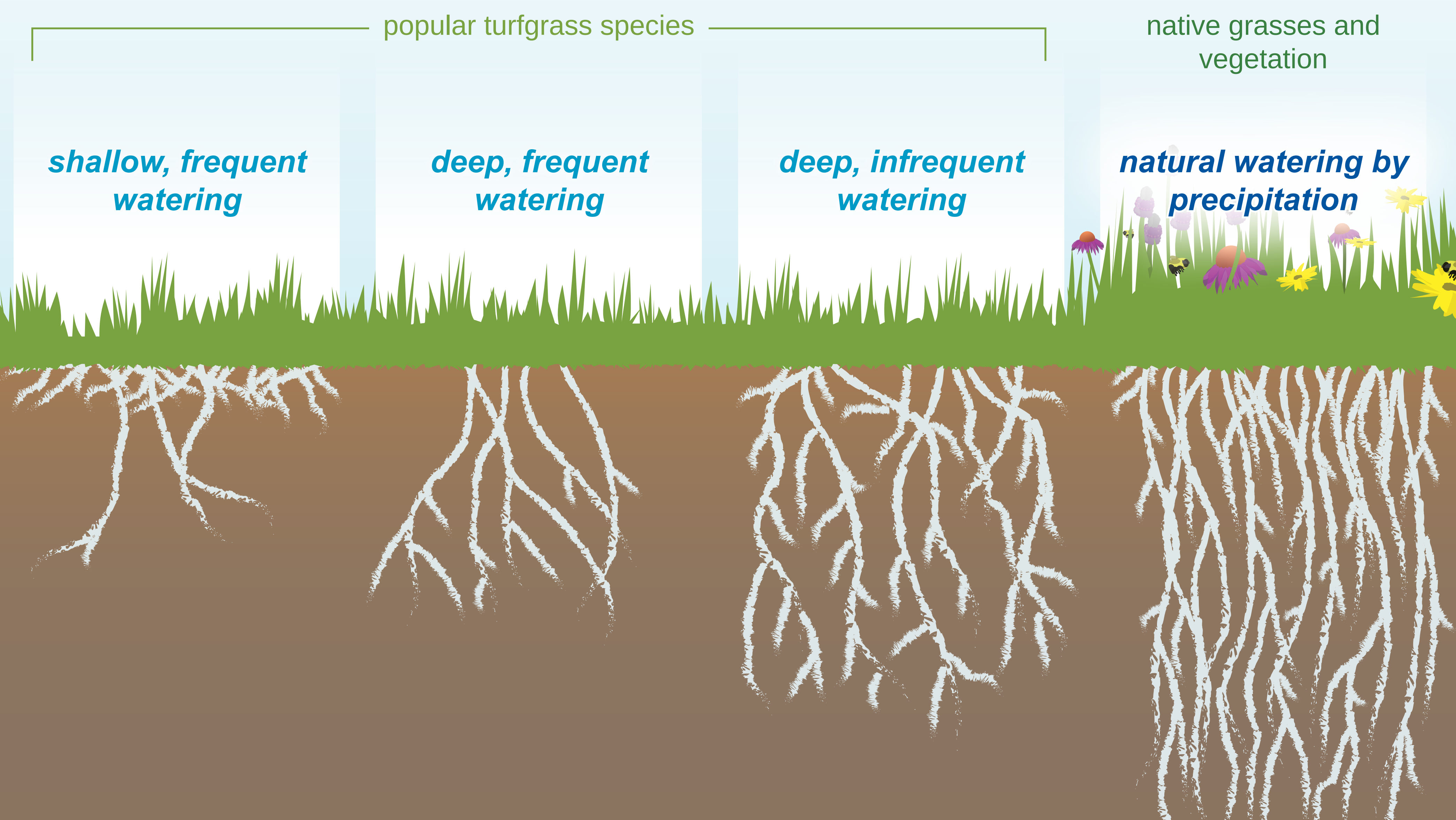
Irrigation audits identify inefficiencies in home and commercial irrigation systems. Leaks, broken sprinkler heads, and placement issues can lead to excessive use and water being used on pavement rather than on the lawns and plants that need it. By checking that irrigation equipment is calibrated and working properly, homeowners and businesses can lower their water bills and use less water.

University of Minnesota

Irrigation controllers are often set to water every other day, depending on local ordinances. This set and forget approach causes lawns to be watered when it is not needed and causes some people to think that lawns must be watered every other day. Modern irrigation system controllers, often referred to as “smart,” offer several improvements over previous technologies. By using data from nearby weather stations and soil moisture sensors, these controllers can more accurately determine how much water is needed for lawns and landscaping, lowering outdoor water use and costs for homes and businesses.

Watering Methods and Lawn Health

Overwatering lawns is bad for their health. Lawns need about an inch of rain per week in Minnesota to maintain a healthy root system; however, most homes, businesses, and landscape managers set their irrigation systems to water every other day, whether the grass needs the water or not. This overwatering weakens grass roots by conditioning them to grow shallow. When hot and dry periods happen, turfgrass with shallow roots can’t access deeper stores of water making them less resilient to harsh conditions. Deep, infrequent watering encourages deeper root growth, allowing grass to be more resilient during dry spells and better recover from drought.

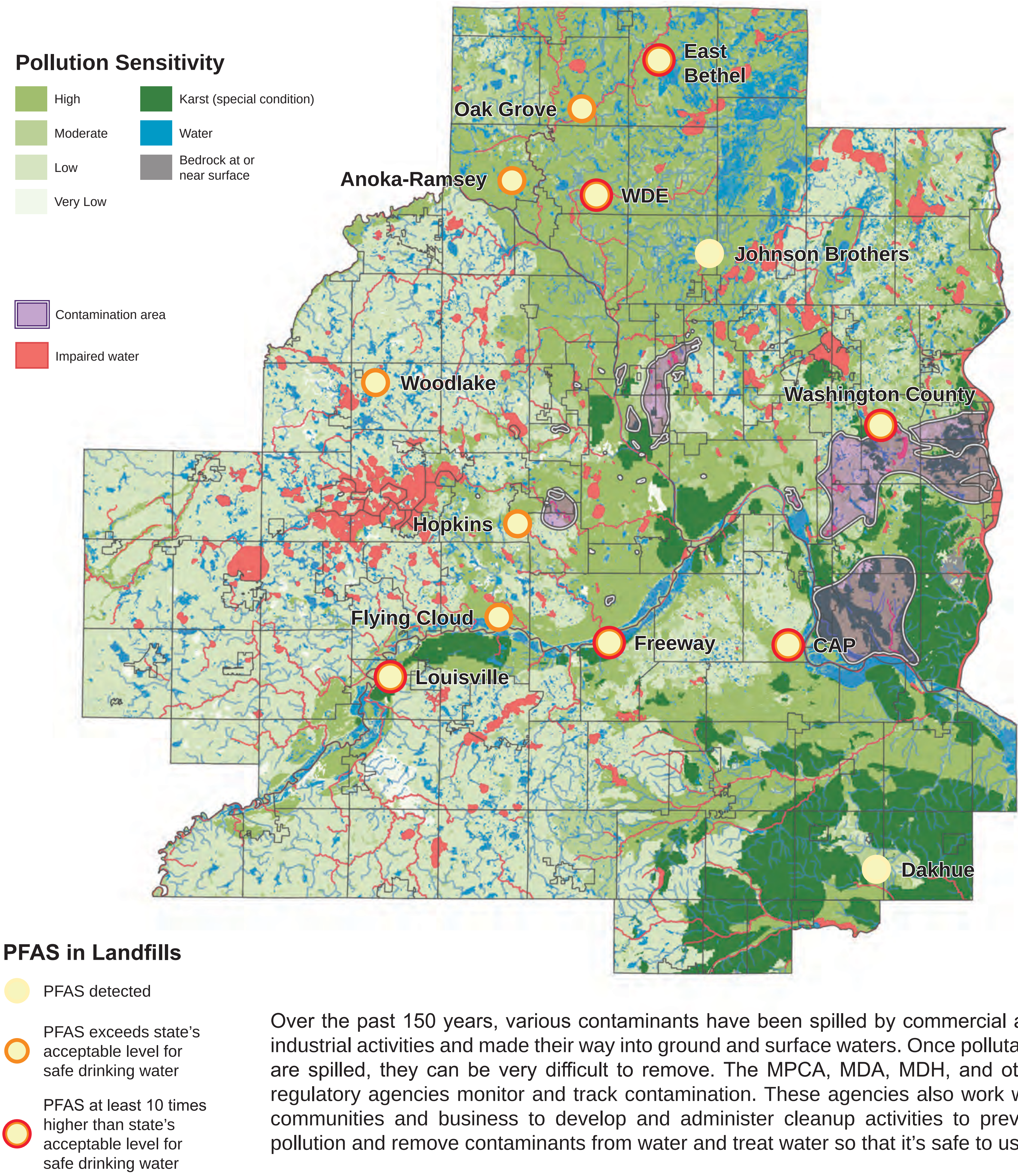


Contaminants & Pollution

Public health and pollution are concerns anywhere water is consumed or used for recreation. Areas of contaminated water are costly to cleanup and treat and can have lasting effects on communities. Common everyday actions also pollute water if residents and businesses are not careful. Things like spilled motor oil or gasoline from lawn mowers or garages, excessive salt use during the winter, lawn fertilizers, and pesticides can impact source waters over time.

Groundwater Contamination, Impaired Waters, & Pollution Sensitivity

In some areas of the metro, water can easily move from the surface to shallow sand and bedrock aquifers. If contaminants are spilled in these areas, groundwater can be easily contaminated. In general, the deeper the water source, the longer it takes for water (and any contaminants that make it into the ground) to reach it. However, the movement of groundwater is complex and influenced by many factors. For instance, groundwater flow changes around pumping wells, pulling water into the well from all directions. Groundwater can be protected naturally by layers of clay or rock that are difficult for water to flow through. Public water suppliers carefully monitor for any contamination concerns and treat the water that's delivered to homes and businesses so that it meets all drinking water standards and is safe for people to consume. People and business with their own (private) wells are responsible for testing their water to ensure it's healthy and safe.



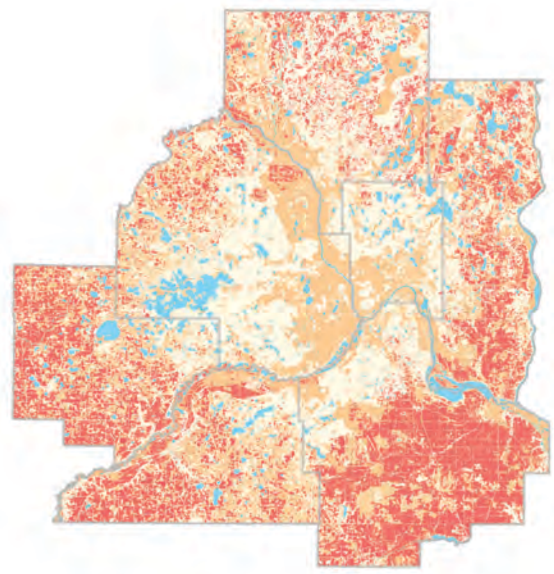
Over the past 150 years, various contaminants have been spilled by commercial and industrial activities and made their way into ground and surface waters. Once pollutants are spilled, they can be very difficult to remove. The MPCA, MDA, MDH, and other regulatory agencies monitor and track contamination. These agencies also work with communities and business to develop and administer cleanup activities to prevent pollution and remove contaminants from water and treat water so that it's safe to use.

Data source(s): Minnesota Department of Natural Resources; Minnesota Pollution Control Agency

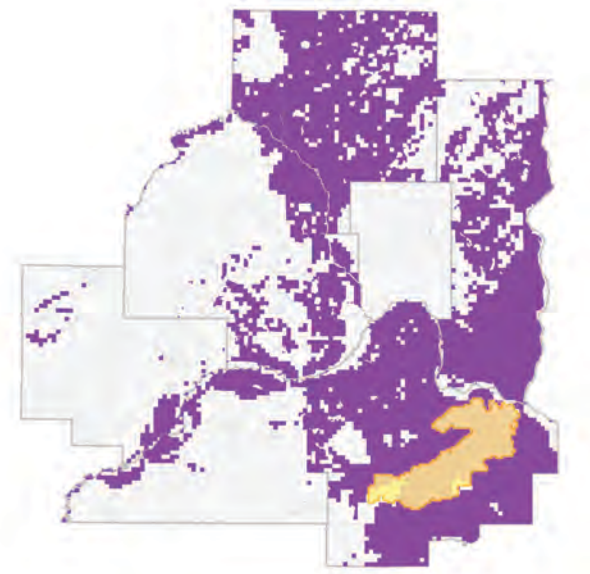
Agricultural Chemicals

Water contamination from fertilizers and pesticides presents potential human and ecosystem health risks. In some areas where surface waters easily infiltrate and interact with groundwater, nitrate can exceed drinking water standards. Once this pollution gets into the groundwater system, it can be difficult and costly to remove for private well owners and public water suppliers. Nitrate pollution is a drinking water concern in many rural parts of the metro. The Hastings and Vermillion drinking water supply management areas (DWSMA) are part of Groundwater Protection Rule programs to address elevated nitrate levels in source water.

Risk of Nitrate Contamination of the Water Table



Restricted Areas for Fall Nitrogen Fertilizer Application



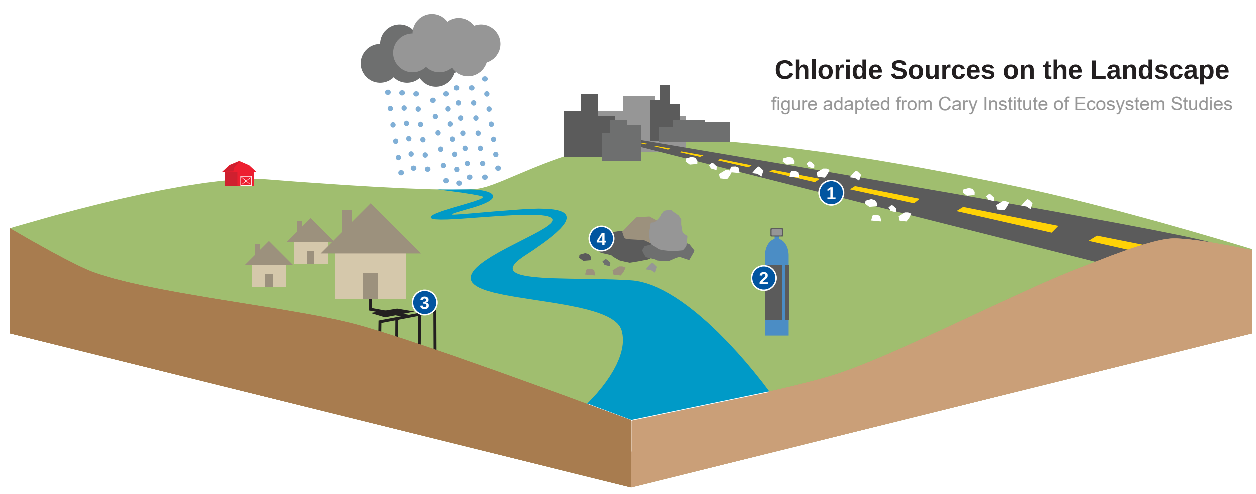
Data source(s): Minnesota Department of Agriculture

Chloride

Chloride from road salt and other sources like fertilizers and home water softeners have been getting into ground and surface waters since their use became widespread in the 1960s. Over time, these compounds accumulate in the environment and can begin to inhibit the ecological function of surface waters and increase drinking water and wastewater treatment requirements.

Chloride Sources on the Landscape

figure adapted from Cary Institute of Ecosystem Studies



PFAS

Per the Minnesota Pollution Control Agency: Per- and polyflouroakyl substances (PFAS) are a group of more than 5,000 manmade chemicals that do not break down over time. Their extreme resistance to degradation in the environment and resistance to destruction in wastewater treatment plants, landfills, and incinerators has led to the nickname “forever chemicals.” PFAS have been used in many applications since the 1940s. Their widespread use in commercial and manufacturing applications has resulted in their wide release into the environment. PFAS can be detected in air, soil, water, fish, and humans. PFAS has been detected in groundwater and surface water in some parts of the metro. State agencies and local communities monitor and test water for PFAS to ensure public and environmental health are protected and water is safe to consume.

Emerging Contaminants of Concern

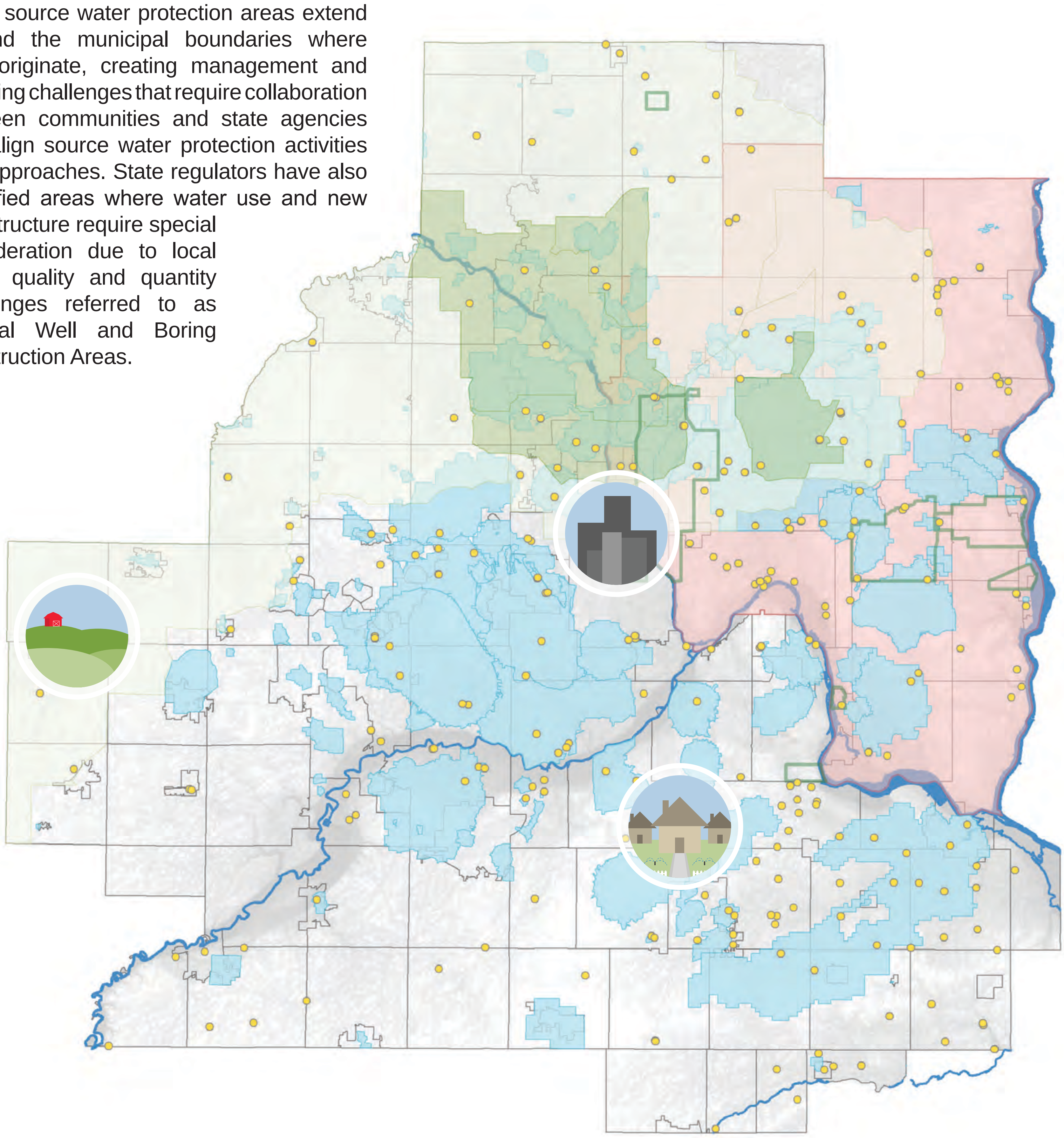
State water agencies and communities are working together to identify and evaluate the potential health hazards posed by Contaminants of Emerging Concerns (CEC). These are chemicals that can be detected in water and are becoming more common in our environments like pharmaceuticals, personal care products, pesticides, microplastics, detergents, disinfection byproducts, and industrial or household products. Emerging pollutants also include certain viruses, bacteria, or other microorganisms.

Source Water Protection

Contamination of groundwater or surface water can occur anywhere potential pollutants are not managed appropriately. Risk of contamination is reduced through sound water management and planning, including the reduction of hazards and potential contamination sources. Reducing the risk of contamination starts with understanding where our drinking water sources come from, identifying contamination risks, removing those risks where possible, and having a thorough response plan to address pollution where and when it occurs. Water suppliers, state agencies, watersheds, and landowners work together to protect public and private water supplies, ensuring the water we drink is healthy and safe. There are extensive source water protection, well testing, and water supply monitoring requirements that protect drinking water in Minnesota.

Throughout the metro, there are drinking water management areas (DWSMAs) for public drinking water supplies. These areas are developed through complex groundwater and surface water flow modeling that allows water suppliers and state agencies to understand how source waters move to supply wells or surface water intakes. Modeling also helps to understand where and how quickly pollutants move through water sources.

Many source water protection areas extend beyond the municipal boundaries where they originate, creating management and planning challenges that require collaboration between communities and state agencies that align source water protection activities and approaches. State regulators have also identified areas where water use and new infrastructure require special consideration due to local water quality and quantity challenges referred to as Special Well and Boring Construction Areas.



- Northeast Groundwater Management Area
- Groundwater DWSMA
- Surface Water DWSMA - Priority Area A
- Surface Water DWSMA - Priority Area B
- Special Well Construction and Boring Area
- DNR Monitoring Well
- Major River

Wellhead Protection Areas (WHPAs) are modeled areas that show, at minimum, the 10-year travel time of water to public water supply wells. DWSMAs are the parcels that contain and surround WHPAs. Surface water protection areas where spills could threaten the Minneapolis and Saint Paul water supplies s are surface water protection areas. These areas follow watershed boundaries, describe different levels of water supply threat potential, and extend beyond the borders of the region.

The NE Groundwater Management Area includes DNR designated communities that represent an area of resource concern. Well advisory areas are identified to provide for the safe construction or sealing of water supply wells and inform the public of potential health risks in areas with groundwater contamination.

