Water quality assessment

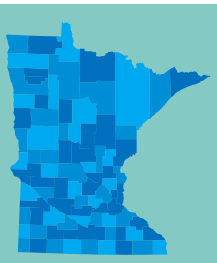
November 2023

2024 Minnesota water quality

Report to Congress of the United States

Clean Water Act Section 305(b) narrative report

MINNESOTA POLLUTION CONTROL AGENCY



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Foreword

2024 Integrated Report

General Report to the Congress of the United States Pursuant to Section 305(b) of the 1972 Clean Water Act

Beginning in 2004, the Minnesota Pollution Control Agency began providing the Water Quality Integrated Report to the U.S. Environmental Protection Agency. This report is intended to combine the requirements of the Clean Water Act Sections 305(b) and 303(d) through the following format by a biennial abbreviated narrative report.

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Abbreviations, Acronyms, and Definitions

AUID	assessment unit identification
WID	water unit identification
BCC	Bioaccumulative Chemicals of Concern
BCG	Biological Condition Gradient
BOD	5-day Biological Oxygen Demand
CARL	name of MPCA's assessment database
CC	Chronic Criteria
chl-*a*	Chlorophyll-*a*, corrected for pheophytin
CS	Chronic Standard
CWA	Clean Water Act
DC	Domestic consumption
DNR	Minnesota Department of Natural Resources
DO	Dissolved oxygen
EPA	U.S. Environmental Protection Agency
EQuIS	Environmental Quality Information System
FCMP	Fish Contaminant Monitoring Program
GLI	Great Lakes Water Quality Initiative
HDS	Human Disturbance Score
HH-WQS	Human Health-based Water Quality Standards
IBI	Index of Biotic Integrity
IWM	Intensive watershed monitoring
LTRMP	Long Term Resource Monitoring Program
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
NHD	National Hydrographic Data
PCB	Polychlorinated biphenyls
PJG	Professional Judgment Group
PFOS	Perfluorooctane sulfonate
QA/QC	Quality Assurance/Quality Control
RES	River Eutrophication Standards
RNR	River Nutrient Region
TALU	Tiered Aquatic Life Uses
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSS	Total Suspended Solids
USGS	United States Geological Survey
WAT	Watershed Assessment Team
WQS	Water Quality Standards

Revisions from past document

- Made updates to staff contact information.
- Updates to new references/reports since 2022

Part A. Executive summary

The Minnesota Pollution Control Agency (MPCA) surface and groundwater monitoring activities provide critical information to support our mission of helping Minnesotans protect the environment. To prevent and address problems, decision-makers need good information about the status of the resources, potential and actual threats, options for addressing the threats, and data on how effective management actions have been. The MPCA primarily follows a 10-year rotation for monitoring and assessing waters of the state on the level of Minnesota's 80 major watersheds. Some monitoring – namely monitoring of toxic parameters – continues to occur on a statewide basis. Assessment of those parameters is done statewide every 2 years, to reflect the monitoring design.

Sections 305(b) and 303(d) of the Federal Clean Water Act (CWA) call for states to report on their waters to help measure progress toward the national goals of fishable and swimmable waters. Data analyses determine the extent that all waters are attaining water quality standards, identify impaired waters and the need to be added to the 303(d) List, and identify waters attaining standards that can be removed from the List. Note that Minnesota's 303(d) List is included in a larger document called the Impaired Waters List (IWL), and will be referred to as such.

Results of 305(b) water quality assessments are submitted to US EPA (EPA, HowsMyWaterway)

Water body specific information is readily available on the MPCA website (MPCA, Surface Water Data Viewer).

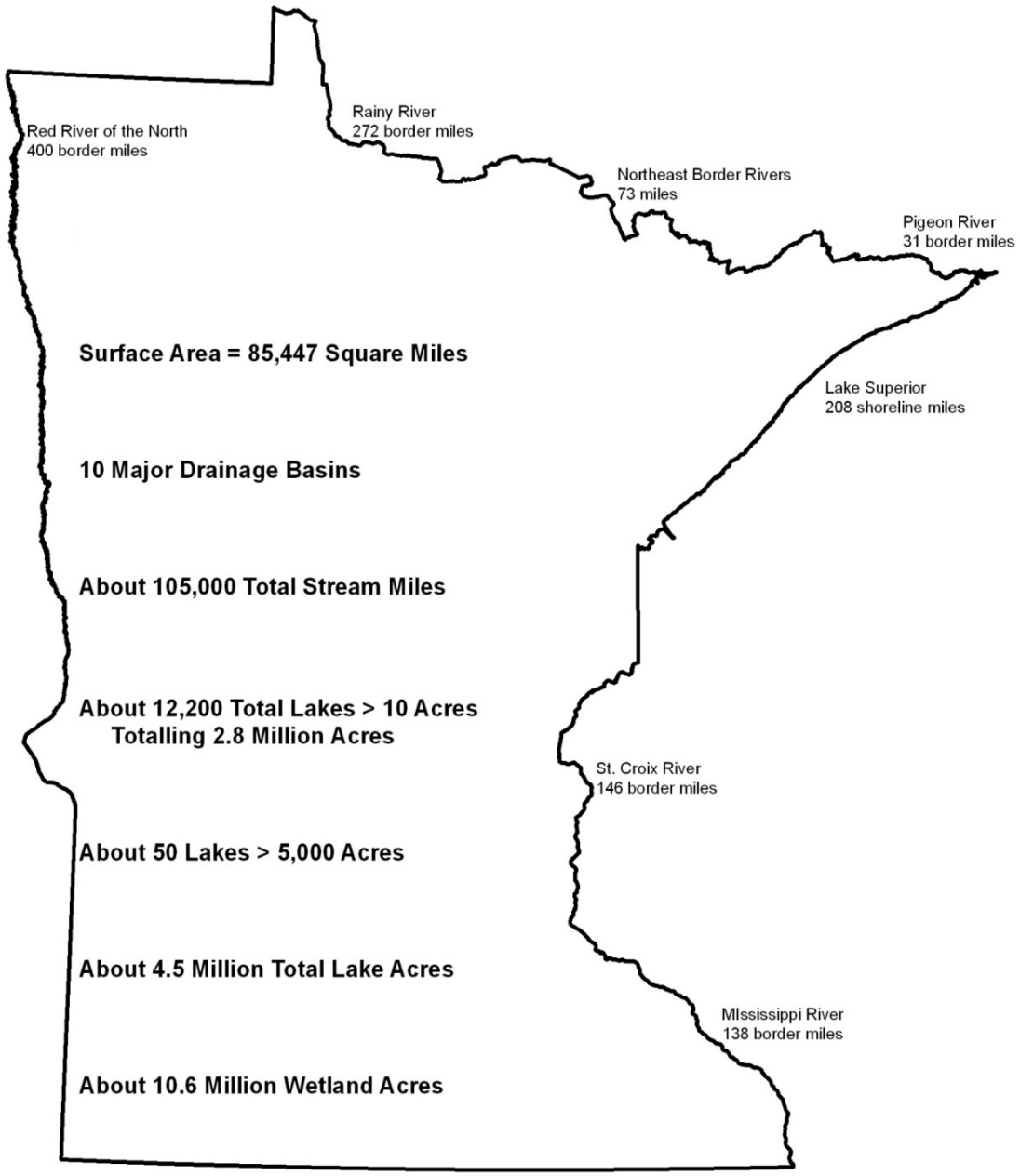
Part B. Background information

B.1. Total waters

B.1.1. State background information

In Figure 1, the estimates of background information for water bodies were developed from 1:24,000 scale National Hydrography Dataset, except for the estimate for wetland acres. The total lake acres' estimate includes the Minnesota portion of border lakes and Lake Superior. Wetland acres' estimates were obtained from the National Wetland Inventory dataset, which is not derived from 1:24,000 source data; rather it was interpreted from aerial imagery at a resolution that makes it appropriate for use at 1:24,000 or smaller.

Figure 1: Minnesota background information and border waters



B.1.2. Watershed approach

Minnesota's Clean Water Legacy Act (CWLA) provides a policy framework and resources to state and local governments to accelerate efforts to monitor, assess, and restore impaired waters, and to protect unimpaired waters. The MPCA primarily follows a 10-year rotation for monitoring and assessing waters of the state on the level of Minnesota's 80 major watersheds (MPCA, Watershed approach to water quality, 2023). Some monitoring – namely monitoring of toxic parameters – continues to occur on a statewide basis. Assessment of those parameters is done statewide every 2 years, to reflect the monitoring design.

The watershed approach provides a unifying focus on the water resource as the starting point for water quality (WQ) assessment, planning, and results measures. It provides a predictable schedule to monitor all of the state's major watersheds while accomplishing the following:

- Provides advance notice to interested stakeholders, local governments, and volunteers participating in monitoring plans.
- Allows local groups to conduct monitoring efforts in conjunction with or in-between agency monitoring efforts.
- Informs stakeholders when Total Maximum Daily Load (TMDL) study or protection strategy work will begin in their area.
- Insures that comprehensive information on the status of WQ and WQ management efforts is collected, evaluated, and provided to state and local partners at least once each decade.

This approach may be modified to meet local conditions, based on factors such as watershed size, landscape diversity and geographic complexity (e.g., Twin Cities Metro Area).

B.2. Water program areas

B.2.1. Wastewater overview

The overall goal of the wastewater programs, to assure that discharge of treated wastewater to surface waters and groundwater, is protective of public health and the environment. To meet these overall goals, the MPCA and its partners conduct technical assistance, develop rules and policy, permitting, land application approvals, limits determination, environmental reviews, technical reviews, compliance and enforcement, financial assistance, training, certification and licensing. The MPCA conducts this work with partners that include the municipal wastewater, water treatment, industrial wastewater and industrial stormwater facilities; local units of government (LGU), U.S. Environmental Protection Agency (EPA), other funding agencies and pumpers, installers, and inspectors of individual sewage treatment systems (MPCA, *Wastewater permits*).

B.2.1.1. TMDLs

The MPCA continues to complete TMDL projects containing wastewater Waste Load Allocations (WLAs) assigned to industrial and municipal dischargers. The agency ensures that water quality based effluent limits included in National Pollutant Discharge Elimination System (NPDES) permits are consistent with EPA approved TMDL WLAs. Multiple individual TMDLs are frequently associated with each TMDL project (MPCA, *TMDL Projects*, 2023).

B.2.1.2. Permitting

MPCA water quality permits establish specific limits and requirements to protect Minnesota's surface and groundwater quality. Permits are regularly reviewed and updated as they expire, allowing the MPCA to incorporate new information about the impacts of pollutants to the environment in subsequent permits. Permits are enforced through a combination of self-reporting (reports to the MPCA, U.S. EPA, or both) and compliance monitoring (MPCA, *Wastewater permits*).

The MPCA continues to evaluate and develop process improvement projects to meet the statutory goal of reissuing permits within 150 days of permit application receipt. The trend continues to show permit timeliness meeting the goals for 90% of permit actions.

