Part III: Water Resource Assessments

Chapter 1: Surface Water Monitoring Program

Monitoring and assessment are the cornerstones upon which the state's water quality program rests. Monitoring information is an essential element in environmental management programs. Without data and information, we cannot characterize the condition of the environment, assess and solve problems or evaluate the effectiveness of management regulatory actions. The overall goal of surface water monitoring is to gather the information needed to effectively manage and regulate surface water resources. Furthermore, the Clean Water Act and State of Wisconsin law and associated rules mandate monitoring of surface waters. The collection of information is also essential to educating and increasing public awareness of the environment and environmental issues.

Multiple types of monitoring are implemented to achieve a comprehensive understanding of the state of our surface waters. These types include ambient or baseline monitoring; special project monitoring, long-term trend monitoring, and total maximum daily load monitoring.

Baseline Monitoring

As both the theory and the practice of "comprehensive monitoring" evolve with improved science and understanding, Wisconsin's approach to documenting the *baseline* quality of its waters continues to change. Historically much of the DNR's monitoring work focused on degraded watersheds or evaluation of waters with a high public profile. Today, our *baseline* water quality monitoring approach is founded on the abundance of surface water resources in Wisconsin precludes adequately monitoring these resources in a timely fashion. With proper program design, not every waterbody need be tested to provide solid spatial coverage of baseline conditions, as much can be inferred from good data and information. For example, over 60% of the state's wadeable streams are small, "headwater" first order streams. These streams provide excellent candidates for implementing a random stratified sample design. This idea, grounded in a statistically valid scientific approach, will provide greater breadth to the number of waterbodies assessed under our basic or core water data gathering efforts.

Wisconsin will in 2002 pilot the use of a "random stratified sampling technique" for assessing wadable streams for an across-the-board look at the condition of our waters that will provide us with greater knowledge of resource condition in a relatively shorter timeframe with less cost in the long run. In addition, standardized assessment techniques for aquatic habitat, macroinvertebrates and fish have been developed and are being applied throughout the state and all data is being captured in a web-accessible database.

Baseline monitoring strategies have been developed for four key resource areas: wadeable streams, non-wadeable rivers, lakes, and wetlands. Sampling designs are also is proposed for baseline toxicological monitoring of sediments and fish. Baseline monitoring is intended to provide adequate spatial and temporal aquatic sampling activities to address the following management questions:

- What are the use expectations for Wisconsin's water resources?
- Are the state's waters meeting their use potential?
- What factors are preventing the state's water resources from meeting their potential?
- What is the statewide status and trend in the quality of Wisconsin's surface waters?

To achieve the goals of the program, the following specific set of monitoring objectives were established:

Determine the designated attainable uses of each waterbody. Stream and lake habitat information (including volume, temperature and limited water chemistry) and fisheries data, and stream macroinvertebrate data collected during baseline assessments will be compared with biological

criteria obtained from "least-impacted" regional reference waters to determine the water's use classification.

Determine the level of use attainment of each waterbody. Stream habitat, macroinvertebrate and fisheries data collected during baseline assessment monitoring will allow the WDNR to determine if waterbodies designated uses are being attained.

Determine why some waterbodies are not attaining their designated uses. Physical, chemical and biological data collected during baseline assessment monitoring will provide some, if not all of the information needed, to determine why streams are not meeting their designated uses.

The monitoring data is captured electronically in centralized database accessible to DNR field staff to improve data analysis and dissemination. The resulting information will be readily accessible to all resource stakeholders and management partners. This database, called the Statewide Fish and Habitat Biological Database, captures raw data and will eventually be linked to the state's 1:24K hydrodrography layer for spatial display. Resource managers are working on developing a linkage between the baseline program, the relational database and the state's overall designated use assessment process.

Wadeable Streams

Historically within DNR different types of information were collected from streams, depending upon the local management questions there were being addressed. This lack of standardized assessment and data-capture produced information of unknown quality inhibited data sharing, and made comparisons of stream quality over time or across geographic areas difficult. Standardized protocols and sampling effort, and electronic data capture will significantly increase the power and utility of field data collected.

For the past two years DNR fisheries and water quality biologists have been applying the standardized protocols to address local and basin-wide data needs. Staff have become more familiar and efficient with the field protocols and the data entry system. With increasing confidence in the fact that the data being collected can serve both local and statewide data needs, the number of sites assessed and the power of the database should increase markedly.

The next step is to improve spatial coverage of stream assessment sites. Baseline data already gathered has allow us to develop a statistically-valid assessment of how many sites need to be assessed on a stream to detect changes in stream habitat or fish community composition. A randomized sampling-site selection process will be piloted in the West Central Region. Relatively few (35-50) randomly-selected stream assessment sites can be used to answer the question of what proportion of streams are meeting (or not meeting) use attainment expectations within a DNR Region, a question that the Department has to date been unable to answer with statistically valid data.

In 1999, a total of 286 stream sites were sampled using baseline protocols, in 2000 a total of 506 stream sites were assessed, and in 2001 a total of 384 stream sites were assessed.

In 2002 an EPA-EMAP project will be initiated in the Driftless Region ecoregion. The objectives of this two-year research project will be to study ways to improve upon how WDNR selects and monitors wadable streams in WI. We currently use a targeted approach to sample streams (i.e. biologists pick stream sites to answer specific questions). This approach is great for addressing local management needs but bad for trying to assess statewide status and trends-type questions (since the resulting data from the targeted sampling is often biased toward either really good or really bad streams depending upon the focus of the study). The three components of the study are: 1) Develop and institutionalize a probability-based stream site-selection method; 2) Develop a multi-metric index that uses stream invertebrates as biological measures of stream integrity; 3) Use watershed land use, water chemistry, macroinvertebrate, and fish community data - collected at the randomly selected stream sites to determine the effects of land cover and land use on the quality of WI stream resources to improve our understanding and management of factors affecting stream health. The pilot study strategy will be applied to the rest of the state once the methods and metrics are refined.

Nonwadeable Streams

A nonwadeable stream is a stream in which you need a boat to conduct biological sampling under normal flow conditions; a stream with a depth of at least 3 to 4 feet for at least 10 miles usually meets this definition. Wisconsin has 34 nonwadeable streams with a total length of approximately 2,500 miles. Some portion of a nonwadeable stream is located in 17 of the 23 geographic management units (GMUs) (See Table 8).

The stated purpose of baseline monitoring is to describe the health of the ecosystem, with the goal of answering the three management questions stated above. Answering these questions will benefit the Water Division's management programs, such as being able to respond to questions from the public about the condition of their stream. Further data analysis may allow tracking the spread of exotic species, for example (See Table 9).

Table 8. Nonwadeable Streams in Wisconsin

Code	River Name	Miles
Mississippi River Basin		
MS	Mississippi	231
IFX	Fox	26
RK	Rock R	132
PC	Pecatonica	60
EBP	E. Br. Pecatonica	20
SU	Sugar	29
BK	Bark	13
CR	Crawfish	21
GR	Grant	19
WI	Wisconsin	379
KP	Kickapoo	84
BA	Baraboo	74
LE	Lemonweir	50
YRW	Yellow	49
TH	Tomahawk	30
BL	Black	76
TR	Trempealeau	32
BU	Buffalo	23
CH	Chippewa	176
RC	Red Cedar	89
ECC	Eau Claire	29
FL	Flambeau	112
SFFL	S. Fk Flambeau	46
SC	St. Croix	144
NA	Namekagon	30
Lake Superior Basin		
SL	St. Louis	18
BA	Bad	34
Lake Michigan Basin		
ME	Menominee	119
PS	Peshtgo	52
OC	Oconto	18
FX	Fox	158
WF	Wolf	120
LW	Little Wolf	11
EM	Embarrass	34

Table 9. Benefits to Answering Management Questions

Help us answers questions from the public about the condition of their stream.
Help us track spread of exotic species
Help us prepare future 303d lists.
Help us prepare annual 305b report.
Help us do basin assessments.
Help us select NPS projects.
Help us provide some biological data for FERC re-licensing.
Help us improve IBI for nonwadeable streams.
Help us evaluate needs for changes in fish management activities, such as size limits.
Help us organize response monitoring
Help us collect fish samples for fish contaminant analysis.
Help us supplement aquatic terrestrial survey.
Help us compare quality of sediments below urban areas.
Help us document quality of fish statewide.
Help us document status of threatened and endangered species.
Help us update existing biological data.

