2008 Minnesota Water Quality: Surface Water Section

(Abbreviated Narrative Report)

Report to the Congress of the United States Water Years 2006 - 07

2008 Integrated Report

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

Water Years 2006-07

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.

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Complete List of Acronyms

ADB	Assessment Database
APO	Administrative Penalty Order
AQL	Aquatic Life Use Support
AQR	Aquatic Recreation Use Support
AQC	Aquatic Consumption Use Support
AU	Assessment Unit
AUID	Assessment Unit Identification
BEACH	Beaches Environmental Assessment and Coastal Health
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BPJ	Best Professional Judgment
BWCAW	Boundary Waters Canoe Area Wilderness
BWSR	Minnesota Board of Water and Soil Resources
CALM	Consolidated Assessment and Listing Methodology
CDX	Central Data Exchange
CWSRF	Clean Water State Revolving Fund
CFR	Code of Federal Regulations
CFU	Colony Forming Units
ch.	chapter
chl-a or Chl	Chlorophyll-a
CLMP	Citizen Lake Monitoring Program
CMS	Compliance Monitoring Survey
CO_2	Carbon Dioxide
COE	St. Paul District Army Corps of Engineers
CSMP	Citizen Stream Monitoring Program
CWA	Federal Clean Water Act
CWAMMS	Comprehensive Wetland Assessment, Monitoring and Mapping Strategy
CWLA	Clean Water Legacy Act
CWP	Clean Water Partnership
DNA	Deoxyribonucleic Acid
DO	Dissolved Oxygen
E. Coli	Escherichia Coli
EDCs	Endocrine Disrupting Chemicals
EQB	Minnesota Environmental Quality Board
FAQ	Frequently Asked Questions
FAV	Final Acute Value
FS	Full Support
FY	Fiscal Year
GIS	Geographic Information System
GPS	Global Positioning System

ha	hectare
HFERP	Horizontal, Fluorophore-Enhanced, Repetitive extragenic Palindromic
Hg	Mercury
HGM	Hydrogeomorphic
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
IBP	Industrial Byproducts
I&E	Information and Education
IR	Integrated Report
IUP	Intended Use Plan
LCMR	Legislative Commission on Minnesota Resources
LDI	Landscape Development Index
LUG	Local Unit of Government
LSTS	Large (10,000 gallons/day) Subsurface Treatment System
LWQA	Lake Water Quality Assessment
m	meter
M.S.	Minnesota Statute
MMP	Mercury Minimization Plan
MCES	Metropolitan Council Environmental Services
MCL	Maximum Concentration Level
max	maximum
MDH	Minnesota Department of Health
MDNR	Minnesota Department of Natural Resources
mg/L	milligram Per Liter
min	minimum
Minn./MN	Minnesota
mL	milliliters
MMP	Mercury Minimization Plan
MnRAM	Minnesota Routine Assessment Method
MOU	Memorandum of Understanding
MPCA	Minnesota Pollution Control Agency
MS4	Municipal Separate Storm Sewer System
MWCA	Minnesota Wetland Conservation Act
N	Nitrogen
NCHF	North Central Hardwood Forest
ln	Natural Log
ng/L	nanograms per liter
NGP	Northern Glaciated Plains
NH_3	Un-ionized Ammonia
NHD	National Hydrography Dataset
NLF	Northern Lakes and Forests
NMW	Northern Minnesota Wetlands

NO_2/NO_3	Nitrite/Nitrate
NO_3 - N	Nitrate - Nitrogen
NO_X	Nitrogen Oxides
NPDES	National Pollution Discharge Elimination System
NPS	Nonpoint Source
NS	Non-Support
NSMPP	Nonpoint Source Management Program Plan
NWI	National Wetland Inventory
OIRW	Outstanding International Resource Waters
orgs.	organisms
ORVW	Outstanding Resource Value Waters
P	Phosphorous
PBDE	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated Biphenyls
PCR	Polymerase Chain Reaction
PFA	Public Facilities Authority
PFC	Perfluorocarbon
PFOS, PFOA & PFBA	Perflourinated Chemicals
PJG	Professional Judgment Group
PMP	Phosphorus Management Plan
ppb	parts per billion
PPL	Project Priority List
ppm	parts per million
Pt-Co Units	Platinum Cobalt
pts.	parts
QA/QC	Quality Assurance/Quality Control
R.	Rule
Red River	Red River of the North
Report	Integrated Report
RF1	Reach File 1
RIWA	Associations of River Waterwork
RRV	Red River Valley
SD	Secchi Disk
SDS	State Disposal System
SE	Standard Error
SONAR	Statement of Need and Reasonableness
SRF	State Revolving Fund
SSTS	Subsurface Sewage Treatment Systems
Stat.	Statute
STORET	Storage and Retrieval System
SU	Standard Units
subp.	subpart
SWPPPs	Storm Water Pollution Prevention Plans

TMDL	Total Maximum Daily Loads
TN:TP	Ratio – total nitrogen to total phosphorous ratio
TP	Total Phosphorus
TSI	Trophic State Index
TSIS	Trophic State Index Secchi
TSS	Total Suspended Solids
µg/L	Micrograms Per Liter
umhos/cm	micromho/centimeter
US	United States
USACOE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UVB	Ultraviolet Radiation
WCA	Minnesota Wetland Conservation Act
WCBP	Western Cornbelt Plains
WHEP	Wetland Health Evaluation Program
WI	Wisconsin
WLSSD	Western Lake Superior Sanitary District
WQ	Water Quality
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plant

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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 305(b) and 303(d) 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 United States' Environmental Protection Agency's (USEPA) Consolidated Assessment and Listing Methodology (CALM) for its 2008 Integrated Report.

CALM integrates the 305(b) Report with the 303(d) Total Maximum Total Loads (TMDL) List and provides a framework for states and other jurisdictions to document how they collect and use water quality (WQ) 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 (WQS), 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.

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

- delineation of WQ Assessment Units (AUs) based on the National Hydrography Dataset (NHD);
- status of and progress toward achieving comprehensive assessments of all waters;
- WQS attainment status for every AU;
- basis for the WQS attainment determinations for every AU;
- additional monitoring that may be needed to determine WQS attainment status and, if necessary, to support development of Total 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 of the first edition of the CALM was that all water bodies must be placed into one, and only one, of five categories as listed below. Minnesota will continue to use this categorization approach for 2008 reporting even though states now have the option of categorizing water bodies by use. The USEPA 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 WQS
Category 2:	some uses are meeting WQS and there are insufficient data (IF) 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 TMDL List.

As noted above, a reach (see page 59 for additional information) can only be placed into one Category using this approach. 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 USEPA-approved TMDL plans.

To differentiate between waters that require TMDLs (the TMDL List), and all impaired waters, the MPCA refers to the waters in Categories 4 and 5 as the Inventory of Impaired Waters.

Beginning with the 2006 reporting, states have the option of multiple categorizations of water body segments by use of Assessment Database (ADB) Version 2.2 or later. The multiple categorizations are based on categorizing each assigned use into one and only one of the five categories listed above instead of an 'overall' category for the water body. This would allow for better tracking of a state's assessment and work on improving impaired waters, but still does not allow for better tracking within a particular use having multiple impairments. Such a use would remain in Category 5 until all causes of impairment had approved TMDL plans. As mentioned earlier, Minnesota will not opt for the new categorization process for 2008 reporting.

Water Quality Assessments for Rivers and Lakes

Presented below are the summary tables for statewide river and lake assessments, using information from the ADB. An electronic update of the entire ADB is also being submitted to the USEPA. Water body 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 III, Chapter Three (see pages 59-68) 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 305(b) of the Clean Water Act (CWA). The 2008 reporting year marks the third consecutive time that Minnesota is providing an integrated report, combining the reporting processes for both 305(b) and Section 303(d), the impaired waters listing section of the CWA. The United States Environmental Protection Agency (USEPA) has requested that states begin preparing integrated reports, and Minnesota has done so.

To accomplish all the requirements for reporting, Minnesota is providing the USEPA with the following items: an update of Minnesota's Storage and Retrieval System (STORET) database; an TMDL List with accompanying information on the public comments; National Hydrography Dataset (NHD) index mapping of impaired and assessed waters; the Assessment Database (ADB) v2.2 containing integrated assessment data; and this report.

The summary tables that appear in this section reflect information from both the assessment process for 305(b) reporting and the listing process for 303(d) reporting. Tables I-1 and I-2 provide summaries of stream assessments that occurred in 2007 for the current assessment cycle, while Table I-3 reports the impaired miles, which are found in the ADB.

Summary Tables I-4 through I-6 reflect summaries of the lake and wetland assessment process. Tables I-4 and I-5 provide summaries of lake and wetland assessments that occurred in 2007 for the current assessment cycle. Table I-6 reports the impaired acres for each pollutant/stressor, which are found in the ADB.

As a result of the integrated reporting the assessment summary tables found in this document may reflect different results than what may be obtained from a query of the ADB. An 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 TMDL waters list assigned to Category 5 in the ADB. The ADB contains assessment data from previous 305(b) assessment cycles in the form of impaired and listed waters, which have been passed forward from previous TMDL Lists. These data may 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.

A new ten year window of sampling data for an AU, which is used in the assessment review may not include information about a previously identified and listed pollutant and therefore would indicate no impairment, but it cannot override the older data that led to a 303(d) impaired listing. Because of this difference the summary tables in this report contain a mixture of 2008 assessment cycle reporting for 305(b) purposes, and integrated reporting that includes impaired AUs from previous assessments.

A Note to Readers on Use of the Word Assessment

The integrated assessment process for lakes and streams was accomplished to satisfy the reporting requirements of sections 305(b) and 303(d) of the CWA. The reader should be aware that the purposes of these two sections are not the same and may use different sets of data. By that we mean that the assessment process begins with a compilation of all monitoring data available on a specific date. All available monitoring data is meant to include data meeting minimum criteria for comparison with WQS within a ten year window beginning on October 1st in the 12th year preceding the reporting of the assessment process results. For example, the reporting in 2008 uses a ten year window of data beginning on October 1, 1996 and extending through September 30, 2006. These data were used to analyze for compliance with WQS and reported for either or both 305(b) and 303(d) requirements.

Data requirements for 305(b) and 303(d) reporting diverge a bit at this point. While all data may be used in a review for 305(b), a minimum number of data and parameters may be required for a 303(d) review. This makes the set of data used for 303(d) review a subset of the data used for 305(b) review.

As stated previously, the assessment process begins with the compilation of all monitoring data available on a specific date. The data are compared to WQS for various pollutant parameters and assessments of support are made for specific uses. *An assessment of support is defined as a review of all available data for a particular water body segment use for their compliance to WQS and maintenance of that intended use.* It should be noted that an assessment of support for a use for one water body may not be based on a complete set of pollutant parameters nor may each water body have the same suite of parameters. Independent applicability as described in the assessment and listing guidance is the basis for making an assessment of support with less than a complete set of pollutant parameters. Assessments of support for each water body use are based on the available data at the time of the assessment process. In light of the ten year window of data and the reporting occurring in two year cycles, the most recent eight years of data used in one cycle are also used in the next cycle.

The compiled data for each water body are reviewed for compliance with WQS and an assessment of support is given to each use. The assessment of support was given a final rating of either, full support, (FS), insufficient data, or not assessed for 305(b) reporting. The subset of data used for 303(d) review was considered to include all stream data used in the 305(b) review plus lake data from the most recent ten year window that met certain minimum data requirements for consideration for listing a segment use support as impaired. The minimum data requirements are defined in the assessment and listing guidance. Final ratings for 303(d) results may only consider data reviewed as full or not supporting and meeting the minimum data requirements, or may include those rated as having insufficient data or reviewed but not assessed in the case of streams.

The use of the word 'assessed' in relation to the work of reporting on surface water monitoring data is somewhat ambiguous and requires an associated definition. The same is true for 'fully assessed'. Any such word usage should be accompanied with a specific definition so that any conclusions or statements made from the data are clearly understood. The words, 'fully assessed' are not used in this report to refer to the assessment process nor is there any attempt

to identify which stream or lake segments may have had more data available for review.

Table I-1. Summary of Fully Supporting 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 Impaired – Category 2	**2755**
Miles Impaired for One or More Uses – Categories 4 & 5	**10287**
Miles Reviewed but having Insufficient Data to Assess as Impaired or Supporting - Category 3	**1646**
Total:	**14688**

Table I-2. Individual Use Support Summary – Rivers.

Goals	Use	Miles Reviewed	Miles Fully Supporting	Miles Insufficient Information to Assess	Miles Not Supporting
Protect & Enhance Ecosystems	Aquatic Life	12782	4137	1869	**6776**
Protect & Enhance Public Health	Aquatic Consumption	5395	0	629	**4766**
	Aquatic Recreation	**5489**	**1155**	**962**	**3372**

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

Cause/Stressor Name	Integrated Reporting Miles Impaired
Acetochlor	**9**
Ammonia	**78**
Aquatic Macroinvertebrate Bioassessments	**539**
Arsenic	**147**
Chloride	**109**
DDT	**19**
Dieldrin	**19**
Dioxin	**13**
Fecal Coliform	**3372**
Fish Bioassessments	**2077**
Lack of Coldwater Assemblage	**38**
Mercury in Fish Tissue	**4617**
Mercury in Water Column	**432**
Oxygen, Dissolved	**1221**
PCB in Fish Tissue	**1186**
PCB in Water Column	**43**
Perfluorooctane Sulfonate in Fish Tissue	**85**
pH	**127**
Temperature	**10**
Toxaphene	**13**
Turbidity	**4764**

Table I-4. Summary of Fully Supporting and Impaired Waters – Lakes and Wetlands (includes Aquatic Recreation and Consumption).

Degrees of Use Support	Assessed Acres
Acres Fully Supporting All Assessed Uses – Category 1	**0**
Acres Fully Supporting at Least One Use & None Threatened or Impaired – Category 2	**107417**
Acres Impaired for One or More Uses – Categories 4 & 5	**3481693**
Acres Reviewed but Insufficient Information to Assess – Category 3	**285432**

Table I-5. Individual Use Support Summary – Lakes and Wetlands.

Goals	Use	Acres Reviewed	Acres Fully Supporting	Acres Insufficient Information to Assess	Acres Not Supporting
Protect and Enhance Ecosystems	Aquatic Life	678	0	0	**678**
Protect and Enhance Public Health	Aquatic Consumption	3437975	0	72117	**3365858**
	Aquatic Recreation	**2142732**	**449657**	**1212396**	**480679**

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

Cause/Stressor Category	Integrated Reporting Acres Impaired
Nutrient/Eutrophication Biological Indicators	**480679**
Mercury in Fish Tissue	**3365141**
Mercury in Water Column	**6968**
PCB in Fish Tissue	**1627560**
Perfluorooctane Sulfonate in Fish Tissue	**1923**
Aquatic Macroinvertebrate Bioassessments	**61**
Aquatic Plant Bioassessments	**651**

WETLANDS

Minnesota's approximately, 9.2 million wetland acres comprise about 1/6th area of the state. Historically, Minnesota is believed to have had as much as 21 million acres of wetland.

Minnesota wetland protection agencies have traditionally placed support for wetland regulatory programs ahead of monitoring and assessing status and trends in this resource. In recent years additional resources have been directed toward wetland monitoring as well as regulatory program delivery. Effective management and assessment of wetland status and trends is challenging and will require continued efforts by local, state and federal agencies.

The Wetland Conservation Act (WCA) continues to be the principal wetland regulatory program in Minnesota. Central to the WCA is the enactment of state policy to achieve a "no net loss" and to increase the, "quantity, quality and biological diversity of wetlands in the state" (Minn. Statutes 103A.201). Several water-related regulatory programs including the 404/401 certification permit program, the Department of Natural Resources (MDNR) Protected Waters permit program and the National Pollution Discharge Elimination System (NPDES) (including stormwater), align with the WCA to provide broad oversight of most types of direct physical wetland alteration in Minnesota.

With support from USEPA, Minnesota recently completed a Comprehensive Wetland Assessment, Monitoring and Mapping Strategy (CWAMMS 2006) in which three integrated approaches are recommended to effectively monitor the status and trends of Minnesota wetland quantity and quality. These three approaches include the following not in order of importance:

- An online georeferenced wetland permitting and restoration accounting system;
- Update Minnesota's National Wetland Inventory (NWI);
- Implement statewide surveys to assess wetland quantity and quality status and trends.

The recommendations in the CWAMMS blend well and support the 2006 Governors Wetland Vision and Strategies for Minnesota. The Wetland Vision is found at: (http://cwc.state.mn.us/documents/Wetlands.vision.pdf). The Wetland Vision compliments the Working Lands Initiative and ongoing efforts to develop a wetland restoration strategy for the state and will enable Minnesota to effectively evaluate the success of these measures in a comprehensive way.

STREAM WATER QUALITY TRENDS

The best available information on pollutant trends in rivers and streams comes from "Minnesota Milestone" sites. These are a series of 80 monitoring sites across the state with good, long-term data.

For the total period of record, which in some cases goes back to the 1950s, the following table shows the percentage of the 80 Milestone sites which had decreasing, increasing or no trends for various pollutants.

	Biochemical Oxygen Demand	Total Suspended Solids	Total Phosphorus	Nitrite/ Nitrate	Unionized Ammonia	Fecal Coliforms
Decreasing pollutant trend	89%	41%	78%	1%	83%	82%
Increasing pollutant trend	1%	4%	1%	75%	4%	0%
No trend	10%	54%	21%	23%	13%	18%

LAKE WATER QUALITY TRENDS

In previous years, the MPCA ran Kendall statistical tests using WQ Stat Plus™ software on lakes with four or more transparency readings per summer (June – September) and eight or more years of data. We used a probability (p) level of $p \leq 0.1$. At this p-level, there is a 10 percent chance of identifying a trend when it does not exist. This statistical package was not ideal for the number of lakes that needed to be analyzed. Each lake had to be analyzed individually, making it a very time consuming process. In 2006, the decision was made to switch statistical packages to one that could easily analyze all the data in one quick process. The statistical package, SYSTAT®, was chosen. The minimum requirements remained the same: only lakes with four or more transparency readings per summer (June – September) and eight or more years of data were analyzed. There were 934 lakes in Minnesota that met the minimum requirements for trend analysis in 2006. Of the 934 assessed lakes, 295 of them exhibited a statistically significant improvement in transparency over time. In contrast, only 99 lakes exhibited a statistically significant decline in transparency. The majority (58 percent) of the assessed lakes (540 lakes) exhibited no change in transparency over time.

PUBLIC HEALTH ISSUES

A. Lake Superior Beach Monitoring and Notification Program

The Beaches Environmental Assessment and Coastal Health (BEACH) Act passed in October of 2000, requires States that border coastal or Great Lakes waters to develop beach monitoring and public notification programs. The BEACH Act also required that States adopt USEPA's new criteria for pathogen and pathogen indicators. Minnesota adopted revised rules December 18, 2007.

In 2007, Minnesota was awarded $204,270 for implementation of the beach monitoring and notification program. The purpose of this project is to monitor selected beaches along the Great Lakes in accordance with BEACH Act requirements, allow for prompt notification to the public whenever bacterial levels exceeds USEPA's established standards, and investigate alternative methods for public notification. This information is used to investigate long-term trends in WQ and to establish a beach monitoring and public notification plan that will assist communities along the lake shore to improve their ability to monitor and notify beach users of risks associated with high bacteria levels.

Program Overview

This project brought together a Beach Team of state and local-level environmental and public health officials, local health officials, and other interested parties to design a beach monitoring and notification program. Approximately 58 miles of public beach miles and a total of 79 coastal beaches were identified along Lake Superior (Appendices II-A). The definition of "beach" for the purpose of Minnesota BEACH Act implementation is:

"A publicly owned shoreline or land area, located on the shore of Lake Superior, that is used for swimming or other water contact recreational activity."

The coastal beaches were geo-located using Global Positioning System (GPS) technologies and maps were created for all beaches. Additional Geographic Information System (GIS) data layers were added to include the location of all wastewater treatment outfalls along with their proximity to the beaches. Additional information was collected for each beach for evaluation: the potential for impacts from stormwater runoff, bather and waterfowl loads, and the location of outfalls and farms. This information was used to rank and classify beaches as "high," "medium," or "low" priority.

A standard sampling protocol was developed and standard advisory signs were designed based on feedback from Beach Team members and public meetings held in coastal communities (Appendix II-C).

The Beach website was designed to include all public beaches monitored under the BEACH Act program. This site also provides information on beach logistics, amenities, and local weather. The website management is contracted through the Natural Resources Research Institute, a research facility of the University of Minnesota.

Goals and Objectives

The purpose of this project in 2007 was to continue a consistent coastal beach water monitoring program to reduce the risk of exposure of beach users to disease-causing microorganisms in water. Selected beaches along Lake Superior were monitored in accordance with BEACH Act requirements with prompt notification to the public whenever bacterial levels exceed USEPA's established standards (Appendix II-D).

Work Completed in 2007

The 2007 beach season was the fifth full season a consistently implemented beach-monitoring program was conducted in the coastal area of Minnesota. A total of 39 beaches were sampled. There were 913 monitoring visits during the 2007 beach season. Out of these samples, 96 of them exceeded the WQ limit of 235 Colony Forming Units (CFU)/100 milliliters (mL) for *Escherichia Coli (E. coli*.)[*].

Beach Sanitary Survey Grant: The MPCA received a grant from the USEPA Great Lakes National Program Office to pilot the standardized sanitary survey to further identify pollution

[*]235 CFU/100mL is a single sample limit for the Lake Superior beaches. This is not a geometric mean limit and does not apply to the rest of the state. We use 126 CFU/100m> as a geometric mean for the Lake Superior beaches.

sources at the Lakewalk and New Duluth Boat Club beaches in Duluth. In addition, the MPCA further developed its existing beach sanitary survey tool to include more parameters such as turbidity and conductivity.

Success Stories and Concurrent Research Projects

The principal success of the Lake Superior Beach Monitoring Program is the continued public awareness the advisories bring to on-going water pollution issues. Residents and tourists are starting to realize that bacteria problems can occur in any part of the Lake Superior Basin but occurs with more frequency in the more urban areas and during storm events. Residents and visitors are picking up after their dogs on a more regular basis. They continue to be vocal about sewage overflows and demand they be corrected. The coastal cities are installing large holding tanks, back-up generators, and home sump pumps to slow and/or stop the storm related sewage overflows.

Microbial Source Tracking

Dr. Randall Hicks is the Director at the University of Minnesota – Duluth's Center for Freshwater Research and Policy. Dr. Hicks and students have isolated fecal coliform bacteria from streams, soils, periphyton, and beach areas, and identified their sources using the horizontal, fluorophore-enhanced, repetitive extragenic palindromic (HFERP) molecular fingerprinting method to help determine the most probable sources of fecal indicator bacteria in different aquatic habitats. They are collaborating with Dr. Michael Sadowsky's lab group at the University of Minnesota on this series of projects. Together with these colleagues, they have established a Deoxyribonucleic acid (DNA) fingerprint database (Dombeck et al. 2000. Appl. Environ. Microbiol. 66:2572-2577; Johnson et al. 2004. Appl. Environ. Microbiol. 70:4478-4485; Hieb. 2005. Minnesota Statutes (M.S.) Thesis) and used it to identify the animal sources of *E. coli* bacteria in streams (Hieb. 2005. M.S. Thesis), riverine soils (Ishii et al. 2006. Appl. Environ. Microbiol. 72:612-621), and aquatic periphyton communities (Ksoll. 2006. M.S. Thesis; Ksoll et al. 2007. Appl. Environ. Microbiol 73:3771-3778). The current project uses this method to identify seasonal changes in the sources of fecal bacteria found at beaches in the Duluth-Superior harbor (Ishii et al. 2007. Environ. Sci. Technol. 41:2203-2209). Dr. Hicks has recently obtained new funding to examine short-term changes in the abundances of fecal bacterial from waterfowl and humans at these beaches using hybridization and quantitative polymerase chain reaction (PCR) methods. Their goal is to determine what sources of *E. coli* bacteria are contributing to beach closures at different times of the year. This research is being supported by the Minnesota Sea Grant Program and the Western Lake Superior Sanitary District (WLSSD).

B. Effects of Atmospheric Pollution on Water Quality

The importance of atmospheric loading will vary, depending on the pollutant and the nature of the watershed. For instance, agricultural watersheds, nutrient loading from the atmosphere may be negligible. But in the same watersheds, the atmosphere may be the main source of toxic pollutants, such as polychlorinated biphenyls (PCBs) and mercury (Hg).

There are two situations where atmospheric deposition may be especially important sources of nonpoint source (NPS) pollution to surface water. First, lakes with a small watershed to lake surface area ratio can receive a large proportion of their loading from the atmosphere. For example, a study of Lake Mille Lacs suggests that precipitation (wet and dry fall) may

contribute approximately 48 percent of the annual phosphorus (P) loading to the lake. (Lake Mille Lacs occupies 53 percent of its total watershed area.) Similarly, airborne dust is thought to deliver the majority of P loading to Lake Superior. Second, some pollutants may be primarily delivered by the atmosphere even when there is significant human activity in the watershed. For instance, the geological source material in most watersheds does not contain a significant source of Hg. Mercury in a water body is most likely the result of atmospheric deposition. In addition, environmentally significant levels often accumulate in soils due to atmospheric deposition. If soil is eroded or inundated (say, through impoundment), there may be significant increases in Hg contamination to aquatic systems in the watershed.

Atmospheric deposition of pollutants is implicitly defined as NPS pollution in this document. Yet, the emission source to the atmosphere may well be a point source such as an emission stack. It is worth pointing out that even if modeling or measurement studies verify a direct relationship between a point source of air emissions and deposition to a water body, water managers may still consider that source of pollution to be nonpoint because it is delivered by the atmosphere.

Mercury vapor emissions from combustion sources result in ambient air concentrations below those of concern for direct human health effects through inhalation. Mercury is probably the most pervasive type of atmospheric NPS pollution in Minnesota, causing fish consumption advisories on over 90 percent of the lakes tested in the state.

The CWA, Section 303(d), requiring TMDLs for targeted impaired waters, led to the MPCA drafting a Statewide Mercury TMDL, which was approved by the USEPA in March 2007 and can be found at: http://www.pca.state.mn.us/water/tmdl/tmdl-mercuryplan.html.

GROUND WATER

The Ground Water Portion of the Integrated Report is being submitted at the same time as the Surface Water Portion, but under separate cover.

PUBLIC PARTICIPATION

A description of the public participation process and a copy of all letters, e-mails, etc. received from the public and a responsiveness summary was included with the TMDL List that was sent to USEPA on February 26, 2008.

The TMDL List is not included here but it will be added as Appendix III once USEPA provides MPCA with final approval.

The draft 2008 TMDL List can be found on the MPCA web site at:
http://www.pca.state.mn.us/publications/wqiw1-03.xls.

II. BACKGROUND INFORMATION

Chapter One: TOTAL WATERS, MAPS AND WATER POLLUTION CONTROL PROGRAM

STATE BACKGROUND INFORMATION

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

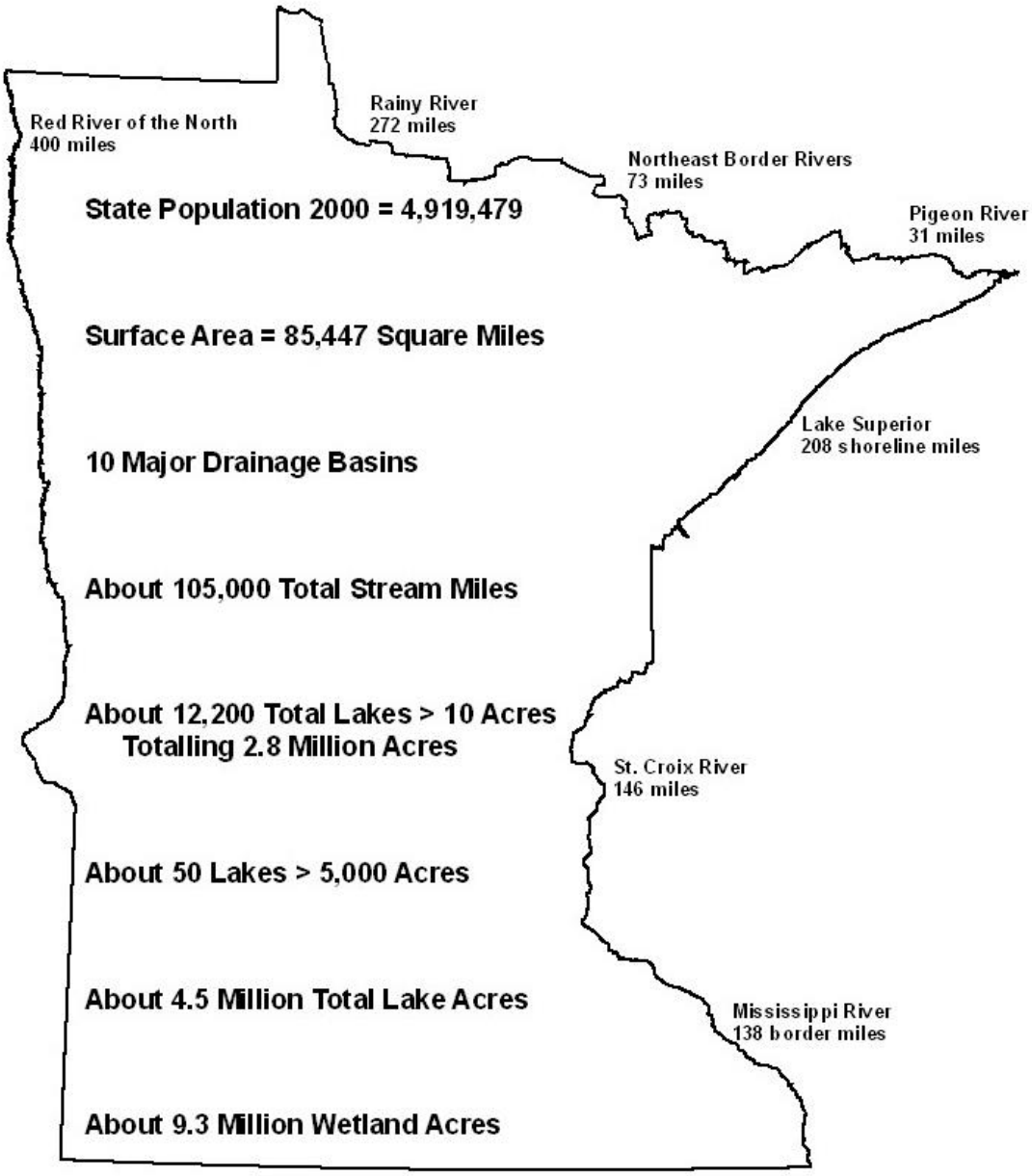


Figure II-1. Minnesota Background Information and Border Waters.

WATERSHED APPROACH

The Minnesota Pollution Control Agency's (MPCA)'s watershed based efforts are directed through watershed planning and implementation on a basin level. The goals, objectives, and targets they specify are to be at least partially achievable within a five year time frame.

Basin plans provide a geographically focused level of water planning and focus on water quality (WQ) issues. The approach is based on the state's ten major drainage basins and is designed to 1) identify WQ problems, 2) work with local governments to establish shared goals and priorities, and 3) develop pollutant reduction strategies. Together, focus of this level of planning is to:

- refine WQ related state objectives
- set basin level WQ priorities
- define priority WQ pollutants and problem areas
- identify actions and projects to be performed to address the identified goals, objectives, priorities, and targets, and
- serve as a mechanism to help secure funding for implementation of the plans

A schedule for basin plan development and other information on the basin planning and management program can be found on the Internet at: http://www.pca.state.mn.us/water/basins/index.html.

The basin approach looks at the "resource" as a whole. The basin approach proposes solutions which, collectively, improve the condition of the basin. The basin approach also links all the jurisdictions in the basin, extending the capacity of local, state and federal governments so that WQ problems can be addressed both ecologically and politically.

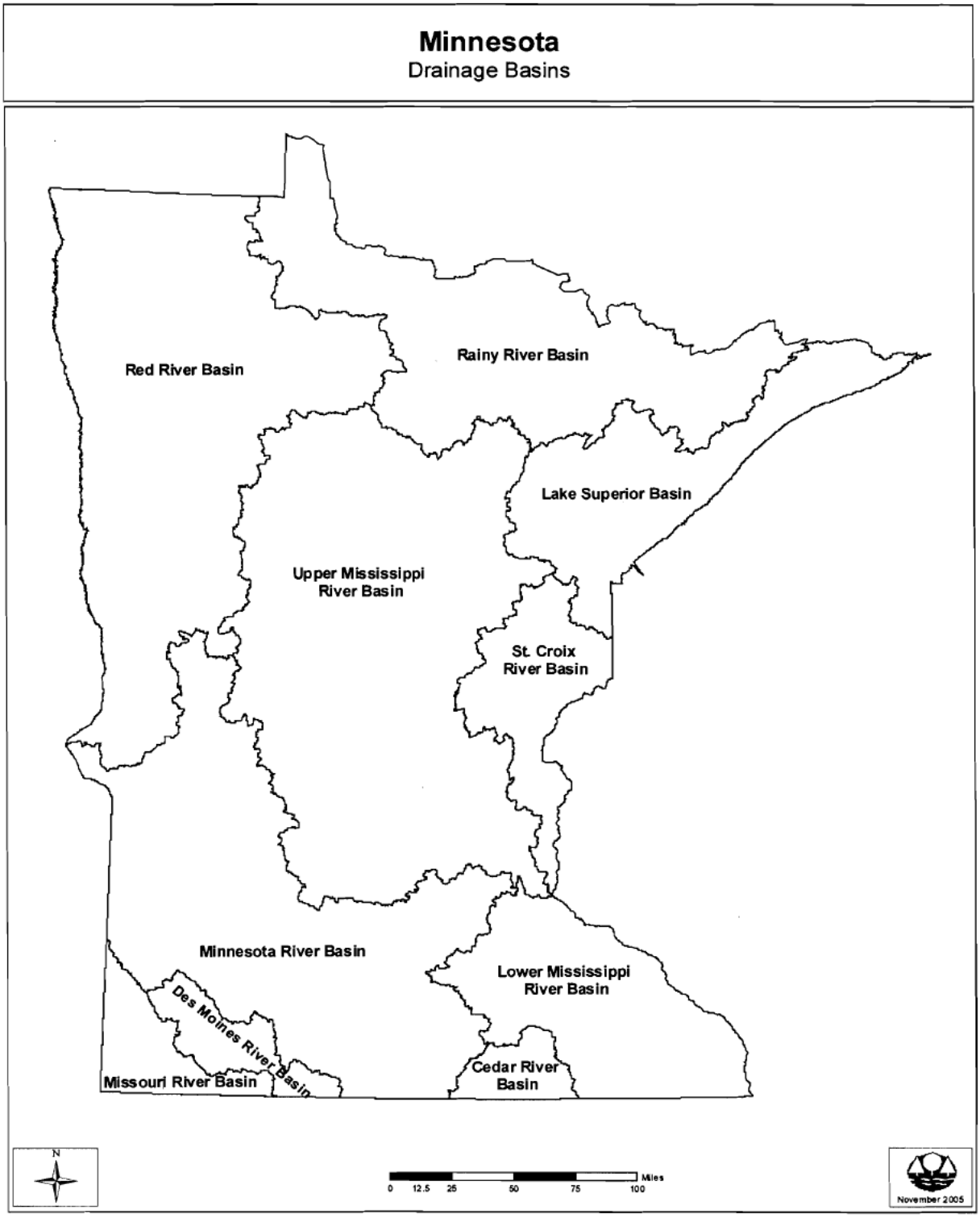
ACCOMPLISHMENTS OF MPCA'S BASIN PLANNING APPROACH

External teams have been established and function in seven basin teams of the state (Figure II-2). These teams are composed of more than 200 separate state and federal agencies, local unit of government (LUG) organizations and non-public constituencies. External basin teams meet monthly in the Lake Superior, Minnesota, Lower Mississippi, Upper Mississippi, Cedar, and Red River basins, and quarterly in the Rainy and St. Croix basins. The names of these teams differ from basin to basin, but the teams each include representatives of federal, state, regional and local government, industry, and citizen and special interest groups. Members are actively recruited. Each team has an open door policy, inviting in anyone who wants to participate. These six groups of more than 200 stakeholders meet routinely and are considered their basin's "go-to" group for WQ. They serve as the stakeholders for development of impaired waters plans. They review and recommend projects for Section 319 funding. The establishment and coordination of these teams brings form and substance to the situational alliances needed to achieve WQ goals.