B.2.1.3. Pretreatment

Pretreatment is the treatment of wastewater by commercial facilities and other non-domestic wastewater sources to remove harmful pollutants before the wastewater is discharged to a municipal sewer system. The Code of Federal Regulation in title 40 Part 403 defines implementation of pretreatment programs and describes the responsibility of the EPA, states, public treatment facilities, and industrial users in protecting infrastructure, workers, and the environment. The communities approved to implement pretreatment programs issue industrial user permits, conduct inspections of industrial and commercial sources, sample industrial discharges, and enforce regulations.

The MPCA maintains routine program oversight, including review of annual reports, annual inspections of the delegated publicly owned treatment plants, and three audits (MPCA, *Wastewater pretreatment*, 2023). The Agency also supports enforcement and annual report reviews.

B.2.1.4. Financial assistance program and policy development/implementation

The MPCA prepares the Project Priority List to determine funding priorities for Clean Water State Revolving Fund Loans and Point Source Implementation Grants.

Minnesota's State Revolving Fund is managed by the Minnesota Public Facilities Authority, a board of six state commissioners from the departments of Employment and Economic Development, Finance, Health, Agriculture, Transportation and the MPCA. The Public Facilities Authority and MPCA staff jointly administer the wastewater components of the State Revolving Fund. The PFA is responsible for the financial elements of the program, while the MPCA is responsible for its environmental and technical components (MPCA, Apply for financial assistance – Clean Water Revolving Fund).

B.2.1.5. Training and certification

In Minnesota, wastewater treatment operators must be certified in order to operate and maintain a wastewater treatment facility. The MPCA administers the certification program and provides workshops and conferences (MPCA, Wastewater training and certification, 2023).

Point of Contact: Ryan Anderson

B.2.2. Nonpoint source pollution control

B.2.2.1. Statewide watershed approach

Several state agencies are involved in carrying out Minnesota’s multiple programs addressing nonpoint source (NPS) pollution based on the statewide watershed approach (MPCA, Watershed approach to water quality). The MPCA is responsible for monitoring and assessment, completing TMDLs and developing Watershed Restoration and Protection Strategies (WRAPS). The Board of Water and Soil Resources (BWSR) works with local governments to develop comprehensive local watershed

management plans based on WRAPS and TMDLs (BWSR, 1W1P) through the One Watershed One Plan (1W1P) process. 1W1P is a criteria-based, systematic process to prioritize Minnesota Clean Water Fund nonpoint source implementation investments (MN Legacy, Clean Water Fund).

WRAPS reports summarize priority areas for targeting actions to improve water quality, identify point sources, and identify nonpoint sources of pollution with sufficient specificity to prioritize and geographically locate watershed restoration and protection actions. Reports include an implementation table of strategies and actions that are capable of cumulatively achieving needed pollution load reductions for point and nonpoint sources.

The implementation strategies, including associated scales of adoption and timelines, are based on what is likely needed to meet the water quality goals for restoration and protection. The strategies are the result of previous watershed reports completed in the watershed approach context, watershed modeling efforts, and professional judgment based on what is currently known and they should be considered approximate. Also, many strategies are predicated on building social readiness and sufficient resource support including needed funding being secured. As such, the proposed actions outlined are subject to adaptive management—an iterative approach of implementation, evaluation and course correction.

Point of Contact: Miranda Nichols

B.2.2.2. Nonpoint source management program plan

The Minnesota Nonpoint Source Management Program Plan (Plan) describes the management program "for controlling pollution added from nonpoint sources to the navigable waters within the State and improving the quality of such waters" as required by Section 319 of the Federal Clean Water Act (CWA) (CWA Sec. 319 (b) (1)). The Plan is required for Minnesota to receive Section 319 program and pass-through grant funding from EPA. The Plan focuses on addressing nonpoint source (NPS) pollution, including phosphorus, nitrogen, sediment, bacteria and other contaminants.

Minnesota is required to comply with these federal requirements in order to remain eligible for federal funding to pass through to local implementers. The Plan is written to comply with EPA's Nonpoint Source Program and Grants Guidelines for States and Territories (2013).

In addition to complying with EPA guidelines for Section 319 funding, the Plan provides an overview of the other local, state, federal, and private programs that address NPS pollution in Minnesota. The programs provide funding and assistance to landowners, producers, and LGUs projects (MPCA, *Water quality initiatives*, 2023).

There are numerous funding sources for NPS pollution implementation for landowners, producers, and LGUs from local, state, federal, and private sources. Minnesota's Plan highlights the state and federal agencies' grants and other programs for funding water quality improvement projects (MPCA, *Water quality initiatives*, 2023).

Point of Contact: Miranda Nichols

B.2.2.4. Federal Clean Water Act - Section 319

Section 319 of the CWA provides funding for NPS program and implementation activities. Funds are split equally between program support and watershed implementation project funding as required by EPA program guidance.

Section 319 Program funds support the MPCA staff and management who provide direction for the program; work in watershed management and protection; program development and management; environmental analysis and monitoring; and support services. The MPCA matches these staff positions

dollar-to-dollar and with similar functions to further leverage the Section 319 funds. These positions provide the science, support, and management needed to implement the NPSMP and the Section 319 Program. The stressor identification reports, the monitoring and assessment reports, TMDLs, WRAPS reports, and local water plans written provide the foundation for the detailed Section 319 Small Watersheds Focus Grant NKE plans. The staff also provide the technical assistance and support to implement on-the-ground work through the Section 319 Small Watersheds Focus grants. Section 319 Program funds augment significant state investments in understanding and addressing NPS pollution.

Section 319 project funds are provided to local units of government for implementation of actions and practices for the restoration of water quality problems due to NPS pollution, and protection of unimpaired waters from NPS pollution through the Section 319 Small Watersheds Focus Program. These funds support and provide the stability needed to implement the systematic and detailed approach of the nine key element (NKE) Plans. Section 319 grant funds can only be used for NPS pollution related activities, in areas with approved watershed-based plans that meets NKE, as described in Section 2.6 of the EPA document, 2008 Handbook for Developing Watershed Plans to Restore and Protect Our Waters.

B.2.2.5. Clean water partnership

The MPCA provides low-interest loans through the state Clean Water Partnership program to local units of government and other organizations for implementing nonpoint-source best management practices and other activities that target the restoration and protection of water resources such as lakes, streams, or groundwater aquifers. Funds can be used for any non-point BMPs, including wellhead protection, inflow and infiltration (residential laterals), green infrastructure, SSTS upgrade/replacements, wetland or stream restorations, and many more. Eligible applicants include Tribes, townships, cities, counties, watershed districts, watershed management organizations, or joint powers board whose members are townships, cities, or counties. Details are found at the Clean Water Partnership and Section 319 funding website.

B.2.2.5. Civic engagement

Since watershed protection and restoration depends largely on changing the behaviors of citizens who live on the land, it will require a real commitment at the community level to address problems in our lakes and streams. Watershed assessment and planning must be much more inclusive, with the public playing a much more active role, beginning early in the planning process. Citizens must be involved in framing the problem, developing solutions and taking responsibility for implementation (MPCA, *Civic Engagement*).

Point of Contact: Miranda Nichols

B.2.3. Stormwater program

Section 402 of the CWA established the NPDES permit program to specifically control the discharge of pollutants from point source dischargers to waters of the United States. A 1987 amendment to the CWA required stormwater discharges from municipal, construction, and industrial sources to be permitted under the NPDES permit program. The amendment was to be implemented in two phases, Phase I in the early 1990s and Phase II in March 2003 (MPCA, *Stormwater Permits*).

B.2.3.1. Municipal stormwater

A municipal separate storm sewer system (MS4) is a conveyance or system of conveyances (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains, etc.) that is also:

Owned or operated by a public entity (which can include cities, townships, counties, military bases, hospitals, prison complexes, highway departments, universities, sewer districts, etc.)

Designed or used for collecting or conveying stormwater

Not a combined sewer

Not part of a publicly owned treatment works

MS4s in Minnesota must satisfy the requirements of the MS4 general permit if they are located in an urban area with a population of 50,000 or more people, or owned by a municipality with a population of 10,000 or more, or a population of at least 5,000 and the system discharges to specially classified bodies of water.

The MPCA issued the original small MS4 General Permit in June of 2002. The MS4 general permit is issued for five years, after which it must be reissued. As part of the reissuance, MPCA staff consult with permittees and stakeholders and solicit public comment to look for ways to improve and revise the permit. The last permit issued was in 2020; see 2020 MS4 general permit.

The MPCA is managing competing demands for staff resources associated with priority projects. These priorities continue to evolve and require stormwater staff resources. These priorities include project management and the *Stormwater Manual* (MPCA, *Stormwater Manual* & MPCA, *Municipal Stormwater*)

Point of Contact: Duane Duncanson

B.2.3.2. Construction stormwater

The Phase I rules regulated large construction activities that disturb five or more acres of land. The Phase II rules required small construction activities disturbing one to five acres, including construction that is part of a common plan of development or sale disturbing one acre or more, to have NPDES permit coverage.

In August 2013, the MPCA reissued the construction Stormwater General Permit to comply with the EPA final rule on *Effluent Guidelines for Discharges from Construction and Development Sites* (December 2009). In addition, the revised permit requires electronic applications and one-inch volume control from new impervious surfaces. With the new volume control requirement, the MPCA will have a concerted effort to ensure the resulting green infrastructure (mostly infiltration basins) will be designed, built, and operated correctly. This will be done through education, compliance/enforcement, and partnering with local governments (MPCA, *Construction Stormwater*).

Point of Contact: Lisa Woog and Todd Smith

B.2.3.3. Industrial stormwater

The Industrial Stormwater General Permit (Permit) is reissued every five years. At this time the Permit is effective through March 31, 2025 (MPCA, *Industrial Stormwater*). The Permit regulates 29 sectors of industrial activity and requires all Permittees to sample their stormwater runoff. Stormwater monitoring results must be submitted to the MPCA after each sampling event. Sampling requirements continue to be a key indicator for Permittees successes and deficiencies; it is a feedback loop to alert permittees if their chosen stormwater management practices are working or if additional measures or maintenance is needed. Sampling requirements started over for all Permittees, regardless of sampling results during past permit cycles. Beginning July 2015 for renewing Permittees (and next full calendar quarter for new applicants), Permittees are required to sample their stormwater discharges for a minimum of four calendar quarters. Over time, the Industrial Stormwater Program has shifted focus from education/outreach and local partner development, to responding to sampling results and

compliance/enforcement strategies. The Industrial Stormwater Program continues to collaborate with the University of Minnesota to provide training on permit requirements. Staff are also working more closely with industrial and municipal permit writers to ensure appropriate stormwater language is being written into their individual permits. The Industrial Stormwater Program's website is updated at routinely to provide up-to date information to Permittees and the public (MPCA, Industrial Stormwater).

Point of Contact: Joseph Braun

B.2.3.4. Stormwater rules

Minnesota state stormwater rules, Minn. R. ch. 7090 (7090 - MN Rules Chapter), were enacted in 2005, combining the Phase I and Phase II rules in one place (MPCA, StormwaterPermits).

