2004 Integrated Report: Surface Water Section

(Abbreviated Narrative Report)

Report to the Congress of the United States
Water Years 2002 - 03

2004 Integrated Report

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

Water Years 2002-03

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: an annual electronic report accompanied biennially (in even years) by an abbreviated narrative report.

For further information, contact:
Elizabeth Brinsmade, Integrated Report Coordinator
Minnesota Pollution Control Agency
Environmental Outcomes Division
520 Lafayette Road
Saint Paul, MN 55155-4194
Phone: (651) 296-7312 or (800) 657-3864
E-mail: elizabeth.brinsmade@pca.state.mn.us

Prepared by

Minnesota Pollution Control Agency

MINNESOTA POLLUTION CONTROL AGENCY

Sheryl Corrigan, Commissioner
Michael J. Sandusky, Environmental Outcomes Division Director

Elizabeth Brinsmade – Integrated Report Coordinator

Contributors and Authors

Craig Affeldt
Jesse Anderson
Carrie Bartz
Nolan Baratono
Pat Baskfield
Sam Brungardt
Joel Chirhart
Dave Christopherson
Jennifer Eddleston
Mike Feist
Brian Frederickson
Lee Ganske
Elizabeth Gelbmann
Larry Gunderson
Douglas Hansen
Steve Heiskary
Jim Hodgson
Paul Hoff
Louise Hotka
Tim James
Tim Larson
Jim MacArthur
Molly MacGregor
Howard Markus
Dave Maschwitz
Sylvia McCollor
Bruce Monson
Bob Murzyn
Mary Osborn
James Porter
Angela Preimesberger
Ralph Pribble
Gaylen Reetz
Jeff Risberg
Norman Senjem
Carol Sinden
Laurie Sovell
Bill Thompson
Tim Thurnblad
Mike Vavricka
Dennis Wasley

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Chuck Johnson – Rice Creek Watershed District
Richard Lacher – Big Fork River Watch
John Sullivan – Wisconsin Department of Natural Resources

This document summarizes the coordinated efforts of additional staff throughout the Minnesota Pollution Control Agency and other agencies that provided extensive information and assistance.

ABBREVIATIONS, ACRONYMS AND SYMBOLS

319	Section 319
ADB	Assessment Database
BOD	Biochemical Oxygen Demand
CALM	Consolidated Assessment and Listing Methodology
CWA	Clean Water Act
CWP	Clean Water Partnership
DO	Dissolved Oxygen
EMAP	Environmental Monitoring and Assessment Program
EPA	U.S. Environmental Protection Agency
FAV	Final Acute Value
FS	Fully Supporting
Hg	Mercury
IAR	Integrated Assessment Report
IBI	Index of Biotic Integrity
L	Liter
MCES	Metropolitan Council Environmental Services
MDH	Minnesota Department of Health
MDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
MS4s	Municipal Separate Stormwater Systems
na	Not Applicable
NHD	National Hydrography Dataset
NPDES	National Permit Discharge Elimination System
NPS	Nonpoint Source
OIRW	Outstanding International Resource Waters
ORVW	Outstanding Resource Value Waters
PCB	Polychlorinated biphenyls
ppb	Parts Per Billion
PS	Partially Supporting
pt.	Part
R.	Rule
SIDRS	Stream Inventory and Data Retrieval Systems Program
STORET	EPA water quality data STOrage and RETreival system
TMDLs	Total Maximum Daily Loads
USGS	U.S. Geological Survey
WQS	Water Quality Standards
≥	Greater than or equal to
≤	Less than or equal to
µg/L	Microgram per liter or ppb

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I. INTRODUCTION AND EXECUTIVE SUMMARY

The Minnesota Pollution Control Agency (MPCA) currently conducts a variety of surface and ground water monitoring activities that support our overall mission of helping Minnesotans protect the environment. To be successful preventing and addressing 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's monitoring efforts are focused on providing that critical information. Overall, the MPCA is striving to provide information to assess – and ultimately to restore or protect – the integrity of Minnesota's waters.

Sections 305b and 303d of the Federal Clean Water Act (CWA) both call for states to report on their waters to help measure progress toward the national goals of fishable and swimmable waters. The MPCA is using the U.S. Environmental Protection Agency's (EPA) Consolidated Assessment and Listing Methodology (CALM) for its 2004 Integrated Report.

CALM integrates the 305(b) Report with the 303(d) Impaired Waters List. It provides a framework for states and other jurisdictions to document how they collect and use water quality data and information for environmental decision making. The primary purposes of these data analyses are to determine the extent that all waters are attaining water quality standards, to identify waters that are impaired and need to be added to the 303(d) list, and to identify waters that can be removed from the list because they are attaining standards.

The CALM requires States to create several new requirements or approaches to enable the Report and List to be blended:

- delineation of water quality assessment units (AUs) based on the National Hydrography Dataset (NHD);
- status of and progress toward achieving comprehensive assessments of all waters;
- water quality standard attainment status for every AU;
- basis for the water quality standard attainment determinations for every AU;
- additional monitoring that may be needed to determine water quality standard attainment status and, if necessary, to support development of Total Maximum Daily Loads (TMDLs) for each pollutant/AU combination;
- schedules for additional monitoring planned for AUs;
- pollutant/AU combinations still requiring TMDLs; and
- TMDL development schedules reflecting the priority ranking of each pollutant/AU combination.

One significant aspect is that all water bodies must be placed into one, and only one, of five categories. The EPA website has a significant amount of information on CALM and how it was developed at: http://www.epa.gov/owow/monitoring/calm.html

The five categories in CALM are as follows:

Category 1: all designated uses are meeting water quality standards
Category 2: some uses are meeting water quality standards and there are insufficient data to assess other uses
Category 3: there are insufficient data to assess any uses
Category 4: at least one use is impaired, but a TMDL is not required
Category 5: at least one use is impaired and a TMDL is required. These become the List of impaired waters.

As noted above, a reach can only be placed into one Category. For example, if a reach is impaired for one pollutant but the other uses are being met, and a TMDL is required, that reach would be placed into Category 5. Furthermore, if the reach is impaired for more than one pollutant, the reach must stay in Category 5 until ALL pollutants have EPA-approved TMDL plans.

Water Quality Assessments for Rivers and Lakes

Presented below are the summary tables for statewide river and lake assessments, using information from the Assessment Database (ADB). An electronic update of the entire ADB is also being submitted to the United States Environmental Protection Agency (USEPA). Waterbody specific information will be posted on the MPCA Web site, http://www.pca.state.mn.us/water/index.html. The methodology for determining these assessments is presented in Part IV, A. of this report.

A Note to Readers about the Summary Tables

This biennial report to Congress on the condition of the waters of the State is required under Section 305b of the Clean Water Act (CWA). 2004 marks the first time that Minnesota is providing an integrated report, combining the reporting processes for both 305b and Section 303d, the impaired waters listing section of the CWA. The U.S. Environmental Protection Agency (EPA) has requested that states begin preparing integrated reports, and Minnesota is the first in EPA Region 5 to do so.

To accomplish all the requirements for reporting, Minnesota is providing the EPA with the following items; an update of Minnesota's STORET database; an Impaired Waters List with accompanying information on the public comments; National Hydrography Dataset (NHD) index mapping of impaired and assessed waters; the Assessment Database (ADB) v2.1.2 containing integrated assessment data; and this report.

The summary tables that appear in this section reflect information from both the assessment process for 305b reporting and the listing process for 303d reporting. Tables I-1 and I-2 provide summaries of stream assessments that occurred in 2003 for the current assessment cycle, while Table I-3 reports both impaired miles assessed for 2004 and the total impaired miles for each pollutant/stressor, which are found in the ADB.

Summary tables I-4 through I-6 reflect summaries of assessments for lakes. Tables I-4 and I-5 provide summaries of lake assessments that occurred in 2003 to meet requirements of section 305b of the CWA. Table I-6 reports both impaired acres assessed for 2004 and the total impaired acres for each pollutant/stressor, which are found in the ADB. Since a second analysis of lake data assessed as partially or not supporting a beneficial use for 305b reporting purposes is required in order to determine impairment for listing on the impaired waters list, the summaries in Table I-6 reflect only those lakes that were found to be impaired after the secondary analysis.

As a result of the integrated reporting the assessment summary tables found in this document reflect different results than what may be obtained from a query of the ADB. An assessment unit (AU) is assigned to only one category based on whether or not there is a cause of impairment, with impaired AUs that are found on the impaired waters list assigned to category 5 in the ADB. The ADB contains assessment data from previous 305b assessment cycles in the form of impaired and listed waters, which have been passed forward from previous impaired waters lists. These data cause a difference to occur in the reporting summaries because they take precedence over newer data, which may show no impairment for a specific AU.

New data for an AU required to be reported for 305b purposes, and showing no impairment exists, cannot override the older data that led to a 303d impaired listing. Because of this difference the summary tables in this report contain a mixture of 2004 assessment cycle reporting for 305b purposes, and integrated reporting that includes impaired AUs from previous assessments.

Table I-1. Summary of Fully Supporting, Threatened, and Impaired Waters - Rivers

Degrees of Use Support	Monitored
Miles Fully Supporting All Assessed Uses - Category 1	0
Miles Fully Supporting at Least One Use & None Threatened or Impaired - Category 2	2171.4
Miles Impaired for One or More Uses - Categories 4 & 5	7219.82
Miles Reviewed but Not Assessed	1011.94

Table I-2. Individual Use Support Summary - Rivers

Goals	Use	Miles Reviewed	Miles Fully Supporting	Miles Fully Supporting but Threatened	Miles Partially Supporting	Miles Not Supporting	Miles Not Assessed
Protect & Enhance Ecosystems	Aquatic Life	10403.16	3743.34	0	477.63	2587.04	3595.15
	Fish Consumption	10403.16	0	0	0	4823.65	5579.51
Protect & Enhance Public Health	Swimming	10403.16	1023.86	0	477.72	743.8	8157.78

Table I-3. Total Miles of Waters Impaired by Various Cause/Stressor Categories - Rivers

Cause/Stressor Category	2004 Assessed Miles Impaired	Integrated Reporting Miles Impaired*
PCBs	62.85	1053.47
Ammonia	0	168.86
Chlorine	14.26	47.13
pH	0	45.8
Organic enrichment/Low DO	230.96	808.32
Pathogen Indicators	337.66	1591.62
Mercury	218.43	5227.96
Biology (Fish)	504.9	1609.29
Biology (Invertebrates)	188.39	188.39
Turbidity	438.82	1824.66
Temperature	0	8.27
DDT	0	18.86
Dieldrin	0	18.86
Dioxin	0	12.62
Toxaphene	0	12.62

* Integrated Reporting Miles reflects causes of impairment from all data in the Assessment Database including data brought forward from previous TMDL lists.

