Wisconsin's Water Monitoring Strategy

2015-2020

A roadmap for understanding, protecting and restoring Wisconsin's water features.

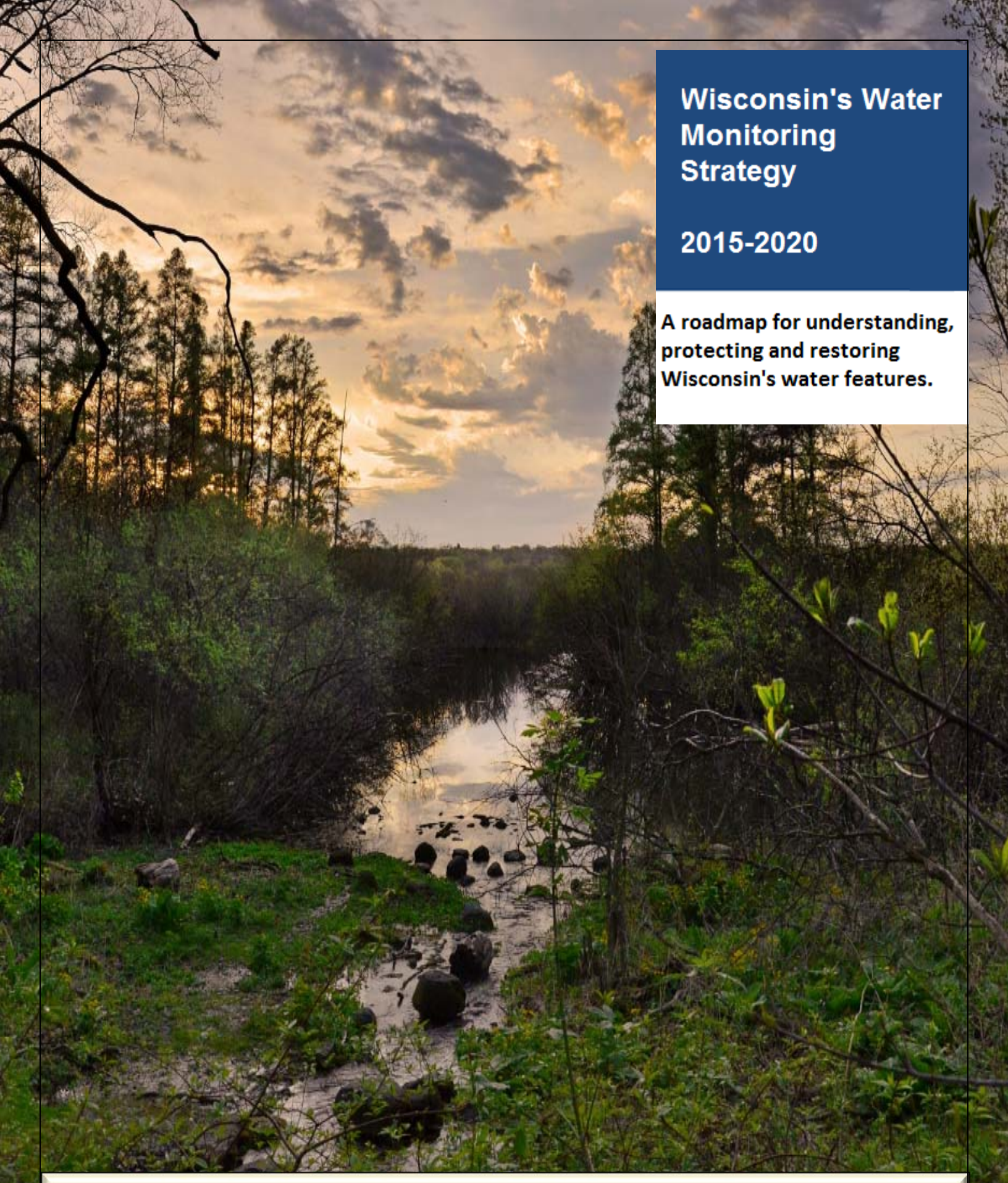

Photo by Richard Hurd, Sunset at Big Spring, 05-11-2014
Water from Big Spring, in the University of Wisconsin-Madison Arboretum,
Flowing toward Lake Wingra on a spring evening at sunset

Water Quality Monitoring Coordination Team

Team Sponsor
Susan Sylvester, Water Quality Bureau Director

Team Leader
Tim Asplund, Monitoring Section Chief

Monitoring Workgroup Steering Team
Tim Asplund, Katie Hein, Lisa Helmuth, Ruth Person, Mike Shupryt