Point of Contact: Ryan Anderson

B.3. Cost-benefit analysis

Underlying the nation's water pollution control efforts is the assumption that the overall cost of those efforts, while considerable, is outweighed by the resulting benefit.

Cost-benefit analysis is an attempt to make this assumption explicit and testable. However, estimating the benefits associated with environmental programs (and, to an extent, even the costs) is challenging. While the influence of environmental factors on market prices and the positive value that people place on environmental improvements is at this point fairly well established, it remains extremely difficult to estimate environmental values with precision. As a result, environmental policy decisions continue to be made through the political process, rather than through the strict application of a quantitative cost-benefit analysis, which would be incomplete and of debatable accuracy.

Nevertheless, the underlying purpose of cost-benefit analysis – the assurance that the public's dollars are well spent – lies at the heart of the MPCA's considerable efforts at cost control and program effectiveness. In a time of decreased funding countered by increased demand for environmental services, the MPCA has done a great deal to ensure that its programs are directed towards the most important environmental problems and that those programs are conducted as cost-effectively as possible. Ongoing process-improvement efforts addressing the efficiency of various agency programs, and the *Environmental Information Report – An Assessment of Stressors Facing Minnesota's Environment*, a tool used by the MPCA to help prioritize the environmental problems currently faced by Minnesota, are only two examples of this continuing effort.

A partial accounting – partly quantitative, partly descriptive – of some of the costs and benefits associated with Minnesota's water quality program is given below.

B.3.1 Costs

The primary water quality programs at the state level are those of the MPCA, Minnesota Department of Natural Resources (MDNR), Minnesota Department of Agriculture (MDA), Minnesota Department of Health (MDH) and BWSR. Including local assistance, the WQ budget of the MPCA is approximately $108 million per year (*MMB, 2024-25 Biennial Budget for MPCA*). The WQ budget of BWSR approximately $77 million per year (*MMB, 2024-25 Biennial Budget for BWSR*). Other costs are incurred at the local level in the regulation of land use, feedlots, and on-site sewage disposal systems. It should be noted also that other environmental programs, such as air quality, solid waste, hazardous waste, and agricultural pesticide regulation have direct effects on the quality of the state's surface and groundwater. The MPCA, which has primary jurisdiction for the first three of these, has an overall budget of approximately $240 million per year (*MMB, 2024-25 Biennial Budget for MPCA*).

Regarding the actual implementation of point source water pollution controls, more than $5 billion in federal, state, and local funds have been spent since the enactment of the CWA for the construction of municipal wastewater treatment facilities in the state, including sanitary sewer connections and improvements (*MPFA, 2022 Annual Report*). The estimated infrastructure investment needs and annual operating costs for water treatment statewide is $5.3 billion over the next five years (*MPCA, Future wastewater infrastructure needs and capital costs, 2022*) Note, however, that municipal facilities treat industrial as well as municipal wastes and that industrial contributions represent a significant portion of the above figures.

In addition to government agency costs, some regulated parties might incur costs in order to adhere to permitting restrictions, such as permit application fees, changes in management practices, investment in water treatment technology, and other costs. Depending on market conditions, firms might incur costs from reducing production and thus become less competitive, and the economy could experience indirect effects to employment.

The overall costs of NPS water pollution control implementation are both more diffuse and more difficult to calculate than are those for point source programs. Due to changing economic circumstances, such as crop prices, it is not possible to estimate the indirect costs of best management practices (BMPs) to control runoff statewide. For example, reduced crop production as a result of buffer strips is a considerable cost, but the economic impact varies by soil quality, type of crop, and many other factors (Srinivas, Drewitz, & Magner, 2020).

One proxy for the cost of non-point pollution abatement is the amount of state funding dedicated towards watershed conservation projects. Between 2016 and 2021, approximately $48 million was awarded by the MPCA to fund watershed load reduction projects (*MPCA, Watershed Achievements Report, FY 2021*).

B.3.2. Benefits

While it is difficult to fully account for all costs of the CWA in Minnesota, the true measurement of benefits is subject to even higher uncertainty. Theoretical models for translating WQ improvement into economically measured benefits have been applied in numerous contexts in the United States and in Minnesota, but no attempts have been made to do this for the state as a whole.

A 2015 economic valuation study using the benefit-transfer method found that the Saint Louis River watershed provides ecosystem services valued at an estimated $5 to $14 billion per year (Fletcher & Christin, 2015). Though the resulting estimate describes the total annual flow of ecosystem goods and services rather than the benefit caused by improvements in water quality, it is an important starting point to conceptualize the economic benefits the water resources of Minnesota offer continually to the economic health of the state.

The MPCA has also made progress towards its turbidity reduction goals for the Minnesota River and the southern basin of the Mississippi River by identifying sediment sources and designing an action plan for an interim goal of 25% reduction of sediment loads by 2020, and 50% reduction by 2030. In conjunction with the sediment TMDL for Lake Pepin, a full cost accounting study estimated that a 50% reduction in sediment and phosphorus loading could lead to net zero economic loss to society when balancing reductions in agricultural production with the increased provision of ecosystem services, including carbon sequestration, recreational hunting, flood prevention, and biodiversity existence value. The results suggest that the most cost-efficient strategy to reduce sediment and phosphorus loading is to convert conventional crop production to forest or to crop production using half as much phosphorus fertilizer (Dalzell, et. al., 2012).

Benefits for point source programs can be described without exact dollar figures. Water quality in the state has significantly improved since the passage of the Clean Water Act. Facilities with secondary treatment increased from 20% of the population served in 1952 to 99.9% in 2022. Municipal and industrial wastewater facilities operate with a high rate of regulatory compliance and 99% of permittees meet their effluent limits. Increased levels of treatment have reduced phosphorus loads discharged from wastewater treatment plants by 57% since 2006.

As a result of both point source and NPS programs, water quality improvements in the state have been significant. Over the last three decades, the large majority of regularly monitored streams show a decreasing pollutant trend for Biochemical Oxygen Demand (89% of sites), fecal coliform bacteria (82%), ammonia (83%), and total phosphorus (78%). (On the other hand, only 42% of the sites show a decreasing trend for total suspended solids, and fully 75% of the sites show an increasing trend for nitrite/nitrate).

Numerous site-specific projects have already resulted in remarkable improvements in water quality. For example, due to decades of remediation efforts, the St. Louis River Area of Concern is on track to be delisted from its nine beneficial use impairments by 2025. Among many noticeable achievements, the first evidence of sturgeon population recovery occurred in 2011, when four young sturgeons were collected. Since 1978, at least $420 million dollars has been invested in this area of concern for infrastructure updates, restoration, and remediation of historic industrial contaminants (MPCA, *Area of concern projects and progress*). The restoration of the St. Louis River is essential for protecting the ever-growing tourism industry in Duluth, for which water resources and natural scenery are major assets. Duluth tourism tax revenues have nearly doubled since 2006 to more than $10 million in 2015, and lodging capacity will grow by 13% within the next two years (Explore Minnesota, 2020).

Indicative of both the value of clean water and the success of Minnesota's clean water programs is the large total revenue of the state's tourism industry, which generated approximately $16 billion in 2021 with a growth of 100% between 2011 and 2021 (Explore Minnesota, 2022, MDOR, 2011). Approximately $3 billion comes from expenditures related to fishing and wildlife viewing alone, according to the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Minnesota's water resources are a considerable attraction for this economically important industry and provide habitat for wildlife that also attract tourists (USFWS, 2013).

Similarly, a study by Bemidji State University on the economic value of Minnesota lakes found a strong relationship between water clarity and lake property values, with an increase of one meter in water clarity associated with additional total property value of tens or even hundreds of millions of dollars for given individual lakes (Krysel et al., 2003). The results of this study, along with numerous similar studies across the United States, for example Mamun et al., 2023 who find that a 10% increase in lake water quality leads to a $6 to $9 billion in lakeshore property values, emphasize that individuals express a preference for high water quality in the real estate market, and gain a direct economic benefit from improved water resources.

In addition to the tourism and property values benefits of clean water, numerous studies have demonstrated that clean water provides many other environmental services, all of which have significant economic value. These services include safe drinking water, agricultural uses (irrigation and raising livestock), commercial fishing, use in manufacturing, use in mining, use in electrical power generation, navigation, and hydropower. The protection of water quality also plays an important role in mitigating the damages associated with floods, human health risks from accidental ingestion or contact with water, and reduced treatment or other damages downstream. In addition, Minnesotans receive non-market benefits from experiencing positive aesthetic properties of clean water bodies, knowing

that pristine ecosystems are kept intact, and protecting surface waters' assimilative capacity for the use of future generations.

While the economic value of all the services provided by maintaining clean surface waters and groundwater in Minnesota have not been estimated, numerous studies have shown that clean water is essential to the U.S. economy, that the economic value of clean water is significant, and that the benefits of having clean water generally outweigh the costs of maintaining clean water.

An accounting of some of the key results regarding the MPCA's environmental programs can be found at MPCA, About us.

Point of Contact: Baishali Bakshi

B.4. Special state concerns and recommendations

Over the past several years, the MPCA has invested significant resources to investigate and evaluate other contaminants now known to be widely present in the environment that are not included in regular monitoring activities. These contaminants are often referred to as contaminants of emerging concern (CECs) and include pharmaceuticals, household and industrial-use products; endocrine active compounds (EACs); brominated flame retardants; and per- and polyfluoroalkyl substances (PFAS). The work done by the MPCA and others is important to inform lawmakers, regulators, the public and industry about the presence and extent of these contaminants in Minnesota's waters, and to evaluate when and how to address the contaminants through agency protection programs. The following paragraphs provide an overview of recent MPCA activities and other developments related to CECs.

B.4.1. Pharmaceuticals, household and industrial-use products

The MPCA has been collaborating on an ongoing basis with researchers from the U.S. Geological Survey (USGS) to monitor the presence of pharmaceuticals, personal care products, and other wastewater-associated chemicals in Minnesota's groundwater, lakes, and flowing waters. In general, these studies show that industrial and household-use compounds and pharmaceuticals are present in streams, groundwater, wastewater, and landfill effluents. Steroidal hormones, prescription and non-prescription drugs, insect repellent, detergents and detergent degradates, and plasticizers are widespread at low concentrations in Minnesota's rivers, lakes, and streams. The chemicals are typically found downstream of sources such as wastewater treatment plants. However, they are also present in more remote surface water where sources of these chemicals are not clear. Two large monitoring campaigns in conjunction with EPA's National Aquatic Resource Survey – one of 150 river and stream locations and one that included a random selection of 50 lakes - revealed that these chemicals are surprisingly widespread in Minnesota's ambient surface water.