Table I-4. Summary of Fully Supporting, Threatened, and Impaired Waters - Lakes

Degree of Use Support	Assessments		Total Assessed Acres
	Evaluated	Monitored	
Acres Fully Supporting All Assessed Uses	224041	1030753	1254794
Acres Fully Supporting All Assessed Uses but threatened for at least One Use	0	0	0
Acres Impaired for One or More Uses	307169	982460	1289629
Acres Not Attainable for Any Use and Not Included in the Line Items Above	0	0	0

Table I-5. Individual Use Support Summary (2004 Only) - Lakes

Goals	Uses	Acres Assessed	Acres Fully Supporting	Acres Fully Supporting but Threatened	Acres Partially Supporting	Acres Not Supporting	Acres Not Attainable
Protect and Enhance Ecosystems							
Protect and Enhance Public Health	Aquatic Recreation	2544423	1254794	0	872779	416850	0
Protect and Enhance Public Health	Aquatic Consumption	12516	0	0	0	12516	0
Social and Economic							

Table I-6. Total Acres of Waters Impaired by Various Cause/Stressor Categories - Lakes

Cause/Stressor Category	Acres of Waters by Contribution to Impairment	
	2004 Only	Integrated
Nutrients	20992	94542
Mercury Fish Consumption Advisories	12516	3696719.5
PCBs	0	1640218.5

Table I-7. Review of 305b assessed lakes in ADB and their categorization

		Evaluated	Monitored	Total			
Numbers:	Total number of lakes assessed for 305b below:	1048	1745	2793			
	Assessed for 305b as Fully Supporting	568	921	1489			
	Assessed for 305b as Partially Supporting	142	130	272			
	Assessed for 305b as Not Supporting	338	694	1032			
Acres:	Total lake acres assessed for 305b below:	531210	2013213	2544423			
	Assessed for 305b as Fully Supporting	224041	1030753	1254794	1254794		
	Assessed for 305b as Partially Supporting	222242	650537	872779	872779		
	Assessed for 305b as Not Supporting	84927	331923	416850	416850		
		307169	982460	1289629	2544423		
Categorization of 305b Lake Assessments (Acres):							
		Category 2	Category 3A	Category 3B	Category 5A	Category 5C	Total
	Assessed for 305b as Fully Supporting (Evaluated)	68157	0	0	4403	151481	224041
	Assessed for 305b as Fully Supporting (Monitored)	174732	0	0	5968	850053	1030753
	Assessed for 305b as Partially Supporting (Evaluated)	0	0	22309	0	199933	222242
	Assessed for 305b as Partially Supporting (Monitored)	0	0	33129	410	616998	650537
	Assessed for 305b as Not Supporting (Evaluated)	0	24	54475	0	30428	84927
	Assessed for 305b as Not Supporting (Monitored)	0	0	137881	36119	157923	331923
							2544423
Categorization of 305b Lake Assessments (Numbers):							
		Category 2	Category 3A	Category 3B	Category 5A	Category 5C	Total
	Assessed for 305b as Fully Supporting (Evaluated)	417	0	0	8	142	567
	Assessed for 305b as Fully Supporting (Monitored)	619	0	0	7	295	921
	Assessed for 305b as Partially Supporting (Evaluated)	0	0	110	0	32	142
	Assessed for 305b as Partially Supporting (Monitored)	0	0	94	1	35	130
	Assessed for 305b as Not Supporting (Evaluated)	0	1	268	0	69	338
	Assessed for 305b as Not Supporting (Monitored)	0	0	451	45	199	695
							2793

II. MONITORING AND ASSESSMENT STRATEGY

A. Types of Monitoring

The MPCA categorizes its environmental monitoring efforts by the purpose for the monitoring and how the information is assessed and used. In general, water monitoring efforts can be grouped into three "use" categories as follows:

- *Condition monitoring:* This type of monitoring is used to identify overall environmental status and trends by examining the condition of individual waterbodies or aquifers in terms of their ability to meet established standards and criteria. Condition monitoring may include chemical, physical or biological measures. The focus of condition monitoring is on understanding the status of the resource, identifying changes over time, and identifying and defining problems at the overall system level. Examples include routine surface water monitoring, basin monitoring, Total Maximum Daily Load (TMDL) listing activities, and the ambient ground water network.

- *Problem Investigation Monitoring:* This monitoring involves investigating specific problems or protection concerns to allow for the development of a management approach to protect or improve the resource. Problem investigation monitoring is used to determine the specific causes of impairments to water or ground water and to quantify inputs/loads from various sources. It is also used to determine the actions needed to return a resource to a condition that meets standards or goals. Examples include Clean Water Partnership (CWP) and Section 319 (319) projects, TMDL development, site assessment, and investigation of specific ground water issues, such as pesticides.

- *Effectiveness Monitoring:* This is used to determine the effectiveness of specific regulatory or voluntary management actions taken to remediate contaminated water. Effectiveness monitoring allows for the evaluation and refinement of the management approach to ensure it is ultimately successful. Examples include environmental monitoring associated with a permitted facility, implementation monitoring for TMDLs, CWPs and 319 projects, drinking water system monitoring, and monitoring associated with a particular best management practice. Another example of effectiveness monitoring is effluent monitoring done to assess the compliance of a facility with a permit, rule or statute (i.e. compliance tracking) and to provide information on the effect of regulatory actions on inputs to water bodies (not the effects on the water body itself).

While there are similarities among the three monitoring types and the definitions are not meant to be exclusive and rigid, the definitions do help to distinguish between the various purposes for monitoring. Perhaps the greatest area of overlap is found between effectiveness and condition monitoring. In this case, the difference between the two is largely a matter of scale. Effectiveness monitoring is done at the management scale, to evaluate particular management actions. In contrast, condition monitoring can be used to track the system-wide effectiveness of environmental protection efforts. In discussing the elements of the monitoring program strategy, it will be important to distinguish among the three types of monitoring, since many elements are different depending on the type of monitoring.

B. Monitoring Goals and Objectives

Minnesota has several sets of goals and objectives related to monitoring. MPCA has adopted three strategic goals to drive its water quality protection and restoration efforts (both point and nonpoint) and achieve its vision of clean, fishable and swimmable surface waters. For nonpoint source pollution, a consortium of federal, state and local organizations have adopted water monitoring goals, as part of the 319 planning process.

MPCA'S STRATEGIC GOALS FOR WATER QUALITY PROTECTION AND RESTORATION

- Goal W.1. Assess the chemical, physical and biological integrity of lakes, streams and wetlands to identify if designated uses are being met, and to provide information on the condition of waters.

- Goal W.2. Maintain and enhance the chemical, physical and biological integrity of Minnesota lakes, streams and wetlands so that water quality standards and designated uses are met and degradation is prevented.

- Goal W.3. Restore the chemical, physical and biological integrity of Minnesota lakes, streams and wetlands that do not support designated uses.

Each of the goals contains several specific, measurable objectives to set direction for all of the agency's surface water quality work, including monitoring. While the monitoring objectives for Goal W.1 are clearly articulated, the monitoring components of the other two goals are implied. Monitoring objectives for Goal W.1. are as follows.

Obj. W1a) By December 31, 2014, gather water quality data and increase assessment of streams to 33 percent.

Obj. W1b) By December 31, 2014, gather water quality data and assess 100 percent of the lakes larger than 500 acres.

Obj. W1c) By December 31, 2014, gather data and increase assessment to 25 percent of the state's depressional wetlands.

C. Condition Monitoring Strategy

LAKES AND STREAMS

Minnesota's statewide surface water quality assessment strategy has four data collection components: 1. MPCA stream and lake monitoring; 2. stream and lake data collected by other organizations; 3. remote sensing; and 4. citizen monitoring. Each of these components contributes important data to the system that results in both geographic coverage and data confidence.

For both lakes and streams, the MPCA considers this four component strategy of data collection to be sufficient for fully assessing streams and lakes in Minnesota over a 10-year cycle. This strategy is considered complete, in that it builds on a foundation of citizen monitoring, remote sensing, and other information to direct attention to waters that may be changing or indicating impairment for further assessment.

Further details on the condition monitoring strategy can be found in Minnesota's Monitoring Program Strategy (now in draft).

Condition monitoring on streams conducted by MPCA staff includes long-term monitoring at fixed sites, integrated stream monitoring, river nutrient monitoring and monitoring for trace metals.

Statistically Based Monitoring Program

The MPCA's "integrated, statistically based" stream-monitoring program uses a random-site approach to gain a statistically valid representation of overall water quality in a given area. Fifty to 60 sites are chosen within a basin, using EPA's Environmental Monitoring and Assessment Program (EMAP) random site-selection protocol. The monitoring focuses on biological measures, with the sites being examined for fish, macroinvertebrates and habitat, plus flow and basic water chemistry. Additional sites are monitored as reference sites to develop the necessary ecoregion-specific biocriteria for assessing stream health.

By eliminating the bias that can result from selectively targeting sites, the design achieves a representative sample that allows extrapolation from a relatively small number of sites to the entire population of rivers and streams within the basin. (The same concept is used in political polling, where the results of a small number of randomly selected interviews can represent the opinions of a much larger population.)

Fieldwork has been done in the St. Croix, Lake Superior, Upper Mississippi, and Minnesota River basins; analysis of the data has been done and reported for the St. Croix basin, with analysis for the others in preparation.

In upcoming years the program will cover all the basins of the state, providing for the first time an unbiased assessment of overall stream and river water quality for the state as a whole.

D. Problem Investigation Monitoring Strategy

Minnesota's problem investigation monitoring strategy is built on two cornerstones – the impaired waters program and the basin management planning process – and includes monitoring by a variety of entities, depending on the purpose.

Within these two cornerstones – the impaired waters program and the basin management process – the problem investigation monitoring work is accomplished. Minnesota's strategy relies on a variety of partners to conduct problem investigation monitoring:

- monitoring by regulated parties for most of its regulatory programs [National Pollutant Discharge Elimination System (NPDES)],
- a mix of MPCA and MPCA-contracted monitoring for its TMDL studies,
- local monitoring for locally-identified problems or protection concerns (through CWP, county water planning, local lake associations, etc.),
- MPCA monitoring to fill gaps and for special projects (fish kills, wasteloads, etc.), and
- monitoring by other organizations for additional needs [U.S. Geological Survey (USGS), Metropolitan Council Environmental Services].

E. Effectiveness Monitoring Strategy

Much like problem investigation monitoring, the state's effectiveness monitoring strategy relies on monitoring activities by a variety of parties. On a project scale, regulated parties, local implementers, MPCA contractors, other organizations and MPCA conduct effectiveness monitoring to evaluate specific management practices or groups of practices in a specific area. And, as in problem investigation monitoring, project-scale effectiveness monitoring will be targeted to the priorities of Minnesota's impaired waters list, as those projects are implemented.