Wisconsin Monitoring Workgroup and Contributors

Citizen Monitoring: Kris Stepenuck, Laura Herman, Christina Anderson, Lindsey Albright
Field Biologists: Mark Hazuga, Jim Amrhein, Mary Gansberg, Jim Kreitlow
Fisheries Management: Tim Simonson, Lori Tate, Candy Schrank
Groundwater Management: Mel Vollbrecht
Lakes and Rivers: Carroll Schaal, Scott Van Egeren, Maureen Ferry
Mississippi River Unit: John Sullivan, Sara Strassman, James Fischer
Monitoring: Mike Shupryt, Katie Hein, Mike Miller, Tom Bernthal, Elizabeth Haber, Lisa Helmuth, Tom Bernthal
Office of the Great Lakes: Andy Fayram, Donalea Dinsmore, Steve Galarneau
Science Services: Matt Diebel, John Lyons, Ron Arneson
Water Evaluation: Brian Weigel, Aaron Larson, Kristi Minahan,
Water Resources Supervisors: Greg Searle, Paul LaLiberte, James Hansen
Wastewater: Diane Figiel
Water Use: Shaili Pfeiffer, Jeff Helmuth
Watershed Management: Corinne Billings, Heidi Kennedy, Pat Trochlell, Cheryl Laatsch

USEPA: Ed Hammer, Linda Holst, Pete Jackson

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http://dnr.wi.gov/topic/surfacewater/monitoring.html

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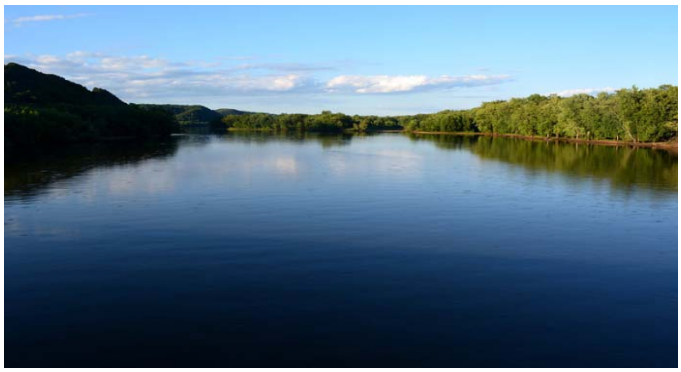
Wisconsin's 2015-2020 Water Quality Monitoring Framework Summary



This update to the Wisconsin Water Quality Monitoring Strategy presents DNR's vision to fulfill Wisconsin's Clean Water Act monitoring responsibilities and is integral to our "blueprint" for improving Wisconsin's monitoring, assessment, and reporting activities. This strategy supports our statewide commitment to achieving better water quality through monitoring that is structurally integrated with key assessment and management requirements across all water programs.

Strategy Highlights

→ Updates Wisconsin's implementation of *10 Key Elements of a Comprehensive Monitoring and Assessment Strategy* reflecting changes in funding emphasis, monitoring design, staff resources, and connectivity with assessment approach based on new science, data and information, modernized information and technology systems, and reorganized agency structure.

→ Adopts a "prescriptive" monitoring approach [Targeted Watershed Assessments (TWA) and Directed Lakes] to address integrated resource assessments by media type.

→ Reallocates funding from probabilistic monitoring and local competitive projects to *prescribed monitoring* which provides a strategic statewide perspective to address federal, state and "local" issues. This monitoring will consume nearly 50% of the allocable budget from federal and state sources.

→ Much greater emphasis on training, oversight, and follow up on staff procedures to ensure that monitoring study design, equipment, methods and analyses are completed and documented as planned in the database.

→ Significantly greater emphasis on linking monitoring, or data collection, with attainment decisions for Clean Water Act 305b/303d reporting and other science-based decisions for management actions.

→ Increased focus on effectiveness monitoring, e.g. evaluating progress toward water quality improvement

Wisconsin's Monitoring Program Implementation Recommendations 2015-2020

- **Program Effectiveness Metrics**: Develop and evaluate measures to determine the effectiveness of our program activities and make modifications to improve that effectiveness.
- **Condition Information and Tools:** Develop and implement effective data collection, evaluation, and reporting tools so that we can communicate a consistent message regarding Wisconsin's water quality.
- **Quantitative Performance Tracking:** Develop systems and processes to measure and demonstrate quantitative improvements in and the maintenance of water quality, monitoring and smart collection design to achieve these goals (from Bureau Strategic Plan).
- **Produce and Share Data with Citizens and Partners**: Improve and demonstrate success with intra-agency, inter-agency, and stakeholder coordination of programs and data sharing.
- **Enhanced Quality Assurance and Control Procedures**: Identify, document, and implement accurate monitoring and assessment procedures.
- **Resource Condition Sharing:** Publish the results of monitoring in easily accessible online reports for the public.
- **Timely, Efficient and Science Driven Federal Reporting:** Meet federal reporting needs in designing and monitoring program that specifically addresses federal requirements.
- **Professional, Intuitive Data Systems:** Emphasis on IT system maintenance and upgrades for monitoring and assessment program protocols results (WisCALM) and monitoring strategy (2015-2020) compliance.
- **Resource Inventory, Planning and Management**: Coordinate a statewide framework with high quality, consistent, and scientifically defensible methods to improve the monitoring, assessment, reporting, implementation and most importantly, the condition, of Wisconsin's water. This framework is part of the state's continuous planning process (CPP) Plan.