B.4.2.1. Pharmaceuticals, household and industrial-use products

The MPCA has been monitoring the presence of pharmaceuticals, personal care products, and other anthropogenic chemicals in Minnesota's lakes, rivers and streams since 2010 via statewide monitoring campaigns that are conducted at five-year intervals in conjunction with EPA's National Aquatic Resource Surveys. These investigations have clearly demonstrated that pharmaceuticals and personal care products (PPCPs) such as antibiotics and antidepressants, the pesticide DEET, alkylphenols, and the disinfectant triclosan are widespread in Minnesota's surface waters. Many of these chemicals are endocrine active, mimicking naturally occurring hormones. Concern is continuing over the effect these chemicals may have on fish and wildlife and human health at very low concentrations.

Also in 2010, the MPCA began collecting groundwater samples from its Ambient Groundwater Monitoring Network for analysis of the same set of emerging contaminants (pharmaceuticals, household and industrial-use products). Initially, the key objective of the groundwater monitoring was to determine the magnitude of contamination; subsequently, the sampling has focused on areas with a high relative potential for groundwater contamination. This work generally shows that fewer contaminants of emerging concern are detected in groundwater compared to surface water, and that the concentrations of the contaminants in groundwater tend to be lower than in surface water.

The results from the 2010 survey along with more information about PPCPs and EACs are available here MPCA, Endocrine Active Chemicals Report, 2012. The MPCA is continuing to monitor Minnesota's surface and groundwater for EACs and other emerging contaminants.

B.4.2. Other contaminants of concern in Minnesota's environment

Over the past ten years, the MPCA has invested significant resources to investigate and evaluate other contaminants known or suspected to be widely present in the environment that are not included in regular monitoring activities. These contaminants are often referred to as contaminants of emerging concern (CECs) and include pharmaceuticals, household and industrial-use products; endocrine active compounds (EACs); brominated and orthophosphate flame retardants; iodinated disinfection by-products, and per- and polyfluoroalkyl substances (PFAS).

This work done by the MPCA and others is important in several ways: first, it informs lawmakers, regulators, the public and industry about the presence and extent of these contaminants in Minnesota's environment; second, local, collected-in-Minnesota samples of water, sediment and/or other media are tested using new and developing gene-based techniques to assess the potential impacts of these less understood chemicals on aquatic life; and finally, it provides a developing foundation to evaluate if, when and how to address emerging contaminants through agency protection programs.

The following paragraphs provide an overview of ongoing MPCA activities and other developments related to CECs.

B.4.2.2. Endocrine active chemicals (EACs)

The potential harm caused to aquatic life through exposure to EACs, including causing adverse behavioral and physiologic effects such as impairment of the reproductive system or disruption of an organism's growth and development driven significant research worldwide.

MPCA scientists, building on the results from the monitoring work described above and other studies of EACs and emerging contaminants, have conducted a number of investigations in collaboration with researchers at the USGS, St. Cloud State University, the University of Minnesota, the University of St. Thomas, and other organizations to further investigate the significance, sources, and occurrence of EACs. Many of these studies have included an analysis of how fish are impacted by EACs or have included some component of study looking at genetic changes in organisms exposed to EACs.

These studies show that sources of emerging contaminants to the environment include wastewater, stormwater, and landfill effluents, and that detectable concentrations of some of these contaminants are present in precipitation. This last finding helps explain why contaminants of emerging concern are found not just downstream of populated areas; they are also found as in pristine lakes in remote areas of the state, such as the Boundary Waters Canoe Area (BWCA).

B.4.2.3. Other emerging contaminants

New contaminants of emerging concern continue to be identified on an on-going basis. One is the broad category of microplastics, for which there is substantial worldwide interest and concern; however, there is still relatively limited information regarding what aspects of microplastics contamination present the most concern. MPCA is staying abreast of developments regarding microplastics and actively working to evaluate different monitoring and analysis techniques, since no standardized method has yet been developed.

Another newly identified emerging contaminant is 6PPD-quinone (6PPD-Q), a breakdown product from the antioxidants used in automobile tires. This chemical was recently identified as the toxic chemical responsible for die-offs of certain salmon during spawning in the Pacific Northwest. There is concern about similar toxicity in the Great Lakes and the Atlantic, and about how 6PPD-Q may affect other species. Again, MPCA scientists are staying on top of the information that is coming available and will consider further action, such as monitoring, when circumstances (i.e. methods, funds, staffing) permit.

The MPCA will continue monitoring for EACs and other emerging contaminants in Minnesota surface waters in conjunction with statewide and nationally based probabilistic surveys. MPCA also conducts additional research to expand our understanding of the occurrence of these emerging contaminants and their potential to negatively impact aquatic life.

B.4.3. Per- and Polyfluoroalkyl Substances (PFAS)

Per- and polyfluoroalkyl substances, commonly known as PFAS, are manmade chemicals used to manufacture products that are heat and stain resistant and repel water. PFAS are widespread and persistent in the environment and they have been found in animals and people all over the globe. There is evidence that exposure to PFAS can lead to adverse human health effects.

The most recent update to the state's work on PFAS is the release of Minnesota's PFAS Blueprint. The Minnesota PFAS Blueprint identifies short- and long-term opportunities, as well as legislative actions, to manage PFAS in our environment and protect families and communities (MPCA, PFAS, 2023). Over the coming months and years, state agencies will further develop these strategies and engage Minnesotans on how best to implement them. Future needs and opportunities are complex and resource-intensive. State agencies and community partners will need to work together to undertake projects that most strategically advance the collective goal to protect human health and the environment from the impacts of PFAS.

The MPCA will continue to evaluate conditions in PFAS-affected waters to determine if further regulatory or prevention activity is needed to assure that these waters fully support their beneficial uses.

Part C. Monitoring and assessment strategy

C.1. Monitoring strategy

C.1.1 Minnesota's water quality monitoring strategy

The Minnesota's Water Quality Monitoring Strategy, 2021-2031, describes elements of the state's surface water and groundwater monitoring programs. The Monitoring Strategy satisfies the EPA monitoring program strategy requirement and serves as the guide to MPCA monitoring programs.

Point of Contact: Lee Engel

C.1.2. Condition monitoring strategy: watershed approach

In recent years, the MPCA has organized components of stream and lake condition monitoring into the watershed framework at the major watershed level. An average of 8 to 10 watersheds are intensively monitored annually and assessed in a yearly rotation expected to complete a statewide assessment every 10 years (MPCA, watershed approach to water quality, 2023). This approach coordinates with the Minnesota's impaired waters program, local groups, and citizens by laying out future work and impairment listings well in advance.

Point of Contact: Lee Engel

C.1.3. Stressor identification strategy

Minnesota addresses impaired biota by examining the interactions of numerous physical, chemical, and biological processes that define community composition. Biological impairments can be driven by natural or unnatural changes to one or many components of these systems. Biological impairments differ from some traditional WQ impairments in that the impaired biotic communities are indicators of disturbance rather than causes of disturbance.

Biological impairments are commonly caused by stressors that are not considered conventional pollutants within our WQ rules. These include stressors such as degraded habitat or altered hydrology. Minnesota utilizes the process of stressor identification developed by the EPA to identify the dominant stressors.

The process of stressor identification draws upon a broad variety of disciplines such as aquatic ecology, biology, geology, geomorphology, statistics, chemistry, environmental risk assessment, and toxicology (MPCA, Stressor identification, 2023).

Point of Contact: Chad Anderson & Scott MacLean

C.1.4. Effectiveness monitoring strategy

Much like problem investigation monitoring, the state's effectiveness monitoring strategy relies on monitoring activities by a variety of parties. For individual projects, a variety of groups (regulated parties, local implementers, agency contractors, other organizations and the MPCA) can be involved in conducting effectiveness monitoring to evaluate specific management practices in a project area. With the MPCA's adoption of the watershed approach, the condition monitoring conducted in the first round of the 10-year cycle becomes dual purpose monitoring in subsequent cycles, since at this point the WRAPS has been developed and implementation is underway (MPCA, Watershed approach to water

quality, 2023). As a result, the second round of monitoring can serve as a measure of the effectiveness of the implemented practices from the previous cycle.

Point of Contact: Lee Engel

C.1.5. Surface water monitoring purposes, designs and indicators

The MPCA's current Condition, Problem Investigation and Effectiveness Monitoring activities are described in detail in Section 2.2 of the Minnesota's Water Quality Monitoring Strategy, 2021-2031 (MPCA, Watershed approach to water quality, 2023). The information provided includes monitoring activity start date, purpose, and description, including the type of monitoring design that is used to meet the specific monitoring purpose, and indicators.

Point of Contact: Lee Engel

C.1.6. Drinking water assessments

The MPCA does not assess groundwater (Class 1A) for potential impairment of the drinking water use. However, the MPCA is assessing Class 1B and Class 1C listed surface waters for potential impairment by nitrate nitrogen. This step was taken in recognition of the trend of increasing nitrate concentrations in Minnesota streams and the public health and economic impact arising from elevated nitrate concentration in drinking water (a particular concern in southeast Minnesota's karst region, where many Class 1B and 1C waters are located). More information about the assessment of Class 1B and 1C waters for nitrate/nitrogen is available in the *2024 Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List* (MPCA, *Impaired waters list*, 2023).

Point of Contact: Sarah Acquah

C.1.7. Source water

The Minnesota Department of Health (MDH) is the lead agency in Minnesota working on source water protection with the EPA. For groundwater-based public water supplies, source water protection is the state's wellhead protection program. For surface water supplies, source water assessment is being approached in various ways, depending on the size and circumstances of each source water and watershed (MDH, *Source Water Protection*, 2023). Where possible, these assessments and MPCA's Watershed Assessment Teams (WAT) are being coordinated.

In the past, the MPCA has worked closely with the MDH on source water protection, through a Memorandum of Agreement. As part of this effort, the MPCA provides data on potential contaminant sources in source water protection areas and provides technical assistance to the MDH, and public water suppliers on managing contaminant sources. The MDH and the MPCA continue to coordinate on special projects that involve both source water protection, and basin and watershed management. The MDH can now electronically access some of the MPCA's electronic databases to obtain information on potential contaminant sources, and the MPCA is continuing to work on the expansion of data access. The MPCA also has a representative on the MDH Ad Hoc Committee on Source Water Protection for Surface Water Systems.

C.2. Assessment methodology

Minnesota's water quality assessment methodology is fully documented in the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List (MPCA, *Impaired waters list*).

C.3. Assessment results

The fulfill CWA Section 305(b) requirements, Minnesota's water quality assessment results are reported to EPA's ATTAINS database on a biennial cycle (EPA, *How's my waterway*).

C.3.1. Impaired Waters List

According to CWA Section 303(d) requirements, Minnesota's list of impaired waters in need of TMDLs are submitted to EPA on a biennial cycle (MPCA, *Impaired waters list*).

Point of Contact: Leya Charles

C.3.2. Total Maximum Daily Loads and impaired waters

For each pollutant that causes a water body to fail to meet applicable WQS, the CWA requires the states to conduct a study called a TMDL study.

A TMDL study determines the assimilative capacity of a water body and identifies both point and NPS of each pollutant that violates standards. Water quality sampling and computer modeling determine how much each pollutant source is contributing to the problem. An allocation process involving stakeholders determines how much each source must reduce its contribution to assure the standards are again met.