Sampling Design

Sampling design includes 1) site selection criteria, 2) number of sites, 3) types of parameters, and 4) sampling frequency. Sampling design decisions are based on starting with the minimum monitoring effort needed to answer the three management questions, which minimizes costs.

Site Selection Criteria:

For nonwadeable streams, the stream is divided into three types of reaches: 1) riverine (unimpounded and more than 1 mile from a dam), 2) tailwater (unimpounded riverine stretches immediately below a dam), and 3) impoundments. Each type of reach tends to have distinct physical-chemical attributes, biological communities, and human use patterns.

Reference sites, which are relatively undisturbed areas used to track the natural variability of the stream's ecological health, are selected for each of the three types of reaches in each region for a total of twelve reference sites statewide. These sites are monitored annually, while other sites are monitored once every five years.

Number of Sampling Sites:

There are about 150 dams on the nonwadeable streams, with about 32 of those dams less than 2 miles in proximity, leaving about 118 dams with three distinct reaches, or a total of 354 reaches. Most regions seem to have about 150 miles of free flowing reaches, which represents about 5 reaches of 30 miles. An additional 20 reaches added for various reasons brings the total number of reaches to 374. The baseline strategy involves monitoring about half of these sites every five years, or about 46 sites each year. Including reference sites, the total number of sites monitored in five years is 180, or from 1-12 in each region each year. . Repeat monitoring at the 180 sites every five years provides data for long-term trend analysis, particularly over a 20-year time span.

Parameter List:

Below is a minimum parameter list. However, some method development is required before all the parameters identified below can be obtained.

Table 10. Types of Sampling Suggested for the Nonwadeable Stream Baseline Monitoring Strategy

Sampling for Riverine and Tailwater Reaches	
Habitat:	Need to develop checklist by next summer. Should include presence of macrophytes and exotic plant species.
Fish Community:	Measurement of IBI - Includes identification of exotic fish species.
Water Quality:	Includes instantaneous D.O., temperature, pH, and secchi disc readings recorded as part of fish community sampling.
Flow:	If available, check USGS flow for day.
Macroinvertebrates:	Need to develop sampling method.
Sport Fisheries:	A limited assessment of sport fisheries, such as catch per unit effort. Methods will vary between different rivers.
Types of Sampling for Impoundments	
Water Quality:	Chlorophyll-a, color, calcium, and Total P analysis, D.O. and temperature profiles along with secchi disc reading. Samples should be collected near the dam three times during a year.
Stage and flow:	If available, record USGS numbers.
Macrophytes:	Need to develop method.
Habitat:	Need to develop check list by next summer. Check list should include presence or absence of major types of macrophytes.
Sport Fisheries:	A limited assessment of sport fishery, eg. catch per unit effort and size structure.

Two monitoring methods that require additional development include macroinvertebrate sampling method for riverine and tailwater reaches and a macrophyte sampling method for impoundments. DNR must also better define the amount of work to be done for the sport fisheries monitoring. Most of the parameters selected for the impoundments will help define water quality. Water chemistry, color, dissolved oxygen, and secchi disk measurements will be used to estimate the trophic status of the impoundments. Macrophyte surveys should help us describe the amount of habitat available for fish and wildlife.

Sampling Frequency

All reaches selected for sampling, except reference sites, should be sampled once every five years. The twelve reference sites are sampled every year. Sampling once every five years means more than one visit during a year for water quality monitoring in impoundments and sport fisheries sampling. Sport fisheries sampling will require at least five consecutive days of visits to the site, while three visits are required for water quality monitoring in impoundments.

Lakes

The objective of the monitoring strategy for lakes is to determine the status of and trends in lake ecosystem health as it relates to the broad ecological endpoints of fishability and swimmability. The focus of the lakes program is on the effects of environmental change related to broad-scale changes in land use and shoreline development. WDNR also monitors human use of lake resources. The program samples all high-visibility waters and sub-samples other waters to provide:

- A context for data collected from all lakes and the capacity to compare lakes within strata.
- Information from trends lakes that will generate a context to compare lake health across strata through time.
- A basic inventory of lake condition.
- An answer to initial questions about the swimmability and fishability of individual lakes.

- A standardized set of spatial and temporal data that can be compared to current lake conditions.
- The capacity to make a statewide determination about the health of our lake resources.

Below are five objectives considered critical to the success of a lake monitoring program. In addition, a proposal for trends monitoring is incorporated into the plan for baseline/condition monitoring because both are vital to achieving the goals for lake monitoring.

- Objective 1. Develop and Evaluate Lake Stratification Framework
- Objective 2. Identify and refine metrics to appropriately assess the ecosystem health of the state's lakes. Determine properties of metrics, including robustness, variability, and sensitivity to changes in lake ecosystem health.
- Objective 3. Design Baseline Plan for Condition Monitoring
- Objective 4. Design an efficient monitoring program that assesses trends in the metrics measuring the ecosystem health of the state's lakes.
- Objective 5. Determine the status of and trends in human uses of lake resources. Document the links between human actions and lake ecosystem health.

Approach/Design

Target Lake Population: The monitoring program will focus primarily on assessing status and trends in Tier I lakes, defined as those > 100 acres in surface area and with public access. Sampling of Tier II lakes (< 100 acres with public access) is included on a reduced scale.

The design of the program includes both trends and status lakes. The status lakes provide spatial data needed for baseline monitoring and statewide assessments. Further, by sampling these lakes on a 5-10 year rotation, we can augment the trends set of lakes. The trend lakes will be monitored every other year beginning in the spring of 2000. This will provide information on interannual variability as well as trends in lakes representative of the lake strata defined below. Managers should use existing programs (e.g., ambient lakes monitoring) to guide their selection of lakes for trends monitoring.

Lake Stratification: Lakes will be hierarchically stratified according to physiography (GMU and ecoregion), hydrology (seepage and drainage type, including impoundments), and morphometry (shallow and deep). Stratification of lakes is necessary to minimize variance in measured response variables, permitting us to understand the patterns within the response measures. Further, stratification of lakes allows us to efficiently extrapolate information to non-sampled lakes.

Metrics Related to Ecosystem Health: Three groups of metrics have potential as endpoint measures of ecosystem health — fishery exploitation, riparian development, and watershed land use change. These metrics are all easily measured and well understood, and are either currently used by staff or are in the process of development. Together, they provide some redundancy as measures of ecosystem health and offer complementary measures of lake ecosystem function. All three metrics should be sampled during the same calendar year for all lakes on the plan as a minimum set of metrics. Additional metrics to measure angler harvest and habitat changes are being evaluated as well.

Trophic Status Indices (TSI): Trophic status is assessed by measuring the following water quality variables during the period of peak stratification (August): total phosphorus (TP), secchi disk transparency, chlorophyll a, dissolved oxygen and temperature profiles, color, and calcium. For the trends lakes, calcium will only be measured the first year, as these data are needed to refine the lake classification scheme.

