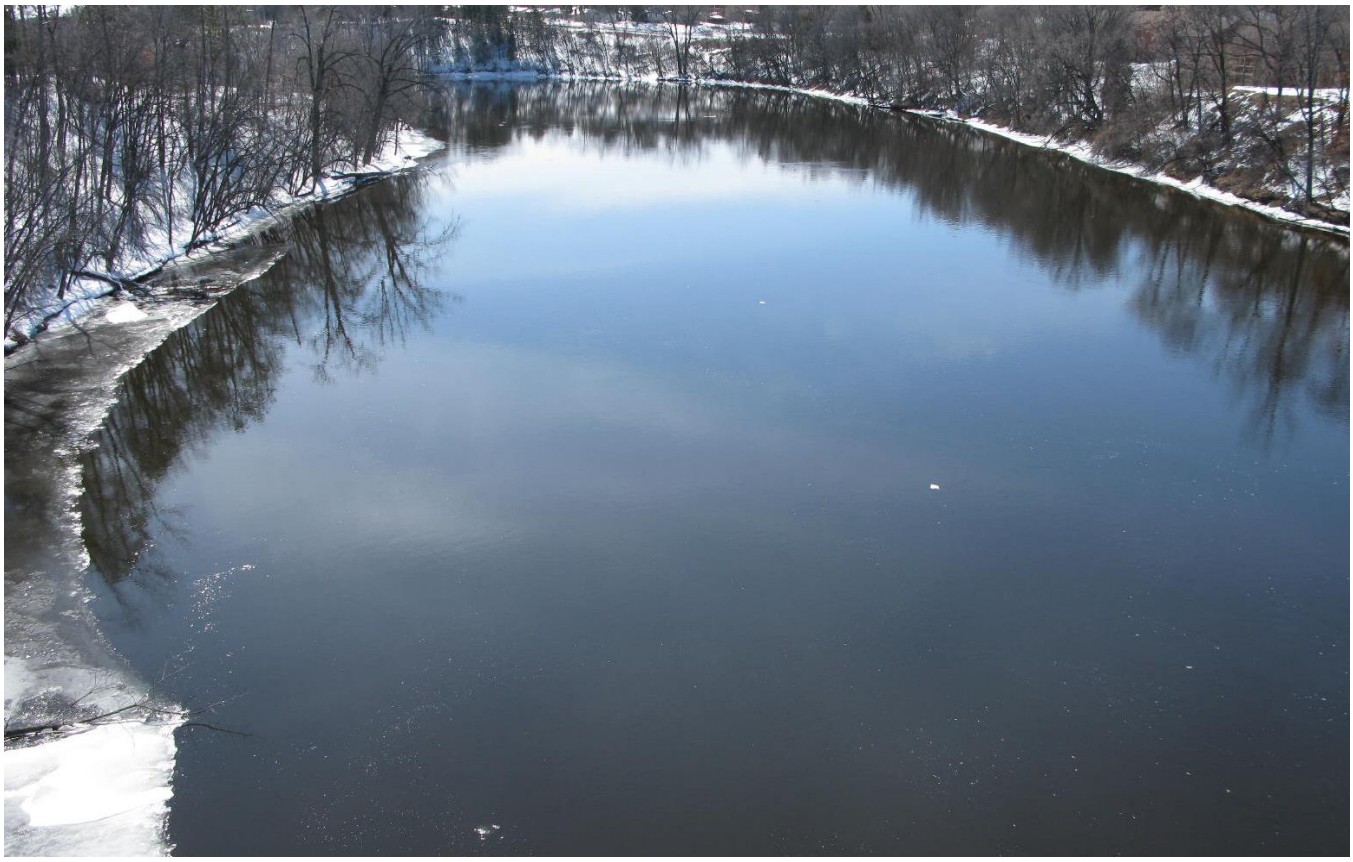
Water quality

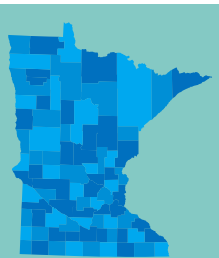
March 2020

2020 Minnesota Water Quality: Surface Water Section

Report to the Congress of the United States Water Years 2018 – 2019
(Abbreviated Narrative Report)



MINNESOTA POLLUTION CONTROL AGENCY



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Foreword

2020 Integrated Report

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

Water years 2018 – 2019

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 Sections 305(b) and 303(d) through the following format by a biennially (in even years), abbreviated narrative report.

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Acronyms

ATTAINS	Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System
AUID	Assessment Unit Identification
BEACH	Beaches Environmental Assessment and Coastal Health
BMPs	Best Management Practices
BWSR	Minnesota Board of Water and Soil Resources
CECs	Contaminants of Emerging Concern
CMP	Chloride Management Plan
CWA	Federal Clean Water Act
CWF	Clean Water Fund
CWLA	Clean Water Legacy Act
E. coli	*Escherichia coli*
EAC	Endocrine Active Compound
EPA	United States Environmental Protection Agency
EQuIS	Environmental Quality Information System
FFY	Federal Fiscal Year
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ISTS	Individual Sewage Treatment Systems
LGU	Local Governmental Unit
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MGS	Minnesota Geological Survey
MIDS	Minimal Impact Design Standards
mg/L	Milligram per liter
MDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer System
N2K	Need-to-know
NPDES	National Pollution Discharge Elimination System
NPS	Nonpoint Source
NPSMPP	Nonpoint Source Management Program Plan
NWCA	EPA's National Wetland Condition Assessment
PCB	Polychlorinated Biphenyl
PFAS	Per- and polyfluoroalkyl substances
POC	Point of Contact
TALU	Tiered aquatic life use
TCMA	Twin Cities Metropolitan Area
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WLA	Waste Load Allocations
WCA	Minnesota Wetland Conservation Act
WQ	Water Quality
WQS	Water Quality Standards(s)

Part A. Introduction and 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, and will be referred to as such.

A.1 Water quality assessments for rivers and lakes

Presented in Tables 1 through 6 are the summary tables for statewide river and lake assessments as of **March 3, 2020**.

Water body specific information will be posted on the MPCA website: https://www.pca.state.mn.us/water/surface-water. For a watershed specific listing of impaired waters with links to additional information, go to the watersheds webpage: https://www.pca.state.mn.us/water/watersheds.

The methodology for determining these assessments is presented in Part C of this report.

The Point of Contact (POC) is Miranda Nichols at 651-757-2416 or miranda.nichols@state.mn.us.

A note to readers about the summary tables:

The summaries in these tables reflect the cumulative assessments from the current reporting cycle and the previous reporting cycles that have not been changed by newer data. They are current with data contained in the 2020 cycle of the ATTAINS on a particular date. Because there are many steps in developing this document occurring over time, there may be minor differences between the mileage and acreage in the summaries and those in the final ATTAINS submittal if last minute changes occur. All tables exclude water bodies located wholly within federally recognized Indian reservations (including parcels held in trust). Table 4, Table 5 and Table 6 include Minnesota's estimated portion of Lake Superior.

Table 1. Summary of fully supporting and impaired waters – streams

Degrees of use support	Miles
Supporting all assessed uses – Category 1	**0**
Supporting at least one use and none impaired – Category 2	**5903**
Impaired for one or more uses – Categories 4 and 5	**17780**
Reviewed but having insufficient data to assess as impaired or supporting – Category 3	**3646**
Total:	**27329**

Table 2. Individual use support summary – streams

Goals	Use	Miles Reviewed	Miles Supporting	Miles Insufficient Information to Assess	Miles Not Supporting
Protect and Enhance Ecosystems	Aquatic Life	**26521**	**9081**	**4340**	**13100**
	Limited Value Resource Waters	**518**	**0**	**333**	**185**
Protect and Enhance Public Health	Aquatic Consumption	**7307**	**0**	**911**	**6396**
	Aquatic Recreation	**15692**	**5258**	**1490**	**8944**
	Drinking Water	**3399**	**0**	**3275**	**124**

Table 3. Total miles of waters impaired by various cause/stressor categories – streams