An impaired water body may have several TMDL studies, each one determining reductions for a different pollutant (MPCA, *Healthier watersheds: tracking the actions taken*). After a TMDL study is written, a detailed implementation plan is developed to meet the TMDL's pollutant load allocation and achieve the needed reductions to restore WQ. Depending on the severity and scale of the impairment, restoration may require many years and millions of dollars.

Point of Contact: Leya Charles

C.3.2.1. Strategies the MPCA employs in the impaired waters restoration process

C.3.2.1.1. State funding

Minnesota voters approved the Clean Water, Land and Legacy Amendment in 2008, which increased the sales and use tax rate by three-eighths of 1% on taxable sales starting July 1, 2009 through 2034. Approximately 33% of those funds are dedicated to the Clean Water Fund (CWF). The MPCA is using these funds to meet the requirements of the federal CWA and the state CWLA which focuses on existing restoration and protection programs. These funds should enable us to keep on track with state goals. More information on current funding can be found on the following websites:

Clean Water Act Summary of the Clean Water Act | US EPA

Clean Water Legacy Amendment Ch. 114D MN Statutes

Clean Water Fund Clean Water Fund Interagency fact sheets | Minnesota's Legacy (mn.gov)

Minnesota state agencies, local government, and nonprofit organizations are spending CWFs on hundreds of projects to protect and restore the state's surface water, groundwater, and drinking water.

Project categories include water-quality monitoring and assessment, watershed restoration and protection strategies, protection and restoration implementation activities, and drinking water protection activities.

Point of Contact: Miranda Nichols

C.3.2.1.2. Partnering with local government

Cities, counties, soil and water conservation districts, and watershed management organizations play a large and growing role in NPS pollution abatement across the state. The MPCA is ultimately responsible for completing and submitting TMDLs to the EPA. However, these stakeholders play a critical role in the development and implementation of TMDLs, therefore, the first priority is to use ready and qualified local government and watershed organizations with jurisdiction in the impaired watershed to develop TMDLs to lead a project. These entities need to have the expertise to do the work, especially for monitoring, land use inventory, choosing reduction scenarios, developing implementation plans and public outreach.

Locally driven projects are most likely to succeed in achieving WQ goals because communities often best understand the sources of WQ problems and effective solutions to those problems. Through grant contracts with the MPCA, local governments and watershed organizations are leading over three-fourths of Minnesota's TMDL projects. The remaining projects, particularly the most complex ones, will often be led by MPCA or other state agencies. The MPCA provides oversight, technical assistance, and training to ensure regulatory and scientific requirements are met.

Point of Contact: Miranda Nichols

C.3.2.1.3. Working with private consultants

The MPCA and local government often employ private consultants to perform specific steps of TMDL studies where needed and where they will be most effective. Consultants are helpful in supplementing MPCA and local staff resources, particularly for technical work. In many cases, consultants assist with data collection, modeling and development of draft reports.

Point of Contact: Miranda Nichols

C.3.2.1.4. Strategies to increase the effectiveness and efficiency of Total Maximum Daily Load development and implementation

Watershed Restoration and Protection Strategies (WRAPS)

The WRAPS report summarizes current water quality conditions from the technical data; identifies the stressors and sources; and lists impaired water bodies with associated TMDLs, as well as water bodies needing protection. In the WRAPS, the critical section is the strategies narrative and/or table, where each impairment/protection need is assigned a list of strategies or types of conservation practices that will effectively address the problem. Similar information is shared with EPA in the annual Environmental Performance Partnership Agreement reporting cycle. In mid-2023, all WRAPS for the state were completed and approved by EPA (Tableau, WRAPS Status Public, 2023). Moving forward, WRAPS reports will be updated on an as-needed schedule and content basis.

One Watershed One Plan (1W1P)

The purpose of the One Watershed, One Plan program is to develop comprehensive watershed management plans, as described in Minnesota Statute Sec. 103B.801 that:

- Align local water planning purposes and procedures under this chapter and chapters 103C and 103D on watershed boundaries to create a systematic, watershed-wide, science-based approach to watershed management.
- Acknowledge and build off existing local government structure, water plan services, and local capacity.
- Incorporate and make use of data and information, including watershed restoration and protection strategies under section 114D.26.
- Solicit input and engage experts from agencies, citizens, and stakeholder groups; focus on implementation of prioritized and targeted actions capable of achieving measurable progress.
- Serve as a substitute for a comprehensive plan, local water management plan, or watershed management plan developed or amended, approved, and adopted, according to chapter 103B, 103C or 103D.

Progress on 1W1P development and approval detailed on the BWSR website (BWSR, 1W1P).

Point of Contact: Miranda Nichols

C.3.2.1.5. Goal Setting and Performance Measurement

Clean Water Fund Performance Reports on progress protecting and restoring waters are produced every two years (MN Legacy, Clean Water Fund Performance Reports, 2023). More information can be found at the MPCA Healthier Watersheds website.

Point of contact: Glenn Skuta

C.4. Wetlands update

At over 10 million acres, Minnesota's wetland resource is large and diverse. There are also important regional wetland quantity and quality differences in the state. These regional differences require consideration in developing the state's regulatory and monitoring practices. The MPCA is committed to monitoring the wide variety of wetlands throughout Minnesota through probabilistic surveys.

C.4.1. Wetland regulatory program

The Minnesota Wetland Conservation Act (WCA) continues to be the principle wetland protection and regulatory program in Minnesota. Central to the WCA is the enactment of state policy to achieve a 'no net loss' and to increase the "quantity, quality and biological diversity of wetlands in the state" (Minn. Stat. Sec. 103A.201. Several non-wetland specific regulatory programs including the 404/401 certification permit program, the MNDNR Public Waters Permit Program and the NPDES Permit Program (including stormwater) align with the WCA and the Federal Food Security Act "Swampbuster", to provide broad oversight of most types of direct and indirect physical alteration to Minnesota wetlands.

Minnesota actively implements Section 401 of the federal CWA (401 certification) based on state water quality standards (Minn. R. ch. 7050), including the wetland WQ standards. Many, though not all, of the Section 401 certification actions, in Minnesota, involve wetland waters.

Figure 3 illustrates the number of MPCA individual Section 401 certifications by industry category for fiscal year 2019. Infrastructure projects, such as road construction, trails, airports, pipelines, waste management, and stormwater and power lines represent the most common project type affecting wetlands. These data generally do not include agricultural land improvement projects. Figure 4 presents the number of statewide Section 401 WQ certifications by the type of determination action; certify, deny and wave. During this time period the MPCA issued slightly more waivers than certifications. The

MPCA recognizes that 401 WQ Certification as an important regulatory tool which has contributed measurable protection to Minnesota's valuable wetlands and watersheds.

Figure 3: Minnesota Section 401 water quality certifications by category for federal fiscal year 2020

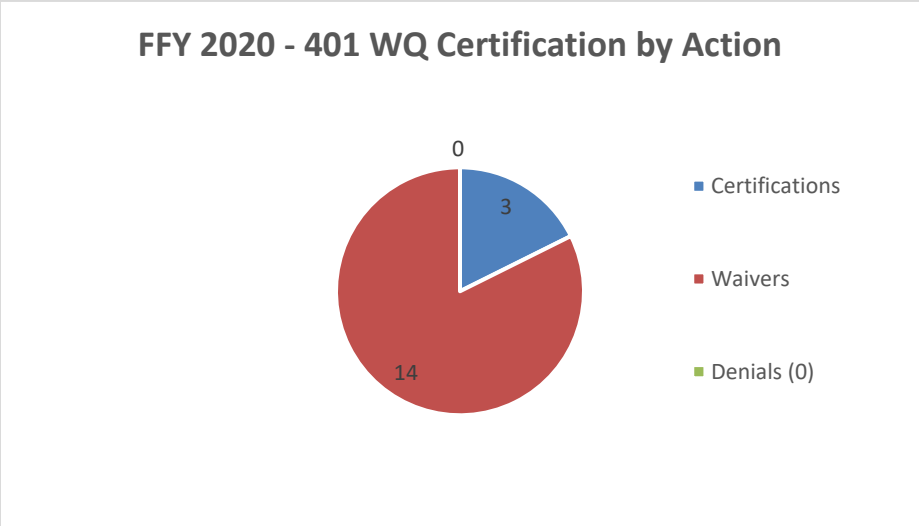
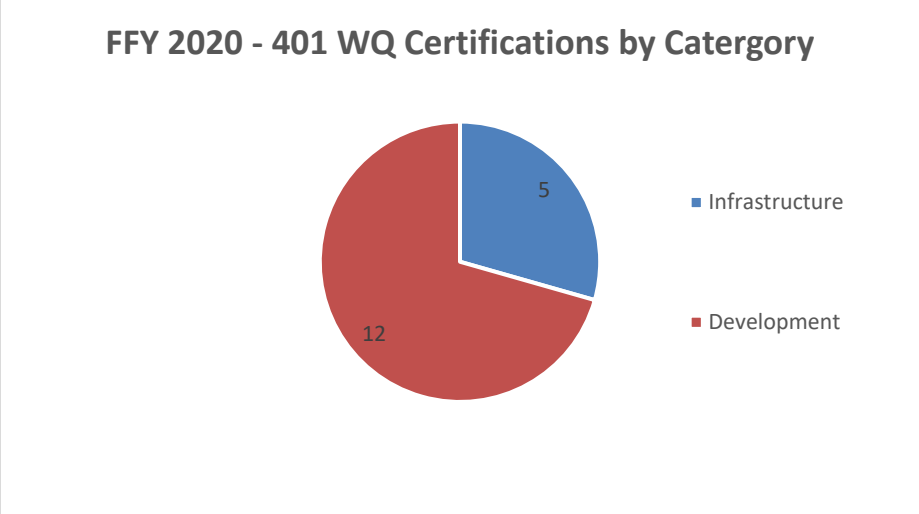


Figure 2: Minnesota Section 401 water quality certification by action federal fiscal year 2020