Fish IBI: Currently under refinement, the IBI uses littoral fish assemblages as an index of biological integrity. This metric has proven to be a sensitive indicator of riparian and watershed land use change and can be calibrated to reflect other water quality problems. The first sampling objective is to create a complete species list from a combination of gears. The species list will be generated from summer seining and mini-fyke nets, and from the spring gamefish sampling. Sampling with seine and mini-fykes can be conducted from June-September. The second objective is to measure proportional abundance of species or guilds of fishes with specific sampling gears (seines and mini-fykes).

Game Fish: Spring gamefish is sampled by electrofishing the entire shoreline when water temperatures have reached 55-65 ^{0} F. If the amount of shoreline is excessive, then 25% of the total shoreline length or a minimum of four miles should be sampled. If the entire shoreline is not shocked then stations of 2 miles in length should be developed.

Wetlands

Unlike other surface waters, wetlands have not been included in planning and monitoring strategies. Resources regularly allocated for water quality programs have traditionally not involved wetlands. There is currently no explicit monitoring strategy for wetlands outside the Wisconsin Wetland Inventory (WWI). To complicate matters further, wetlands do not fall within any one program. Management typically occurs in the Land Division, regulations are administered in the Water Division and research is carried out in the Division of Enforcement and Science. A program to monitor wetlands must not only start at a very preliminary level, but it also must cross program boundaries to involve water, land and enforcement and science division programs.

The results of wetland monitoring are needed for analysis at the watershed and landscape level. Monitoring of wetland locations, types and health, can aid in the assessment of watershed "protector" functions (maintenance of hydrologic regime, stormwater and flood storage, downstream water quality related functions) and other human use values such as recreation and education. The ultimate goal is to determine how wetlands in a given landscape unit are functioning, how they are being used, what their potential uses are and how to restore functions.

- Provide a meaningful wetland analysis component for regionally based planning efforts (including evaluating the causes and cumulative effects of wetland loss in a given geographical area) for use in the basin planning process, in a redesigned priority watershed planning process, and in identifying acquisition, restoration and management priorities.
- Strengthen and prioritize the focus of the Department's water regulatory program.
- Provide good baseline information for use by the NRB, Department and public to set statewide policy on wetland protection, restoration and management.
- Answer current questions posed by the Natural Resources Board and public on wetland losses and gains.

Specific Goals and Objectives for Baseline Wetland Monitoring

Wetland baseline monitoring is broken down based on the types of questions this work can address — wetland quantity (by type and location) and wetland biotic health; monitoring goals and objectives have been developed for each area.

Goal: Quantify the amount and type of wetland in the pre-settlement landscape and what changes have taken place historically. Monitor current baseline status in wetland quantity (number of acres) and type.

Goal: Determine the overall health of the states' wetlands. Determine how wetland health is changing and what is causing the change.

In the area of identifying overall wetland health, development of assessment tools that can be used in a variety of applications, particularly at the watershed level, is needed. It is critical to focus attention on the biotic health of wetlands in discussing regulatory issues, planning and restoration, though we need to be very careful about how these tools are used.

Develop methods to quantify biotic integrity of wetlands.

Develop a multi-metric Index of Biotic Integrity using reference wetlands. The long-term goal is to develop IBIs for the most critical wetland types over the next few years. Examples are riverine, lacustrine, groundwater flowthrough, palustrine.

DNR has obtained funding from an EPA Wetland Grant for a research project to develop an Index of Biotic Integrity for Depressional Wetlands. The project goal is to develop a multi-metric index using macro-invertebrates and plants. Samples of diatoms and zooplankton have also been taken, but not analyzed. The grant project was to be completed in September 1999, with the project report due in December.

For the long term, continued research is necessary to test the Index, to expand it to other wetland types and to develop sampling methods that can be used by volunteers and school groups.

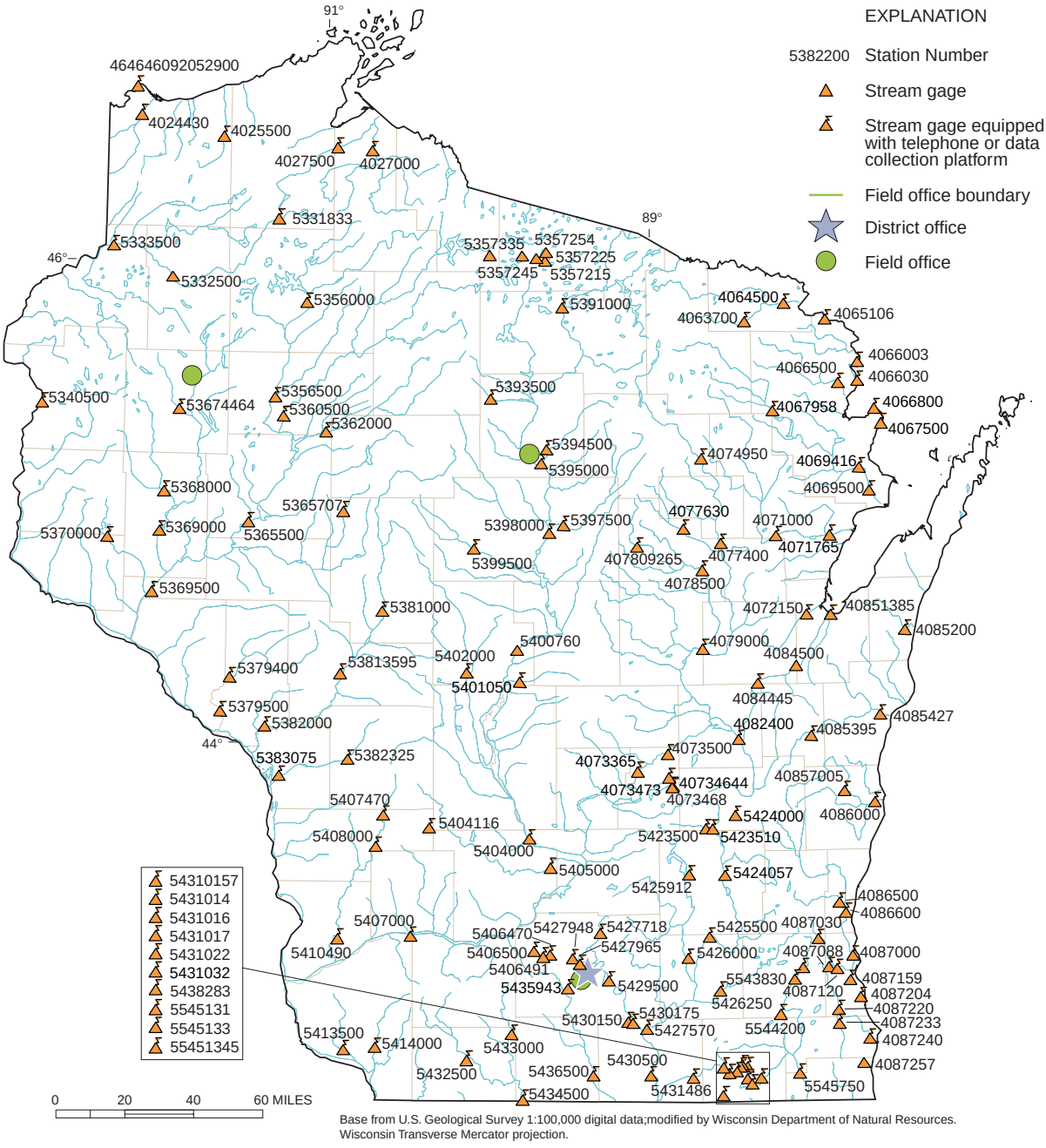
Pathogens

While the DNR does not regularly conduct pathogen monitoring, the department is working with local governmental units and state and federal partners to better coordinate monitoring of pathogens at beaches throughout the coastal waters through the USEPA BEACH Initiative.