Cause/Stressor Name	Impaired Miles
Acetochlor	**9**
Aluminum	**193**
Ammonia, unionized	**55**
Arsenic	**293**
Benthic macroinvertebrate bioassessments	**6795**
Chloride	**219**
Chlorpyrifos	**126**
Copper	**5**
DDT	**19**
Dieldrin	**19**
Dioxin (including 2, 3, 7, 8-TCDD)	**13**
Dissolved oxygen	**1999**
Escherichia coli	**5928**
Fecal Coliform	**3182**
Fish bioassessments	**7052**
Lack of cold water assemblage	**17**
Mercury in fish tissue	**6083**
Mercury in water column	**871**

Cause/Stressor Name (cont.)	Impaired Miles
Nitrates	**124**
Nutrients	**814**
PCB in fish tissue	**936**
PCB in Water Column	**85**
Perfluorooctane Sulfonate (PFOS) in fish tissue	**41**
PFOS in water column	**41**
pH	**56**
Temperature, water	**10**
Toxaphene	**13**
Turbidity	**5550**
Total suspended solids	**755**

Table 4. Summary of fully supporting and impaired waters – lakes*

Degrees of Use Support	Acres
Supporting All Assessed Uses – Category 1	**0**
Supporting at Least One Use & None Impaired – Category 2	**236473**
Impaired for One or More Uses – Categories 4 & 5	**3458839**
Reviewed but having Insufficient Data to Assess as Supporting or Impaired – Category 3	**151263**
Total:	**3846575**

Table 5. Individual use support summary – lakes*

Goals	Use	Acres Reviewed	Acres Supporting	Acres Insufficient Information to Assess	Acres Not Supporting
Protect and Enhance Ecosystems	Aquatic Life	**2793644**	**223460**	**2507218**	**62966**
Protect and Enhance Public Health	Aquatic Consumption	**3344191**	**0**	**49611**	**3294580**
	Aquatic Recreation	**2186570**	**1224439**	**339535**	**620898**
	Drinking Water	**2097742**	**0**	**2097742**	**0**

Table 6. Total acres of waters impaired by various cause/stressor categories – lakes*

Cause/Stressor Name	Acres
Ammonia, unionized	**3573**
Chloride	**1400**
Fishes bioassessments	**22127**
Mercury in fish tissue	**3573696**
Mercury in water column	**7555**
Nutrient/eutrophication biological indicators	**624600**
PCB in fish tissue	**1627562**
PFOS in fish tissue	**1576**

***Data includes Lake Superior.**

A.2. Water quality assessments for wetlands

The MPCA has completed a limited number of assessments on depressional wetlands that typically have open water and marsh vegetation. Alternatively, the MPCA focuses our wetland monitoring efforts on probabilistic surveys that can provide overall wetland quality status and trend estimates at broad scales. Probabilistic wetland monitoring is summarized in section C.5 of this report.

The summary wetland assessment information is provided in Tables 7, 8, and 9.

Water body specific information will be posted on the MPCA website: https://cf.pca.state.mn.us/water/watershedweb/wdip/search_more.cfm.

POC is Mike Bourdaghs at 651-757-2239 or michael.bourdaghs@state.mn.us.

Table 7. Summary of fully supporting and impaired waters – wetlands

Degrees of Use Support	Acres
Supporting All Assessed Uses – Category 1	**0**
Supporting at Least One Use and None Impaired – Category 2	**0**
Impaired for One or More Uses – Categories 4 & 5	**995**
Reviewed but Insufficient Data to Assess as Supporting or Impaired – Category 3	**914**
Total:	**1909**

Table 8. Individual use support summary – wetlands

Goals	Use	Acres Reviewed	Acres Supporting	Acres Insufficient Information to Assess	Acres Not Supporting
Protect and Enhance Ecosystems	Aquatic Life	**1074**	**0**	**79**	**995**
Protect and Enhance Public Health	Aquatic Recreation	**908**	**0**	**908**	**0**

Table 9. Total acres of waters impaired by various cause/stressor categories – wetlands

Cause/Stressor Name	Acres
Benthic macroinvertebrate bioassessments	**323**
Aquatic plant bioassessments	**878**
Chloride	**55**

A.3. Water quality assessments for Great Lakes shoreline beaches

The CWA defines Coastal Recreation Waters as the Great Lakes and marine coastal waters (including coastal estuaries) that are designated under section 303(c) of the CWA for use for swimming, bathing, surfing, or similar water contact activities. The MPCA is applying the coastal waters definition and Beaches Environmental Assessment and Coastal Health (BEACH) Act water quality standards to all bacteria monitoring sites on the Lake Superior shoreline and in the mouths of tributaries that are representative of shoreline/Lake Superior conditions. The St. Louis River and Duluth-Superior Harbor sites monitored in the BEACH Act program that extends upstream in the St. Louis River to the Boy Scout Landing Beach are also considered within the coastal recreation designation. AUIDs were established for each individual beach, which generally includes only one beach monitoring station.

Lake Superior coastal waters are subject to Escherichia coli (*E. coli*) water quality standards in the BEACH Act rule [November 2004 *Water Quality Standards for Coastal and Great Lakes Recreation Waters* rule (69 FR 67217, November 16, 2004), found at http://www.gpo.gov/fdsys/pkg/FR-2004-11-16/html/04-25303.htm].

Presented in Tables 10 through 12, are the summary tables for Great Lakes shoreline beach assessments.

The POC is Jesse Anderson at 218-302-6621 or jesse.anderson@state.m.us.

Table 10. Summary of fully supporting and impaired Waters – Great Lakes shoreline beaches

Degrees of Use Support	Miles
Supporting All Assessed Uses – Category 1	**0.00**
Supporting at Least One Use and None Impaired – Category 2	**5.63**
Impaired for One or More Uses – Categories 4 & 5	**1.05**
Reviewed but Insufficient Data to Assess as Supporting or Impaired – Category 3	**0.05**
Total:	**6.73**

Table 11. Individual use support summary – Great Lakes shoreline beaches

Goals	Use	Miles Reviewed	Miles Supporting	Miles Insufficient Information to Assess	Miles Not Supporting
Protect and Enhance Public Health	Aquatic Recreation	**10.04**	**8.87**	**0.11**	**1.06**

Table 12. Total miles of waters impaired by various cause/stressor categories – Great Lakes shoreline beaches