Monitoring Section Strategic Implementation Areas

Staffing Resources:

Creation of the Monitoring Section to centrally coordinate and manage the state's data collection endeavors was a significant step forward. Analyzing proposed work against existing and projected resources now and in the future is a critical implementation step.

Funding:

Strategic funding allocations for monitoring allow the section to work with programs to create scientifically based study designs (developed in cooperation with and to support the needs of critical programs) including Runoff Management, Wastewater, Water Evaluation, Fisheries, Waterways and Wetlands, Drinking Water and Groundwater, and more.

Equipment:

Documenting, managing and planning for current and future equipment needs is a strategic implementation area for the monitoring program. Identification of and management of equipment needs including new acquisitions, maintenance, and strategic planning for future items are high priorities. Exercises to think broadly and strategically will help better allocate resources for costly purchases with upfront considerations.

Clean Water Act Objectives:

- Establish, review, and revise water quality standards, including use designations and use attainability (Section 303(c)).
- Determine attainment of designated uses and identify impaired waters (Section 305(b), 303(d)).
- Identify causes and sources of water quality impairments (Sections 303(d), 305(b)); and
- Implement water management programs and support evaluation of water management program effectiveness (Sections 303, 305, 314, 319, 402, etc.).

A comprehensive monitoring strategy that meets all of these objectives will enable DNR to answer five general questions:

1) What is the overall quality of waters in the state?
2) To what extent is water quality changing?
3) What are problem areas and those in need of protection?
4) What level of protection is needed?
5) How effective are water management programs?

Training:

Technical and generalized work function training is a strategic implementation area for the coming biennium. Creating core, standardized technical training elements for new employees and ongoing training opportunities for veteran employees is a critical goal. This training strategy, an outgrowth of the monitoring strategy, is a strategic implementation area for the program.

Sampling Procedures, Methods:

Inventory, documentation, and access to written sampling procedures is critical for maintaining a high quality program. This is a high priority strategic area for the monitoring program. Standardized protocols, document storage, easy access, and use of multimedia tools are all part of this implementation area.

Data Analysis Procedures:

Documentation of core knowledge metrics for data management and analysis is fundamental to collectively turning raw data into condition decisions or in answering other management questions. This implementation area will integrate resource specialist expertise with IT professionals and current and emerging tools to ensure that Wisconsin is providing the highest quality information for decisions.

Information Technology Management:

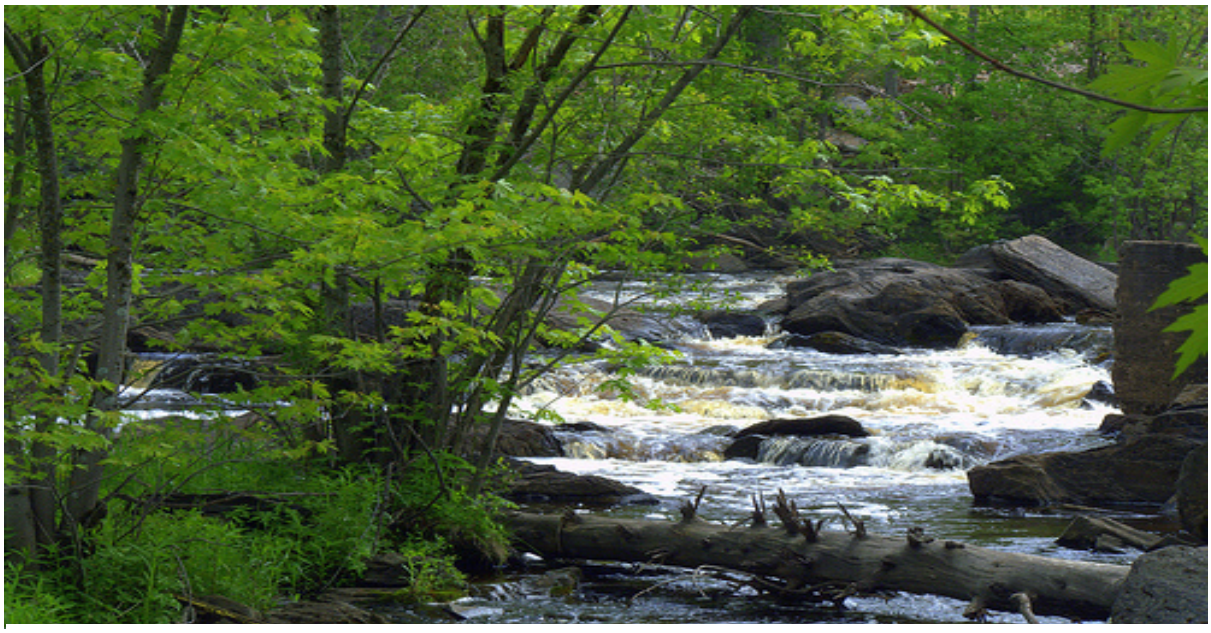
Inventory, analyze and recommend current and future IT needs for programs to help advance infrastructure support funding and maintenance which is critical for a successful Water Quality Program.