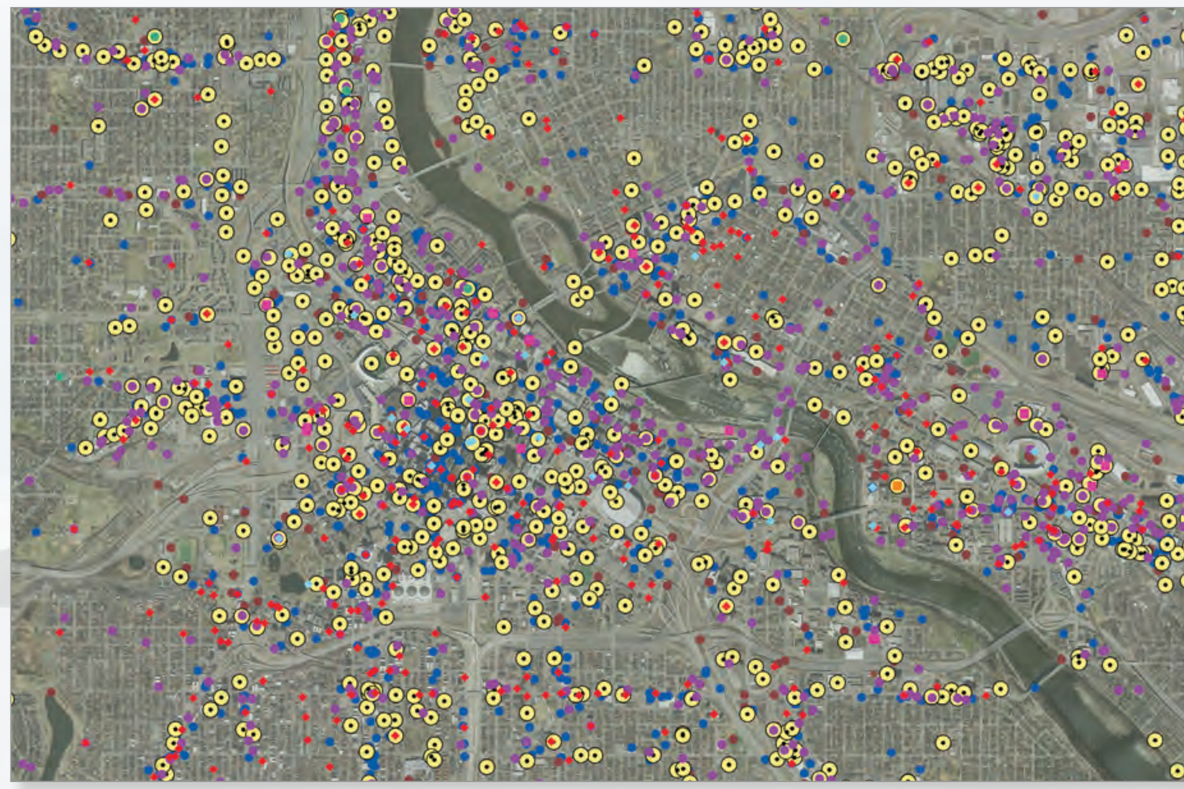
Data source(s): Minnesota Department of Health, Minnesota Department of Natural Resources

Potential Contamination Sources Change with Land Use

The type and amount of potential water contaminants depend on how land is developed and used, and what human activities or industries are present. Some pollution types are residential and can occur anywhere homes are built, but others are more connected to development patterns. For instance, agricultural areas have different sources of pollution than highly developed urban areas. The MPCA has a number of tools to help water service providers and individuals plan for potential water supply risks. The What's In My Neighborhood mapping application identifies potential contamination sources for water and air. This tool provides water managers and communities with essential information to protect water sources.

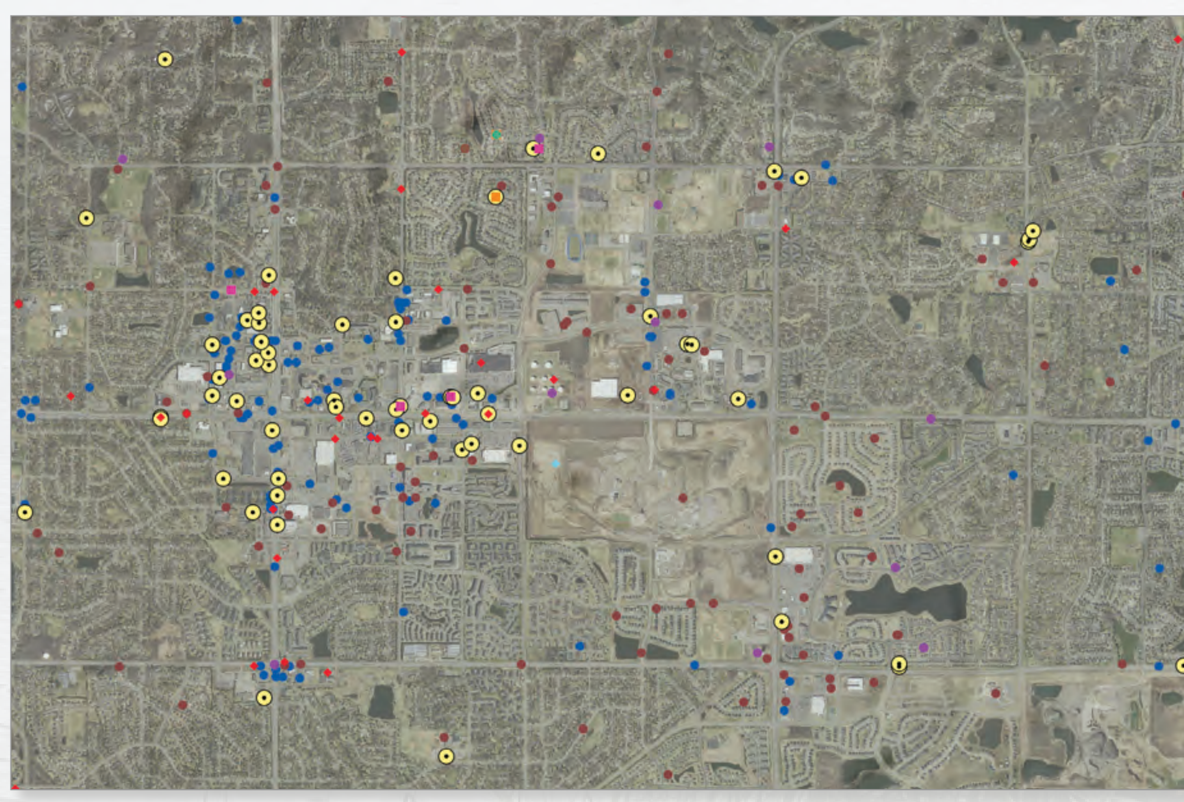
URBAN

The most developed areas of our metro, with many industrial and commercial sites, often have the most potential sources of contamination. These areas also tend to have more active investigation and cleanup sites than others.



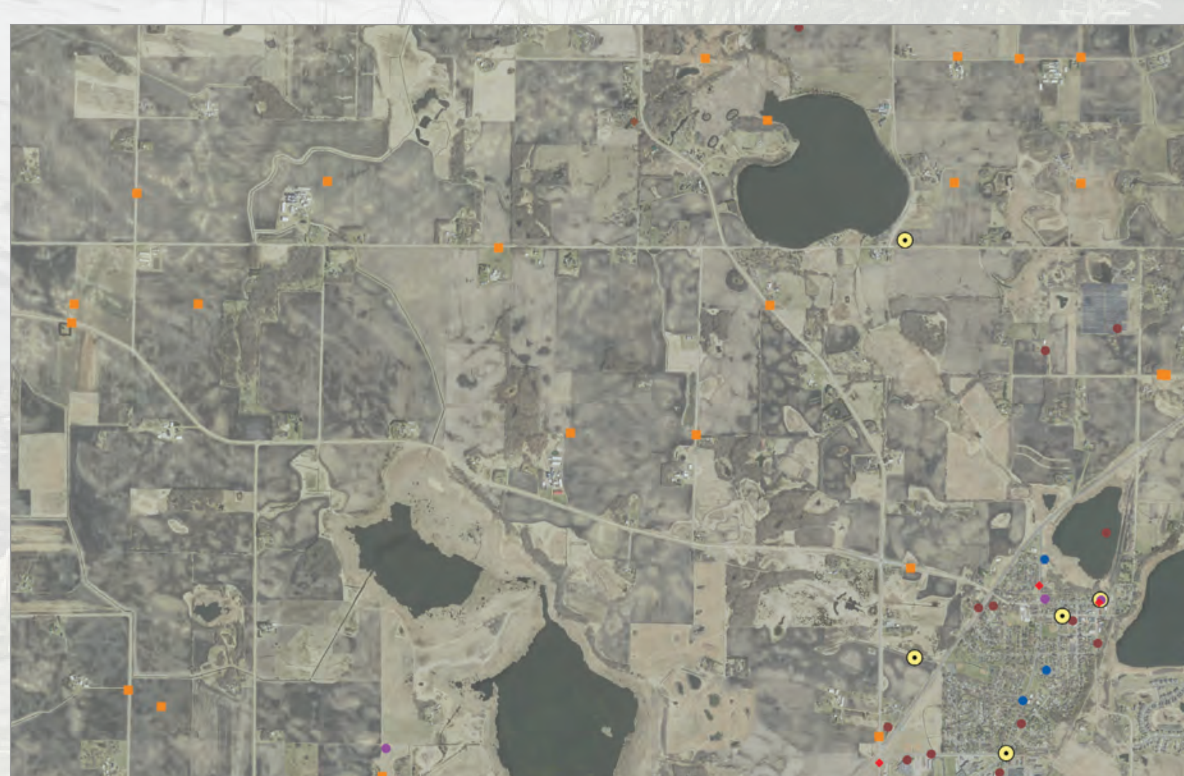
SUBURBAN

Contamination risk in more moderately developed areas tends to be concentrated where commercial and industrial land uses are present. As more rural areas develop and land uses shift from agricultural to industrial, commercial, and residential uses, the types of potential water pollutants also change.



RURAL

Smaller towns and agricultural communities in less developed areas face unique water contamination challenges. Pollution from local industrial or agricultural sources can make their way into drinking and recreational waters. As in other areas, economic vitality and best management practices are important considerations when addressing water sustainability challenges.



Multiple Programs	Feedlots	Investigation and Cleanup	Solid Waste	Tanks
Air Quality	Hazardous Waste	SSTS	Stormwater	Water Quality

Data source(s): Minnesota Pollution Control Agency

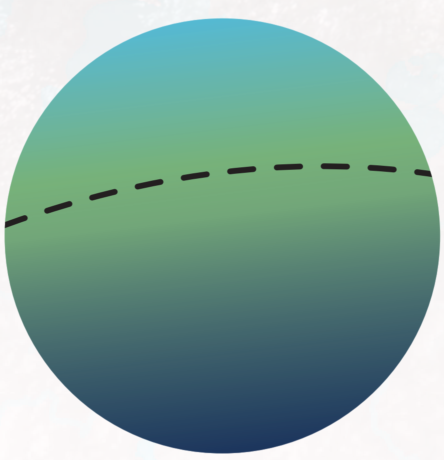
Water Resource Connections & Interactions

In the metro region, groundwater and surface waters are intimately linked. Both types of water are influenced by and dependent on the other. Rivers, lakes, streams, and wetlands are maintained by a combination of precipitation and groundwater inputs. Likewise, groundwater is maintained by the infiltration of precipitation and water temporarily stored at the surface. Recognizing that surface waters and groundwater are interacting to varying degrees is essential to address complex, interdisciplinary water sustainability challenges.

Water Resource Interactions

Water Elevations

When the water entering a lake, river, or stream is out of balance with the water leaving those surface waters, changes to water levels, flows, and surrounding ecosystems occur. Similarly, when the amount of water infiltrating the ground to recharge groundwater is out of balance with the amount of water leaving the system, groundwater quantities and flow change. Changes to surface water levels, water tables, and upwelling groundwater quantity and quality can have significant physical, chemical, and cultural impacts on water resources and communities.



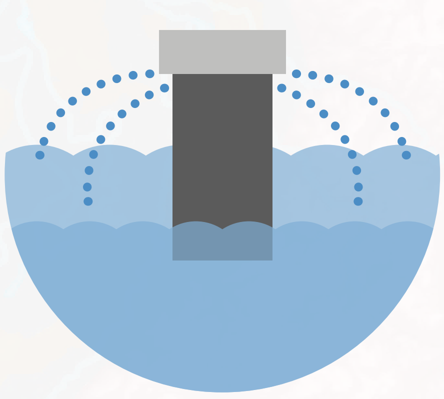
Water Quality

When water from the surface meets groundwater (or vice versa), the qualities of each are altered. Some of these changes are benign or necessary to support ecosystem function, as in the case of upwelling groundwater in trout streams or calcareous fens. In other cases, pollutants can be transferred from one water type to the other. Some contaminants that are long-lived in the environment repeatedly move back and forth between surface and ground water.

Social, Cultural and Economic Impacts

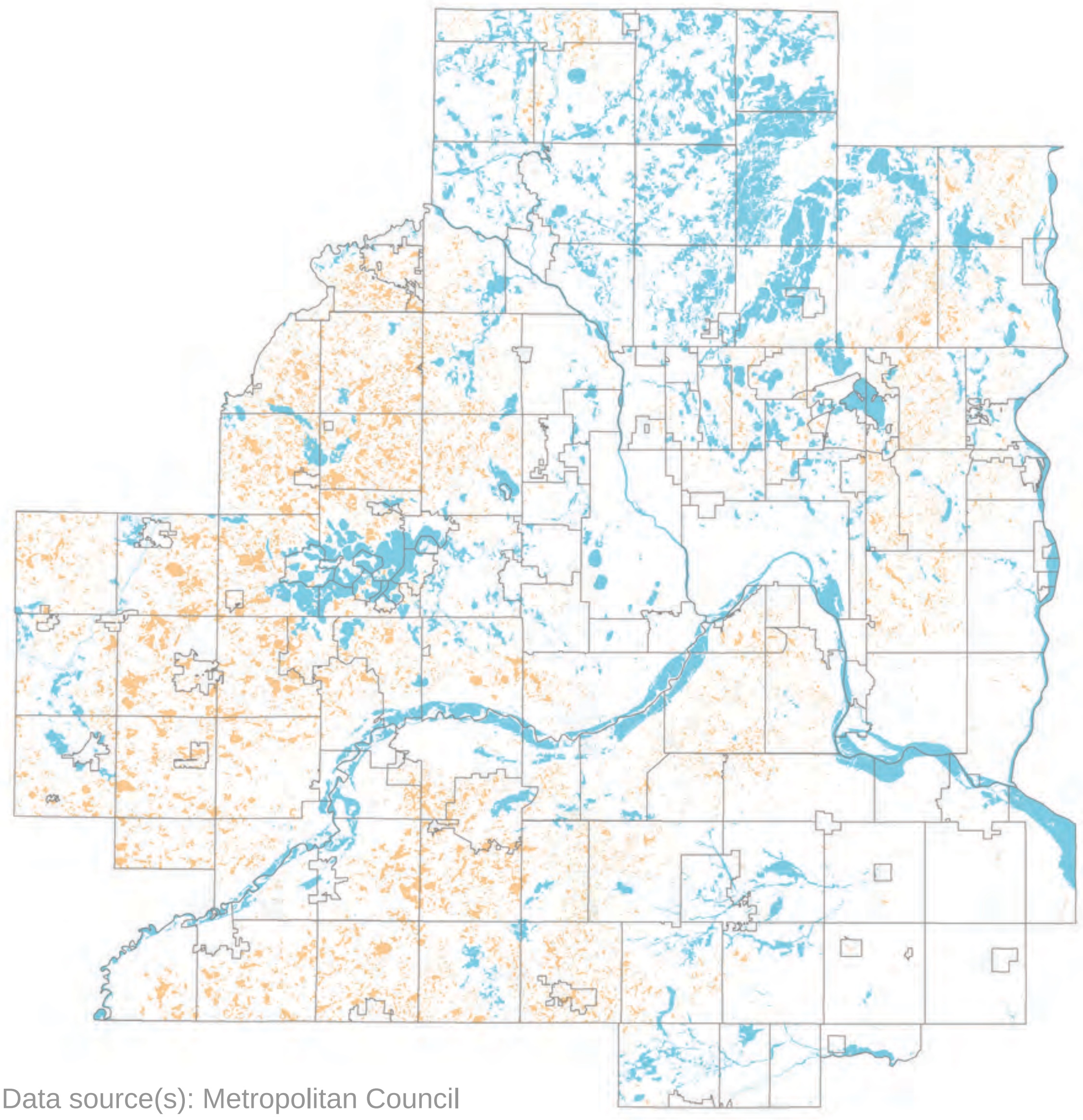
Recreation

When the quality and quantity of water is negatively impacted, ecosystem and public health are affected as is our ability to access the services water provides. Nearby groundwater use can impact surface waters in some areas, particularly during times of drought when water use is high, and resources are stressed. Changes in lake levels or groundwater inputs to streams and wetlands can limit fishing, boating, and other recreational activities, impacting local economies and community well-being.



Infrastructure

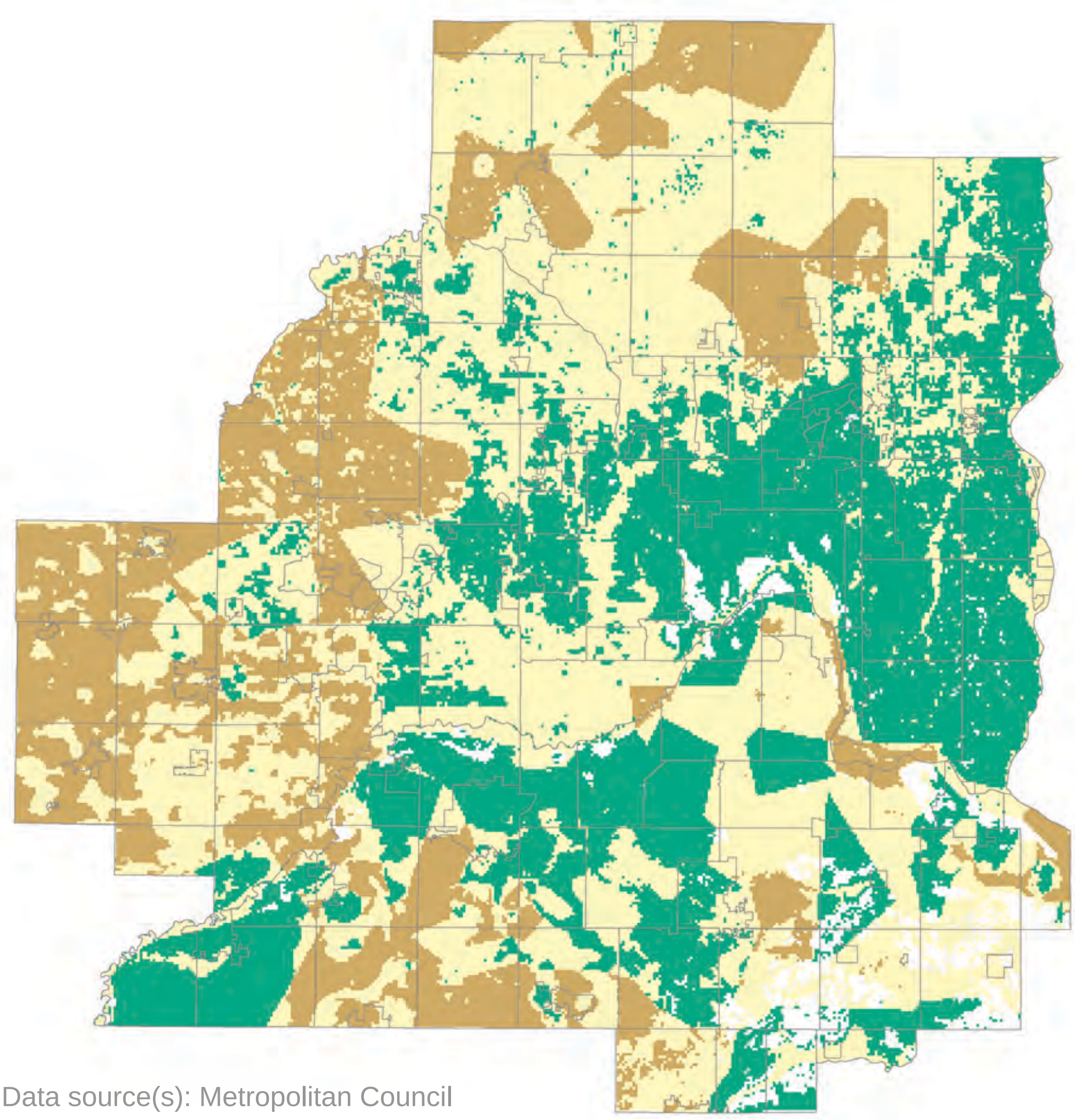
The built environment and water utilities are impacted when water tables rise and fall. Areas prone to higher water tables may experience flooding during longer periods of consistently wet conditions. When neighborhoods, homes, and businesses flood, communities and residents are impacted. Repairs to these systems can be costly for individuals and entire communities.



Data source(s): Metropolitan Council

Groundwater and Surface Water Connections

The surface waters we see and interact with everyday are connected to groundwater flowing beneath our feet. This map shows groundwater-connected surface waters either through inputs, outputs, or both. Surface waters that are labeled disconnected are underlain by relatively impermeable sediments or bedrock layers that limit water movement.