Basin plans provide information about watershed conditions, based on WQ monitoring, pollution potential, and the capacity of local partners and the state to address those problems. The basin coordinators role, at the MPCA, is to collect and disseminate the required information and to coordinate internal (within MPCA) and external (with stakeholders) response to the information.

The external basin teams provide the means to mobilize watersheds for action. The basin plans are a plan of action for the basin. Involving the basin teams in the review and recommendation of projects for funding adds significant local involvement. It also has the potential to increase participation in actual projects as the opportunity arises. This process closes the loop from gathering information and developing goals arriving at the means to achieve the goals by actually implementing a plan. These activities also demonstrate how the resources of external basin teams can be utilized in future WQ improvement efforts. Additionally, our partners learn to understand and accept that resources are not great enough to cover everyone's needs.

Figure II-2. Map of Minnesota Basins.



- **Point Source Program Overview**

Introduction

The National Pollutant Discharge Elimination System (NPDES) permit program originated in the 1972 amendments to the Federal Water Pollution Control Act. The 1972 and subsequent amendments are referred to as the CWA. The objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the Nation's surface waters. The principal vehicle for achieving goals and objectives is the NPDES permit program, which regulates all point source discharges of pollutants to surface waters in the United States.

Permitting

National Pollutant Discharge Elimination System permits are required for all wastewater discharges to surface waters of the state. Important features of NPDES permits include:

five year permit period
30 day public comment period of draft permits
all surface water dischargers must meet minimum technology based requirements
water quality based requirements necessary to further protect WQ
delegation of permit issuance to qualified states

State law, Minnesota Statutes (M.S.) chapter (ch.) 115, gives the MPCA authority to require permits for the operation of disposal systems. As a result, all of the NPDES discharge permits issued by the MPCA are also State Disposal System (SDS) permits, combined into one document. MPCA also issues SDS permits for disposal systems that do not discharge to surface waters, and do not require an NPDES permit.

Compliance/Enforcement

When facilities violate permit requirements, the MPCA has an escalating approach to enforcement. Our first objective is always to bring the permittees into compliance. Our initial response to minor violations is often a phone call or letter of warning. If the violations are more serious, we may issue a formal notice of violation, which requests a response to the problem within 30 days. With more serious violations, or continued noncompliance, the staff may issue an administrative penalty order (APO). Administrative penalty orders may be up to $10,000.00 and may be forgivable, non-forgivable or a combination of both. Beyond APOs, negotiated stipulation agreements are used. These are out of court settlements for noncompliance, with upfront penalties for non-compliance and stipulated penalties. If necessary, usually as a last resort, the MPCA can pursue litigation as a solution to noncompliance.

2008 Point Source Plan

The overall goal of the 2008 Point Source Plan is to assure that discharge of wastewater to surface waters and groundwater is done in a manner that is protective of the environment. The work done under the plan to assure that this goal is met includes: technical assistance, development of rules and policy, permitting, land application approvals, limits determination, environmental reviews, technical reviews, compliance and enforcement financial assistance, training, certification and licensing. Staffs conducting this work are located in Outcomes

Division, Industrial Division, Prevention and Assistance Division, Regional Division and Municipal Division. The facilities or individuals that we work with to assure that the goal is met are the municipal wastewater and water treatment facilities, private domestic wastewater treatment facilities, industrial facilities that have a discharge from their facility process or wastewater treatment facility, industrial and large municipal stormwater, and pumpers, installers and inspectors of Subsurface Sewage Treatment Systems (SSTS).

2007 Goals and Accomplishments

As with the past several years, we have met most of our goals while continuing to make many process improvements. The following are some of the accomplishments of the Point Source Programs.

Permitting Accomplishments

Joint

Issued 75 percent of permits within 180 days of application receipt.
Maintained overall permit backlog at <10 percent.
New Phosphorus Management Plan (PMP) permitting policy and language.
New Interim Mercury Permitting Strategy including Mercury Minimization Plan (MMP) and guidance.
New Variance Processing Guidance for permit writers.
New permit checklists for administrative support staff.
Reissued MNG49 (Sand and Gravel) and MNG12 (Pre-treatment for metal finishing).
Numerous Delta enhancements, including language and requirement upgrades.

Municipal

Issued New General Mechanical Permit (MNG55).
Updated Large (10,000 gallons/day) Subsurface Treatment System (LSTS) design guidance document.
Updated LSTS permit writers guidance.

Industrial

Completed one day Spray Certification Refresher Course.
Completed dredge management guidance and developed web page.
Updated Industrial Byproducts (IBP) guidance.
Re-issued sand and gravel general permit (MNG49).
IBP report added to the Annual Compliance Report to permittees.
Re-issued general pretreatment permit for metal finishing (MNG12).
Completed Dredge Management Guidance completed and developed web page.

Inspection numbers

The program conducted 375 inspections through June 13, (Compliance Monitoring Survey (CMS), recon, construct, tech assist, etc.)
The average compliance rates are as follows:

Municipal minors	94 percent
Industrial minors	93 percent
Municipal majors	99 percent
Industrial majors	95 percent

Technical Assistance

Continued rule revisions to MN Rule 7080 for the SSTS component of the water program. The rule was on public notice in March 2007 with public hearings in April 2007, and target promulgation in December 2007.
Provided support for the development of the new "Need To Know" criteria for advanced and mid-sized Individual Sewage Treatment System (ISTS).
Provided research on the costs of P removal equipment for the Minn. Rule 7050 triennial review.
Continued development and implementation of the ISTS Six Sigma Project, "Improving support for local ISTS programs" (Roles and Responsibilities, Model Ordinance, and Training Manual improvements).

Financial Assistance Programs

The point source stormwater aspect of the financial assistance program has been fully implemented and the first awards have been made.
Developed and fully implemented three new Clean Water Legacy financial assistance programs:

- Total Maximum Daily Loads (TMDL) Grant Program
- Phosphorus Reduction Grant Program
- Small Community Wastewater Treatment Grant and Loan Program

Published the 2007 Project Priority List (PPL) and the mid-September adoption of the 2007 Intended Use Plan (IUP). Both were completed on schedule.
Continued close administrative coordination with our funding partners particularly the Public Facilities Authority (PFA), U.S. Department of Agriculture (USDA) Rural Development, Department of Employment and Economic Developments Small Community Development Grant Program and US Corp of Engineers 569 Funds.
Began Clean Water State Revolving Fund (CWSRF) benefits tracking through data entry in a new CWSRF "Benefits" Database in conjunction with United States Environmental Protection Agency (USEPA).

Legislative Activities

Completed the required legislative report on New Wastewater Treatment facilities on schedule.
Provided staff support on the Clean Water Legacy Act (CWLA) Capital Bonding Bill, new wastewater facility reporting requirements and the ISTS "Straight Pipe" bill which were passed by Minnesota Legislature.

Operator Training

Provided assistance to the University of Minnesota SSTS training program, including both teaching some of the modules in the pre-licensure classes, talking at all continuing education sessions and proctoring tests on site after each pre-licensure class.
2007 Annual Operator Training.
Biosolids Training for WQ Engineers and Type IV Operators.

Future Goals

The overall goal for the Point Source Program is to assure that discharge of wastewater to surface waters and groundwater is done in a manner that is protective of the environment. To achieve this goal the Program has a very ambitious yet attainable level of objectives for 2008 which include:

Compliance and Technical Goals

Meeting the 95 percent and 90 percent significant compliance rates for majors and minor respectively.
Making process improvements that work towards meeting the 120 day APO goal.
Developing an industrial stormwater permitting and enforcement plan.
Continue to implement steps to improve our ability to retrieve accurate WQ compliance and enforcement data and annually report results to applicable regulated facilities.
Develop and implement a system to address the new P grant.
Continue to make refinements and changes to the LSTS strategy.
Developing a plan to address the chloride limits.
Develop and implement a strategy to address the new straight pipe APO legislation.
Standardize/Update the Enforcement Response Plan for WQ violations.
Finalize assessment of Minnesota's small community wastewater needs (also called unsewered communities/areas) then develop a management strategy based on impaired water needs or other priority ranking. This may include development and implementation of administrative and technical assistance to small wastewater system owners and LUGs.
Continue modification of the existing time tracking system to better account for construction project resource expenditures.
Complete development of and promulgate the SSTS rule.
Finalizing the pretreatment rule.
Provide assistance to the counties towards developing ordinance that comply with the new SSTS rules.
Fully implement the new State Revolving Fund (SRF) rule.
Make significant advances in the implementation of the new SSTS rule.

Permitting Goals

Joint

Issue >80 percent of permits within 180 days of application receipt.
Maintain permit backlog at <10 percent.
Build site on MPCA's external Web site to hold issued permits.
Update Delta processes to utilize standardized permit templates.
Further refine and communicate pre-TMDL pollutant trading processes resulting from Annandale/Maple Lake decision.
Develop a plan to address potential permit fee increases.
Continue redesign of the application review process – update forms.
Complete first draft of new Water Trading rule.

Municipal

Re-issuance the water treatment plant general permit (MNG64).
Continue enhancement of LSTS design and permitting processes.

Industrial

Achieve zero backlog on major facilities.
Issue new dredge general permit.
Reissuance the noncontact cooling water general permits (MNG25).
Add industrial spray to the Annual Compliance Report to permittees.
Continue work in mining and ethanol sectors.

B. Nonpoint Source Control Program

Introduction

Minnesota is fortunate not only in that is has so many water bodies, but also that many of those water bodies are in good condition because their terrestrial watersheds still have minimal development, although all surface waters are affected by atmospheric pollutants such as Hg. The relatively good condition of many water bodies emphasizes the importance of a protection component in WQ plans, even while there are many degraded water resources that need to be addressed.

Most of the pollution originating from point sources (municipal and industrial facilities discharging to a state water) has been controlled. Water quality is mainly degraded by the pollutants entering surface waters from nonpoint sources (NPS), which is derived from both air pollution and runoff from land, particularly from watersheds dominated by agricultural and urban land use. Nonpoint source pollution is the major driver of WQ degradation of Minnesota's surface and ground water, impairing recreation, fish consumption, drinking water use, and support of aquatic life.

The state's efforts to restore these resources center around the concept of a "resource-management system," whereby a set of Best Management Practices (BMPs) appropriate to the site-specific concerns within a watershed unit are selected and applied on a watershed basis.

Updated Nonpoint Source Assessment

The Updated NPS Assessment in the 2008 Nonpoint Source Management Program Plan (NSMPP) reflects a number of steps that have been taken since 2001 to improve the assessments.

Incorporating biological assessment information, where available, into the process. This includes development of biocriteria for watersheds where none had existed before.
Biological monitoring of randomly selected sites has been conducted, which will allow for characterization of entire basins.
Coordination of monitoring and assessment activities among local, state and federal agencies has been increased.
Atmospheric deposition as a source of pollutant loading is included in the assessment.
Assessments using an increasing number of credible sources of information are being developed.

All contributing monitoring entities are reviewing assessment data for adequacy, relevance and validity.
Different use supports to reflect adequacy of WQ for various uses are being reported, rather than simply reporting an "overall use."

2008 Nonpoint Source Management Program Plan

Minnesota's 2008 NSMPP is in progress. Developing this Plan was a massive statewide effort. Seventeen technical committees comprised of more than 200 representatives of 50 federal, state and local governmental agencies and public and private environmental organizations worked to develop the NSMPP. The MPCA coordinated overall development of the NSMPP. The 17 chapters/strategies of the NSMPP examine sources of NPS pollution contributing to water pollution. Five year action plans recommending implementation of NPS pollution control measures for 2008 are included in most chapters/strategies.

The web site for Minnesota's 2008 NSMPP is:
http://www.pca.state.mn.us/water/nonpoint/mplan.html.

Federal Clean Water Act - Section 319

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

- run for a specific number of years;
- identify the NPS controls necessary;
- specify the programs that will apply the controls;
- certify that the state has adequate authority to implement these measures;
- identify all sources of funding for these programs; and
- establish a schedule for implementation.

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

Investment in education must be considered an essential and integral part of every step in the 2008 NSMPP. Education cannot be viewed as a minor component of the NSMPP, but one of the many steps that must be taken to meet the management plan's goals. In almost every chapter of this management plan, education is recognized as an important means for effecting change with respect to NPS water pollution problems.

Statewide Information and Education Program

As Minnesota's clean water program continues moving to a watershed approach with a commitment to identify and address remaining WQ problems, good information about the condition of waters and the health of aquatic systems on a watershed scale is absolutely critical. The MPCA addresses impaired waters through TMDLs or TMDLs studies. The CWA's impaired waters provisions call for taking measures to mitigate NPS pollution, but neither state nor federal agencies have the authority to regulate much of the activity that

causes such pollution. Many of the needed mitigation measures will consist of education and pollution reduction incentives. This makes it all the more important to have in place sound information and education (I&E) approaches and strategies for NPS issues.

Five major I&E goals are set for the 2008 through 2012 version of the NSMPP to address NPS water pollution. They are:

- Build and improve capacity to deliver NPS-related I&E at state and local level.
- Raise awareness of the general public about the nature of NPS pollution, how communities and individuals contribute to it, and what governmental organizations and individuals are doing about it.
- Foster coordination and cooperation between governmental agencies and private, nonprofit and other organizations to carry out I&E efforts.
- Include NPS I&E in formal and informal educational curricula.
- Effectively measure impact of NPS I&E activities.

Prioritization of Watersheds for Nonpoint Source Management

Minnesota currently targets watersheds for NPS controls through the Clean Water Partnership (CWP) program administered by the MPCA. The program, established in 1987, relies upon LUG and other partners to prioritize the watersheds within their regions and subsequently submit proposals to MPCA for watershed projects. The MPCA and an interagency task force called the Project Coordination Team score the projects based on a set of scoring criteria established in state rules. The highest-scored projects are then eligible for financial and technical assistance from the state. CWP projects involve the following:

Completing a comprehensive diagnostic study of a water body and its watershed by identifying the pollutants that cause a reduction of WQ and the origin of the pollutants,

Developing an implementation plan that identifies the BMPs needed to restore and protect WQ, and

Implementing the BMPs.

Through twenty annual CWP funding cycles (1989 through 2008) the MPCA has awarded $31,063,308 to 84 resource investigation projects, 57 implementation projects and 59 continuation projects.

Through fourteen annual CWP funding cycles for loans (1995 through 2008), the MPCA has awarded $38,208,330 in low-interest loans to 180 implementation and continuation projects.

In 1987, the CWA was amended to include Section 319, a new section which authorized federal assistance to the tribes and states for implementing NPS programs. Proposals are submitted and scored in a process similar to that of CWP.

Through nineteen annual funding cycles of the Federal Section 319 program (1999 through 2008); the MPCA has awarded $40,400,009 for 445 NPS projects.

2008 – 2012 Nonpoint Source Management Program Plan

The state of Minnesota NSMPP is a requirement for Minnesota to remain eligible to receive NPS grant funds from the USEPA under Section 319 of the CWA. Any actions to be undertaken by a NPS water pollution control project must be cited in this document to be eligible for a Section 319 grant award.

Narrative discussions of NPS pollution are included in Chapters 1 – Updated NPS Assessment, 2 – Programs and Funding for Implementing NPS Programs, and 3- Watershed Planning and Management Framework. The remaining 14 chapters/strategies include narratives and also Needs, Priorities and Milestones (Action Steps) tables for each chapter/strategy. These tables detail 2008-2012 recommended Action Steps, schedules, potential funding sources, and lead agencies that would be involved with implementing the recommendations. These remaining chapters are:

4.1 Ground Water
4.2 Lakes
4.3 Rivers and Streams
4.4 Wetlands
4.5 Monitoring
4.6 Information and Education
4.7 Feedlots
4.8 Agricultural Erosion
4.9 Agricultural Nutrients
4.10 Agricultural Chemical
4.11 Urban runoff
4.12 Forestry
4.13 Subsurface Sewage Treatment Systems
4.14 Affects of Atmospheric Pollution on Water Quality

Needs, Priorities and Milestones tables are included at the back of chapters 4 through 14 of Minnesota's NSMPP. These tables include proposed measures (Action Steps) recommended for implementation.

Basin Planning

The MPCA has implemented a biennial planning process for aligning and coordinating the Agency's WQ activities. This process is built from information, priorities and needs of the basins, program goals and commitments, environmental condition monitoring, and statewide policies and priorities.

Since 1995 MPCA has organized delivery of its water programs geographically according to the state's major drainage basins. The MPCA's 1998 Continuing Planning Process Report's description of the goals of this action is still relevant:

> Increase environmental outcomes by maximizing limited resources;
> Clearly identify WQ goals and priorities;
> Integrate point and NPS pollutant reduction strategies; and
> Develop more effective partnerships with MPCA customers, including local governments, environmental groups and permittees.

The basin approach looks at the "resource" as a whole. The basin approach proposes solutions which, collectively, improve the condition of the basin. The basin approach links all the jurisdictions in the basin, extending the capacity of local, state and federal governments so that WQ problems can be addressed both ecologically and politically.

External teams function in seven basin teams of the state. These teams are composed of more than 200 separate state and federal agencies, LUGs, organizations and non-public

constituencies. External basin teams meet monthly in the Lake Superior, Minnesota, Lower Mississippi, Upper Mississippi, and Red River basins, and quarterly in the Rainy and St. Croix basins. These teams include representatives of federal, state, regional and local government, industry, and citizen and special interest groups. Members are actively recruited. Each team has an open door policy, inviting in anyone who wants to participate.

These six groups of more than 200 stakeholders meet routinely and are considered their basin's "go-to" group for WQ. They serve as the stakeholders for development of impaired waters plans. They review and recommend projects for Section 319 funding. The establishment and coordination of these teams bring form and substance to the situational alliances we need to achieve WQ goals.

Basin planning established Web sites for each basin, which are now used routinely by the public and others to gain information about the resources, condition and priorities of the major drainage basins of Minnesota. The basin Web sites are the most accessible repository for WQ information that is used routinely by the public and others to understand the conditions, resources and priorities within the watersheds in which they live. These Web sites also serve as portals to the Web sites of related agencies and activities. E-newsletters are published for the Minnesota, Lower Mississippi, Red, Rainy and Superior basins.

Basin planning has produced two sets of documents for the state's major drainage basins:

1. Basin information documents. These summarize conditions and resources of the basin, assess pollution control status, list ongoing research and identify major issues. Also included are, prepared and published assessments of the effects of land use on WQ and how they relate to the types of activities regulated by the MPCA. This information is the focus of the basin information document. It is generally provided by major watershed (of which there are 81 in the state). It helps the public link environmental conditions, human uses and WQ expectations and it provides critical information about impacts on WQ. It is the foundation for WQ work which requires the identification and assessment of sources as a starting point. This information has several uses. For the impaired waters program, this land use assessment is the first source of information for the development of a TMDL, which requires the allocation of pollutant load back to all sources in the watershed of the listed reach. Its greatest value is that it develops the practice of starting water management with a comprehensive assessment of information about the condition of the water body and the identification of sources that may impact WQ.

- Basin water quality plans. Basin planning has established the practice of setting basin-wide environmental goals to measure performance. This type of goal setting helps basin residents and stakeholders understand the connection between NPSs and point sources and the desired condition of the waters. These plans provide specific goals to measure WQ improvements.

3. The role of the basin coordinator, at the MPCA, is to collect and disseminate this information and to coordinate internal and external response to it. That response lies on a continuum of potential actions, from information to LUGs to diagnostic studies or WQ restoration projects.

Minnesota Watermarks

The Minnesota Environmental Quality Board (EQB) is directed by Minnesota Statutes, section 103B.151, to prepare a comprehensive, long-range water resources plan every ten years. The board and its partners have begun preliminary discussions on what the upcoming 2010 plan should look like.

The most recent water plan, *Minnesota Watermarks: Gauging the Flow of Progress 2000-2010,* called for a unified approach to protecting and preserving water throughout the state. The plan is intended to aid in evaluating programs and guiding strategies. Highlights include:

A statewide section that provides a framework of goals, objectives and measurable indicators.
Locally developed basin sections that provide an overview of unique environmental conditions and pressures and suggestions for measurable indicators.
Maps and graphics to illustrate the state of our water resources.

The plan was organized into the state's major water basins and reflected the unique environmental conditions of each water basin, as well as statewide conditions. The plan recommended:

A focus on major water basins, such as the Mississippi, Minnesota and Red River basins, to recognize the differences in water resources and management choices throughout Minnesota.
Unification of water management through interagency teams in each basin that will work with local entities and the public.
Measurement of results by developing and tracking progress toward a statewide framework of goals and objectives adapted to each basin.

Statewide goals are to improve WQ, conserve the diverse characteristics of state waters, restore and maintain healthy aquatic ecosystems, and provide diverse recreational opportunities. Indicators are used in measurement of results at both state and basin levels.

Biennial Water Policy and Priorities Reporting

Minnesota Statutes, Sections 103A.43 and 103B.151, directs the EQB to report to the Governor, Legislature and Legislative-Citizen Commission on Minnesota Resources on its water policy recommendations each biennium. The EQB recently adopted its priorities for the current biennium in the report, *Protecting Minnesota's Waters: Priorities for the 2008-2009 Biennium*. The priorities demonstrate a commitment to protecting the economic, social and ecological value of Minnesota's water resources.

The EQB believes that four needs rise above the rest:

Dedicating significant new resources to implementing the CWLA, including the development of pollutant load studies, called TMDLs, in order to accommodate economic growth and provide the blueprints for effective, focused cleanup of polluted waters.

Increasing landowner assistance for practices targeted at protection and restoration of waters, as well as technical assistance to small unsewered communities.

Adopting measures to safeguard water supplies across the state, including development of a water supply interconnect between Minneapolis and Saint Paul and better definition of the

location and characteristics of ground water resources. Areas subject to new ethanol production and population growth should be given priority.

Amending the Minnesota Wetland Conservation Act (MWCA) and rule to improve monitoring of wetland changes and reduce losses, and funding a range of efforts to implement these authorities.

The state's vision for water management requires all Minnesotans to:

> Guard their waters from present and future threats;
> Restore waters that are impaired;
> Maintain an accurate picture of waters for citizens, managers and policy-makers; and
> Ensure adequate reserves of safe water to keep Minnesota prosperous and sustain healthy communities.

The EQB also recently worked with the Minnesota Department of Natural Resources (MDNR) and others to coordinate an assessment of the quantity of surface and ground water in the state and the availability of water to meet the state's needs. In this report, the board found that counties in the Twin Cities - St. Cloud growth corridor place significant demands on their water resources. Ramsey, Washington, Hennepin and Dakota counties may reach or exceed sustainable use levels in the next two decades. The report, *Use of Minnesota's Renewable Water Resources: Moving toward Sustainability*, calls for better information about Minnesota's water resources, including accelerated research to map and evaluate ground waters and define important connections to surface waters. It also argues for better understanding of how land use activities and WQ may affect future water supplies.

Minnesota's 2006 TMDL List shows 2,250 impairments on 1297 water bodies but only a small portion of the state's surface waters have been tested. Identifying and correcting additional impairments will necessitate a significant increase in the number of WQ studies and restoration activities. Upon EPA's approval of the 2008 TMDL List, these numbers change.

Accordingly, EQB recommends dedicating significant new resources to implementing the CWLA. This includes the development of pollutant load studies, called TMDLs, in order to accommodate economic growth and provide the blueprints for effective, focused cleanup of polluted waters.

The EQB also recommends increased landowner assistance for practices targeted at protection and restoration of waters and technical assistance to small unsewered communities.

The recent drought was a reminder to Minnesotans of just how important water is to their well-being. In addition, while citizens consider water resources the crown jewels of the state, these resources have limits.

Because a number of signs indicate that use is beginning to overwhelm the resource, the EQB recommends several measures to safeguard water supplies across the state. In addition to the Minneapolis - St. Paul water supply interconnect project, safeguards include working to better define the location and characteristics of ground water resources with areas subject to new ethanol production and population growth given priority.

Minnesota has approximately 10 million acres of wetlands, half the amount that existed at the beginning of European settlement. The state WCA, enacted in 1991, has been successful in dramatically slowing wetland losses. But the act's goal of no net loss remains unattained within the scope of regulatory programs. In response, the EQB sees changes to the WCA and rule as a priority, as well as funding to implement a range of efforts to monitor and reduce wetland losses.

These reports and their recommendations demonstrate a commitment to protecting the economic, social and ecological value of Minnesota's water resources. The EQB intends to complete the next generation priories report in the fall of 2008.

C. Stormwater Program Development

The Phase I federal regulations (promulgated November 1990), required NPDES permit coverage to address stormwater runoff from two broad categories of stormwater discharges: 1) medium and large municipal separate storm sewer systems (MS4s) serving populations of 100,000 or more, and 2) eleven categories of industrial activity, including larger construction activities disturbing five or more acres of land.

The Phase II federal regulations (promulgated December 1999) expanded the scope of the Phase I program NPDES permit program to include discharges of stormwater from smaller MS4s in urbanized areas, construction activities that disturb between one and five acres, and smaller municipally owned industrial activities.

In implementing the Phase II Stormwater federal requirements, the MPCA was directed by the Minnesota Court of Appeals to address Minnesota nondegradation rules stemming from federal antidegradation policy under 40 Code of Federal Regulations (CFR) 131.12, and to provide for review, public comment, and approval of the individual permittee's stormwater pollution prevention plan in a general permit setting. Together these present a considerable challenge and burden on MPCA resources.

Minnesota's nondegradation rules, Minn. R. ch. 7090, include distinct rules for discharges to all waters of the state, outstanding resource value waters (ORVWs), and wetlands. These rules were written in a traditional point source setting, and their application to stormwater discharges have proven difficult. The 2003 Legislature provided time for the MPCA to rewrite these rules to better address stormwater discharges by 2007. The MPCA initially expected to address this issue as part of the triennial review of the state's WQS required under federal law. The MPCA now intends to undertake a larger rulemaking effort, beyond only addressing the effect of stormwater discharges, and plans to broaden the scope of the nondegradation rulemaking in order to reflect changes that have occurred since the existing rules were adopted. Public notice of request for comments on planned amendments to Minnesota's nondegradation rules was published in January 2007. The proposed timeline for completion of the rulemaking is December 2011.

Minnesota and other states have had courts remand the general permit for small regulated 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 community permit when most of the substantive BMPs chosen by the community were within the applications, which were not open to public comment.

The MPCA formed a Stormwater Design Team of stakeholders 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 evolved into the Stormwater Steering Committee in 2004. This Committee completed the *Minnesota Stormwater Manual* in September 2006; and recently completed a final report and recommendations for NPDES construction permit compliance, and study conclusions and recommendations on a watershed based permitting approach for MS4s in Minnesota. The Stormwater Steering Committee will continue to address stormwater policy for the state of Minnesota.

Construction Stormwater

The MPCA issued a revised construction stormwater general permit on August 1, 2003, for construction activity over one acre of disturbance in accordance with the Phase II requirements. This permit provides additional environmental protection for the state's 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. The MPCA plans to re-issue this permit with revisions before expiration in August 2008. The draft permit was placed on public notice February 25, 2008 for a 30 day comment period.

Municipal Stormwater

The MPCA Citizen's Board authorized issuance of the small regulated 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 MPCA to address nondegradation, public process, and other issues. The regulated small MS4s followed the appealed permit until issuance of the new permit. On February 28, 2006, the MPCA Citizen's Board authorized issuance of the revised small regulated MS4s general permit that meets the court remanded issues. This permit addresses impaired waters, ORVWs, and nondegradation of all waters. Applications for this new permit and Storm Water Pollution Prevention Plans (SWPPPs) were required June 2006. As of February 2008, the MPCA has conducted meaningful review of and provided public notice of opportunity to comment on 140 MS4 permit applications and SWPPPs. In addition to the permit, the MPCA is also working with the University of Minnesota and other contractors to develop methods, protocols and approaches to monitor municipal stormwater in the future.

Industrial Stormwater

Comments received during the public comment period to re-issue the Industrial Stormwater general permit in 2002 included the need to better address nondegradation and other issues. The MPCA put further work on this permit on hold, first because of the need to address many issues around the March 10, 2003 date for Phase II implementation, then because of the staff resources needed for issuance of the construction general permit and for rule development, and finally until USEPA's Multi-sector General Permit was completed. In fall 2006, an industrial stormwater work group was formed to work with the MPCA to develop Minnesota's industrial multi-sector general permit and permit program. USEPA's permit is being used as a model for Minnesota's permit. Public notice of the draft permit is planned for

late summer 2008. 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

New stormwater rules Chapter 7090 were enacted August 15, 2005, which incorporate the Phase II federal regulations. This rule chapter combines all stormwater rules, Phase I and II in one place. The rules designated 43 additional MS4s, who were required to apply for permit coverage and submit their SWPPPs by February 15, 2007.

D. Rivers and Streams Assessment Development

While implementing the monitoring and assessment strategy, considerable progress has been made incorporating additional data and information from other local, regional, state and federal monitoring and management entities. The MPCA actively seeks both narrative and numeric data from all sources utilizing appropriate Quality Assurance/Quality Control (QA/QC). Criteria used to determine whether to use data from other sources are outlined in the document *"Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment, 305(b) Report and 303(d) List"* developed and revised concurrently with each assessment cycle by MPCA staff. Data from the Citizen Lake Monitoring Program (CLMPs) and Citizen Stream Monitoring Programs (CSMPs) are used as part of assessing lakes and streams. Important outside sources of numeric data include the Metropolitan Council Environmental Services (MCES), United States Geological Survey (USGS), Long Term Resource Monitoring Program on the Mississippi River at Onalaska, Wisconsin (WI), Upper Mississippi River Headwaters Board, WI Department of Natural Resources, Western Lake Superior Sanitary District (WLSSD), the National Forest Service, and the Hennepin County Conservation District. Data is used from CWP projects that meet the criteria. CWP projects are funded by the MPCA and monitoring is done by local governments. Staff from other agencies contributing monitoring data have also participated in the professional judgment group (PJG) process.

The major limiting factor in making use of data from external sources has been inaccessibility of some data due to diverse storage formats; lack of information on how data was collected; and difficulty of interpreting measures that lack established WQS, but have intuitive or practical value for local programs.

The two major goals of the CWA, "fishable and swimmable" waters, are assessed in terms of aquatic life use support (AQL), aquatic recreation use support (AQR), and aquatic consumption use support (AQC).

E. Lake Assessment Process and Development: 2008 Assessment

The most recent ten years of data (1997-2006) from USEPA's Storage and Retrieval System (STORET) database was the primary basis for the assessment. The focus of the assessment is on trophic state and its relation to support and non-support (NS) of designated uses, specifically aquatic recreation uses, which includes swimming, wading, aesthetics and other related uses. The parameters used to assess trophic state and aquatic recreational use were epilimnetic total phosphorous (TP), chlorophyll-a (chl-a) and Secchi disk (SD) transparency.

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 outweighed 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 marketplace, 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 be incomplete and of debatable accuracy.

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

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 WQ programs.

Costs

The primary WQ programs at the state level are those of the MPCA and the Minnesota Board of Water and Soil Resources (BWSR). Including local assistance, the WQ budget of the former is approximately $55 million per year and of the latter approximately $20 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 $170 million per year.

Regarding the actual implementation of point source water pollution controls, approximately $2 billion in federal, state, and local funds have been spent since the enactment of the CWA for the construction of municipal wastewater treatment facilities in the state, including the separation of combined sewers. 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 represent a significant portion of the above figures.

Regarding the implementation of NPS 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 current 303(d) list that are impaired by NPSs. Details on these estimated costs can be found at http://www.pca.state.mn.us/publications/reports/lrwq-s-lsy03-appendix.pdf.

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 WQ 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 WQ have occurred over the past several decades, especially since the passage of the CWA. 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 percent of major WQ permittees meeting their effluent limits.

Even more striking are the indications of WQ 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 WLSSD 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 NPS 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 WQ in Lake Bemidji and Lake Shokatan are examples of this. Perhaps even more impressive is the WQ 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 P and biochemical oxygen demand (BOD) concentrations in the river.

As a result of both point source and NPS programs, WQ 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 percent of sites), fecal coliform bacteria (82 percent), ammonia (83 percent), and TP (78 percent). (On the other hand, only 42 percent of the sites show

a decreasing trend for Total Suspended Solids (TSS), and fully 75 percent of the sites show an increasing trend for nitrite/nitrate (NO_2/NO_3)).

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 WQ protection and improvement.

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

SPECIAL STATE CONCERNS AND RECOMMENDATIONS

A. Impaired Waters - Total Maximum Daily Loads

Impaired waters are a special and growing concern. When a water body fails to meet WQS because of one or more pollutants, it is considered "impaired."

Minnesota has 12,200 lakes and 105,000 miles of rivers and streams. Of those water bodies, 1,123 lakes and rivers, approximately 40 percent of those assessed thus far, are on Minnesota's 2006 draft list of impaired waters, updated every two years. The total number of impairments in these rivers and lakes is 2,299. However due to resource limitations, water body assessments have occurred on only 18 percent of Minnesota's lakes and 14 percent of its rivers and streams. The MPCA expects to find more than 10,000 impairments statewide, with impaired waters located in nearly every watershed in the state, once it assesses all the state's waters.

An approach to help control water pollution is through TMDLs. A TMDL determines the maximum amount of a pollutant a water body can receive without violating WQS, and an allocation of that amount to the pollutant's sources. The CWA requires states to adopt WQS to protect the nation's waters. These standards define how much of a pollutant can be in a surface and/or ground water while still allowing it to meet its designated uses, such as for drinking water, fishing, swimming, irrigation or industrial purposes. Many of Minnesota's water resources cannot currently meet their designated uses because of pollution problems from a combination of point and NPSs. Total maximum daily loads determine all sources of pollutants in a water body that is not meeting its designated uses, including NPSs and those sources that may not be located near the water body but are in its watershed. The information is used to allocate loads to all sources in the watershed for each pollutant that is exceeding standards. Minnesota has begun to implement TMDLs on some water bodies as required by the CWA.

To help accelerate Minnesota's efforts to address impaired waters, the Minnesota Legislature adopted the CWLA in 2006. The Act provided additional funding for monitoring and assessment, TMDL development, and restoration activities, as well as created a citizen/state advisory group called the Clean Water Council to administer the Act. Legacy Act

appropriations totaled $25 million for fiscal year (FY) 2007, and $54 million for FY 2008-2009. (MPCA received ~$31 million.)

B. Nutrient Criteria

The USEPA has requested that states develop nutrient criteria for lakes, streams, wetlands and estuaries. Further, they recommend the criteria be developed on an ecoregion basis. The MPCA has long used ecoregions as a basis for examining lakes and characterizing lake condition. In the mid 1980's reference lakes for the four ecoregions that contain 98 percent of Minnesota's lakes were identified and sampled over the course of two to three years. Data from these reference lakes combined with a variety of other information, served as the basis for developing P criteria in 1988. This work also served as the basis for our current effort to develop eutrophication criteria.