Significant Changes in the 2015 Update

Table 1: Significant Changes in the 2015 Update

Area	2008 Strategy	2015 Strategy Update	Comments
Management and team structure.	Inter-bureau Standing Monitoring Team and subteams created strategy reflecting fisheries, groundwater, and watershed management/ water quality	Water Quality Bureau's new Monitoring Section and statewide Monitoring Success Team (multi-program, ad-hoc team for strategy creation)	Agency redesign reflected in approach to monitoring coordination. Significant work to strategically connect with pertinent programs and staff where value added work was possible.
Address 10 Elements of a successful monitoring strategy	10 Elements discussed and issues identified.	10 Elements addressed up front and in each media (as in 2008); proposed performance goals identified to meet highest level of compliance.	Areas identified for work reflected in rolling list of actions (prioritized) for work planning as resources allow.
Monitoring to fulfill Clean Water Act assessment and management needs.	Acknowledgement of Clean Water Act reporting requirements linked to specific studies.	Specific outputs from study designs are work planned products linked to program goals and objectives and individual staff assignments.	Biennial work plan cycle will reflect "ripe" high priority items or available funding for specific projects. Remaining work will stay in queue and will be reprioritized next work planning cycle.
Emphasis on probabilistic, prescribed and local needs	Primary emphasis for monitoring water resources condition placed on probabilistic study designs and the 'competitive/local needs' project procurement process.	Reallocation of funding from a focus on probabilistic monitoring and local competitive projects to prescriptive or prescribed monitoring, which provides a strategic statewide perspective while addressing federal, state and "local" issues.	Prescriptive monitoring will consume 50% of the allocable budget, probabilistic 15% and local needs 35%. Local needs may be local representations of statewide issues, like confirming natural communities, or compliance monitoring for WPDES issues.
Role of follow up monitoring	Follow up monitoring may not have been strategically represented in the report but over time has become critical for gap filling to make attainment decisions.	Follow up monitoring, linked to probabilistic, targeted or local needs studies, is now a specific type of work identified in strategy and budget under prescriptive monitoring that is purposefully conducted to help meet attainment decisions.	Acknowledging that WI must conduct some form of follow up monitoring to close data gaps for attainment decisions is realistic and transparent. Over time, as the strategy and WisCALM (assessment guidance) are more tightly integrated, the need for follow up monitoring will decline.

Area	2008 Strategy	2015 Strategy Update	Comments
Use of Natural Communities for streams, rivers and lakes	Natural communities as a concept and as a basis for decision making were in their infancy and therefore were the focus of exploratory research.	Natural communities have now moved from conceptual design, modeled output to tightly integrated into DNR systems and decision making, influencing monitoring protocols, database analysis and report / package creation.	New Designated Use and Biocriteria updates are heavily influencing short and long-term monitoring work. Identification of new parameters and protocols pre-and post- rule promulgation will heavily affect the amount, type and location of monitoring in subsequent biennium.
Tiered approach versus media specific	A tiered approach was used as an organizing principle in the 2008 strategic plan.	The 2015 update uses a media-specific outline, with emphasis on statewide/probabilistic and prescriptive studies.	The term "tier 1, 2, 3" unwittingly conveyed a priority, whereas the use of a media specific approach that incorporates statewide and prescriptive monitoring reduces the relative "weight" or importance of these different studies, while the budget and prioritization of work actions conveys the strategic emphasis.
Quality assurance/ quality control measures.	Protocols, procedures, and quality assurance work was incorporated into each description.	This update emphasizes the creation of a protocol inventory, and professionalization of field procedures, training plans and documentation.	The emphasis shifts to work that reflects advances in study designs which answer questions aligned with federal and state program requirements and goals.
Implementation Planning	Implementation planning for the coming biennium has begun through 2015 work planning. Progress will be tracked and posted online for management and staff to view and update.		



Pine River, Wisconsin. Jim Klosiewski

Section 1 Strategy Overview

Water is Wisconsin's most precious resource. It provides an essential lifeline between wildlife, recreation, public trust resources, agriculture, industry, health and safety, and environmental, urban and rural interests throughout the state. With a growing population of more than 5.5 million (Figure 1) and a precious supply of fresh water, the protection of water for designated and beneficial uses is of paramount importance.

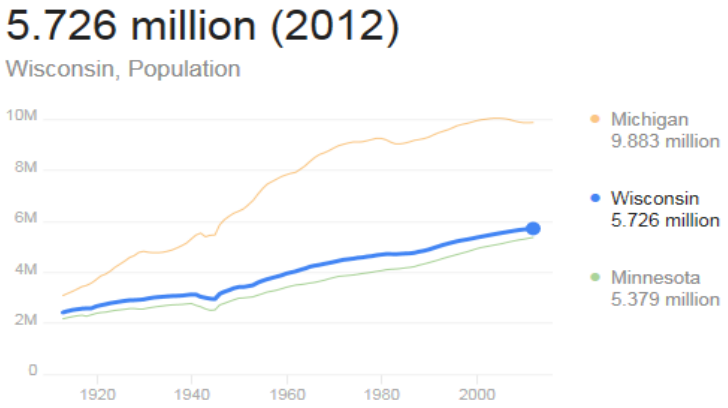


Figure 1 Population from Google Statistics

This update to Wisconsin's strategic water monitoring plan identifies current program elements in relation to USEPA recommendations for key elements of a comprehensive strategy. This document presents recommendations for short and long-term actions to evolve DNR's program through the year 2020.