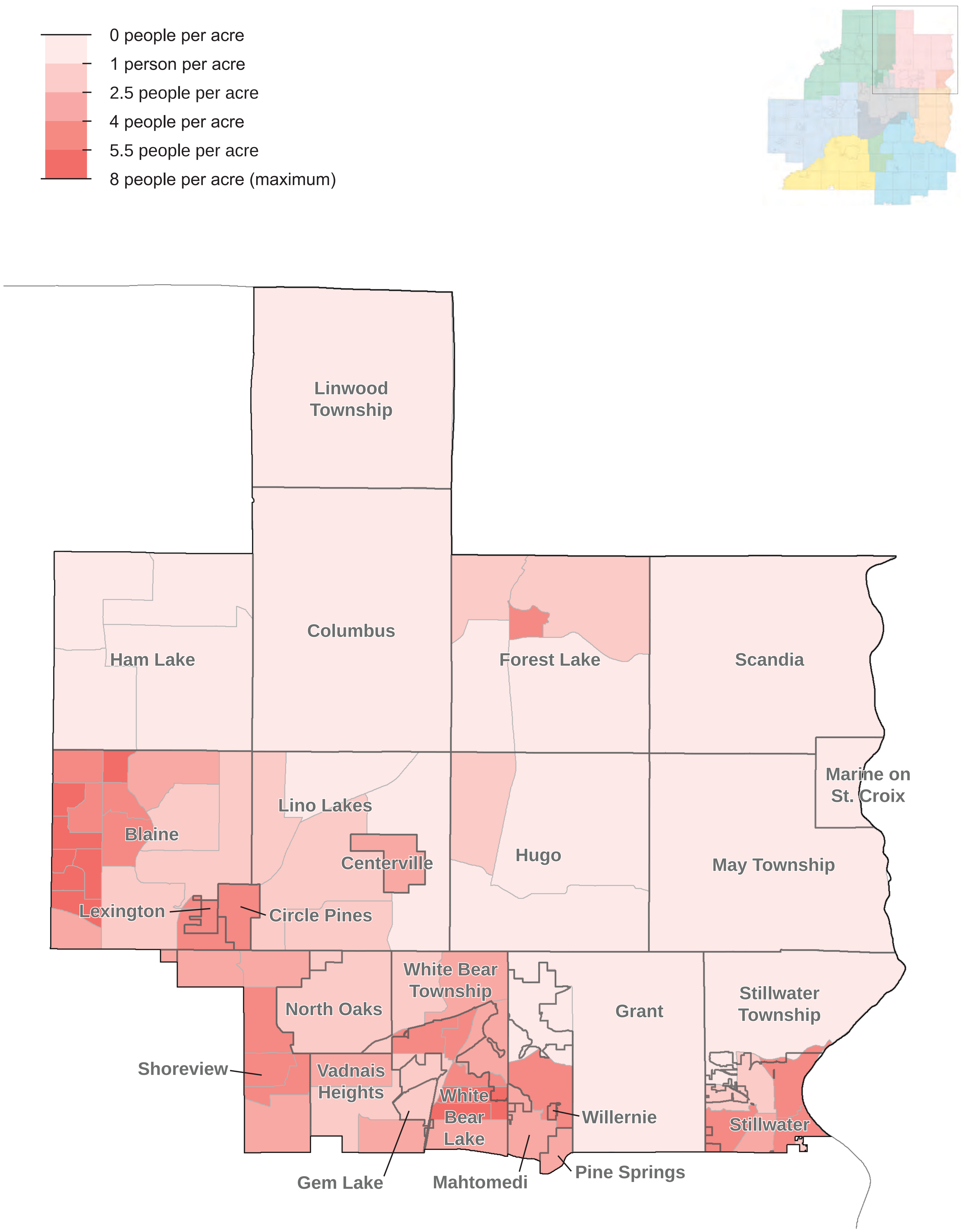


Data source(s): Metropolitan Council

Surface Water - Bedrock Interaction Potential

This map describes areas of the metro where water at or near the surface can easily travel to bedrock aquifers. Groundwater chemistry from wells was compared to hydrogeological estimates of groundwater travel times to determine areas where surface and bedrock water are more or less likely to interact. Surficial sand aquifers were not explicitly evaluated in this study but assumed to have a high likelihood of surface water interaction.

NORTHEAST



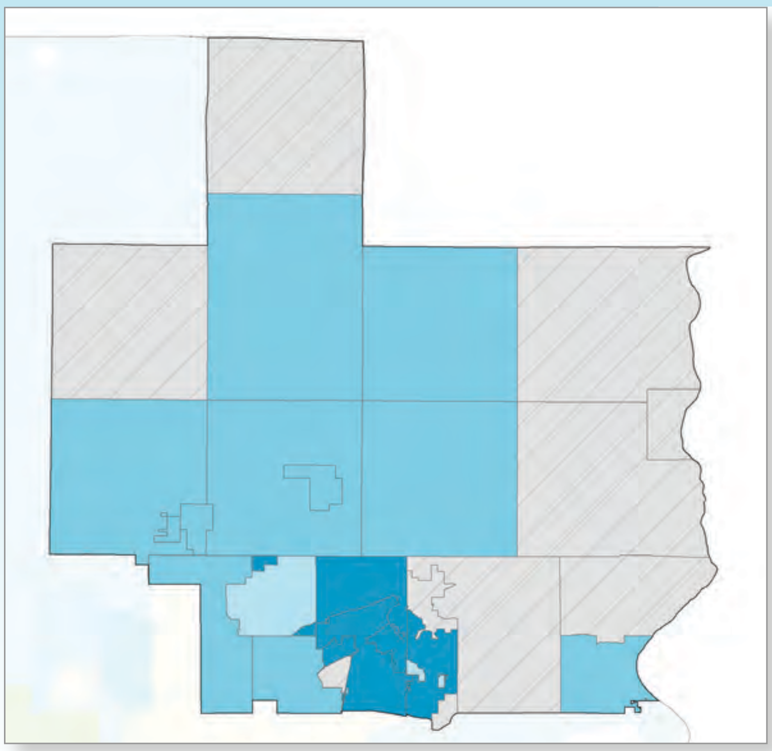
The Northeast subregion stretches east from Saint Paul to the St. Croix River, north to the Chisago County border, and west into Anoka County. Communities in this part of the metro consist of older suburban developments, newer growing suburbs, rural areas, and smaller communities within more rural areas to the north and along the St. Croix river. Older developed areas close to Saint Paul or Stillwater are the most densely populated areas.

Northeast metro communities have some unique water resource limitations and associated water supply challenges. Increasing water demand from a growing population, shallow aquifers connected to surface waters, shifting climate trends, and legacy contamination sites have created sustainability challenges for communities. Communities and state regulators continue to collaborate on solutions to ensure water resources are protected and community needs are met, while use restrictions have been put in place by state regulators.

The North & East Groundwater Management Area (NE GWMA) covers all of Washington and Ramsey Counties and extends into eastern Anoka and Hennepin Counties, covering the Northeast subregion. The NE GWMA was created in 2015 by the DNR to address water management challenges in the area.

Data source(s): US Census

Water Resources



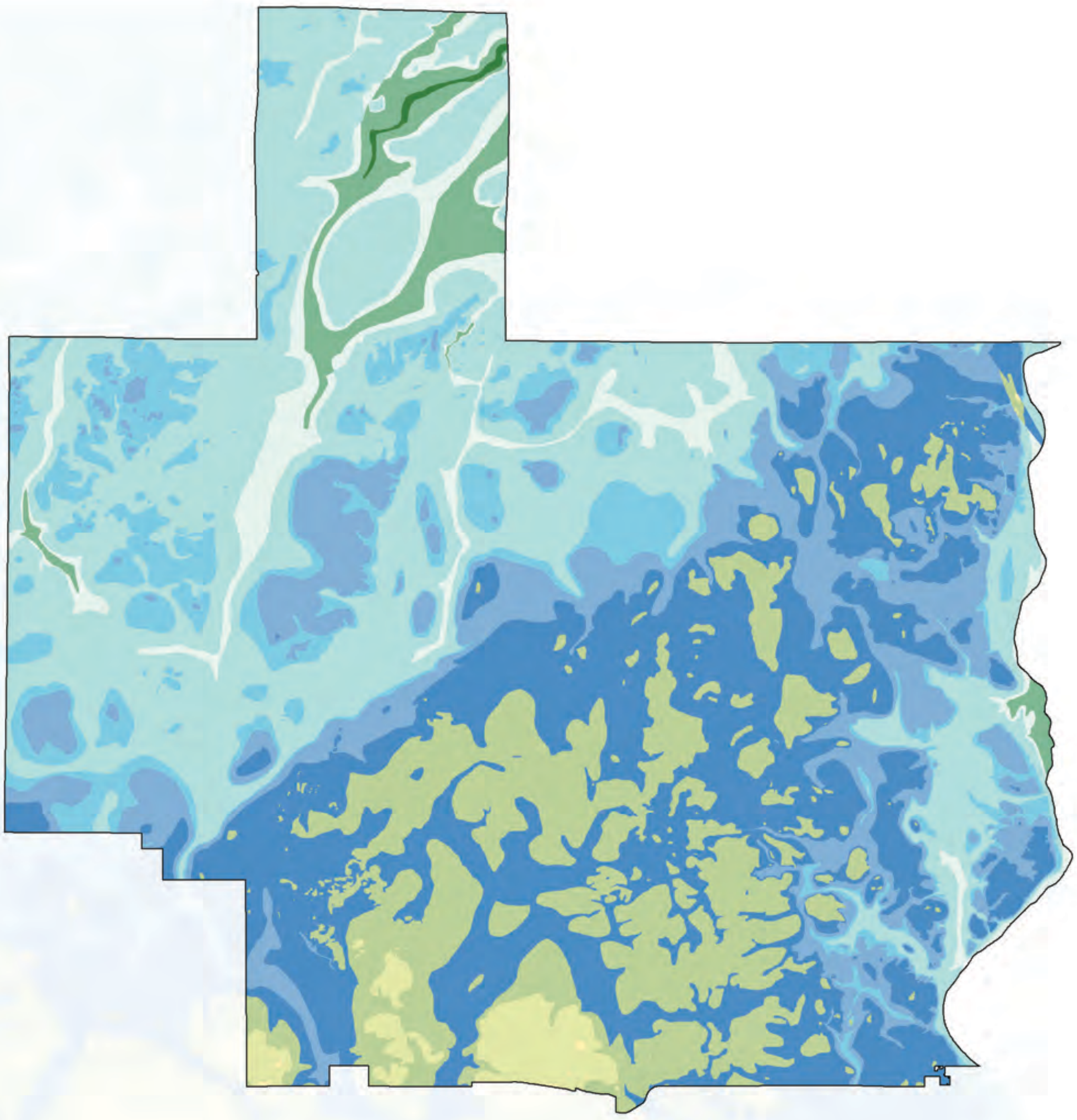
Water Supply Sources by Community

Communities in the Northeast subregion rely exclusively on groundwater sources for their water supplies. Most communities in this subregion operate public water supply systems that provide residents and businesses with water, but some communities do not have public water supply systems. In these communities, which are often more rural, residents get water from privately owned and operated wells.

GROUNDWATER
- Community serves multiple communities using a local source for public water supply
- Community uses a local source of public water supply
- Community uses local and outside sources for public water supply
- Community uses outside sources for public water supply

Community has no public water supply

Data source(s): Metropolitan Council

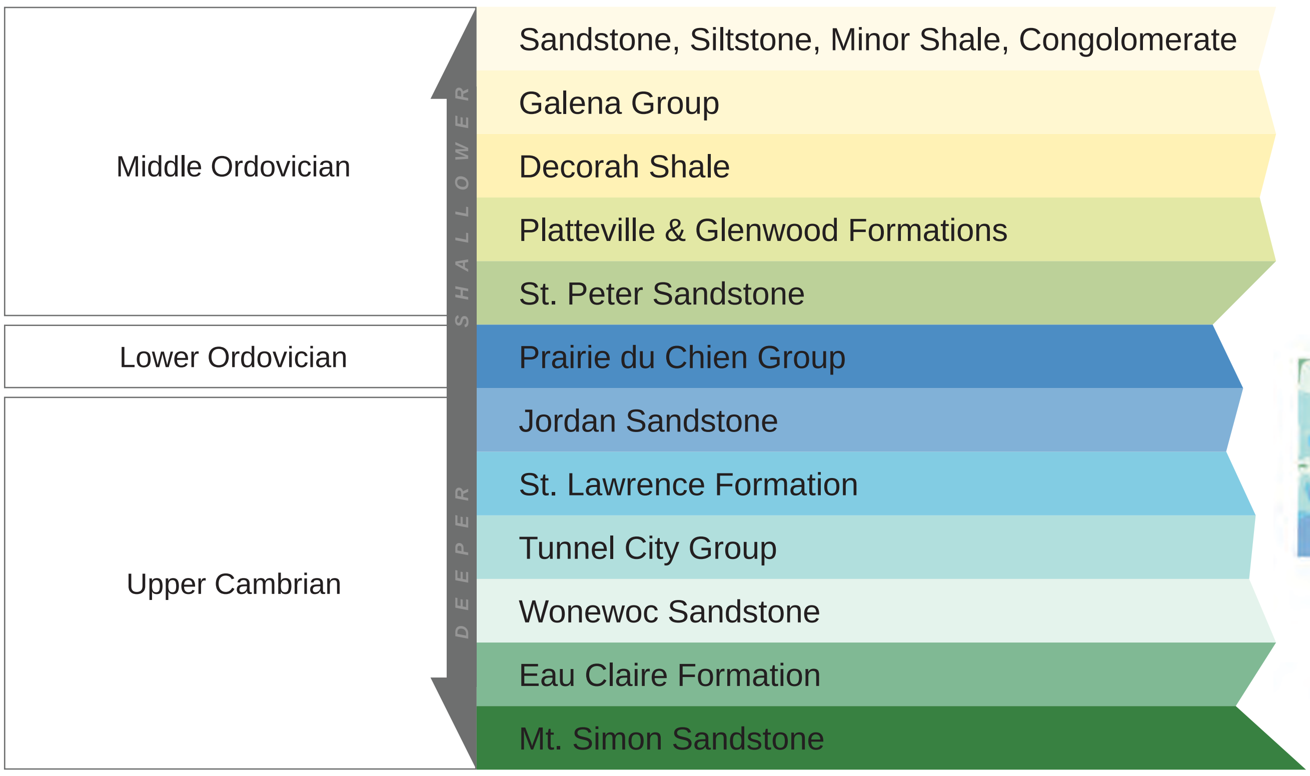


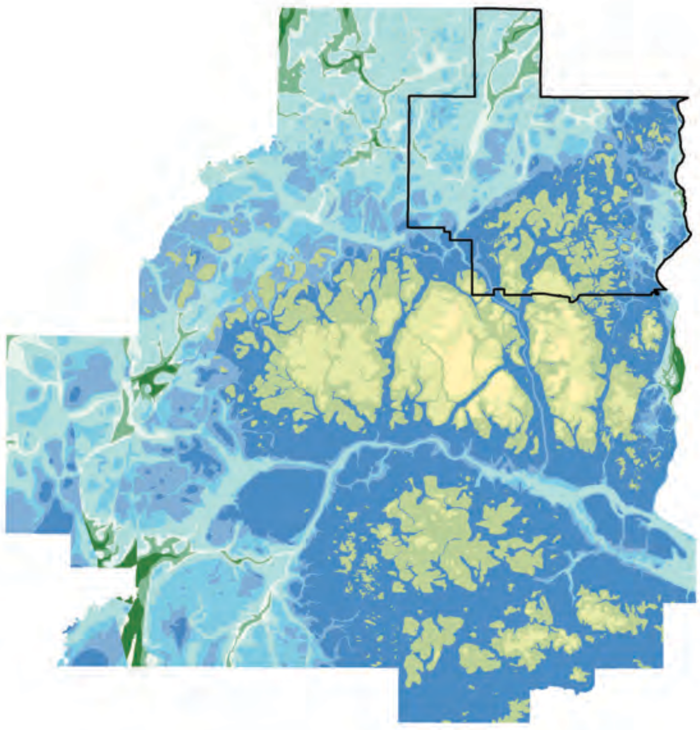
Bedrock Geology

Most drinking water in this area is sourced from the Prairie du Chien and Jordan aquifers. In this part of the metro, bedrock aquifers tend to be closer to the surface than in other areas, making them convenient and cheaper sources of drinking water. However, because drinking water sources are often shallow, contamination and pumping impacts on surface waters can be a concern. Where the Decorah Shale and Platteville and Glenwood formations are present, underlying aquifers are less vulnerable to contaminants.

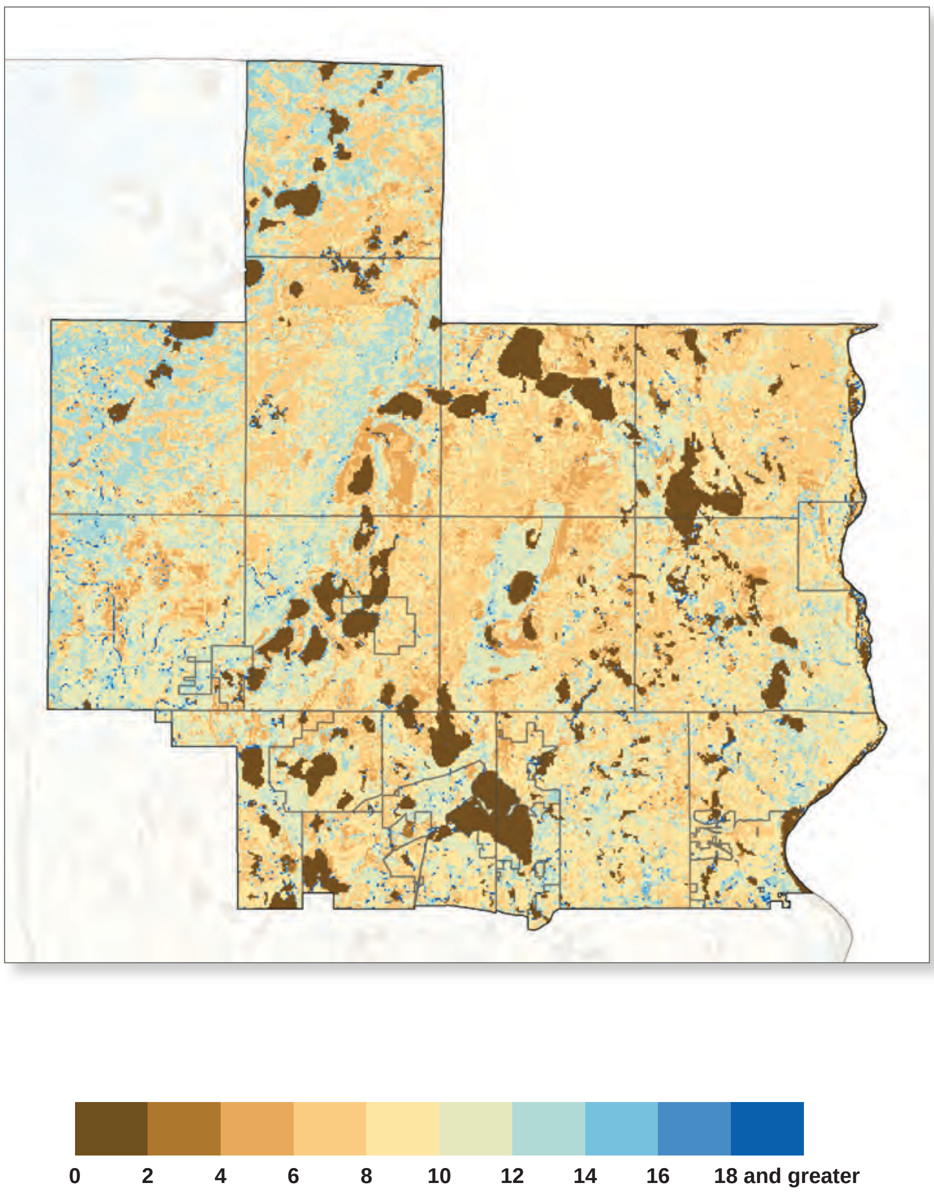
A major groundwater divide crosses this subregion. The divide runs north to south from approximately the east side of White Bear Lake, through Hugo and Scandia to Chisago County. Water on the east side of the divide drains to the St. Croix River, while water on the west side drains to the Mississippi River.