Point of Contact: Jim Brist

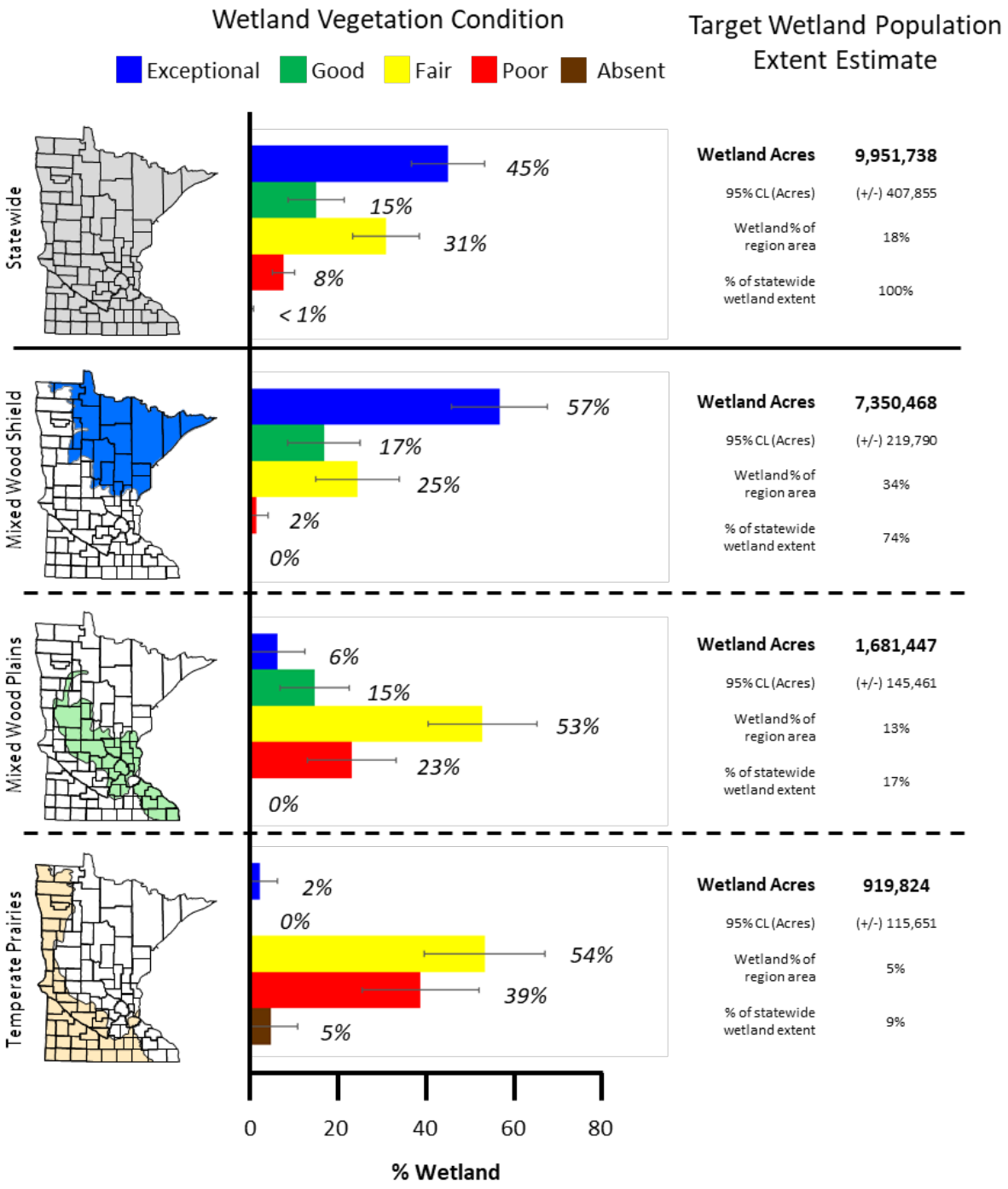
C.4.2 Wetland monitoring and assessment

The MPCA is the lead agency for wetland quality monitoring in the state. The primary indicators are biological indices based on vegetation (applicable to all wetland types in the state) and macro-invertebrate (applicable only in depressional wetlands that typically have some open water) communities. A limited number of vegetation and macro-invertebrate depressional wetland assessments have been made; however, given the size and diversity of the resource and that wetlands are often restored as a means to improve stream and quality, it was decided that monitoring overall wetland quality and trends through broad surveys is of greater priority than individual wetland assessment.

Beginning in 2011, the MPCA has worked in conjunction with EPA on the National Wetland Condition Assessment in Minnesota. Statewide and regional intensification surveys have been completed in 2011/12 – 2016 to provide wetland vegetation quality status and trends information. Overall, Minnesota's wetland vegetation quality is high; however, condition varies widely in different parts of the state (Figure 5). Wetland vegetation is predominately in exceptional/good quality in the northern part of the state (where most of Minnesota's wetlands occur) and predominately in fair/poor quality in the remainder of the state. The MPCA is continuing this survey on the 5-year National Wetland Condition Assessment schedule and began the next iteration in 2021.

In addition, the MPCA conducts an independent survey of depressional wetland quality. These wetlands occur in a distinct basin, have marsh type vegetation, and typically some open water. Depressional wetlands make up a small (6% of the statewide wetland extent over an estimated 160,000 wetland basins) but iconic part of Minnesota's wetland resource. Three depressional wetland survey iterations have been completed in the Mixed Wood Plains and Temperate Prairies ecoregions—where depressional wetlands are more common. No significant wetland quality changes in have been detected over the survey iterations. The MPCA monitored depressional wetlands in 2023 for the latest round of the survey, with subsequent results anticipated to be included in Minnesota's 2026 305(b) narrative report.

Figure 4: 2016 wetland vegetation condition category proportion and extent estimates statewide and by ecoregion.



Points of Contact: Michael Bourdaghs & John Genet

C.5. Trends analysis

C.5.1. Water quality trends for Minnesota rivers and streams

The Watershed Pollutant Load Monitoring Network, which consists of permanent flow and chemistry monitoring sites on a basin, major watershed, and subwatershed scale. A number of the load monitoring sites are located at former Minnesota Milestones sites. The load monitoring stations will be used to provide information about long-term water quality trends in Minnesota rivers (MPCA, *Watershed pollutant load monitoring*, 2023).

Trend analysis of stream water clarity data has also recently been done using all stream and river transparency measurements available at the MPCA, including those collected by volunteers through the Volunteer Water Monitoring Program, and a methodology and detailed statewide map is available (MPCA, *Volunteer monitoring reports and data*, 2023). Table 1 shows the most recent trends from 2022.

Table 1: 2022 water clarity trends in Minnesota rivers and streams

Stream trend	Streams with this trend in 2022
Degrading	248 (17%)
Improving	314 (21%)
No Trend	243 (16%)
No Change	65 (4%)
Too clear to run a test	625 (42%)
Insufficient data	2,602
Total # of stream stations with data	4,097
Total # of stream stations with enough data to run a test	1,495

Points of contact: James Jahnz

C.5.2 Biology

Every five years the MPCA conducts a statewide probabilistic survey of rivers and streams in Minnesota to evaluate biological condition. The latest iteration of this survey was completed in 2015, the results of which are presented here. Each site sampled was evaluated using an IBI based on fish community and aquatic invertebrate community attributes, independently. These IBI scores were compared to thresholds unique to each stream class that are based on characteristics of the sampling location including region (e.g., northern vs. southern), drainage area, and gradient (Minn. R. ch. 7050.0222). There are nine fish and nine invertebrate IBI classes used by the MPCA to assess the aquatic life designated use of rivers and streams. Within five of the fish IBI classes and four of the invertebrate IBI classes there are distinct thresholds for general and modified (i.e., channelized) aquatic life use streams. These thresholds, along with those for exceptional use streams (not used in this analysis), represent criteria for use in a tiered aquatic life use (TALU) framework that was adopted into water quality standards (MPCA, *Tiered aquatic life uses*, 2023). Therefore, the IBI results from each survey site were compared to the appropriate threshold in relation to stream classification and channel condition, providing an approximation of its aquatic life use support status.

Figure 5: Estimated percent of stream miles that meet (i.e., Yes) invertebrate IBI TALU criteria

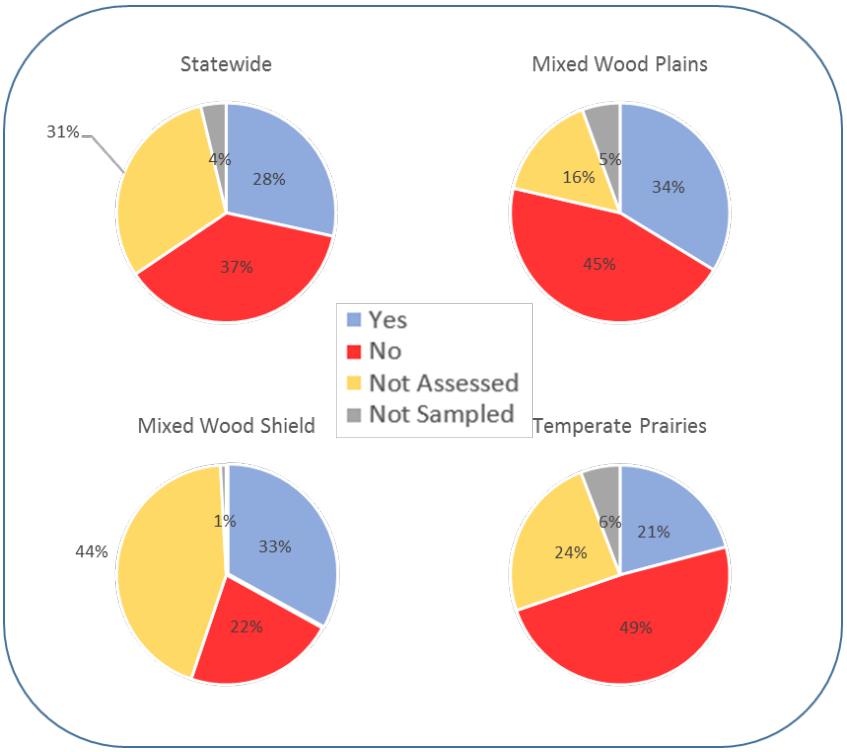
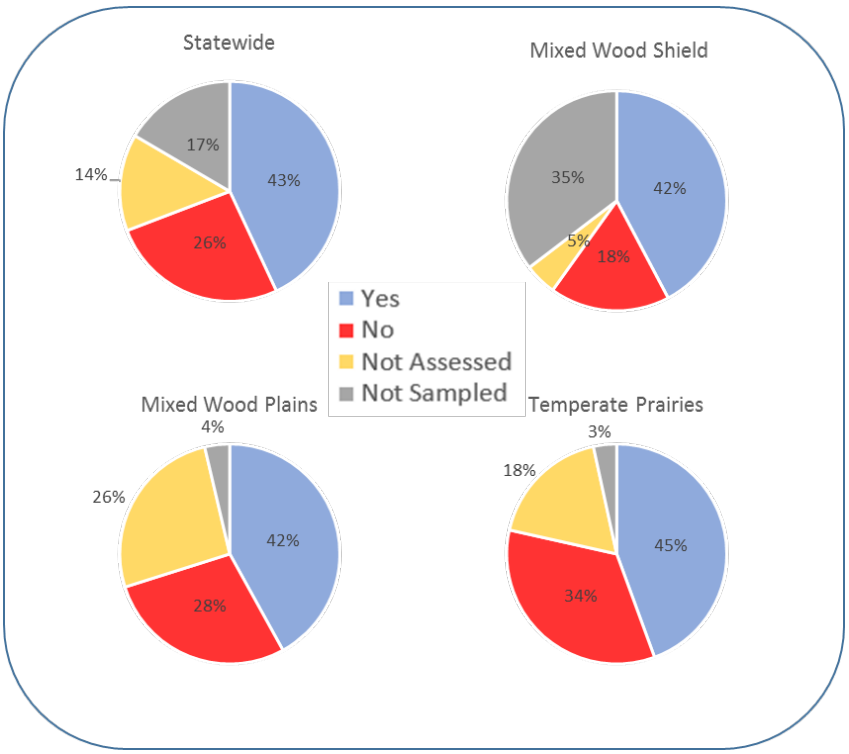
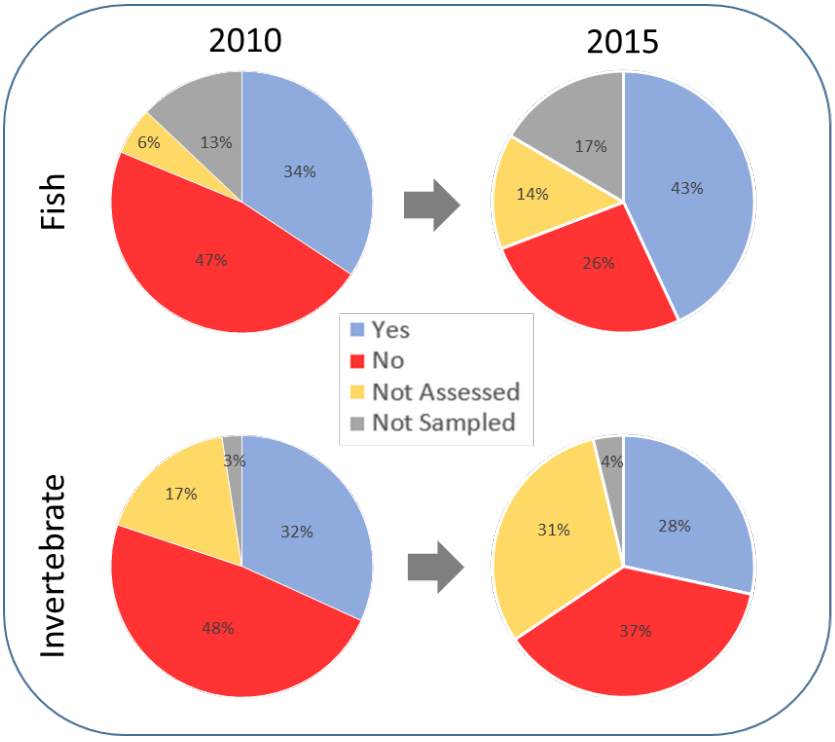