One of the most significant facets of this update is a shift in funding emphasis from a probabilistic monitoring scheme to greater work on '*prescriptive" monitoring* which will include a Targeted Watershed Assessments (TWA), Directed Lakes, 319 (Non-point) Project Evaluation, and follow up monitoring. These four areas of strategic emphasis directly support a rotating watershed approach to monitoring, assessments, planning and management. A critical leg of this resource management cycle (monitoring) is now redesigned to better reflect DNR/USEPA co-funded pilot watershed studies which were conducted in the East Branch Pecatonica and Yellow River Watersheds. These pilot studies laid the groundwork for creation of a new facet of Wisconsin's integrated monitoring of rivers, streams, lakes, wetlands and more in the strategic plan implementation period.

Section 1.1 Monitoring Strategy Goals and Objectives

This strategic monitoring plan is designed to guide ambient monitoring through 2020 with an updated framework including media-specific studies, protocol inventory, and field procedures that reflect advances in study designs to answer questions aligned with federal and state program requirements and goals. This strategy builds upon the 2008 Water Division Strategic Monitoring Plan, created by the Division Monitoring Team. However, this update focuses primarily on water resources program goals (Clean Water Act and federal and state cross program needs).

The initial portion of the plan identifies key drivers for the strategy update:

- USEPA's monitoring program evaluation method.
- Water Quality Bureau's Strategic Plan with specific performance measures driving biennial work planning.
- Analysis of Wisconsin's programs for Bioassessment/Tiered Aquatic Life Use approach.
- USEPA's 10 key elements of a comprehensive monitoring strategy.

These requirements set the stage for describing Wisconsin's media-specific monitoring studies, program-specific monitoring needs, and the inventory of work needed to achieve program goals in the next five to ten years. This plan update is geared to form the basis of work plan items in the coming biennium to create a comprehensive (water quality, biology, habitat, hydrology), cross-media (lakes, streams, rivers, wetlands), monitoring plan driven by assessment and management needs, adequately resourced (staffed and funded), and one which highlights collaboration with partners and volunteers.

Section 1.2 Water Quality Bureau Strategic Plan

The Wisconsin DNR is responsible for protecting the state's water resources (Water Quality Bureau Strategic Plan, 2013-15). The strategy includes the agency's approach to surface water monitoring with multiple goals and objectives including water quality restoration and protection. Appendix B provides a detailed listing of Strategic Plan Objectives, Goals, and Performance Measures that directly relate to monitoring. The Water Quality Bureau operates within the Division of Water and works cooperatively with the Bureaus of Watershed Management, Drinking Water and Groundwater, and Fisheries with the integrating oversight of the Water Management Team.

- ➔ This monitoring strategic plan addresses multiple bureau and program needs, with specific emphasis on Clean Water Act related performance measures from the Water Quality Bureau's Strategic Plan.

Figure 2: Strategic Linkages

Water Quality Strategy Vision and Mission

Our vision is a sustainable Wisconsin, made possible by clean water and water availability for wildlife, humans, and a vibrant economy through excellent environmental resource management. Our mission is to protect and enhance our aquatic ecosystems, and to ensure clean, safe water by adhering to state and federal requirements for water quality and environmental protection.

Monitoring in Support of Goals and Performance Measures

Appendix H provides a Water Program and Monitoring Element Integration Chart. This chart is designed to match each of the previously described strategic goals with specific program elements and then cross-references these "needs" with the monitoring strategy elements. The matrix highlights the program's sufficiency. Results have been incorporated into symbolic descriptions found in media monitoring descriptions.

- ➔ Lakes, rivers, and streams throughout the state are assessed using representative data collected with standardized biological, chemical, and physical metrics.

- ➔ Water quality is supported by an annual monitoring work plans that incorporate baseline (status and trends), problem assessment, evaluation, and response monitoring needs for the agency in a balanced and cost effective manner.

Section 1.3 Characterization of Wisconsin Waters

The water program has initiated an update of the state's surface water quality standards. For the past 10 years, resource professionals have evaluated emerging science and tools applicable to the assessment of flowing waters and lakes, and the agency is now using this information to update its classification and assessment framework.

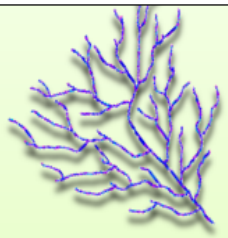
The goals behind these changes are to more accurately characterize our waterbodies, clearly set expectations for their quality, and use biological metrics to assess whether those expectations have been met. Two key concepts that underpin the proposed shift are U.S. EPA's "Tiered Aquatic Life Uses" and "Biological Condition Gradient". The State of Wisconsin intends to advance this concept for as many water resource types as possible given science, aquatic resources, and staff resources. DNR is addressing these emerging program issues with USEPA in the future.