F. Surface Water Monitoring Purposes, Designs and Indicators

Tables 1, 2 and 3 (see Appendix A) describe current Condition, Problem Investigation and Effectiveness monitoring activities, respectively. Each table provides information on the monitoring activity: activity start date, purpose, description of monitoring with an indication of the type of monitoring design to meet the specific monitoring purpose, and indicators.

G. Monitoring Planning Database

In 2002, MPCA conducted a comprehensive evaluation of all of its monitoring programs. The report assessed MPCA's monitoring projects to identify needs and gaps, opportunities and ways to make the projects more efficient and effective. The report included a series of recommendations that applied across the media and recommendations for surface water monitoring.

A primary need identified in the monitoring evaluation (and the evaluation's first recommendation) was the need for an annual planning process for identifying and coordinating monitoring efforts and needs. The Monitoring Leadership Team (supervisors and managers involved in all three types of monitoring, responsible for coordinating surface water monitoring at a strategic level) has authorized development of a prototype database for use in annual monitoring planning. Monitoring staff will enter their monitoring plans into the database annually, which then will be available to staff and management for planning and coordination purposes. This will serve as a first step in establishing an annual planning process, and will be evaluated for effectiveness.

III. ASSESSMENT TOOLS

A. Water Quality Standards Program

INTRODUCTION

At the heart of the assessment process are the beneficial uses we derive from our water resources and the water quality standards (WQS) that protect these uses. WQS are the fundamental benchmarks by which the quality of surface waters is measured. WQS have been adopted into Minnesota's administrative rules, principally Minn. R. chs. 7050 and 7052.

BENEFICIAL USE CLASSES FOR SURFACE WATERS

The beneficial use classification system adopted into Minnesota's water quality rules in the late 1960s is essentially unchanged, except that limited resource value waters (Class 7) were added in 1980. In the Minnesota system, all surface waters are classified and protected for fisheries and recreation, unless they are classified as limited resource value waters. Also, all surface waters are protected for multiple beneficial uses (Minn. R. pts. 7050.0400 – 7050.0470). Surface waters include lakes, rivers, streams, wetlands, temporary pools, and man-made as well as natural water bodies.

Minnesota R. ch. 7050 identifies seven beneficial uses as listed below. The use class numbers 1-7 are not intended to imply a priority rank to the uses.

Use Class	Beneficial Use
Class 1	Drinking water
Class 2	Aquatic life and recreation (swimming)
Class 3	Industrial use and cooling
Class 4A	Agricultural use, irrigation
Class 4B	Agricultural use, livestock and wildlife watering
Class 5	Aesthetics and navigation
Class 6	Other uses
Class 7	Limited resource value waters (not fully protected for aquatic life due to lack of water, lack of habitat or extensive physical alterations)

Class 1 through 3 waters have further been divided into subclasses. Since the goal of the CWA is 'fishable and swimmable' waters, Minnesota assesses waters with respect to Class 2 subclasses as follows:

Class 2A	Cold water fisheries, trout waters
Class 2Bd	Cool and warm water fisheries, in addition these waters are protected as a source of drinking waters
Class 2B	Cool and warm water fisheries (not protected for drinking water)
Class 2C	Indigenous fish and associated aquatic community
Class 2D	Wetlands

Protection of aquatic life and recreation means the maintenance of healthy, diverse and successfully reproducing populations of aquatic organisms; and the maintenance of conditions suitable and safe for swimming and other forms of water recreation. This is consistent with the goal in the CWA that the nation's waters should be "fishable and swimmable" wherever attainable. Class 7 waters are not able to support a fishery due to lack of water, habitat and extensive alterations; most are headwater channelized ditches. About one percent (approximately 900-950 miles) of Minnesota's 92,000 miles of rivers and streams are limited resource value waters.

Both Class 2 and Class 7 waters, i.e., all surface waters of the state, are also protected for industrial (Class 3), agricultural (Class 4A&B), aesthetics and navigation (Class 5), and other uses (Class 6). For example, the St. Croix River from the dam in Taylors Falls to its mouth is classified as 1C, 2Bd, 3B, 4A, 4B, 5 and 6; and is therefore protected for all uses defined by these use classes (Minn. R. pt. 7050.0470, subp. 6). If a pollutant has numerical standards in more than one beneficial use class, the most stringent applies.

All ground waters, but only selected surface waters, such as the St. Croix example cited above, are protected as a source of drinking water (Class 1). The federal drinking water standards apply to these waters.

Drinking Water Assessments

At the present time the MPCA does not assess surface waters of the state for drinking water; however, discussions have been held with the Minnesota Department of Health on the subject. The agencies are investigating the possibility of making such assessments, and staffs have attended source water protection meetings with the municipal water suppliers for the major metropolitan cities of Minneapolis, St. Paul, and St. Cloud, Minnesota. These three cities all use surface waters in their municipal supplies and provide drinking water to a large portion of the state's population. They have helped the state agencies to identify some of their contaminants of concern in intake waters that presently fall within current monitoring strategies and others which are not currently being monitored. These initial steps will be followed by a more statewide review of contaminants of concern for present municipal water suppliers who use surface waters.

NUMERICAL WATER QUALITY STANDARDS

A numerical water quality standard (WQS) is a safe concentration of a pollutant in water, associated with a specific beneficial use. Numerical standards are associated with all use classes except Class 6 (other uses). Ideally, if the standard is not exceeded, the use will be protected. However, nature is extremely complex and variable, and the MPCA must use a variety of tools in addition to numerical standards, such as biological monitoring, to fully assess beneficial uses.

Surface waters are assessed for this Report only with respect to Class 2 standards. However, compliance with the Class 2 standards will, with some exceptions, protect the usually less sensitive Class 3, 4, 5 and 6 beneficial uses.

All Class 2 standards for toxic pollutants have three parts[1].

- Chronic standard
- Maximum standard, and
- Final Acute Value (FAV)

The chronic standard is the highest concentration of a toxicant to which aquatic organisms can be exposed indefinitely with no harmful effects to the organism itself, or to human or wildlife consumers of aquatic organisms. The maximum standard protects aquatic organisms from potential lethal effects of a short-term "spike" in toxicant concentrations. The maximum standard is always equal to one half the Final Acute Value (FAV). The FAV is most often used as an "end-of-pipe" effluent limit to prevent an acutely toxic condition in the effluent or the mixing zone.

Class 2 chronic standards are based on one of three "end points", as listed below.

- Toxicity-based. The chronic standard is based on the direct toxicity of the toxicant to fish and other aquatic life.
- Human Health-based. The chronic standard is based on the protection of people that eat fish from Minnesota waters (and drink the water, if the surface water is also a Class 1 water).
- Wildlife-based. The chronic standard is based on the protection of wildlife species that eat aquatic organisms (Minn. R. ch. 7052 has four wildlife-based standards, Minn. R. ch. 7050 has none).

Both toxicity-based and human health-based criterions are calculated by the MPCA, and the more restrictive of the two is adopted into Minn. R. ch. 7050 as the applicable chronic standard. Wildlife-based criteria have not been calculated outside of those adopted in Minn. R. ch. 7052. Minn. R. ch. 7052 is the Great Lakes Initiative Rule, applicable only to the Lake Superior basin. Maximum standards and FAVs are always toxicity-based, never human health or wildlife-based. Most of Minnesota's aquatic life (Class 2) standards are based on EPA aquatic life criteria. The EPA develops and publishes aquatic life criteria as required by Section 304(a) of the Clean Water Act.

NARRATIVE WATER QUALITY STANDARDS

A narrative water quality standard (WQS) is a standard that prohibits unacceptable conditions in or upon the water, such as floating solids, scums, visible oil film, or nuisance algae blooms. Narrative standards are sometimes called "free froms" because they help keep surface waters free from very fundamental and basic forms of water pollution. The association between the standard and beneficial use is less well defined for narrative standards than it is for numerical standards; however, most narrative standards protect aesthetic or aquatic life beneficial uses. Because narrative standards are not quantitative, the determination that one has been exceeded typically requires a "weight of evidence" approach to data analysis showing a consistent pattern of violations. There is an unavoidable element of professional judgment involved in using

[1] Un-ionized ammonia, di-2-ethylhexyl phthalate, hexachlorobenzene, and vinyl chloride have only a chronic standard and no maximum standard or final acute value.

narrative standards to determine impairment. The narrative standards most relevant to 305(b) assessments are found in Minn. R. pts. 7050.0150 and 7050.0222 subp. 7. These standards protect surface waters and aquatic biota from:

- Eutrophication (particularly lakes)
- Impairment of the biological community
- Impairment of fish for human consumption

NONDEGRADATION

Nondegradation (equivalent to the federal term, antidegradation) is a third element of water quality standards, in addition to (1) numeric or narrative standards and (2) the beneficial uses. The fundamental concept of nondegradation is the protection of water bodies whose quality is better than the applicable standards, so that the existing high quality is maintained and not allowed to degrade down to the level of the WQS.

Federal guidance establishes three levels or tiers of nondegradation. The first level is, at a minimum, waters should be in compliance with WQS, and that beneficial uses should be protected. Level two is the protection of waters that have quality better than standards so the existing high quality is maintained, unless there is a social and economic need to degrade the waters down to the level of the standards (Minn. R. 7050.0185). The third level, which provides the highest level of protection from pollution, are waters designated as outstanding, very sensitive or unique resources (Minn. R. 7050.0180). The MPCA has specifically designated a number of waters that are special for a variety of reasons. In Minnesota these special waters are called Outstanding Resource Value Waters (ORVW). There are two categories of ORVWs, "prohibited" and "restricted". New or expanded point and nonpoint sources of pollution are entirely prohibited to the first category (examples are waters in the Boundary Waters Canoe Area Wilderness and Voyagers National Park). New or expanded point and nonpoint sources of pollution are prohibited to the restricted category unless the discharger can demonstrate there is no "prudent or feasible alternative" to allowing the increased pollutant loading (examples in the restricted category are Lake Superior and federal and state designated scenic and recreational river segments such as the St. Croix River). In addition to designated ORVWs, which are located statewide, all surface waters in the Lake Superior basin are designated as Outstanding International Resource Waters (OIRW) (Minn. R. 7052.0300). Implementation of nondegradation for OIRW waters focuses on reducing the loading of bioaccumulative pollutants to the Lake Superior basin because of the sensitivity of the Lake Superior ecosystem to these pollutants.

B. Assessment Units

Assessments of use support in Minnesota are made for individual water bodies. The water body unit used for river system assessments is the river reach or "assessment reach". A river reach extends from one significant tributary river to another and is typically less than 20 miles in length. The reach may be further divided into two or more assessment reaches when there is a change in the use classification (as defined in Minn. R. ch. 7050), or when there is a significant morphological feature such as a dam, or a lake within the reach. In the past, Minnesota used EPA's Reach File 1 to define reaches. Many of our current assessment reaches are Reach File 1

reaches, or subsegments of Reach File 1 reaches. MPCA is now using the National Hydrography Dataset (NHD) to identify stream segment locations because it provides a much more complete accounting of all the streams in the State. All of our assessment reaches will be indexed to the NHD. Each water body is identified by a unique water body identifier code, comprised of the USGS eight digit hydrologic unit code plus the three digit assessment reach. It is for these specific reaches that the data are evaluated for potential use impairment.