An important aspect of the criteria-setting process requires the definition of "most sensitive sub-uses" of lakes. In this context, we have defined a sensitive sub-use of a lake as that use (or uses) which can be affected or even lost as a result of an increase in the trophic status of the lake. Two examples of sensitive uses include coldwater fisheries and primary contact recreation (aquatic recreation use support). In the case of a coldwater fishery, increased nutrient loading will result in a reduction of oxygen in the hypolimnion, and die-offs of coldwater species may occur as these populations are driven into warmer surface waters. In the case of aquatic recreational use, excess P stimulates the production of algae growth that can lead to frequent and severe nuisance blooms and reduced transparency that will limit use of the resource. Most sensitive uses have been identified for each region, and appropriate P, chl-a and Secchi criteria are noted. These criteria are ecoregion-based and reflect several considerations including: reference lake condition; assessed lake condition; background trophic status based on diatom reconstruction of P; interrelationships among P, chl-a, Secchi and nuisance bloom frequency; lake morphometry; lake-user perception; lake ecology (fishery composition and rooted macrophytes); and appropriateness as reflected by overall characteristics of the ecoregions and assessed trophic status for each ecoregion.

The draft criteria were included in the 2007 triennial revision of WQS. This revision was approved by the hearing examiner that presided over the WQ rule hearing and were formally approved by the MPCA Citizens Board in December 2007 and signed by the Governor in January 2008. Final adoption of the rules are anticipated by Spring 2008 following USEPA Region V approval. We anticipate that these standards will have a broad range of application including, but not limited to 305(b) assessment, 303(d) listing, evaluating NPDES permit limits, and for setting goals and protecting the condition of lakes that are below criterion levels.

The Developing Nutrient Criteria report and the general Lake Water Quality Assessment report can be found at this Web site:
http://www.pca.state.mn.us/water/lakequality.html#reports:

C. Other Contaminants of Concern in Minnesota's Environment

There are a number of newly recognized environmental contaminants and other issues that are not fully understood but which have the potential to cause known or suspected adverse ecological and/or human health effects. "Emerging Issues" are new areas of environmental

concern that are not currently incorporated into regular environmental protection activities in Minnesota.

These stressors enter the environment through consumer products, solid waste disposal, agricultural and urban runoff, residential and industrial wastewater, and long-range atmospheric transport. In some cases, release of these substances to the environment occurred long ago, but may not have been recognized because methods to detect them at low concentrations did not exist. In other cases, synthesis of new chemicals or changes in use and disposal of existing chemicals can create new sources of contamination. At the same time, observations of troubling effects, including feminization of male fish or malformed frogs, raise questions on causes. Public health experts often have an incomplete understanding of the toxicological effects of these contaminants, including the significance of long-term exposure.

Even with incomplete knowledge, science and policy must continue to ensure protection of human health and the environment through the process of identifying and preventing problems.

Here are a few examples of emerging issues currently being investigated in Minnesota:

- Perfluorinated chemicals (PFCs)
- Pharmaceuticals, household and industrial-use products
- Endocrine-disrupting compounds
- Polybrominated diphenyl ethers (PBDEs)

Perfluorinated chemicals

Perfluorinated chemicals such as perflourinated chemicals (PFOS), (PFOA), (PFBA) and others are manmade chemicals that are used in the manufacture of products that are heat and stain resistant and repel water. Perflourinated chemicals, used in emulsifier and surfactant applications, are found in fabric, carpet and paper coatings, floor polish, shampoos, fire-fighting foam and certain insecticides. Perflourinated chemicals are used in the manufacture of fluoropolymers that are used in the production of many personal care products, textiles, non-stick surfaces and fire-fighting foam. In Minnesota, 3M manufactured PFOS and PFOA from approximately 1950 until they were phased out in 2002.

Perfluorocarbons are widespread and persistent in the environment and they have been found in animals and people all over the globe. However, little is known about their toxicity to humans and wildlife. MPCA and Minnesota Department of Health (MDH) testing has found PFOS and PFOA in some municipal and private drinking water wells in Oakdale and Lake Elmo. A potentially less-toxic but more mobile form, PFBA, also has been found in wells in Oakdale, Lake Elmo, Cottage Grove, Newport, St. Paul Park, Hastings, South St. Paul and Woodbury. Perflourinated chemicals and PFOA have not been detected in those areas.

MPCA studies have detected PFOS at elevated concentrations in fish taken from the Mississippi River near the 3M Cottage Grove plant and downstream as well as in several metro area lakes. In additional to fish tissue, PFCs have been found in some shallow ground water wells, in the effluent and sludge of wastewater treatment plants (WWTPs), and in landfill leachate and gas.

The MPCA and the MDH continue to examine potential sources of exposure to PFCs. A complete description of all MPCA and MDH activities related to PFCs is available on the following web pages:

http://www.pca.state.mn.us/publications/gp5-18.pdf

http://www.pca.state.mn.us/hot/pfc.html;

http://www.health.state.mn.us/divs/eh/hazardous/topics/pfcshealth.html

Pharmaceuticals, Household and Industrial-Use Products:

In 2002, the USGS published results of the first nationwide survey of pharmaceuticals, hormones, and household and industrial products in surface waters. The compounds analyzed in the study encompassed a wide variety of compounds including: antibiotics, over-the-counter pharmaceuticals, hormones, detergents, disinfectants, plasticizers, fire retardants, insecticides and musks used in the production of fragrances. The USGS included certain compounds in their survey because they have biological activity, such as pharmaceuticals or chemicals that are suspected endocrine disruptors. These products are widely used in consumer and industrial products and continuously released into the environment through human activities. Sources can include wastewater discharge, manure from confined animal feedlots, landfill leachate, and urban runoff.

The MPCA has been collaborating with Kathy Lee and Larry Barber (of the local and national USGS offices) since 2000 and with Heiko Schoenfuss (St. Cloud State University) since 2004 to further monitor and define health effects associated with this suite of compounds in Minnesota's water resources. The first state reconnaissance study by USGS, the MPCA and the MDH showed that industrial and household-use compounds and pharmaceuticals are present in streams, ground water, wastewater and landfill effluents. Steroids, nonprescription drugs and insect repellent were the chemical groups most frequently detected, with detergent degradates and plasticizers measured in the highest concentrations. The complete report may be found at: http://water.usgs.gov/pubs/sir/2004/5138/.

The MPCA has also worked since 2002 with several partner organizations and the Minnesota Hospital Association to improve environmental compliance and pollution prevention throughout healthcare facilities in Minnesota. Compliance evaluations of healthcare facilities had revealed widespread mismanagement of complex hazardous wastes such as pharmaceuticals, laboratory solvents and reagents, and mercury-containing wastes. As a result of this collaboration, hospitals have been changing their waste management methods. Fiscal year 2006 resulted in 28 metro area hospitals properly managing 75 tons of pharmaceuticals and 30 tons of laboratory wastes as hazardous waste. Twelve hazardous waste compliance training events have been presented throughout the state in FY 2006 with over 500 healthcare professionals in attendance. Partner organizations participating in this effort include the Solid Waste Management Coordinating Board, the Minnesota Technical Assistance Program, and the MCES. More information on these efforts can be found at: http://www.pca.state.mn.us/industry/healthcare.html.

Endocrine Disrupting Chemicals

Endocrine disruption is a broad term referring to both natural and synthetic compounds that cause adverse effects in humans, fish, or wildlife by mimicking or altering the endocrine or hormone systems. Originally, studies of endocrine disrupting chemicals (EDCs) focused on those chemicals affecting the estrogenic, androgenic (testosterone), or thyroid systems of humans and wildlife. However, the scope of interest has expanded to include other signaling chemicals in humans and wildlife, such as neurochemicals, in addition to other chemical signals in lower organisms and plants. Because endocrine disruption encompasses numerous sources, exposures, and organisms, it is critical to approach endocrine disruption in the context of environmental protection through a multidisciplinary and collaborative approach. To this end, MPCA has been supporting Minnesota-based EDC studies and researchers that build on national studies and perspectives.

Building on the results of the 2002 USGS pharmaceuticals, household and industrial products survey, Kathy Lee and Larry Barber from the USGS, and Heiko Schoenfuss from St. Cloud State University continue to investigate the significance, sources, and occurrence of compounds with endocrine-disrupting activity in Minnesota's waste streams and waters. This multidisciplinary team of experts has designed a phased approach from laboratory to field studies to discover what effects this diverse suite of compounds has on hormonal activity in aquatic organisms.

Lee, Barber, and Schoenfuss began their examination of EDCs with alkylphenols. Alkylphenols, including nonylphenol, are a class of chemicals resulting from the breakdown of widely used household and industrial surfactants (cleaning detergents, airplane deicers, surfactants used with pesticides, etc.). Their wide use has resulted in high concentrations detected in wastewater effluents. Nonylphenol, one of the most studied chemicals for EDC activity, demonstrates estrogenic activity in numerous species of fish with corresponding reproductive abnormalities.

MPCA currently has three ongoing projects with Lee, Barber, and Schoenfuss. The results from these studies will include detailed monitoring results from four WWTP and receiving water and a longitudinal study on the Mississippi River. MPCA will utilize the results for developing future WQS and helping determine management strategies. The MDNR is also contributing technical expertise to the projects and receives results.

In January 2008, the MPCA completed a report to the Minnesota Legislature titled *Endocrine Disrupting Compounds*. This report summarizes what is understood about the range of EDC and their effects on humans, fish, and wildlife, as well as reviewing possibilities for preventing the release of EDCs to the environment and the options for treatment at waste water treatment plants. The report is available at: http://www.pca.state.mn.us/publications/reports/lrp-ei-1sy08.pdf.

Polybrominated diphenyl ethers:

Polybrominated diphenyl ethers are manmade chemicals that are added to plastics and other products to reduce flammability. Products in which PBDEs or PBDE-containing material are commonly used include electrical appliances and equipment, textiles, furniture, building materials and automobiles.

There are three primary formulations of PBDEs. They are commonly referred to as Penta-BDE, Octa-BDE and Deca-BDE formulations. The Penta- and Octa-BDE formulations were voluntarily phased out by the sole US manufacturer of these products in 2004, leaving only Deca-BDE in use in the US. Similarly, the European Union effectively banned the use of Penta- and Octa-BDE in legislation passed in 2002; however, Deca-BDE remains in use.

Polybrominated Diphenyl Ethers have been a subject of growing concern because they are now ubiquitous in the environment, and the detected concentrations are increasing. Polybrominated Diphenyl Ethers have been detected in rivers, lakes and sediments, in indoor and outdoor air, in food, and in sewage sludge. It has also been detected animals, including fish, birds, terrestrial and marine mammals, and people.

The concentrations of PBDEs in the blood and breast milk of North Americans (Canada and the US) have also been increasing. Studies show that the body burden concentrations of PBDEs in North Americans are at least an order of magnitude higher than in Europeans.

The presence of PBDEs in the environment and in human blood and breast milk is of concern because of the association of these chemicals with endocrine disruption, reproductive toxicity, and developmental neurotoxicity in laboratory animal studies.

The PBDE congeners that make up the Penta-BDE formulation appear to be the main contributor to current environmental and body burden PBDE concentrations. While the Penta-BDE formulation has been withdrawn from the US marketplace, recent studies have demonstrated that Deca-BDE, which is still in wide use, can debrominate by photolytic or biological mechanisms to form the PBDE congeners associated with the Penta-BDE formulation.

Dietary intake and inhalation and ingestion of indoor dust containing PBDEs are the primary ways that humans are exposed to PBDEs.

The MPCA has been involved in investigating the impacts of PBDE contamination in Minnesota for several years. A 2001 MPCA study found that PBDEs were present in different environmental settings, including fish and sediments from major river basins in Minnesota. This study also detected PBDEs in waste management processes, including landfill leachate, and WWTP sludge.

In 2003, the MPCA conducted a study of PBDEs in Lake Superior sediment, water and fish tissue. Historical concentrations of PBDEs in the sediments were generally found to coincide with PBDE commercial production and use. Sediment samples dating to the late 1950s to the early 1960s showed the first detectable concentrations of PBDEs, with increased total concentrations and increased rates of deposition of PBDEs in sediment samples dating from more recent times and continuing through the present. PBDEs were also detected in fish tissue samples.

A scientific background paper, *Flame Retardants: Polybrominated Diphenyl Ethers* (*PBDEs*), was published by the MPCA in February 2005, and is available at the following link to 2005 Legislative Reports: http://www.pca.state.mn.us/publications/reports/tdr-g1-02.pdf.

In 2007, the MPCA prepared a report on Decabromodiphenyl Ether (Deca-BDE), the only PBDE still widely used in the US. The MPCA prepared this report at the request of the Legislature after a bill was proposed to phase out the use of Deca-BDE in Minnesota during the 2007 legislative session. This report is available on the MPCA website at the following link: http://www.pca.state.mn.us/publications/reports/lrp-ei-2sy08.pdf.

III. MONITORING AND ASSESSMENT STRATEGY

Chapter One: WATER QUALITY STANDARDS PROGRAM

INTRODUCTION

At the heart of the assessment process are the beneficial uses we derive from our water resources and the WQS that protect these uses. The WQS are the fundamental benchmarks by which the quality of surface waters is measured. The 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 WQ 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)

Classes 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, 3C, 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.

NUMERICAL WATER QUALITY STANDARDS

A numerical 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[†].

- 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 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).

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

- 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 USEPA aquatic life criteria. The USEPA develops and publishes aquatic life criteria as required by Section 304(a) of the CWA.

NARRATIVE WATER QUALITY STANDARDS

A narrative 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 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 WQS, 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 ORVW. There are two categories of ORVW, "prohibited" and "restricted." New or

expanded point and NPS of pollution are entirely prohibited to the first category (examples are waters in the Boundary Waters Canoe Area Wilderness (BWCAW) and Voyagers National Park). New or expanded point and NPSs 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 ORVW, 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 bio-accumulative pollutants to the Lake Superior basin because of the sensitivity of the Lake Superior ecosystem to these pollutants.

The agency will be revising the nondegradation portion of its WQS. A series of stakeholder meetings will be held over the next year. Final rule revision adoption is anticipated in 2010.

Chapter Two: MONITORING STRATEGY

A. Minnesota's Water Quality Monitoring Strategy and the Clean Water Legacy Act

In 2004 the MPCA completed a report that pulled together all of the elements of the State's monitoring program strategy for surface water and for ground water. The document, entitled *Minnesota's Water Quality Monitoring Strategy, 2004-2014* (Monitoring Strategy), satisfied the requirement of the USEPA for preparing a monitoring program strategy, and more importantly to guide MPCA monitoring programs for the future.

The Monitoring Strategy has been useful for communicating the MPCA's monitoring plans, particularly with respect to assessing the condition of Minnesota's water resources and identifying trends over time. The Monitoring Strategy was also a key planning and budgeting tool used during the development and passage of the CWLA, which is a ground-breaking policy bill.

The stated purpose of the CWLA is "to protect, restore, and preserve the quality of Minnesota's surface waters by providing authority, direction, and resources to achieve and maintain WQS for surface waters as required by section 303(d) of the CWA…" (M.S. Ch. 1114D, http://www.leg.state.mn.us/leg/statutes.asp).

The CWLA was passed by the Minnesota Legislature in 2006 and funds were appropriated for the MPCA and other state agencies to begin implementing the act. With the increased funding provided for water monitoring, the MPCA began to ramp-up its monitoring efforts, in conjunction with state and local partners, to more fully implement the ten year monitoring strategy. In 2007, the Minnesota Legislature provided an appropriation that allows for full implementation of the Monitoring Strategy during the 2008-2009 biennium. Assuming that full funding is continued into the future, the MPCA and state and local partners are on track to reach the goal of assessing Minnesota's surface water resources over a ten year period.

Types of Monitoring

In its USEPA approved ten-year monitoring strategy, the MPCA categorizes its environmental monitoring efforts by 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 water bodies 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, 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 CWP and Section 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 Section 319 projects, drinking water system monitoring, and monitoring associated with a particular BMP. 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 monitoring types 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 WQ protection and restoration efforts (both point and nonpoint) and achieve its vision of clean, fishable and swimmable surface waters. For NPS pollution, a consortium of federal, state and local organizations have adopted water monitoring goals, as part of the Section 319 planning process.

MPCA's Strategic Goals for Water Quality Protection and Restoration

- Goal W.1. and W.2. address ground water.

- Goal W.3. 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.

Objectives:

W3a) By January 1, 2015, gather WQ data and increase assessment of streams and rivers to 33 percent, in comparison to the 2003 level of five percent.
W3b) By January 1, 2015 gather WQ data and assess 100 percent of the lakes larger than 500 acres.
W3c) By January 1, 2015, gather data and increase monitoring so that 25 percent of the state's depressional wetlands are assessed.
W3d) By January 1, 2009, assess Minnesota's contribution to identified regional, national and international water pollution problems.
W3e) Ensure data is readily available to the public within one year of season it is collected.
W3f) Complete impaired waters list according to USEPA requirements.

- Goal W.4. Maintain and enhance the chemical, physical and biological integrity of Minnesota lakes, streams and wetlands so that WQS and designated uses are met and degradation is prevented**.**

Objectives:

W4a) Ensure that discharges from all permitted point sources are in significant compliance with state and federal limits 95 percent of the time for major facilities and 90 percent of the time for regular facilities. [‡]
W4b) By July 1, 2009, all of the 240 MS4s are actively managing storm water programs.
W4c) By January 1, 2008, 95 percent of the storm water permits for construction sites less than 50 acres will be issued within seven days.
W4d) Ensure that feedlots with NPDES permits meet state and federal requirements 90 percent of the time.
W4e) By January 1, 2011, 90 percent of the feedlot facilities enrolled in the open lot program meet WQ effluent standards.[§]
W4f) By January 1, 2007, conduct a performance evaluation of the WQ program basin management framework and make adjustments.
W4g) By October 1, 2006, and every three years thereafter, review Minnesota's WQS to incorporate changes to the standards to reflect current science and information.

[‡] Federal or State Guidance
[§] Federal or State Rule or Law

W4h) By January 1, 2014, strengthen local programs to reduce the percentage of septic tanks characterized as failing or imminent threats to public health and safety from 39 percent to less than 5 percent.
W4i) Annually complete 95 percent of the non-TMDL watershed activities specified in the federal work plan.
W4j) Annually complete 95 percent of the watershed projects specified in the federal work plan.

- Goal W.5. Restore the chemical, physical and biological integrity of Minnesota lakes streams and wetlands that do not support designated uses**.**

Objectives:
W5a) Complete TMDL studies within 13 years of initial listing.
W5b) Within one year of USEPA approval of each TMDL study, implementation plans will be approved and initiated.
W5c) By January 1, 2007, implement the impaired waters program plan and report annually.

C. Condition Monitoring Strategy

Lakes and Streams

Minnesota's statewide surface WQ 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 ten year cycle. This strategy is complete, in that it builds on a foundation of citizen monitoring, remote sensing, and other information to direct agency attention to waters that may be changing or indicating impairment for further monitoring and assessment.

Further details on the condition monitoring strategy can be found in the Minnesota WQ Monitoring Strategy available at: http://www.pca.state.mn.us/water/pubs/wqms-report.html

Within the framework of the ten year monitoring strategy, the MPCA operates programs to monitor water resources and to support the efforts of partners and volunteers. MPCA monitoring is focused on lakes and streams, although some wetlands are monitored as part of a multi-agency effort to determine the condition of Minnesota's wetlands. Specific MPCA monitoring efforts include the following:

- **Integrated Stream Monitoring** – This involves biological, chemical and physical monitoring to assess Minnesota streams. The MPCA uses two approaches: probabilistic (random) and intensive watershed monitoring. In probabilistic design monitoring, sites are selected randomly within a basin using a statistical method. The basin sites are re-sampled every ten years to track changes in stream quality. Intensive watershed monitoring allows for detection of impaired sites. In this approach, a major watershed is

sampled in smaller and smaller watershed units down to a 25 square-mile scale. This design was used successfully in the Snake (St. Croix basin), the Pomme de Terre, and the North Fork Crow River watersheds, and statewide implementation begins in 2008.

- **Minnesota Milestone Program** – The MPCA samples 80 permanent river sites across the state on a rotating basis for trends (30-40 sites are sampled each year).
- **Major Watershed Loading** – In partnership with the MDNR, the MPCA is establishing permanent flow and chemistry sampling sites at the outlet of each of the 81 major watersheds in the state. This effort is in the beginning stages, and is being expanded as funding allows.
- **Lake Assessment Monitoring** – The MPCA focuses its sampling efforts on lakes greater than 500 acres, lakes where no monitoring data is available, and lakes where citizen or remote-sensing data suggest a problem. The Lake Assessment Program allows citizens to apply to cooperatively monitor their lakes. Lakes are selected each spring based on applications received, data gaps, remote sensing or trend data, and logistics.
- **Citizen Monitoring** – The agency's citizen stream and lake monitoring programs provide training and equipment to volunteers interested in monitoring the transparency of their lake or stream. Sites are typically selected by the volunteers based on their location and interest. The MPCA recruits annually to bring more volunteers to the programs. In 2000, the citizens lake monitoring program added an advance monitoring component. This rotating program moves between counties each year and provides volunteers with equipment and training to collect the data needed for lake assessments.
- **Surface Water Assessment Grants Program** – The assessment grants created by the CWLA, and currently funded through 2009, are designated to provide local organizations and citizen volunteers the funding to complete the monitoring needed to meet assessment requirements on Minnesota lakes and streams. Data collected from these projects will be of the rigor necessary for surface water assessments (the 303(d) level assessments). Grantees are required to submit data to STORET (USEPA's WQ database) annually.

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:

1.monitoring by regulated parties for most of its regulatory programs under NPDES;
2.a mix of MPCA and MPCA-contracted monitoring for TMDL studies;
3.local monitoring for locally identified problems or protection concerns (through CWP, county water planning, local lake associations, etc.);
4.MPCA monitoring to fill gaps and for special projects (fish kills, wasteloads, etc.); and
5.monitoring by other organizations for additional needs (USGS, MCES).

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. 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 I) 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. 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 MDH on the subject. The agencies are investigating the possibility of making such assessments, and staff of both agencies are continuing to attend source water protection plan development 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 current municipal water suppliers who use surface waters.

H. Source Water

The MDH is the lead agency in Minnesota working on source water protection with USEPA. For ground water-based public water supplies, source water protection is the state's wellhead protection program. For surface water supplies, source water assessment is being approached in various ways, depending on the size and circumstances of each source water and watershed. Where possible, these assessments and MPCA's basin and watershed assessments are being coordinated.

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

Chapter Three: ASSESSMENT METHODOLOGY AND SUMMARY DATA

2. 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 USEPA's Reach File 1 (RF1) to define reaches. Many of our current assessment reaches are RF1 reaches, or subsegments of RF1 reaches. The MPCA is now using the 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 (HUC) 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 (Schupp, 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.[**] 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 milligram per liter (mg/L) P effluent limit in Minn. R. pt. 7050.0211 (MPCA 2000). The 14 day residence time is consistent with USEPA'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 (USEPA 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.

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

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 USEPA's WQ data storage and STORET station numbers; for example, 27-0104 is Medicine Lake in Hennepin County. In addition to the six-digit numbers, a two-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.

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 ten 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.

In order to provide a consistent reporting regimen for stream miles and lake and wetland acres, Minnesota is moving toward reporting water body sizes that will comply with 1:24,000 scale NHD. As such the state of Minnesota is using estimates of about 105,000 stream miles and about 4.5 million lake acres for totals. (See Figure II-1, Minnesota Background Information and Border Waters.)

3. Data Management

The MPCA stores surface water monitoring data 'the state's STORET Database', and regularly uploads the data to USEPA's National Data Warehouse. With the date approaching that USEPA will continue to support the Warehouse, but no longer support STORET, MPCA is planning internally, and in conjunction with a group of other states, to build a replacement system to the current STORET.

It is MPCA policy that all WQ monitoring data required or paid for by MPCA be entered into STORET. Included are Projects funded by MPCA include Section 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 MPCA in STORET-ready format. These projects then also have their data accessible to a variety of users through the MPCA's Environmental Data Access Initiative.

4. Integrated Assessment Process

Integrated Assessment Methodology

Tables III-1 and III-2 summarize the fundamental data and information requirements for the 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 III-1 and III-2. The professional judgment review of the pre-assessment determines the final assessment.

Table III-1. Summary of Data Needed for Water Quality Assessments for Use Support and Impairment Determinations, for Pollutants with Numeric Standards.

Pollutant Category **Integrated Report**	**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
	5 values in 3 years	Not listed	na	Listed
Pollutants with Human Health-based Standards	Number of Exceedances →	≤ 1	Na	≥ 2
	5 values in 3 years	Not listed	na	Listed
Conventional Pollutants and Water Quality Characteristics	Percent Exceedance →	< 10 %	10 – 25 %	> 25 %
303(d)	20 values in 10 years	Not listed	Listed	Listed
Fecal Coliform, Step 1 200 orgs./100 m.	Percent Exceedance →	< 10 %	≥ 10 %	Na
	10 values in 10 years	Not listed	Step 2	na
Fecal Coliform Step 2 200 orgs./100 m.	*Number of months with Exceedances* → (geometric mean)	No months	1 or 2 months	> 2 months
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 %
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 "review" category for toxics and fish tissue contaminants, no "listed" category for step 1 of fecal coliform assessments, and no specific minimum data requirements for biological and fish tissue contaminant assessments.

Table III-2. Summary of Data Needed for Water Quality Assessments for Use Support and Impairment Determinations, for Pollutants with Narrative Standards.[††]

Pollutant Category **Integrated Report**	**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
	10 Total phosphorus, 10 chlorophyll-*a* and 10 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
	10 Total phosphorus, 10 chlorophyll-*a* and 10 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
	10 Total phosphorus, 10 chlorophyll-*a* and 10 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. na = not applicable. There is no "review" category for toxics and fish tissue contaminants, no "listed" category for step 1 of fecal coliform assessments, and no specific minimum data requirements for biological and fish tissue contaminant assessments.

[††] The number of observations and exact thresholds for full support may vary from Table III-2. See Table III-7 for further details on this.

Table III-2. continued

Pollutant Category **Integrated Report**	**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.	Not listed	Listed	Listed
Fish Tissue Contaminants	Tissue concentration →	≤ 0.2 ppm Hg or PCBs	na	> 0.2 ppm Hg or PCBs
	Hg: 1. Fish collected after 1989 (i.e., 1990-2005) 2. Filet with or without skin on; no whole fish 3. At least five fish in a species, including fish within a composite sample 4. Impaired if ≥ 10% are greater than 0.2 ppm **PCBs**: 1. Fish collected in last 10 years 2. Minimum of one fish in a size class 3. Size class mean based on last five years of data 4. Impaired if size class mean is > 0.2 ppm	Not listed	na	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.

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 WQ 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 (DO) or high P, etc).

MPCA staff and a professional judgment team compare monitoring data from all sources to the WQS 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 USEPA guidance. USEPA's discussion of independent application is the integration of assessments of: 1) chemical-specific data, 2) biological assessments, and 3) whole effluent toxicity testing (USEPA 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 WQ, and use impairment. For examples the team may consider:

A. the quality and quantity of all available data;
B. the magnitude, duration and frequency of exceedances;
C. timing of exceedances;
D. naturally occurring conditions that affect pollutant concentrations and toxicity;
E. weather and flow conditions;
F. consistency of the preliminary assessment with information on other numeric or narrative WQS;
G. known influences on WQ in the watershed; and
H. any changes in the watershed that have changed WQ.

The MPCA assembles the professional judgment teams and chairs the meetings. 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 (PJG) "transparency" form for assessed streams (see Figure III-1), so that

readers can understand how the decision was reached. The form is housed in a database which allows for better tracking of assessment decisions over multiple reporting cycles.

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

Figure III-1. Professional Judgment Group "Transparency" Form.

Example

Transparency Documentation

Assessment Unit Identification (**AUID):** 07020012-515

Assessment Cycle: 2008

Aquatic Life Assessment: NS

Swimming Assessment: NS

Review For Delisting: No

More Monitoring: Yes

Comments:
PJG comment: 3 of 8 DO exceedances are within margin of error. Follow up to look at values at individual sites and compare with flow records.

Followup comment: CLS (5-18-07) Additional detailed review of DO and flow data for the 8/56 observations exceeding the DO standard. Three exceedances occurred on dates when the flow gage reported zero flow. It was confirmed the water in Bevens Creek was pooled and not flowing during most of August, and by mid September 2000, the streambed was completely dry. Low DO readings on these three dates could be attributed to sampling stagnant water. Considering this, along with other values (4.8, 4.88, 4.99 mg/L) that are within margin of error for sampling, recommend that we not list for DO impairment at this time, but collect additional DO data and re-evaluate.

Impairment ID: 138

Impairment Name: Chloride

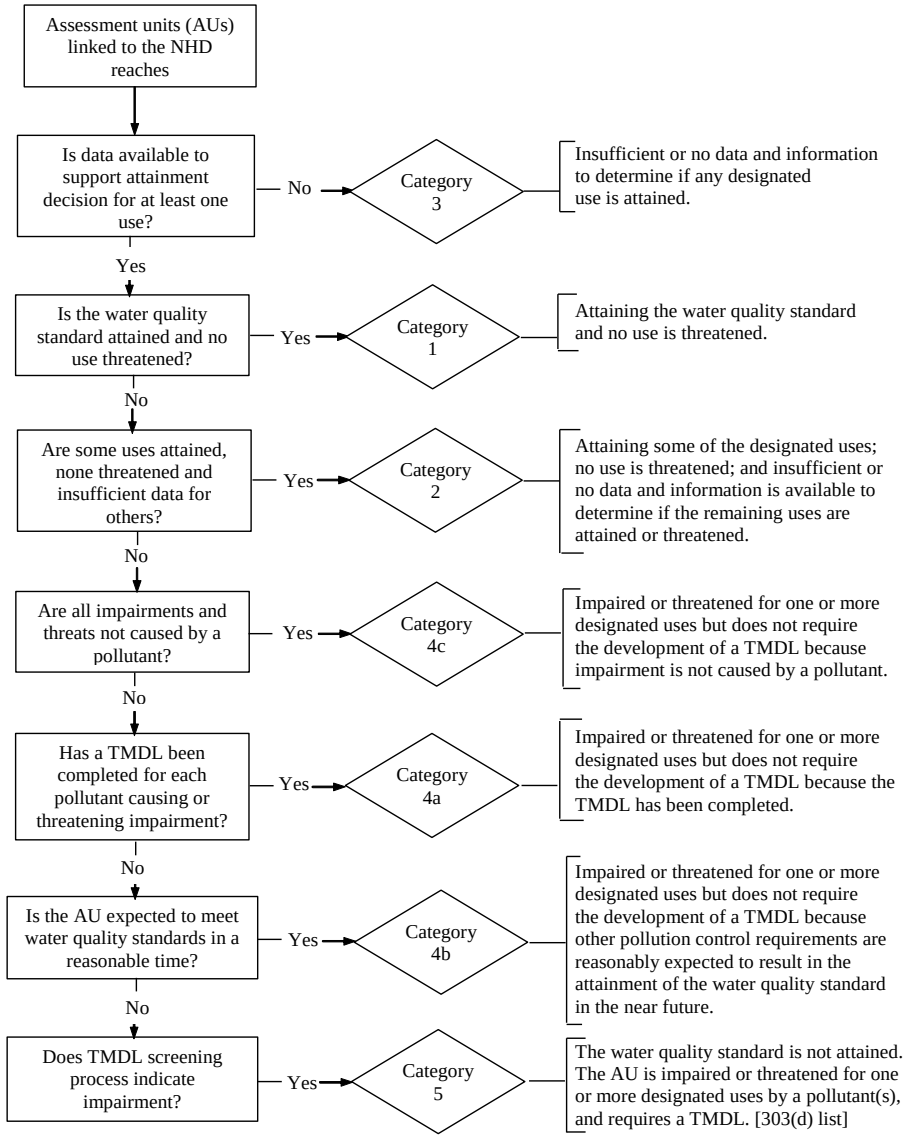
Impairment ID: 400

Impairment Name: Fecal Coliform

Impairment ID: 413

Impairment Name: Turbidity

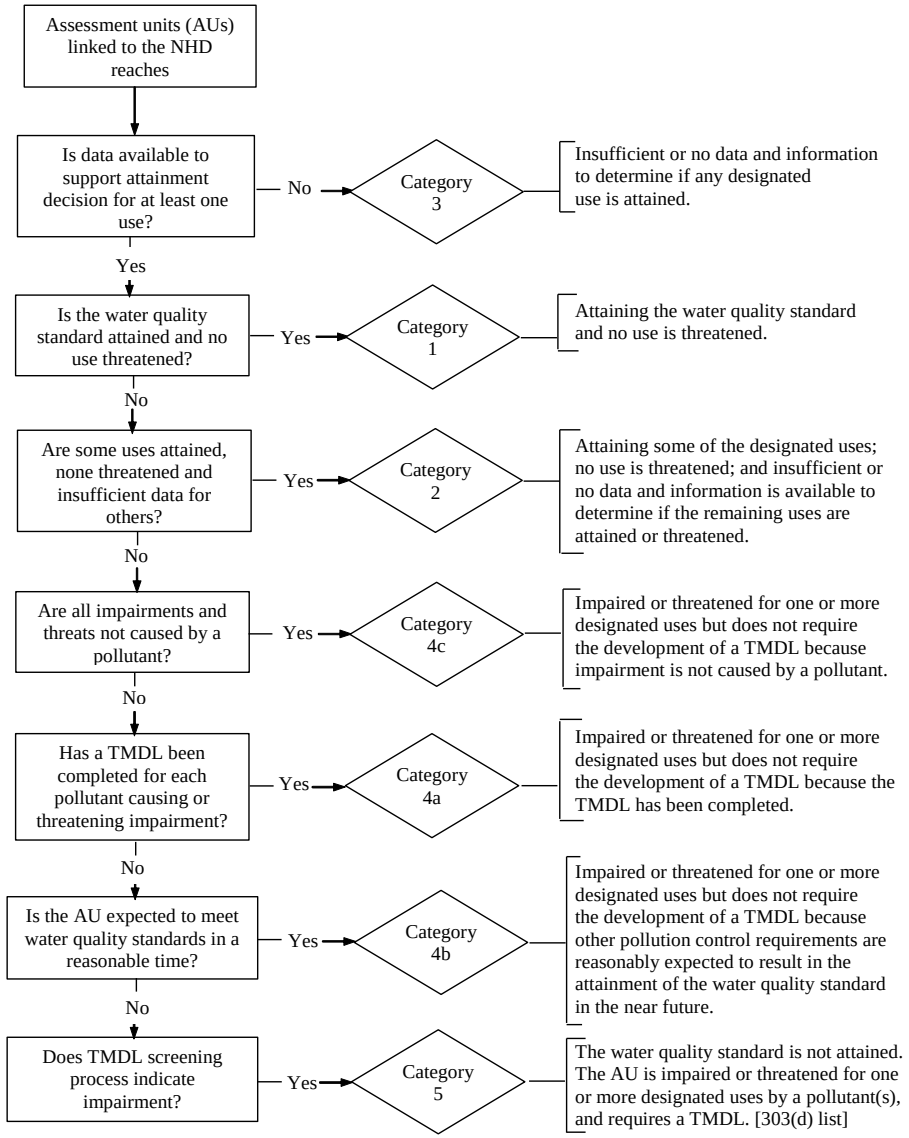
Figure III-2. Flowchart of Non-Impaired Waters, Impaired Waters and TMDL Listed Waters.