Cause/Stressor Name	Miles
Escherichia coli	**1.05**

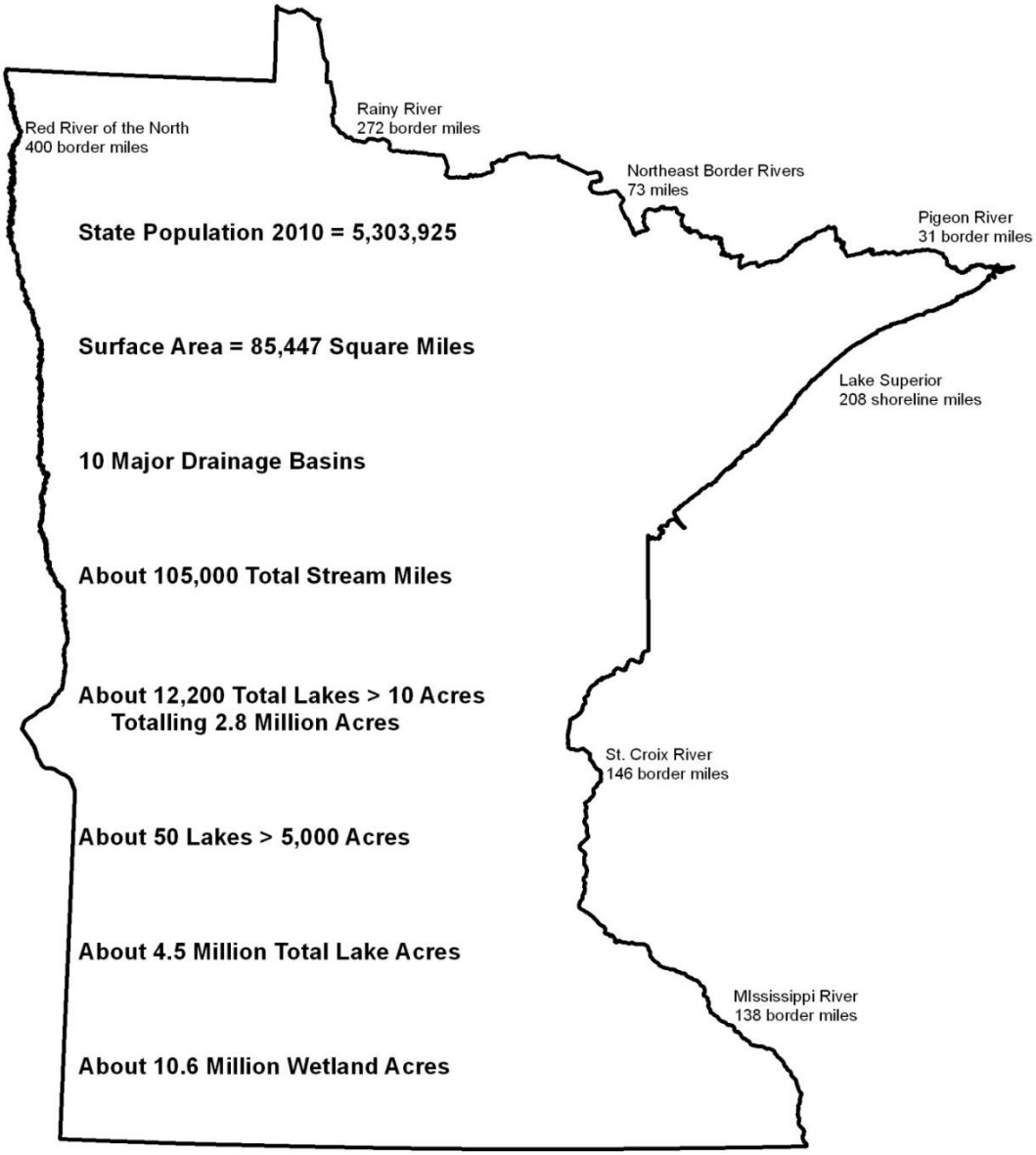
Part B. Background information

B.1. Total waters

B.1.1. State background information

The estimates of background information (in Figure 1) for water bodies were developed from 1:24,000 scale National Hydrography Dataset, with the exception of 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), passed in 2006, 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. 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).

For more detail on MPCA's watershed approach, including the 10-year Intensive Watershed Monitoring Schedule, see the Watershed Approach webpage at: https://www.pca.state.mn.us/water/watershed-approach-restoring-and-protecting-water-quality.

The POC for this is Lee Engel at 651-757-2339 or lee.engel@state.mn.us.

B.2. Water program areas

B.2.1. Wastewater overview

B.2.1.1. Background

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 (ISTS). For more see https://www.pca.state.mn.us/water/wastewater.

The POC is Aaron Luckstein at 507-206-2606 or aaron.luckstein@state.mn.us.

B.2.1.2. Accomplishments

B.2.1.2.1. TMDLs

2018 – 2019, the MPCA has completed an additional 19 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. The list of TMDL projects can be found here: https://www.pca.state.mn.us/water/total-maximum-daily-load-tmdl-projects.

B.2.1.2.2. Permitting

- Reissued general permits for Non-Contact Cooling Water (MNG25 and MNG255)
- Continued 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.
- Developed a Metallic Mining Permit Priority List and reissuance implementation plan, in conjunction with EPA Region 5, to address expired metallic mining permits.
- Address impaired waters through pre-TMDL water quality based effluent limits and effluent limits that are consistent with TMDL WLAs.
- Issued the Met Council Mississippi Basin overlay permit on September 11, 2015. This permit established a total phosphorus limit for five Met Council Wastewater Treatment Plants that complies with the state's river eutrophication standards and Wisconsin's standards.
- Developed a permitting implementation plan to achieve the point source nitrogen reduction goals established in the Statewide Nutrient Reduction Study. As a first step towards achieving the reduction goals, influent and effluent total nitrogen monitoring started being required in NPDES/State Disposal System permits.
- The permitting program contributed to a continuous improvement for handling chemical addition approvals, which will result in a more defined process that should increase timeliness of approvals.
- The permitting program contributed to the development and implementation of a new TEMPO database for issuing and tracking permits.

B.2.1.2.3. Pretreatment

- Routine program oversight, including review of annual reports, annual inspections of the delegated publicly owned treatment plants, and three audits.
- One reissued wastewater treatment permit has a compliance schedule for the development of delegated pretreatment programs.
- Enforcement support.
- Added one new delegated pretreatment program and in the process of requiring the development of two more delegated pretreatment programs as individual permits are reissued
- Completed all pretreatment annual report reviews.

B.2.1.2.4. Financial assistance program and policy development/implementation

- Completed our Clean Water Revolving Fund Project Priority Lists and associated support to the satisfaction of those seeking financial assistance as well as to the satisfaction of our funding partner, the Public Facilities Authority.
- Implement requirements included in Water Resources Reform and Development Act of 2014 to comply with all State Revolving Fund requirements to manage the funds which provided a

significant amount of wastewater and stormwater infrastructure funding assistance, state match or leveraging and related project activity.

- Completed Project Priority List to the satisfaction of our Clean Water Revolving Fund partner, the Public Facilities Authority.
- Completed required legislative report on Future Wastewater Infrastructure Needs and Capital Costs.
- Completed report on Fiscal Year 2018 (FY18) New Wastewater Treatment Facilities.

B.2.1.2.5. Training and certification

- Continued learning events, training, and annual conferences: https://www.pca.state.mn.us/water/wastewater-operators-training-and-certification.
- Continued success with the Need-to-Know (N2K) Certification Implementation.
- Successful Collection System Operators and Wastewater Treatment Plant Operation Annual Conferences had a combined attendance of almost 800 people.
- The Wastewater Training Advisory Committee continues to review current courses and complete a needs assessment for new wastewater courses.
- The unit continues to work to establish better systems, processes and procedures to do more with fewer resources. We are working hard to reach out to new customers and reaffirm and strengthen relationships with established partners and customers.
- Formal training is offered in the Wastewater, Solid Waste and ISTS programs, the unit also provides much needed one-to-one consulting with city, wastewater facilities, and small business personnel.
- The Wastewater Training Team has reviewed and updated the Wastewater Collection System Operator Exams. This review will be conducted again as the Wastewater N2K is completed.
- Wastewater Training is working on fine tuning the Type IV Certification Course and working on possible hours of credit rule change.

The POC is Aaron Luckstein at 507-206-2606 or aaron.luckstein@state.mn.us.

B.2.2. Nonpoint source pollution control

B.2.2.1. Introduction

Minnesota is fortunate to have many water bodies that are in good condition because their terrestrial watersheds still have minimal development, although all surface waters are affected by atmospheric pollutants such as mercury. It is important to protect the good condition of many water bodies, while also addressing degraded water resources.

Minnesota has adopted a watershed approach to address the state's 80 major watersheds on a 10-year cycle. Each major watershed will have a Watershed Restoration and Protection Strategy (WRAPS) report that summarizes work done as part of the watershed approach and includes water quality monitoring and assessment, watershed characterization, civic engagement/public participation, and restoration and protection strategy development.

The CWLA requires that the 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. In addition, the CWLA requires including 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.

B.2.2.2. Nonpoint source management

The Minnesota Nonpoint Source Management Program Plan (Plan) focuses on addressing nonpoint source (NPS) pollution, including phosphorus, nitrogen, sediment, bacteria and other contaminants. This Plan is required by the Federal CWA, Section 319(b) to describe a management program for NPS pollution. The purpose of the Plan is two-fold:

1. Ensure compliance with Section 319 requirements of the Federal CWA for providing a long-term programmatic direction of Minnesota's overall approach to addressing NPS pollution.
2. Provide a "one-stop" resource to understand the state's multiple efforts, overall goals and programs, and connections among them for addressing this pollution source.

Statewide Watershed Approach

Several state agencies are involved in carrying out Minnesota's multiple programs addressing NPS pollution. Much of the effort has been integrated into a framework that is referred to as the Minnesota Water Quality Framework. In addition, there is extensive ongoing coordination among the various public agencies and other entities.

The Minnesota Legislature passed a law in 2013 requiring Board of Water and Soil Resources (BWSR) to prepare and post on its website protection actions based on available WRAPS, TMDL implementation plans, and local water plans. The resulting One Watershed One Plan is a criteria-based, systematic process to prioritize Clean Water Fund (CWF) non-point source implementation investments. See http://www.bwsr.state.mn.us/planning/1W1P/index.html.