The MPCA has routinely relied on Bulletin 25 [Minnesota Department of Natural Resources (MDNR) 1968] as the primary basis for identifying lakes and reservoirs. However, some "lakes" listed in Bulletin 25 are really wetlands. If a "lake" basin in Bulletin 25 is listed as a wetland on the MDNR Public Waters Inventory, it will be considered a Class 2D wetland, and it will be protected for the maintenance of a healthy aquatic community and for boating and other forms of aquatic recreation for which they are suitable. This may exclude swimming because the shallow water, soft bottom substrates and plentiful vegetation make many wetlands unattractive for swimming.

Also, to help define reservoirs for assessment of the impacts of excess nutrients the MPCA will use a minimum hydraulic residence time of 14 days. Reservoirs with residence times less than 14 days will not be assessed as lakes. For this purpose, residence times are usually determined under conditions of low flow.[2] The MPCA may establish a minimum residence time of less than 14 days on a site-specific basis if credible scientific evidence shows that a shorter residence time is appropriate for that reservoir. The 14-day residence time was originally established as part of the "Phosphorus Strategy" to guide the MPCA in the application of the 1 mg/L phosphorus effluent limit in Minn. R. pt. 7050.0211 (MPCA 2000). The 14-day residence time is consistent with EPA's current guidance, which recommends that reservoirs with residence times less than 14 days be included with rivers for the purposes of nutrient criteria development (EPA 2000a, Kennedy 2001).

The application of residence time is relevant in the assessment of eutrophication described here, since the nutrient impairment threshold values are applied to lakes and reservoirs rather than rivers. The eutrophication of rivers is a concern, but the assessment of rivers will require the development of separate river-specific eutrophication thresholds. The professional judgment teams will consider residence time as part of their "weight of evidence" review.

Bulletin 25 provides unique identification numbers for all lakes greater than 10 acres in size in Minnesota (15,291 listed). The Bulletin 25 numbers serve as the EPA's water quality data Storage and Retrieval System (STORET) station numbers; for example, 27-0104 is Medicine Lake in Hennepin County. In addition to the 6-digit numbers, a 2-digit suffix may be added as a basis for defining distinct bays in a lake (e.g., 27-0133-01 = Grays Bay in Lake Minnetonka). The bay suffixes are assigned consecutively, starting with the most downstream (outlet) bay as "-01", and so on.

[2] A mean flow for the four-month summer season (June-September) with a once in ten-year recurrence interval is normally used.

Bulletin 25 also provides surface acreage and location information for each lake listed. Lake acreage used by MPCA in lake assessments are drawn from Bulletin 25 or bathymetric maps, whichever source is most current at the time the lake sampling station is established in STORET. The MDNR public waters inventory, which encompasses Bulletin 25, is an additional source of identification numbers and is updated routinely as new water bodies are identified (e.g., mine pit lakes). While the Public Waters Inventory may include water bodies less than 10 acres in size, MPCA assessments for the 303(d) list will only consider lakes of 10 acres or greater.

Typically, the listing of impaired waters is by individual NHD reach or individual lake. The major exception to this is the listing of river reaches for contaminants in fish tissue. Over the time it takes fish, particularly game fish, to grow to "catchable" size and accumulate pollutants to unacceptable levels there is a good chance some have moved considerable distance from the site where they were sampled. The impaired reach is defined by the location of significant barriers to fish movement such as dams upstream and downstream of the sampled reach. Thus, the impaired reaches often include several NHD reaches.

The state of Minnesota uses the figure of 91,944 stream miles. This figure is from a 1981 report from the MDNR Office of Planning. That report references a total of 37,793 watercourses, or some 147,930 kilometers (91,944 miles) of streams, rivers and ditches indexed in the MDNR Stream Inventory and Data Retrieval Systems Program (SIDRS). The database contains the center trace of most of the watercourses shown on the large scale (1:24,000 or 1:62,500) topographic maps covering Minnesota. The 77,456 stream miles figure in the NHD is based on the 1:100,000 scale NHD linework. MPCA and MDNR staff agree that the discrepancies come in the forms of fewer intermittent stream/rivers, fewer ditches, and less sinuosity due to the larger, less detailed NHD scale.

C. Data Management

The MPCA stores surface water monitoring data in EPA's STORET system. In the last few years, STORET has undergone an extensive modernization process led by the EPA.

It is MPCA policy that all water quality monitoring data required or paid for by MPCA be entered into STORET. Projects funded by MPCA include 319 projects, CWP projects, and more recently, TMDL projects.

It is also MPCA policy to use all credible and relevant monitoring data collected by others for its assessment activities. Because of this policy, many local projects not funded by MPCA choose to submit data to the Agency in STORET-ready format. These projects will then also have their data accessible to a variety of users through the MPCA's Environmental Data Access Initiative. In fall, 2002, a call for data was sent out to agencies and organizations that either collected water monitoring data or used data collected by others, asking if they would be interested in submitting their data to the MPCA.

IV. INTEGRATED ASSESSMENT PROCESS

A. Integrated Assessment Methodology

Tables 1 and 2 summarize the fundamental data and information requirements for 305(b) and 303(d) use-support and impairment determinations for all categories of pollutants. Pre-assessments are made automatically following the methodology reflected in Tables 1 and 2. As reflected in these tables, there are some water bodies for which a 305(b) assessment will indicate impairments but for which there is insufficient data to determine a TMDL impairment.

Table IV-1. Summary of Data Needed for Water Quality Assessments for 305(b) Report and 303(d) List for Use Support and Impairment Determinations, for Pollutants with Numeric Standards.

Pollutant Category **305(b) Report, or 303(d) List**	**Minimum Number of Values*, and Data Treatment**	**Exceedance Thresholds:** • **Number or Percent Exceedances of Chronic Standards** **Use Support or Listing Category**		
Pollutants with Toxicity-based Standards	Number of Exceedances →	≤ 1	na	≥ 2
305(b)	5 values in 3 years	Fully supporting	na	Not supporting
303(d)	5 values in 3 years	Not listed	na	Listed
Pollutants with Human Health-based Standards	Number of Exceedances →	≤ 1	na	≥ 2
305(b)	5 values in 3 years	Not assessed for 305(b)	na	Not assessed for 305(b)
303(d)	5 values in 3 years	Not listed	na	Listed
Conventional Pollutants and Water Quality Characteristics	Percent Exceedance →	< 10 %	10 – 25 %	> 25 %
305(b)	10 values in 10 years	Fully supporting	Partially supporting	Not supporting
303(d)	10 values in 10 years	Not listed	Listed	Listed
Fecal Coliform, Step 1 200 orgs./100 ml	Percent Exceedance →	< 10 %	≥ 10 %	na
305(b)	10 values in 10 years	Fully supporting	Step 2	na
303(d)	10 values in 10 years	Not listed	Step 2	na
Fecal Coliform, Step 2 200 orgs./100 ml	*Number of months with Exceedances* → (geometric mean)	No months	1 or 2 months	> 2 months
305(b)	Geometric mean of 5 values over 10 years for each month	Full supporting	Partially supporting	Not supporting
303(d)	Geometric mean of 5 values over 10 years for each month	Not listed	Listed	Listed
Fecal Coliform, Step 2 2000 orgs./100 ml	Percent Exceedance →	< 10 %	10 – 25 %	> 25 %
305(b)	10 values in 10 years	Full supporting	Partially supporting	Not supporting
303(d)	10 values in 10 years	Not listed	Listed	Listed

* Values are individual or single data points. Exceedance thresholds are of individual values unless noted otherwise.
na = not applicable.
There is no "partially supporting" or "review" category for toxics and fish tissue contaminants, no "not supporting" or "listed" category for step 1 of fecal coliform assessments, and no specific minimum data requirements for biological and fish tissue contaminant assessments.

Table IV-2. Summary of Data Needed for Water Quality Assessments for 305(b) Report and 303(d) List for Use Support and Impairment Determinations, for Pollutants with Narrative Standards.

Pollutant Category **305 (b) Report, or 303(d) List**	**Minimum Number of Values*, and Data Treatment**	**Exceedance Thresholds:** **• Eutrophication Guideline values** **• IBI Scores** **• Contaminant Levels in Fish Tissue** **Use Support or Listing Category**		
Eutrophication (lakes) Northern Lakes and Forests Ecoregion	Total phosphorus →	< 30 µg/L	30 – 35 µg/L	> 35 µg/L
	Chlorophyll-a →	< 10 µg/L	10 – 12 µg/L	> 12 µg/L
	Secchi disk →	≥ 1.6 meters	1.6 – 1.4 meters	< 1.4 meters
305(b)	1 total phosphorus, chlorophyll-a or Secchi disk	Full supporting	Partially supporting	Potentially Not supporting to Not supporting
303(d)	12 total phosphorus, 12 chlorophyll-a and 12 Secchi disk	Not listed	Review, to determine to list or not list	Listed
Eutrophication (lakes) North Central Hardwood Forests Ecoregion	Total phosphorus →	< 40 µg/L	40 – 45 µg/L	> 45 µg/L
	Chlorophyll-a →	< 15 µg/L	15 – 18 µg/L	> 18 µg/L
	Secchi disk →	≥ 1.2 meters	1.2 – 1.1 meters	< 1.1 meters
305(b)	1 total phosphorus, chlorophyll-a or Secchi disk	Full supporting	Partially supporting	Potentially Not supporting to Not supporting
303(d)	12 total phosphorus, 12 chlorophyll-a and 12 Secchi disk	Not listed	Review, to determine to list or not list	Listed
Eutrophication (lakes) Northern Glaciated Plains and Western Corn Belt Plains Ecoregions	Total phosphorus →	< 70 µg/L	70 – 90 µg/L	> 90 µg/L
	Chlorophyll-a →	< 24 µg/L	24 – 32 µg/L	> 32 µg/L
	Secchi disk →	≥ 1.0 meters	1.0 – 0.7 meters	< 0.7 meters
305(b)	1 total phosphorus, chlorophyll-a or Secchi disk	Full supporting	Partially supporting	Potentially Not supporting to Not supporting
303(d)	12 total phosphorus, 12 chlorophyll-a and 12 Secchi disk	Not listed	Review, to determine to list or not list	Listed

* Values are individual or single data points. Exceedance thresholds are of individual values unless noted otherwise.

** Assessment of mercury fish tissue data not limited to most recent 10 years. na = not applicable. There is no "partially supporting" or "review" category for toxics and fish tissue contaminants, no "not supporting" or "listed" category for step 1 of fecal coliform assessments, and no specific minimum data requirements for biological and fish tissue contaminant assessments.