Proposed concepts for Fish and Aquatic Life Designated Uses are:

Refine waterbodies' classification categories to better represent the diversity of stream, river, and lake types in the state. This entails assigning a "natural community" category to each waterbody which describes its natural character and potential.

- Assign a "Tier" of Excellent, General, Modified, or Limited to each waterbody. The Tier defines the state's expectation of quality for that waterbody. All waters would be assigned to General Tier unless specific procedures are followed to reassign it to a different Tier, which may have different criteria associated with it. More details regarding this design will be available in future technical documents.
- Develop and implement biological criteria (biocriteria) to assess whether a waterbody is meeting its FAL designated use classification and Tier. Different biological metrics will be used a) to assess the water's overall health at the community level, and b) as Phosphorus Response Indicators to assess whether the waterbody is showing a response to ambient phosphorus concentrations. Once developed, biocriteria may be codified or established through guidance.

Figure 3: Drainage Basin



Example of a drainage basin. The dashed line is the main water divide of the hydrographic basin

As the department completes development of the above structural changes, it will conduct rulemaking to revise and add to ch. NR102, Wis. Adm. Code. These changes will be presented to the public for comment during the rule development process. They are described further below.

Rivers and Streams - Natural Communities and Biological Assessments

Wisconsin's river and stream Natural Communities were developed through a USGS/WDNR Bureau of Science Services model based on predicted flow and temperatures. Ranges of flow and temperature for flowing waters are associated with specific fish communities; each category has a distinct assemblage.

Natural Communities for Flowing Waters
Macroinvertebrate (non-fish)
Coldwater (includes both headwater & main stem)
Cool-Cold Headwater
Cool-Cold Mainstem
Cool-Warm Headwater
Cool-Warm Mainstem
Warm Headwater
Warm Mainstem
River

Figure 4: Natural Communities Flowing Waters

About the stream model

The model used to generate proposed stream natural communities is based on a variety of base data layers at various scales, and was initially applied to the federal 100k scale NHD (National Hydrography Dataset) hydrography layer. The data was then extrapolated or "conflated" to the 24K scale WDNR hydrography layer (version 5). The model was re-run and published at the 1:24K scale in 2013 and updated in October, 2014 to reflect improvements in data based on improved data inputs.

Biological Criteria for Streams and Rivers

The two primary biological metrics for assessing the overall community health of streams and rivers are the Wisconsin Fish Index of Biological Integrity (FIBI) and the Wisconsin Macroinvertebrate Index of Biological Integrity (MIBI). These metrics, which were developed by WDNR researchers and have been published in peer-reviewed journals, have been in use for several years in Wisconsin. Different IBI calculations are applied depending on the type of stream or river.

WDNR is in the process of determining which metrics will be used as Phosphorus Response Indicators. For flowing waters, these will likely include measures of primary productivity, macroinvertebrates, and dissolved oxygen.

Lakes and Flowages - Natural Communities and Biological Assessments

For lakes, DNR researchers and limnologists identified key variables that define water condition, including aquatic life inhabiting the lakes. Lakes 'natural communities' are based on lake surface area, stratification status, hydrology and watershed size, which are stored in the Register of Waterbodies (ROW) database.

Figure 5: Natural Communities Lakes

Natural Community	Stratification Status	Hydrology
Lakes less than 10 acres		
Small	Variable	Any Hydrology
Lakes 10 acres or greater		
Shallow Seepage	Mixed	Seepage
Shallow Headwater	Mixed	Headwater Drainage
Shallow Lowland	Mixed	Lowland Drainage
Deep Seepage	Stratified	Seepage
Deep Headwater	Stratified	Headwater Drainage
Deep Lowland	Stratified	Lowland Drainage
Other Classifications (any size)		
Spring Ponds(a)	Variable	Spring Hydrology
Two-Story Lakes (b)	Stratified	Any hydrology
Impounded Flowing Waters(c)	Variable	Headwater or Lowland Drainage

Biological Criteria for lakes

WDNR is in the process of developing biocriteria for lakes. The main biological metric proposed for lakes is a measure of the macrophyte (plant) community. Other metrics, such as phytoplankton or fish, may be developed in the future.

Staff is also determining which metrics will be used as Phosphorus Response Indicators for lakes. Chlorophyll a concentrations are already used in this capacity by the department. Other metrics may include specific plant or algae taxa and dissolved oxygen.

Section 1.4 Monitoring Providing Multi-Program Support

The Water Quality Bureau gathers environmental information to assess aquatic environmental health, evaluate environmental problems and to determine success of management actions intended to protect aquatic resources. This Strategy directs efforts to address a variety of management information needs, while providing adequate depth of knowledge to support management decisions in multiple programs. With this Strategy, the WDNR strives to meet the goal of comprehensive coverage of all of the state's waters, while maintaining efficiency necessitated by resource availability. The Figure 6 (below) represents a sampling of programs that require data for answering mandatory questions. The areas highlighted with a red boundary are the primary programs supported by this strategy. All data may be used for ancillary purposes, but the essential questions grounded in performance measures and strategic goals are focused on those areas outlined in red. Also below are the primary program needs required of the Clean Water Act, cross program objectives, and related activities that are affected by and influence monitoring needs.