Fixed Station/Long Term Trend Monitoring

In Wisconsin the U.S. Geological Survey operates 110 long-term flow gages, most of which are at least 60% supported by cooperators (Figure 18). There are over 30 cooperators including the COE, FERC regulated dam owners, native American tribes, planning agencies, counties, cities, sewerage districts, as well as the DNR. Real time data from all sites are available on USGS's web site.

Figure 18. Wisconsin Long Term Trends Sites



Base from U.S. Geological Survey 1:100,000 digital data;modified by Wisconsin Department of Natural Resources. Wisconsin Transverse Mercator projection.

In 2001, the DNR funded operation of 14 of the gages, 12 normal stage type and 2 acoustic velocity meters. As part of the budget process, DNR staff were asked to identify needs for additional gages. Ten sites were identified to support groundwater and high capacity well issues, long-term water quality needs, development of TMDLs, and floodplain zoning work. Many more sites would be useful and requested if money for long-term support was available.

Sediment Monitoring

Sediment monitoring is conducted as part of baseline condition monitoring or for special projects to 1) investigate areas with contaminants associated with pollutant sources, 2) investigate areas of fish advisories, 3) establish reference/background concentrations of metals and organic compounds through various sampling efforts, 4) determine pre-dam removal assessments or other stream disturbance assessments, and 5) assess contaminated sediment sites.

Sediment Mapping

Sediment mapping continues to be an integral part of Wisconsin's contaminated sediment program. Sediment mapping techniques continue to improve in efficiency and data analysis with the use of Global Positioning Systems technology and multiple levels of GIS integration. By using proven field techniques and sound analytical methods, spatial and temporal components of contaminated sediment occurrence and transport can be identified. Subsequently, sampling, planning and site management efforts are greatly refined.

In the last two years WDNR sediment mapping has been used in a number of contaminated sediment investigations and post-remediation monitoring. Sites of primary concern include:

- Post-remediation mapping and sampling of the Rib River oxbow - metals contamination site (Rib River, Wausau).
- Contaminated sediment investigations at the Linen Mills Dam impoundment prior to removal of the Linen Mills Dam (Baraboo River, Baraboo).
- Sub-bottom profiling and sediment sampling for the Devils Lake phosphorous-reduction project (Devils Lake State Park).
- Sediment characterization and sampling for the Kewaunee Marsh Arsenic Site Remedial Investigation (Kewaunee River, Kewaunee).

WDNR is also currently investigating techniques to document the behavior of site-specific sediment bed dynamics in response to varying flow regimes.

Special Project Monitoring

A number of studies fall under the special project monitoring category, including total maximum daily load (TMDL) monitoring, best management practice (BMP) evaluation or assessment monitoring, and ongoing water quality sampling unrelated to the state's baseline monitoring program. Below is a list and description of selected special projects monitored during 2000-2001.

Castle Rock Creek Watershed TMDL Work

Castle Rock Creek has been receiving considerable attention from watershed landowners, trout angling enthusiasts and public agencies over concern for environmental threats and perceived water quality decline. In 1998/99 the stream was monitored to assess biological integrity and habitat as part of a stream bank restoration project. In 2000 a WDNR Rivers Protection Grant enabled the Castle Rock Creek Committee to monitor the stream, while WDNR staff conducted baseline monitoring. While these projects have provided valuable information on the health of biotic communities and habitat quality, a much more detailed study was needed to identify threats, use impairments, and pollutant loads. This project involves conducting intensive chemical and flow monitoring sufficient for use in support of TMDL development. The sampling design is based on a USGS study which included both baseflow and event pollutant load monitoring. Baseline bioassessment monitoring will also be continued during this time, and expanded to

include periphyton productivity and bacteria content in the stream. In addition, inventories of barnyards, land use types, crop rotation data, plant and harvest dates, fertilizer application rates and tillage practices will be gathered and used in TMDL model development.

Mill Creek TMDL Work

Mill Creek is on the Wisconsin 303(d) list of impaired waters, and will require development of a TMDL. Recent studies below Marshfield during summer 1998, winter 2000, summer 2000 and winter 2001 found persistent dissolved oxygen (D.O.) problems at various locations in Mill Creek. We suspect the DO problems are due to several potential causes including nutrient and BOD loading from point and nonpoint sources. The purpose of the synoptic surveys, nutrient load monitoring and modeling will be to better define the extent, severity, potential causes and sources of D.O. problems in Mill Creek, both during summer and winter conditions. Results of the monitoring and modeling will provide the technical basis for the TMDL.

Study Design

Synoptic water quality surveys were conducted on the main stem of Mill Creek during summer 2001 under low-flow conditions. DNR has not yet collected the above normal flow samples and budget problems may prevent their collection altogether. Grab water samples were collected from 36 sites located throughout the entire length of Mill Creek. Field parameters included pH, temperature and D.O. SLOH analyzed parameters included N-series, P-series, total suspended solids, volatile suspended solids, BOD5 and long-term BOD, chlorophyll a, hardness and chlorides. The surveys also included stream physical measurements (i.e. width, depth, shading) at sites located every 1mile of stream (the stream is about 50 miles in length). Stream travel time will be determined using dye studies. Dissolved oxygen, temperature and water levels will be monitored during the synoptic surveys using AQUA recording DO meters and staff gauges. The data collected during these surveys will be used in a QUAL II or water quality model to help determine the cause of DO problems in the stream.

In December 2001 two USGS continuous flow monitoring stations were installed at two sites in Mill Creek and monitoring began in February 2002; these stations will operate for two years. Semi-monthly (plus limited storm-chasing) water chemistry samples will be collected by USGS at the continuous flow sites to determine annual nutrient and sediment loads. In addition, wastewater treatment plant operators were asked to collect monthly total phosphorus samples starting in October 2001. The difference between stream and WWTP nutrient loads will provide an estimate of nonpoint loads to Mill Creek.

Little Lake Wissota/Moon Bay TMDL

Little Lake Wissota and Moon Bay are eutrophic embayments of Lake Wissota in Chippewa County. These waterbodies are on the Sec. 303(d) impaired waters list due to pH standards violations as a result of algae blooms caused by nutrient loading to the impoundments. Consequently, the Department is required to develop Total Maximum Daily Loads (TMDLs) for these waterbodies. Development of TMDLs will require considerable monitoring to determine current in-lake water quality conditions and annual nutrient loading from the Yellow River watershed.

Water sampling is being conducted for a minimum of two years beginning in April 2001at both stream and lake monitoring sites. Continuous flow monitoring stations have been established at 3 primary stream sites (Paint Creek, Yellow River, Drywood Creek). In addition, water levels will be measured continuously using a Telog level sensor at Miller Dam. These stations will measure nutrient loading using continuous streamflow and semi-monthly water chemistry sampling. Monitoring will also be conducted in 5 lakes (9 sites) over a two-year period. Samples will be collected in mid-lake at the deepest part of each lake during late winter, spring turnover and semi-monthly during May through September. Department staff will be responsible for lake sampling and U.S. Corps of Engineers (COE) staff will be responsible for stream gauging and sampling.

The internal P load will be estimated using soluble P release rates from sediment samples collected by COE from Little Lake Wissota and Moon Bay. The sediment sample release rate studies will be conducted at the COE field laboratory in Spring Valley.

During Wisconsin's FY03, nutrient loading from various land uses will be simulated using the SWAT model. The model uses a GIS database and will require some level of field verification of land use types, cropping and fertilizer practices and crop rotations. A student intern will be hired to conduct these county land use inventories.

The COE will use Flux and Bathtub to estimate P loads and to model the watershed lakes. The models will be used to simulate water quality conditions in Little Lake Wissota, Moon Bay, Otter Lake and Chequamegon Waters Flowage. The Bathtub model will also be used to simulate the effects of various nutrient load reduction scenarios for each lake.