Non-Impaired Waters

Impaired Waters

TMDL Listed Waters



Non-Impaired Waters

Impaired Waters

TMDL Listed Waters

Chapter Four: DATA ANALYSIS PROCEDURES

- **Data Age and Quality for Assessments**

  Assessed Data

  Lakes with summer data (defined as the time period from June through September) collected between calendar years 1997-2006 were considered for this assessment. Summer data are preferred for assessments to better represent the maximum productivity of a lake and yield the best agreement among trophic variables. This time period also reflects the primary season when the resource is used for aquatic recreation. Summer-means were calculated for each variable and used in the assessment. In addition the number of observations (N), standard error (SE) of the mean, maximum (max) and minimum (min) values were calculated as well. These additional statistics can be used to place the mean values in perspective and improve the ability to make comparisons of values among lakes. In addition to this database, we also calculate individual summer-mean TP, chl-a, and Secchi by year for all assessed lakes that can be used for trend assessment and is included as a part of the "reviews" that may be conducted as a part of 303(d) assessments (see Table III-4).

  Data Quality

  Assessing the quality of data used in the assessment is somewhat similar to the approach used in the 2006 305(b) assessment. Since the data used in these assessments was derived from STORET, we assume that certain quality control thresholds were already established for the data. Hence our definition of quality will focus on the relative amount of information available for the assessment. In the case of aquatic recreational use assessments for lakes, TP is the initial variable used, so we place the greatest emphasis on the amount of TP data available for the assessment. The quality terms used in Table III-3 were drawn from USEPA guidance. In general, assessments based on multiple measurements are more reliable than those based on only a few measurements. The rationale for assigning the respective quality definitions corresponds roughly to typical lake-monitoring regimens (e.g. monthly sampling during the summer season), whereby four TP samples often represent one summer; eight samples two summers and 10-12 samples two-three summers.

  Table III -3. Data quality characterizations for 305(b) and 303(d) assessments.

Quality	Data requirements	Potential assessment categories
Poor	< 4 TP measurements	Insufficient data
Fair	4 ≤ TP < 8, some chl-a & Secchi	Full support or insufficient data
Good	8 < TP < 10, some chl-a & Secchi	Full support or insufficient data
Excellent	10 TP, 10 chl-a & 10 Secchi	Full support or non support

Trophic Status Assessment

Trophic Status was determined for each lake using Carlson's Trophic State Index (TSI). This index was developed using the relationship among summer Secchi transparency, epilimnetic concentrations of chl-a, and TP (Table III-4, Figure III-3).
The TSI values are calculated as follows:

- *Secchi disk* (SD) TSI Trophic State Index Secchi (TSIS) = 60 – 14.41 natural log (ln) SD;
- *Total phosphorus* (TP) TSI (TSIP) = 14.42 ln TP + 4.15;
- *Chlorophyll-a* (chl-a) TSI (TSIC) = 9.81 ln chl-a+30.6;

(Chl-a and TP in micrograms per liter (µg/L) and SD transparency in meters).

The index ranges from 0 to 100 with higher values indicating more eutrophic conditions. The TSI values were calculated for each variable; however trophic status is based on TP when data are available. If no TP data are available for a lake, the Secchi TSI value is used to estimate trophic status. Ideally, chl-a would be used for this purpose; however chl-a (corrected) is measured much less frequently than Secchi or TP so we focus on TP. The following breakpoints were used to define the trophic status of the lake: TSI ≤40 "oligotrophic (O)", ≥41 TSI <50 "mesotrophic (M)", ≥50 TSI ≤70 "eutrophic (E), and TSI ≥70 "hypereutrophic (H). This index and interrelationships among TP, chl-a, and Secchi figure prominently in definition of use-support categories to be addressed later.

Table III-4. Trophic Status Thresholds for Determination of Use Support for Lakes. (Carlson's TSI noted for each threshold.) Actual use support designation is dependent on the lake having the appropriate number of observations as noted in Table III-3.

Ecoregion (TSI)	TP ppb	Chl ppb	Secchi m	TP Range ppb	TP ppb	Chl ppb	Secchi m
	Full Support			Review	Non-Support		
NLF	**<30**	**<10**	**≥1.6**	**30 – 35**	**>35**	**>12**	**<1.4**
(TSI)	(<53)	(<53)	(<53)	(53 – 56)	(>56)	(>55)	**(>55)**
NCHF	**<40**	**<15**	**≥1.2**	**40 – 45**	**>45**	**>18**	**<1.1**
(TSI)	(<57)	(<57)	(<57)	(57 – 59)	(>59)	(>59)	**(>59)**
WCBP & NGP	**<70**	**<24**	**≥1.0**	**70 – 90**	**>90**	**>32**	**<0.7**
(TSI)	**(<66)**	**(<61)**	**(<61)**	**(66 – 69)**	**(>69)**	**(>65)**	**(65)**

TSI = Carlson trophic state index; Chl = Chlorophyll-a; ppb = parts per billion or µg/L, m = meters

Figure III-3. Carlson's Trophic State Index.

Carlson's Trophic State Index
RE Carlson

TSI < 30 Classic Oligotrophy: Clear water, oxygen throughout the year in the hypolimnion, salmonid fisheries in deep lakes.

TSI 30 - 40 Deeper lakes still exhibit classical oligotrophy, but some shallower lakes will become anoxic in the hypolimnion during the summer.

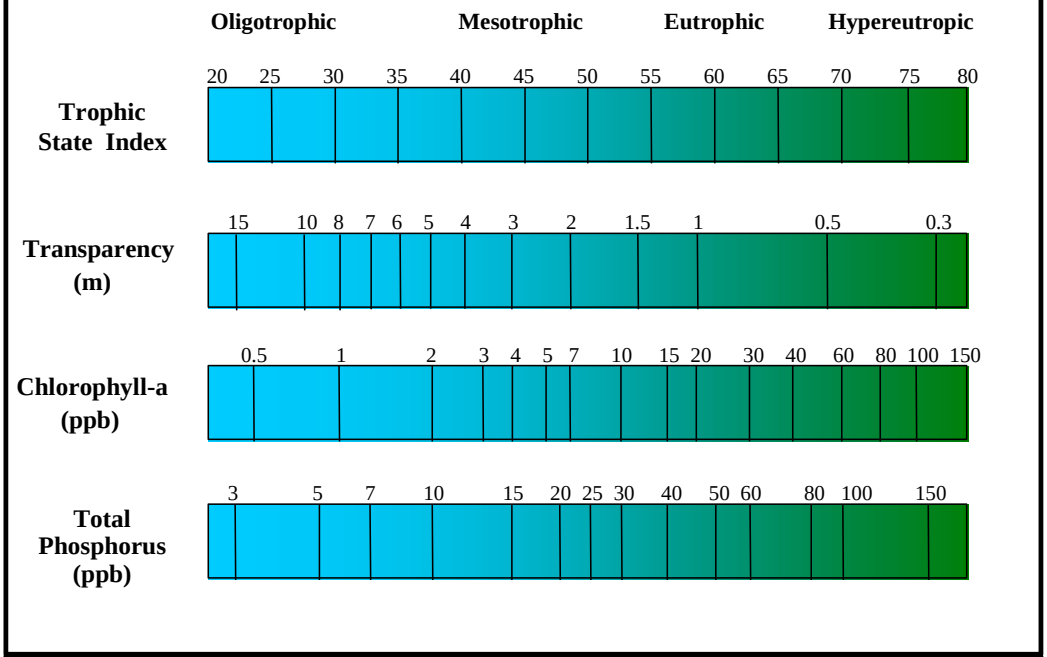
TSI 40 - 50 Water moderately clear, but increasing probability of anoxia in hypolimnion during summer.

TSI 50 - 60 Lower boundary of classical eutrophy: Decreased transparency, anoxic hypolimnia during the summer, macrophyte problems evident, warm-water fisheries only.

TSI 60 - 70 Dominance of blue-green algae, algal scums probable, extensive macrophyte problems.

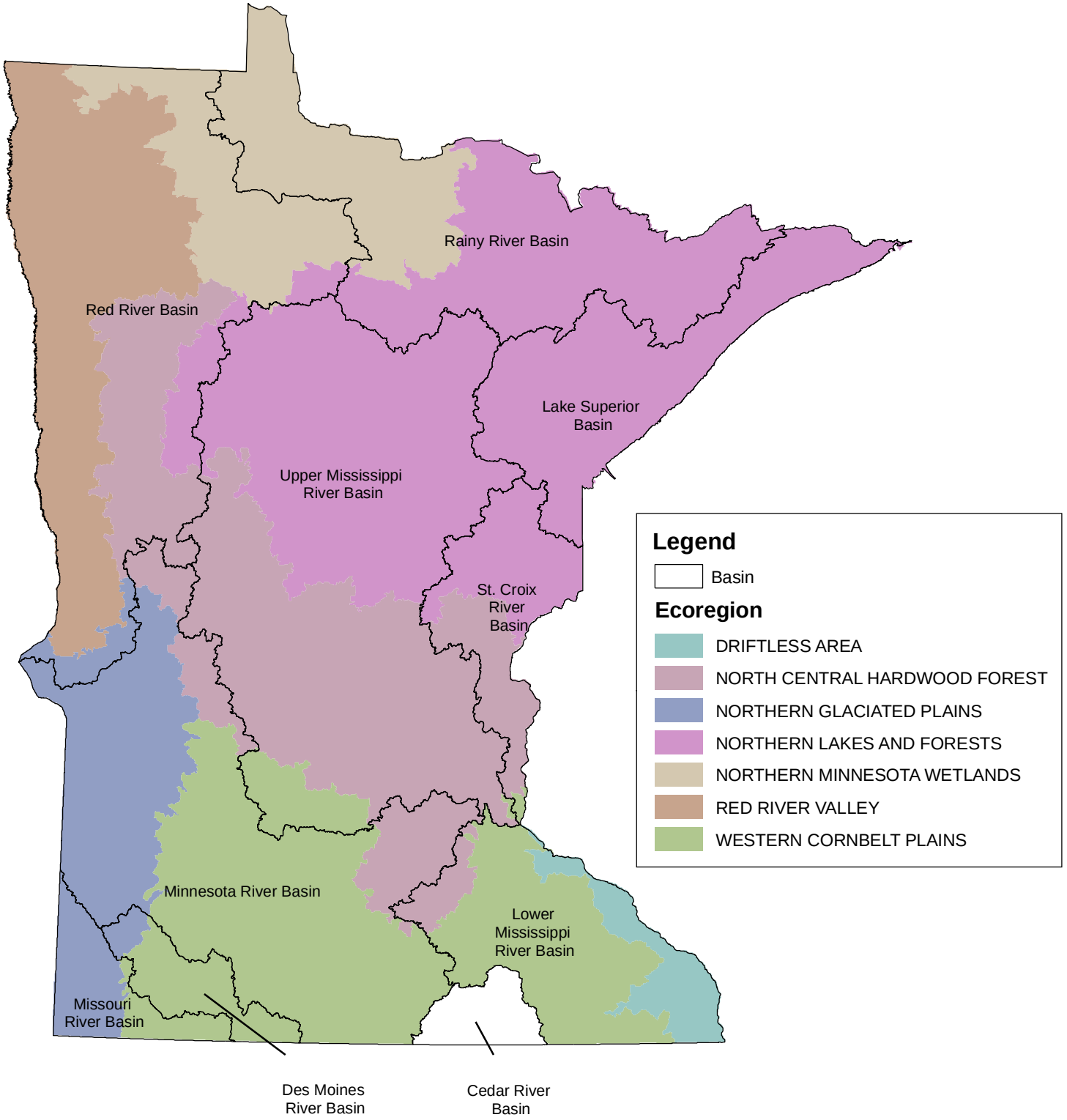
TSI 70 - 80 Heavy algal blooms possible throughout the summer, dense macrophyte beds, but extent limited by light penetration. Often would be classified as hypereutrophic.

TSI > 80 Algal scums, summer fish kills, few macrophytes, dominance of rough fish.



After Moore, 1. And K. Thornton, [Ed.]1988. Lake and Reservoir Restoration Guidance Manual. USEPA>EPA 440/5-88-002.

Figure III-4. Minnesota's Ecoregions and Major Drainage Basins.



Aquatic Recreation Use Assessment: Eutrophication Criteria Development and Use Support

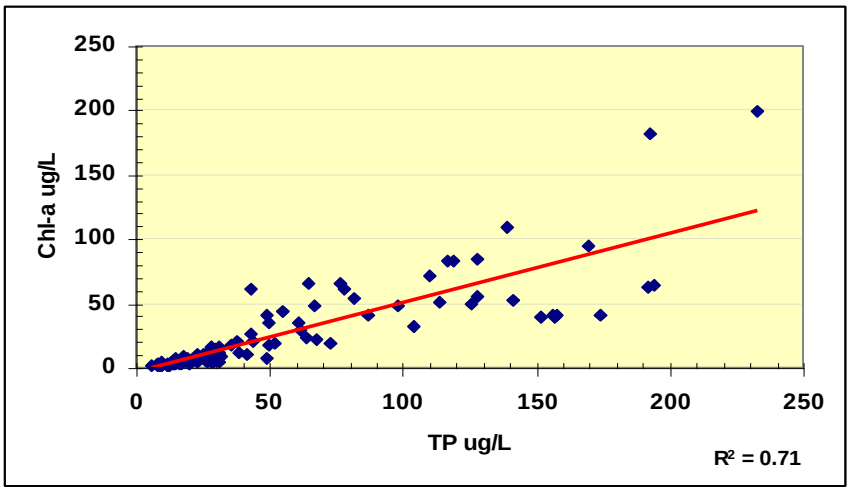
Assessing whether lakes "support" or "do not support" aquatic recreation is required as a part of Section 305(b) of the CWA. Minnesota has long used an ecoregion-based approach for these assessments. Previously developed ecoregion-based phosphorus (TP) criteria have long been used in conjunction with Carlson's TSI scale (Figure III-3) to establish use support thresholds (Table III-4). These thresholds are described in more detail in *MPCA's "Guidance Manual for Assessing the Quality of Minnesota Surface Water"* that may be found at: http://www.pca.state.mn.us/water/tmdl/index.html#publications. These thresholds provided a basis for determining nutrient-impaired waters for the 2002, 2004, 2006 and 2008 303(d) lists and guide the 305(b) assessments as well.

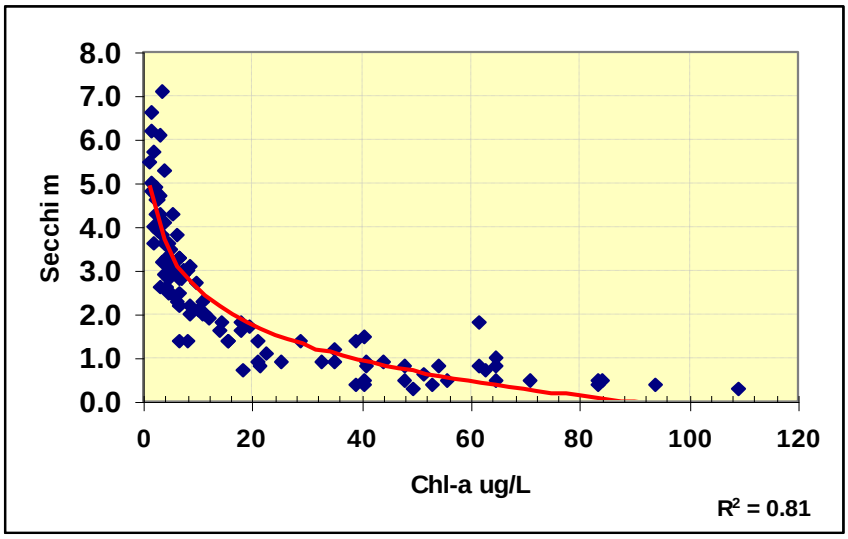
For 2008 the thresholds and nomenclature used for 305(b) were modified from previous assessments so they were consistent with use support definitions developed for 303(d) assessment (Table III-4). In previous 305(b) assessments we employed three "levels" of support: full, partial, and NS and the numeric translators for the assessment are noted in Table III-4. While these translators remained the same for the 2008 assessments we have abandoned the use of "partial support" category in favor of "insufficient data." Previously, lakes assessed as "partially supporting" had data that fell between the full support and NS categories. In the 2008 assessment these lakes are classified as having insufficient data (IF) for assessment.

Eutrophication Criteria

The Northern Lakes and Forests (NLF) and North Central Hardwood Forest (NCHF) ecoregion phosphorus (TP) criteria levels, 30 µg/L and 40 µg/L, respectively, serve as the upper thresholds for full support of aquatic recreational use. Those concentrations correspond to Carlson's TSI values of 53 and 57, respectively. Phosphorus concentrations above criteria levels would result in greater frequencies of nuisance algal blooms and increased frequencies of "impaired swimming." The upper threshold for partial support of aquatic recreational use was set at 56 and 59 Carlson's TSI units, respectively, for these two regions. As P concentrations increase from about 30 µg/L to 60 µg/L, summer-mean chl-a concentrations increase from about ten µg/L to 30 µg/L, and Secchi transparency decreases from about 2.5 meters to 1.5 meters (Figure III-5). Over this range, the frequency of nuisance algal blooms (greater than 20 µg/L chl-a) increases from about five percent of the summer to about 70 percent of the summer (Figure III-6). The increased frequency of nuisance algal blooms and reduced Secchi transparency results in a high percentage of the summer (26-50 percent) perceived as "impaired swimming."

Figure III-5. Total Phosphorus, Chlorophyll-a, and Secchi Scatterplots and Regressions. Based on ecoregion reference lake data.





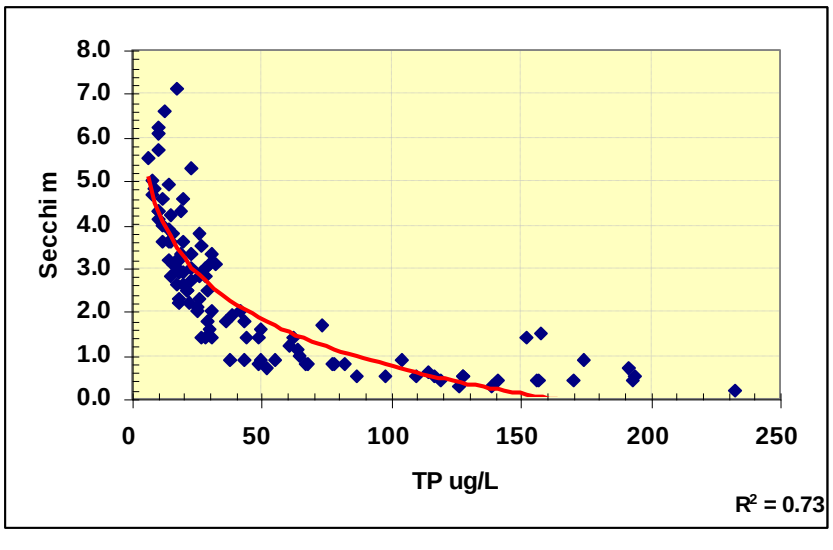
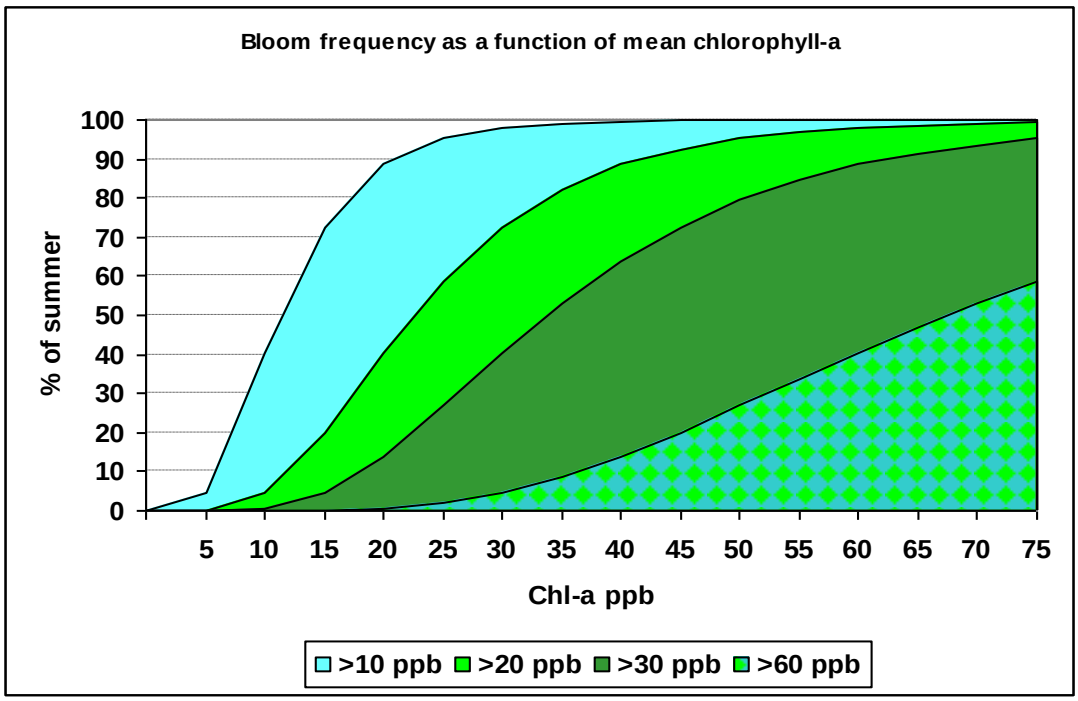
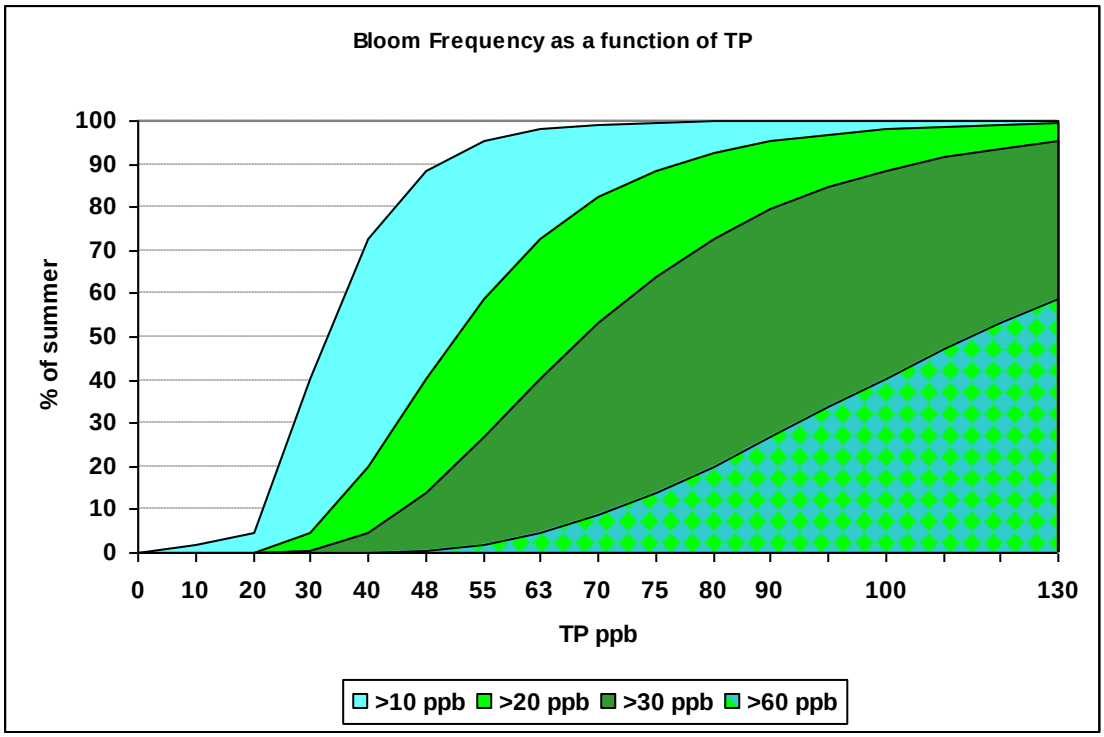


Figure III-6. Algal Bloom Frequency as a Function of Mean Chlorophyll-a and Total Phosphorus.





For the NLF ecoregion, summer-mean TP above 35 µg/L is associated with NS of aquatic recreational use. At TP concentrations above 3µg/L, mild algal blooms (>10 ug/L chl-a) occur over 50 percent of the summer and nuisance blooms (> 20 µg/L chl-a) about 15 percent of the summer. Secchi transparency typically averages 1.6 m or less. The combination of frequent blooms and reduced transparency result in a high frequency of impaired swimming (perhaps 50 percent of summer) and greater than 25 percent as "no swimming."

For the NCHF ecoregion, summer-mean TP above 45 µg/L is associated with NS of aquatic recreational use. At TP concentrations above about 45 µg/L, mild blooms occur over 80 percent of the summer, nuisance blooms about 40 percent of the summer, and severe nuisance blooms about 15 percent of the summer. Secchi transparency typically averages 1.1 m or less over this range of TP. Transparencies less than 1.4 m are typically associated with impaired swimming, while those less than 1.1 m are typically associated with no swimming (Heiskary and Wilson, 1989).

For the Western Cornbelt Plains (WCBP) and Northern Glaciated Plains (NGP), the upper TP threshold for fully supporting is 70 µg/L (Table III-4). This corresponds to a TSI of 66. At a TP of 70 ug/L, summer-mean chl-a averages about 24 µg/L and Secchi transparency is about 0.8 meters. Nuisance algal blooms (>30 ug/L chl-a for these regions) would occur for approximately 50 percent of the summer. Few lakes in these two ecoregions have TP concentrations of 70 ug/L or less. Total phosphorous concentrations greater than 90 ug/L are considered not supporting of aquatic recreational use. At TP concentrations greater than 90 ug/L, Secchi transparency averages 0.5 meters or less and nuisance algal blooms may occur over 75 percent of the summer.

Lakes in the Red River Valley (RRV) and Northern Minnesota Wetlands (NMW) ecoregions were assessed using the NCHF and NLF criteria, respectively, since there were too few lakes to establish reference conditions in the RRV or NMW ecoregions.

Table III-5. Ecoregion Reference Lake Data Summary. Based on interquartile (25^{th} – 75^{th} percentile) range for reference lakes. Also referred to as "typical range."

Parameter	Northern Lakes and Forests	North Central Hardwood Forests	Western Corn Belt Plains	Northern Glaciated Plains
# of reference lakes	30	35	12	10
Total Phosphorus (µg/L)	14 – 27	23 – 50	65 – 150	122 – 160
Chlorophyll mean (ug/l)	4 – 10	5 – 22	30 – 80	36 – 61
Chlorophyll max. (µg/L)	< 15	7 – 37	60 – 140	66 – 88
Secchi Disk (feet) **(meters)**	8 – 15 (2.4 – 4.6)	4.9 – 10.5 (1.5 – 3.2)	1.6 – 3.3 (0.5 – 1.0)	1.3 – 2.6 (0.4 – 0.8)
Total Kjeldahl N (mg/l)	0.4 – 0.75	< 0.60 – 1.2	1.3 – 2.7	1.8 – 2.3
Nitrite + Nitrate-N (mg/l)	<0.01	<0.01	0.01 – 0.02	0.01 – 0.1
Alkalinity (mg/l)	40 – 140	75 – 150	125 – 165	160 – 260
Color Platinum Cobalt (Pt-Co Units)	10 – 35	10 – 20	15 – 25	20 – 30
pH Standard Units (SU)	7.2 – 8.3	8.6 – 8.8	8.2 – 9.0	8.3 – 8.6
Chloride (mg/l)	0.6 – 1.2	4 – 10	13 – 22	11 – 18
Total Sus. Solids (mg/l)	< 1 – 2	2 – 6	7 – 18	10 – 30
Total Suspended Inorganic Solids (mg/l)	< 1 – 2	1 – 2	3 – 9	5 – 15
Turbidity (NTU)	< 2	1 – 2	3 – 8	6 – 17
Conductivity micromho/centimeter (umhos/cm)	50 – 250	300 – 400	300 – 650	640 – 900
Total nitrogen to total phosphorous ratio (TN:TP)	25:1 – 35:1	25:1 – 35:1	17:1 – 27:1	7:1 – 18:1

Table III-6. Draft eutrophication criteria by ecoregion and lake type (Heiskary and Wilson, 2005). To be in compliance with criteria concentrations should be at or below the stated value for TP and chl-a and at or above for Secchi**.**

Ecoregion	**TP**	**chl-a**	**Secchi**
	ppb	ppb	**Meters**
NLF – Lake Trout (Class 2a)	12	3	**4.8**
NLF – Stream Trout (Class 2a)	20	6	**2.5**
NLF – Aquatic Rec. Use (Class 2b)	30	9	**2.0**
NCHF – Stream Trout (Class 2a)	20	6	**2.5**
NCHF - Aquatic Rec. Use (Class 2b)	40	14	**1.4**
NCHF – Aquatic Rec. Use (Class 2b) Shallow Lakes	60	20	**1.0**
WCBP & NGP – Aquatic Rec. Use (Class 2b)	65	22	**0.9**
WCBP & NGP – Aquatic Rec. Use (Class 2b) Shallow	**90**	**30**	**0.7**

Once the WQS promulgation is complete the draft nutrient criteria (Table III-6) will be the future basis for 305(b) and 303(d) lake assessments and will allow for a more comprehensive assessment of lake WQ and use support. Two important features of the draft criteria are that they allow for the differentiation between deep and shallow lakes and also consider fishery requirements more fully in contrast to the existing thresholds (Table III-4). A detailed report on the development of the criteria is available at: http://www.pca.state.mn.us/water/lakequality.html#reports.

In previous years separate, but interrelated, assessments for the 303(d) and 305(b) assessment processes were conducted. Now as we move away from "separate" processes we are challenged with finding a means to accurately assess and "list" lakes that are fully supporting of aquatic recreational usage relative to nutrient impairment.

One of the stumbling blocks is the relatively high bar we have for 303(d) assessment which is as follows for 2008: 10 TP, chl-a, and Secchi measurements collected during the ten year period of 1997 – 2006. Ten measurements often translate to about two or three summers of monitoring. Since potentially "impaired waters" have been the emphasis of recent monitoring efforts (prioritized lake monitoring based on 305(b) level classifications of either "non-supporting" or "partially supporting"), we have monitored increasingly fewer potentially "fully supporting" lakes. As such, new data and evaluation thresholds for the 2008 assessment were developed that allow us to confidently assess more lakes as "fully supporting" at a 303(d) level. A summary of that approach follows.

For 2008 we assessed "fully supporting" lakes based on: 1) four pairs of TP, chl-a and Secchi data (i.e. one summer of monitoring); and 2) a review of CLMP data for the most recent ten year assessment cycle. For a lake to be assessed as "fully supporting," based on this reduced data set, all three TSI indicators must be below the numeric thresholds (Table III-4), which have been adjusted to provide a "safety factor" to ensure that the lake is well below the threshold (Table III-7). The revised thresholds should minimize the risk of making an incorrect assessment based on a reduced data set (e.g. assessing a lake as fully supporting when it may in fact be non-supporting).

A factor of 0.8 was applied to the current thresholds, which means that the revised thresholds are 20 percent lower. This factor takes into account the typical variation (e.g. coefficient of variation) observed when calculating summer-means, which is often on the order of 10-15 percent for most lakes. As an aside, a factor of 0.8 was used by the Rhine Water Works (RIWA) to communicate waters that were in full compliance of water standards (Stoks 2007 presentation at Enhancing State Lakes Management Programs, April 2007, Chicago IL). Those waters that fell between 80 percent of the standard and the standard value were deemed as "moderate compliance," which is roughly equivalent to what we formerly referred to as "partially supporting."

The secondary basis (recent Citizen Lake–Monitoring Program (CLMP) record) serves to corroborate the assessment based on #1, addresses concerns on year-to-year variability, and

serves to reinforce the value of volunteer collected Secchi measurements. In our initial development of this approach we required a minimum of seven years of CLMP data and that all summer-mean Secchi measures should be below the threshold for full support (e.g. Secchi measures for NCHF lakes should be >1.2 m) for this portion of the assessment. In general, we found that for most lakes where the TSI variables indicated full support that CLMP Secchi was in compliance as well in most years. However, we found that strict application of this approach (seven years and all years in compliance) was too limiting and reduced the number of lakes that could be assessed with confidence, given the safety factor applied to the thresholds (Table III-7). Subsequently, we settled for reviewing whatever CLMP data was available and using best professional judgment (BPJ) to evaluate whether the lake was fully supporting based on "weight of evidence" of both data sets. This review, resulted in two NCHF lakes (Laddie 02-0072 and Carol 82-0017) that were otherwise "fully supporting" to be assessed as "insufficient data" because each had multiple years where Secchi fell below the threshold.

Ecoregion (TSI)	TP ppb	Chl ppb	Secchi m
	Full Support		
NLF	≤24	≤8	**≥1.9**
(TSI)	(50)	(51)	**(51)**
NCHF	≤32	≤12	**≥1.4**
(TSI)	(54)	(<57)	**(<57)**
WCBP & NGP	≤56	≤19	**≥1.2**
(TSI)	**(64)**	**(60)**	**(57)**

Table III-7. Trophic Status Thresholds for Determination of Full Support Based on Reduced Datasets. A 20 percent "safety factor" has been applied to full support thresholds in Table III-4.

RESULTS AND DISCUSSION

Following is a discussion of AQR use support and associated data used in this assessment. For 305(b) purposes, assessments are commonly done on both a statewide and basin-specific basis. Hence our analysis will include results and discussion pertinent to Minnesota's nine major drainage basins (Figure II-2). In addition ecoregion-specific results will be shared to offer further insight into the status of lakes, potential causes of support or NS, quality and sources of data used in the assessment. Where appropriate results are expressed in terms of number of lakes and number of lake acres. An ecoregion-based summary of trophic status measurements (TP, chl-a and Secchi) and lake morphometry of the assessed lakes is presented (Table III-8).

Available data and data quality

Trophic status data used in this assessment were available for 2,343 lake segments (lakes and lake bays) representing approximately 2,153,779 acres.[12] A programmatic change for the 2008

[12] 10 acres or more in size

assessment allowed only waters with samples in the most recent ten years to be reviewed (previously reported as the number of waters/acres "monitored"). As such, there was a drop in the total number of lake segments reviewed for the 305(b) assessment from 2006; however the actual number of lake segments that were deemed "monitored" increased by 20 percent (4 percent acres).

The greatest numbers of lake segments reviewed for assessments were located in the Upper Mississippi Basin (Figure III-7). Active participation in the CLMP, numerous local water plans, MCES activities, and related monitoring efforts contribute to the high number of reviewed lakes in this basin. The Rainy Basin was the next highest by number. Though there is participation in the CLMP, it is not nearly as high as that seen in the Upper Mississippi Basin. Much of the monitored acreage in the Rainy Basin can be attributed to Lake of the Woods (312,070 acres), Rainy (220,800 acres) and Vermilion (40,557 acres), all of which have been monitored by the MPCA in the past ten years. Individual lake assessment reports for some of these lakes may be found at: http://www.pca.state.mn.us/water/lakereport.html.

Table III-8. Minnesota Lake Water Quality Assessment Data Base Summary (2008). Water quality values represent summer means.