Table IV-2. continued

Pollutant Category **305 (b) Report, or 303(d) List**	**Minimum Number of Values*, and Data Treatment**	**Exceedance Thresholds:** • **IBI Scores** • **Contaminant Levels in Fish Tissue** **Use Support or Listing Category**		
Biological Community (fish)	IBI score → (old method)	Excellent, good or fair	na	Poor or very poor
	IBI score → (new method)	IBI ≥ basin-specific threshold IBI	Discrepant results within stream segment	IBI < basin-specific threshold IBI
	See Section IX.B.	Fully supporting	Partially supporting	Not supporting
	See Section IX.B	Not listed	Listed	Listed
Fish tissue Contaminants**	Tissue concentration →	≤ 0.2 ppm Hg or PCBs	na	> 0.2 ppm Hg or PCBs
	Water bodies with fish consumption advice	Information	na	Information
	mean concentration, by lake by species by size, over most recent 5-year period having data	Not listed	na	Listed

* Values are individual or single data points. Exceedance thresholds are of individual values unless noted otherwise.
** Assessment of mercury fish tissue data not limited to most recent 10 years. na = not applicable. There is no "partially supporting" or "review" category for toxics and fish tissue contaminants, no "not supporting" or "listed" category for step 1 of fecal coliform assessments, and no specific minimum data requirements for biological and fish tissue contaminant assessments.

These pre-assessments are then reviewed by professional judgment teams, as part of 305(b) and 303(d) efforts. Incorporation of professional judgment teams recognizes the value and necessity of including professional judgment as a "formal" step in assessments. No assessment guidance and protocol, no matter how detailed, can address all the unforeseen aspects of the multi-step assessment process. Under the process, a professional judgment team is formed for each basin. The team is made up, for example, of regional MPCA basin coordinators knowledgeable about local water quality issues, MPCA monitoring and data assessment staff, and staff from organizations outside the MPCA whose data were used in the assessments, if appropriate. The professional judgment teams meet to review how the data were used and interpreted, and whether outside data were used appropriately. They determine whether the data (possibly data combined from more than one source) are adequate and appropriate for making statements about use-support and about causes of impairment (such as low dissolved oxygen or high phosphorus, etc.).

MPCA staff and a professional judgment team compare monitoring data from all sources to the WQSs for a specific stream reach or lake to assess protection of beneficial uses. If data are available to assess more than one type of standard that protect the same beneficial use, exceedance of any applicable standard normally indicates impairment. This concept is called "independent application." In general, independent application means that a water body should meet multiple assessment tests (standards) to be considered un-impaired for a given use. This is consistent with the national and state goal to protect the "chemical, physical and biological integrity" of surface waters, and it is consistent with EPA guidance. EPA's discussion of independent application is the integration of assessments of, 1) chemical-specific data, 2) biological assessments, and 3) whole effluent toxicity testing (EPA 1991). The independent tests must apply to the same beneficial use. Independent application does not apply when assessing different uses, such as aquatic life (toxicity), fish consumption (human health), swimming or aesthetics. Assessments for different uses are carried out separately.

The professional judgment team's first step in making impairment decisions is to review the results of an "automated" pre-assessment of the available chemical and biological data. The pre-assessment is a computerized screening of the data which identifies water bodies meeting minimum data requirements, appropriate periods of record, and showing the necessary exceedances of impairment thresholds. Following a review of the pre-assessment results, the team considers a wide range of factors that can affect water quality, and use impairment. For examples the team may consider:

- The quality and quantity of all available data,
- The magnitude, duration and frequency of exceedances,
- Timing of exceedances,
- Naturally occurring conditions that affect pollutant concentrations and toxicity,
- Weather and flow conditions,
- Consistency of the preliminary assessment with information on other numeric or narrative WQSs,
- Known influences on water quality in the watershed, and
- Any changes in the watershed that have changed water quality.

The MPCA assembles the professional judgment teams and chairs the meetings; and the MPCA takes responsibility for all team decisions regarding impairment. While consensus on impairment decisions is the goal, and is normally achieved, if consensus can't be obtained, the MPCA will make the final decision. All professional judgment decisions are recorded on a professional judgment group "transparency" form for assessed streams (see Figure IV-1), so that readers can understand how the decision was reached.

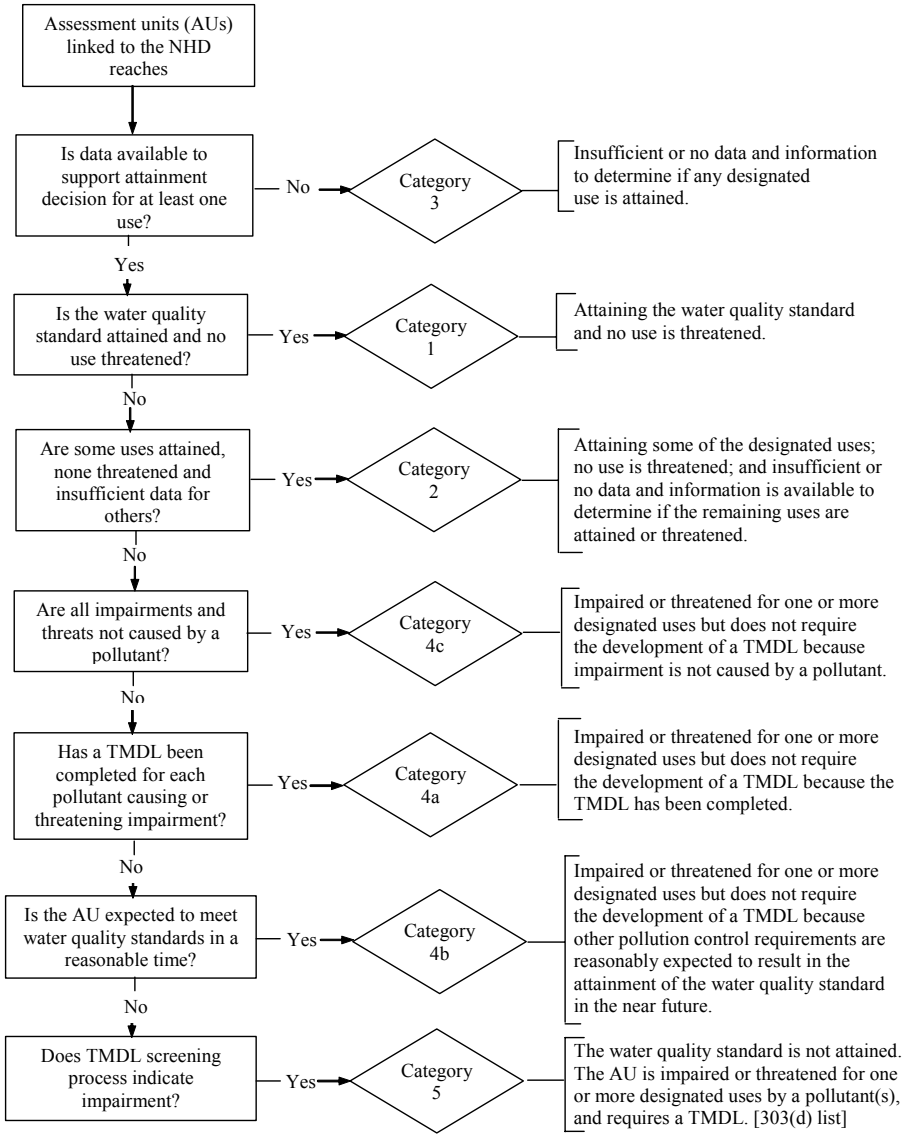
Each water body is assigned to an integrated assessment report category, as shown in the flow chart in Figure IV-2.

Figure IV-1.

Example

HUC AUID Seg Miles Reach Name Reach Description
07010103 503 131 2.85 Mississippi R Grand Rapids dam to Prairie R
Aquatic life—preliminary assessment **PS** Final assessment **PS** Based on **Dissolved Oxygen**
AQL assessment quality (Excellent, good, fair, poor)_____**Excellent**_____
Factors used, please describe
A. Timing of exceedances _____
B. Magnitude of exceedances _____
C. Seasonality of exceedances _____
D. Naturally occurring conditions _____
E. Combination of narrative and numeric standards _____
F. Known point and nonpoint influences in the watershed_____
G. Additional data __**being collected by PCA-Brainerd staff to confirm validity of impairment listing**_
Aquatic recreation use—preliminary assessment __**FS**_____ Final assessment ____**FS**__
Aquatic recreation assessment quality (Excellent, good, fair, poor)_____**Poor**_____
Fish consumption use____**NS**_____
1998 TMDL listing (Y/N)_**Y**___ Which pollutants___**DO**_____
2002 TMDL listing (Y/N) _**Y**__ Which pollutants____**DO, Mercury FCA**__
2004 Impairment (4 or 5) (Y/N)__**Y**___Which pollutants_ **DO, Mercury FCA**__
Delisting status (if applicable)_____
IAR category_____**5**_____
Additional Comments **Recommend additional DO measurements during similar flow and dam setting conditions as original exceedances.**

Figure IV-2



Non-Impaired Waters

Impaired Waters

TMDL Listed Waters

B. IMPAIRED WATERS LIST

CURRENT STATUS

The table below contains the pollutants listed in the MPCA's draft 2004 Impaired Waters List (Appendix B) and the number of impairments in streams and lakes caused by each. Only nine percent of river miles and 14 percent of lakes in Minnesota have sufficient data for the MPCA to determine whether they are impaired.

Bioaccumulative toxics include mercury, PCBs, DDT, dieldrin, dioxin and toxaphene. Impairments due to mercury in water and fish tissues account for 92 percent of the bioaccumulative total and 65 percent of all the impairments on the 2004 draft impaired waters list.

Pollutant	**# impairments**
Ammonia	13
Bioaccumulative toxics	1367
Chlorides	3
Excess nutrients	153
Fecal coliform	102
Impaired biota	112
Low dissolved oxygen	45
pH	2
Temperature	1
Turbidity	118

A separate 303d impaired waters list is being submitted to EPA, but it is MPCA's intent to use version 2.X of the EPA Assessment Database (ADB) for integrated reporting. The category 5 assessment units in the ADB will match with the submitted impaired waters list.

PUBLIC PROCESS FOR THE IMPAIRED WATERS LIST

A series of informational public meetings throughout the state were scheduled two months before the draft list was due. At the same time, notice of the availability of a draft list for review and comment was placed in the *State Register* (for January 12, 2003), plus letters were again mailed to more than 300 individuals and groups.

V. DEVELOPMENT AND IMPLEMENTATION OF TMDLs

A. TMDL Studies

In most cases, TMDL project schedules priorities for the 303(d) impaired waters list are set by the MPCA in consultation with external basin teams that help develop basin plans. They consider several criteria, including: environmental factors (severity and designated beneficial use); readiness/capacity to participate in or lead the project, project complexity; opportunities for

efficiencies (watershed or regional projects); coordination with other existing or planned watershed efforts, and permitting schedules.