Baird Creek Watershed Management Study

This study (May 2001-June 2003) involves collecting baseline information on the existing physical, chemical and biological conditions in Baird Creek to determine if water quality criteria and state standards are being met. The result will be a plan to establish criteria and standards to improve and protect use of the waters by aquatic life as well as for the public to enjoy.

- Review historical water quality data.
- Establish 3 sites in the Creek to collect chemical water quality samples that will determine current nutrient and sediment levels using the format (Robertson et. al. December 1999).
- Establish a stream gauging station that will allow us to measure flow on a continuous basis and determine nutrient and sediment delivery at various reaches of the stream as well as loadings to the East River.
- Determine land use in the watershed and estimate nutrient and sediment loadings to Baird Creek and the East River. Mathematical models will be used in this phase of the study. ARC VIEW and other GIS applications will be used to manage the data.
- Conduct a habitat assessment using the Department's current methods in several reaches of the stream.
- Collect macroinvertebrates from several reaches of the stream in the spring of 2002 to apply to Hilsenhoff's biotic index.
- Work with members of the public, other officials, Baird Creek Preservation Association, Lower Fox River Partnership Group for their input and approval in developing the final monitoring plan.
- Work with members of the Fox/Wolf Data Acquisition Group for their input and approval of the final monitoring plan.
- Use this information to apply to the 10 step US EPA Total Maximum Daily Load (TMDL) criteria.
- The final plan for improvement or protection can be used as a model for developing nutrient and sediment load allocations in the Fox/Wolf Basin, if the final conclusion determines its applicability.

Additional Special Monitoring Studies include:

- Mead Lake
- Cedar Creek Ruck Pond
- Sheboygan River, Fox River Sediment Projects
- Wisconsin River
- St. Croix
- Half Moon Lake
- Tainter Lake

Fish Tissue Monitoring

During calendar years 2000-2001, over 1200 fish samples were collected as a part of the fish contaminant monitoring program (Table 11).

Table 11. Fish Samples Collected Years 2000-2001

Year	Sites Sampled	Samples Collected
2000	96*	806*
		Statewide mercury advisory adopted
2001	57*	407*

* Estimated at time of publication

These samples were from inland waters (lakes and rivers) and the Great Lakes. In 2000-2001, samples were collected from approximately 80 lakes, 50 streams and river segments, and 20 areas of Lakes Michigan and Superior (preliminary data as of January 2002).

Samples from the Great Lakes were analyzed for PCBs, pesticides, and mercury, while samples from river systems were primarily analyzed for PCBs and mercury. Fish samples from inland lakes were analyzed almost exclusively for mercury.

In 1999, the WDNR initiated a new baseline strategy for lakes, wadeable, and non-wadeable streams and rivers for fish community and habitat monitoring. Under this monitoring strategy, fish are collected for contaminant analysis at a subset of the baseline sites where little/no data exists. The goal is to determine statewide distribution of contaminants, provide a comparison of the levels of contaminants between impacted sites throughout the state and with unimpacted (reference) sites, and to provide information to ascertain whether more intensive monitoring is needed at a given site.

In addition to baseline monitoring, special assessments will continue in order to update advisory waters and those involved in remediation efforts. In addition, WDNR uses fish tissue monitoring for source investigation, to track the effectiveness of remediation efforts, and to determine potential effects of toxic substances and contaminated sediments on fish-eating birds and wildlife.

Another major element of the fish tissue monitoring is the assessment of contaminant levels for Lakes Superior and Michigan and their tributaries. This trend assessment, requiring the collection of game and forage species biennially, primarily is designed to determine contaminant trends and geographic patterns of contamination.

Public Health Fish Advisories

Refer to Chapter 7 for information on Wisconsin's public health fish advisories.

Intensive Surveys

Ongoing intensive studies on major waterbodies in the state are often implemented in conjunction with cooperators such as the USGS and the USEPA. Three major systems that DNR conducts special studies on include the Mississippi, Wisconsin and St. Croix Rivers. (See Part III, Chapter 3: Rivers and Streams for a discussion of these studies.)

Volunteer Monitoring

To learn more go to: http://www.dnr.state.wi.us/org/water/fhp/lakes/shlmmain.htm or http://clean-water.uwex.edu/wav/monitoring/index.htm

Lakes Volunteer Program

Wisconsin has had a solid volunteer monitoring program in place for lakes for several years. Self-Help Citizen Lake Monitoring and the Self-Help Volunteer Lake Monitors have been an integral part of the Wisconsin lake management since 1986. Citizens who live on their lake and know their lake better than anyone else have volunteered themselves in partnership with the Department of Natural Resources. This concept has been so successful that Self-Help Citizen Lake

Monitoring was expanded to include volunteer opportunities for chemistry, dissolved oxygen monitoring, and aquatic plant surveys. Since its beginning, over 3200 volunteers have participated in the program on over 1000 different lakes.

Lake monitoring data collected by volunteers is now available at http://www.dnr.state.wi.us/apps/LakeSelfHelp/lakeshome.asp

For the lakes program, DNR provides all equipment. Training is provided by either DNR or University of Wisconsin - Extension staff. Volunteers provide their time, expertise, energy and a willingness to share information with their lake association or other lake residents. The information gathered by the volunteers is used by lake biologists, fisheries staff, water regulation and zoning, U.W. Extension office, Lake Associations and other interested individuals. For example, data from this program is used extensively in the state's 305b Water Quality Assessment Database, which is summarized in this report.

Rivers Volunteer Program

Until recently, river monitoring in Wisconsin has been conducted in a much more decentralized and less structured fashion than the Lakes Monitoring Program. Central support for rivers monitoring is provided cooperatively by the Wisconsin Department of Natural Resources and the University of Wisconsin-Extension for the Water Action Volunteer (WAV) Program, an outreach education program for Wisconsin citizens that involves stream monitoring, storm drain stenciling, and river and shoreline cleanup programs. Historically this popular program has provided a rich format for ecology and water quality education. However, due to the complexity of river systems and the absence of laboratory support, this program has generally not produced data for use in DNR analysis of water quality.

Beginning in 1996, the Department and UW-Extension through the WAV Program initiated two pilot projects — in Dell Creek and in the Pigeon River watershed (see below)— involving community representatives and volunteers to develop systematic protocols for volunteer monitoring work. The goal of this part of the program is to standardize monitoring techniques so classrooms, citizen groups and staff are able to share information using the same technology. Today, there are over a dozen groups, monitoring about a hundred stream sites throughout the state. Citizen groups can now enter their data directly into a web-based database; the data can be viewed by anyone with internet access. Benefits of this program include providing useful data to the community and the department for the site-specific projects as well as this 305b Water Quality Report.

WAV Program Results

Painting a message next to storm drain inlets has become the water quality hallmark for almost 100 communities across Wisconsin. This highly visible event has educated communities about storm water pollution and ways to curb its effects. With spray paint in hand, volunteers representing 4-H clubs, school groups, religious groups and civic groups have painted storm drains with the message: "Dump no Waste." Brightly colored fact sheets are distributed that explain the origin of stormwater pollution with suggestions of practical ways for an individual to lessen the load. Both stencils and door hangers were also available in Spanish. About 3500 volunteers have stenciled over 9000 storm drains in the past five years. The success of this event is due to the many DNR, county, and UW-Extension local offices that worked closely with the WAV program to distribute or loan supplies to local volunteers.