Data source(s): Minnesota Geological Survey

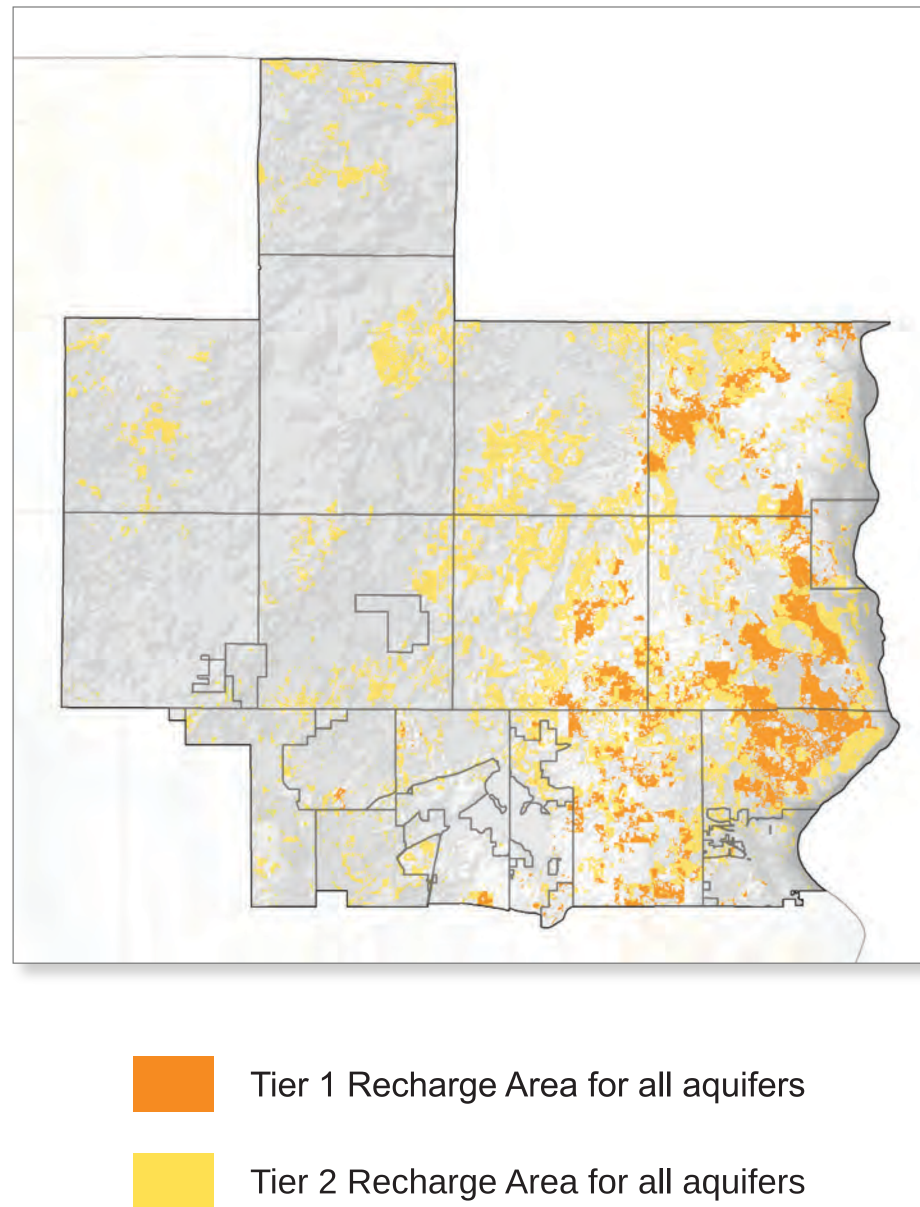




Modeled Infiltration



Potential Areas for Enhanced Recharge

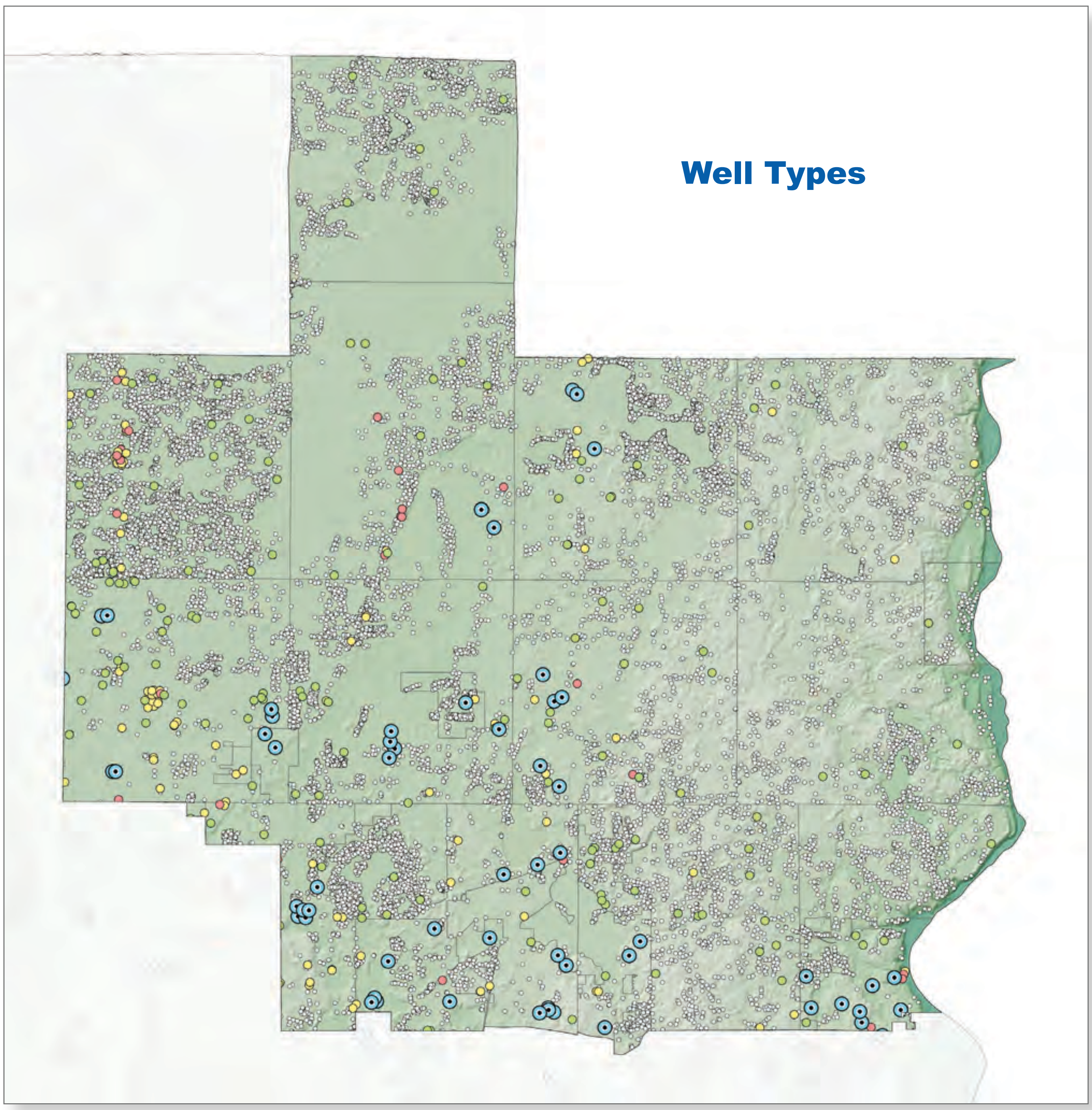


Water within the ground is always moving, flowing from the surface to deeper aquifers and eventually discharging to area surface waters. Water enters the ground where it can, when it can. In some areas where there is a lot of impervious surface or sediments don't allow for much water to enter the ground, there is limited infiltration. In other areas, water can easily move through soils and sediments and be available to recharge aquifers.

Most pumped groundwater is used and then enters the regional wastewater system. That water is cleaned and usually released to area rivers to flow downstream. Extending the life of water on the landscape through enhanced infiltration and water reuse helps to improve water sustainability, particularly when and where water resources and supply systems are stressed. A study conducted by the Met Council in 2016 identified areas that may be suitable for enhanced recharge activities. However, getting water back into the ground is complicated. Once water is exposed to the surface, treated, used, and treated again, it may not be suitable to enter aquifers.

Water Supply Systems & Treatment

Many Northeast metro residents receive water from a public water supplier. Water suppliers go through many steps to access viable water sources and then treat that water to ensure clean and safe water is available to people, homes, and businesses. Many people also own and operate individual private wells, especially in more rural areas. Those residents are responsible for their water infrastructure and any treatment in their homes. Businesses may receive water from a water supplier or have individual permits to pump water for agricultural or golf course irrigation or other commercial and industrial purposes.



Data source(s):
Minnesota Department of Health

Water Supply Treatment Process

The steps required to treat raw water vary depending on water source. Surface water sources typically have more water quality challenges than groundwater. Therefore, surface water treatment requires additional treatment steps.

Different aquifers are made up of different minerals that sometimes need to be removed during treatment to address taste, odor, or potential health concerns. Much of the groundwater in Minnesota is considered “hard.” Hardness is a measure of the dissolved minerals, usually calcium and magnesium, in water. These minerals are not a health concern, but they do produce deposits (scale) that can reduce the life of appliances and other equipment. Hardness can be treated by softening at the treatment plant or through home treatment systems. However, the salts used to soften water can contribute chloride pollution to the environment and drinking water.

Water is pumped from a surface water or groundwater source.

Filtration

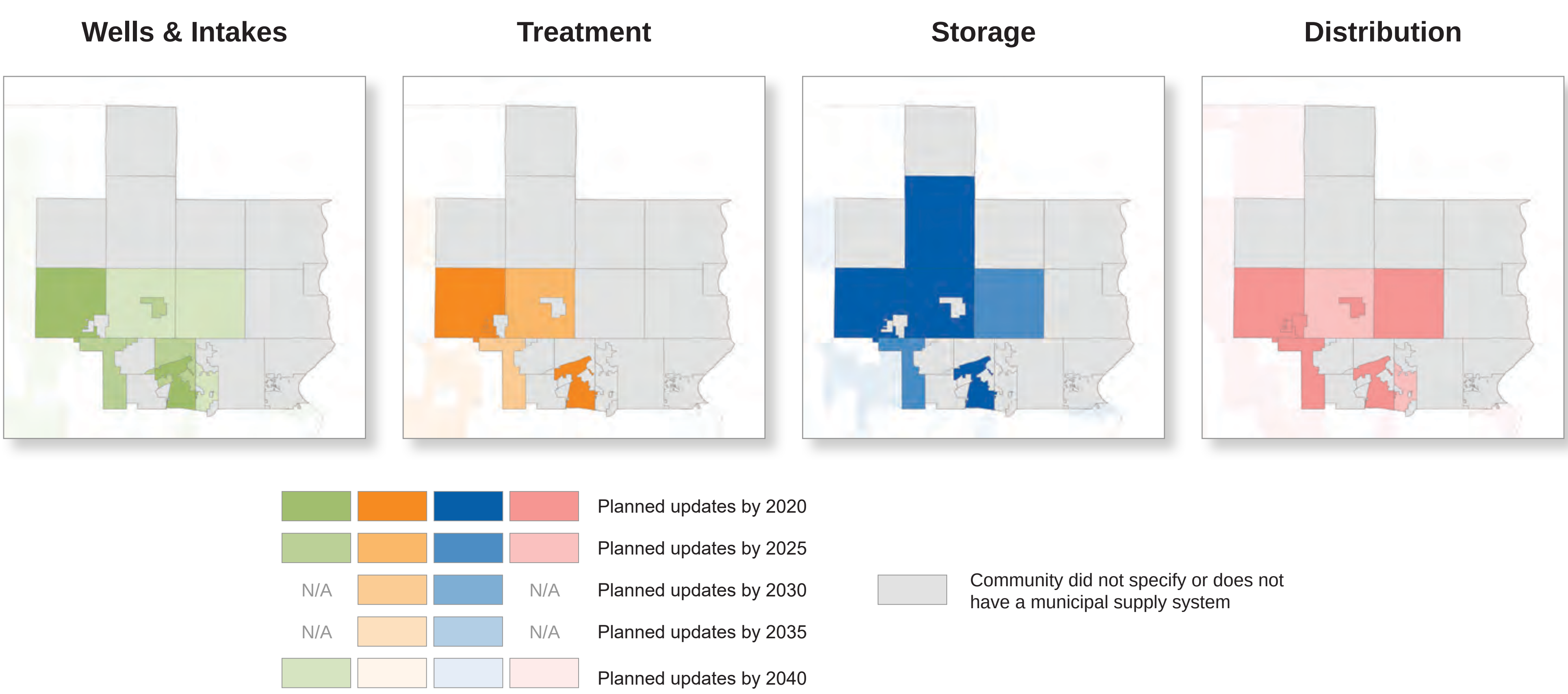
The water moves through a series of filters that help remove additional particles, bacteria, chemicals, and more.

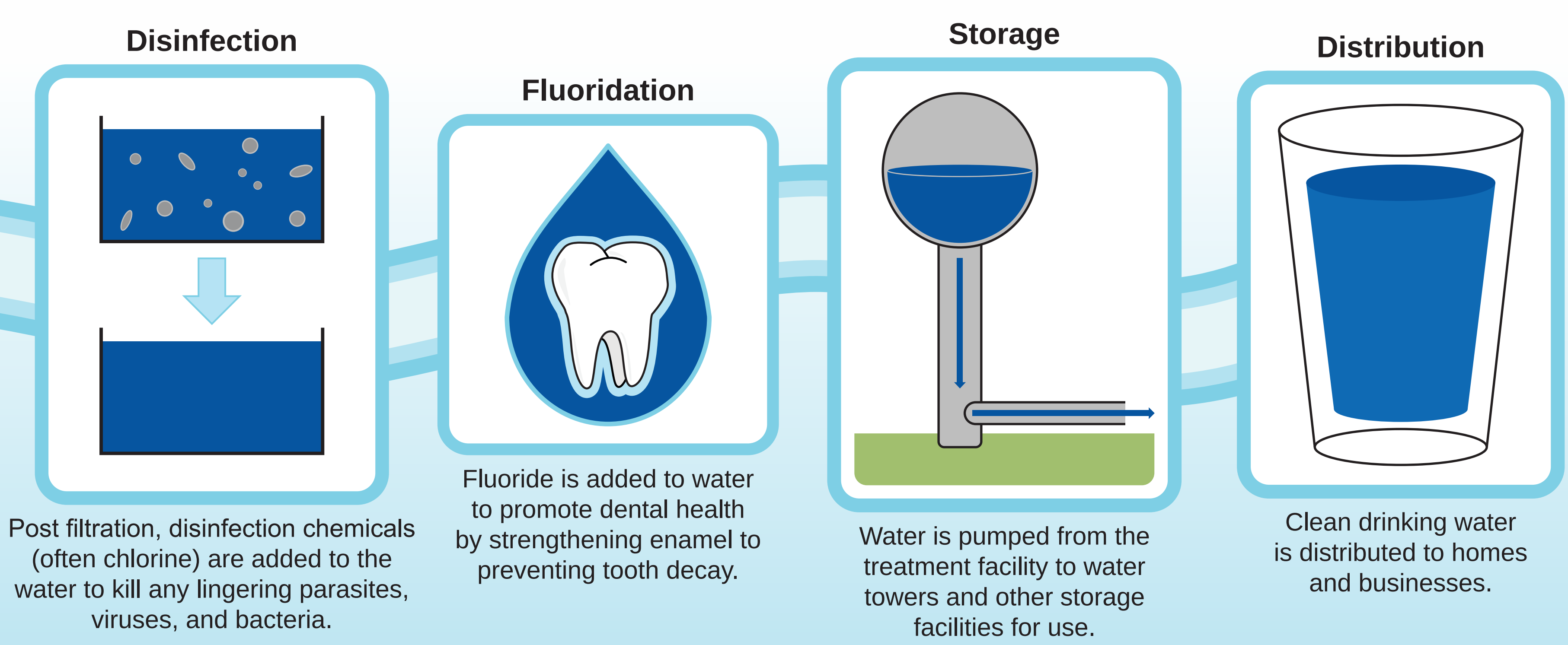
As the Northeastern metro continues to grow, more people will rely on municipal/public water supplies for their water needs. To deliver service to more homes and businesses, communities may need new infrastructure like additional wells and new service lines. Expansion of water supply systems comes with costs and is not without financial, social, or environmental risk.

Planned Water Supply System and Infrastructure Investments by 2040 as Reported in Local Water Supply Plans

(as of 06/15/2023)

Communities with public water supplies are asked to report potential system and facility additions, as well as potential repair and replacement activities, in their local water supply plans. Significant investments in water supply facilities and infrastructure are planned over the next 20 years. Infrastructure maintenance and repairs are always occurring, while larger replacement or additions projects happen less regularly or as increased demand, treatment needs, or funding dictate.

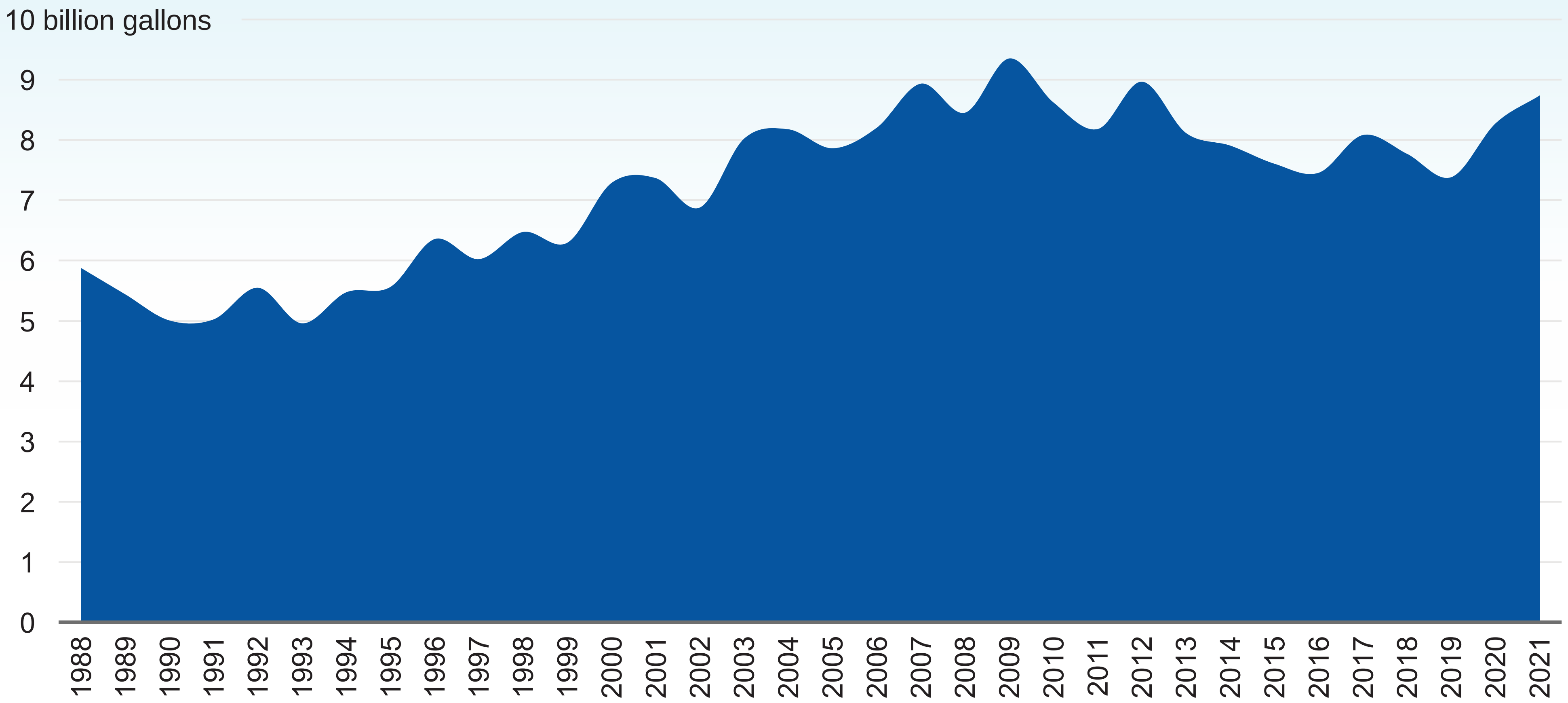




Water Uses

Water use varies from community to community, depending on the needs and practices of residents and businesses. Water use is influenced by many factors including weather, how developed an area is, local cultural practices, and the number of people who rely on water service providers. When looking at historical water use data, it's important to consider these factors and how they may or may not change in the future. Land use changes, population growth, and resource availability need to be considered so that water use can be sustainable, and communities can adapt to new challenges. By looking at historical pumping and water use trends, we can understand how water demand is influenced by these factors, take steps to increase efficiency, and better prepare for the future.

Annual Gallons Pumped, 1988 to 2021

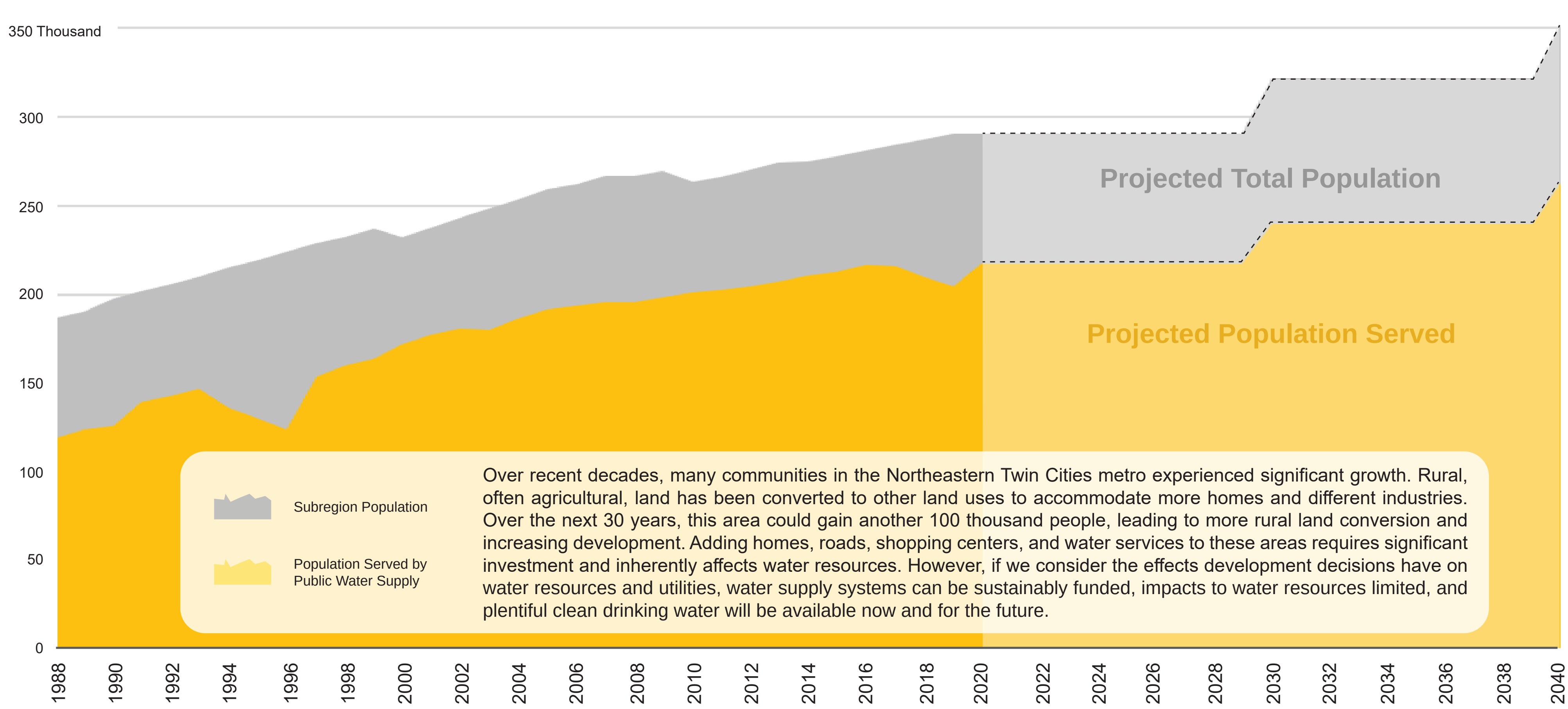


Peak groundwater pumping in the Northeast subregion occurred during the mid to late 2000s, reaching a high of over 8 billion gallons per year. The previous 20-year period shows consistent increases in the gallons pumped coinciding with population growth and development. Over the past two decades, communities have continued to grow. Despite adding homes and businesses to the systems, the amount of water pumped by municipalities is slightly less than in the previous decade. Increases in efficiency and wetter summers have likely led to this demand reduction. However, recent droughts and growth have led to a significant increase in water use.

Data source(s): Minnesota Department of Natural Resources water permitting and reporting system (MPARS)

Historical and Projected Population Change, 1988 to 2040

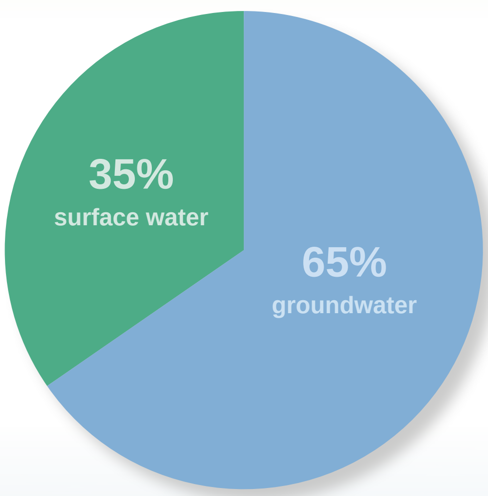
The amount of water needed is driven (in part) by population growth. The number of people served by a water supply system helps to determine how much water will be needed in the future. Factors like weather conditions, increasing the efficiency of appliances and irrigation systems, and individual behaviors also influence how much water is needed, but vary more from place to place and over time. Knowing the amount of water used in the past per person and having good estimates of the number of people who will need water in the future helps to better estimate future water demands and potential water resource and supply system limitations.