WHAT IS A TMDL STUDY?

For each pollutant that causes a water body to fail to meet applicable water quality standards, the Clean Water Act requires the states to conduct a study called a Total Maximum Daily Load (TMDL) Study.

A TMDL study identifies both point and nonpoint sources 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.

B. Strategies the MPCA Employs in Developing the Impaired Waters Restoration Process

POLICY DISCUSSIONS WITH STAKEHOLDERS

The MPCA has conducted policy discussions with stakeholders, and will continue to do so.

Responsibility for keeping our water resources healthy resides with individual citizens, businesses, and a number of state and local government agencies, including the MPCA, the Minnesota Department of Natural Resources, the Minnesota Department of Agriculture, the Board of Water and Soil Resources, counties, cities, soil and water conservation districts, and watershed districts.

Despite all these players in the game, water quality improvements are not happening rapidly enough. All of these entities must come together to meet the challenge of impaired waters. The good news is a diverse advisory group, facilitated by the Minnesota Environmental Initiative, along with the Clean Water Cabinet (created as part of Governor Pawlenty's Clean Water Initiative), are taking steps to get us there. The Stakeholder Group recommended a design for a state impaired waters program to the Minnesota Pollution Control Agency and identified the partnerships that will be required for implementing the program. Topics such as funding options, a plan for priority setting, and strategies for identifying and restoring impaired waters were addressed.

PARTNERING WITH LOCAL GOVERNMENT

Local units of government – cities, counties, soil and water conservation districts, and watershed management organizations – play a large and growing role in nonpoint source pollution abatement across the state.

WATERSHED AND REGIONAL APPROACHES TO TMDL STUDIES AND RESTORATION ACTIVITIES

Collaborating with local government, the MPCA has planned several TMDL projects that will cover multiple impairments within an entire watershed (several stream reaches or lakes) or across an entire region (several watersheds or an entire basin).

USING PRIVATE CONSULTANTS

The MPCA uses private consultants to perform specific steps of TMDL studies when appropriate, necessary and desirable. Consultants are helpful in supplementing MPCA staff resources, particularly for technical work. Many local governments also hire consultants to help them with technical aspects of TMDLs.

The MPCA normally hires consultants through a state master contract. However, the agency also has used contractors hired and funded by the EPA, and will continue to partner with EPA in this way as needed, particularly when national expertise is needed for particularly complex TMDL studies and projects where impaired waters are shared with tribes, Canada or other states.

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 percent 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 can't control the many sources of this toxic pollutant outside our borders. The MPCA is working nationally with other states and EPA to address mercury by developing alternatives to traditional TMDLs for individual water bodies. The agency is also open to other suggested approaches from external stakeholders.

STRATEGIES FOR INCREASING EFFICIENCIES AND EFFECTIVENESS

Given the growing number of TMDL studies, limited staffing, and available funding, the MPCA is developing plans to increase the efficiency and effectiveness of its impaired waters activities, including:

- **Grouping multiple impairments.** The MPCA is striving to increase the number of impairments that can be addressed in a single project by looking at options to expand the regional and watershed approaches discussed above. Here are two examples:

  -- **Regional TMDL studies for lakes:** The 2002 impaired waters list includes about 100 lakes that are currently being planned for individual TMDL projects. The MPCA will be analyzing ways to create a regional approach to lakes that have similar problems (e.g., excess nutrients causing algal blooms) and natural characteristics, in order to combine several lakes in a single project.

-- **Single-entry watershed projects:** This approach, similar to that employed by the state of Washington and other states, is designed to study and restore all of a watershed's impairments in a single, comprehensive project

- **Specialized technical teams.** The agency needs to better provide technical expertise to regional staff on technical work related to TMDLs and restoration projects. Technical teams could look toward developing more routine or "cookbook" approaches to conducting projects for impaired biota, turbidity, excess nutrients in lakes, and some toxic pollutants. Doing so will require more research using benchmarking, professional judgment and research to train such teams. The agency will look to the experience of other states and consider assistance from consultants.

- **Improved coordination with state and federal agencies.** Given the daunting and growing size of Minnesota's impaired waters workload, the MPCA will need assistance from a wide range of other agencies.

  On the federal level, the MPCA is negotiating with EPA for potentially direct assistance on some TMDLs, particularly for those impaired waters that Minnesota shares with tribes, other states and Canada. In addition, the MPCA has contracted with the USGS to do monitoring work on studies in the Red River basin, and we will continue to rely heavily on the many funding programs sponsored by the U.S. Department of Agriculture to address nonpoint source pollution.

  The MPCA will also look to the expertise of other states to facilitate coordination of state, federal and local programs. For example, the state of Wisconsin has recently adopted new regulations that create financial incentives and prioritization for watershed assessment and restoration, while at the same time improving coordination of public agencies during every phase of the process.

GOAL SETTING AND PERFORMANCE MEASUREMENT

The MPCA is in the early stages of implementing its impaired waters effort. Working with stakeholders, the agency will set measurable goals for this implementation, based on both shorter-term administrative (e.g., productivity and cost effectiveness) targets and longer-term environmental outcomes. We will be evaluating our program on an annual basis to measure progress against these goals.

The cost to restore waters impaired by nonpoint sources on the 2002 list is estimated at $600 million to $3 billion. This does not include costs to upgrade point sources, such as municipal wastewater treatment facilities. The MPCA has $1.1 million per year in dedicated funding for restoration activities related to nonpoint sources. To meet current estimates, an additional $45 million to $230 million per year would be needed, some of which may be available through aligning resources at MPCA and with other state and federal agencies. Local governments will play a leading role in restoration. The MPCA believes that additional funds will need to be allocated to enhance local government's capacity to restore impaired waters.

VI. SPECIAL STATE STRATEGIES

A. Phosphorus Strategy

Introduction

Phosphorus is the primary pollutant associated with the eutrophication of Minnesota's surface waters, a condition in which excess nutrients cause proliferation of algae and other aquatic vegetation. Excess phosphorus results in nuisance algal blooms and reduced transparency, making waters unsuitable for swimming or other activities. This problem tends to persist as the phosphorus moves downstream, making it a pollutant of regional, statewide and national concern. Phosphorus is an increasingly important area of environmental regulation.

Background

Phosphorous in lakes and streams comes from both point and nonpoint sources (NPSs). Point sources of phosphorus (*e.g.,* wastewater-treatment facilities) are most significant during periods of low precipitation and below-average stream flow, while NPSs (*e.g.,* runoff from farms and cities) are most significant during periods of high precipitation and above-average stream flow.

Minnesota has a long history of point-source phosphorus controls. Since the early 1970s, MPCA rules have required phosphorus limits of 1 milligram per liter at all wastewater facilities discharging directly to or affecting a lake or reservoir. This rule primarily focused on impacts of phosphorus to individual lakes.

Phosphorus Strategy

As land uses have changed and population continues to increase, concern over excess phosphorus in our surface waters also has increased. Recognizing this, the MPCA formed a team to develop a phosphorus strategy. The team developed six action steps, which are in various stages of implementation. These action steps form the MPCA's strategy for dealing with phosphorus pollution from both point and NPS.

Many presentations have been made and discussions held with stakeholder groups over the past year. This is an on-going activity of the MPCA.

1. *Co-sponsor basin-wide phosphorus forum(s).* Various forums and discussion on affects of phosphorus have been held in conjunction with basin planning efforts.

2. *Use basin management as the main policy context for implementing the phosphorus strategy.* Basin information documents and cooperators for the Minnesota, St. Croix, Upper Mississippi, Lower Mississippi and Red River basins have or are addressing phosphorus as a pollutant of concern for each basin. Individual responses range from proposed reductions in phosphorus loads (Minnesota River), "no net increase" in phosphorus loads (St. Croix), to considerations of downstream impacts on Lake Winnipeg (Red River). In addition, the

Metropolitan Council of the Twin Cities has proposed that all its wastewater-treatment facilities will control phosphorus to 1 milligram per liter or lower by 2008. The Metro plant achieved concentrations of 1 mg/L or lower as of early in 2004.

3. *Broadly implement Minnesota's point source phosphorus controls.* The MPCA will be applying part of its phosphorus rule ("affects a lake or reservoir") more broadly to reflect basin-wide loading, rather than solely on individual source loading, where there are TMDLs or related concerns regarding excess nutrients. This approach, which addresses the cumulative effects of phosphorus, has been used in permits on the St. Croix, Crow, Minnesota and Lower Mississippi rivers. Also, major wastewater-treatment plants are encouraged to have phosphorus-management plans to reduce or control phosphorus discharges. PMPs and phosphorus effluent monitoring are now a routine part of re-issued NPDES permits. This relates back to the adoption of the "Phosphorus Strategy" by MPCA Management and Board in March 2000 and is now being implemented.

4. *Broadly promote lake-protection initiatives.* MPCA's in-lake phosphorus criteria provide a basis for setting goals in lake projects and for prioritizing protection efforts. Controlling NPSs is essential to lake protection, and is managed by many regional, state and federal agencies. The MPCA works with citizen groups, local governments, watershed organizations, state and federal agencies and other organizations to reduce NPS pollution. Lake protection was emphasized in the state's NPS strategy that was be revised in 2000. It continues to be emphasized with the listing of nutrient –impaired lakes on the 2002 303(d) list. Lake nutrient criteria are now under development as a part of the triennial standards review process with adoption anticipated for 2005.

5. *Address phosphorus impacts on rivers*. Studies from around North America document the links between phosphorus and in-stream algal concentrations. The MPCA conducted sampling in several river basins in 1998 and 1999 to improve our understanding of the effects of phosphorus in Minnesota streams. A USEPA grant is helping to fund similar work in 2000. This work will contribute to national efforts to develop nutrient criteria for rivers. A paper documenting relationships between nutrients, algal abundance, and biochemical oxygen demand was published in December 2001, in Lake and Reservoir Management. A subsequent paper on this topic made further connections among nutrients, diurnal dissolved oxygen fluctuation, and fish and invertebrate IBIs.

6. *Modify WQ standards if necessary***.** Regulatory-related activities the MPCA is involved in or is considering include:
   - Participating in USEPA regional and national work groups which are developing nutrient criteria as part of the federal Clean Water Action Plan. As stated above rulemaking is currently underway for lakes.
   - Revising Minnesota rules to allow wastewater facilities to meet annual-average phosphorus limits (where appropriate), rather than monthly-average limits. This will encourage the use of new technologies for phosphorous removal. This provision was included in the 2000 triennial revision of Minnesota's WQS. Further refinements of this rule are under consideration for the current rulemaking.