Ecoregion	Parameter	Percentile							
		5	10	25	50	75	90	95	# of lakes
NLF[1]	Area (acres)	13	21	63	182	457	1251	2206	1,256
	Depth-max. (ft)	10	15	24	38	60	88	111	985
	TP (ppb)	9	10	14	19	27	36	46	441
	Chl-a (ppb)	2	2	3	4	7	13	21	417
	Secchi (m)	1	1	2	3	4	5	6	1,244
NCHF[1]	Area (acres)	9	16	50	159	376	885	1,585	938
	Depth-max. (ft)	5	8	16	29	47	70	83	753
	TP (ppb)	15	18	26	52	108	220	299	748
	Chl-a (ppb)	3	4	7	19	43	80	118	743
	Secchi (m)	0	1	1	2	3	4	4	932
WCBP	Area (acres)	19	24	85	234	545	1,314	2,011	115
	Depth-max. (ft)	6	6	7	10	15.5	26.7	33	84
	TP (ppb)	26	51	89	163	250	348	488	91
	Chl-a (ppb)	7	10	30	56	102	178	194	87
	Secchi (m)	0	0	0	1	1	2	2	110
NGP	Area (acres)	90	133	195	392	767	2,116	5,491	34
	Depth-max. (ft)	4	5	7	10	14	22	24	28
	TP (ppb)	45	71	111	149	210	314	326	20
	Chl-a (ppb)	13	24	33	46	70	120	133	20
	Secchi (m)	0.2	0.2	0.4	0.6	1.3	2	2.1	33

[1] NLF summary includes lakes from NMW and NCHF includes lakes from RRV and DA.

For example, a TP concentration of 14 ppb ranks at the 25th percentile for lakes in the NLF and NMW ecoregions, which implies that 75 percent of the assessed lakes in these ecoregions have a

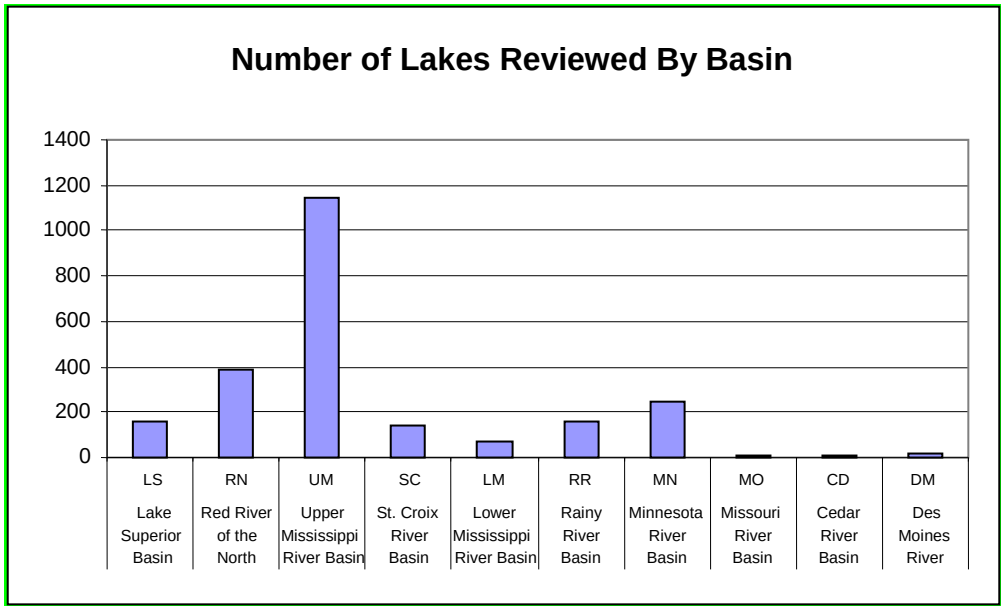
TP > 14 ppb. Number of lakes assessed for that parameter is noted (e.g. for TP in the NLF the distribution is based on 934 lakes).

Table III-9. Trophic Status (Aquatic Recreation Use Only) of Significant Publicly Owned lakes, not including Lake Superior.

Description	Number of Lakes	Acres of Lakes
Total in State	12,167*	**2,863,356***
Assessed	2,343	**2,153,779**
Oligotrophic	321	**171,230**
Mesotrophic	817	**783,633**
Eutrophic	871	**1,065,148**
Hypereutrophic	334	**133,769**
Dystrophic	0	**0**
Unknown	**9,824**	**709,577**

*Ten acres or more in size, not including Lake Superior.

Figure III-7. Number of reviewed lake segments by basin.



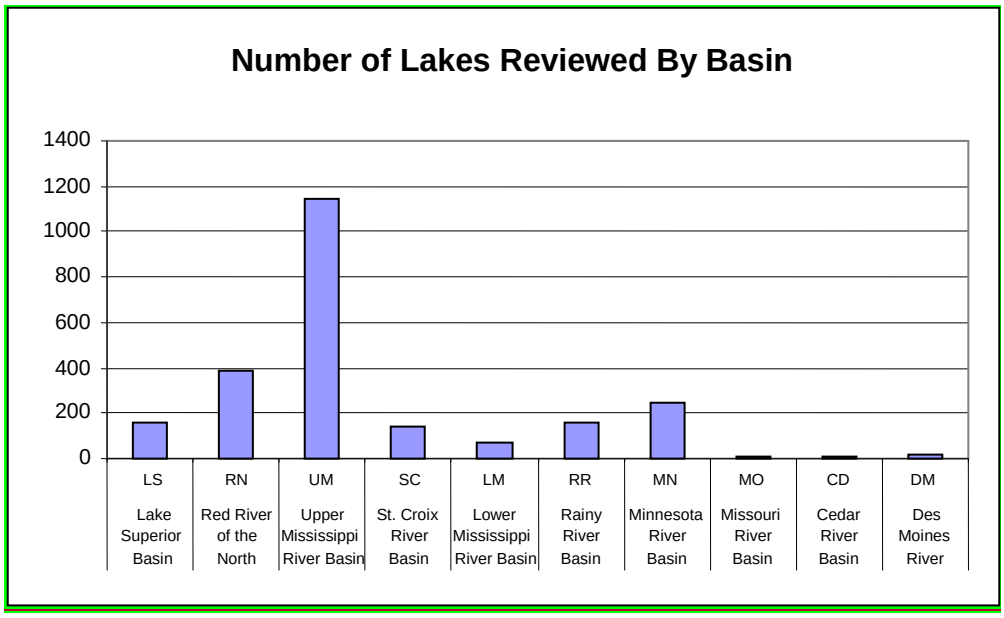
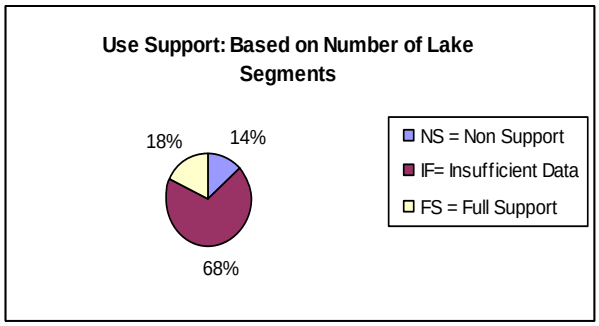
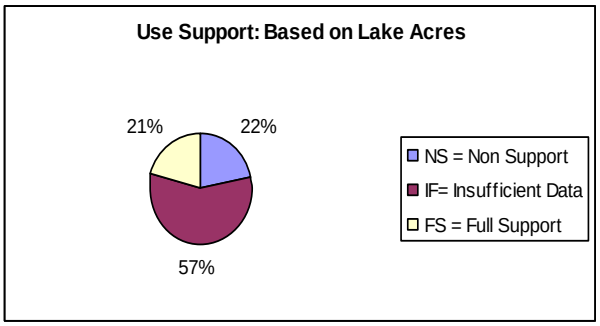


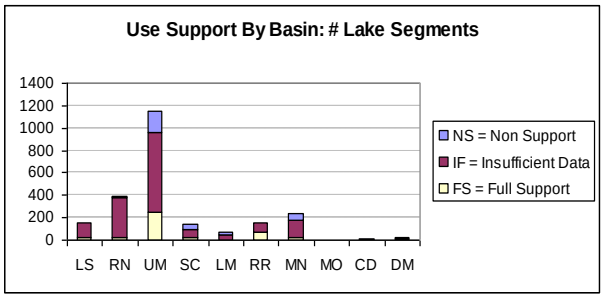
Figure III-8. Aquatic recreational use support by a) state, b) basin, and c) ecoregion

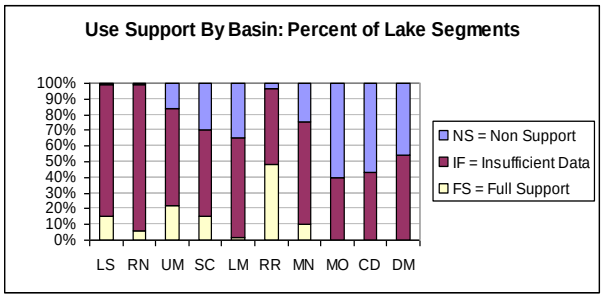
a) State

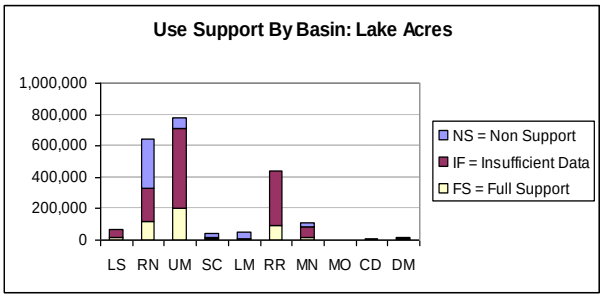


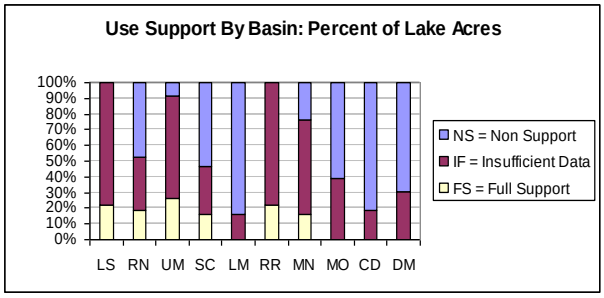


b) Basin

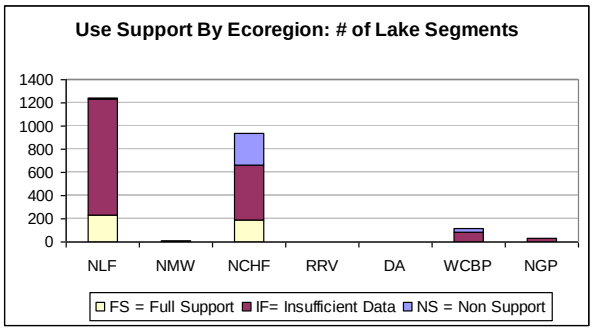


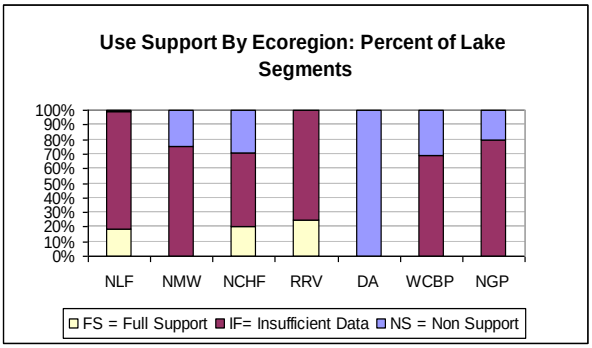


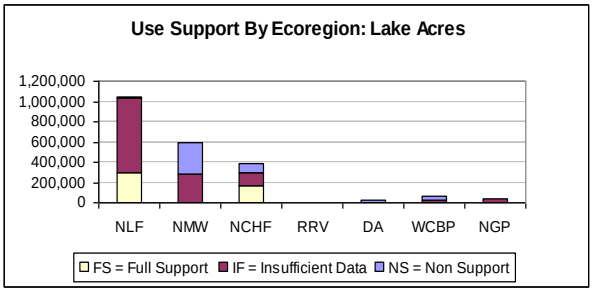


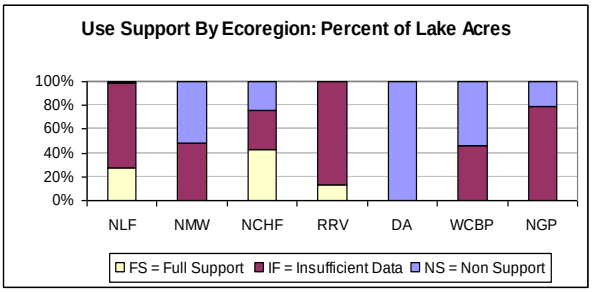


c) Ecoregion









Lake Superior Basin (LS), Red River of the North Basin (RN), Upper Mississippi River Basin (UM), St. Croix River Basin (SC), Lower Mississippi River Basin (LM), Rainy River Basin (RR), Minnesota River Basin (MN), Missouri River Basin (MO), Cedar River Basin (CD), Des Moines River Basin (DM)

Lake Superior Basin (LS), Red River of the North Basin (RN), Upper Mississippi River Basin (UM), St. Croix River Basin (SC), Lower Mississippi River Basin (LM), Rainy River Basin (RR), Minnesota River Basin (MN), Missouri River Basin (MO), Cedar River Basin (CD), Des Moines River Basin (DM)

SOURCES

The examination of use support by ecoregion may provide more insight than the basin-based comparisons, since the thresholds used in the assessment are ecoregion-based and the underlying characteristics that comprise the ecoregions-- land use, soil type, potential natural vegetation and landform can-- strongly influence the delivery of nutrients to the lake. The NLF and NMW ecoregion tend to have higher percentages of lake segments that are fully supporting than ecoregions found in less forested areas of the state (Figure III-8c). These two ecoregions are characterized by moderately deep lakes (Table III-8) and watersheds dominated by forest and wetland uses. However, as noted in Figure III-8c, in 2008 Lake of the Woods (a large, shallow lake) was listed as impaired and as a result the NMW ecoregion does not exhibit the expected pattern. In contrast, the lake segments in the WCBP and NGP ecoregions have a higher percentage of waters that are non-supporting of aquatic recreational uses. The lakes found in the NCHF ecoregions tend to have significant percentages of both fully and non-supporting lake segments for aquatic recreation use. This ecoregion is a transitional zone between the forested regions of northern Minnesota to the more agricultural regions of southern and western Minnesota. The reasons for NS of aquatic recreational use vary between regions. Northern Lakes and Forests ecoregions lakes that do not support aquatic recreational use are often smaller and shallower than the norm and often have some past or present sources of excess P loading in their watershed, such as a WWTP discharge. In the WCBP and NGP ecoregions, the vast majority of lakes are quite shallow (Table III-8) and have highly agricultural watersheds. Runoff from these agricultural lands is typically very high in P. This high P loading from the watershed and shallowness of the lakes (which promotes poor retention of P by lake sediments and internal recycling of P) typically lead to high in-lake P concentrations and, subsequently, nuisance algal blooms and low transparency. The combination of high watershed P loading and the limited assimilative capacity of shallow lakes often limit the degree to which WQ of these lakes might be improved. Northern Central Hardwood Forest ecoregion lakes that do not support aquatic recreational use are often shallower than the norm. Also they often have a source (or multiple sources) of excessive P loading in their watershed such as WWTP, numerous feedlots, excessive land application of bio-solids, high percentage of agricultural land use, or high percentage of impervious area (receive larges amounts of stormwater run-off). All of these sources can contribute high P loading to a lake.

http://www.pca.state.mn.us/water/lakequality.html#reports - This includes the Lake Water Quality Assessment (LWQA): Developing Nutrient Criteria report and the general LWQA report as well.

http://www.pca.state.mn.us/water/lkwqSearch.cfm - This allows for the individual search for lakes in Minnesota.

http://www.pca.state.mn.us/water/nonpoint/nsmpp-ch4-2.pdf - This is MPCA's Section 319 Strategy.

Chapter Five: IMPAIRED WATERS LIST

CURRENT STATUS

The table below contains the pollutants listed in the MPCA's Draft 2008 TMDL List and the number of impairments in streams and lakes caused by each. Only 14 percent of river miles and 18 percent of lakes in Minnesota have sufficient data for the MPCA to determine whether they are impaired. Details on the draft 2008 impaired waters list is contained in the 2nd column.

Bioaccumulative toxics include PCBs, dichlorodiphenyltrichloroethane, dieldrin, dioxin, PFOS, and toxaphene. Impairments due to Hg in water and fish tissues account for 62 percent of the bioaccumulative total and 20 percent of all the impairments on the draft 2008 TMDL List.

Pollutant	2006 Approved List # impairments	2008 Draft List # impairments
Ammonia	8	**5**
Bioaccumulative toxics & Mercury	1469	**478**
Chlorides	4	**6**
Excess nutrients	208	**329**
Fecal coliform	163	**147**
Impaired biotic communities	144	**154**
Low dissolved oxygen	54	**62**
pH	5	**10**
Temperature	1	**1**
Turbidity	218	**283**
TOTAL	**2274**	**1475**

A separate 303(d) impaired waters list is being submitted to USEPA, but it is MPCA's intent to use Version 21.4 of the USEPA Assessment Database (ADB) for integrated reporting. The Category 5 assessment units (AUs) in the ADB will match with the submitted impaired waters list.

PUBLIC PROCESS FOR THE IMPAIRED WATERS LIST

For the approved 2006 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*, plus letters were again mailed to more than 300 individuals and groups.

For the draft 2008 impaired waters list, the draft list was placed on the MPCA Web site on September 11, 2007. The public was informed by a statewide MPCA press release and letters to over 450 individuals and groups on the MPCA TMDL mailing list. Nine public meetings were held between September 27 and October 29, 2007. The 30-day formal public comment period was between October 8 and November 7, 2007.

WHAT IS A TMDL STUDY?

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

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

An impaired water body may have several TMDL studies, each one determining reductions for a different pollutant. After a TMDL is written, a detailed implementation plan is developed to meet the TMDL's pollutant load allocation and achieve the needed reductions to restore WQ. Depending on the severity and scale of the impairment, restoration may require 10-20 years and millions of dollars.

Approximately 400 projects are planned to complete TMDLs on over 1000 impairments for conventional pollutants. As of 2008, 15 TMDL projects for conventional pollutants have been completed, addressing 95 impairments (listings), and another 80 projects are *underway* (covering over 300 listings) Another innovative statewide TMDL that is underway on Hg covers 998 listings (see Hg section below).

- **Strategies the MPCA Employs in Developing the Impaired Waters Restoration Process**

  Clean Water Legacy Act

  To help accelerate Minnesota's efforts to address impaired waters, the Minnesota Legislature adopted the CWLA in 2006. The Act provided additional funding for monitoring and assessment, TMDL development, and restoration activities, as well as created a citizen/state advisory group called the Clean Water Council to administer the Act. Legacy Act appropriations totaled $25 million for FY 2007, and $54 million for FY 2008-2009.

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

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

Using Private Consultants

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

The MPCA normally hires consultants through a state master contract. However, the MPCA also has used contractors hired and funded by the USEPA, and will continue to partner with USEPA 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 Hg deposited from the air in Minnesota comes from other states and countries. Therefore, the traditional TMDL approach to addressing impairments will not work for Hg, as Minnesota can't control the many sources of this toxic pollutant outside our borders.

The MPCA's Hg TMDL was approved by USEPA in March 2007. Implementation planning has been underway since then. Implementation planning will take one to two years,

Strategies to Increase the Effectiveness and Efficiency of TMDL Development and Implementation

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

- Watershed Approaches: The MPCA has several TMDL projects either planned or underway 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).

- Protocol Development: The MPCA is working to better provide technical expertise to MPCA staff and stakeholders on technical work related to TMDLs and restoration projects. For example, guidance or protocol documents have been written by the MPCA

to create more standardized approaches to TMDLs in Minnesota. Guidance documents that are on the agency's Web site include fecal coliform bacteria, DO, turbidity and excess nutrients in lakes. Another protocol addressing TMDLs for biotic impairments should be completed by the end of 2008. The Agency is also applying these protocols to TMDL projects through new standing technical staff teams called "parameter teams." The MPCA is also making great progress on challenging issues related to stormwater TMDLs and the incorporation of TMDL requirements into stormwater permits.

- Coordination with state and federal agencies: The cornerstone strategies of the CWLA is to better fund and utilize *existing* state and federal programs with WQ programs. On the state level, the MPCA is coordinating closely with the MDNR, BWSR, and the Minnesota Department of Agriculture (MDA) on many of these programs. On the federal level, the MPCA is working closely with the Natural Resource Conservation Service, the USGS, and other agencies. Finally, the MPCA has worked with USEPA on direct assistance on some TMDLs, particularly for those impaired waters that Minnesota shares with tribes, other states, and Canada.

Goal Setting and Performance Measurement

The MPCA has set some basic measures for its impaired waters effort that are based on both shorter term administrative (e.g., productivity and cost effectiveness) targets and longer term environmental outcomes. The MPCA is updating its strategic plan in Spring 2008, including revising goals, objectives and measures related to impaired waters. So, these are currently in flux. Also, as required by the CWLA, the Clean Water Council will be recommending measures by the end of 2008 to help the MPCA and other state agencies develop more effective measures for the our impaired waters activities.

- **Relationship of 305(b) Report to 303(d) List**

Introduction

The purpose of the 305(b) report is to convey the use-support status of all surface waters statewide, while the purpose of the 303(d) list is to identify impaired water bodies for which a plan will be developed to remedy the pollution problem(s) (the TMDL). Thus, based on this difference in purpose, when discussing water bodies that do not meet WQS, the term "non-support" is associated with the 305(b) report and the term "impaired" with the 303(d) list.

In 2004, Minnesota initiated an integrated 305(b) reporting and 303(d) listing process, known as the Consolidated Assessment and Listing Methodology (CALM). It followed the *Guidance for 2004 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act* provided by USEPA in July, 2003. For the 2008 reporting cycle Minnesota will use the *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act* dated July 29, 2005 and subsequent Memorandum on Information Concerning 2008 Clean Water Act Sections 303(d), 305(b) and 314 Integrated Reporting and Listing Decisions dated October 12, 2006.

The integrated reporting process establishes that a list of impaired waters be generated on April 1 of every even-numbered year. This time frame coordinates submittal of 303(d) (TMDL) lists with 305(b) reporting and paves the way for using categorization of surface waters as the means for developing a 303(d) list. The categorization of surface waters ties listing of impaired waters to the assessment of the waters of the state and is described in the following section. The integrated process has changed how impaired waters are determined.

In the past, water bodies were considered impaired based on a commonly held conceptual model about the link between 305(b) and 303(d) that the 305(b) report contained the complete and comprehensive list of all water bodies not supporting or partially supporting one or more designated uses. This list of water bodies, assessed as "non-supporting" and "partially supporting" in the 305(b) report, were then passed through a "303(d) filter" which screened out water bodies with insufficient data to meet the more rigorous, site-specific data requirements associated with the 303(d) listing requirements. The water bodies that made it through the "filter" constituted a shorter 303(d) (TMDL) list of impaired waters. The 303(d) "filter" was composed of any additional data or information required for the 303(d) assessment to arrive at an impairment determination.

Under this model the 303(d) list was always a subset of the 305(b) list of non- and partially supporting waters. Generally, this model held true for the assessment of lakes for nutrient enrichment, but it did not hold true for the assessment of rivers and streams. This model broke down for rivers mainly because water bodies could be determined to be impaired and listed on the 303(d) list, based on data not used in the 305(b) reporting. This difference reflected the use of local or site-specific data, as well as statewide data, in 303(d) assessments versus the use (in general) of mostly statewide data in the 305(b) reporting. For example, in 1998 data for bioaccumulative pollutants collected in St. Louis Bay were used just in 303(d) but not 305(b) reporting (MPCA 1999).

The integration of 303(d) listing and 305(b) reporting has changed the assessment process for rivers and streams by considering all available data in a ten year window of data. Since the 303(d) list of impaired waters comes directly from the categorization of assessed waters there is no separation of mostly statewide data used for 305(b) reporting and local or site-specific data used in the past for 303(d) listing. All available data are used to develop the assessments and identify any new impaired segments for the most current draft 303(d) list. This integration does not change how lakes are assessed for nutrient enrichment because the methodology requires a certain amount of data be available to consider a lake impaired for the purposes of 303(d) listing.

Integration does affect how surface waters are categorized for purposes of 305(b) reporting. Data used for both the 305(b) report and the 303(d) list need to be adequate, both with respect to quality and quantity. However, as indicated, water bodies may be categorized in the 305(b) report to reflect non- and partial support, where additional data must be collected before a definitive impairment categorization for the 303(d) list can be made. In general, these water bodies are placed in subcategories of Category 3 to allow the state to differentiate between non- and partially supporting waters, and potentially supporting waters for the purposes of future monitoring. Table III-10 summarizes, in general, the types and sources of

data used in the two assessments. Note in the table that the same types of data are used to identify both candidates and “finalists” for the 303(d) list.

Table III-10. Generalized Summary of Data and Information Used for the 305(b) Report and Determination of Impairment for the 303(d) List.

Type or Source of Data or Information	Used in Assessments for:		
	305(b) Report	Candidate for 303(d)	303(d) List
Milestone stations, and other chemistry data	Y	Y	Y
Clean water partnership - rivers	Y	Y	Y
Clean water partnership - lakes	Y	A	A
Lake Assessment Program	Y	A	A
Citizens Lake Monitoring Program (Secchi disk)	Y	A	A
Citizens Stream Monitoring Program (Transparency tube)	Y	Y	Y
Bio-monitoring (indices of biotic integrity)	Y	Y	Y
Chemistry data which is part of bio-monitoring	A	A	A
Fish tissue contaminants (fish consumption advise)	Y	Y	Y
Metals data obtained using clean technique	Y	Y	Y
Lakes – single data point = 1-0-0, 0-1-0 or 0-0-1***	Y	N	N
Lakes – minimum data = 10-10-10***	Y	Y	Y
Local studies for specific pollutants	Y	Y	Y

Y = Yes, data can be used independent of other data in assessments
N = No, data is not used
A = Associated, data is used only in association with other data/information
***1-0-0 and 10-10-10 mean data points for TP, chl-a and SD, respectively. The single data point may be for any one of the three variables. Some lakes may be determined to be impaired with slightly less data, on a case-by-case basis.

- **Integration of 305(b) and 303(d)**

  As alluded to in the previous section, the process of 303(d) listing and 305(b) reporting of assessed surface waters has been integrated following the guidance provided by USEPA (USEPA 2005 & 2006). It begins with the collection and assessment of all available data within a ten year window of data using the guidelines in this or subsequent guidance to make determinations of impaired, not impaired, insufficient information, or not assessed for each AU based on use support assessments. An AU is defined as a surface water body or portion thereof for which monitoring data are available.

  Once an assessment has been made, the AU is categorized into one of the five main categories or sub-categories. The categorization of an AU occurs automatically within the ADB (Version 2.2 or later) provided by USEPA and is based on the data provided. The use of ADB V2.2 allows for a variety of different approaches to categorizing an AU. Minnesota is continuing with an overall categorization per AU for 2008 reporting. In addition, the ADB allows states to apply their own categorization to each AU and Minnesota uses the following state categories or subcategories to identify the overall assessment status of each AU, which is intended to aid in determining future monitoring scheduling.

Category/ Subcategory	Description
	• All designated uses are met and no use threatened.
2	Some uses are met; none are threatened and insufficient data to assess other uses.
3A	No data or information to determine if any designated use is attained.
3B	Sufficient data are available for a 305(b) assessment of NS, but insufficient data and information to determine TMDL impairment. (Example: single lake data point showing NS)
3C	Data available that currently has no assessment tools to allow its use in assessing. (Example: data with only eco-region expectation standards)
3D	Sufficient data are available for a 305(b) assessment of full support, but insufficient data and information to assess for Category 1 or 2. (Example: non-corroborated transparency tube data showing support)
3E	Sufficient data are available for a 305(b) assessment of partial support, but insufficient data and information to determine TMDL impairment. (Example: lake data just below the threshold showing NS.)
4A	Impaired or threatened but all needed TMDLs have been completed.
4B	Impaired or threatened but doesn't require a TMDL because it is expected to attain standards in the near future.
4C	Impaired or threatened but doesn't require a TMDL because impairment not caused by a pollutant.
4D	Impaired or threatened but does not require a TMDL because impairment is a result of natural causes.
5A	Impaired or threatened by multiple pollutants and no TMDL plans approved.
5B	Impaired or threatened by multiple pollutants and either some TMDL plans approved but not all or at least one impairment is the result of natural conditions.
5C	Impaired or threatened by one pollutant.

All AUs falling into Category 5 become the 303(d) (TMDL) list. This list is subject to review and public comment before submittal to USEPA, which may result in the reassessment of a particular AU into one of the other categories.

D. Levels of Use Support – 305(b) and 303(d)

The purpose of meeting WQS is to protect the beneficial uses associated with the standards. See Section III Chapter One for a description of the beneficial uses. All surface waters in Minnesota are protected for the beneficial uses of aquatic life and recreation. To accomplish this in the integrated process, three use supports are assessed. These use supports are identified as aquatic life, aquatic consumption, and aquatic recreation.

The AQL assessments are aimed at protecting the organisms that reside in the surface waters of the state, while the AQC's goal is to protect consumers of the aquatic life. This allows the integrated process to include in the 305(b) portion site-specific data formerly used only in the 303(d) listing process such as fish consumption advisories.

The AQR is assessed for protection of recreation in surface waters. The combined assessments of these three use supports are aimed at being consistent with the goal in the CWA that the nation's waters should be "fishable and swimmable" wherever attainable.

Based on the review of the WQ data and other relevant information compared to the standards for a given pollutant or WQ characteristic, the use supports may be assessed as:

Fully supported,
Partially supported,
Not supported (= non-support) or
Not assessed.

As stated previously, an AU's overall integrated assessment is impaired, not impaired, insufficient information, or not assessed based on the worst case use support assessment. An overall not impaired assessment implies that no use support was assessed as partially or not supported and at least one use support was assessed as fully supporting. An overall impaired assessment indicates that at least one use support is not supported or at least one use support was assessed for 305(b) purposes as non- or partially supported and secondary analysis indicated enough data were available to assign an overall impairment assessment. A not assessed overall assessment occurs when no data are available to make any use support assessment, subcategory 3A. An insufficient information assessment generally was reserved for AUs placed in subcategory 3B, 3C, 3D, or 3E.

The categorization of an AU is an added step that occurs in the integrated process. It does not change the way assessments are reported in the 305(b) process. AU **fully supporting** all assessed use supports are listed as "fully supporting" in the 305(b) report and they do not appear on the 303(d) list. Generally, a determination of **partial support** of a use means that the stream or lake segment is listed as "partially supporting" in the 305(b) report, and it **may** be listed as "impaired" on the 303(d) list. For purposes of integrated reporting a water body that is determined overall to be partially supporting, but not impaired is considered to have insufficient data to make an integrated assessment. It would fall into USEPA's Category 3 and is earmarked for additional state monitoring by providing it with a state subcategory of 3E. A determination of **non-support** indicates an impaired condition and the water body is placed on the "not supporting" list for the 305(b) report, and it may go on the 303(d) list. Generally a water body is listed unless a secondary analysis determines there is insufficient information for listing, in which case the water body is placed in subcategory 3B.

A use is considered **not assessed** if there are insufficient or no data to determine support. For some assessments, lake eutrophication for example, the "partial support" category is a trigger for further analysis of that water body before an impairment decision is made (if it meets minimum data requirements). The term **potentially supporting** may be initially used in assessing impairment of aquatic recreation use (fecal coliform bacteria), where a two step screening process is applied to determine whether there is adequate data to make an assessment of partial or NS. The MPCA plans in the future to maintain a list of water bodies for which insufficient data are available to make a complete assessment, but the available

data suggest some impairment. This list will help establish priorities for allocating future monitoring resources.

E. Data Used for Both 305(b) and 303(d) Assessments

In general, the assessment of data for conventional WQ characteristics of streams, such as DO, turbidity, and fecal coliform, and for two frequently measured toxic pollutants, un-ionized ammonia (NH_3) and chloride, requires the same quantity and quality of data for a determination of impairment for both the 305(b) report and the 303(d) list. Beginning with the 2006 assessment process was the use of citizen stream monitoring data. These data are transparency tube readings used as a surrogate measure for turbidity. For the 2008 reporting process additional TSS data were used as a surrogate for turbidity for the determination of use support in the NCHF ecoregion .

Data for trace metals (arsenic, cadmium, chromium, copper, lead, Hg, nickel, selenium, and zinc) must be collected using "clean" techniques for both the 305(b) and 303(d) assessments. Metals data collected without the use of the more rigorous clean techniques may be used as a screening tool to identify sites where additional monitoring may be needed.

The biological monitoring program includes limited chemical monitoring as well as habitat assessment. The chemical data are rarely used for either 305(b) or 303(d) assessments because of the small amount of data provided. Habitat data are used to support the biological data. These data are taken into consideration during the professional judgment phase of the 303(d) listing process (Table III-10).

F. Data Used Only for 305(b) Assessments

USEPA encourages states to assess as many water bodies as resources permit when preparing the 305(b) report, recognizing that there are various levels of confidence associated with assessments involving varying quantities of data. To that end, and to facilitate the integrated assessment process, all available data within a ten year window beginning in the water year 12 years prior to the reporting year are considered initially for 305(b) including site-specific data formerly used only for 303(d) assessments. Absent for the 2008 reporting cycle are assessments based on what were referred to as 'evaluated' lake data that was older than the ten year window of data (referred to as 'monitored' data).

Assessments for lake eutrophication for the 305(b) report can be based on fewer observations and data for fewer variables than are required for 303(d) listing. In fact, a preliminary 305(b) assessment may be based on a single value for TP, chl-a or SD. Similarly, a preliminary 305(b) assessment for turbidity can be based upon 20 observations of any combination of transparency, TSS, and turbidity when professional corroboration of stream transparency tube data is not available. This information provides a useful screening tool for persons concerned about a particular lake or stream.

Currently lakes less than 10 acres in surface area are generally not placed on the 303(d) list for excess nutrients. If such sized lakes having data within the ten year window of data are reviewed, an assessment for 305(b) only would be reported.

G. Data Used Only for 303(d) Assessments

As indicated in Section F, all data within a ten year window beginning in the water year 12 years prior to the reporting year are considered for 303(d) reporting in the integrated assessment process, except where data do not meet the minimum data requirements (See Table III-10). In addition, a draft 303(d) list will include listings from the previous cycle's final approved TMDL List that were not de-listed, removed by correction, or for which a TMDL plan was approved. These inclusions may be referred to as carry forwards and may not reflect the data for the same use supports or pollutant parameters as are found in the ten year window used for the current 305(b) assessments. In such cases there might be differences in reporting between the 305(b) overall assessments and the 303(d) listings.

H. Data Quality

The integrated assessment process requires a quality rating or confidence level be assigned to the data used to make use support assessments. The rating options available in the ADB are low, fair, good, or excellent for each type of data (physical/chemical, biological, pathogens, etc.). In an effort to use "all available data" in the integrated process Minnesota conducted a public call for data in 2006 to obtain data from stakeholders. Use support assessments are carried out separately for lakes and streams and the rating process for each type of assessment is as follows:

1 Data quality for lake assessments

The data used in these assessments was derived from STORET, so we assume that certain "quality control" thresholds were already established for the data. Hence our definition of "quality" will focus on the relative amount of information available for the assessment (see Table III-3). In the case of our aquatic recreational use assessments, TP is the primary variable used so we place the greatest emphasis on the amount of TP data available for the assessment. The "quality" terms were drawn from USEPA guidance. In general, we feel that assessments based on multiple measurements are more reliable than those based on only a few measurements. The rationale for assigning the respective "quality" definitions corresponds roughly to typical lake-monitoring regimens (e.g. monthly sampling during the summer season), whereby four TP samples often represent one summer; eight samples two summers and 12 samples three summers. In the case of 303(d) assessments, 10 or more TP, chl-a and Secchi measurements are usually required to determine if a lake should be placed on the 303(d) list, and was considered "excellent" quality data for assessment. In general, the thresholds were similar for the "monitored" (recent) and the "evaluated" (old) data with the exception that there would be no "excellent" evaluated data as these data are more than ten years old.