Figure 6: Estimated percent of stream miles that meet (i.e., Yes) fish IBI TALU criteria



The 2015 results indicate that about 43% of the stream miles statewide support aquatic life (general or modified) based on fish IBI results, and 28% support aquatic life based on invertebrate IBI results. These percentages shown in Figures 9 and 10 also demonstrate some ecoregion dissimilarity; for example, the percentage of streams supporting invertebrate aquatic life criteria (i.e., Yes) in the Temperate Prairie region is less than the corresponding statewide estimate while the Mixed Wood Plains and Mixed Wood Shield both exceed the statewide estimate. Estimates of the percentage of stream miles in Minnesota supporting aquatic life use did not change significantly between 2010 and 2015 regardless of the community type used to derive the estimates. Fish IBI results did yield a significant change in the estimated percent of stream miles not supporting aquatic life, decreasing by ~20% in the 5-year period (Figure 9). However, this decrease was partially due to increases in the percentage of not sampled and not assessed stream miles. Therefore, it is premature to draw conclusions at this early stage of the long-term status and trends monitoring program. Future iterations of the survey will provide a clearer picture of aquatic life condition trends in Minnesota resulting from the implementation of watershed restoration and protection strategies.

Figure 7: Comparison of 2010 and 2015 statewide condition estimates based on fish and aquatic invertebrate IBI results



Point of Contact: Shannon Martin

C.5.3. Water quality trends for Minnesota lakes

Annual trend analysis of lake water clarity data is conducted using all lake transparency measurements available at the MPCA, including those collected by volunteers through the Volunteer Water Monitoring Program (MPCA, *Volunteer monitoring reports and data*, 2013). Table 2 shows the most recent trends from 2022.

Table 2: 2022 water clarity trends in Minnesota lakes

Lake trend	Lakes with this trend
Degrading	157 (9%)
Improving	533 (31%)
No Trend	788 (45%)
No Change	254 (15%)
Insufficient Data	3,144
Total # of lakes with data	4,876
Total # of lakes with a trend	1,732

In addition, the Sentinel Lakes Monitoring Program, a component of Sustaining Lakes in a Changing Environment, which is a long-term collaborative monitoring effort led by the MDNR, involves long-term monitoring of water chemistry, fisheries, habitat and other factors. The MPCA is a partner in the effort with the primary focus on collection and assessment of water quality data for these lakes (MPCA, *Lake Water Quality Monitoring*, 2023).

Probabilistic (or random) surveys have become an important tool for monitoring the condition of Minnesota's water resources. These surveys provide data sets that yield statistically sound, unbiased estimates of the condition of the state's water bodies, and are very helpful in determining trends in water resource condition over time. Minnesota participated in the 2007 and 2012 National Lakes Assessment reports (MPCA, *National Lakes Assessment*, 2023).

C.5.3.1 National Lakes Assessment survey

Minnesota's participation in the EPA's National Lake Assessment involved a collaborative approach with other agencies. A total of 1,000 lakes were included in the national survey. Minnesota drew 42 lakes as a part of the initial draw for this statistically-based national survey effort and added 8 lakes to allow for state-based assessment (MPCA, *National Lakes Assessment*, 2023). All 50 lakes received the national level of assessment and contributed to both the state-based and national assessments. In addition, 100 lakes were added from EPA's randomized list of lakes to allow for ecoregion-based assessments (50 per major ecoregion) in Minnesota.

While the data collected are not sufficient for broad, state-scale, assessment of temporal trends, they are valuable for assessing spatial trends (patterns) and provide valuable insight on a variety of lake management issues (MPCA, *Watershed pollutant load monitoring*, 2023).

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Part D. Groundwater monitoring and assessment

The state agencies work together to provide a coordinated approach to groundwater monitoring and protection in Minnesota.

D.1. Minnesota's groundwater resources

Minnesota's groundwater is contained within 14 principal aquifers that are composed of unconsolidated sand deposits and a series of bedrock units. The uppermost aquifers in the state are sand and gravel aquifers that are generally of glacial origin. Twelve bedrock aquifers, which generally are composed of sedimentary rocks, underlie the sand and gravel aquifers.

The sand and gravel aquifers are important sources of water supply throughout the state. These aquifers occur throughout Minnesota but are concentrated in the central and western parts. These aquifers primarily were formed by materials deposited during a period of continental glaciation, which occurred about 10,000 to 350,000 years ago. The sand and gravel aquifers are found near the land surface or buried within more impermeable materials. The surficial sand and gravel aquifers are most prevalent in the central part of the state. The buried sand and gravel aquifers occur in areas with thick glacial deposits where multiple glaciations occurred. The sand and gravel aquifers yield moderate to good amounts of water in the central and western parts of the state; elsewhere the yields from these aquifers are limited. For example, northeastern Minnesota has a relatively thin covering of glacial materials overlying crystalline bedrock.

The Prairie du Chien-Jordan, Tunnel City/Wonewoc, and Mount Simon Hinckley are the three main bedrock aquifers used for water supply in Minnesota. These aquifers are composed of limestone, dolostone, and sandstones that generally were deposited when seas covered Minnesota about 500 million years ago. The Prairie du Chien-Jordan is the uppermost of these three aquifers and is highly developed in the Twin Cities Metropolitan Area (TCMA). The Tunnel City/Wonewoc aquifer underlies the Prairie du Chien-Jordan and is an important source of water supply in parts of southeastern Minnesota where the Prairie du Chien-Jordan aquifer is either near the land surface or not present. The Mount Simon/Hinckley aquifer underlies all of southeastern Minnesota and extends as far north as the city of Duluth, Minnesota. Groundwater withdrawals from the Mount Simon/Hinckley aquifer increase substantially north of the TCMA.

Groundwater resources are limited in southwestern and northeastern Minnesota. Surficial sand and gravel aquifers that yield moderate amounts of water are the main groundwater resources in southwestern Minnesota. In this part of the state, the sand and gravel aquifers often are located near streams. Northeastern Minnesota has the most limited groundwater resources in the state because this area is composed of very old crystalline rocks with a thin veneer of glacial materials that yield little water.

D.2. Groundwater protection programs

Minnesota's groundwater protection programs primarily are shared among four state agencies—the MPCA, MDA, MDH, and MDNR (Table 4), with regional coordination in the TCMA by the Metropolitan Council. The MPCA's programs focus on protecting the state's groundwater from non-agricultural chemical contamination. The MDA's programs protect the groundwater from agricultural chemicals. The MDH is charged with protecting the state's drinking water supplies from groundwater contamination. The MDNR's manage groundwater quantity by regulating water allocation and withdrawals.

The MPCA administers regulatory and monitoring programs that protect the groundwater from contamination by non-agricultural chemicals. The agency's regulatory programs identify, regulate, and remediate spills of non-agricultural contaminants. These include the state's Brownsfields, Emergency Response, Landfills/Dumps, Petroleum Remediation, Resource Conservation and Recovery Act Corrective Action, Superfund, Voluntary Investigation and Cleanup, Subsurface Sewage Treatment System, Feedlot, and Stormwater programs. The MPCA also maintains an ambient groundwater monitoring network to determine the presence and distribution of non-agricultural chemicals and identify any trends. This monitoring also includes an "early warning network" of shallow monitoring wells. The main goal of the "early warning network" is to identify trends in groundwater quality early, so BMPs to reduce contamination can be put in place rather than more-costly remediation.

The MDH administers several programs that protect the public's health from waterborne contaminants. The agency administers the state's Well Management Program that regulates the construction of new wells and the proper sealing of unused ones. The agency also administers the state's Drinking Water and Source Water Protection programs and develops human health-based guidance for groundwater.

The MDA is the lead state agency for regulating pesticides and fertilizers in the state and administers programs, which protect the groundwater from agricultural chemical contamination. The MDA approves new pesticide products for use in the state in cooperation with the EPA. The MDA also monitors the groundwater to determine that pesticides are used properly and do not have a harmful impact on the state's groundwater. The MDA also takes enforcement actions when improper disposal or application of pesticides is found. The MDA also develops BMPs for pesticide use and regulates the sale, use, and disposal of pesticides.

The MDNR administers programs related to groundwater appropriations. The agency permits groundwater withdrawals, performs aquifer vulnerability assessments, resolves water use conflicts, and monitors groundwater levels across the state.