- A major study of the sources of phosphorus in the various river basins in Minnesota was commissioned by the Legislature. That study, completed early in 2004, will provide an improved basis for evaluating sources and solutions for nutrient pollution.

B. Storm Water Program Development

In implementing the Phase II Stormwater federal requirements, the Minnesota Pollution Control Agency (MPCA) has been challenged to address Minnesota nondegradation rules stemming from federal antidegradation policy under 40 CFR 131.12, and providing public comment on individual permittee's plans in a general permit setting.

Minnesota's nondegradation rules include distinct rules for discharges to all waters of the state, ORVWs, and wetland. These rules were written in a traditional point source setting and application to stormwater discharges have proven difficult, including court challenges. The 2003 Legislature provided time for the agency to rewrite these rules to better address stormwater discharges by 2007.

Minnesota and other states have had courts remand the general permit for small regulated Municipal Separate Stormwater Systems (MS4s) on the issue of public process within a general permit structure, among other issues. At issue was how the public could comment on a communities permit when most of the substantive best management practices chosen by the community were within the applications, which were not open to public comment.

The MPCA formed a Stormwater Design Team during the fall of 2003 due in part to 1) the importance of stormwater pollution in Minnesota, 2) the implementation of Phase II, 3) the large contentious policy issues, 4) the future issues with impaired waters, and 5) the need to work more closely with various partners to have an effective program to reach down to the individual citizen and smaller/more numerous regulated parties. This team will continue from 2004-2006 at a minimum and will shape stormwater policy for the state of Minnesota.

<u>Construction Stormwater</u>

The MPCA issued a revised construction stormwater general permit on August 1, 2003 for use of all construction activity over 1 acre of disturbance incorporating the Phase II requirements. This permit provides additional environmental protection for the states ORVWs and wetlands, better regulates those actually doing soil disturbances within subdivisions, and provides more options for post construction BMPs than the previous permit. The permit also addresses impaired waters.

<u>Municipal Stormwater</u>

The MPCA Citizen's Board authorized issuance of the small regulated Municipal Separate Stormwater Systems (MS4s) general permit in June of 2002. The Minnesota Center for Environmental Advocacy appealed the decision and the Minnesota Court of Appeals remanded the permit to the agency to address nondegradation, public process, and other issues. The regulated small MS4s are currently following the appealed permit until these issues can be

resolved and a new permit reissued. This permit also addresses impaired waters and ORVWs. The reissued permit will also address nondegradation of all waters.

Industrial Stormwater

Comments received during the public comment period for the Industrial Stormwater general permit included addressing nondegradation and other issues. The MPCA is currently working on policy on these issues to reissue the draft permit. Phase I regulated permittees are currently regulated under an expired general permit. Phase II regulated parties have submitted applications to the agency awaiting permit issuance.

Stormwater Rules

The MCPA is currently drafting a new stormwater rules chapter which will incorporate the Phase II federal regulations. Stakeholder meetings are being held through the winter of 2004 for feedback on issues including: 1) designation of additional small MS4s for permit coverage, 2) conditional exclusion from permit coverage for certain restoration projects following compliance with rule requirements, and 3) requirements for utility installation. Rules for nondegradation as it relates to stormwater will be addressed in a future rulemaking effort.

VII. ECONOMIC COST BENEFIT ANALYSIS

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

Cost-benefit analysis is an attempt to make this assumption explicit and testable. However, the benefits associated with environmental programs (and, to a certain extent, even the costs) are not well quantified at present. Environmental amenities, for the most part, are not traded in the market place, and prices, in the normal sense, are not attached to benefits such as clean water, healthy aquatic communities, or even the well-being that comes with good health. While various attempts have been made to put dollar figures on some of these, their value remains largely intangible.

As a result, environmental policy decisions are inevitably, and perhaps best, made through the political process, rather than through the strict application of a quantitative cost-benefit analysis which would necessarily 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 Agency 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. The ongoing Six Sigma analysis of the efficiency of various Agency process 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.

At the same time, even if complete figures are lacking, a partial accounting – partly quantitative, partly descriptive – can be given of some of the costs and benefits associated with Minnesota's water quality programs.

Costs

The primary water quality programs at the state level are those of the MPCA and the Minnesota Board of Water and Soil Resources. Including local assistance, the water quality budget of the former is approximately $25 million per year and of the latter approximately $15 million per year. Other costs are incurred at the local level in the regulation of land-use, feedlots, and on-site sewage-disposal systems. It should be noted also that other environmental programs, such as air quality, solid waste, hazardous waste, and agricultural pesticide regulation have direct effects on the quality of the state's surface and ground waters. The MPCA, which has primary jurisdiction for the first three of these, has an overall budget of approximately $115 million per year.

Regarding the actual implementation of point-source water pollution controls, close to $2 billion in federal, state, and local funds have been spent since the enactment of the Clean Water Act for the construction of municipal wastewater-treatment facilities in the state, including the separation of combined sewers. Operating costs for Minnesota municipal sewer utilities are estimated at more than $200 million per year. At this point, no similar figures exist regarding industrial water-pollution-control costs. It should be noted, however, that municipal facilities treat industrial as well as municipal wastes and that industrial contributions thus represent a significant portion of the above figures.

Regarding the implementation of nonpoint-source water pollution controls, the overall costs are both more diffuse and more difficult to calculate than are those for point-source programs. Current estimates, however, are that it will take between $600 million and $3 billion to restore Minnesota waters on the 2002 303(d) list that are impaired by nonpoint sources.

Benefits

If the comprehensive costs of water pollution control efforts are not yet fully calculated, the benefits are even less precisely measured. Theoretical models for translating water quality improvement into economically measured benefits do exist, but no attempts have been made to do this for the state as a whole.

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 Clean Water Act. While only 20 percent of the state's sewered population was served by facilities capable of at least secondary treatment in 1952, fully 99.9 percent are so served at present. In a similar vein, rates of regulatory compliance for municipal and industrial facilities are at a high level, with more than 95% of major water quality permittees meeting their effluent limits.

Even more striking are the indications of water quality improvements associated with improvements in specific major wastewater treatment facilities. On the Mississippi River below the Twin Cities, both the elimination of floating mats of sludge and the return of the mayfly are evidence of cleaner water conditions that followed massive treatment facility construction and storm water separation. Parks are being developed up and down the river's shores and recreational boat use has increased significantly. In the St. Louis River Bay, while sediment and fish tissue contamination problems remain, facility construction by the Western Lake Superior Sanitary District has led to noticeably cleaner water and return to use of the river as a walleye fishery. Similar results have been achieved on the Rainy River below International Falls.

While the nonpoint source program is considerably younger than that for point sources, similar benefits are beginning to be shown. Water quality projects implemented through local cooperators have led to significant improvements in specifically targeted problem areas. Improved water quality in Lake Bemidji and Lake Shokatan are examples of this. Perhaps even more impressive is the water quality improvements for the Minnesota River, with a 25 percent reduction in sediment carried by the river during typical flow conditions. Increased use of agricultural soil-conservation practices in recent years appears to be the main reason behind the reductions, and is a large step towards meeting the ultimate goal of a 40 percent reduction in sediment originating from cropland in the basin. Similar improvements have been seen for phosphorus and biochemical oxygen demand (BOD) concentrations in the river.

As a result of both point-source and nonpoint-source 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 BOD (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.)

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. At approximately $10 billion per year, the economic importance to the state is considerable; water is one of the state's greatest attractions and plays a critical role in those dollars. Similarly, a recent study by Bemidji State University on the socio-economic value of Minnesota lakes found a strong relationship between water clarity and lake property values, with an increase (or decrease) of one meter in clarity leading to changes of tens or even hundreds of millions of dollars for given individual lakes. This matches with the results of studies elsewhere in the United States demonstrating and quantifying the benefits of water quality protection and improvement.

An accounting of some of the key results regarding the MPCA's environmental programs can be found at www.departmentresults.state.mn.us.

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Appendix A

Table 1. Current Minnesota Condition Monitoring Efforts

Activity Name	Start	Monitoring Design/Description	Purpose	Indicators
Rivers and Streams				
MPCA Milestone Monitoring	1953 (some sites)	Fixed station design with periodic grab sampling for a suite of conventional chemical/physical parameters. Samples collected monthly for ten months of the year. Currently 80 sites, 20 with flow. 32 sites monitored each year on a rotating basin basis.	Compare basic water chemistry to water quality standards, looking at trends at a consistent set of sites.	Dissolved oxygen, temperature, pH, nitrite/nitrate nitrogen, ammonia nitrogen, conductivity, turbidity, and fecal coliform bacteria and/or E. coli (collected for special projects and when sample holding times can be met) When continuous flow data is available: total phosphorus, chlorophyll-a, pheophytin 5-day biochemical oxygen demand, residue, total non-filterable (total suspended solids), suspended volatile solids When appropriate: trace metals
MPCA Integrated Monitoring in Streams (w/DNR)	1990	Statistically-based design with random site selection. Periodic grab samples for integrative biological, physical, chemical parameters. Sampling at 200 sites per year, on a	Used for biocriteria development, trend monitoring, 305(b) and 303(d) assessments and reporting, evaluation of water quality	Composite index of fish and invertebrate community characteristics; dissolved oxygen, conductivity, nutrients, turbidity, stream

		rotating basin basis. More than XX site monitored in five basins.	permit limits, and evaluating water quality standards.	flow, bottom type, bank stability
Activity Name	**Start**	**Monitoring Design/Description**	**Purpose**	**Indicators**
MPCA River Nutrient Studies (w/USGS)		Fixed station with periodic grab sample, physical/chemical parameters. Samples collected at about 20 river sites. Combined with USGS flow records.	Data set used to provide basis for standards, nutrient criteria. Also used for research, model development.	Nutrients, chlorophyll-a and related data
MPCA Trace Metals in Streams	1996	Probabilistic monitoring with fixed station design collected on a rotating basin basis. Samples collected at locations to represent basin characteristics. Basin-focused measurement of metals in whole water and dissolved-phase of streams. Data available for six basins to date.	Used for water body assessments, including 305(b) use assessments and 303(d) listing, assist in the development of water quality standards and effluent limits, and to estimate typical metal concentrations in surface waters of the basin.	Hg, As, Cd, Cr, Cu, Pb, Ni, Zn and hardness in whole water and dissolved-phase of streams.
Citizen Stream Monitoring Program	1998	Self-selected volunteer effort, periodic sampling. Citizen monitoring of river water clarity using a transparency tube. Approximately 500 volunteers; goal to increase to 650.	Monitor the transparency of MN rivers and streams for baseline conditions, goal setting, trend identification and targeting more intensive monitoring.	Transparency
MPCA Basin Assessments	2002	Condition monitoring conducted as a component of basin management. Upper Mississippi River initiative currently underway. Fixed station with continuous (automated) monitoring. Eight stations in the basin. First two years focused on major tributaries.	Assess condition of basin tributaries and main stem rivers. Used to identify trends and exceedences of standards. Also serves as effectiveness monitoring on a basin scale.	Nonpoint parameters: nutrients, TSS, BOD and fecal