Data source(s): Local Water Supply Plans, Metropolitan Council

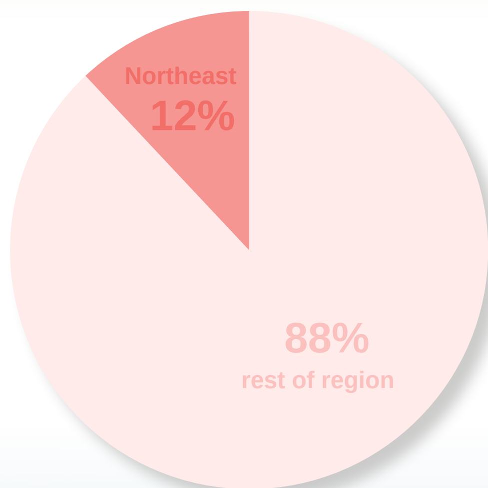
Growth and development are dependent on the sustainability of water supply systems and drinking water resources. To estimate future water needs, we need to understand how changes in population and development patterns influence water demand and how demand can impact water resources. Doing so allows communities to identify water infrastructure needs and potential resource limitations. Understanding the relationships between historical water use information, estimates of future population growth and associated development, and future drinking water demand allows communities to grow sustainably, ensuring the water needs for the region are met.

Regional Municipal/Public Pumping by Source



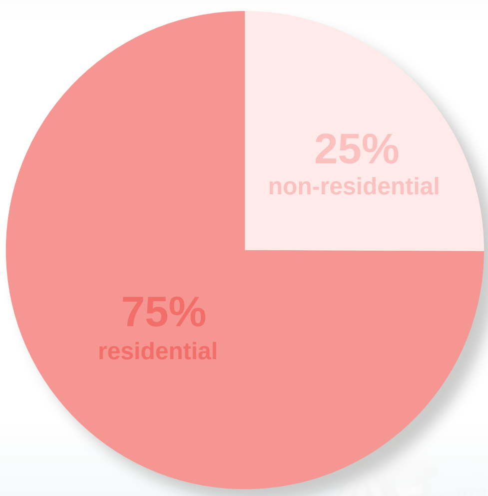
Across the metro, about 65% of all water extracted by municipal/public water suppliers is groundwater. Surface water use is concentrated in the Central metro.

Percent of Groundwater Pumped by Subregion



Northeast subregion communities pump about 12% of all groundwater pumped by municipal/public water suppliers across the metro region.

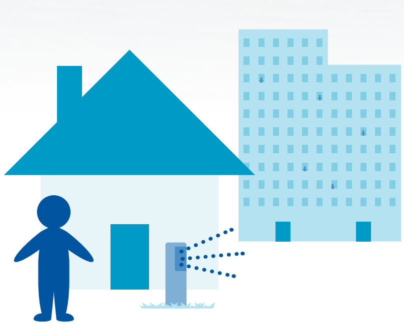
Subregion Delivered Water



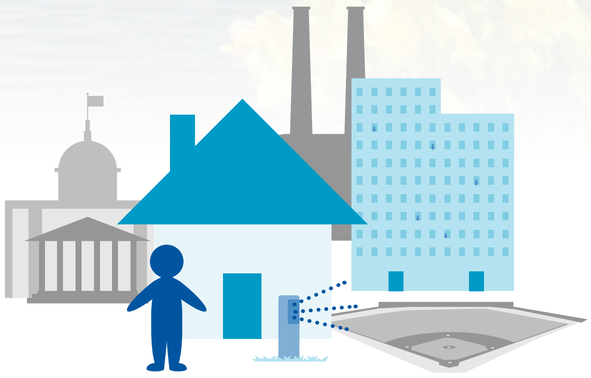
75% of water pumped by public water suppliers in this subregion is used residentially. Commercial, industrial, and institutional uses account for most of the remaining water use. Some water is lost through treatment and delivery processes.

Total and Residential Per Capita Use

Per capita water use is one way to describe how efficiently water is used. Per capita residential water use is an estimate of the amount of water used by each resident served by a municipal or public water supply. Total per capita use is similar but includes the water used by non-residential (commercial, industrial, and institutional) customers. Per capita water use is not the same in every community because how water is used varies from place to place, home to home, and business to business. There are many factors to consider when describing water use efficiency or identifying which water conservation practices might be most helpful.



Residential GPCD



Total GPCD

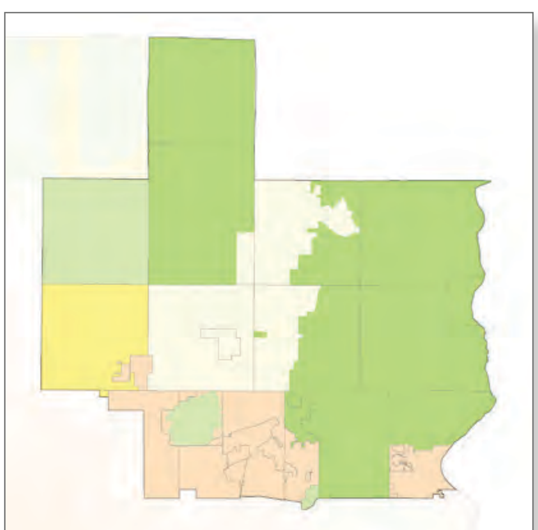
	Residential GPCD	Total GPCD
2000 - 2009	83 gallons per person per day	121 gallons per person per day
2010 - 2019	79 gallons per person per day	116 gallons per person per day

Land Use & Development

Land uses in Northeast subregion range from developed suburban areas dominated by single-family detached housing and commercial areas to rural and highly agricultural areas. Green space in this area is often found along rivers or around area lakes and wetlands. Suburban communities bordering Saint Paul were being established by the middle of the 20th century and continued to grow through the last half of the century as more agricultural and natural areas were converted to lots for single-family homes. One of the areas in the Northeast metro that has seen more development over recent years is the intestate 35 E corridor. Rural communities in the area are also developing but at a slower pace than emerging suburban edge communities.

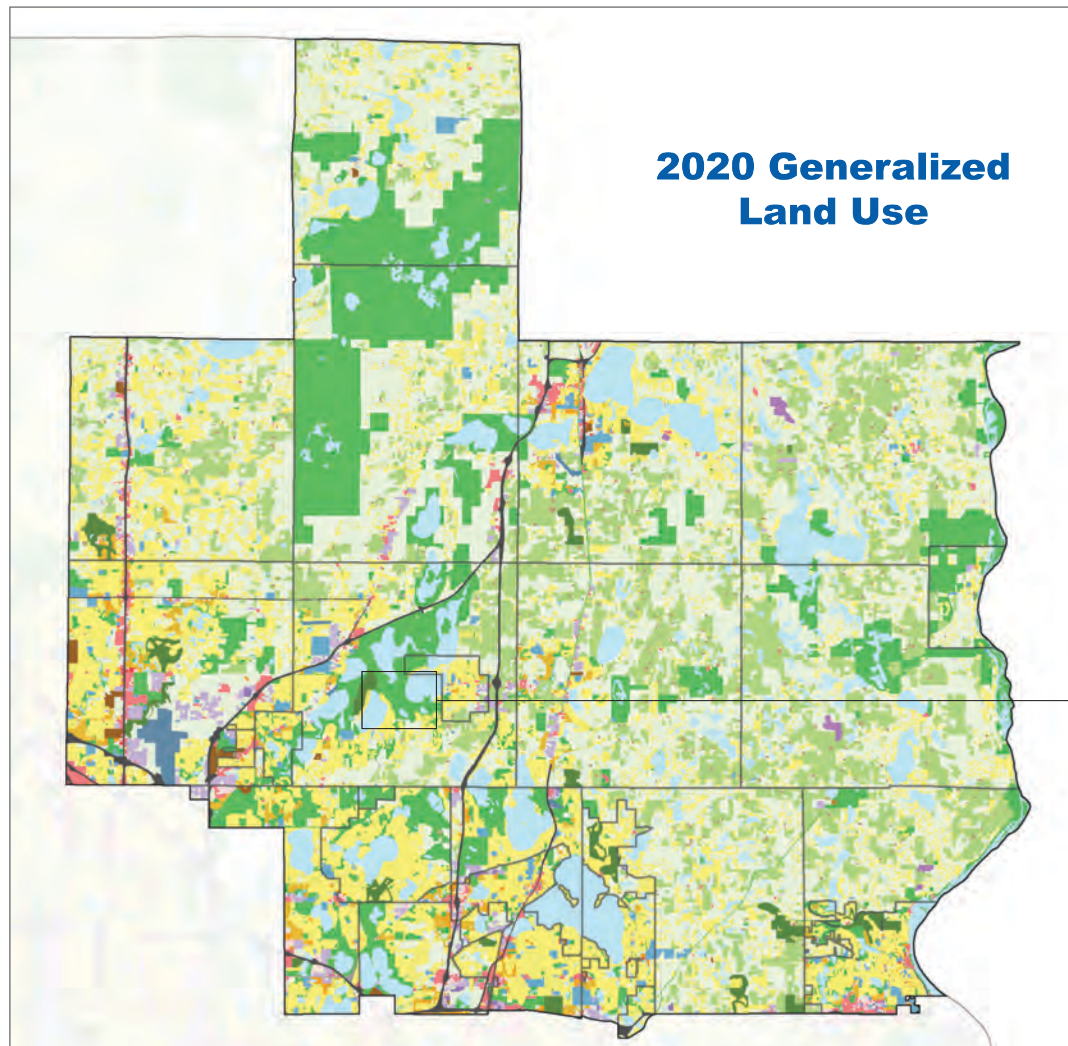
The Northeast subregion spans older suburban communities, newer developments and rural communities. Communities in this subregion are designated as Suburban, Suburban Edge, Emerging Suburban Edge, Diversified Rural, and Rural Residential designations in the Met Council's Thrive MSP 2040 Regional Development Guide.

Thrive MSP 2040 Community Designations



Suburban
Suburban Edge
Emerging Suburban Edge
Diversified Rural
Rural Residential

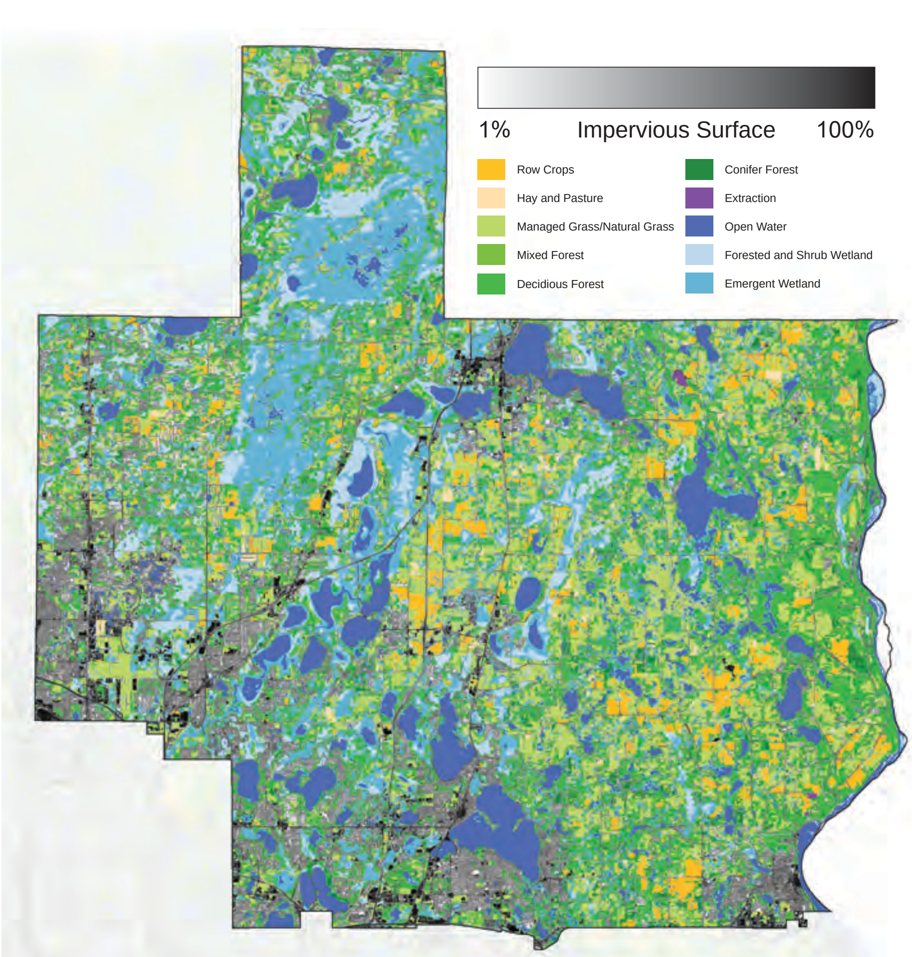
2020 Generalized Land Use



Farmstead
Seasonal/Vacation
Single Family Detached
Manufactured Housing Park
Single Family Attached
Multifamily
Retail and Other Commercial
Office
Mixed Use Residential
Mixed Use Industrial
Mixed Use Commercial and Other
Industrial and Utility
Extractive
Institutional
Park, Recreational or Preserve
Golf Course
Major Highway
Railway
Airport
Agricultural
Undeveloped
Water

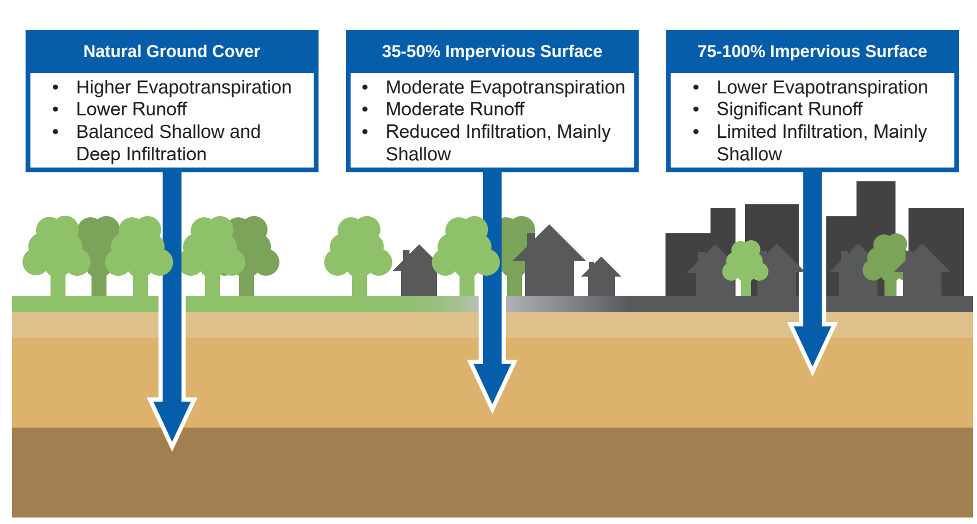
Data source(s): Metropolitan Council

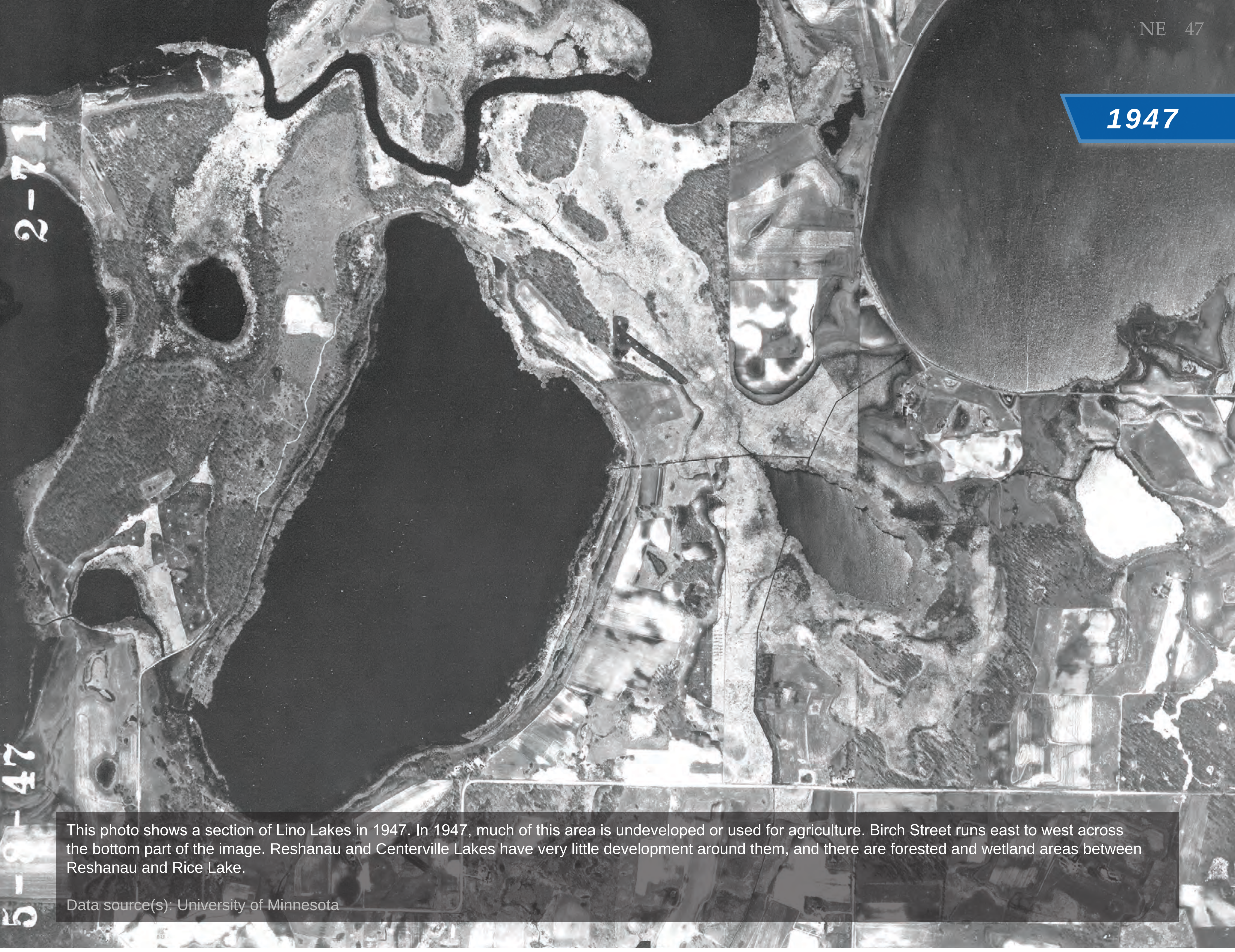
Impervious Surfaces and Runoff



Data source(s): University of Minnesota

An impervious surface is an area where water is unable to pass through into the ground (typically a water-resistant, artificial structure like a sidewalk). Impervious surfaces increase the volume and speed of runoff and limit groundwater recharge, which can negatively impact water resources and ecosystems. In the Northeast subregion, most impervious surfaces are concentrated in and around urban and suburban development. As the region continues to grow and develop, more land conversion to impervious surface is likely.





This photo shows a section of Lino Lakes in 1947. In 1947, much of this area is undeveloped or used for agriculture. Birch Street runs east to west across the bottom part of the image. Reshanau and Centerville Lakes have very little development around them, and there are forested and wetland areas between Reshanau and Rice Lake.

Data source(s): University of Minnesota

By 2016, significant changes had been made to this landscape. Reshanau Lake is more developed on its east side and has a golf course on its west side. The channel of Rice Creek that connects George Watch Lake to Rice Lake appears to have been altered during the construction of the golf course.

Data source(s): Metropolitan Council

Climate & Weather

Changing Climate and Extreme Weather

Climate and weather are always changing, but over recent decades, the impacts of ever-increasing greenhouse gasses have become more noticeable. Across the state, we are seeing less extreme cold and warmer winters, especially warmer winter nights. Winters are becoming shorter, extending the growing season. Over the past few decades, the region has experienced a few periods of intense drought; however, there has been a steady increase in the overall amount of precipitation. Some of the wettest years on record have happened of the last decade, but much of the precipitation is falling during intense storm events where much of the rain runs off into storm sewers or surface waters.

These changes create planning challenges for communities, utilities, and watersheds. Less predictable weather patterns can lead to more variable water demand. Increases in storm intensity and frequency means a greater chance of flooding, stormwater issues, and contamination. During extended wet periods, rising water tables can cause localized flooding impacting homes, water infrastructure, and public spaces. Hotter summers and extended periods of drought can lead to increased water demand and aquifer drawdown, leading to well conflicts and water shortages.