Blending Program Objectives

One purpose of this strategy is to create a more efficient match between our monitoring programs and our program objectives found in state and Federal legislation related to water. In addition to reviewing and revising water monitoring programs, the WDNR is focusing efforts to meet other water program objectives. Establishing more comprehensive procedures for ensuring statewide consistency in Water Division program areas is also critical. To do this, consistent protocols must be developed and documented.

To meet Clean Water Act objectives, DNR must answer the following questions:

- *What is the overall quality of Wisconsin's surface waters?*
- *To what extent is surface water quality changing over time?*
- *What are the problem areas and areas needing protection?*
- *What level of protection is needed?*
- *How effective are clean water projects and programs?*

Clean Water Act Objectives:

- Establishing, reviewing and revising water quality standards, including use designations, use attainability and criteria.
- Determine water quality standards attainment and identify impaired waters and causes and sources of water quality impairment.
- Identifying trends in water quality.
- Identifying Outstanding or Exceptional Resource Waters.
- Implementing water quality management programs and evaluating the effectiveness of management actions.

Cross Program Objectives:

- Develop quantitative management objectives for waters.
- Identifying areas or hotspots not meeting objectives.
- Compile data to identify problem causes or sufficient limits.
- Compile input for developing management recommendations.
- Analyze responses to management actions.
- Secure additional funding for execution of decision making and management actions that would "close out" or restore waters to their beneficial uses.

Standards Program Needs:

- Establishing and documenting attainable and designated uses for waterbodies.
- Creating and using bioassessment metrics to understand water condition status for listing impaired waters, ORW/ERW candidates, and Clean Water Act reporting. Bioassessment analyses are needed to modify the state's water quality standards to incorporate biocriteria.
- Integrating new findings and model results, including modeled natural communities based on flow and temperature projections, to identify the biological potential of a stream, river, lake, wetland, spring or recharge area.

Permit Issuance Program Needs:

- Establishing timely permits for effluent limits but in particular phosphorus and sediment in those areas where impaired waters are identified.
- Conducting timely permit processing for decisions based on wetland and shoreline data that is used to identify potential impacts.
- Evaluating the effectiveness of WPDES permits.
- Analyzing and permitting proposals for high capacity well requests while protecting and minimizing impacts to surface and groundwater resources.

Runoff Management – Nonpoint Source Program and Restoration Program Needs:

- Analyzing data for 305 (b) reporting and 303(d) attainment decisions.
- Collecting pollutant and landscape source data for assessments, point and nonpoint source permits, and multiple resource areas to best target management actions through Watershed Planning and/or TMDL Implementation Planning or Nine Key Element Plans.
- Identifying projects for Lakes, Rivers, aquatic invasive species (AIS) or Runoff Management Grant Projects.
- Prepare for and implement large analyses and restorations such as Total Maximum Daily Load (TMDL) analyses, implementation and evaluation.