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 some important state and federal agencies' grants and other programs for funding water quality improvement projects.

The website for Minnesota's Plan is: https://www.pca.state.mn.us/water/minnesota-nonpoint-source-management-program-plan.

The POC is Celine Lyman at 651-757-2541 or celine.lyman@state.mn.us.

B.2.2.4. Federal Clean Water Act - Section 319

Section 319 of the CWA requires each state to assess NPSs of pollution within its boundaries. State investigations must identify NPSs of pollution that contribute to WQ problems, as well as waters or stream segments unlikely to meet Water Quality Standard (s) (WQS) without additional NPS controls. State management programs must:

- Run for a specific number of years
- Identify the NPS controls necessary
- Specify the programs that will apply the controls
- Certify that the state has adequate authority to implement these measures
- Identify all sources of funding for these programs
- Establish a schedule for implementation

Section 319 NPS funds are made available to assist LGUs and organizations in Minnesota to implement NPS measures that reduce water pollution to lakes, rivers, wetlands and groundwater resources.

In almost every chapter of Minnesota's management plan, education is recognized as an important means for effecting change with respect to NPS water pollution problems. Through 2013 Federal Section 319 Program, the MPCA has awarded $58,315,478 for 525 NPS projects.

MPCA anticipates about $2.5 million will be available in the federal fiscal year (FFY) 2019 funding round for projects that will reduce nonpoint source pollution in Minnesota's lakes, rivers, and streams. Following MPCA recommendation, the EPA funded 12 projects with nearly $2.8 million in financial assistance in FFY2018. Details are found here: https://www.pca.state.mn.us/water/clean-water-partnership-and-section-319-programs.

The POC is Cynthia Penny at 651-757-2099 or cynthia.penny@state.mn.us.

B.2.2.5. Clean Water Partnership financial assistance

Good information about the condition of waters and the health of aquatic systems on a watershed scale is absolutely critical. This is especially important as Minnesota's clean water program continues moving to a watershed approach with a commitment to identify and address remaining WQ problems. The

MPCA addresses impaired waters through TMDL studies. The CWA's impaired waters provisions call for taking measures to mitigate NPS pollution, but neither state nor federal agencies have the authority to regulate much of the activity that causes such pollution. Many of the needed mitigation measures will consist of education and pollution reduction incentives.

Civic engagement

For many years, watershed assessment and planning has largely been a government agency activity, with limited citizen involvement. Too often, citizens and stakeholders were given opportunities to become involved too late in the process when they could do little to influence policy decisions and implementation plans. As a result, there has been limited ownership or buy-in to these plans. Not surprisingly, implementation of water quality plans and practices have often stagnated or not met goals developed for a particular watershed. This experience has led MPCA to reconsider the ways in which it studies and manages water pollution. In addition, The Clean Water Council has recommended that MPCA encourage 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.

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

See more information at: https://www.pca.state.mn.us/water/civic-engagement-watershed-projects.

The POC is Celine Lyman at 651-757-2541 or celine.lyman@state.mn.us.

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.

Extensive information on MPCA's stormwater is available at:
https://www.pca.state.mn.us/water/stormwater

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 urbanized area and used by a population of 1,000 or more 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 2013; the MPCA is currently worked and reissuance. See https://www.pca.state.mn.us/water/reissuing-municipal-stormwater-general-permit.

The MPCA is managing new and competing demands for staff resources associated with priority projects highlighted in 2012. These priorities continue to evolve and require stormwater staff resources. These priorities include project management and the ongoing *Stormwater Manual* update effort (https://www.pca.state.mn.us/water/minnesotas-stormwater-manual).

Additional information on Minnesota's Municipal Stormwater Program can be found at https://www.pca.state.mn.us/water/municipal-stormwater-ms4.

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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. Additional information on Minnesota's Construction Stormwater Program can be found at https://www.pca.state.mn.us/water/construction-stormwater.

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B.2.3.3. Industrial stormwater

Industrial Stormwater General Permit (Permit) are reissued every five years. At this time the 2020-2025 the Permit has been public noticed and Permittees are applying for coverage. The Permit is expected to be reissued April 1, 2020, and effective through April 1, 2025. The timelines of current and post Permits are found at https://www.pca.state.mn.us/water/industrial-stormwater-permit-development-and-program-history. The Permit regulates dozens sectors of industrial activity and required all Permittees to sample their stormwater runoff and send the results to the MPCA. 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 not. Sampling requirements started over for all Permittees, regardless of their outcomes 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 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 least monthly with frequently-asked-questions, steps to compliance, quarterly newsletters, and more: https://www.pca.state.mn.us/water/industrial-stormwater.

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B.2.3.4. Stormwater rules

Minnesota state stormwater rules, Minn. R. ch. 7090 (https://www.revisor.mn.gov/rules/?id=7090), were enacted August 15, 2005, combining the Phase I and Phase II rules in one place. Information on rulemaking is found at https://www.pca.state.mn.us/water/stormwater-program-rulemaking.

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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 $106 million per year [*]and of BWSR approximately $64 million per year.[†] Other costs are incurred at the local

[*] MMB. 2019. 2020 – 21 Governor's Budget – Pollution Control Agency: https://mn.gov/mmb-stat/documents/budget/2020-21-biennial-budget-books/governors-recommendations-february/pollution-control-agency.pdf

[†] BWSR, Biennium budget, FY 2018-19, from BWSR Chief Financial Officer.

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 $300 million per year.

Regarding the actual implementation of point source water pollution controls, more than $4 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 the separation of combined sewers. The estimated infrastructure investment needs and annual operating costs for water treatment statewide is $4.99 billion over the next five years.[§] 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.

One proxy for the cost of non-point pollution abatement is the amount of state funding dedicated towards watershed conservation projects. Between 2009 and 2018, $40.2 million was awarded by the MPCA to fund watershed load reduction projects.[††] Based on past estimates for restoration and current impairments, approximately $2 billion to $9 billion will be needed to restore Minnesota waters on the current 303(d)[‡‡] list that are impaired by NPSs.

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 recent study performed an economic valuation of the ecosystem services of the St. Louis Watershed,[§§] which valued the water resources of the St. Louis Watershed at $2 to $5 billion per year. Though the resulting estimate describes the total annual flow of ecosystem goods and services rather than the benefit

[‡] Minnesota Public Facilities Authority, 2019 Annual Report: https://mn.gov/deed/assets/pfa-annual-report_tcm1045-290187.pdf

[§] MPCA, 2018. *Fiscal Year 2018 Biennial Survey of Wastewater Collection and Treatment*: https://www.pca.state.mn.us/sites/default/files/lrwq-wwtp-1sy18.pdf

[**] Srinivas, R., Drewitz, M., & Magner, J. (2020). Evaluating watershed-based optimized decision support framework for conservation practice placement in Plum Creek Minnesota. *Journal of Hydrology*, 124573.

[††] MPCA, 2018. *Watershed Achievements Report 2018*. Retrieved from https://www.pca.state.mn.us/sites/default/files/wq-cwp8-22.pdf

[‡‡] https://www.pca.state.mn.us/water/impaired-waters-viewer-iwav

[§§] Fletcher, A., Christin, Z. 2015. *The Value of Nature's Benefits in the St. Louis River Watershed*. Earth Economics, Tacoma, WA.

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.[***]

For point source programs, even if dollar figures are not readily available, benefits can be illustrated in descriptive terms. Significant improvements in state water quality have occurred over the past several decades, especially since the passage of the CWA. While only 20% of the state's sewered population was served by facilities capable of at least secondary treatment in 1952, fully 99.9% are so served at present. In a similar vein, rates of regulatory compliance for municipal and industrial facilities are at a high level, with 99% of permittees meeting their effluent limits. As a result of the MPCA's efforts, phosphorus loads from wastewater treatment plants have decreased 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. 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.[‡‡‡]

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 generates approximately $13.6 billion per year.[§§§] More than $2 million comes from expenditures related to fishing and wildlife viewing alone,

[***] Dalzell, B., Pennington, D., Polasky, S., Mulla, D., Taff, S., and Nelson, E. 2012. *Lake Pepin Watershed Full Cost Accounting Project*.