Average Temperature Change in the Metro Region

Summer Maximum Temperature		**Winter Minimum** Temperature	
1981-2010	81.1 °F	1981-2010	7.6 °F
2050-2070	88.7 °F	2050-2070	17.2 °F
Projected Change	**+7.7 °F**	**Projected Change**	**+9.6 °F**

Average Precipitation Change in the Metro Region

Early Summer Precipitation		**Early Fall** Precipitation	
1981-2010	4.4”	1981-2010	2.9”
2050-2070	5.0”	2050-2070	2.9”
Projected Change	**+0.6”**	**Projected Change**	**0**

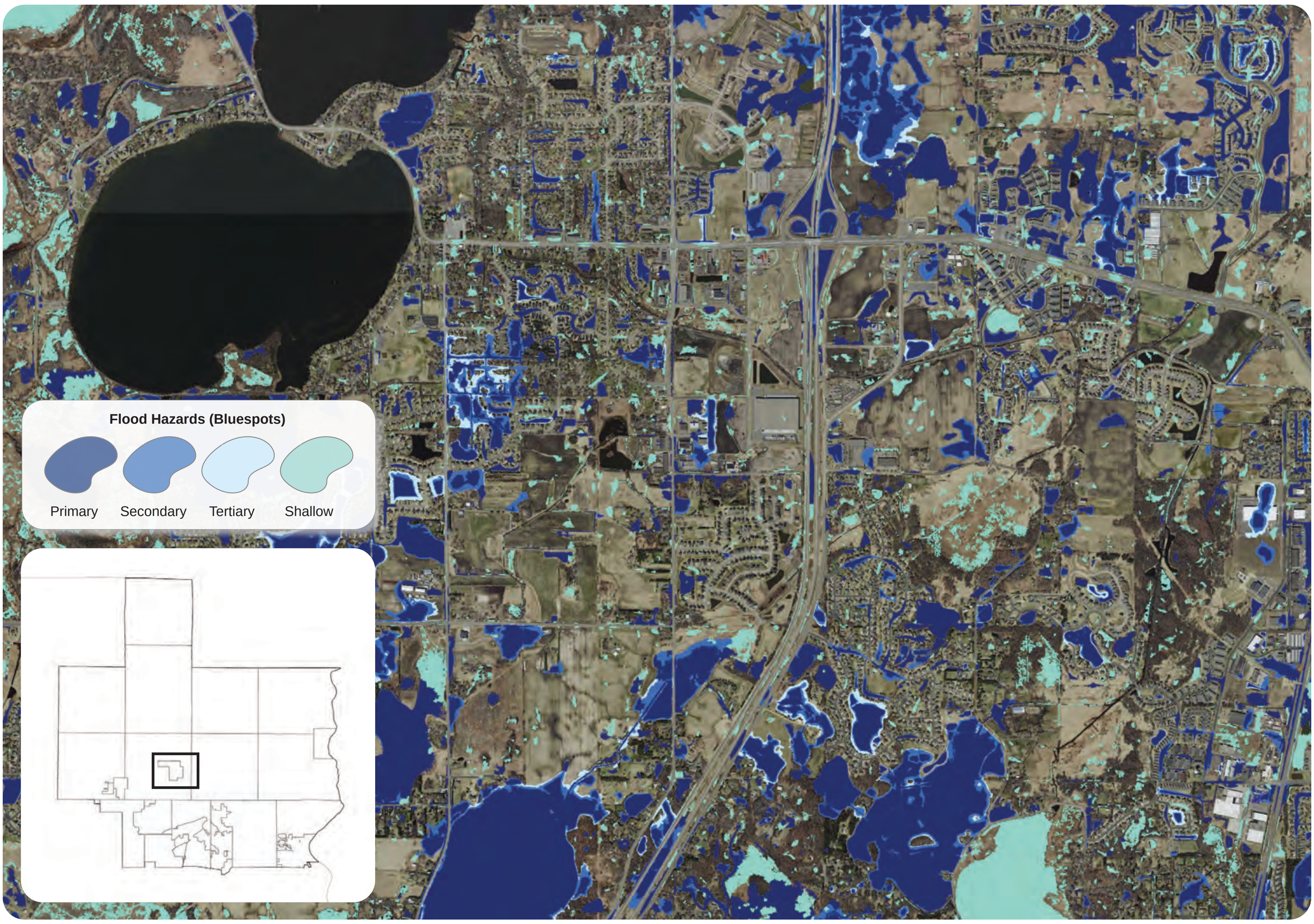
Data source(s): Minnesota Climate & Health Program, 2018

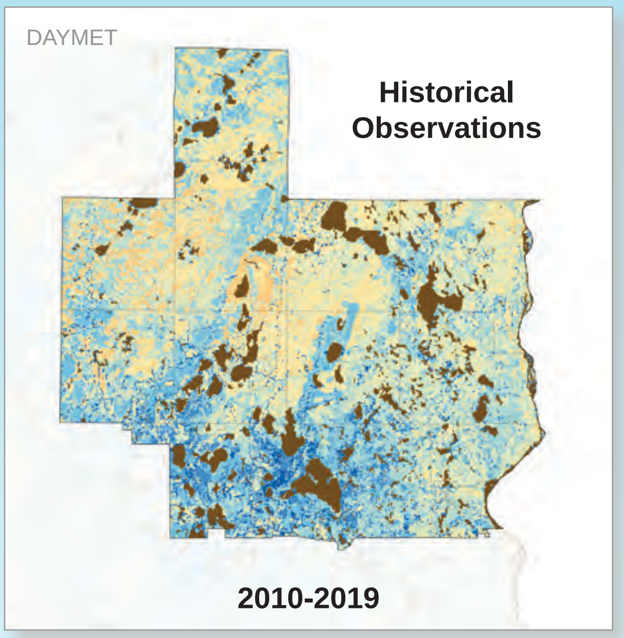
Shifting Temperatures and Precipitation

Temperature and precipitation measurements over the past 150 years tell us that the metro region is getting warmer and wetter. However, these temperature and precipitation changes are not evenly distributed throughout the year. Although the state is getting warmer overall, winter low temperatures are rising faster than summer highs. Similarly, the region seems to be getting wetter during some parts of the year and drier during others. Greater weather variability and lower climate predictability are making estimates of future water demand more difficult to predict, potentially increasing the stresses on water resources and supply systems.

Localized Flooding

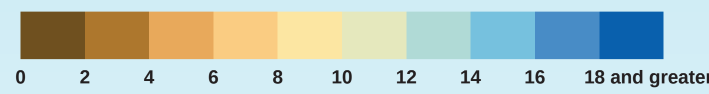
The Localized Flood Map Screening Tool gives communities the opportunity to determine what areas and assets may experience flooding during extreme and intense rain events. The tool identifies potential flood hazard areas, called Bluespots. These Bluespots are broken into categories of flood water depth. This tool aims to help cities and watersheds prioritize policy and implementation strategies. For instance, the tool could be used to target green infrastructure projects or stormwater design improvements that may reduce localized flood risk.

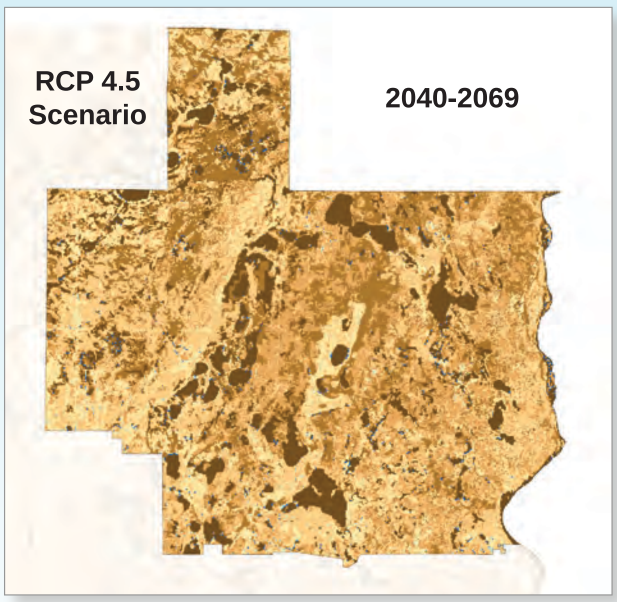


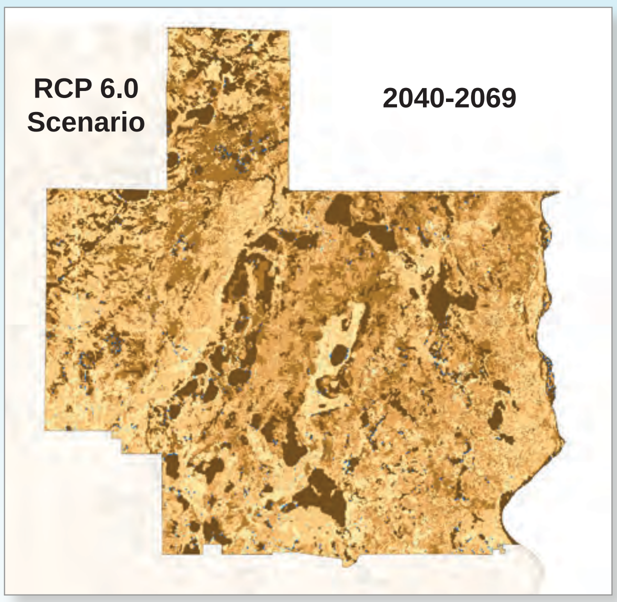


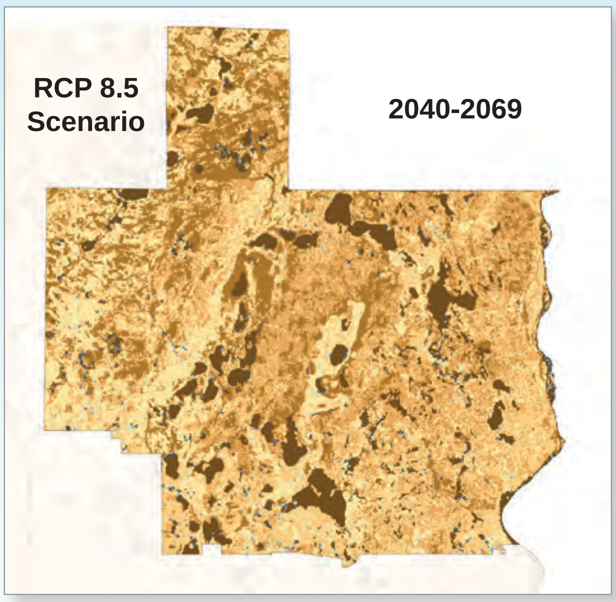
Climate Change Impacts Future Groundwater Recharge Estimates

The water that's able to infiltrate the ground to recharge the groundwater system during any single precipitation event is dependent on many factors including the amount of impervious surface, previous weather trends, and soil conditions. More precipitation does not necessarily mean there will be more groundwater. As growing seasons extend, precipitation becomes less frequent, or rain falls primarily during intense storm events, less water could make it into the ground. Recently, global climate models were used to estimate future weather conditions in the metro region. Modeling of the water available to recharge groundwater aquifers under these future climate scenarios generally shows that recharge would be lower in most places in the future.





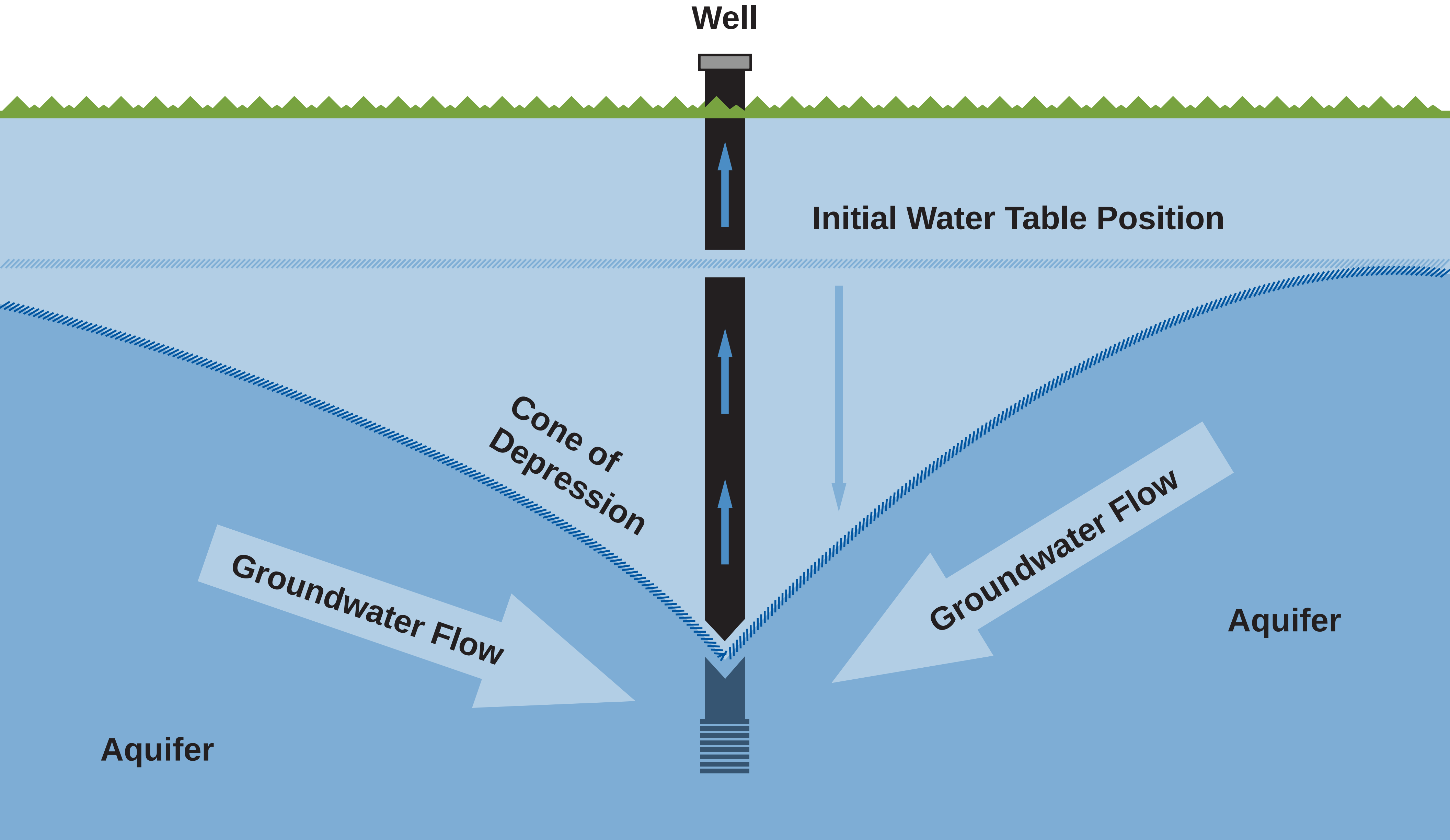




Pumping Impacts on Groundwater

When wells are pumping, they pull water from all directions within the aquifers they are open to. This alters the elevation of water around the pumping well, creating a cone of depressed water elevation. During hot summers and periods of drought, increased groundwater demand leads to more pumping and larger cones of depression. When high-capacity wells significantly draw down surrounding aquifer water levels, nearby wells may not be able to provide water, leading to conflicts between water users. If wells need to be dug deeper to access water due to aquifer drawdown, infrastructure and energy costs increase and water sources and supply systems are less sustainable.

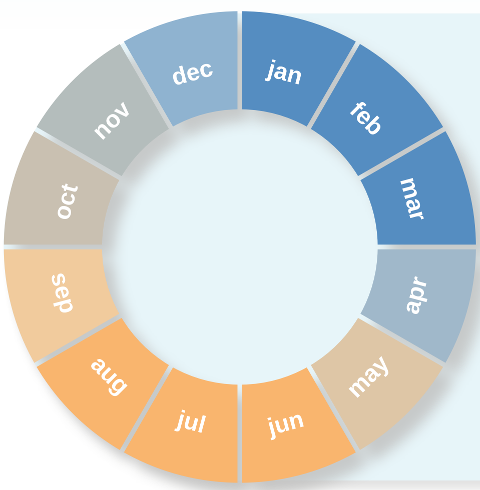
Aquifer water levels are consistently monitored in high-capacity public water supply wells by communities. Surrounding groundwater and surface water is also monitored by communities, watersheds, and state agencies. This monitoring helps to ensure water levels remain consistent, plentiful clean water is available, and that nearby wells won't be impacted during times of high demand.



Efficient Water Use

When we use more water than we need, our use is inefficient. We're not being as respectful of water or as considerate of future water needs as we can be. When we don't carefully use water, the costs of water treatment and distribution grow and water resources become stressed, particularly during hot and dry weather. Conserving water in and outside of our homes and businesses helps to build community resiliency by lowering spending and making negative impacts to our water resources less likely. When we ensure we're using water as efficiently as possible, we're helping to make clean and plentiful water available for future generations.

Calculating Seasonal Use



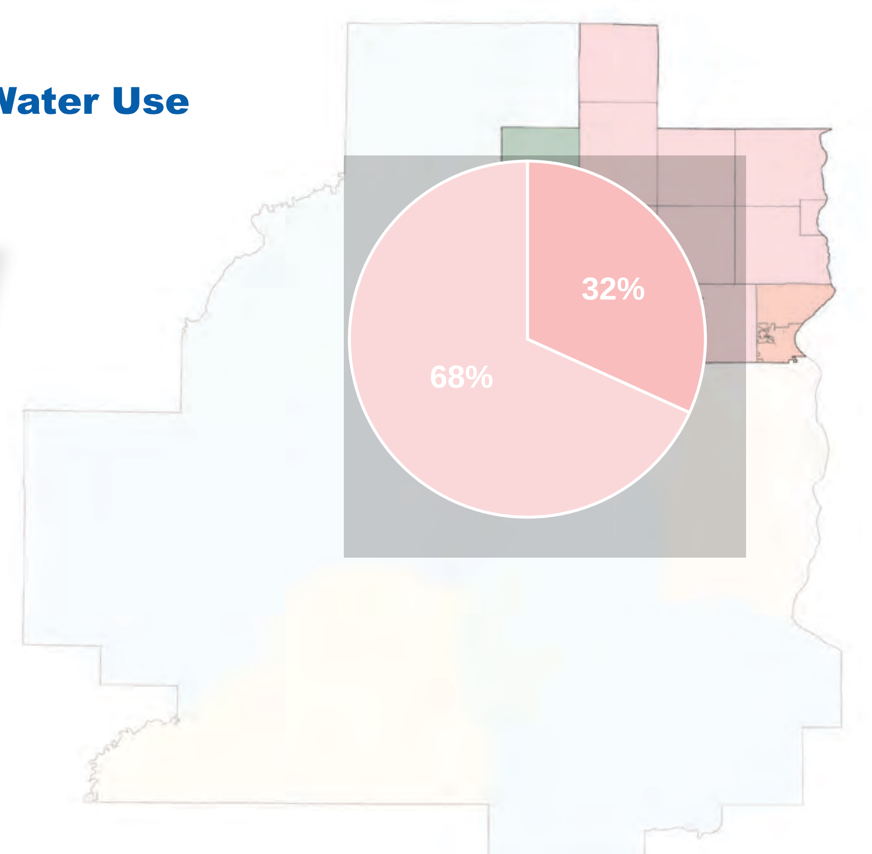
Outdoor Use / Total Use = Percent of Municipal Pumping Used Outdoors

Warm Months: (May + Jun + Jul + Aug + Sep + Oct) - Cold Months: ((Jan + Feb + Mar + Apr) + (Nov + Dec)) = **Estimated Outdoor Use**

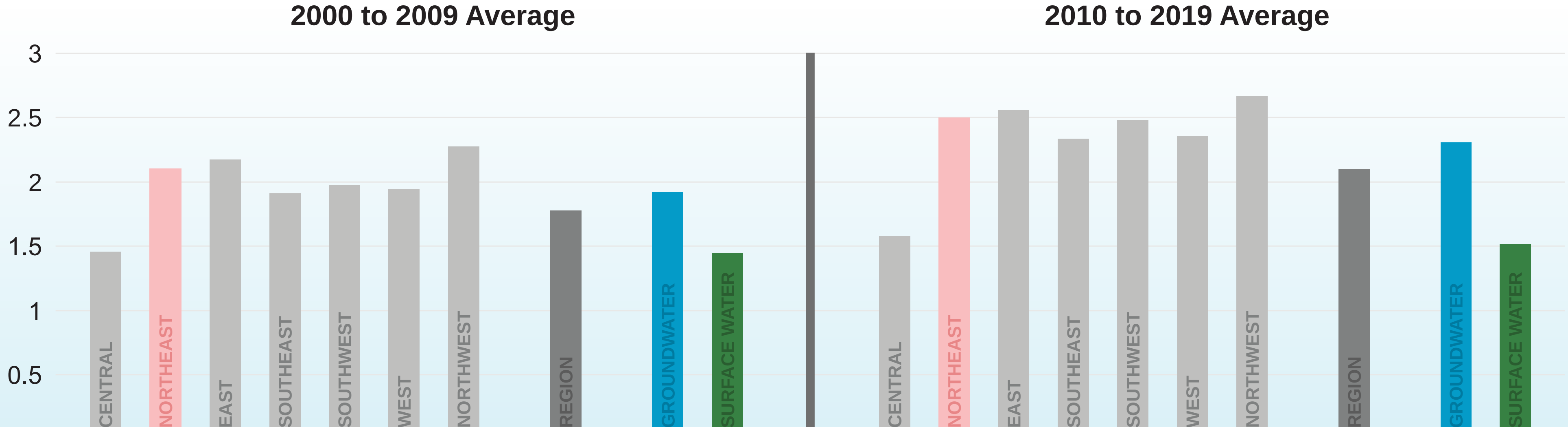
Summer: (Jun + Jul + Aug) / Winter: (Jan + Feb + Mar) = **Summer to Winter Pumping Ratio**

Estimated Outdoor Water Use

In the Northeast subregion, about 32% of water that enters municipal water supply systems is used outdoors. This is about the same as the other subregions where the primary water source is groundwater. Many homes and businesses in suburban and rural communities have larger lots than those in the cities of Minneapolis and Saint Paul and include more in-ground irrigation systems. While those two factors do not automatically cause excessive or inefficient water use, they do indicate a greater potential need for outdoor water use.



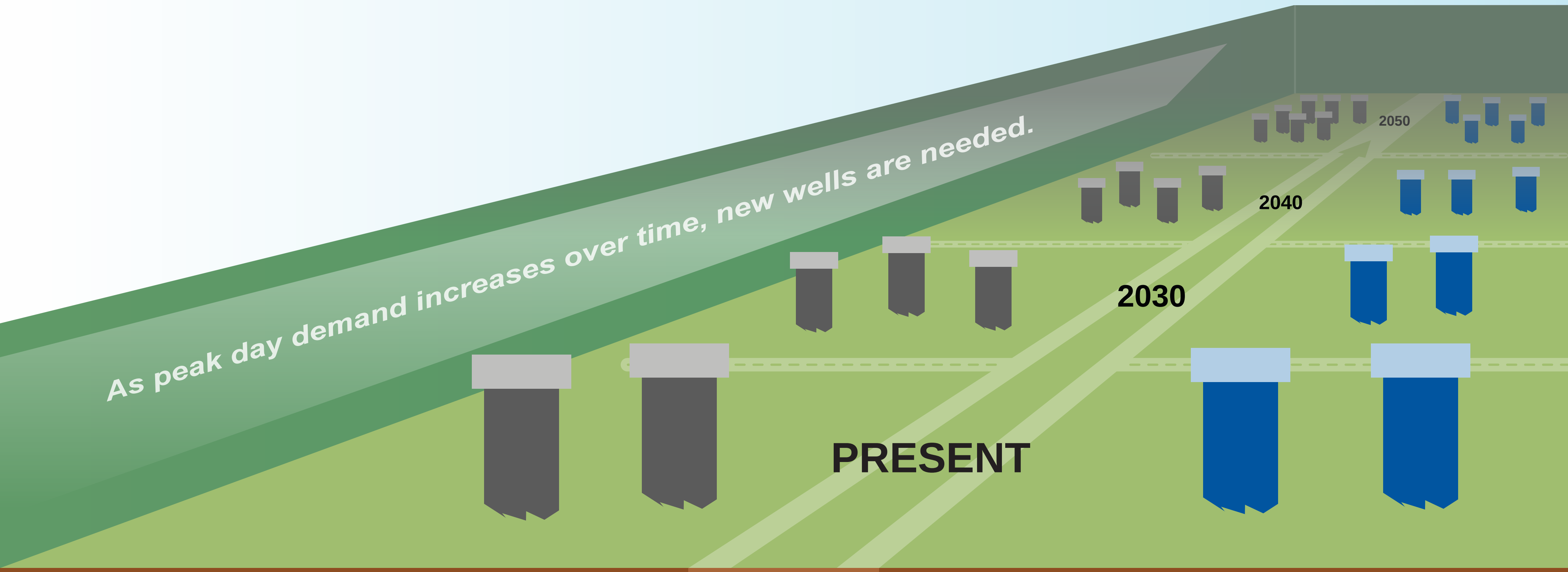
Comparing Summer to Winter Pumping



Across the metro, communities use 2-3 times as much water in the summer as the winter. In some communities, summer water use has been as high as 5 or 6 times winter usage. Hot, dry summers and inefficient outdoor water use worsen this trend.