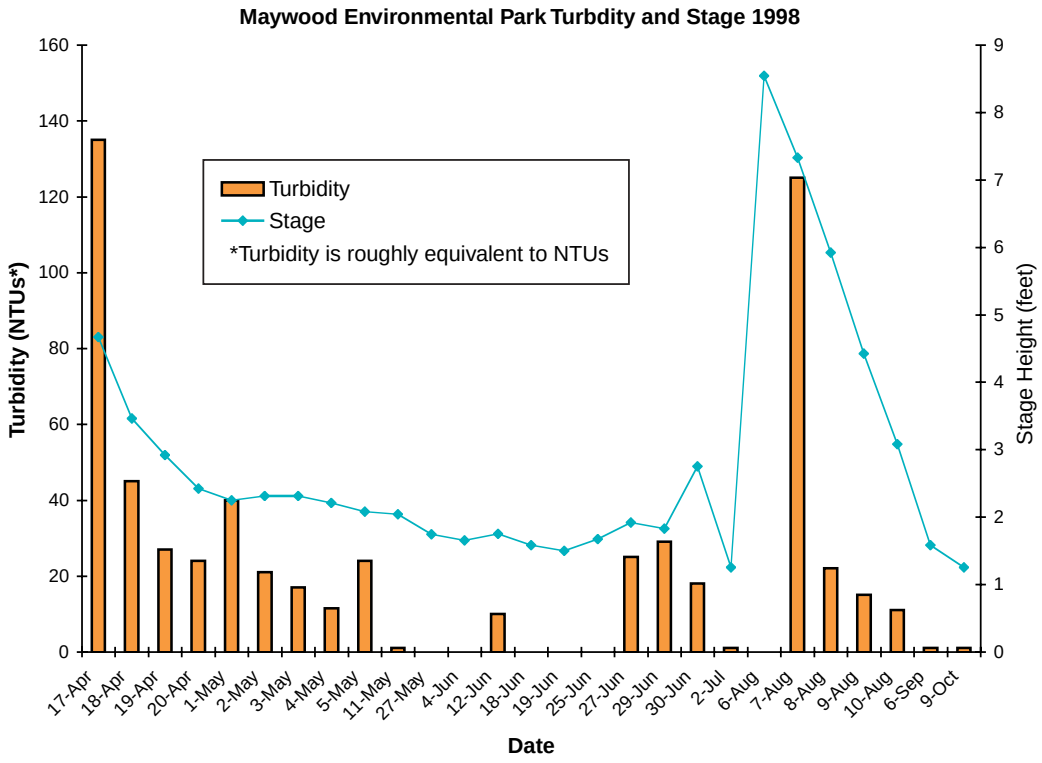
Another activity that WAV is involved in is cleanup of river and stream shorelines. Over 11,000 volunteers have collected over 80 tons of garbage from nearly 500 miles of Wisconsin's shoreline since 1997. All across Wisconsin, volunteers are joining together to make their local waterways cleaner, safer and healthier for everyone. Much of the success can be attributed to the cooperative effort of local interest groups that make cleaning a river a community-wide event.

Activity packets are a very popular way to get the message out about WAV. Since the program began in 1994, activity packets containing educational materials and hands-on activities specific to rivers and streams have been distributed free to Wisconsin residents. WAV outreach efforts include sharing water-quality related educational displays and programs, and assisting local groups with monitoring, storm drain stenciling.

Pigeon River Water Action Volunteers:

Citizens began monitoring water quality in the Pigeon River and its tributaries in 1996 as a pilot project for the WDNR's and UW-Extension's Water Action Volunteers' citizen stream monitoring program. In the 2001 monitoring season, 15 dedicated citizen monitors continued to collect data at nearly 25 sites in at least three sub-watersheds and along the main stem of the Pigeon River in both Manitowoc and Sheboygan Counties. Monitors collect data on water temperature, dissolved oxygen content, and turbidity on a monthly basis. Each spring, the monitors assess within-stream and riparian habitat. They assess biotic community health, using a macroinvertebrate biotic index, once in the spring and a second time in the fall. Some of the volunteers also collect stream stage height and precipitation data on a regular basis. The Pigeon River monitors cooperate with local WDNR biologists to determine monitoring sites and to provide data for the State of the Basin Report. Other integral cooperators with the program include both the Sheboygan and Manitowoc County Land/Soil and Water Conservation Departments, local municipal offices, UW-Extension's Basin Educators, and the Maywood Environmental Park, where training is held on a yearly basis for new and returning volunteers. The citizen monitoring effort is recognized as an important part of the Pigeon River Priority Water shed Project as well. The group meets yearly to discuss their results. They were one of the first groups to begin entering data into WAV's web-based database for citizen stream monitoring data. At the Maywood Environmental Park, an interesting correlation was observed between the stage height and turbidity as collected by one of the Pigeon River's most active monitors (Figure 19).

Figure 19. Pigeon River Graphic

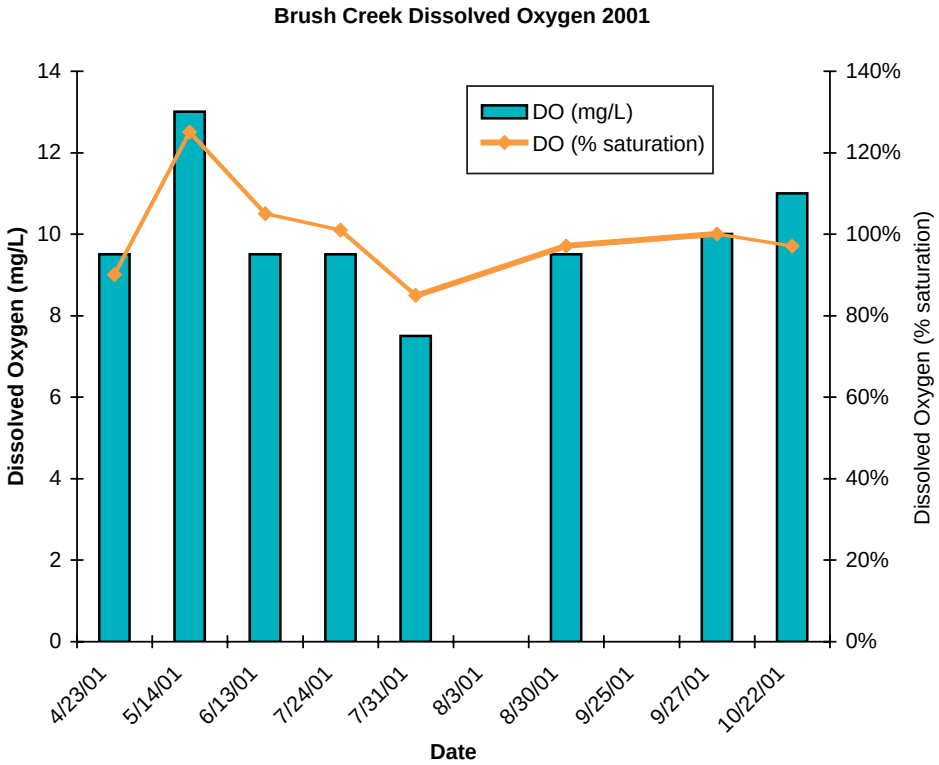


Nohr Citizen Monitors

Another group of citizens is monitoring stream quality using WAV protocols in the Grant-Platte-Sugar-Pecatonica (GPSP) Basin. The Nohr Network Stream Monitors are sponsored by the Harry and Laura Nohr Chapter of Trout Unlimited and UW-Extension. The group works in cooperation with the WDNR for program and event planning, training, and reporting. The goals of this group

are to promote citizen involvement in natural resources and to encourage citizens to appreciate and protect the water resources of southwestern Wisconsin. A training session was held as an interest indicator in 1999 and monitoring began in 2000 following a second training event. The Nohr Network Stream Monitors assess water temperature, turbidity and dissolved oxygen, as well as flow on a monthly basis. They monitor habitat and biotic index once a year. In 2001, the Network's 21 volunteers monitored 17 sites on as many streams in the GPSP Basin. The full-day training session brought together citizen monitors from not only the GPSP Basin, but those from the lower Wisconsin Basin as well. Second-year monitors shared their knowledge with new monitors by instructing at several of the training stations. DNR personnel were on hand to instruct and assist with the training as well. Also in 2001, the groups established an advisory committee made up of stream monitors and agency professionals to help guide their stream monitoring program. During the summer, the Nohr Network Stream Monitors hold an annual quality assurance picnic during which monitors come together to hear an educational speaker and also do a quality check on their dissolved oxygen kits. The event also offers the opportunity for monitors to interact with one another, which helps to keep this group going strong. For the past two years, the Nohr Monitors also held a Water Celebration in the fall. This event brought together school groups that have conducted monitoring efforts, college clubs conducting watershed research and the citizen stream monitors. Ninety people participated in the day-long event in 2001, showing the true interest citizens have in water quality programming. Both Trout Unlimited and UW-Extension report the group's data results on their websites. An example of their monitoring results is shown below. Afternoon dissolved oxygen sampling along Brush Creek showed saturated or nearly saturated conditions throughout the sampling season (Figure 20). Information about this group of monitors has also been included in both the Grant-Platte-Sugar-Pecatonica and the lower Wisconsin River State of the Basin Reports.