2 Data quality for stream assessments

The data for stream assessments include data drawn from STORET as well as other data that are made available through a specified cut off date. The cutoff date will depend on when the date of the first PJG assessment meeting is scheduled and will occur early enough to allow for the compilation of pre-assessment data before the meeting. The quality of data used in these assessments is based on the four-tiered rating system available in the ADB with a rating assigned to each type of data used in each use support assessment. For AQL data quality ratings are:

- Excellent – both biological and physical/chemical data available;
- Good – either biological or physical/chemical data available in sufficient quantities, which the PJG deems enough to make a good assessment;
- Fair – physical/chemical data available in sufficient quantities, which the PJG deems enough to make a fair assessment; and
- Low – only a few physical/chemical parameters available in minimum quantities needed to make an assessment.

Aquatic consumption use support assessments at this time use fish consumption advisory data from the MDH, which we have assigned a 'good' quality rating.

For AQR data quality ratings, some general guidelines are given below.

- Excellent – 6-7 months of data with at least 5 observations;
- Good – ~3-5 months of data with at least 5 observations;
- Fair – ~1-2 months of data with at least 5 observations; and
- Low – no months with at least 5 observations, very few additional data points above the minimum 10 required.

In addition, other factors considered in rating the quality of aquatic recreation data include looking at the dates when samples were collected (years and months). A lower quality rating is generally given where all the data are collected in one calendar year and/or where the dataset does not include months that typically have higher fecal coliform counts (June – September).

I. Wetlands Update

Minnesota has an estimated 9.2 million acres of wetland, which comprises about 1/6th the area of the state. Regulating, monitoring and assessing this large and diverse resource presents many challenges. Numerous programs and increasing cooperation among local, state, federal and nongovernmental partners are beginning to pay dividends in protecting wetland and watershed integrity in Minnesota.

Regulatory Overview

In a Sept. 7, 2005 letter to his Clean Water Cabinet, Minnesota Governor Tim Pawlenty recommended a reassessment of Minnesota's commitment to the no net loss of wetlands policy and specifically suggested a review of the regulatory mechanisms within the WCA. In response to the Governor's letter, the BWSR led a rigorous assessment of the WCA with significant input by a diverse workgroup of stakeholders throughout 2006. Several preliminary recommendations were made regarding changes needed within the WCA and during the 2007 legislative session authority was granted to BWSR to undertake emergency rulemaking to quickly implement some of the WCA recommended changes. There were four primary areas of WCA improvement that were acted on within the WCA emergency rulemaking: 1) reporting and accounting of activities affecting wetlands; 2) changes to the WCA exemptions; 3) revisions to wetland replacement regulations; and 4) WCA program administrative changes. More information is available from the BWSR at WCA Assessment. Interim emergency rules were adopted in August in 2007. The BWSR is now beginning permanent WCA rulemaking which is expected to take approximately two years.

In parallel with the WCA assessment, specific wetland mitigation issues were raised by the St. Paul District Army Corps of Engineers (COE) in response to national policy initiatives and regional needs to improve wetland mitigation outcomes. In May 2007, the BWSR and the COE signed a Memorandum of Understanding (MOU) to implement revised wetland mitigation guidance. This guidance focused on proposals to work toward agreement in six areas:

Criteria for the use of preservation as a wetland mitigation option;
Mitigation credit for stream restoration;
In lieu fee mitigation;
Definition of in kind, in place, and in advance for wetland mitigation;
Options for mitigation credit, including credit for WQ treatment areas; and
Mitigation ratios.

In accordance with this MOU, the COE and BWSR will continue to work to bring their respective regulatory program policies into closer agreement.

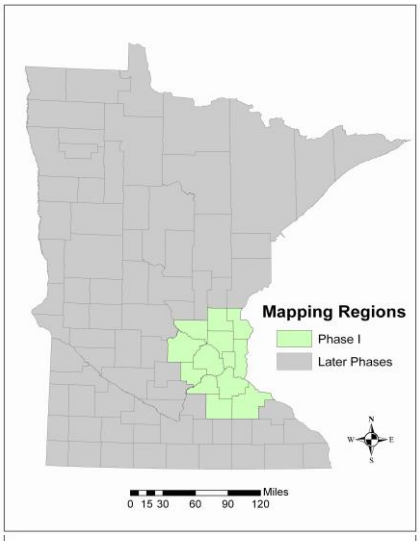


Figure III-9. Proposed initial NWI update in Phase I proposal

NWI update in Phase I proposal

Minnesota Department of Natural Resources Enforcement Flights

Beginning in 2006 MDNR Division of Enforcement began using focused summer and fall aerial surveys with Conservation Officers who specialize in wetland resource violations to look for potential wetland/water violations. In 2006, a total of 542 possible wetland impacts were identified, of which ground investigation found 315 to be

actual wetland impacts requiring additional actions. Nearly 50 percent of these (148) were violations of the WCA. These enforcement flyovers have been named "Birds Eye View" and have, thus far, focused on approximately a dozen Northern and North Central Minnesota counties. MDNR Enforcement Officers plan to continue Birds Eye View for the foreseeable future.

Wetland Assessment, Monitoring and Mapping

Significant progress has been made toward being able to assess whether state policy to achieve a "no net loss" and to increase the, "quantity, quality and biological diversity of wetlands in the state" (Minn. Statutes 103A.201) has been met. The Comprehensive Wetland Assessment, Monitoring and Mapping Strategy (CWAMMS), completed in 2006, recommended three integrated approaches to improve wetland assessment and inventory.

Implement an online geo-referenced wetland integrated permitting and restoration accounting system.
Update Minnesota's 1,745 7.5' quadrangles of digital NWI which in most cases is based on 25 year-old or older data.
Implement statewide surveys with high precision to assess wetland quantity and quality status and trends.

A business plan design model is currently being constructed to develop a geo-referenced wetland permitting and restoration accounting system. The BWSR is leading this development work.

In December 2007, the Legislative Citizens Commission on Minnesota's Resources recommended funding the MDNR $550,000 proposal for the initial phase of updating the state's NWI. This recommendation needs approval from the full legislature before becoming official, likely beginning July 1, 2008. This Phase I proposal includes a wetland mapping research and development component with the University of Minnesota Remote Sensing Laboratory and proposes to begin updating the wetland inventory within 13 counties in east-central Minnesota (Figure III-9) encompassing the Twin Cities metropolitan area.

In 2006, Minnesota began collecting baseline data from nearly 5000 random one mi^2 survey plots for a statewide probabilistic survey to assess status and trends of wetland quantity and quality. Following collection of baseline data this comprehensive survey will yield vital data on trends of wetland quantity and quality in Minnesota. Collection of wetland quality data stratified by Level II Omernick Ecoregions (Figure III-10) began in 2007. Status and trends in wetland quality are expected to be reported by ecoregion beginning in late 2008.

Indicator Development

Minnesota is following USEPA guidance which recommends wetland assessment using landscape, rapid- and intensive-site indicators (Level I, II and III). Within the wetland assessment community there are two fundamental "schools of thought" regarding wetland functional and wetland condition assessment. Functional assessment evaluates what "goods

and services" wetlands provide given their landscape setting and position. In contrast to functional assessment, condition assessment evaluates wetland ecological integrity or the deviation of the wetland from a least impacted state. Effective wetland management can make use of both assessment approaches and as such Minnesota recognizes the need to develop Level I, II and III indicators for both functional and condition assessment.

In a pilot Level I condition assessment project to examine use of the Landscape Development Index (LDI) in the NCHF ecoregion of Minnesota the MPCA found the LDI to correlate well with wetland Indices of Biological Integrity (IBI) and thus MPCA believes LDI has potential as a Level I assessment method. Further testing and validation of LDI with additional datasets was recommended and is planned.

A Level II functional assessment method, the Minnesota Routine Wetland Assessment Method; (MnRAM) has been developed and implemented for regulatory and comprehensive wetland management planning. An interagency workgroup continues to maintain and update MnRAM and MnRAM version 3.1. In addition, the MPCA is in the early stages of developing a Level II condition assessment method. This indicator is likely to be plant based and will be designed to apply to all wetland classes and be applicable for multiple wetland protection and assessment programs. An interagency workgroup, coordinated by the MPCA has convened to direct this work.

Depressional wetland IBIs (Level III condition assessments) based on invertebrates and vegetation have been developed for all three Omernick Level II ecoregions in Minnesota (Figure III-10). Final IBI 303(d) assessment criteria have been developed for depressional wetlands within the Mixed Wood Plains. Assessment criteria are still preliminary in the two other ecoregions.

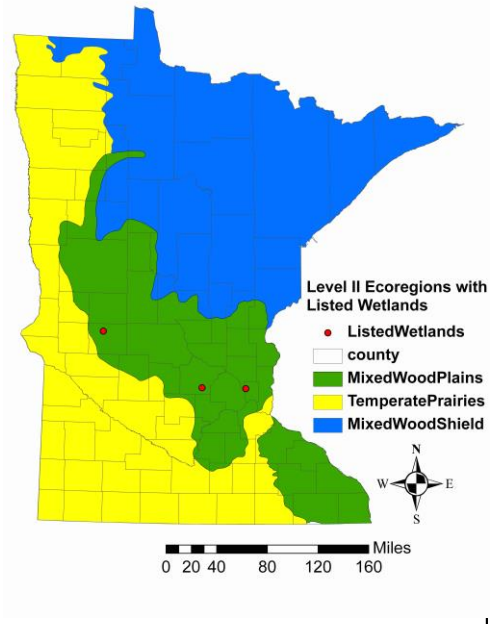


Figure III-10. Geographic framework for IBI condition assessment with 2008 listed wetland locations.

In 2007, an interagency workgroup, led by the COE in cooperation with Minnesota State University, Mankato began development of an organic flats hydrogeomorphic (HGM) assessment guidebook targeted at the Anoka Sand Plains region in Central Minnesota. Field work for model development and testing for this HGM guidebook is planned for 2008. Once developed, this guidebook will be the second HGM assessment model applicable to Minnesota wetlands. The first Minnesota applicable HGM guide is for Prairie Potholes. HGM assessment guides are recognized as Level III functional assessment indicators.

Wetland Assessment and Reporting

The *2007 MPCA Guidance Manual for Assessing the Quality of Minnesota Surface Waters: determination of impairment 305(b) report and 303(d) list (*2007 MPCA Guidance*)* includes guidelines for wetland biological assessment. As discussed in the *2007*

MPCA Guidance per stakeholder recommendations, the MPCA will only list impaired wetlands under 303(d) when monitoring data: 1) demonstrated an impaired condition, and 2) the assessed wetland was hydrologically connected to a known impaired lake or stream. Three depressional wetlands with appropriate monitoring data (Figure III-10) meet these criteria and are included on the draft 2008 Section 303(d) list (Table III-11).

Lake Jones is situated within the Twin Cities urban landscape and receives urban stormwater as well as having history of adjacent industrial activities. Trappers is situated within an agricultural landscape in West Central Minnesota and receives agricultural drainage water as well as an upstream small wastewater treatment discharge. Woodland occurs in a rapidly urbanizing agricultural landscape west of the Twin Cities Metropolitan area. It also has an agricultural drainage ditch running through the middle of it as well as a moderate sized municipal wastewater discharge directly to the wetland. Woodland is owned and managed by the MDNR as a wildlife management area.

Table III-11. IBIs results for impaired depressional wetlands proposed on the 2008 draft 303(d) list. Bolded IBI results indicate aquatic life impairment.

AUID	MPCA ID	Area (acres)	County	Invertebrate IBI Impairment Criteria	Invertebrate IBI Result	Plant IBI Impairment Criteria	Plant IBI Result
62-0076-00	Lake Jones	33.6	Ramsey	49	**43**	42	**3**
61-0522-00	Trappers	26.8	Pope	49	**35**	42	56
86-0085-00	Woodland	617	Wright	49	No sample	42	**21**

Wetland Citizen Monitoring—Wetland Health Evaluation Program

The MPCA has continued to cooperate with Dakota and Hennepin Counties in the Twin Cities Metropolitan area in their coordination of citizen wetland monitoring using simplified invertebrate and plant IBIs. This cooperation has evolved into the Wetland Health Evaluation Program (WHEP). This cooperative program has been in operation since 1996 in Dakota County and since 2000 in Hennepin County. In 2006 nine city teams participated in WHEP in Dakota County and four cities and two commissions participated in WHEP from Hennepin County.

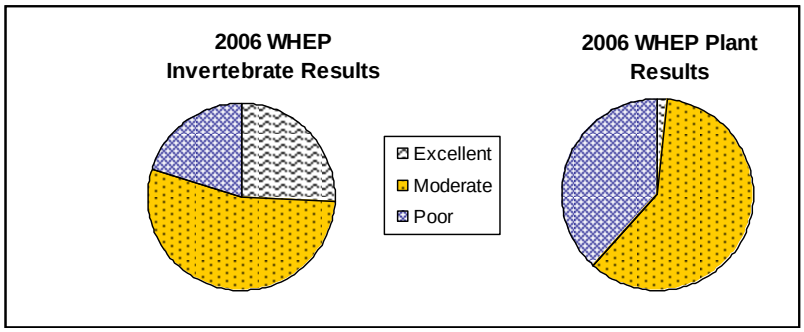


Figure III-11. WHEP citizen wetland monitoring - 2006 results. WHEP indicators are simplified IBIs suitable for citizens.

Local sponsoring cities have found the data useful in their wetland management programs. Several of the communities, including the City of Lakeville, are using the WHEP data to track before and after development conditions in some of the wetlands they selected for monitoring. Another common use of WHEP data, for example, by the city of Eagan, is to evaluate the success of BMP implementation. During 2006 WHEP teams sampled 60 wetlands which comprised over 600 acres in these two large metropolitan counties. Sites are selected for WHEP sampling based on recommendations made by sponsoring City Water Resource Managers based on their needs to collect data for various management decisions or evaluations. Figure III-11 illustrates the proportion of wetlands rated as poor, moderate, and excellent for both the invertebrate IBI and the plant IBI. The invertebrate results present a fairly balanced distribution of wetlands across the three condition categories. In contrast, the plant results present a skewed distribution toward poor quality wetlands. The invertebrate and plant IBIs are independent results. Dakota and Hennepin County are both within the Twin Cities metropolitan area. Thus wetlands assessed in WHEP occur within an urban or developing urban land use. Roughly eight percent of the WHEP sampled wetlands occur within regional or local parks where they don't have constructed inlets and less than ten percent impervious surface within their watersheds.

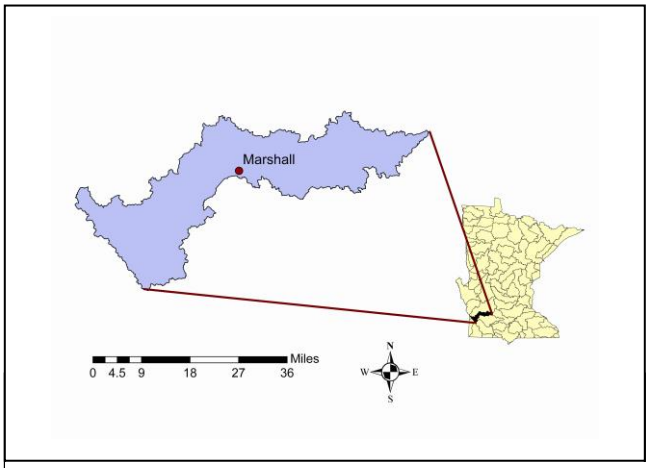


Figure III-12. Redwood River Watershed

Figure III-12. Redwood River Watershed

Redwood River Watershed Probabilistic Survey

In 2003, the MPCA conducted a probabilistic survey of seasonal, semi-permanent, and permanently flooded depressional wetlands in the Redwood River Watershed in southwestern Minnesota (Figure III-12). Row crop agriculture is the dominate land use and there has been much corresponding wetland drainage in this watershed. This survey included both wetland

quality and wetland quantity results. Only wetland quality results are presented here. The complete report Assessing the Quantity and Quality of Depressional Wetlands in the Redwood River Watershed Utilizing a Probabilistic Sampling Design is available online. Invertebrate and plant IBIs were the indicators used to evaluate wetland condition. The invertebrate IBI was not able to evaluate seasonal wetlands and thus estimates derived from the invertebrate indicator are based on a sample of 25 semi-permanent and permanent wetlands. The plant IBI was able to evaluate seasonal, semi-permanent and permanent wetlands; therefore estimates derived from the plant IBI area based on a sample of 40 depressional wetlands. Table III-12 presents results for this watershed survey including results by area and estimated number of basins by invertebrate and plant indicators as well as overall with both indicators combined. Overall an estimated 2,477 hectare (ha) (91 percent) of wetland area in the watershed is not attaining the aquatic life designated use. This corresponds to an estimated 593 (69 percent) seasonal, semi-permanent and permanent depressional wetland basins not attaining their aquatic life designated use.

Table III-12. Depressional wetland survey results calculated using probabilistic monitoring in the Redwood River Watershed.

Project Name	Assessing the quantity and quality of depressional wetlands in the Redwood River watershed	
Target Population	Depressional wetlands with seasonal, semi-permanent, and permanently flooded water regimes	
Type of Water body	Depressional Wetlands	
Designated Use	Aquatic Life	
Indicator	Invertebrate IBI for semi-permanent and permanent water depressional wetlands Plant IBI for seasonal, semi-permanent and permanent water depressional wetlands	
Assessment Date	Invertebrates (June); vegetation (July) – 2003	
Units of Measure	**AREA (ha)**	**BASINS**
Size of Target Population	2721 ha	864
Precision	95%	95%
Percent **attaining** (by indicator)	Invertebrates** – 47 (3%) Plants – 517 (19%)	Invertebrates** – 21 (14%) Plants – 323 (37%)
Percent not attaining (by indicator)	Invertebrates** – 1761 (97%) Plants – 2204 (81%)	Invertebrates** – 126 (86%) Plants – 541 (63%)
Percent **attaining** (independent applicability)	244 ha (9%)	268 (31%)
Percent not attaining (independent applicability)	2477 ha (91%)	593 (69%)

**Invertebrates were only able to be sampled in 25 of the 40 sampled wetlands which resulted in a total extrapolated area of 1808 ha and 147 basins. Plants were able to be sampled at 40 randomly selected wetlands which resulted in an extrapolated area of 2721 ha and 864 basins.

Chapter Six: TRENDS ANALYSIS

POLLUTANT TRENDS FOR MINNESOTA RIVERS AND STREAMS

The best available information on pollutant trends in rivers and streams comes from Minnesota Milestone sites. These are a series of 80 monitoring sites across the state with high quality, long term data. While the sites are not necessarily representative of Minnesota's rivers and streams, as a whole they do provide a valuable historical record for many of the state's waters. Monitoring results over the period of record, which in some cases goes back to the 1950s, show significant reductions across the state for BOD, TSS, P, ammonia and fecal coliform bacteria. These results reflect the considerable progress made during that time in controlling municipal and industrial point sources of pollution. Nitrite/nitrate levels, on the other hand, show increases at many of the Minnesota Milestone sites, perhaps reflecting continuing nonpoint-source problems. Table III-13 and Figure III-13 through Figure III-18, on the following pages, provide further detail. (Statistical analysis was performed using Excel and Systat software)

Table III-13. Pollutant Trends at Minnesota Milestone Sites

Basin	Station	Length of Record	Biochemical Oxygen Demand	Total Suspended Solids	Total Phosphorus	Nitrite/ Nitrate	Unionized Ammonia	Fecal Coliforms
Cedar - Des Moines	CD-10	1967 - present	decrease	no trend	decrease	increase	decrease	decrease
	CD-24	1967 - present	decrease	no trend	decrease	no trend	decrease	no trend
	OK-25.6	1973 - present	decrease	insuf data	increase	increase	decrease	insuf data
	SR-1.2	1961 - present	decrease	decrease	no trend	increase	decrease	no trend
	WDM-3	1967 - present	no trend	no trend	decrease	increase	decrease	decrease
Lake Superior	BRU-0.4	1973 - present	decrease	insuf data	decrease	insuf data	insuf data	insuf data
	BV-4	1973 - present	no trend	decrease	decrease	no trend	increase	decrease
	KN-0.2	1973 - present	insuf data	decrease	decrease	increase	insuf data	decrease
	LE-0.2	1973 - present	insuf data	decrease	decrease	insuf data	insuf data	decrease
	POP-0	1973 - present	insuf data	insuf data	decrease	insuf data	increase	insuf data
	SLB-1	1974 - present	decrease	decrease	decrease	decrease	no trend	decrease
	SL-9	1953 - present	decrease	decrease	decrease	no trend	decrease	decrease
	SL-38	1953 - present	decrease	no trend	decrease	no trend	decrease	decrease
	SL-110	1967 - present	decrease	no trend	decrease	no trend	no trend	decrease
Minnesota	BE-0	1967 - present	decrease	no trend	decrease	increase	decrease	decrease
	CEC-23.2	1974 - present	decrease	no trend	decrease	increase	decrease	decrease
	CO-0.5	1967 - present	decrease	no trend	no trend	increase	decrease	decrease
	MI-3.5	1974 - present	decrease	no trend	no trend	no trend	decrease	no trend
	MI-64	1955 - present	decrease	no trend	decrease	no trend	decrease	decrease
	MI-88	1955 - present	decrease	no trend	decrease	no trend	decrease	decrease
	MI-133	1957 - present	decrease	no trend	decrease	increase	decrease	decrease
	MI-196	1967 - present	decrease	no trend	decrease	increase	decrease	decrease
	MI-212	1957 - present	insuf data	insuf data	insuf data	increase	decrease	insuf data
	PT-10	1971 - present	decrease	decrease	decrease	increase	decrease	decrease
	RWR-1	1974 - present	decrease	no trend	decrease	increase	decrease	no trend
	WA-6	1968 - present	decrease	no trend	decrease	increase	decrease	decrease
	YM-0.5	1967 - present	decrease	no trend	no trend	increase	decrease	decrease
Missouri	PC-1.5	1963 - present	decrease	no trend	decrease	increase	decrease	decrease
	RO-0	1962 - present	decrease	no trend	decrease	increase	decrease	no trend

Basin	Station	Length of Record	Biochemical Oxygen Demand	Total Suspended Solids	Total Phosphorus	Nitrite/ Nitrate	Unionized Ammonia	Fecal Coliforms
Rainy	BF-0.5	1971 - present	insuf data	decrease	decrease	increase	insuf data	decrease
	KA-10	1967 - present	decrease	decrease	decrease	no trend	no trend	decrease
	LF-0.5	1971 - present	insuf data	insuf data	insuf data	increase	insuf data	decrease
	RA-12	1958 - present	decrease	decrease	decrease	increase	no trend	decrease
	RA-83	1953 - present	decrease	decrease	decrease	increase	no trend	decrease
	RA-86	1974 - present	decrease	decrease	decrease	increase	insuf data	insuf data
	RP-0.1	1971 - present	insuf data	decrease	decrease	increase	decrease	insuf data
	WR-1	1958 - present	insuf data	insuf data	decrease	increase	decrease	insuf data
Red	OT-1	1953 - present	decrease	no trend	decrease	increase	decrease	decrease
	OT-49	1967 - present	decrease	decrease	decrease	insuf data	decrease	decrease
	RE-298	1953 - present	decrease	no trend	no trend	increase	decrease	decrease
	RE-403	1967 - present	decrease	no trend	no trend	increase	no trend	decrease
	RE-452	1971 - present	no trend	increase	no trend	increase	decrease	decrease
	RE-536	1953 - present	no trend	no trend	no trend	increase	decrease	decrease
	RL-0.2	1953 - present	decrease	decrease	decrease	no trend	decrease	decrease
	RL-23	1955 - present	decrease	insuf data	decrease	insuf data	decrease	decrease
	SK-1.8	1971 - present	decrease	insuf data	insuf data	insuf data	decrease	insuf data
	TMB-19	1971 - present	decrease	insuf data	decrease	insuf data	decrease	decrease
St. Croix	KE-11	1967 - present	decrease	decrease	decrease	no trend	decrease	decrease
	SC-17	1967 - present	decrease	decrease	decrease	increase	no trend	decrease
	SC-23	1953 - present	decrease	decrease	decrease	insuf data	insuf data	decrease
	SC-111	1957 - present	decrease	decrease	decrease	no trend	no trend	decrease
	SN-10	1971 - present	decrease	decrease	decrease	insuf data	insuf data	decrease
	SUN-5	1974 - present	decrease	insuf data	insuf data	insuf data	increase	insuf data
Upper Miss -- Lower Portion	CA-13	1953 - present	decrease	decrease	decrease	no trend	decrease	decrease
	GB-4.5	1981 - present	decrease	no trend	no trend	increase	decrease	no trend

Basin	Station	Length of Record	Biochemical Oxygen Demand	Total Suspended Solids	Total Phosphorus	Nitrite/ Nitrate	Unionized Ammonia	Fecal Coliforms
	RT-3	1958 - present	decrease	no trend	decrease	increase	decrease	decrease
	ST-18	1955 - present	decrease	no trend	decrease	no trend	decrease	decrease
	UM-698	1958 - present	decrease	no trend	decrease	increase	decrease	no trend
	UM-714	1962 - present	decrease	decrease	decrease	no trend	decrease	decrease
	UM-738	1974 - present	decrease	no trend	decrease	increase	decrease	no trend
Upper Miss -- Lower Portion (continued)	UM-815	1958 - present	decrease	no trend	decrease	increase	decrease	decrease
	UM-826	1975 - present	decrease	increase	decrease	increase	decrease	decrease
	UM-840	1973 - present	decrease	increase	no trend	increase	decrease	decrease
	VR-32.5	1981 - present	increase	decrease	no trend	increase	decrease	no trend
	WWR-26	1974 - present	decrease	no trend	no trend	increase	decrease	no trend
	ZSF-5.7	1973 - present	decrease	no trend	decrease	increase	decrease	no trend
Upper Miss -- Upper Portion	CR-0.2	1953 - present	decrease	no trend	no trend	increase	decrease	decrease
	LPR-3	1974 - present	no trend	no trend	no trend	increase	decrease	decrease
	RUM-0.6	1953 - present	decrease	decrease	decrease	insuf data	insuf data	decrease
	RUM-34	1955 - present	decrease	decrease	decrease	increase	decrease	decrease
	SA-0	1953 - present	no trend	no trend	no trend	no trend	decrease	decrease
	UM-859	1953 - present	decrease	no trend	decrease	increase	decrease	decrease
	UM-895	1976 - present	no trend	no trend	decrease	increase	decrease	no trend
	UM-914	1967 - present	decrease	no trend	no trend	increase	no trend	decrease
	UM-930	1953 - present	decrease	decrease	decrease	increase	decrease	no trend
	UM-982	1967 - present	decrease	no trend	decrease	increase	decrease	decrease
	UM-1172	1974 - present	decrease	no trend	decrease	increase	decrease	decrease
	UM-1186	1967 - present	decrease	decrease	decrease	increase	decrease	decrease
	UM-1292	1967 - present	decrease	decrease	decrease	increase	decrease	decrease
	UM-1365	1965 - present	decrease	decrease	decrease	increase	decrease	decrease

Milestone sites (having sufficient data) showing:								
Decreasing pollutant trend	**89%**	**41%**	**78%**	**1%**	**83%**	**82%**		
Increasing pollutant trend	**1%**	**4%**	**1%**	**75%**	**4%**	**0%**		
No trend	**10%**	**54%**	**21%**	**23%**	**13%**	**18%**		
Milestone sites (out of 80) having insufficient data:			8	10	4	11	9	9

(Insufficient data means p>.05 and n<80)
((Logs of) TSS, TP, BOD, and fecal coliforms analyzed using Pearson's correlation coefficient and p values; NH_3 and NO_2/NO_3 analyzed using Kendall's Tau B and p values)
(Nov, Dec, Jan, and Feb data not used; NH3 data prior to 1979 not used)