[†††] St. Louis River Area of Concern, 2019 Remedial Action Plan, Retrieved from https://www.pca.state.mn.us/sites/default/files/wq-ws1-31.pdf

[‡‡‡] Passi, Peter. (2016, February 2). Duluth's tourism industry continues to grow. *Duluth News Tribune*. Retrieved from http://www.duluthnewstribune.com/ on June 6th, 2016.

[§§§] Explore Minnesota. 2016. *Tourism and Minnesota's Economy*. Retrieved from www.exploreminnesota.com on June 9, 2016.

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.

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. The results of this study, along with numerous similar studies across the United States, 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 https://www.pca.state.mn.us/about-mpca/dashboard-environmental-and-performance-measures.

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B.4. Special state concerns and recommendations

B.4.1. Restoring impaired waters and protecting unimpaired waters

Impaired waters continue to be a special and growing concern. When a water body fails to meet WQSs because of one or more pollutants, it is considered impaired. As of March 2, 2020, the 2020 proposed Impaired Waters List has 5,775 impairments. The largest sources of the increases include additional water bodies with excess bacteria, additional water bodies with eutrophication excesses, and additional water bodies with excess mercury in fish. These pollution problems are caused by a combination of point and NPSs.

In November of 2008, the voters of Minnesota approved an amendment to the state's constitution to raise the sales and use tax rate by three-eighths of 1% on taxable sales, starting July 1, 2009, and continuing through 2034. Of those funds, approximately 33% will be dedicated to a CWF to protect, enhance, and restore WQ in lakes, rivers, streams, and groundwater, with at least 5% of the fund targeted to protect drinking water sources. Revenues appropriated from the CWF will vary depending on the economy, but estimates range from $150-$200 million per biennium. The majority of CWF appropriations will be allocated to point and nonpoint-related programs governed by several state

agencies, including the MPCA, BWSR, the MDA, the MDNR and the MDH. These agencies are coordinating closely with LGUs to implement water programs.

Detailed appropriations for fiscal years can be found in the fact Sheets found here: https://www.legacy.mn.gov/clean-water-fund-interagency-fact-sheets. Performance reports on progress protecting and restoring waters are produced every two years: https://www.legacy.mn.gov/funds/clean-water-fund/clean-water-fund-performance-reports; the latest 2020 report can be downloaded directly at https://www.legacy.mn.gov/2020-clean-water-fund-performance-report. For additional information, see https://www.pca.state.mn.us/water/clean-water-fund.

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

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.4.2.1. 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. The results of many of these studies can be found in reports located at https://www.pca.state.mn.us/water/endocrine-active-compounds.

B.4.2.2. Endocrineactive chemicals

Building on the results of the study referenced above and other surveys of pharmaceuticals, household, and industrial products in the aquatic environment, scientists from the USGS, St. Cloud State University, the University of Minnesota, the University of St. Thomas, and the MPCA conducted a series of investigations into the significance, sources, and occurrence of EACs in Minnesota's waste streams and waters. EACs mimic hormones causing adverse behavioral and physiologic effects, including impairment of the reproductive system or the disruption of growth and development of an organism. Many of the pharmaceuticals, personal care products, and other wastewater-associated chemicals included in MPCA's monitoring studies are considered EACs.

Beginning in 2010, the MPCA began collecting groundwater samples from its Ambient Groundwater Monitoring Network for analysis of over 100 CECs, which included EACs. The primary objective of the first year of sampling was to determine the magnitude of contamination in the groundwater; consequently, the sampling focused on areas with a high relative potential for groundwater contamination. The results from the 2010 survey are available here: https://www.pca.state.mn.us/sites/default/files/wq-cm4-03.pdf. The MPCA is continuing to monitor Minnesota groundwater for EACs and other emerging contaminants in partnership with the USGS.

The MPCA will continue monitoring for EACs and other emerging contaminants in Minnesota surface waters in conjunction with statewide and nationally based probabilistic surveys to build trend information over time. For details see the reports posted at https://www.pca.state.mn.us/water/pollutants-emerging-concern.

B.4.2.3. Perfluorinated chemicals

Perflourinated chemicals (PFCs) are manmade chemicals used to manufacture products that are heat and stain resistant and repel water. PFCs 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.

In Minnesota, 3M manufactured PFCs from approximately 1950 until they were phased out in 2002. During that time, large volumes of PFCs were released into the Mississippi River in effluent from the 3M Cottage Grove Wastewater Treatment Plant. In addition, four sites in Washington County were identified where 3M disposed of PFC wastes prior to the advent of modern solid and hazardous waste laws and regulations aimed at protecting groundwater. These are in Oakdale, Woodbury, and Cottage Grove, and at the former Washington County Landfill in Lake Elmo.

Initial work by the MPCA and MDH focused on identifying contaminated drinking water wells in these areas, and making sure residents had access both in the short and long term to safe drinking water. While these more immediate concerns were addressed by the MPCA, MDH and 3M, investigations and negotiations with 3M led to a formal Consent Order in 2007 between the MPCA and 3M regarding the release and discharge of PFCs from these sites. The consent decree set forth specific steps required of 3M to remediate its disposal sites and ongoing PFC releases. On February 20, 2018, the state of Minnesota settled its lawsuit against the 3M Company in return for a grant of $850 million. Minnesota's attorney general sued 3M in 2010 alleging that the company's production of chemicals known as PFCs had damaged drinking water and natural resources in the southeast Twin Cities Metro Area. After legal and other expenses are paid, about $720 million will be invested in drinking water and natural resource projects in the Twin Cities east metropolitan region. How this grant will be used is summarized at https://www.pca.state.mn.us/waste/3m-and-pfcs-2018-settlement.

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. More information can be found at https://www.pca.state.mn.us/waste/perfluorochemicals-pfcs.

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Part C. Monitoring and assessment strategy

C.1. Water quality standards development

At the center of the assessment process are the beneficial uses we derive from our water resources and the water quality standards that protect these uses. The water quality standards are the fundamental tool by which the quality of groundwater and surface waters is measured. The water quality standards listed in Minn. R. chs. 7050 and 7052 consist of three elements:

- Classifying waters with designated beneficial uses
- Narrative and numeric standards to protect those uses
- Nondegradation (antidegradation) policies to maintain and protect existing uses and high quality waters

For a full discussion on WQSs, see MPCA's WQSs webpage at https://www.pca.state.mn.us/water/water-quality-standards. Minn. R. chs. 7050 and 7052 can be found at https://www.revisor.mn.gov/rules.

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C.2. Monitoring strategy

C.2.1 Minnesota's water quality monitoring strategy

The Minnesota's Water Quality Monitoring Strategy, 2011-2021 (Monitoring Strategy), 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.

Minnesota's WQ monitoring strategy is available at: https://www.pca.state.mn.us/sites/default/files/p-gen1-10.pdf.

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C.2.2. 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. 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. For a full discussion of the benefits and components of the watershed approach, refer to the Watershed Approach webpage (https://www.pca.state.mn.us/water/watershed-approach-restoring-and-protecting-water-quality).

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C.2.3. 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. Information and reports can be found at https://www.pca.state.mn.us/water/your-stream-stressed.

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C.2.4. 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 2 years 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. As a result, the second round of monitoring can server as a measure of the effectiveness of the implemented practices from the previous cycle.

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C.2.5. Surface water monitoring purposes, designs and indicators

The MPCA's current Condition, Problem Investigation and Effectiveness Monitoring activities are described in detail in Section 2.4 of the Monitoring Strategy, from pages 33 - 44. 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. The Monitoring Strategy is available here: https://www.pca.state.mn.us/sites/default/files/p-gen1-10.pdf.

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C.2.6. 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 Section VI., Part D, of the *2020 Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List* available here: https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list.

As part of the latest Triennial Standards Review, the MPCA has taken the first step to engage the MDH and the public on needed improvements to the approach for designating and setting Class 1, Domestic Consumption, water quality standards for drinking water protection. The basis for current Class 1 designation and standards needs revisions to improve consistency with other statutes and rules that

protect groundwater and drinking water. This project is a priority for work in the coming three years following the Triennial Standards Review. The discussions with the MDH will include consideration of monitoring and assessment approaches.

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C.2.7. Source water

The 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. 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.

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C.3. Assessment methodology and summary data

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* posted at https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list. A direct link to the 2020 version document can be directly downloaded here: https://www.pca.state.mn.us/sites/default/files/wq-iw1-04k.pdf.