Figure 20. Nohr Citizen Monitoring Graphic



Note: all data collected between 4:30 and 5:30 PM

Valley Stewardship Network

For approximately the last five years the Valley Stewardship Network has organized citizen stream monitoring efforts in the Kickapoo River Valley. This group monitors the water chemistry and the flow of the streams. In addition, the group has placed temperature loggers in the streams to establish a record of the water temperature in the other portions of the basin, UW Extension in partnership with the Harry and Laura Nohr Chapter of Trout Unlimited (see above) have held training sessions to teach interested citizens how to monitor streams for temperature, turbidity, and dissolved oxygen and how to conduct biotic index and habitat assessments. As a result of these programs, there are numerous citizen stream monitoring projects in the Lower Wisconsin Basin. In the fall of each year, these stream monitors get together with others interested in learning more about water quality and citizen monitoring for the annual Water Celebration, sponsored by the Nohr Chapter of TU, UW Extension and the Valley Stewardship Network.

Water Quality Modeling

WDNR uses water quality modeling to manage water resources. Modeling helps assess the assimilative capacity of a stream (how much of a pollutant a stream can carry and dilute without harming aquatic life) or the movement of pollutants in an aquatic ecosystem. Models are also used to help determine causes of existing water quality problems, to evaluate responses to proposed management options and to predict future changes likely to occur without any management action.

Development of water quality models often requires the collection of extensive amounts of data on existing water quality and stream flow, as well as the many factors that can affect water quality. Data requirements vary depending on the type of model and its intended use. WDNR uses models in the following areas:

- Stream dissolved oxygen models for waste load allocations
- Contaminated sediment transport models
- Watershed loading models
- Lake response models
- Mixing zone models

Beginning in the mid-1970s, WDNR developed waste load allocation models on stream segments such as the Wisconsin and Fox Rivers where multiple point sources contributed to water quality problems. The allocations were used to establish water quality based effluent limits for industrial and municipal point source discharges. The WDNR is currently re-evaluating allocations for Segment A of the Wisconsin River from Rhinelander to Tomahawk.

Contaminated sediment transport models are used to predict the transport and fate of sediments containing chemicals of concern. Fate and transport models help to predict the bioavailability of contaminants to the food chain but not the concentration of chemicals in the food chain. For this, food chain models are used. In particular, WDNR models sediments containing high levels of polychlorinated biphenyls (PCBs) to determine the rate of PCB movement and the biological concentration of the chemical in the food chain, and to predict the potential benefits from selected cleanup options. WDNR has applied fate and transport models to the Lower Fox, Sheboygan and Milwaukee River systems and all are on file with the Great Lakes National Program Office. While the Sheboygan and Milwaukee studies were screening level models and the Fox a much more detailed model, all three studies were developed for comparison with predictions made by USGS based on the Great Lakes steam tributary monitoring project.

Watershed loading models link pollutant export from various land use practices to loads in streams and lakes. WDNR uses both screening level (export coefficient) models, as well as more detailed mechanistic process based models such as the Soil and Water Assessment Tool (SWAT), a Barnyard Evaluation Model currently under development , the Source Loading and Management Model (SLAMM) and the P8 Urban Catchment Model. WDNR is also working with the U.S. Department of Agriculture, Agricultural Research Service, the developers of SWAT, to test and refine SWAT for application to agricultural practices in Wisconsin. SWAT is one of a number of modeling and analysis tools identified for TMDL development in Wisconsin.

Lake models predict the changes in lake trophic state, as reflected in total phosphorus concentration, water clarity and the severity of algae blooms, to changes in nutrient loading to a lake. The purpose is to determine how individual lakes will respond to changes in land management practices or proposed lake restoration activities. The Wisconsin Lake Modeling Suite (WiLMS) is a lake and watershed evaluation tool developed by WDNR and currently used throughout the state for lake management. It is used for about 80% of the six to eight lakes modeled per year in Wisconsin. WILMS also is used extensively by consultants working on lake planning and protection grant projects. The Army Corps of Engineers BATHTUB model is used for the other 20%.

WDNR reviews mixing zone models that are part of applications for modified mixing zones for industrial and municipal dischargers. Results are used to determine effluent limits for toxic compounds to protect fish and aquatic life in the receiving waters. Mixing zone models are a tool for determining the extent to which a diffuser outfall enhances rapid mixing of the effluent and reduces toxicity to aquatic organisms that may be caused by specific pollutants.

Laboratory Analytical Support

The DNR has annual contracts with the Wisconsin State Laboratory of Hygiene (SLOH) for water chemistry and sediment chemistry analyses. Physical analyses for sediment studies are conducted at UW-Madison Soils Laboratory. DNR contracts with UW-Stevens Point and UW-Superior for macroinvertebrate analyses and with various external, state-certified laboratories for parameters not covered by the existing state contracts.

Data Storage, Management and Sharing

To learn more go to: http://www.dnr.state.wi.us/org/at/et/geo/

Wisconsin has a number of systems to store, manage and share its aquatic data and assessment information. WDNR utilizes Geographic Information Systems (GIS) as a tool for water quality management, employing a systems approach to integrate data and assist in analysis. GIS links information from diverse sources with a geographic layer of information, allowing resource managers to use spatial and tabular data to identify and analyze resource issues and problems. Not all DNR data systems are currently accessible via GIS; however, long-term plans for the Department involve converting key data systems to a GIS-compatible format. The foundation of this system is the Surface Water Integration System (SWIS), described below.

Surface Water Integration System (SWIS)

To maximize the benefits of a GIS for water management, WDNR initiated development of a **S**urface **W**ater **I**ntegration **S**ystem (SWIS) in 1992. The SWIS is designed to integrate diverse data layers of information with "point and click" technology to query and analyze surface water related data. The 'base' datalayer (or framework) through which multiple surface water related databases are integrated is the 1:24,000 scale hydrography layer (see update below), which has recently been completed. Using the SWIS, DNR staff will be able to see the spatial relationships between water-related datasets on screen and will examine these data using a customized Arcview interface tool.

SWIS provides the "framework" (*the 24K hydrography GIS layer*) for integrating the department's water data, *tools* for linking their data to the 24k hydro layer, *training* on how to use the tools, and *documentation* and guidance on how to get datasets integrated into the Surface Water Integration System. Additional program applications may be built upon this framework to meet specific needs beyond those provided for in the SWIS common query interface.