Trends at Minnesota Milestone Sites

Biochemical Oxygen Demand

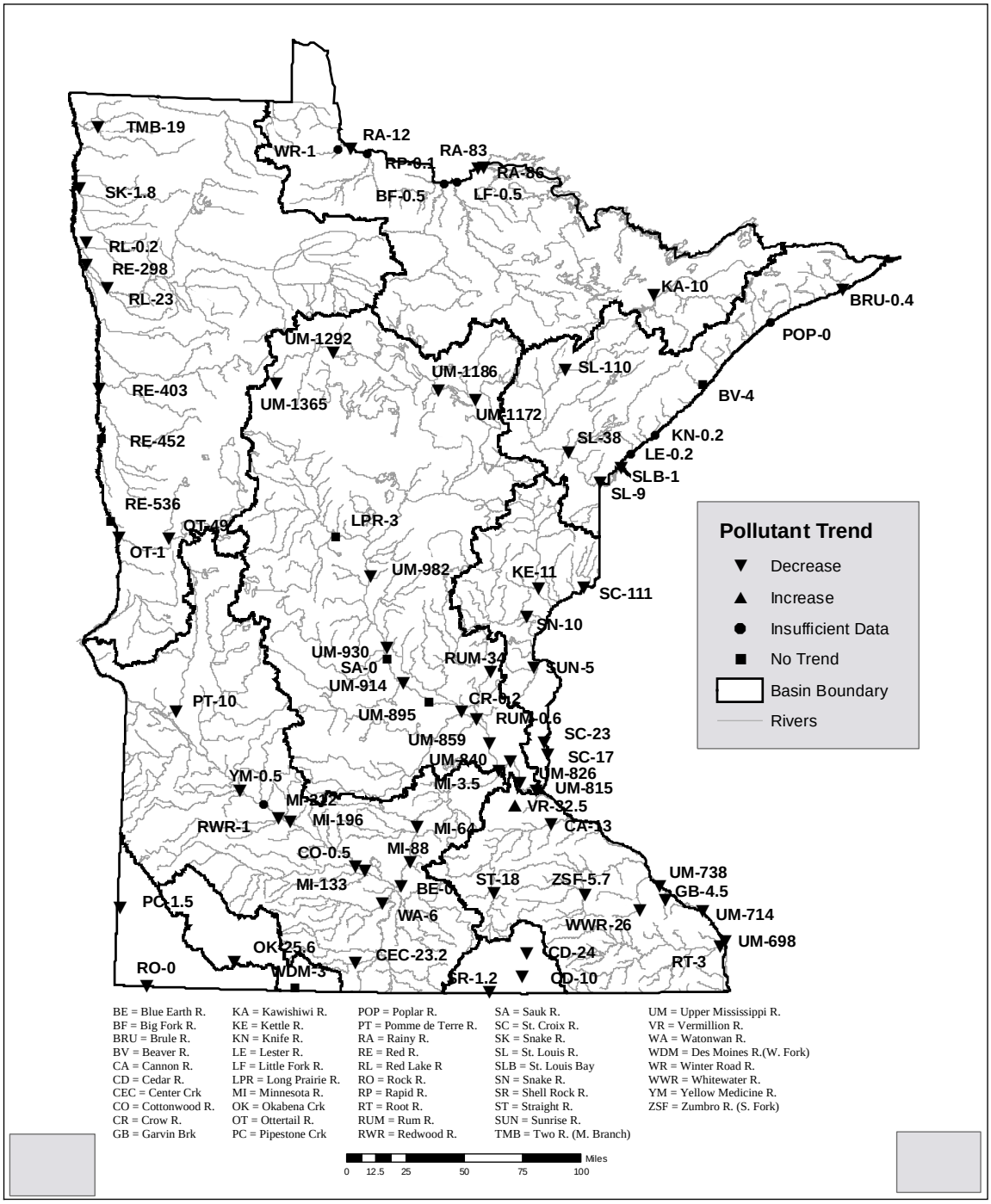


Figure III-13

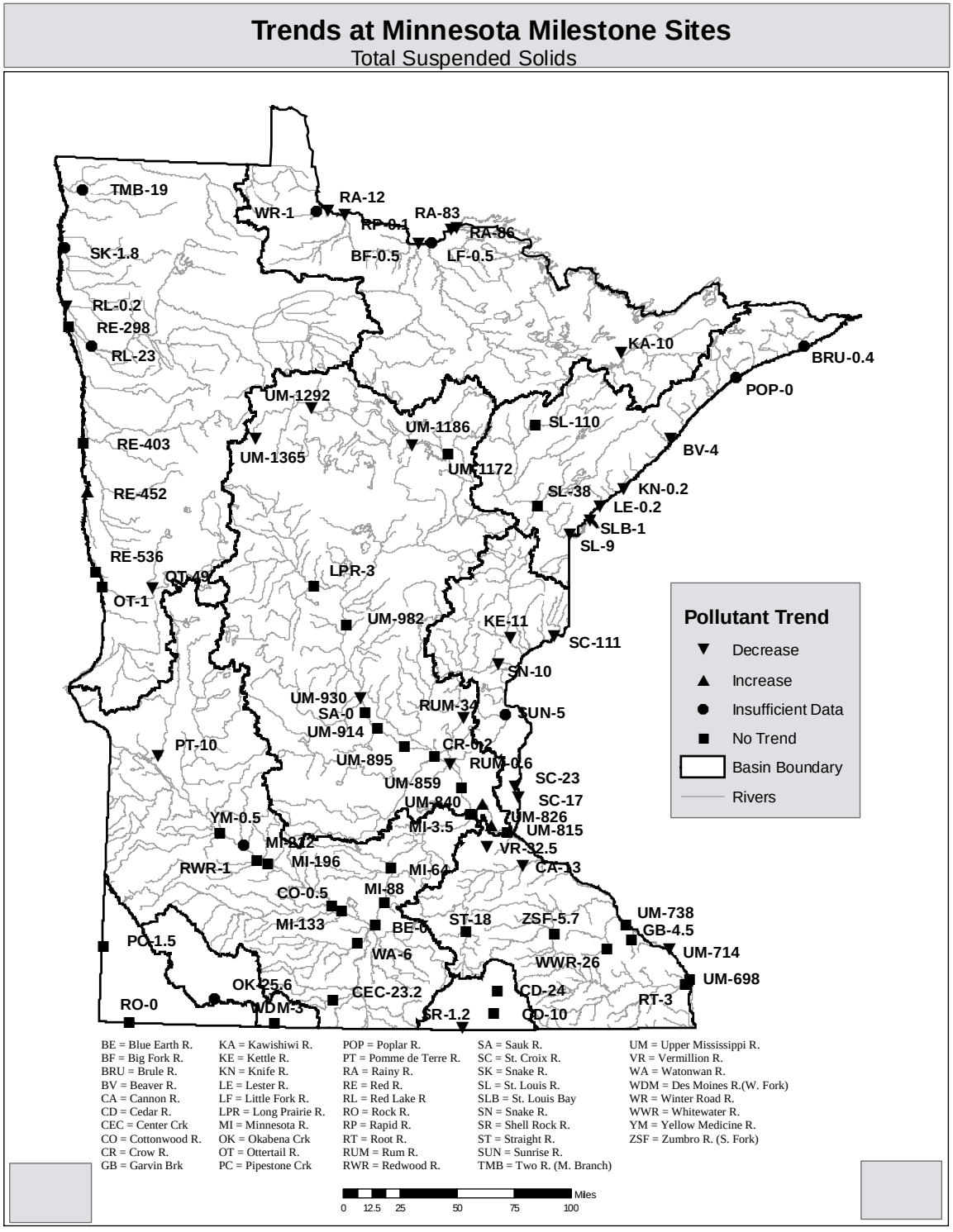


Figure III-14

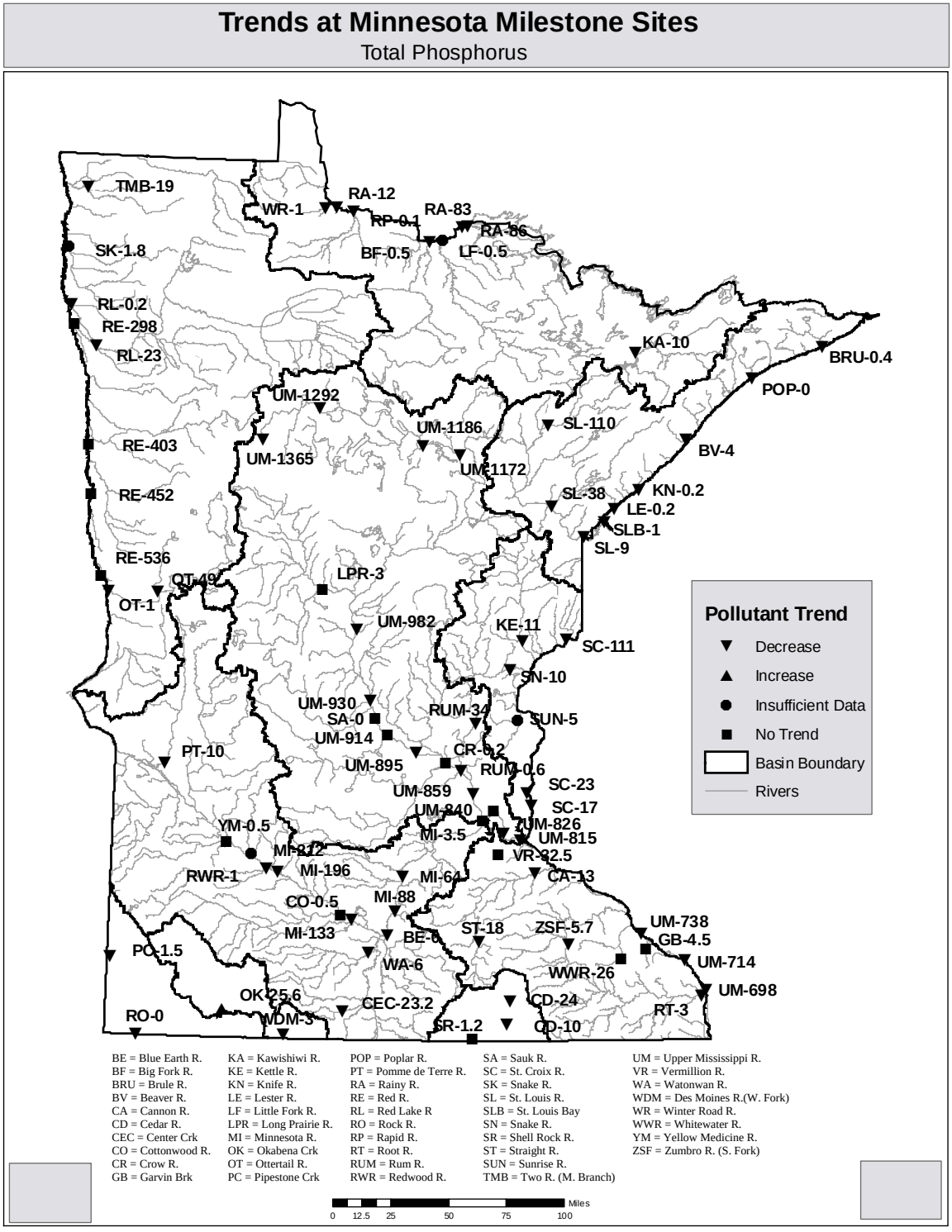


Figure III-15

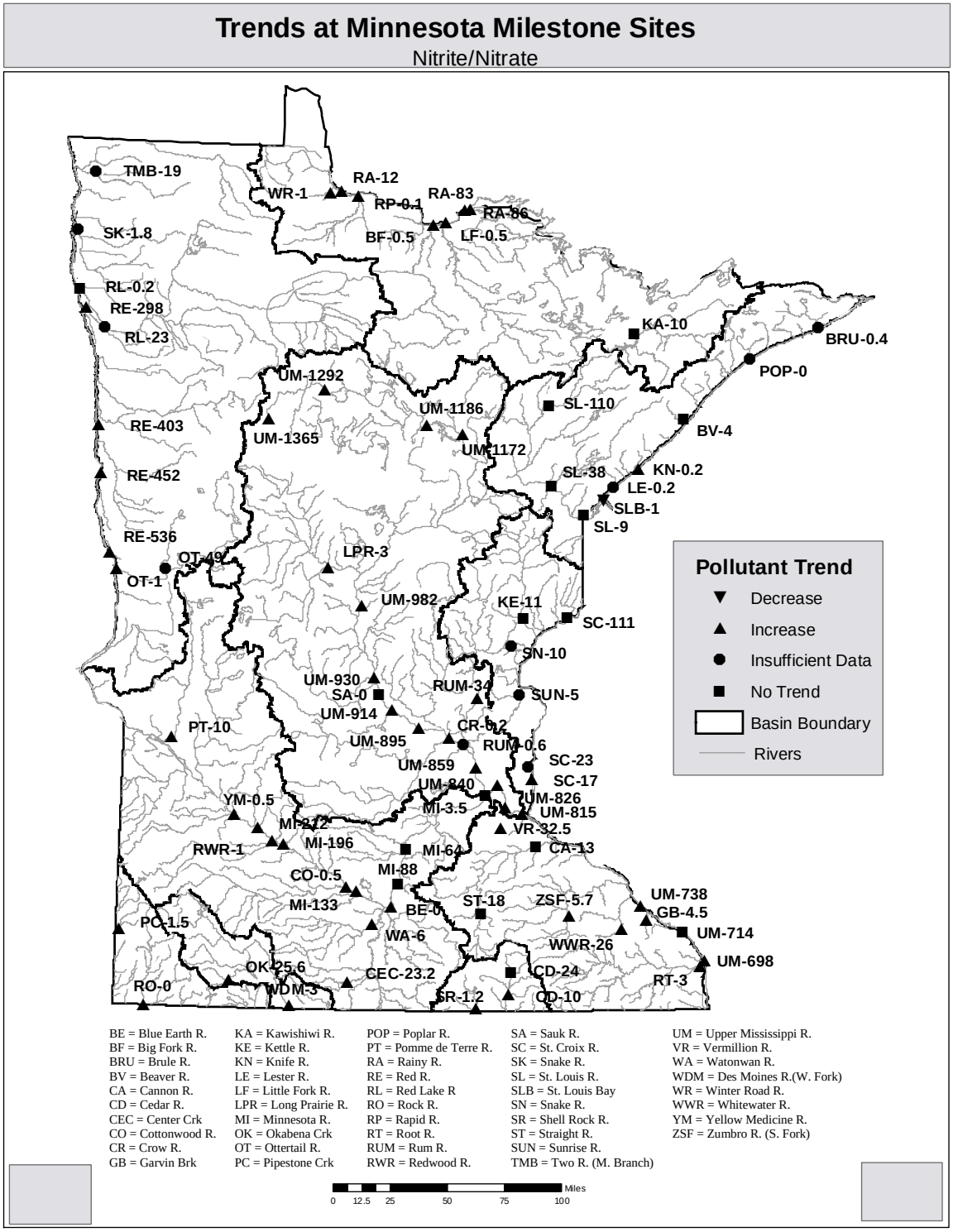


Figure III-16

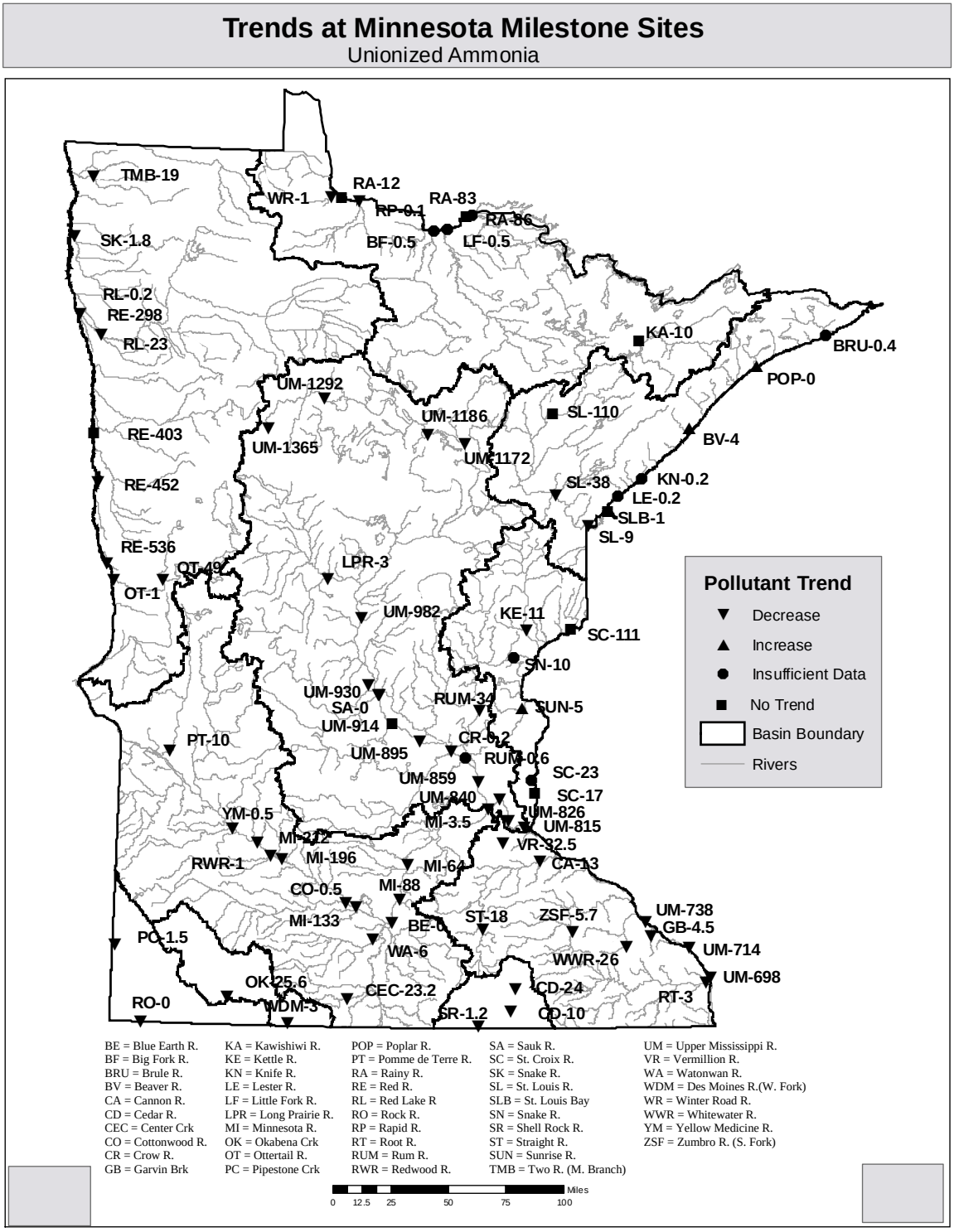


Figure III-17

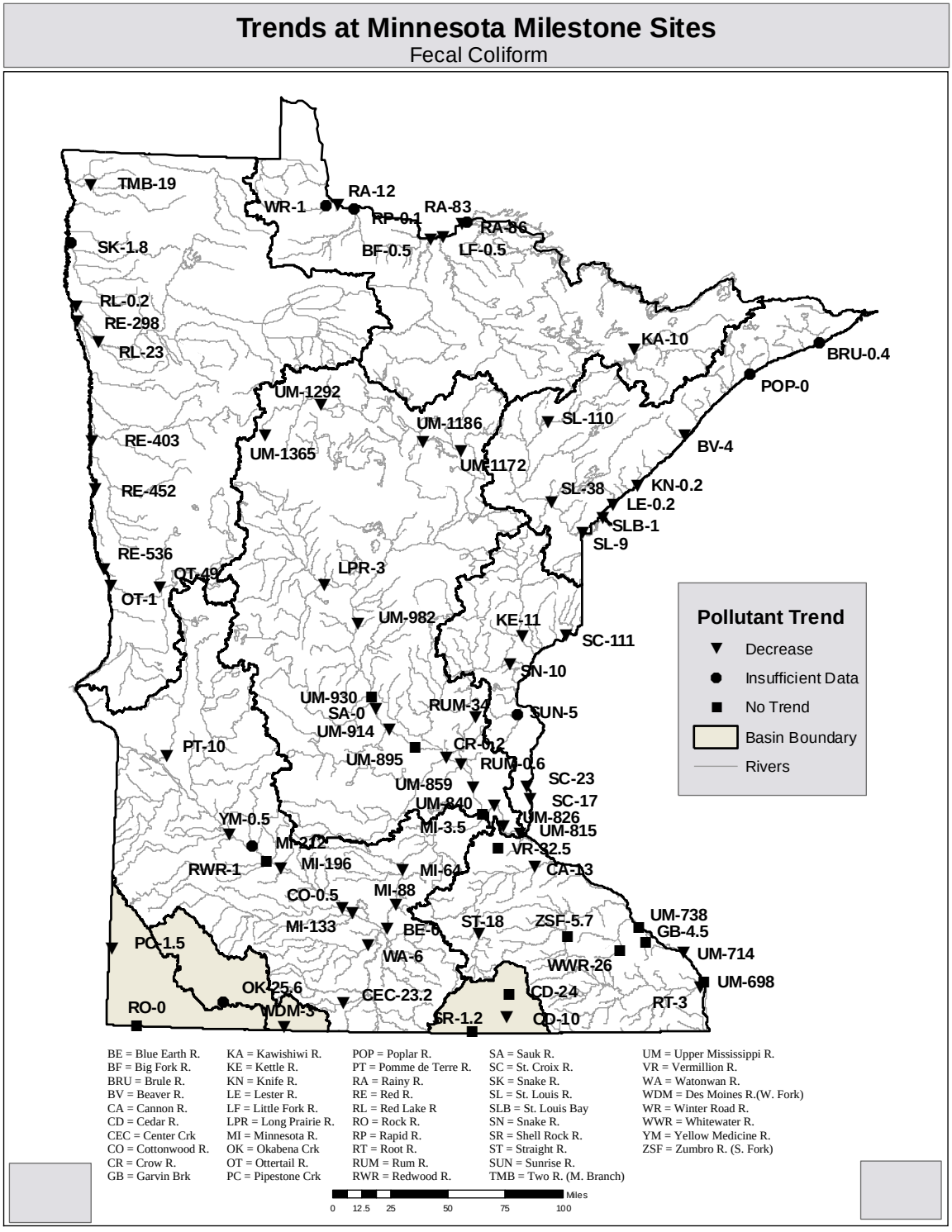


Figure III-18

WATER QUALITY TRENDS FOR MINNESOTA LAKES

In addition to characterizing trophic status, detecting changes (trends) in WQ over time is a primary goal for many lake-monitoring programs. Detecting trends requires many measurements each summer and several years' worth of data. An ideal database for trend analysis consists of eight or more measurements per summer with eight or more years of data at a consistent site in the lake. One of the best parameters for characterizing the trophic status of a lake and trend detection is Secchi transparency. Secchi transparency is the preferred parameter for many reasons: low cost, it is easily incorporated in volunteer monitoring programs and it allows for the collection of a large number of samples in a given sampling period on many lakes. A variety of statistical tests can be used to perform trend analysis. Kendall's tau-b is a statistical test that has been used in previous MPCA 305(b) reports to Congress (MPCA, 1990 and 1992) for assessing trends in Secchi transparency over time. In 2006, the decision was made to switch statistical packages to one that could easily analyze all the data in one quick process. The statistical package, SYSTAT®, was chosen. The minimum requirements remained the same: only lake with four or more transparency readings per summer (June – September) and eight or more years of data were analyzed.

There were 934 lakes in Minnesota that met the minimum requirements for trend analysis in 2006. Of the 934 assessed lakes, 295 of them exhibited a statistically significant improvement in transparency over time. In contrast, only 99 lakes exhibited a statistically significant decline in transparency. The majority (58 percent) of the assessed lakes (540 lakes) exhibited no change in transparency over time.

See http://www.pca.state.mn.us/water/clmpfactsheets.html for lake and county-specific trend information.

Table III-14. Trends in Minnesota Lake Water Quality.

Description	Number of Lakes	Acres of Lakes
Assess for Trends	934	-
Improving	295	-
Stable	540	-
Degrading	99	-
Fluctuating	-	-
Trend Unknown	-	-

Lake Transparency Trends

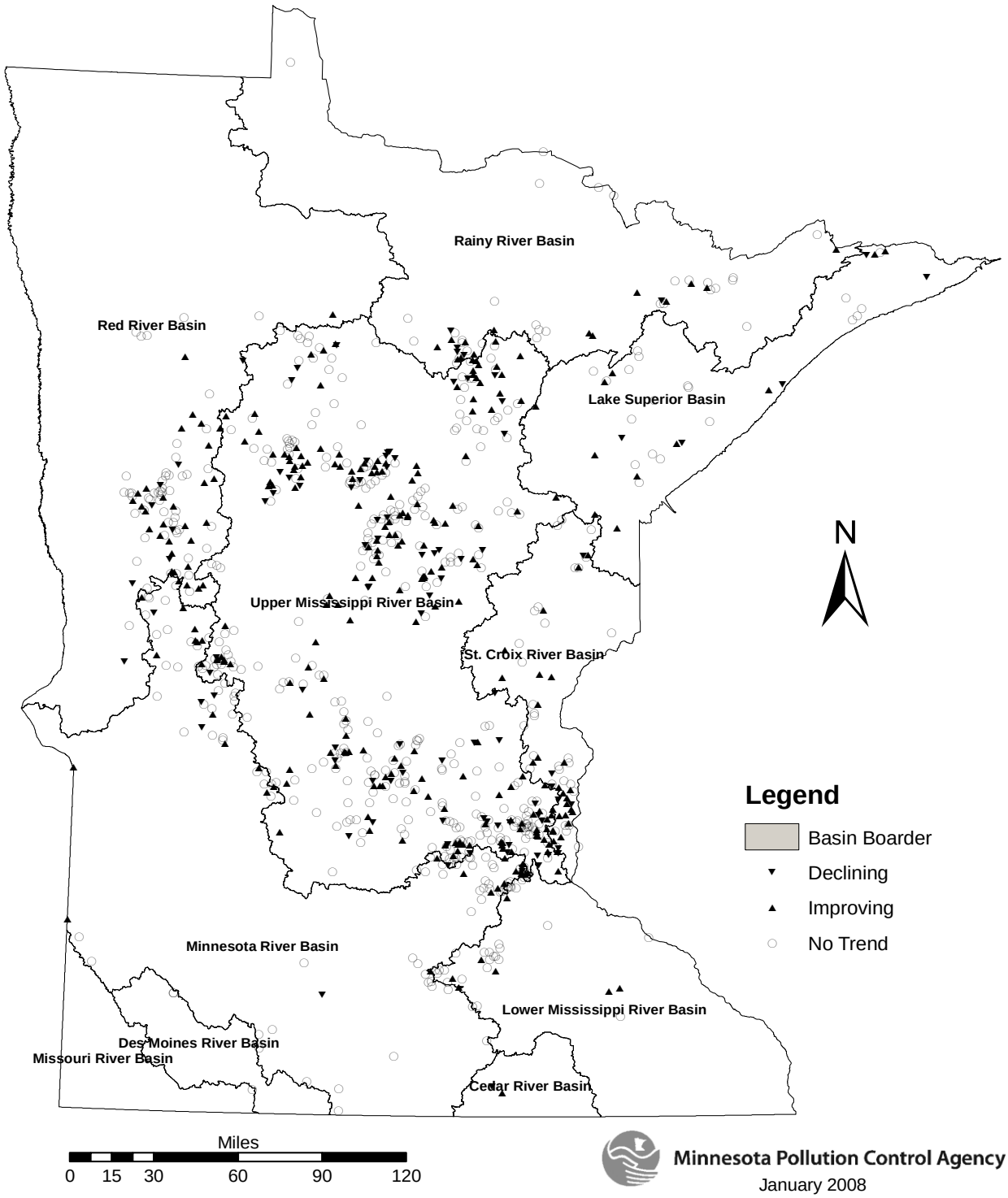


Figure III-19

Chapter Seven: PUBLIC HEALTH /AQUATIC LIFE CONCERNS

A. Lake Superior Beach Monitoring and Notification Program

The Beaches Environmental Assessment and Coastal Health (BEACH) Act passed in October of 2000, requires States that border coastal or Great Lakes waters to develop beach monitoring and public notification programs. The BEACH Act also required that States adopt USEPA's new criteria for pathogen and pathogen indicators. Minnesota adopted revised rules December 18, 2007.

In 2007, Minnesota was awarded $204,270 for implementation of the beach monitoring and notification program. The purpose of this project is to monitor selected beaches along the Great Lakes in accordance with BEACH Act requirements, allow for prompt notification to the public whenever bacterial levels exceeds USEPA's established standards, and investigate alternative methods for public notification. This information is used to investigate long-term trends in WQ and to establish a beach monitoring and public notification plan that will assist communities along the lake shore to improve their ability to monitor and notify beach users of risks associated with high bacteria levels.

Program Overview

This project brought together a Beach Team of state and local-level environmental and public health officials, local health officials, and other interested parties to design a beach monitoring and notification program. Approximately 58 miles of public beach miles and a total of 79 coastal beaches were identified along Lake Superior (Appendices II-B). The definition of "beach" for the purpose of Minnesota BEACH Act implementation is:

"A publicly owned shoreline or land area, located on the shore of Lake Superior, that is used for swimming or other water contact recreational activity."

The coastal beaches were geo-located using Global Positioning System (GPS) technologies and maps were created for all beaches. Additional Geographic Information System (GIS) data layers were added to include the location of all wastewater treatment outfalls along with their proximity to the beaches. Additional information was collected for each beach for evaluation: the potential for impacts from stormwater runoff, bather and waterfowl loads, and the location of outfalls and farms. This information was used to rank and classify beaches as "high," "medium," or "low" priority.

A standard sampling protocol was developed and standard advisory signs were designed based on feedback from Beach Team members and public meetings held in coastal communities (Appendix II-C).

The Beach Web site was designed to include all public beaches monitored under the BEACH Act program. This site also provides information on beach logistics, amenities, and local weather. The Web site management is contracted through the Natural Resources Research Institute, a research facility of the University of Minnesota.

Goals and Objectives

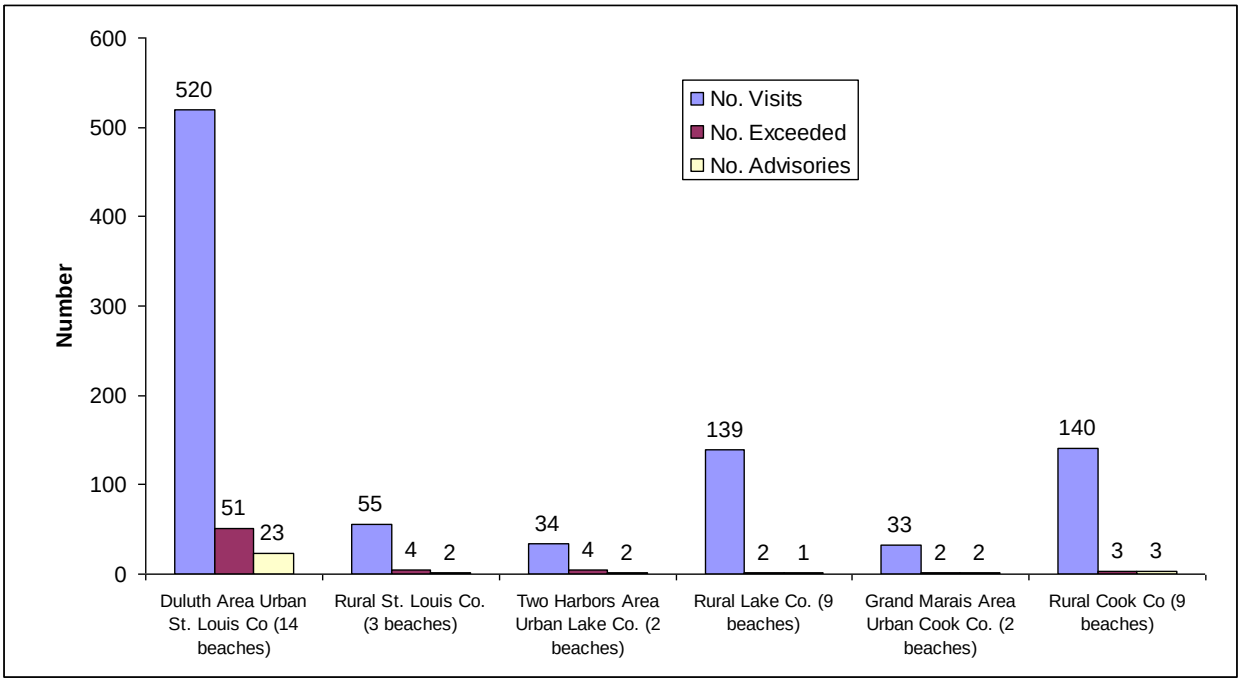
The purpose of this project in 2007 was to continue a consistent coastal beach water monitoring program to reduce the risk of exposure of beach users to disease-causing microorganisms in water. Selected beaches along Lake Superior were monitored in accordance with BEACH Act requirements with prompt notification to the public whenever bacterial levels exceed USEPA's established standards (Appendix II-D).

Work Completed in 2007

The 2007 beach season was the fifth full season a consistently implemented beach-monitoring program was conducted in the coastal area of Minnesota. A total of 39 beaches were sampled. There were 913 monitoring visits during the 2007 beach season. Out of these samples, 96 of them exceeded the WQ limit of 235 Colony Forming Units (CFU)/100 milliliters (mL) for *Escherichia Coli (E. coli*.)[13].

Beach Sanitary Survey Grant: The MPCA received a grant from the USEPA Great Lakes National Program Office to pilot the standardized sanitary survey to further identify pollution sources at the Lakewalk and New Duluth Boat Club beaches in Duluth. In addition, the MPCA further developed its existing beach sanitary survey tool to include more parameters such as turbidity and conductivity.

Figure III-20. Comparison of no. visits, no. of exceedances, no. advisories for 2007.



[13]235 CFU/100mL is a single sample limit for the Lake Superior beaches. This is not a geometric mean limit and does not apply to the rest of the state. We use 126 CFU/100m> as a geometric mean for the Lake Superior beaches.

Figure III-21. Comparing Exceedances.

Year	Regional Type	Duluth Area Urban St. Louis Co	Rural St. Louis Co.	Two Harbors Area Urban Lake Co.	Rural Lake Co.	Grand Marais Area Urban Cook Co.	Rural Cook Co.	Total
2003	No. Beaches	12	3	1	9	2	8	**35**
	No. Exceeded	16	3	1	0	1	1	**22**
	No. Advisories	13	2	2	0	1	1	**19**
2004	No. Beaches	15	3	1	9	2	8	**38**
	No. Exceeded	48	3	3	4	3	0	**61**
	No. Advisories	13	3	3	5	2	0	**26**
2005	No. Beaches	15	3	2	9	2	8	**39**
	No. Exceeded	85	3	2	1	1	0	**92**
	No. Advisories	22	3	2	1	1	0	**29**
2006	No. Beaches	15	3	2	9	2	8	**39**
	No. Exceeded	46	1	0	2	0	2	**51**
	No. Advisories	11	1	0	2	0	2	**16**
2007	No. Beaches	14	3	2	9	2	9	**39**
	No. Exceeded	51	4	4	2	2	3	**66**
	No. Advisories	23	2	2	1	2	3	**33**

Implementation of Monitoring Program

- 39 sites were monitored once a week, May-October, for both *E. coli.* and fecal coliform.
- Nine of the sites were monitored twice a week.
- 17 of the monitoring sites had one or more advisories posted during the monitoring season.

- Two of the monitored beaches were under advisory for most of July, August, and September and into October.
- There were few rain and wind events during the "swimming" season but there was one large rain/wind event in June in the Duluth area and one in September in the Grand Marais area.
- Organized and participated in 2007 Beach Sweep trash pick-up in the Duluth area at one beach with the Beach Team members and MPCA Duluth Office staff.

Continued Implementation of Advisory Notification Program

- E-mail news releases when advisories are posted and removed.
- "Water Contact Not Recommended" advisories signs are placed on the beach.
- "Water Contact Not Recommended" advisory is posted on webpage: (www.MNBeaches.org)
- Local beach hotline with recorded message (218-725-7724).
- "Water Contact Not Recommended" advisory e-mail distribution list.

Education and Outreach Activities

Developed Web page address and hotline business cards, magnets, beach balls, carabiner key chains, sand pails, and small hand sanitizer bottles for distribution at public events and while on the beaches monitoring.

Made presentations at four public meeting/conferences

~1 internet news stories

~5 newspaper articles

~3 radio interviews

~4 television interviews

Conducted survey of beach goers to find out what they know about beach monitoring and how they prefer to get information about beach WQ.

Maintained/Updated Database

a. Database maintained in compliance with USEPA BEACH Act Data Element requirements as well as USEPA STORET database.

Beach Program staff met with the Beach Team two times during 2007 to discuss the program and look for ways to make improvements in the program.

Success Stories and Concurrent Research Projects

The principal success of the Lake Superior Beach Monitoring Program is the continued public awareness the advisories bring to on-going water pollution issues. Residents and tourists are starting to realize that bacteria problems can occur in any part of the Lake Superior Basin but occurs with more frequency in the more urban areas and during storm events. Residents and visitors are picking up after their dogs on a more regular basis. They continue to be vocal about sewage overflows and demand they be corrected. The coastal

cities are installing large holding tanks, back-up generators, and home sump pumps to slow and/or stop the storm related sewage overflows.

Microbial Source Tracking

Dr. Randall Hicks is the Director at the University of Minnesota – Duluth's Center for Freshwater Research and Policy. Dr. Hicks and students have isolated fecal coliform bacteria from streams, soils, periphyton, and beach areas, and identified their sources using the horizontal, fluorophore-enhanced, repetitive extragenic palindromic (HFERP) molecular fingerprinting method to help determine the most probable sources of fecal indicator bacteria in different aquatic habitats. They are collaborating with Dr. Michael Sadowsky's lab group at the University of Minnesota on this series of projects. Together with these colleagues, they have established a Deoxyribonucleic acid (DNA) fingerprint database (Dombeck et al. 2000. Appl. Environ. Microbiol. 66:2572-2577; Johnson et al. 2004. Appl. Environ. Microbiol. 70:4478-4485; Hieb. 2005. Minnesota Statutes (M.S.) Thesis) and used it to identify the animal sources of *E. coli* bacteria in streams (Hieb. 2005. M.S. Thesis), riverine soils (Ishii et al. 2006. Appl. Environ. Microbiol. 72:612-621), and aquatic periphyton communities (Ksoll. 2006. M.S. Thesis; Ksoll et al. 2007. Appl. Environ. Microbiol 73:3771-3778). The current project uses this method to identify seasonal changes in the sources of fecal bacteria found at beaches in the Duluth-Superior harbor (Ishii et al. 2007. Environ. Sci. Technol. 41:2203-2209). Dr. Hicks has recently obtained new funding to examine short-term changes in the abundances of fecal bacterial from waterfowl and humans at these beaches using hybridization and quantitative polymerase chain reaction (PCR) methods. Their goal is to determine what sources of *E. coli* bacteria are contributing to beach closures at different times of the year. This research is being supported by the Minnesota Sea Grant Program and the Western Lake Superior Sanitary District (WLSSD).

The following are Web site addresses for the projects cited above:

http://www.ncbi.nlm.nih.gov/pubmed/17468280?ordinalpos=9&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVDocSum

http://www.ncbi.nlm.nih.gov/pubmed/16391098?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstractPlusDrugs1

http://www.ncbi.nlm.nih.gov/pubmed/15294775?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstractPlusDrugs1

http://www.ncbi.nlm.nih.gov/pubmed/10831440?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstractPlusDrugs1

http://www.ncbi.nlm.nih.gov/pubmed/17438764?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstractPlusDrugs1

2008 Beach Season Scope of Work

The overall objective of this Program is to continue implementing a comprehensive beach monitoring and public notification plan for beaches adjacent to Lake Superior. The 154 miles of Lake Superior's Minnesota shore line include 79 coastal recreational water access points which have been identified, 40 of which will be monitored one or more times a week. More sites are being investigated to add to the monitoring and notification plan.

The MPCA has developed and supports a Microsoft Access database to store field, notification, and lab data. Field data is provided by county staff via fax, and then manually entered by MPCA staff. Notification data is manually entered by MPCA staff. Lab data is submitted via e-mail in an Excel spreadsheet and transferred into the BEACHES database. Current Beach status information is available via www.MNBeaches.org. All beach data is available by request.

Monitoring data will continue to be submitted to Minnesota's local STORET, and then transferred to USEPA's STORET annually. Notification data is currently submitted annually to USEPA via Central Data Exchange (CDX).

Signs, the MPCA Beach Web page, beach hot line (218-725-7724), e-mail alerts, Earth 911 webpage and news releases to the media will be utilized to alert the public to the hazards. Interested parties and managers of sites are also called when an advisory is posted and again when the advisory is removed.

A central aim of the Beach Team is to produce a comprehensive communication plan to inform the public of beach water health risks and WQ issues in general. Several products are being developed for prior beach seasons in Minnesota and will be updated for the 2008 season.

Beach program staff will continue to take comments at public meetings and is including a comment form on the new Web page to allow public feedback opportunities all year long. Staff will continue to work with the local and statewide media to provide information to the public and ask for comments from the public. Many comments are received via e-mail and phone calls as well as at public meetings, festivals and other events.

Beach staff will organize and participated in 2008 Beach Sweep trash pick-up in the Duluth area with the Beach Team members and MPCA Duluth Office staff.

B. Effects of Atmospheric Pollution on Water Quality

The atmosphere as a significant source of pollution to surface water is a relatively recent idea, first demonstrated for acid rain (which results from emission to the atmosphere of SO_2 and Nitrogen Oxide (NO_x)), and later for Hg, PCBs, and nutrients such as N and P. Most pollutants in urban runoff are picked up by relatively clean precipitation running off dirty surfaces; yet the contamination on the surfaces likely came from the atmosphere and the rain may already contain some of pollutants, such as P, N, Hg, pesticides, and PCBs. The

development of impervious surfaces (paving, etc.) and storm sewers has the effect of increasing the efficacy of transport to surface water of deposited airborne pollutants. Consequently, impervious surfaces alone may create a NPS pollution problem for surface water, even without considering the watershed activities that contribute pollutants, such as lawn care, pet feces, eroded soil, and vegetative litter.

The importance of atmospheric loading will vary, depending on the pollutant and the nature of the watershed. For instance, in agricultural watersheds, nutrient loading from the atmosphere may be negligible. But in the same watersheds, the atmosphere may be the main source of toxic pollutants, such as PCBs and Hg.