C.4. Impaired waters

C.4.1. Impaired Waters List

Minnesota's Impaired Waters List can be found on the MPCA website at: https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list. The Impaired Waters List is considered final until EPA provides MPCA with approval. The MPCA will use ATTAINS for integrated reporting. The Category 5 Assessment Units in the ATTAINS will match what is in the submitted Impaired Waters List. Pollutants listed in the MPCA's 2020 proposed Impaired Waters List are listed in the Summary section of the 2020 Impaired Waters List which can be downloaded directly at https://www.pca.state.mn.us/sites/default/files/wq-iw1-65.xlsx.

C.4.2. Total maximum daily loads and impaired waters

For each pollutant that causes a water body to fail to meet applicable WQSs, 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 NPSs 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. 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.

The MPCA's progress on TMDLs is updated frequently here: https://www.pca.state.mn.us/water/tmdl-status.

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C.4.2.1. Strategies the MPCA employs in the impaired waters restoration process

C.4.2.1.1. 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 CWF. The CWF appropriations for all fiscal years are in fact sheets found at https://www.legacy.mn.gov/clean-water-fund-interagency-fact-sheets. 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:

- CWA: https://www.epa.gov/laws-regulations/summary-clean-water-act
- CWLA: https://www.revisor.mn.gov/statutes/?id=114D
- CWF: http://www.legacy.leg.mn/funds/clean-water-fund

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.

The POC is Celine Lyman at 651-757-2541 or celine.lyman@state.mn.us.

C.4.2.1.2. 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. Our 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.

The POC is Celine Lyman at 651-757-2541 or celine.lyman@state.mn.us.

C.4.2.1.3. 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.

The POC is Celine Lyman at 651-757-2541 or celine.lyman@state.mn.us.

C.4.2.1.4. Strategies for waters impaired by mercury and other toxic pollutants

Mercury can be carried great distances on wind currents before it eventually falls on our land and water bodies. In fact, about 90% of the mercury deposited from the air in Minnesota comes from other states and countries. Therefore, the traditional TMDL approach to addressing impairments will not work for mercury, as Minnesota cannot control the many sources of this toxic pollutant outside our borders.

The MPCA's statewide Mercury TMDL was approved by EPA in March 2007, and an implementation plan was completed in October 2009. The implementation plan includes measures to reduce mercury from airborne sources such as coal-fired power plants. For more information on the Mercury TMDL and implementation plan, go to: https://www.pca.state.mn.us/water/statewide-mercury-reduction-plan.

The POC is Bruce Munson at 651-757-2579 or bruce.monson@state.mn.us.

The MPCA has undertaken a Metropolitan Area Chloride Project, partnering with local and state experts in the seven-county metro area to evaluate and address chloride impairments. This project included extensive data analysis, a literature review, a telephone survey of local municipalities, and analysis of potential strategies for further research, public education, and potential regulation. The Twin Cities Metropolitan Area (TCMA) Chloride Management Plan (CMP) was also developed as part of this effort. The CMP incorporates water quality assessment, source identification, implementation strategies, monitoring recommendations, and measurement and tracking of results into a performance-based adaptive approach for the TCMA. While this plan was developed to address chloride impacts specifically to waters in the TCMA, the restoration and protection goals, implementation strategies, and monitoring and tracking recommendations can be applied statewide. For more information, see https://www.pca.state.mn.us/water/chloride-salts.

The POC is Brooke Asleson at 651-757-2205 or brooke.asleson@state.mn.us.

C.4.2.1.5. Strategies to increase the effectiveness and efficiency of total maximum daily load development and implementation

Given the growing number of TMDL studies, limited staffing, and available funding, the MPCA has made important strides to increase the efficiency and effectiveness of its impaired waters activities.

Minnesota watershed approach on the 10-year cycle

The state of Minnesota has adopted a Watershed Approach on a 10-year cycle to address the water quality of the state. The scale is based on the major watershed, or more specifically the 8-digit hydrologic unit code or HUC. Minnesota has 80 HUC8 watersheds. In a 10-year period, all 80 watersheds will be intensively monitored or sampled, assessed for impaired waters and waters in need of protection, modeled with USGS Hydrological Simulation Program-FORTRAN, and investigated for biological stressors. Using this data, the needed TMDLs will be developed according to the 10-year cycle.

For more information see https://www.pca.state.mn.us/water/watershed-approach-restoring-and-protecting-water-quality.

Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program

The MPCA has prioritized TMDLs for the years 2016-2022 as part of EPA's "Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program". These TMDL priorities are a subset of our Section 303(d) list and reflect our priorities identified by the TMDL Start and Completion dates on the list. Minnesota's TMDL priorities identified for the prioritization goal of EPA's Long-Term Vision are those water bodies listed for conventional pollutants with an estimated TMDL Completion date of 2021 or earlier. Waterbodies listed for nonconventional pollutants (chloride and mercury for example) will continue to be done according to the 303(d) list dates, but they will be done through a separate process rather than through the watershed approach. A small number of water bodies listed for conventional pollutants have been deferred to later dates when Cycle 2 of the watershed approach is in progress.

- Documents
  - Minnesota's TMDL Priority Framework: https://www.pca.state.mn.us/sites/default/files/wq-iw1-54.pdf
  - EPA's Long-Term Vision: https://www.epa.gov/sites/production/files/2015-07/documents/vision_303d_program_dec_2013.pdf
  - Water Governance Evaluation: https://www.pca.state.mn.us/sites/default/files/lrwq-gen-1sy13.pdf

The POC is Celine Lyman at 651-757-2541 or celine.lyman@state.mn.us.

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 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. Progress is reported at https://www.pca.state.mn.us/water/watershed-restoration-and-protection-strategy-status.

The POC is Celine Lyman at 651-757-2541 or celine.lyman@state.mn.us.

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 103B.801 (https://www.revisor.mn.gov/statutes/cite/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 is found at https://bwsr.state.mn.us/one-watershed-one-plan-participating-watersheds.

The POC is Pam Anderson at 651-757-2190 or pam.anderson@state.mn.us.

C.4.2.1.6. Goal setting and performance measurement

Clean Water Fund Performance Reports on progress protecting and restoring waters are produced every two years: https://www.legacy.mn.gov/funds/clean-water-fund/clean-water-fund-performance-reports. The latest 2020 CWF Performance Report can be downloaded directly at https://www.legacy.mn.gov/2020-clean-water-fund-performance-report.

The POC is Pam Anderson at 651-757-2190 or pam.anderson@state.mn.us.

C.4.2.2. Relationship of 305(b) Report to 303(d) List

A complete description of the integration of the 305(b) Report with the 303(d) listings, the levels of use support, how data are used and data quality are determined may be found in the *Guidance Manual*. This report, along with Minnesota's past and present versions of the Impaired Waters List, may be found at https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list. The *2020 Guidance Manual* can be downloaded directly at https://www.pca.state.mn.us/sites/default/files/wq-iw1-04k.pdf.

C.5. 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.5.1. Wetland regulatory program

The 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. § 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 2 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 3 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 2. Minnesota Section 401 water quality certifications by category for fiscal year (FY) 2019