Efficient Water Use Can Reduce Demand and Infrastructure Costs

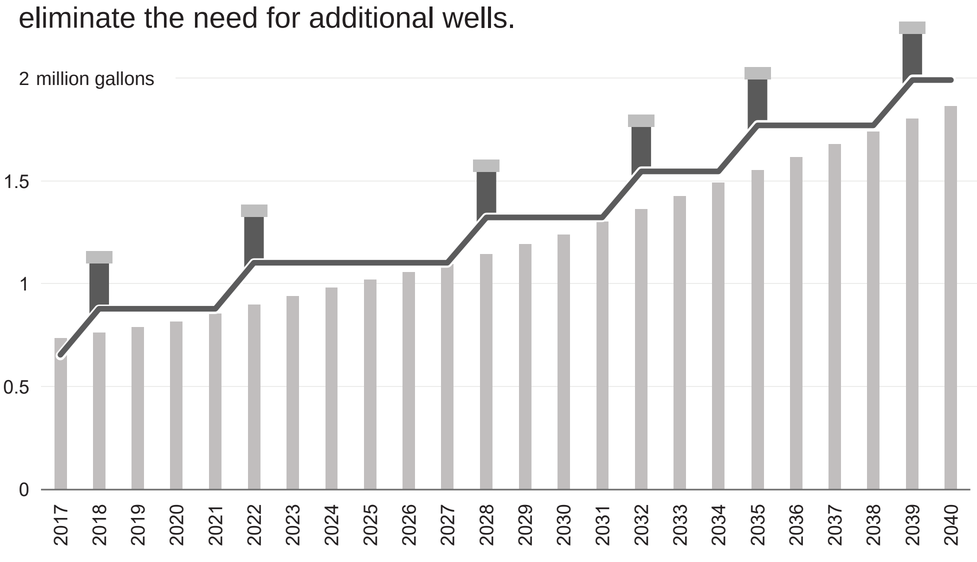
Communities with public water supply systems must have enough water available and system capacity to meet peak day demands that typically occur during the summer months. Meeting these demands can require ever-increasing infrastructure investments. Increasing efficiency, employing sound use and conservation practices, and maintaining residential and commercial infrastructure can help to limit or delay the need for more wells and lower costs.

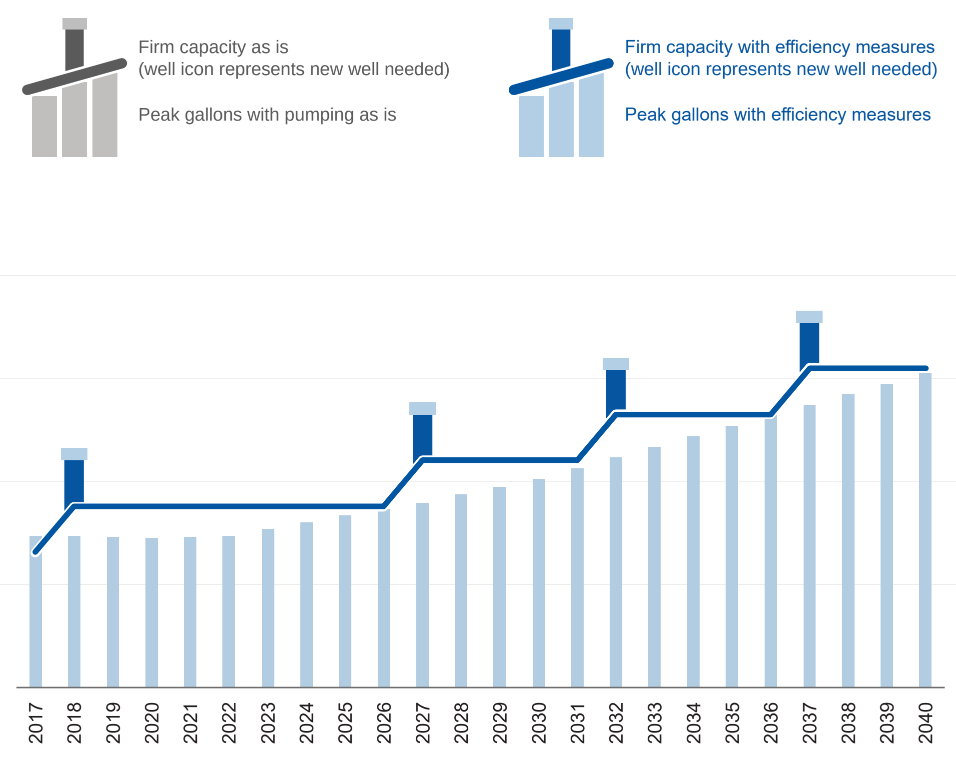


Wells needed | **Wells needed with efficiency measures**

Reducing Peak Day Demands

These figures show theoretical differences in peak day demand and infrastructure needs for a metro area community with and without implementing water conservation and efficiency activities being implemented by the community. Without conservation practices (in grey), the community would need more wells, sooner. With conservation practices (in blue), the community is able to reduce peak day demands and delay or eliminate the need for additional wells.

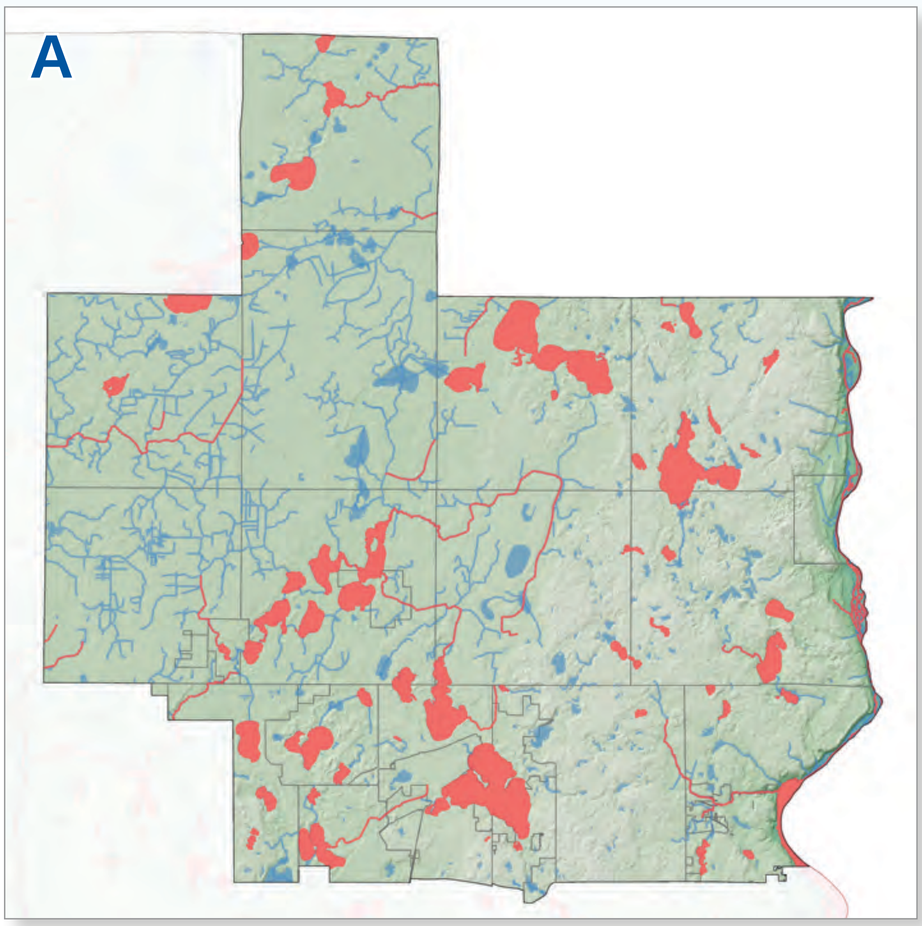




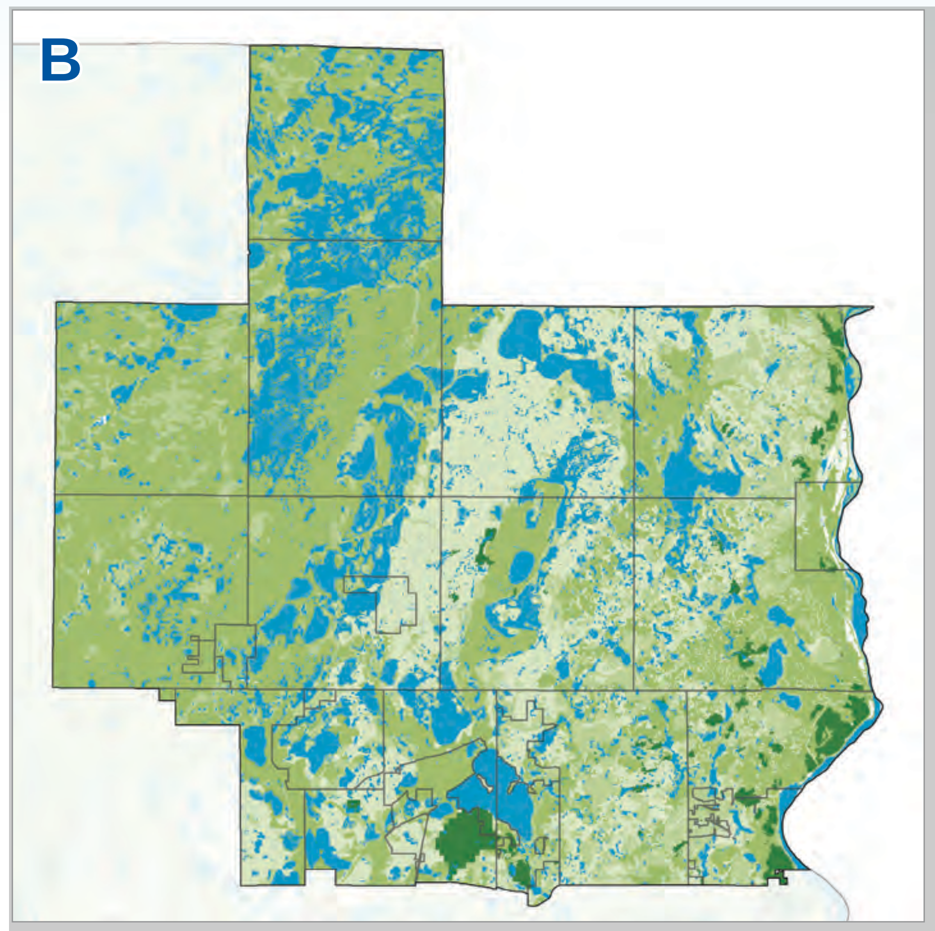
Source Water Protection

Safe and healthy drinking water starts by protecting water sources. Source water protection includes properly disposing of household chemicals and waste, cleaning up sites contaminated by past industrial and commercial activities, identifying contamination risks, and wellhead protection planning. Once pollutants enter the environment, they can be very difficult and expensive to remove. Limiting our use of chemicals, instituting best management practices, and having sound emergency response plans in place helps to protect water supplies and ensure clean water is available and affordable for current and future generations.

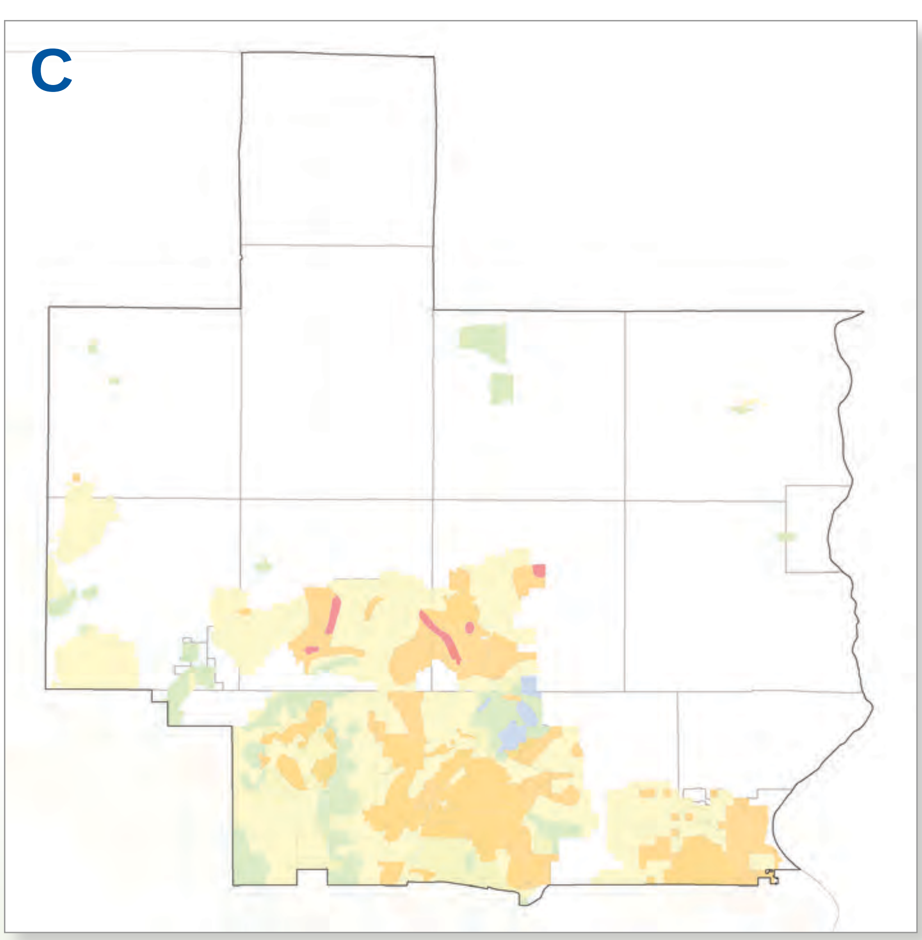
Public water suppliers ensure water is safe to drink by treating water at the source or in water treatment plants. Water is tested daily to meet state and federal drinking water standards before it can be delivered to homes and businesses. Residents and businesses with their own private wells are responsible for testing their water and maintaining their systems.



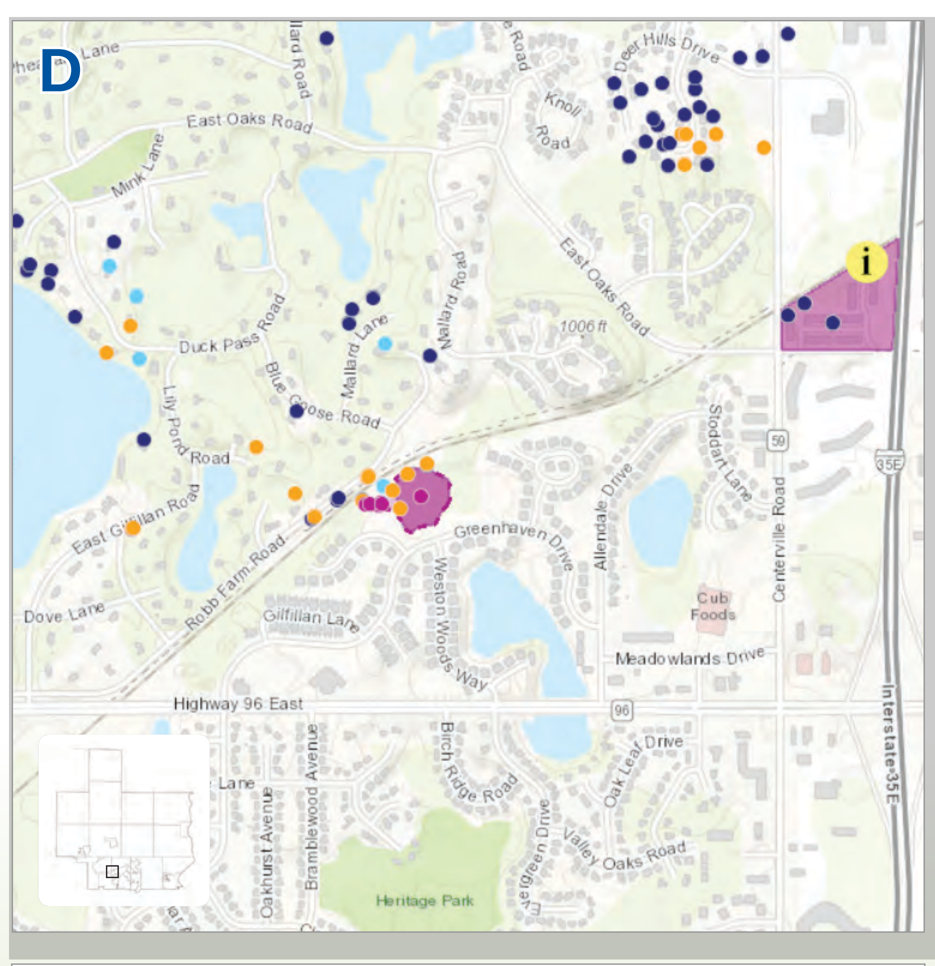
Impaired water
Other water
High
Elevation
Low



High
Moderate
Low
Very Low
Karst
Water
Bedrock at or near surface



Very High
High
Moderate
Low
Very Low



Well - Contamination above health-based guidance
Well - Contamination below health-based guidance
Well - Contamination not detected
Well - No data from last five years
Insufficient groundwater sampling data
Potential source area
High confidence
Low confidence
Groundwater area of concern

Any chemicals added to the environment in excess can pollute surface and ground waters. Everyday activities like using salt in the winter on our roads and sidewalks, spilling the gasoline or oil we use in our lawn and automotive equipment, over fertilizing lawns and crops, or spraying pesticides can contaminate water. Being responsible water stewards means limiting our use of contaminants, using safe alternatives when feasible, and considering best management practices when applying or disposing of chemicals.

A - Impaired Waterbodies

The federal Clean Water Act requires all waters of the state are assessed, with waters that don't meet water one or more quality standards added to a list of impaired waters. Minnesota water quality standards further protect surface waters by defining how much of a pollutant can be in water before it is no longer drinkable, swimmable, fishable, or other beneficial uses are limited.

Data source(s): Minnesota Pollution Control Agency

B - Pollution Sensitivity of Near Surface Materials

This map shows many areas where groundwater may be susceptible to spills due to the permeability of soils, rocks, and sediments near the surface. Sandy sediments associated with the Anoka Sand Plain, areas of karst, and shallow sediments in the eastern part of the subregion are the most vulnerable. Areas near the major rivers generally consist of relatively thin soils and sediment covering bedrock that's near the surface, making these areas more vulnerable to pollutants than others where thicker sedimentary layers cover deeper bedrock aquifers.

Data source(s): Minnesota Department of Natural Resources

C - Vulnerability of Drinking Water Supply Management Areas (DWSMAs)

DWSMAs include parcels that cover wellhead protection areas for public drinking water supplies. Pollution that enters the ground in these areas can impact water supplies. These areas often extend beyond the municipal boundaries of the communities they originate in and sometimes overlap with DWSMAs from neighboring communities. This creates water protection and land use planning challenges that require communication and collaboration between communities to address potential conflicts and risks to water supplies.

Data source(s): Minnesota Department of Health

D - Mapping and Tracking Groundwater Contamination

Contamination is addressed through state and federal cleanup programs. The MPCA's Groundwater Contamination Atlas maps and describes the testing and cleanup history of these sites. The information contained in the atlas is helpful for understanding where pollution has occurred and how contaminants have moved through the groundwater system. When making development decisions and assessing drinking water system and resource needs for communities, this information is to consider.

Data source(s): Minnesota Pollution Control Agency

Water Resource Connections & Interactions

In the Northeast Twin Cities metro, groundwater delivers essential inputs to area lakes, rivers, and streams. These surface waters are important socially, culturally, and economically. Vadnais Lake provides drinking water for Saint Paul and surrounding communities, while many others like White Bear Lake are important recreation areas. Many of these waters have strong connections to underlying aquifers. Where overlying sediments are relatively thin, water moves rapidly from the surface to bedrock. Large wetland complexes provide important habitat and help to slowly filter the surface water infiltrating into the ground that recharges groundwater supplies.

Water Resource Interactions

Water Elevations

We can see water levels, flows, and ecosystems change over time when inputs and outputs to surface waters features and the groundwater system are unbalanced. Too much water surface water can cause flooding and erosion by expanding shorelines, overflowing streambanks, and increasing streamflow. When groundwater levels are too high, water tables rise, leading to localized flooding. Likewise, to little water has consequences for the ecosystems and water supply sources, with associated socioeconomic impacts.

Water Quality

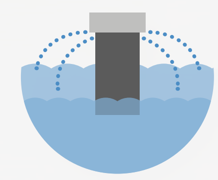
The temperature and chemistry of water can change when groundwater and surface water interact. When there's too little upwelling groundwater critical habitats like trout streams and calcareous fens warm and dry negatively impacting ecosystems. Similarly, when surface waters infiltrate and recharge groundwater or are drawn into the groundwater system through deeper connections with area surface waters, any pollutants carried by that water can enter the groundwater system impacting surrounding environments and water supplies.

Societal, Cultural, & Social Impacts

Recreation

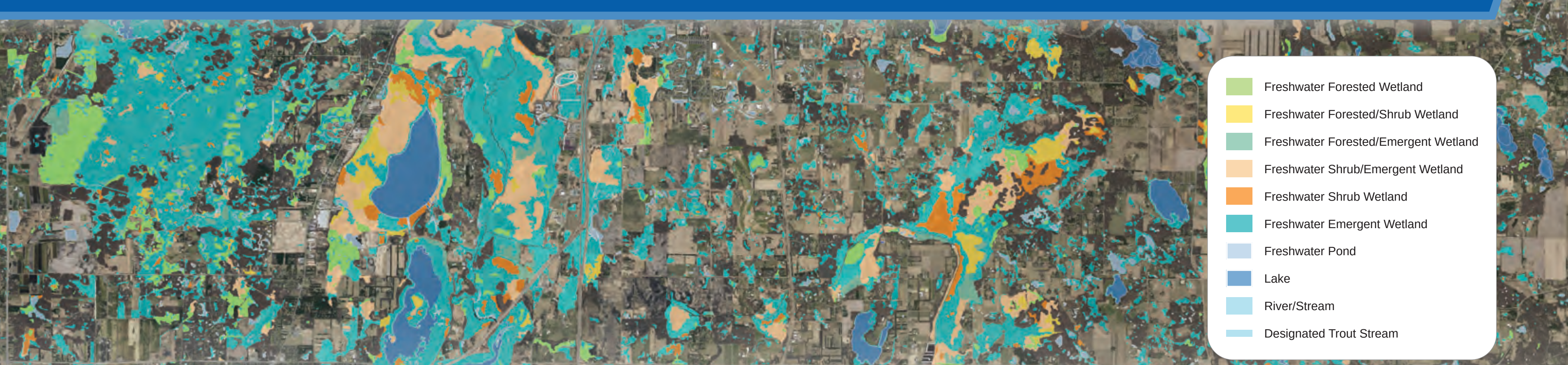
When the quality and quantity of water resources are negatively impacted, it can limit the health of ecosystems and our ability to access the services (fishing, boating, swimming, mental and physical health) recreational waters provide. Nearby groundwater use can impact surface waters in some areas, particularly during the summer or times of drought when more water is used, and water resources are stressed. These changes can have significant economic, social, cultural, and political costs.