1:24,000 Scale Hydrography Layer

In October of 2000, the WDNR completed a multi-year effort to develop a statewide Hydrography geographic data layer from 1:24,000-scale sources. This DNR corporate data layer will play a major role in integrating various DNR databases containing information about features located in, along, and around waterbodies. Since the initial release of the WDNR 24K Hydrography database, a

series of data updates and enhancements have been completed, resulting in Version 2 of the 24K Hydro layer. Version 2 is now available for distribution on CD as the full 24K Hydrography data model in ArcInfo coverage format and as the 24K Hydrography data in shapefile format, accompanied by several preconstructed ArcView legend files intended to facilitate use of the data. The coverage and shapefile versions are both provided statewide in extent and accompanied by the full set of current user documentation.

The WDNR 24K Hydrography data conversion effort was completed statewide using several *1:24,000-scale sources*. This layer includes information about surface water features represented on the USGS 1:24,000-scale topographic map series such as perennial and intermittent streams, lakes, and so on. A large portion of the Agency's Waterbody Identification Codes (WBICs) have been incorporated into the hydro layer, along with surface water names from the U.S. Geological Survey's Geographic Names Information System (GNIS) database.

Linked Water Related Databases

SWIS involves identifying and linking water related datasets to the 24K Hydrography layer. The User Database Status Table 12 shows datasets currently being prepared for SWIS. These datasets were originally chosen due to data quality, interest of others in using this data, availability, staff support, dataset size, and financial considerations. Additional datasets are being considered for a "Phase II" of SWIS, moving beyond the initial datasets to evaluate, ready and link additional user datasets. Datasets being considered for this effort include:

- Self-help lake monitoring data
- Stream and Lake Classifications: 305b Assessment Data (includes outstanding resource waters, variance waters and impaired waters)
- Storet (new and legacy data)
- Outfalls
- Exotics
- Fish and Habitat Biological Database

Table 12. User Database Status (Status as of November, 2001)

Data System	# Records to Process	# Records Processed	% Complete	Anticipated Completion Date
Register of Waterbodies (ROW)	28,000	22,000	79%	September 1st, 2000
Chapter 30 Permits	53,000	0	0%	July 1st, 2001
Engineering Studies	5,800	0	0%	July 1st, 2001
Master Fish File	22,150	0	0%	July 1st, 2001
Natural Heritage Inventory	Approximately 8,000-10,000	0	0%	July 1st, 2001
Dams Location	4,635	4,635	100%	Complete (as of 12/00) **
Fish/Sediment Toxics	2,445	2,445	80%	October 1, 2001

Additional Data Management Projects

To learn more go to: http://infotrek.er.usgs.gov/pls/wdnr_biology_wdb/wdnr_biology_wdb.home

Fish and Habitat Statewide Database

This oracle database, a project of the Bureau of Fisheries and Habitat Protection and the United States Geological Survey (USGS), involves capturing and providing tools for analyzis of data for streams, rivers and lakes. This database directly supports the state's baseline monitoring program, providing an electronic "warehouse" to store the data via a WEB-based application for data input and access. Within 2002, plans are to provide an automated method of calculating selected metrics for the identified media (lakes and rivers and streams). These metrics include the Hilsenhoff biotic index (HBI) for macroinvertebrate data, stream suitability index for physical habitat, and the Index of Biotic Integrity (IBI) for fish data. All data can also be utilized for additional analyses; for example, fish data can be used not only to calculate an IBI, but also to develop summary data for fish managers, such as fish size, distribution or population estimates.

Currently, the database focuses exclusively on biological data, as chemical data is stored and accessed through STORET; however, work is being conducted to analyze connections between these two databases and with the state's SWIS.

Integrated Planning Automated Mapping System (DV_Map)

This mapping package has provided a distributed mapping solution to people developing integrated plans statewide. In the past, DNR contracted for centralized map production. With the distribution of this mapping application and a related program that works with ArcView, DNR has been able to decentralize, simplify and standardize the map generation aspect of the planning process. Further, because this mapping package utilizes a variety of general datasets that are commonly used in mapping and analysis, this mapping package can move beyond integrated planning and serve a variety of ArcView users. Even though this application is advertised as a mapping package, as with any GIS dataset, analysis can be performed on this data to answer questions otherwise missed without the use of GIS technologies.

Aquatic and Terrestrial Resources Inventory

The Aquatic and Terrestrial Resources Inventory (ATRI) is "a public and private partnership to gather, link, and make available data used for making decisions affecting Wisconsin's landscape." It is an integrated information management system that currently functions as an inventory of data, regardless of location or format. The goal of the program is the identification, inventory, storage and distribution of Wisconsin's ecological data. Products of the program include a metadata repository, department data standards which provide guidelines concerning the collection and structure of data that is consistent with current WDNR practices and recognized federal standards. The inventory is available to anyone with internet access, and includes interactive mapping using ArcIms.

To learn more go to: http://maps.botany.wisc.edu/atri/

Sediment and Fish Consumption Advisory Database

This oracle-based system contains sediment sample and fish tissue results used to develop the state's fish consumption advisories.

Contaminated Sediment Active Project Sites

This GIS-based datalayer, accessible in ArcView, provides a listing of all active sediment management sites in the state, the waterbody and waterbody identification code involved, the key contact for the project, an indication of the project's status status, and the region in which the site is located.

305B Access Database (Microsoft Access)

This Microsoft Access database, containing assessment data used in this 305b report, is currently centrally located. However, future plans include conversion of the data to a web-compatible program to allow access and update privileges by regional staff. This change in data sharing would eliminate the duplicative step of developing streams and lakes tables in basin plans and then re-entering the data into the database. The data would be entered by regional staff and assessment information would be generated directly from the database.

Impaired Waters/TMDL Database

Currently this database, which is also in Microsoft Access, is not physically connected with the "305b Database" (described above). However, managers believe it is imperative to connect the two, as the impaired waters database is, in part, derived from assessments developed through updating the 305b database (ie., Wisconsin's impaired waters list is a subset of 305b "impaired waters").

Register of Waterbodies – ROW

The Register of Waterbodies is another Oracle-based system that was originally developed from historical county waterbody listings and descriptions. Because this database is partially duplicative with the state's 305b database, the two systems need to be evaluated and meshed together when the 305b database is converted to an Oracle-based system.

Master Waterbody Fish File

This database holds the sites of fish specimen collected using USGS Quads and Wisconsin Transverse Mercator (WTM 83/91). The purpose is to inventory the fish species and their distribution in Wisconsin waterbodies. This data was compiled by the Wisconsin DNR for fisheries inventory and monitoring and is stored in an Oracle database.

Wetlands Inventory

The state's Wetlands Inventory is a 1:24,000-scale GIS-based coverage containing all digitized wetlands down to at least 5 acres in size, and in some areas down to 2 acres in size. This database, used for regulatory purposes, is a critical element in the state's water management program. Recently a project was completed that makes this data more accessible to resource managers (see below).

Wetlands Datalayer GIS Coverage Clipping Project

The DNR has completed a manipulation of the Digital Wisconsin Wetlands Inventory (DWWI) that allows the digital wetlands layer to be accessed and displayed by water basin in Arcview. Each major water basin or Geographic Management Unit (GMU) has an associated "clip-out" of the DWWI that displays the wetlands of the Basin. The Basin "clip outs" are available on the DNR's GIS library. This has made DWWI information much more accessible for basin planning and 305 (b) reporting. Summaries of wetland acreage by wetland type can now be provided for each water basin, and the distribution of wetlands throughout the basin can be displayed. Recently completed State of the Basin Reports have used this data layer. Prior to this project wetland information could only be displayed by county. The protocol developed for this project can also be applied to "clip-out" the DWWI for subwatersheds to meet specific project needs.

To learn more go to:
http://www.dnr.state.wi.us/org/water/fhp/wetlands/mapping.shtml

Lakes Volunteer Monitoring Database

In 2001 all data from the Volunteer Monitoring Program (Self-Help) became accessible to the public through a web-based application on the DNR's website. This Oracle based application provides up-to-date information to residents on the quality of their lake through a series of predesigned report formats.