Point Source Emissions to Air Can Become Nonpoint Source Pollution

Atmospheric deposition of pollutants is implicitly NPS pollution in this document. Yet, the emission source to the atmosphere may well be a point source such as an emission stack. It is worth pointing out that even if modeling or measurement studies verify a direct relationship between a point source of air emissions and deposition to a water body, water managers may still consider that source of pollution to be nonpoint, because it is delivered by the atmosphere.

Air managers identify three basic categories of emissions: point sources, area sources, and mobile sources. Each category is further subdivided into subcategories. Point sources are permanently fixed stacks of known diameter, elevation, temperature, and exit velocity.

Area sources include windblown dust from stockpiles or tilled fields, fugitive emissions from a landfill or the numerous valves and connections at a refinery, and forest fires. Mobile sources are divided into on-road sources such as traffic emissions and dust from unpaved roads, and off-road sources such as lawn mowers, portable generators, chain saws, and snowmobiles.

Types of Airborne Pollution That Can Affect Surface Water

Any change in the physics or chemistry of the atmosphere can negatively affect surface water. For example, depletion of stratospheric ozone could increase the damage to aquatic life from increased ultraviolet radiation (UVB). Global warming is projected to virtually eliminate the cold water fishery in Minnesota, while simultaneously reducing the duration of ice-cover and therefore winterkills.

A wide variety of materials are deposited from the atmosphere that can affect the surface water. Some airborne materials are toxic (e.g. Hg, PCBs, lead, dioxin), some are nutrients (e.g., P and N), and some interact with other pollutants (e.g., calcium carbonate in wind-blown soil can neutralize acid rain, or sulfate deposition may stimulate the methylation of Hg in low-sulfate systems).

Emerging Contaminants

Two groups of persistent bioaccumulative toxic compounds, which have been categorized as emerging contaminants are PFOS and PBDE. PFOS is a perfluorinated compound produced for numerous products and has been found in the tissues of fish and wildlife in remote areas. Polybrominated Diphenyl Ethers are brominated flame retardants used in many household products and have also been found to be bioaccumulating in fish and wildlife. Polybrominated Diphenyl Ethers are similar in structure to PCBs, but unlike PCBs, which are decreasing in the environment, PBDEs are increasing. This has been clearly demonstrated in Great Lakes fish. Chernyak et al. 2005. Environmental Toxicology and Chemistry 24:1632-1641.

The dissemination of PFOS is expected to diminish. Some types of PBDEs have been banned, while others continue to be used and studied.

Best Management Practices

BMP usually control pollutants as near as reasonable to the pollution source. Atmospherically deposited pollutants generally migrate from sources outside the watershed, making the conventional concept of BMPs difficult to implement. The best BMPs to reduce atmospheric deposition are to halt the release of these pollutants into the atmosphere. Because of the diversity of sources, cessation of release is complicated and would require the coordination of the full spectrum of the economy, including agriculture, energy production, transportation, waste disposal, manufacturing, and government. Because the atmosphere carries some materials long distances, it may be necessary to address many of these atmospheric pollutants on a national and international basis. For instance, the MPCA estimates that 90 percent of the Hg deposited in Minnesota comes from out-of-state. It is therefore important to communicate the need for national level controls to the USEPA for Hg and other pollutants subject to long-distance atmospheric transport.

Existing BMPs for some other pollutants may lead to some surprising situations. For instance, it is increasingly common to use wetlands to trap sediments and associated nutrients in storm water before the pollutants can get to a lake or stream. However, the high biological activity of wetlands may lead to some negative consequences for persistent bioaccumulative chemicals. For instance, Hg deposited to terrestrial systems binds strongly to soil particles. Eroded soil may be caught in a wetland, where the Hg would be subject to biological activity. Because of the heightened activity of anaerobic bacteria that convert sulfate to sulfide, methylation rates are perhaps 100 times higher in wetlands than in lakes. Use of wetlands to clean runoff may therefore enhance methylmercury loading to surface water, which would increase the concentration of Hg in fish.

Best management practices for a particular atmospheric pollutant should be selected only after its cycle and fate have been evaluated. Otherwise, we may find ourselves exacerbating the effects of a particular pollutant, as in the hypothetical case of Hg, above. Another example of the consequences of an incomplete understanding might be attempting to reduce PCBs in Lake Superior by reducing inputs. The PCB burden in Lake Superior is determined by volatilization back to the atmosphere, not external loading. Although research on the environmental fate and budgets of persistent chemicals may be expensive, it is most likely

less expensive than making management decisions based on erroneous assumptions, resulting in expensive but ineffective treatment.

Programs and Authorities

NPDES permits – pretreatment requirements,
Pollution prevention,
WQS,
Air emission controls,
Fish consumption advisories,
Recycling and product screening (e.g., Hg switches in consumer items, such as shoes),
Market incentives, and
Statutes and Rules (e.g., ch. 7050).

Minn. Stat. § 116.454, authorized the MPCA to initiate a statewide air toxics monitoring network and air toxics inventory in calendar year 1993.

The Acid Deposition Control Act (Minn. Stat. § 116.42-116.45) was passed in 1982 and was the first of its kind in the nation. It required the MPCA to (1) identify the areas of the state containing resources sensitive to acid deposition, (2) develop a standard to protect these resources, (3) adopt a control plan to reduce sulfur dioxide emissions, and (4) ensure that all Minnesota sources subject to the control plan are in compliance by January 1, 1990.

Minn. Stat. 116.915 subd. 1 - known as the 1999 Hg reduction law called for specific Hg reductions and established Hg emission goals for 2001 and 2005. Those goals were achieved.

The CWA, Section 303(d), requiring TMDLs for targeted impaired waters, led to the MPCA drafting a statewide Hg TMDL, which was approved by the USEPA in March 2007: http://proteus.pca.state.mn.us/water/tmdl/tmdl-mercuryplan.html.

Sequence for Implementation of NPS Effort for Atmospheric Pollutants

1	Identify WQ problem.
2	Determine air pollution as the cause.
3	Determine source of air pollution (e.g., area or facility).
4	Evaluate the relative efficacy of BMPs within the watershed in contrast to air emission reductions.

The 2006 through 2010 (January 31, 2006 through December 31, 2010) 5-year Action Plan provided below summarizes the milestones identified in the preceding sections. Many of the 2006 through 2010 milestones listed below, as well as the implementation of specific projects, are contingent upon adequate funding and local involvement.

2006 – 2010 Milestones (Action Steps)	**06**	**07**	**08**	**09**	**10**	**Funding Source(s)**	**Lead Agency(ies)**
1. Develop monitoring effort for effect of global warming on surface water; ice cover times and water temperature.	X	X	X	X	X	General Fund	MPCA
2. Evaluate effect of nonpoint sulfate loading on mercury methylation.	X	X	X	X	x	USEPA, MPCA	MPCA, Science Museum
3. Quantify relationship between emissions of persistent bioaccumulative pollutants and deposition to surface water and watersheds. (contract for model development)		X	X			MPCA	MPCA
4. Investigate the impact of atmospheric deposition of "hormonal copycats" on aquatic organisms. (literature review)		X	X			General Fund	MPCA

Action Steps Completed	Funding Source	Lead Agency(ies)	Outcomes
1. Quantify atmospheric deposition of metals (cadmium, lead, iron, etc.) and phosphorus in select watersheds.	MPCA	MPCA	Use in statewide P mass balance & lead emission enforcement action.
2. Evaluate why lakes vary greatly in mercury contamination of fish, given that atmospheric deposition is relatively homogeneous.	MPCA, USGS	MPCA, USGS, Univ. Wisconsin Lacrosse	Wiener, J. et al.. (2006). "Mercury in Soils, Lakes, and Fish in Voyageurs National Park (Minnesota): Importance of Atmospheric Deposition and Ecosystem Factors." Environmental Science and Technology, 40(20), 6261-6268.
3. Evaluate effect of nonpoint sulfate loading on mercury methylation.	USEPA, MPCA	MPCA, Science Museum of Minnesota	Jeremiason, J.D., et al. 2006 Sulfate addition increases methylmercury production in an experimental wetland. Environmental Science and Technology. 40:3800-3806.
4. Evaluate methylation of mercury in wetlands used as BMPs for trapping storm water runoff.	USEPA, MPCA	MPCA	Monson, B.A. Report to USEPA.
5. Quantify the deposition of organics: PCBs, dioxin, and pesticides (chlordane, DDT/DDE, dieldrin, hexachlorobenzene, alpha-HCH, lindane, toxaphene, and others.	Legislative Commission on Minnesota Resources (LCMR)	MPCA, U of Minnesota	Report to LCMR.
6. Evaluate the environmental cost of atmospheric pollutants on aquatic systems. LCMR MPCA willingness to pay study on mercury is done.	LCMR	MPCA, Bemidji State University	http://www.pca.state.mn.us/publications/reports/mercury-economicbenefits.pdf

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- **Appendices**

Appendix I

Table 1. Current Minnesota Condition Monitoring Efforts

Activity Name Rivers and Streams	*Start*	*Monitoring Design/Description*	*Purpose*	*Indicators*
MPCA Major Watershed Intensive Stream Monitoring.	2006	Progressive watershed design of sample collection at the outlet reaches of watersheds working upstream from (8-digit HUC) outlets. Indicators for aquatic life, recreation, and fish consumption. Use support collected at appropriate frequency and watershed tiers.	Assessing use support for aquatic life, aquatic recreation, and aquatic consumption in the context of hydrologic relationships within watersheds and to provide information for the completion of TMDL studies on impaired waters.	Composite index of fish and invertebrate community characteristics; dissolved oxygen, conductivity, pH, nutrients, turbidity, transparency, E. coli bacteria, qualitative habitat assessment, stream flow, and fish tissue.
Remote Sensing Lakes.	2003	Statewide assessment of lake trophic status and trends. Images ground-truthed based on CLMP Secchi measures.	Assess trophic status of lakes > 20 acres using Landsat. Assess trends. Used for 305(b) and for monitoring prioritization.	Lake transparency. Trophic state index.
MPCA Major Watershed Pollutant Load Monitoring (formerly called Basin Assessments).	2002	Statewide network of fixed stations at outlets of major watersheds (8-dig. HUC) with continuous flow monitoring and grab or continuous sampling for pollutant concentrations. Sampling frequency designed to capture flow-driven concentration variations to derive loadings. Finer scale monitoring is conducted as basin needs are defined and resources allow.	Assess condition of basin tributaries and main stem rivers. Used to identify trends and exceedances of standards. Also serves as effectiveness monitoring on a basin scale.	Nonpoint parameters: nutrients, TSS, BOD and fecal bacteria, and other region-specific concerns.
MPCA Integrated Basin-Scale Monitoring in Streams.	1990	Statistically-based design with random site selection at the major river basin scale. Fish and benthic macroinvertebrate collections to score with IBI are made at each site, along with a quantitative habitat assessment and grab samples for basic WQ measurements. Field collection is completed statewide and resources will now be devoted to completing reports and the intensive watershed program.	Used for biocriteria development, trend monitoring, 305(b) and 303(d) assessments and reporting, evaluation of water quality permit limits, and evaluating WQS.	Composite index of fish and invertebrate community characteristics; dissolved oxygen, conductivity, nutrients, turbidity, stream flow, bottom type, bank stability.

Activity Name Rivers and Streams	*Start*	*Monitoring Design/Description*	*Purpose*	*Indicators*
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, two years in each five year period. About 30 sites monitored each year on a rotating basin basis. Currently a total of 80 sites, 20 with flow, all with observations of water level.	Compare basic water chemistry to WQS, looking at trends at a consistent set of sites.	Dissolved oxygen, temperature, pH, nitrite/nitrate nitrogen, ammonia nitrogen, conductivity, turbidity, and E. coli bacteria. Added during open water months at all sites in 2007: total phosphorus, chlorophyll-a, pheophytin, 5-day BOD, residue, total non-filterable (total suspended solids), and suspended volatile solids, with total mercury sampled three times per year.
MPCA River Nutrient Studies (w/USGS and DNR).	1999	Fixed station with periodic grab sample, physical/chemical parameters. Combined with USGS and DNR flow records. These indicators are now collected as part of Milestone and watershed intensive water chemistry sampling.	Data set used to provide basis for standards, nutrient criteria. Also used for research, model development.	Nutrients, chl-a and related data.
MPCA Trace Metals in Streams.	1996	Stream 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. Completion of sampling in all basins in 2008.	Used for water body assessments, including 305(b) use assessments and 303(d) listing, assist in the development of WQS 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 sample almost 800 stream locations.	Monitor the transparency of MN rivers and streams for baseline conditions, goal setting, trend identification, targeting more intensive monitoring and as a surrogate for turbidity for 303(d) assessments in specific situations.	Transparency.

Activity Name Lakes	*Start*	*Monitoring Design/Description*	*Purpose*	*Indicators*
MPCA Intensive Study Lakes (with DNR and MDH).	Fish tissue sampling began in 1968	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 305(b) and 303(d) 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 305(b) and 303(d) assessments. Used to develop WQ 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, chl-a.
MPCA Lake Assessment Program (with local lake associations).	1985	Fixed station design; monthly sampling May-September. Collect nutrient, chl-a and related data at lakes. More than 200 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, chl-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. Approximately 1200 volunteers monitor approximately 1250 lakes. Limited chemistry at approximately 15 lakes/year.	Monitor the transparency of MN lakes for baseline conditions, goal setting and targeting, and trend identification.	Secchi disk transparency. Phosphorus, chl-a, DO and temperature profiles at approximately 15 lakes/year.
MPCA Short-term Special Studies.	Varies	Lake, stream and biota studies to look at emerging issues (perfluorinated compounds, endocrine disrupting chemicals, 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, advise citizens of potential exposures, guide regulatory efforts to address impairments.	Indicators vary depending on conditions being studied, e.g. fish tissue and water concentrations are used for perfluorinated compounds.

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 WQ 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. WQ and released material sample collection. Fish and wildlife collections made in conjunction with DNR and/or the U.S. Fish and Wildlife Service.	Incident response, WQ 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 [BOD5 for wastewater releases], nutrients, metals and E. coli bacteria). For industrial or releases of unknown origin: most of above plus more comprehensive metals, VOCs, SVOCs and pesticides. Others as case requires.
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, two to three day surveys under low-flow conditions. Approximately 100 surveys, 500+ stations.	Determine appropriate effluent limits for a discharge so that WQS 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, chl-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 39 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.	E. coli.
Fluvial Geomorphology.				

Table 3. Effectiveness Monitoring Designs

Activity	*Start*	*Description/Monitoring Design*	*Purpose*	
Stormwater Monitoring.	2004	Developed four levels of standard stormwater BMP assessment protocols from simple visual to state-of-the-art computerized monitoring. Augmenting gaps in particle size, low impact infiltration pollutant fate and operation and maintenance needs coupled with development of case studies with partnering groups. Extensive thermal monitoring and modeling of Vermilion and Miller Creek trout streams accomplished.	To evaluate effectiveness of MPCA's stormwater permitting programs and BMPs.	**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 WQ 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, Phosphorus, 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.	On-going	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.**
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**	**Impact of system on lake or other water body.**	**Phosphorus.**

		sampling. Part of State Disposal System permit.		

Activity	*Start*	*Description/Monitoring Design*	*Purpose*	*Indicator*
Monitoring to evaluate Clean Water Partnership implementation projects, Section 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.[14]	To assess the effectiveness of NPS 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 WQ rules for nonpoint discharge.	**Primarily VOCs and metals.**
Monitoring of storm water and surface water bodies adjacent to permitted solid waste facilities.	1990s	Designs vary by site. Monitoring may involve routine WQ sampling for stormwater ponds, wetlands, streams, rivers or other surface water features in the vicinity of solid waste facilities.	To evaluate effectiveness of storm-water BMPs.	**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. Seven metro-area landfills.**	**Used to determine compliance with MCES standards.**	**Metals, VOCs, SVOCs, PCBs and 2, 3, 7, 8 – TCDD.**

[14] 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).

Appendix II-A
Beach Monitoring Program

Beach List and Priority

Tier 1 – High

Beach	STORET	Location
Park Point Beach House	16-0001-B003	St. Louis County
Park Point Harbor Parking Lot/Sky Harbor Airport	16-0001-B004	St. Louis County
Park Point Southworth Marsh	16-0001-B036	St. Louis County
Park Pt Lafayette Community Center	16-0001-B005	St. Louis County
Park Point 20th St/Hearding Island Canal Beach	16-0001-B037	St. Louis County
New Duluth Boat Club Boat Landing	16-0001-B007	St. Louis County
Tot Lot/13th Street South	16-0001-B006	St. Louis County
Lakewalk Beach	16-0001-B008	St. Louis County
Brighton Beach	16-0001-B012	St. Louis County

Tier 2 – Medium

Beach	STORET	Location
Boy Scout Landing	16-0001-B001	St. Louis County
Clyde Ave – West Duluth	16-0001-B002	St. Louis County
Leif Erickson Park	16-0001-B009	St. Louis County
Lakewalk East/16th Avenue East	16-0001-B038	St. Louis County
42nd Avenue East	16-0001-B010	St. Louis County
Lester River	16-0001-B011	St. Louis County
French River	16-0001-B013	St. Louis County
Bluebird Landing	16-0001-B014	St. Louis County
Stony Point	16-0001-B015	St. Louis County
Knife River Marina Beach	16-0001-B035	Lake County
Agate Bay	16-0001-B039	Lake County
Burlington Bay	16-0001-B016	Lake County
Flood Bay	16-0001-B017	Lake County
Stewart River Beach	16-0001-B018	Lake County
Gooseberry Falls State Park	16-0001-B019	Lake County
Twin Points Public Access	16-0001-B020	Lake County
Split Rock River	16-0001-B021	Lake County
Split Rock Lighthouse State Park	16-0001-B022	Lake County
Silver Bay Marina	16-0001-B023	Lake County
Tettegouche State Park	16-0001-B024	Lake County
Sugar Loaf Cove	16-0001-B025	Cook County
Schroeder Town Park	16-0001-B026	Cook County
Temperance River State Park	16-0001-B027	Cook County
Cutface Creek Wayside Rest	16-0001-B028	Cook County
Grand Marais Campground	16-0001-B029	Cook County
Grand Marais Downtown	16-0001-B030	Cook County
Old Shore Road Beach Area	16-0001-B031	Cook County
Durfee Creek Area	16-0001-B032	Cook County

Kadunce Creek Outpost Motel Area	16-0001-B033	Cook County
Paradise Beach	16-0001-B034	Cook County
Chicago Bay Boat Launch Beach	16-0001-B078	Cook

Tier 3 – Low

Beach	**STORET**	**Location**
Morgan Park Beach	16-0001-B040	St. Louis
Smithville Park Beach	16-0001-B041	St. Louis
Indian Point Campground Beach	16-0001-B042	St. Louis
Waterfront Trail/Riverside Beach	16-0001-B043	St. Louis
Waterfront Trail/Radio Towers Beach	16-0001-B044	St. Louis
Waterfront Trail/Interlake Beach	16-0001-B045	St. Louis
Blatnik Fishing Pier Beach	16-0001-B046	St. Louis
Bayfront Park Beach	16-0001-B047	St. Louis
Minnesota Point Harbor Beach	16-0001-B048	St. Louis
Lakewalk East/26th Avenue East Beach	16-0001-B049	St. Louis
Glensheen Cemetary Beach	16-0001-B050	St. Louis
North Shore Drive Wayside Rest/72nd Ave E	16-0001-B051	St. Louis
Lakewood Pump Station Beach	16-0001-B052	St. Louis
North Shore Drive Wayside Rest/Cant Road	16-0001-B053	St. Louis
McQuade Road Safe Harbor Beach	16-0001-B054	St. Louis
Stony Point Wayside Rest Beach	16-0001-B055	St. Louis
Two Harbors City Park Beach	16-0001-B056	Lake
Silver Creek Beach	16-0001-B057	Lake
Silver Cliff Beach	16-0001-B058	Lake
Split Rock Lighthouse State Park/Split Rock Point	16-0001-B059	Lake
Split Rock Lighthouse State Park /Crazy Bay	16-0001-B060	Lake
Split Rock Lighthouse State Park /Corundum Point	16-0001-B061	Lake
Split Rock Lighthouse State Park /Gold Rock Point	16-0001-B062	Lake
Blueberry Hill Beach	16-0001-B063	Lake
Palisade Beach	16-0001-B064	Lake
Tettegouche State Park/Baptism River	16-0001-B065	Lake
Tettegouche State Park/Crystal Bay	16-0001-B066	Lake
Manitou River Beach	16-0001-B067	Lake
Temperance River State Park East	16-0001-B068	Cook
Ray Berglund Wayside Rest Beach	16-0001-B069	Cook
Cascade State Park West Beach	16-0001-B070	Cook
Cascade State Park Campground Beach	16-0001-B071	Cook
Butterwort Cliffs Beach	16-0001-B072	Cook
Croftville Beach	16-0001-B073	Cook
Red Cliff Beach	16-0001-B074	Cook
Coville Creek Beach	16-0001-B075	Cook
Judge C.R. Magney State Park West	16-0001-B076	Cook
Judge C.R. Magney State Park East	16-0001-B077	Cook
Horseshoe Bay Boat Launch Beach	16-0001-B079	Cook

Appendix II-B
Beach Monitoring Program

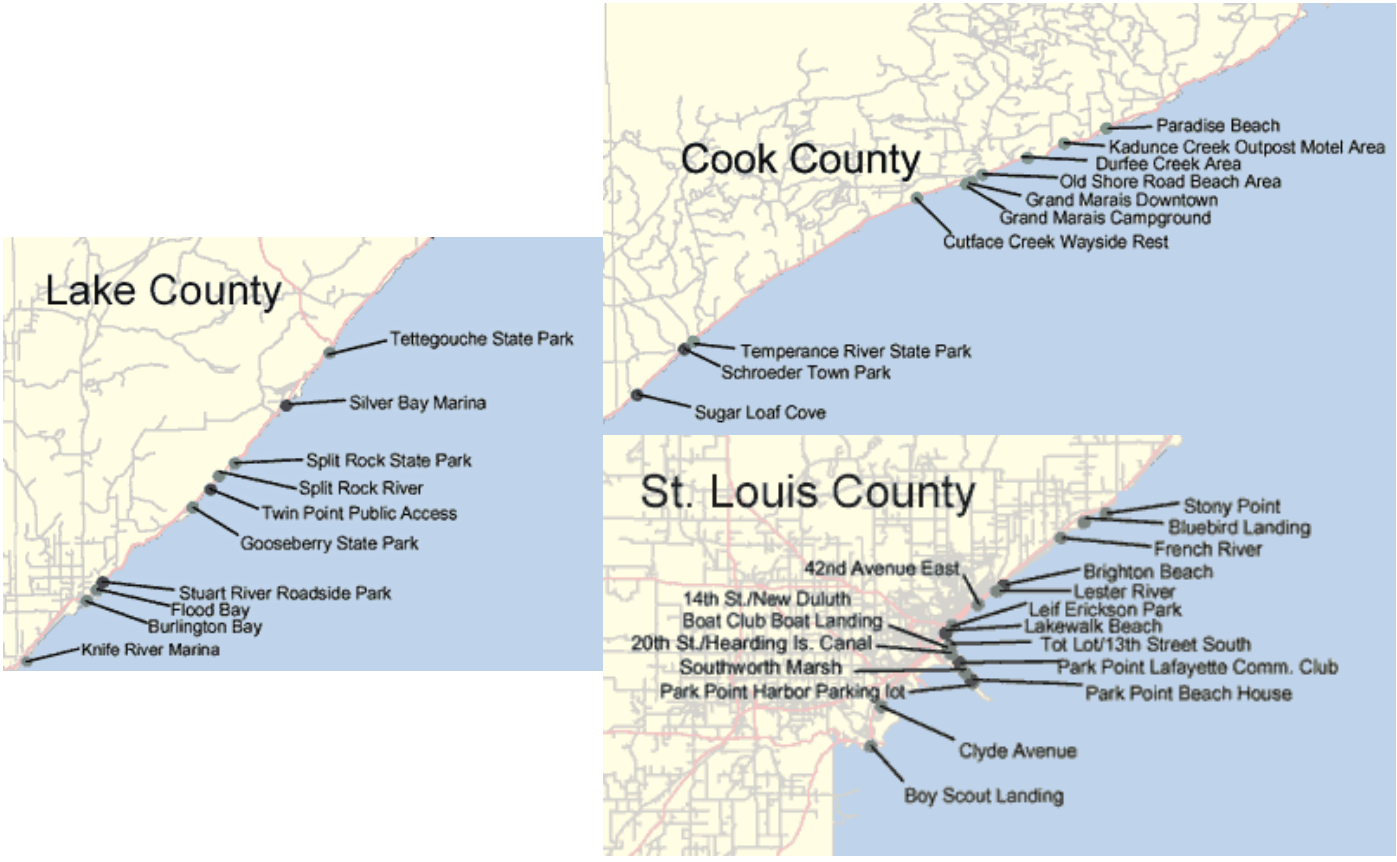
Beach Miles

Monitored Minnesota Lake Superior Beaches

County	No. of Beaches	Total Beach Miles	Total Beach Feet	Total Beach Meters
Cook Monitored	11	11.41	60,219	**18,355**
Lake Monitored	11	6.73	35,509	**10,823**
St. Louis Monitored	18	12.13	64,040	**19,519**
Total	**40 beaches**	**30.27 miles**	**159,768 feet**	**48,697 meters**

All Minnesota Lake Superior Beaches

County	No. of Beaches	Total Beach Miles	Total Beach Feet	Total Beach Meters
Cook All	22	21.67	114,429	**34,878**
Lake All	23	16.05	84,744	**25,830**
St. Louis All	34	20.02	105,677	**32,210**
Total	**79 beaches**	**57.74 miles**	**304,850 feet**	**92,918 meters**



Appendix II-C
Beach Monitoring Program

Tiered Monitoring, Sampling and Analysis Plans

Tiered Monitoring Plan
Tier 1 beaches are those that receive the most use by the public for swimming, bathing, surfing, kayaking, or similar water contact activities and/or have the highest potential risk of pathogen pollution within the immediate area. These beaches are sampled a minimum of twice a week on Mondays and Thursdays.

Tier 2 coastal recreational water sites usually receive moderate use by the public for water contact recreational purposes and have fewer source of pathogen pollution in the area. These beaches are sampled a minimum of once a week on Mondays.

Tier 3 sites typically receive sporadic use, have limited access, and few if any potential sources of pollution in the area. These sites are not sampled.

Sampling Protocol
To assure consistency in collecting samples for analysis, the following procedures will be used:

1. Specific sites will be designated for collecting samples during the bathing season. Samples will be collected exclusively at these sites for the duration of the sampling period.
2. Sample bottles will be prepared and provided by the laboratories charged with conducting bacteria analyses.

General Rules of Sampling

- Take extreme care to avoid contamination of the sample and sample container.
  - Do not remove bottle covering and closure until just prior to obtaining each sample.
  - Do not touch the inside of the sample container.
  - Do not rinse the sample container.
  - Do not put caps on the ground while sampling.
  - Do not transport the samples with other environmental samples.

- Adhering to sample preservation and holding time limits is critical to the production of valid data.
  - Samples should be labeled, iced or refrigerated at 1 – 4 degrees immediately after collection and during transit to the lab.
  - Care should be taken to ensure that sample bottles are not totally immersed in water during transit or storage.
  - Samples should arrive in the lab no later than six hours after collection. Whenever possible samples should arrive at the lab on the day of collection, preferably before 3 p.m.

- The sampler will complete the laboratory data form noting time, date, and location of sample collection, current weather conditions (including wind direction and velocity), water temperature, clarity, wave height and any abnormal water conditions.

Sampling Method

- Label the bottle.
- Carefully move to the first sampling location. Water should be approximately knee deep. While wading slowly in the water, try to avoid kicking up bottom sediment at the sampling site.
- Open a sampling bottle and grasp it at the base with one hand and plunge the bottle mouth downward into the water to avoid introducing surface scum.
- The sampling depth should be approximately six to twelve inches below the surface of the water.
- Position the mouth of the bottle into the current away from your hand. If the water body is static, an artificial current can be created by moving the bottle horizontally with the direction of the bottle pointed away from you.
- Tip the bottle slightly upward to allow air to exit and the bottle to fill.
- Make sure the bottle is completely filled before removing it from the water.
- Remove the bottle from the water body and pour out a small portion to allow an air space of two centimetre for proper mixing of the sample before analyses.
- Tightly close the cap.
- Store sample in a cooler immediately.

The laboratory data form serves as a Chain-of-Custody record for each sample collected and analyzed. In keeping with laboratory requirements (Standard Methods), all samples must be sealed, chilled, and transported from the sample point to the laboratory for analysis within six hours after sampling. Sample collectors have exclusive custody of any sample from the time of collection until the sample is deposited with the laboratory. The laboratory assumes custody of each sample it receives and is responsible for forwarding all sample analysis results to the Project Manager within twenty-four hours to forty-eight hours of receiving the sample.

Analytical Methods

All analyses shall be performed in laboratories certified by the MDH for microbiological analysis of *E. coli* in water.

Appendix II-D
Beach Monitoring Program

Public Notification and Risk Communication Plan

The public notification and risk communication plan is to address all advisories for "water contact not recommended" at Minnesota's Lake Superior beaches. The plan is to provide the public with accurate and timely information regarding beach WQ, risks associated with water contact, and suggestions on how the public can assist in the protection and improvement of the beach WQ.

A. Public notification and risk communication plan

1. Identify measures to notify USEPA and local governments when indicator bacteria levels exceed a WQS.

   A. The single sample maximum shall not exceed 235 CFU/100mL for *E. coli*.
   B. The geometric mean of five most recent samples collected during a 30 day period shall not exceed 126 CFU/100mL for *E. coli*.
   C. The Minnesota Lake Superior Beach Monitoring and Notification Program issues beach advisories when indicator bacteria levels exceed the above standards.

2. Identify measures to notify the public when indicator bacteria levels exceed a WQ standard.

   Signs, the MPCA Beach webpage (www.MNBeaches.org), Earth 911 webpage, e-mail alerts to participants and media, local phone hotline message, and news releases to the media will be utilized to alert the public to the hazards. Interested parties and managers of sites are also called when an advisory is posted and again when the advisory is removed.

3. Identify notification report submission and delegation process.

   Currently, two of the three counties have health department staff that work directly on the monitoring and notification program. When indicator bacteria levels exceed a WQ standard the county staff are notified, the county staff post the sign, an e-mail alert is generated by beach program staff and sent to interested participants and media, and appropriate parties are notified with a phone call. Because the program is coordinated through the MPCA office, including lab facilities and the notification process, there is no need for notification report submission to the MPCA from the county health departments.

B. Measures to notify USEPA and local governments

1. Identify measures to notify USEPA when a state WQ standard is exceeded.

   The USEPA will be notified in the annual report of exceedances of state WQS. The USEPA can be notified on a more timely fashion, if they so choose.

2. For states, identify measures to notify local governments when a WQ standard is exceeded.

   Minnesota has a small number of local governments to work with on the north shore of Lake Superior. There are three counties, seven cities/towns, and four state parks. The MPCA will send out e-mail notification with a follow-up phone call to make sure the information was received and the proper action taken.

3. States, tribes, and local governments must notify USEPA annually if exceedances of WQS and actions taken to notify the public.

   The USEPA will be notified in the annual report of exceedances of state WQS in the annual report. The USEPA can be notified on a more timely fashion, if they so choose.

4. States only must notify local governments promptly of exceedances of WQS and actions taken to notify the public.

   When there is an exceedance of the bacteria standard the county is notified with a phone call and asked to post the sign, the public is notified through the media via a news release and posting on the Web page, and interested parties such as state park managers receive a phone call. We are using the same process for removal of an advisory.

C. Measures to notify the public

1. Identify measures to notify the public when a WQ standard has been exceeded.

   A central aim of the Beach Team is to produce a comprehensive communication plan to inform the public of beach water health risks and WQ issues in general. Several products were developed for previous beach seasons in Minnesota and will be updated for the 2008 season.

   Web sites
   The Beach Act staff is currently developing several Internet outlets to post updated information about beach WQ status at individual beaches. The MPCA website (www.MNBeaches.org) itself features a page about beach WQ and public health and the BEACH Act. The staff is also working with the Earth 911 website to post detailed information about Minnesota Lake Superior public beaches. Other Web pages to have links to our Web page include: MDH, MN Planning, Duluth Stream (www.lakesuperiorstreams.org), MDNR State Parks, WLSSD, and North Shore Water Trail.

   Brochures
   The Team has an informational brochure to distribute to the public. “Business” cards with website and program information have been developed and distributed. A series of fact sheets are also being developed with the frequently asked questions (FAQ) already completed.

Signs
The Team has developed standard beach advisory signs. The signs clearly show when risk is present using both words and a "no-swim" icon. The sign presents information about causes of water contamination and shows how to contact authorities for more information.

Media Partnering
The Team will continue working to partner with local mass media outlets to communicate beach health risk information to the public. This includes newspapers, radio and television. Program staff have done a number of interviews with all local television stations, a number of radio stations, and all local news papers.

MPCA Outlets
The Team will take advantage of MPCA information dissemination media, such as the MPCA's quarterly "Minnesota Environment."

Other Outlets
The staff will be working to make presentations at appropriate public meetings such as the Park Point Community Club, North Shore Water Trail Board, County and Township Boards, and other appropriate groups. Other outlets could include articles in the Minnesota Volunteer, Lake Superior Magazine, a booth at the annual Boat Show, and participation in the Riverquest.

Promotional Items
The Team has developed a number of promotional items – beach balls, hand sanitizer, carabiner key chains, magnets, sand pales and business cards – to get the word out about the new website and hot line number. These have been very well received at public meetings, festivals and other events.

Hotline
A local hotline (218-725-7724) which has a recorded message with updated beach advisories was started in the late summer of 2004 and will continue into the future.

2. Immediately issue a public notification or resample for bacterial exceedance of a WQ standard.

   When bacteria samples are exceeded the public is notified with news releases, Web page updates, e-mails, and phone calls. The site is resampled, as soon as possible (Monday through Thursday sampling only because of availability of the lab), and daily sampling continues until the site is back below the WQ standard.

3. Promptly notify the public of a WQ standard exceedance when there is no reason to doubt the accuracy of the sample.

The “all clear” is issued through the same steps as the advisory. Signs are removed, a news release goes out, and appropriate phone calls are made.

4. Post a sign or functional equivalent when a WQ standard is exceeded.

   Advisory signs are posted on large portable orange and white hazard signs with reflective material. They are placed on the high traffic areas of the beach.

D. Notification report submission and delegation

State, tribes, and local governments must notify USEPA and in the case of states, local governments must be notified annually of notification plan changes and any delegation of responsibilities.

The Lake Superior Beach Monitoring database is being designed to generate a variety of summary reports from a variety of categories. The following summary reports will be submitted to USEPA on an annual basis:

A. Steps utilized for public notification of advisories;
B. Beach descriptive data;
C. Beach programmatic data;
D. Station and method identification data; and
E. Beach advisory data.

There are no delegated local governments at this time. All local governments participate and coordinate through the MPCA Duluth office.

Appendix III

Final 2008 Impaired Waters List

The MPCA will not have "final" approval of the Impaired Waters list by USEPA in time to meet the IR's April 1, 2008 deadline. Subsequently, the list is not included here but will be added as Appendix III once USEPA provides MPCA with final approval.

On June 10, 2008, Region 5 U.S. EPA approved the 2008 TMDL list. This list can be found at the following link;

http://www.pca.state.mn.us/publications/wq-iw3-15.xls