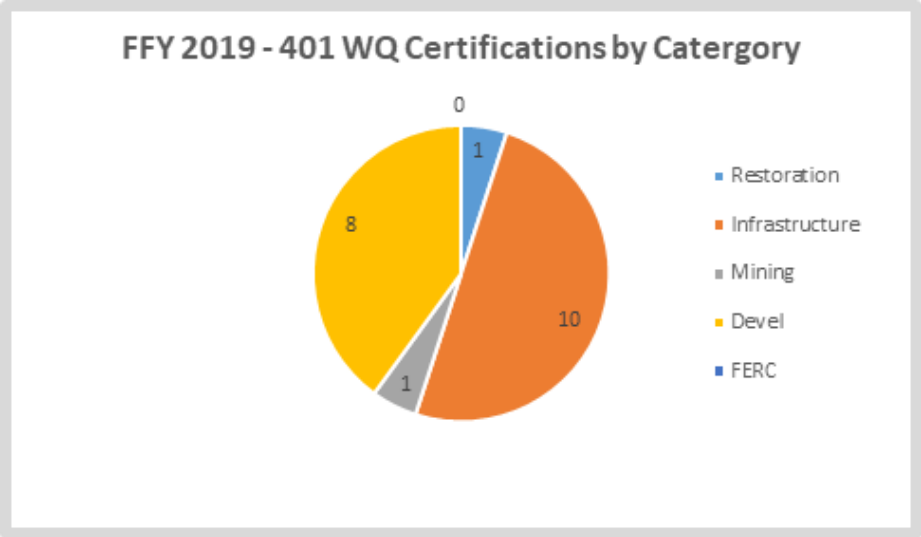
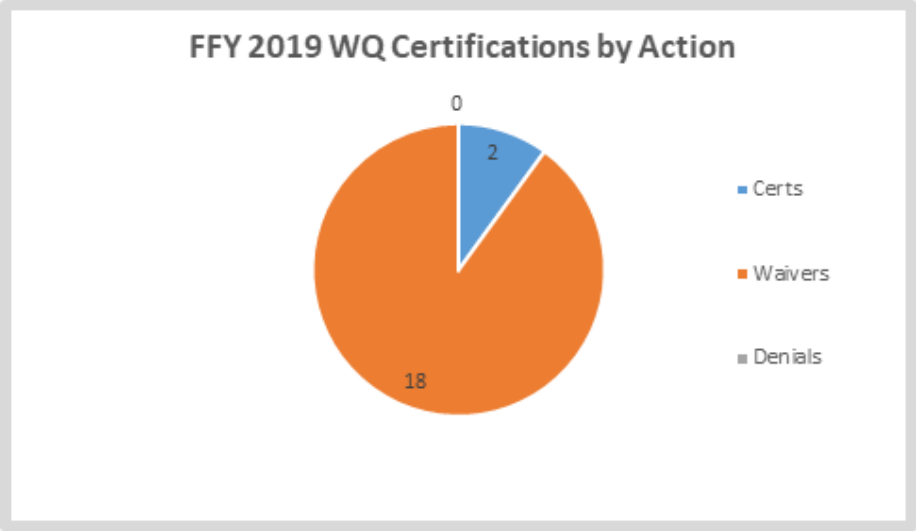


Figure 3. Minnesota Section 401 water quality certification by action fiscal year (FY) 2019



The POC is Jim Brist at 651-757-2245 or jim.brist@state.mn.us.

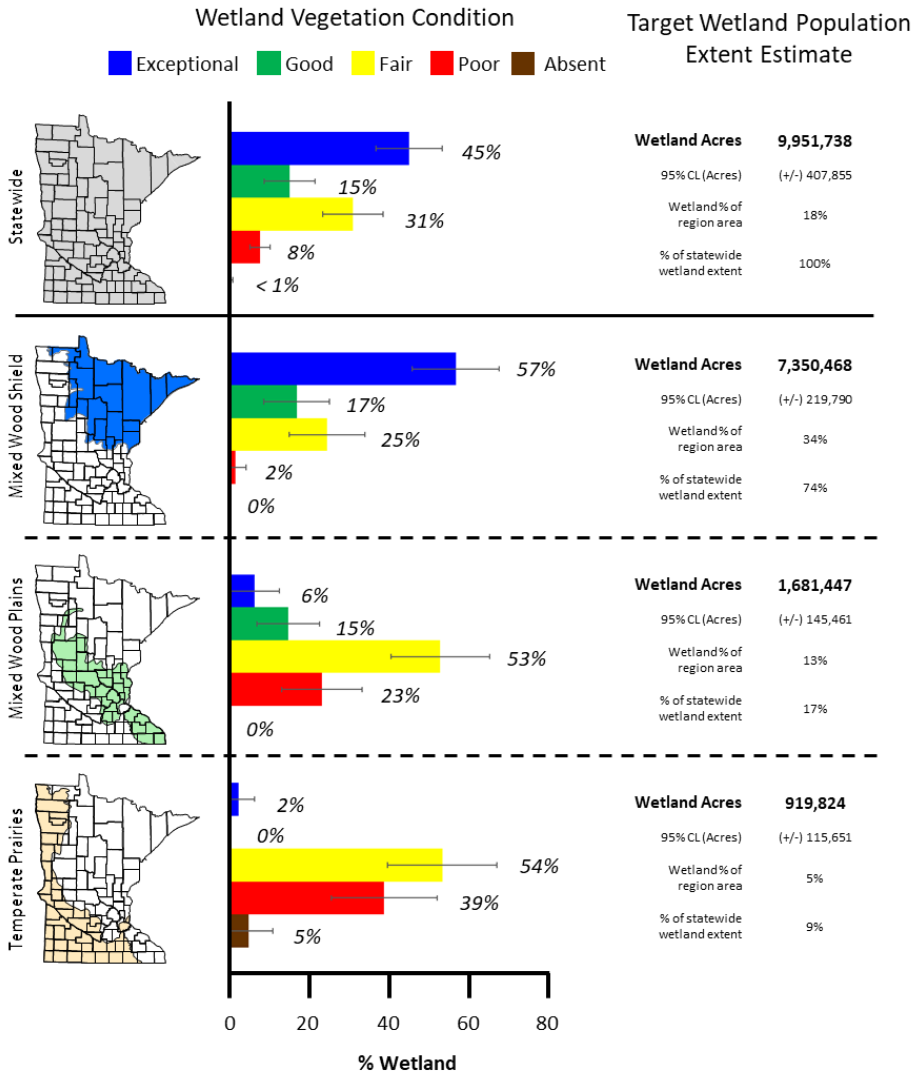
C.5.2 Wetland monitoring and assessment.

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 (NWCA) in Minnesota. Statewide and regional intensification surveys have been completed in 2011/12 and 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 4). 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 anticipates continuing this survey on the 5-year NWCA schedule and is prepping for the next iteration beginning 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 (2007-09, 2012, and 2017) in the Mixed Wood Plains and Temperate Prairies ecoregions—where deperessional wetlands are more common. No significant wetland quality changes in have been detected over the survey iterations. The MPCA anticipates continuing the depressional wetland survey in 2023.

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



The POCs are Michael Bourdaghs at 651-757-2239 or michael.bourdaghs@state.mn.us; John Genet at 651-757-2386 or john.genet@state.mn.us.

C.6. Trends analysis

C.6.1. 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. Information about the Watershed Pollutant Load Monitoring Network is available at: https://www.pca.state.mn.us/water/watershed-pollutant-load-monitoring-network.

The POC is James Jahnz at 651-757-2214 or james.jahnz@state.mn.us.

Trend analysis of stream water clarity data has also recently been done using all stream and river transparency measurements available in EQuIS, including those collected by volunteers through the Citizen Stream Monitoring Program. Table 15 shows the most recent trends from 2108. See for https://www.pca.state.mn.us/water/transparency-trends methodology and a detailed statewide map of stream trends.

Table 13. Trends in Minnesota stream water clarity

Stream trend	Streams with this trend: 2018
Degrading	243 (34%)
Improving	232 (32%)
No trend	210 (29%)
No change	38 (5%)
Too clear to run a test	514
Insufficient data	2526
Stream stations with data	3762
Stream stations with enough data to run a test	722

The POC is Laurie Sovell at 651-757-2750 or laurie.sovell@state.mn.us.