Infrastructure

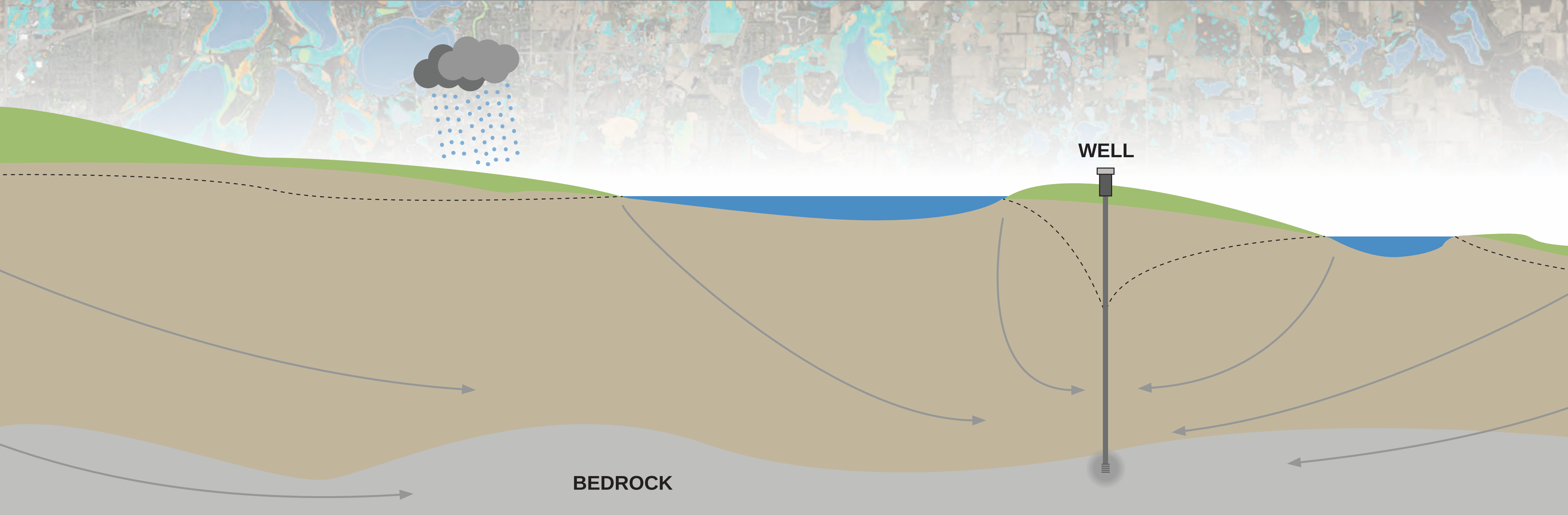


When the connections between and interactions of groundwater and surface water change and bring about associated effects on water quality and quantity, the water infrastructure can be impacted. Whether it's the pipes that convey water supply to our homes or wastewater away from our homes, or conduits that connect area surface waters, or water supply wells, the lifespan and function of these engineered systems can be impacted. Identifying how connections between the surface and groundwater systems can be managed to increase the resiliency of water infrastructure is an important sustainable planning and water management consideration.

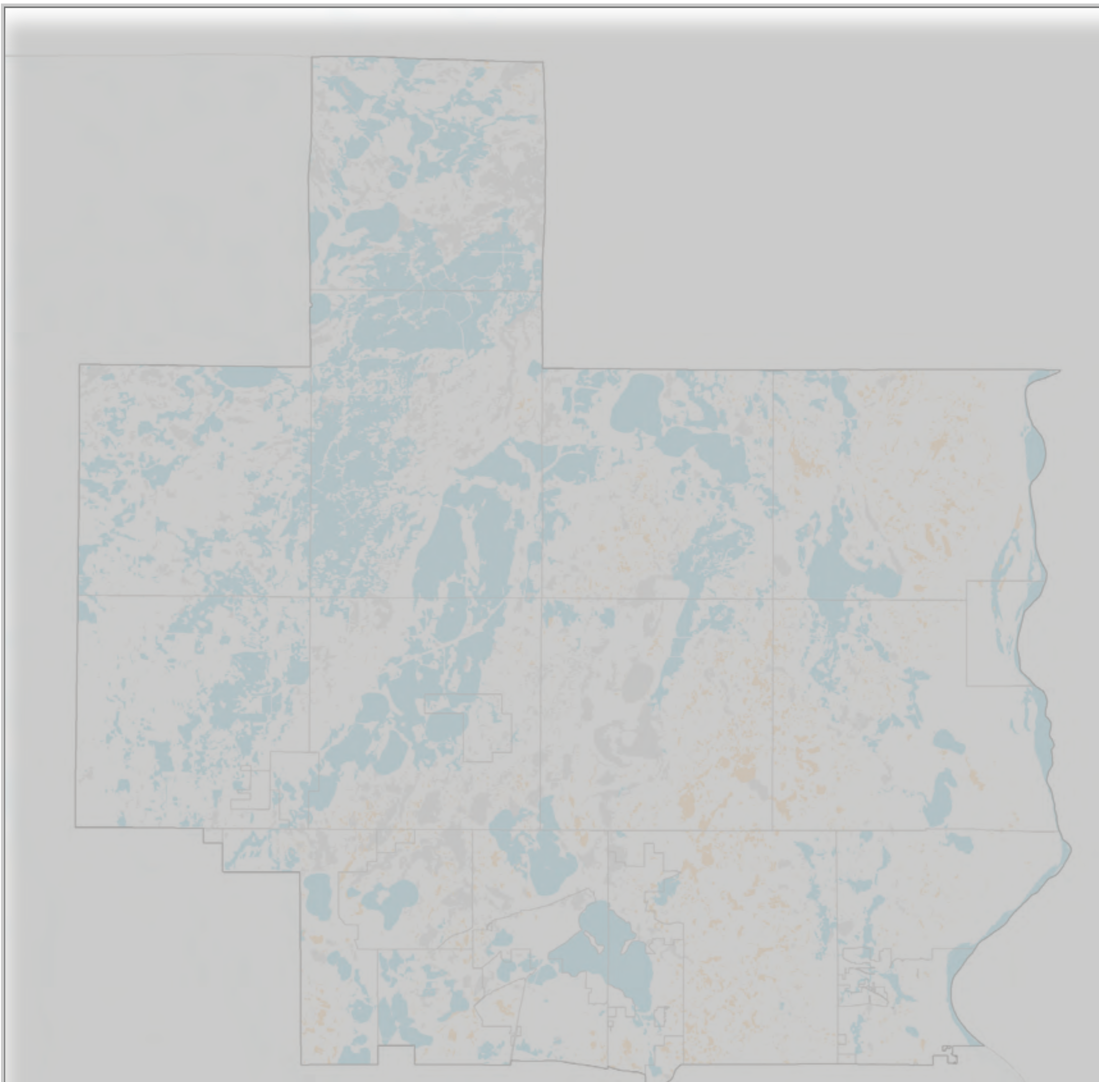
Understanding how and where surface water and groundwater interact is essential to sustainably manage water and ensure its viability for the future. Negative impacts to surface water quality or quantity can impact groundwater and vice versa. These impacts can have lasting effects on communities and water resources. However, by identifying these interactions and studying where water quality or quantity have been impacted, we can better manage water as an integrated system.



Wetland areas are unique parts of the landscape that provide vital habitat for plants and animals, benefit water quality, and offer recreational opportunities. Many wetlands store water at the surface for some period of time, allowing water to slowly infiltrate into underlying sediments. Sandy sediments near the surface in Anoka and Washington Counties allow for rapid infiltration of surface water. Buried sand and gravel aquifers used for private and community water supplies often have a strong connection to nearby lakes and wetland complexes. Over the past 150 years, many of the wetlands in Minnesota have been drained and lost to development and agricultural use. Preserving and rehabilitating these essential parts of the landscape helps to make our water resources more sustainable and resilient to stresses like development pressure and climate change.



As this topic has gained more attention in recent years, a need has been identified to better understand how and where these interactions are likely to lead to negative changes to either surface water features or groundwater aquifers. Negative impacts can have lasting impacts on communities and water resources. To be proactive in addressing these challenges we (water managers, planners, regulators, and users) need to understand how and where these interactions are likely to occur.

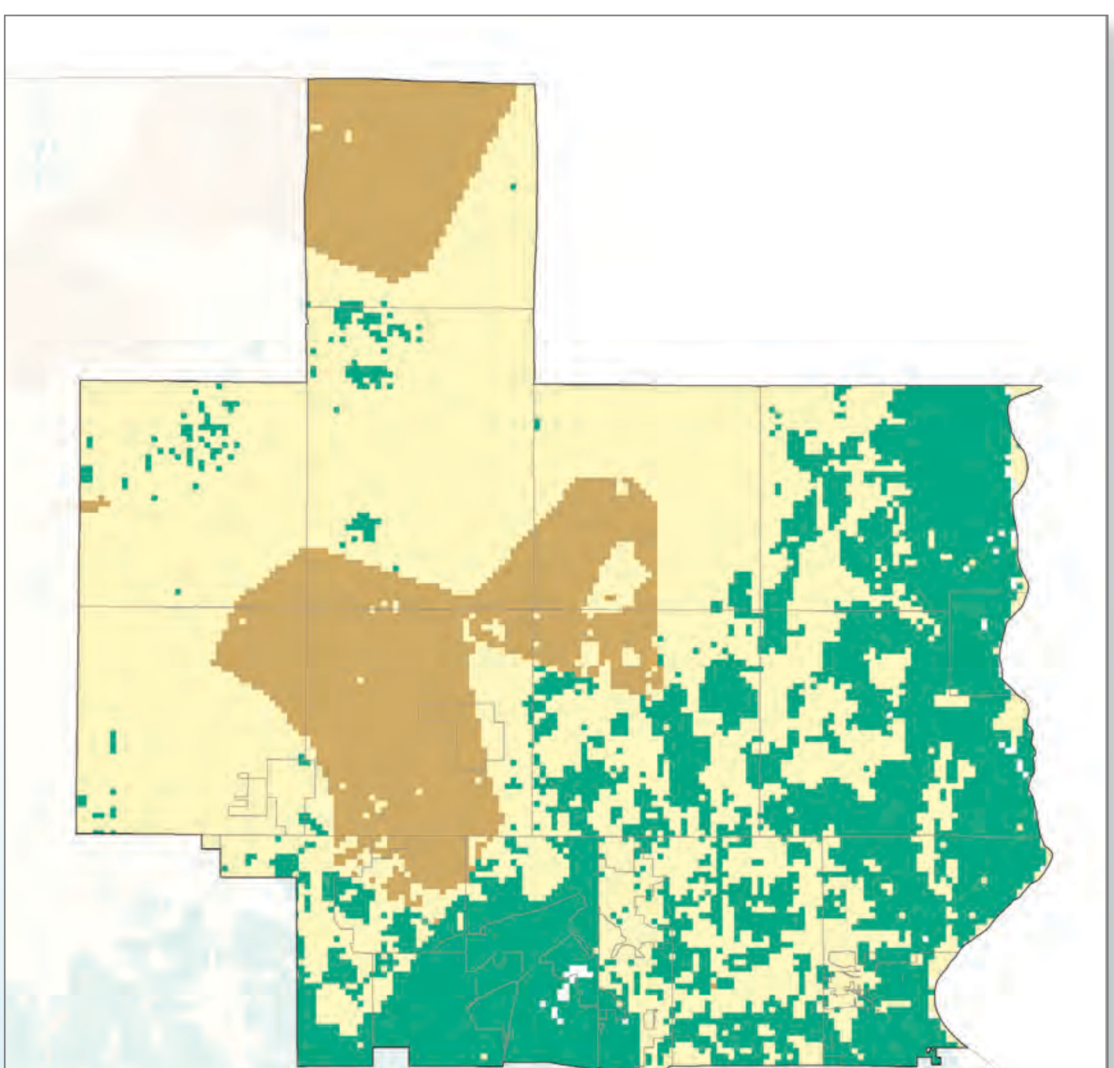


Data source(s): Metropolitan Council

Groundwater and Surface Water Connectedness

Many of the lakes, streams, rivers, and wetlands in the Northeast subregion are connected with groundwater. Groundwater is the foundational input for most surface waters in the area. Upwelling groundwater discharges to rivers and streams, maintaining flows. Likewise, the sediments at the bottom of some area lakes are in close contact with bedrock, allowing for water to easily move from the surface to sources that may be used for water supply. Understanding which surface waters and groundwater are connected helps to better manage water resources and plan for sustainability. The Anoka Sand Plain extends into this area of the metro. Surface waters in these areas are closely linked with sandy surficial aquifers.

- Connected
- Disconnected
- Indeterminate



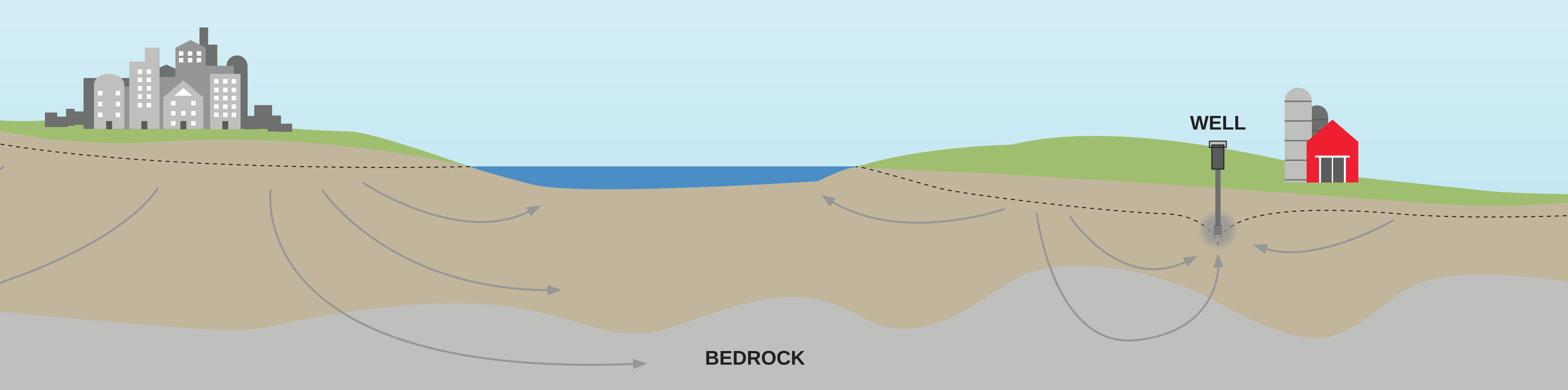
Data source(s): Metropolitan Council

Surface Water – Bedrock Interaction Potential

Across much of the Northeast subregion, there is a strong hydraulic connection between the surface and bedrock aquifers, particularly in Washington County moving eastward towards the St. Croix River. Bedrock is relatively shallow in this area and overlying sediments are relatively thin, allowing water from the surface to easily move from the surface to bedrock.

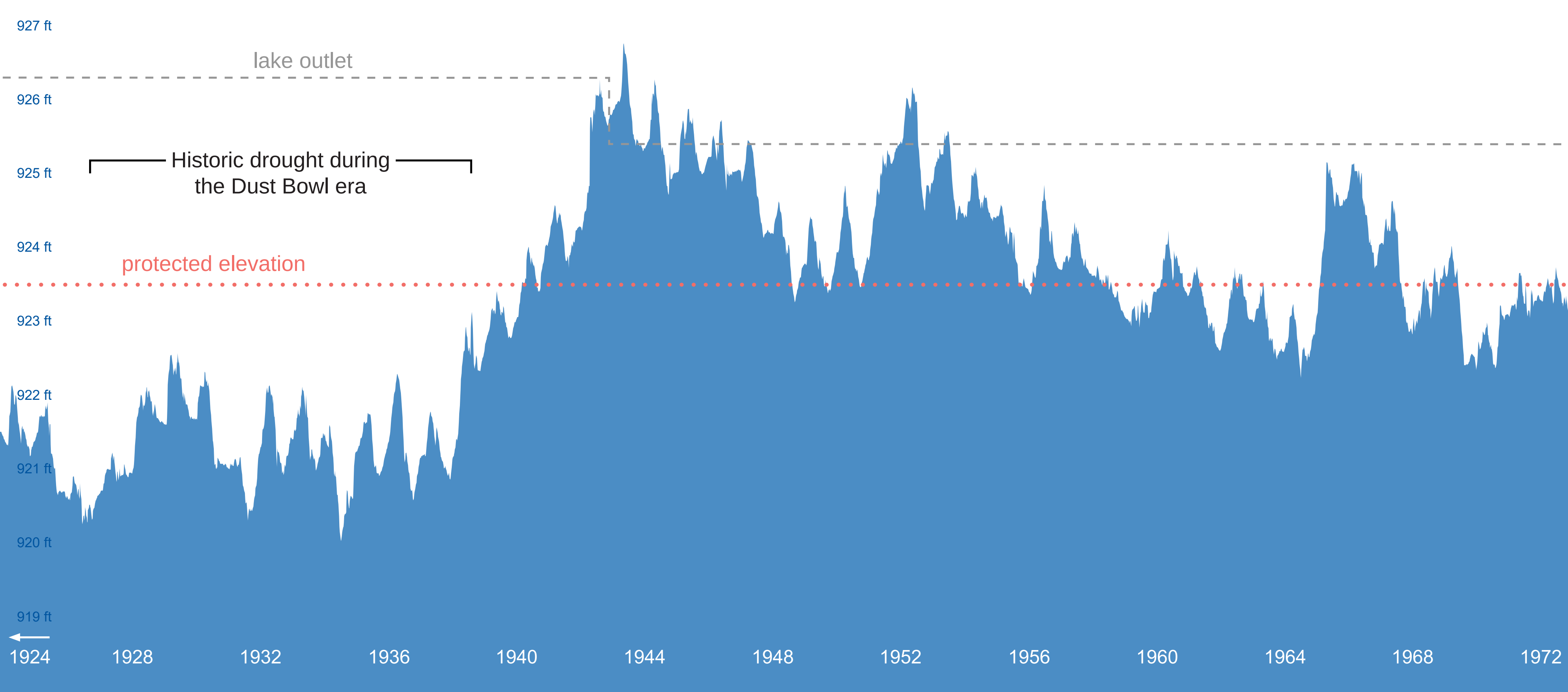
Areas that are blank on this map could not be assessed due to a lack of data or bedrock being present at the surface. This usually occurs along the major rivers in the Twin Cities metro.

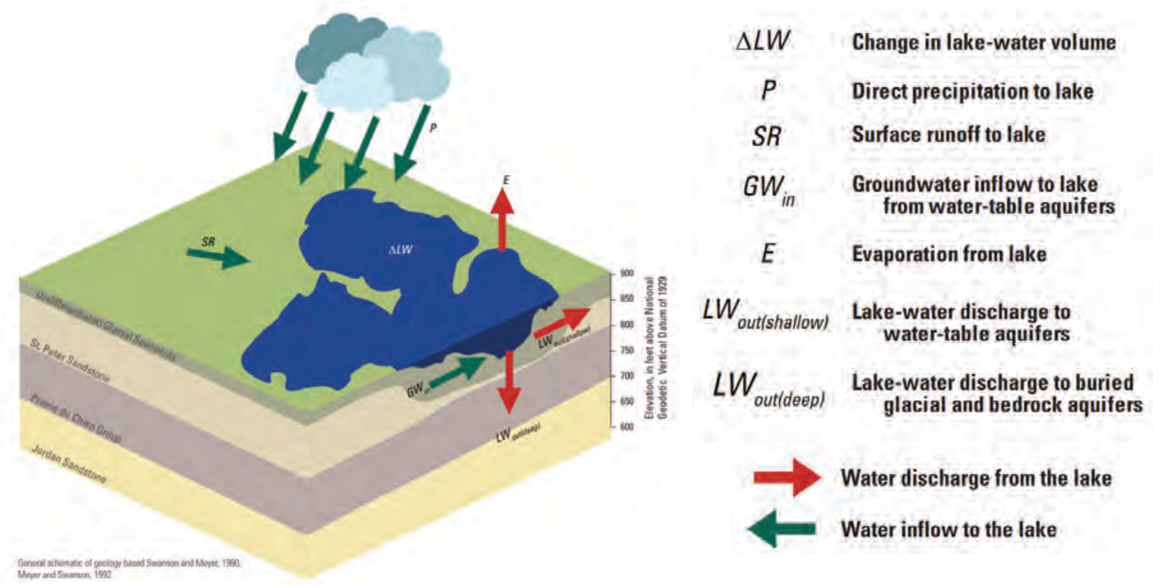
- Lower
- Indeterminate
- Higher
- Data Unavailable



White Bear Lake Level, 1924-2021

The elevation of water in White Bear Lake fluctuates over time. The lake is relatively large and has a comparatively small lakeshed, meaning that during periods of drought limited inputs are likely to lead to a lower water level. Prior to 1978 lake level was maintained with additions of groundwater. Over recent decades, increased development and population growth, warmer summers, and increased irrigation have led to more groundwater usage and the record low lake levels observed in 2013. Some of the lake level change can be attributed to lower inputs, but not all, leading to the conclusion that nearby groundwater pumping was contributing to lower lake elevation over time.





How Does Lake Level Change?

White Bear Lake is unique in many ways. It's a relatively large lake with a comparatively small drainage area, that's been developed over the past century. This means water inputs to the lake can be limited, particularly during hot, dry summers and periods of droughts. Inputs include direct precipitation, surface runoff, and groundwater from the water table. Outputs from the lake include evaporation, discharge to the water table, and discharge to deeper, buried glacial sediments and bedrock aquifers.

Data source(s): United States Geological Survey

Why Here? Looking Closer at White Bear Lake's Anatomy

White Bear Lake lies above two distinct glacial lithologies (sediments). Des Moines lobe (Grantsburg sub-lobe) sediments were deposited over Superior lobe sediments that were laid down beneath an earlier Laurentide Ice Sheet advance around 12 -16,000 years ago. These materials are mixed to some extent, with Grantsburg deposits tending to be more calcareous than Superior lobe deposits. White Bear Lake is surrounded by sandy and poorly sorted sediments. At the surface, bordering the lake are silt, clay, and sand deposits consistent with lake basins. The thickness and composition of surrounding sediments promotes connections between the lake and groundwater. Sediments forming the lakebed have been slowly building up over the past 10,000 years. The lakebed is about 80 feet from the surface in the deepest part of the lake, but much of the lake is shallow (less than 15 ft.), leading to dramatic shoreline changes when lake level declines.