Activity Name	Start	Monitoring Design/Description	Purpose	Indicators
Lakes				
MPCA Intensive Study Lakes (with DNR and MDH)	Fish tissue sampling began in '68	Collect predator fish and one-year-old panfish for mercury and other contaminants. About 100 lakes, monitored approximately every five years.	Identify trends in fish-tissue mercury concentrations. Also used for 305b and 303d assessments.	Mercury
MPCA Lake Trend Analysis	1985	Ecoregion-based monitoring design using fixed-station reference lakes. Lakes chosen based in part on Citizen Lake Monitoring Program trends.	Characterize trophic status for each ecoregion in Minnesota. Used to develop status and trend reports for Minnesota lakes, and also for 305b and 303d assessments. Used to develop water quality criteria for lakes.	pH, conductivity, Secchi disk, temperature (profile), dissolved oxygen (profile), total phosphorus, total Kjeldahl nitrogen, nitrate/nitrite nitrogen, residue, total non-filterable (total suspended solids), alkalinity, chloride, color, turbidity, chlorophyll-a
MPCA Lake Assessment Program (with local lake associations)	1985	Fixed station design; monthly sampling May-September. Collect nutrient, chlorophyll-a and related data at lakes. More than 160 studies since 1985.	Used to develop status and trend reports for Minnesota lakes and for 305(b) reporting. Also used to recommend actions for local lake management efforts.	Secchi disk transparency, nutrients, chlorophyll a, solids, pH, color, plus a depth profile of oxygen and temperature. Fisheries and lake level measures provided by DNR.
Citizen Lake Monitoring Program	1973	Self-selected volunteer effort, periodic sampling. Citizen monitoring of lake water clarity using Secchi disk. About 1200 volunteers; goal of 1450. Limited chemistry at some sites.	Monitor the transparency of MN lakes for baseline conditions, goal setting and targeting, and trend identification.	Secchi disk transparency

Activity Name	Start	Monitoring Design/Description	Purpose	Indicators
MPCA Short-term Special Studies	Varies	Lake and stream studies to look at emerging issues (pharmaceuticals, wastewater compounds, etc.), other critical toxic pollutants (e.g., mercury) or special areas (Lake Superior streams). Designs vary based on the conditions studied.	Used to provide understanding of identified issues.	Indicators vary depending on conditions being studied.
Wetlands				
MPCA[3] Wetland Monitoring	1996	MPCA samples wetland aquatic plants and invertebrates to develop an Index of Biotic Integrity (IBI) for each wetland. Focus is on developing IBIs for depressional wetlands statewide before attempting to focus on other types of wetlands.	IBI is a good indicator of the condition of Minnesota's wetlands. To be used for status and trends. Also used for problem investigation, effectiveness monitoring. Can be used in permit issuance and possibly in TMDL process in the future.	Aquatic plants, aquatic invertebrates to the species level, general chemistry, sediment toxicity.
Wetland Health Evaluation Program	1996	Self-selected volunteer effort, periodic sampling in two metro-area counties (Dakota and Hennepin). MPCA provides annual training.	Data used in water resource and city planning decision making.	Aquatic plants, aquatic invertebrates to the family level.

[3] A note on wetlands: Currently, the MPCA is not assessing wetlands for TMDL listing purposes. To meet its newly-established goal of assessing 25% of the state's depressional wetlands by 2014, the MPCA will begin with a dual approach. By June 30, 2005, the MPCA will sample 50 to 75 depressional wetlands on forested land, from which an IBI report will be developed. The MPCA will also work with its partner agencies (Department of Natural Resources, Board of Water and Soil Resources, U.S. Fish and Wildlife Service and EPA) to develop a long-term monitoring plan for Minnesota wetlands. This plan will be completed by June 30, 2005 and will include a focus on wetland inventory needs using remote sensing techniques. The plan will be attached to the final strategy.

Table 2. Problem Investigation Monitoring Designs and Indicators:

Activity Name	Start	Description/Monitoring Design	Purpose	Indicators
TMDL studies	1999	Monitoring associated with completing TMDL studies. Monitoring conducted by local groups and MPCA. Designs vary depending on parameter	Develop TMDL allocations.	Fecal coliform, turbidity, dissolved oxygen, ammonia, chloride, pH, temperature, impaired biota, excess nutrients, mercury and PCB in water, mercury and PCB in fish tissue, various toxics in the St. Louis River.
Clean Water Partnership Phase I	1987	Locally-based monitoring projects, funded through MPCA. Flow-based monitoring of watershed inputs to a lake, river or wetland to determine loadings in areas of local concern.	Determine the major sources of a water quality concern, develop goals and identify strategies for achieving goals. Provide input data for models.	Depends on project. Most common are those related to runoff – nutrients, nitrogen, phosphorus, sediment, flow and hydrological modifications.
Special studies	1998	Small, short-term projects providing needed timely information. Sites and designs vary by year.	To develop short-term, timely information needed for decision-making.	
Fishkill investigations and discharge violations	1950s	Case-specific monitoring designs, usually involving upstream and downstream sampling and sampling of candidate cause, if suspected. Water quality and released material sample collection. Fish and wildlife collections made in conjunction with DNR.	Incident response, water quality impact documentation and enforcement case development (supporting emergency response, NPDES and feedlot programs)	Case-specific parameters. For manure & wastewater releases: general chemistry (pH, conductivity, TSS, turbidity, chloride, sulfate, BOD5), nutrients, metals, and fecal coliform, for manure fecal strep. For industrial or releases of unknown origin: most of above plus more comprehensive metals, VOCs, SVOCs and pesticides. Others as case requires.

Activity Name	Start	Description/Monitoring Design	Purpose	Indicators
Waste Load Allocations to Support NPDES Program	1977	Monitor chemical or physical parameter of concern on selected streams and rivers receiving discharges from municipal wastewater treatment plants. Typically two, 2 to 3 day surveys under low-flow conditions. Approximately 100 surveys, 500+ stations	Determine appropriate effluent limits for a discharge so that water quality standards are maintained and the designated uses protected. Effluent limits incorporated into NPDES permits.	Diurnal DO, temperature, pH, flow, time of travel, physical measure of stream channel, CBOD, nutrients, chlorophyll a, TSS, turbidity, conductivity, alkalinity, chloride, sometimes metals. Also composite sampling of wastewater effluent.
MPCA Lake Superior Beach Monitoring Project (with MDH, local organizations)	2003	Tiered monitoring at 36 Lake Superior beaches for bacteria.	Used to assure safe and healthy aquatic recreation and inform the public about risks of contracting waterborne diseases from exposure to contaminated water.	Fecal coliform and E. coli
Fluvial Geomorphology				

Table 3. Effectiveness Monitoring Designs

Activity	Start	Description/Monitoring Design	Purpose	Indicator
Stormwater Monitoring	2004	Monitoring design to be determined.	To evaluate effectiveness of MPCA's stormwater permitting programs and best management practices.	Flow and chemistry
Monitoring associated with TMDL implementation plans	2003	Monitoring by local groups or MPCA to evaluate effectiveness. At a minimum, monitoring meets delisting guidance in MPCA's *Guidance for Assessing Water Quality Impairments*. In addition, monitoring design is customized, based on parameter or BMP implemented.	To assess effectiveness of TMDL implementation plan/BMPs and ultimately to delist water body.	Dependent on impairment: Fecal coliform, turbidity, dissolved oxygen, ammonia, chloride, pH, temperature, impaired biota, excess nutrients, mercury and PCB in water, mercury and PCB in fish tissue, or various toxics in the St. Louis River.
NPDES effluent monitoring	1970s	Monitoring by permittees for parameters required in permits. Monitoring frequency varies by parameter and by size and type of facility, from continuous to a few samples per year. Includes tile-line discharge monitoring at NPDES feedlots.	Used for compliance determination, standards development and enforcement	Parameters identified in individual permits. Typical parameters for domestic wastewater include: flow, CBOD, TSS, pH, Phos-phorus, DO Fecal coliform, chlorine residual. Typical for industrial include flow, TSS, temperature. May be additional parameters based on situation.
Up/down stream monitoring to support NPDES permit program.	ongoing	Approximately 110 permittees do this monitoring, at 270 stations. Monitoring design based on permit issues, frequency of sampling ranges from once per week to conditional monitoring during low-flow conditions.	Used to evaluate effluent limits for an NPDES permit, compliance determination, and requirement of variance process.	A number of parameters depending on situation (about 30 total for all permits). Typically includes DO, temperature, pH, ammonia, phosphorus.

Activity	Start	Description/Monitoring Design	Purpose	Indicator
Monitoring associated with feedlot regulatory activities		Case-specific monitoring design as part of enforcement case development.	To verify information for enforcement cases.	Fecal and BOD
Monitoring associated with ISTS regulatory activities	1980s	Occasional monitoring at cluster systems or large, multi-party drainfield systems in shoreland areas. Fixed station design, periodic sampling. Part of State Disposal System permit.	Impact of system on lake or other water body.	Phosphorus
Monitoring to evaluate Clean Water Partnership implementation projects, 319 projects, etc.	Late 1980s	Locally-based projects, jointly funded through MPCA and external organization. Monitoring designs vary by project and BMPs implemented. An example is the Whitewater River Watershed National Monitoring Project.[4]	To assess the effectiveness of nonpoint source water-pollution-control efforts.	Depends on project. Most common are those related to runoff – nutrients, nitrogen, phosphorus, sediment, flow and hydrological modifications.
Basin Assessment	2002	See description under "Condition Monitoring"	To evaluate effectiveness of implementation projects at a basin scale.	See Condition Monitoring
Monitoring to support Closed Landfill discharge between ground water and surface water.	1994	Monitor surface water points for closed landfills where ground water discharges to a surface water body (river, wetland, lake). Monitoring frequency ranges from seasonal to annual.	Used to determine compliance with water quality rules for nonpoint discharge.	Primarily VOCs and metals.

[4] In *2002 Annual Report to the U.S. Environmental Protection Agency on Clean Water Act Section 319 and Clean Water Partnership Projects in Minnesota* (attached).

Activity	Start	Description/Monitoring Design	Purpose	Indicator
Monitoring of storm water and surface water bodies adjacent to permitted solid waste facilities	1990s	Designs vary by site. Monitoring may involve routine water quality sampling for stormwater ponds, wetlands, streams, rivers or other surface water features in the vicinity of solid waste facilities.	Compliance with permit intervention limits.	Stormwater related contaminants: turbidity, specific conductance, etc. Occasionally also for inorganics.
MCES compliance monitoring	1994	Monthly sampling of leachate, gas condensate, and contaminated groundwater discharged to MCES. Five metro-area landfills.	Used to determine compliance with MCES standards.	Metals and VOCs.