C.6.2 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 (found at https://www.revisor.mn.gov/rules/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 in November 2017. 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

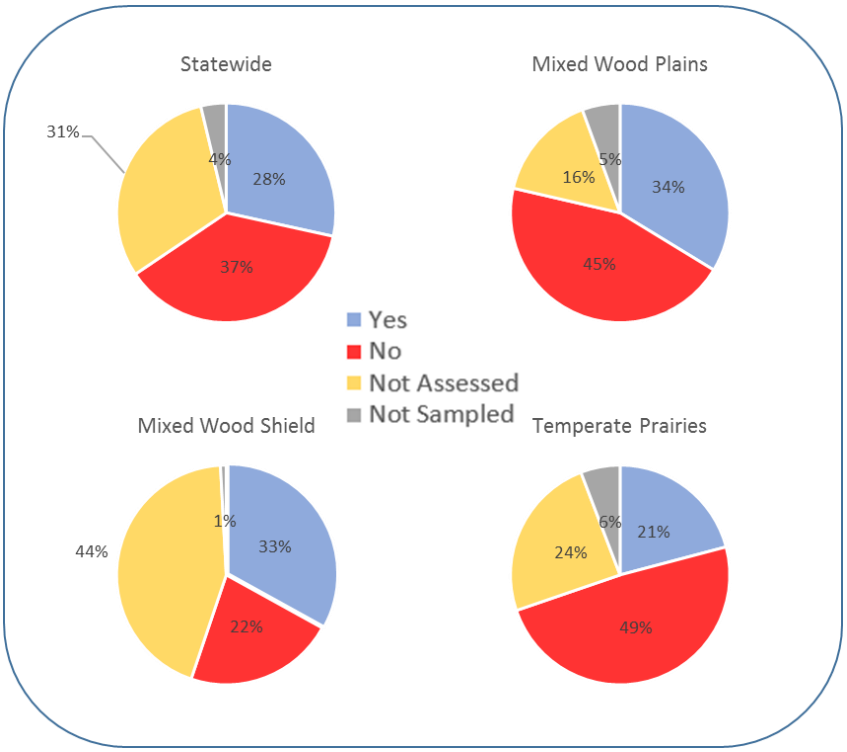
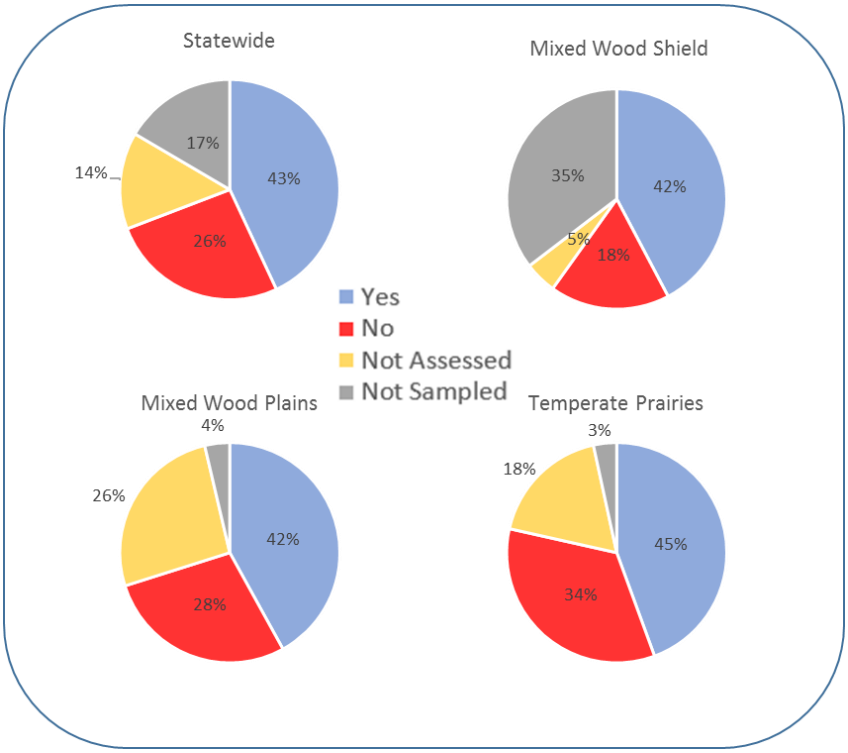
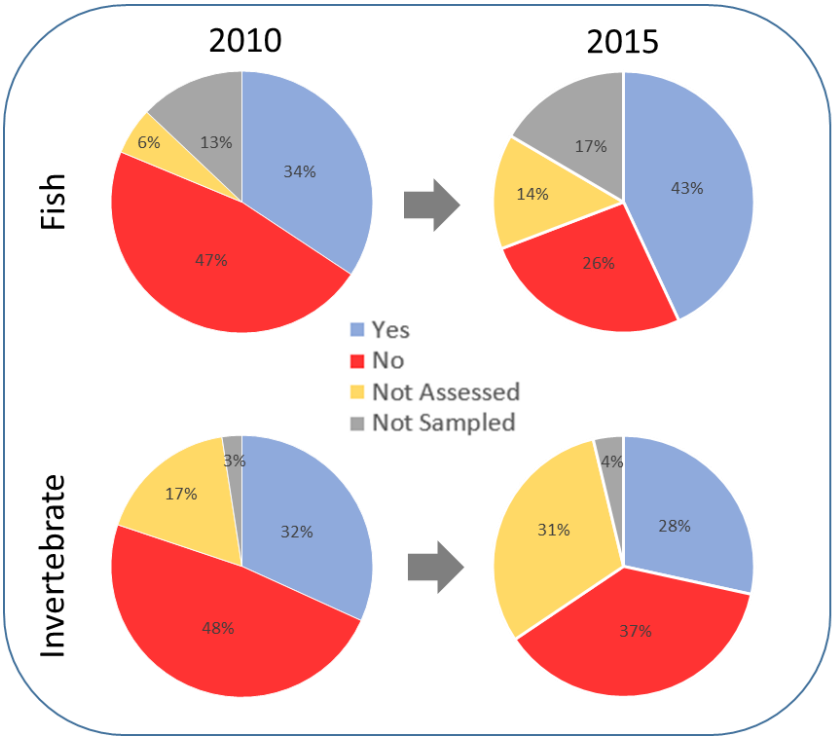


Figure 6. Estimated percent of stream miles that meet (i.e., Yes) fish IBI TALU criteria



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 7). 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



C.6.3. Water quality trends for Minnesota lakes

Trend analysis of stream water clarity data has also recently been done using all stream and river transparency measurements available in EQuIS, including those collected by volunteers through the Citizen Stream Monitoring Program. Table 14 shows the most recent trends from 2108. See for https://www.pca.state.mn.us/water/transparency-trends methodology and a detailed statewide map of stream trends.

Table 134. 2018 Lake transparency trend assessment

Lake trend	Lakes with this trend
Degrading	187 (11%)
Improving	482 (29%)
No trend	788 (48%)
No change	189 (11%)
Insufficient data	3150
Lakes with data	4796
Lakes with a trend	1646

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. More information about the Sentinel Lakes Monitoring Program is available here: https://www.pca.state.mn.us/water/sentinel-lakes.

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. Reports developed from Minnesota's participation in the 2007 and 2012 National Lakes Assessment may be found here https://www.pca.state.mn.us/water/national-lakes-assessment-project-nlap.

The POC is Shannon Martin at 651-757-2874 or shannon.martin@state.mn.us.

C.6.3.1 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. 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. Additional details may be found at https://www.pca.state.mn.us/water/national-lakes-assessment.

The POC for this is Lee Engel at 651-757-2339 or lee.engel@state.mn.us.

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. Further details may be found at https://www.pca.state.mn.us/water/watershed-pollutant-load-monitoring-network.

The POC is James Jahnz at 651-757-2214 or james.jahnz@state.mn.us.

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 15), 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 MPCA approves new pesticide products for use in the state in cooperation with the EPA. The MPCA also monitors the groundwater to determine that pesticides are used properly and do not have a harmful impact on the state's groundwater. The MPCA 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 14. Summary of Minnesota groundwater protection programs

Programs or Activities	Check (✓)	Implementation Status	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 (Minnesota Pollution Control Agency 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 commercial data management system called EQuIS, which is 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 (Minnesota Department of Agriculture 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. Additional information about the program can be found at the MDA's website here: http://www.mda.state.mn.us/monitoring.

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 2019, 30,769 private drinking water wells in 306 townships were sampled for the Township Testing Program, and about 5,300 wells were tested for the Private Well Pesticide Project from 2014-2018. Additional information concerning these programs can be found at the MDA's website

here: http://www.mda.state.mn.us/townshiptesting and https://www.mda.state.mn.us/pesticide-fertilizer/private-well-pesticide-sampling-project.

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 and 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 in southeastern Minnesota, often in places where the shallow groundwater was naturally vulnerable to contamination from the land surface. 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 (Minnesota Pollution Control Agency and Minnesota Department of Agriculture 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 (Minnesota Pollution Control Agency and Minnesota Department of Agriculture 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. See more information at: https://www.pca.state.mn.us/water/civic-engagement-watershed-projects.

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 2020 303(d) Impaired Waters List was placed on the MPCA website in November 2019. The public was informed by a statewide MPCA press release and emails to individuals and groups on the MPCA 303(d) distribution list. Four public meetings were held in December 2019. The formal public comment period was between November 12, 2019 and January 14, 2020.

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 at: https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list.

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