Table 3: Summary of Minnesota groundwater protection programs

1. Programs or Activities	2. Check (✓)	3. Implementation Status	4. Responsible State Agency
Active Sara Title III Program	✓	Established	MPCA, MN Dept. of Public Safety
Ambient groundwater monitoring system	✓	Continuing Effort	MPCA, MDA
Aquifer vulnerability assessment	✓	Continuing Effort	MNDNR
Aquifer mapping	✓	Continuing Effort	MGS
Aquifer characterization	✓	Continuing Effort	MPCA, MDA, MNDNR, MGS
Comprehensive data management system	✓	Continuing Effort	MPCA, MDA, MNDNR, MDA, MGS
Consolidated cleanup standards	✓	Continuing Effort	MPCA, MDH
Groundwater Best Management Practices	✓	Continuing Effort	MPCA, MDA
Groundwater legislation	✓	Continuing Effort	All agencies
Groundwater classification	✓	Established	MPCA
Groundwater quality standards	✓	Continuing Effort	MDH, MPCA, MDA
Interagency coordination for groundwater protection initiatives	✓	Established	All agencies
Nonpoint source controls	✓	Established	MPCA, MDA
Pesticide State Management Plan	✓	Established	MDA
Resource Conservation and Recovery Act Primacy	✓	Established	MPCA
Source Water Assessment Program	✓	Continuing Effort	MDH
State Property Clean-up Programs	✓	Established	MPCA, MDA
Susceptibility assessment for drinking water/wellhead protection	✓	Established	MDH
State septic system regulations	✓	Established	MPCA
Underground storage tank installation requirements	✓	Established	MPCA
Underground Storage Tank Remediation Fund	✓	Established	MPCA/Dept. of Commerce
Underground Injection Control Program	✓	Established	MDH
Underground Storage Tank Permit Program	✓	Established	MPCA
Well abandonment regulations	✓	Established	MDH
Wellhead Protection Program (EPA-approved)	✓	Established	MDH
Well Installation Regulations	✓	Established	MDH

D.3. Groundwater monitoring programs

Four state agencies jointly conduct groundwater quantity and quality monitoring in Minnesota. The MDNR maintains the state's groundwater level monitoring network (quantity). The MPCA, MDA, and MDH jointly conduct groundwater quality monitoring based on their individual state and federal authorities and requirements. The MPCA monitors non-agricultural chemicals, and the MDA monitors agricultural chemicals such as pesticides and fertilizers. The MDH monitors the groundwater used by the public to ensure any chemicals are below concentrations that present a threat to human health. Further information on this multi-agency approach to groundwater monitoring is contained in Minnesota's Water-Quality Monitoring Strategy document (MPCA, 2011).

Several state agencies have integrated the storage of their groundwater data into a shared data management system. The MPCA, MDA, and MDNR all store the water quality data collected by their groundwater condition monitoring networks in a data management system maintained by the MPCA. These advances in data management have facilitated the analysis and interpretation of groundwater data collected across state agencies.

D.4. MPCA's monitoring and assessment strategy

The MPCA's monitoring and assessment strategy continues to focus on aquifers that are vulnerable to human contamination and underlie the urban and undeveloped parts of Minnesota. The MPCA's ambient groundwater network currently focuses on the surficial sand and gravel and the Prairie du Chien-Jordan aquifers. Water samples generally were collected annually to determine concentrations of over 100 chemicals, including nitrate, chloride, trace elements, and volatile organic compounds (VOCs).

D.5. MDA's monitoring and assessment strategy

The MDA continues to monitor the State's groundwater to provide information about the impacts from the routine application of agricultural chemicals. The primary focus of this monitoring is to assess the presence and distribution of pesticides in the groundwater (MDA, 2019). The network typically monitors the upper part of the sand and gravel aquifers and consists of about 230 monitoring wells. About 165 of these locations are located in central Minnesota. The remaining sites (approximately 45 monitoring wells, 12 domestic water supply wells, and 13 springs) are located in agricultural areas in other parts of the state. Domestic wells and springs are sampled in southeastern part of the state in lieu of monitoring wells since springs integrate water-quality conditions in karstic areas and domestic wells are a good alternative in places where monitoring wells are expensive to install (MDA, *Agricultural Chemical Monitoring and Assessment,* 2023).

From 2013-2019, the MDA conducted the Township Testing Program to determine current nitrate-nitrogen concentrations in private wells on a township scale. For this project, the MDA identified townships for nitrate sampling throughout the state that were vulnerable to groundwater contamination and had significant row crop production. From 2014-2019, the MDA conducted a similar program, called the Private Well Pesticide Project, to evaluate the occurrence and distribution of pesticides in private drinking water wells where nitrate was detected as part of the Township Testing Program. As of February 2021, 32,217 private drinking water wells in 344 townships were sampled for the Township Testing Program, and about 5,700 wells were tested for the Private Well Pesticide Project from 2014-2021 (MDA, *Agricultural Chemical Monitoring and Assessment, & Private Well Pesticide Sampling Project,* 2023).

D.6. MDH's monitoring and assessment strategy

The MDH continues to monitor the condition of the state's public water supplies, which often utilize groundwater. The MDH samples the state's finished drinking water in cooperation with the public water supply systems to determine whether contaminant concentrations meet Safe Drinking Water Act regulations. Private drinking water wells are not assessed as part of this effort; however, the MDH reviews nitrate, arsenic, and coliform bacteria data collected by well drillers from newly installed drinking water wells to determine the potability of the water. The MDH also conducts investigative monitoring to assist the public water suppliers in locating wells in aquifers with lower concentrations of arsenic, radionuclides, and nitrate. In addition, the MDH measures the tritium values in some wells to identify locations with recently recharged groundwater which are very susceptible to contamination. The MDH also administers the state's wellhead protection program to protect the groundwater from contamination.

D.7. MDNR's monitoring and assessment strategy

The MDNR continues to maintain a groundwater level monitoring network across the state. The MDNR uses the collected data to assess groundwater resources, determine long term trends in water levels, interpret impacts of pumping and climate, plan for water conservation, and evaluate water conflicts. Water level readings are measured on an approximately monthly schedule in cooperation with soil and water conservation districts or other LGUs.

D.8. Minnesota's groundwater quality

The MPCA's 2019 condition monitoring report integrated data on nitrate, chloride, trace elements, VOCs, poly- and perfluoroalkyl substances (PFAS), and other contaminants of emerging concern (CECs) like medicines in the groundwater (Kroening & Vaughan, 2019). This information was collected by several state agencies and national monitoring efforts. The monitoring data from the 2019 report indicated high nitrate concentrations were primarily an issue in the groundwater beneath agricultural parts of Minnesota. In these areas, 49% of the tested shallow monitoring wells had nitrate concentrations exceeding the standard set for drinking water (10 mg/L as nitrogen). The MDA's Township Testing Program identified where domestic water supplies in agricultural areas were most impacted by high nitrate concentrations, which was defined as at least 10% of the tested wells having concentrations of 10 mg/L or greater. The majority of these townships were, often in places where the shallow groundwater was naturally vulnerable to contamination from the land surface, such as southeastern and southwestern Minnesota. The MPCA's monitoring data showed that chloride was primarily a concern in the groundwater underlying urban areas. The greatest chloride concentrations generally occurred in the TCMA, where most of the wells with concentrations exceeding the secondary maximum contaminant level of 250 mg/L were located. The MPCA continued to determine long-term temporal trends in nitrate and chloride concentrations in the groundwater. The analyses in the 2019 report evaluated trends using data from 2005-2017. Statistical testing found that chloride concentrations increased in 40 percent of the tested wells. The majority of the wells with upward chloride trends were installed in bedrock aquifers in the TCMA or southeastern Minnesota; some of these wells were as deep as 340 feet. This result suggests some of the chloride used in the State is beginning to seep downward into the groundwater used for drinking. In contrast, statistical testing found no consistent temporal trends in nitrate concentrations at the statewide or watershed scale or in any particular land use setting.

The MPCA has collected samples annually from selected wells in its condition monitoring network for analysis of over 100 CECs since 2009 and periodically samples the network for PFAS. Detections of both of these suites of chemicals in the ambient groundwater were associated with urban land use. PFAS sampling conducted in 2013 (Kroening, 2017) found that one or two PFAS typically were detected in the ambient groundwater underlying urban areas, but these chemicals usually were not detected in the groundwater underlying forested, undeveloped areas. This result suggested that most of the PFAS measured in the ambient groundwater originated from chemicals being disposed to the land surface rather than regional atmospheric deposition. Perfluorobutanoic acid (PFBA) was the most commonly detected PFAS in the ambient groundwater, being found in almost 70% of the sampled wells. The most commonly detected CECs in the groundwater were the antibiotic sulfamethoxazole, the flame-retardant tris (1,3-dichloro-2-propyl) phosphate, the x-ray contrast agent iopamidol, and the non-anionic surface mixture branch p-nonylphenols. These chemicals all are known to be widely used, resistant to degradation, and persistent in the environment.

D.9. Groundwater contamination sources

Monitoring of Minnesota's groundwater has identified contamination from non-point sources from agricultural fertilizers and pesticides, urban runoff, manure applications, septic systems, road salt and stormwater infiltration, in many vulnerable aquifers (MPCA & MDA, 2015). The most common contaminants detected include nitrate, pesticides, and road salt in urban areas. In addition, CECs that are not commonly monitored or regulated are being identified at low concentrations in groundwater. These include antibiotics, fire retardants, detergents, and plasticizers and includes endocrine active chemicals.

Sources of groundwater contamination in Minnesota were listed in Appendix A of the Environmental Quality Board's 2015 water policy report (MPCA & MDA, 2015). Most nitrate enters the groundwater from anthropogenic sources such as animal manure, fertilizers used on agricultural crops, failing subsurface sewage treatment systems, fertilizers used at residences and commercially, and nitrous oxides from the combustion of coal and gas. Pavement deicing chemicals and water softeners were identified as the primary sources of chloride to groundwater. The disposal of fluorochemical manufacturing wastes prior to the advent of modern solid and hazardous waste laws and regulations caused the most well-known PFAS contamination in Minnesota's groundwater. In contrast, naturally-occurring soil and rock are the main sources of arsenic in the state's well water.

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Part E. Public participation

In general, public participation is critical throughout Minnesota's TMDL process. Minnesota expects advisory groups to be involved from the earliest stages of the project. At a minimum, the EPA requires that the public must be given an opportunity to review and comment on TMDLs before they are formally submitted to EPA for approval. Every TMDL is formally public-noticed in Minnesota with a minimum 30-day comment period.

In addition, the MPCA has a comprehensive effort underway to build civic engagement into watershed projects. The MPCA is trying to build greater civic engagement in watershed planning by encouraging more citizens to become leaders for change in their communities and holding individuals personally responsible for making needed changes that could reduce water pollution. The MPCA is engaged in several activities to promote civic engagement in watershed plans and has developed several civic engagement products and services for use by local partners and citizens (MPCA, *Civic Engagement*).

Finally, in addition to the TMDL development, the MPCA has an active public participation process during the development of biennial updates to the 303(d) List, including public meetings throughout the state on the draft List and a 60-day public comment period.

The draft 2024 303(d) Impaired Waters List was placed on the MPCA website in November 2023. The public was informed by a statewide MPCA press release and emails to individuals and groups on the MPCA 303(d) distribution list. A 60-day public comment period followed with multiple meetings scheduled for the public to attend.

Minnesota's Impaired Waters List, the comments received during the public comment period, and the MPCA's responses to comments are available on the MPCA website (MPCA, IWL).

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