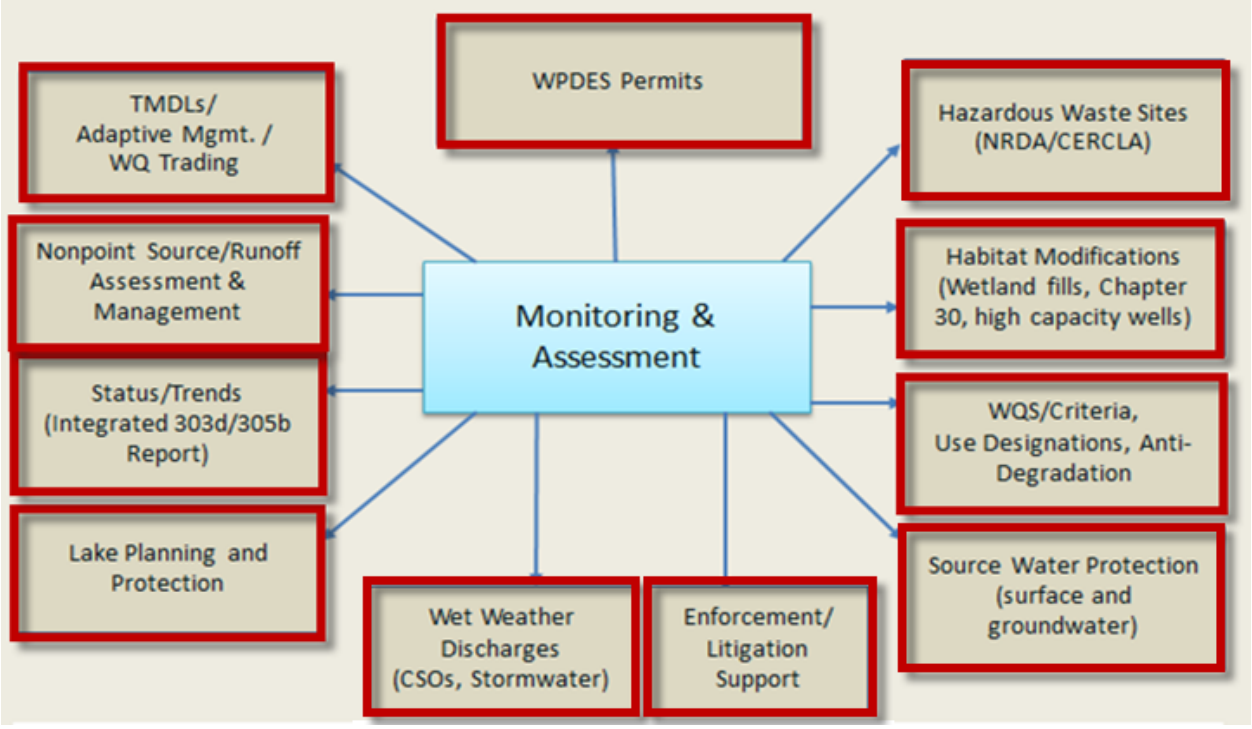


Figure 6: Program Reliance on Monitoring Data

The strategy focuses on **documenting and ensuring that core elements of a comprehensive monitoring strategy are successfully identified for each of the state's resources** (rivers, streams, wetlands, lakes, etc.), that gaps are documented and a plan for closing gaps are articulated. This work must answer questions for a variety of needs.

An overall framework for monitoring is presented in light of the state's strategic plan, changing climate of state service, variety of program need, and changes in resource availability. By documenting the core elements and identifying what we have, we will be able to successfully fill gaps through budget requests, additional position requests, or key work items for existing staff. *The strategy employs a stratified approach to meeting various monitoring objectives as follows:*

"Baseline" – Statewide

- Trends sites (Lakes, Rivers)
- Probabilistic surveys (streams, AIS, NARS (coastal condition and wetlands))
- Reference sites (wadeable streams, macrophytes, large river macroinvertebrates)

"Prescribed" – Statewide and District Collaboration

- Targeted Watershed Assessments
- Directed Lake Assessment (including APM and Critical Habitat)
- 319 (Non-point) Project Evaluation
- Follow-up for Impaired Waters

"Local Needs" - District Initiated

- Cross program support
- Unique stressors, projects

Implementation of the strategy is overseen by resource technical teams charged with programmatic direction, evaluation and implementing monitoring plans. Biennial work planning is advocated. Monitoring technical teams (rivers/streams, lakes, wetlands) are charged with meeting the following goals:

- Establish the annual and/or biennial sampling schedule for each resource type to reflect data needs.
- Audit implementation to ensure that sampling designs are being properly executed and documented.
- Assess and evaluate technical needs based on feedback from monitoring of Wisconsin surface waters.

Baseline Monitoring – Statewide

This 2015 strategy update supports continuation of ongoing studies described below.

- Trends sites (Lakes, Rivers) – Long Term Trend Projects (ongoing)
- Probabilistic surveys (streams, AIS, NARS (coastal condition and wetlands))
- Reference sites (wadeable streams, macrophytes, large river macroinvertebrates)

DNR will work to continue collection of ambient water quality data such as dissolved oxygen, pH, temperature, hardness, heavy metals, and pesticides important in understanding the assimilative capacity that is appropriate for specific receiving waters under its Long-Term Trend Rivers and Wadeable Streams Programs. There is an important emphasis on collection of phosphorus and stream base flow data statewide, as the issues of phosphorus permit issuance, site specific permit issuance, and high capacity well permit reviews are conducted. The emphasis on biological data and background information needed to create assessment parameters to support the creation of updated designated uses and biocriteria for the state's water quality standards will precipitate new and additional monitoring requirements in the current and future work plans.

Prescribed Monitoring – Statewide and District Collaboration

Prescribed Monitoring includes directed monitoring activities with common purpose and a suite of standard monitoring procedures. A major goal of this monitoring effort is to coordinate water selection across disciplines (e.g., more integration between streams and lakes, water resources and fisheries) to obtain diverse data sets from the same water body (e.g., water chemistry, physical habitat, and biological data on a single lake). However, the field sites will vary from year to year and will be selected jointly by District and Central Office staff. In some cases Prescribed Monitoring projects may be used for stream, river and/or lake monitoring waterbodies individually for whole watersheds.

For those areas in the state where protection is warranted or pollutant problems are known, such as an impaired water or an existing listed watershed where a TMDL is needed, more intensive sampling will occur to verify the cause, extent, or loading rates of the pollutant or problem. *Prescribed monitoring* is designed to meet statewide data needs through consistent data collection schemes and generalized site selection priorities, however watershed/site selection and monitoring designs are developed by Districts.

Four examples of this type of work include:

- Targeted Watershed Assessments
- Directed Lake Assessment (including APM and Critical Habitat)
- 319 (Non-point) Project Evaluation
- Follow-up for Impaired Waters

Targeted Watershed Approach (TWA) will initially include rivers/streams and **Directed Lakes Studies** will focus on lakes, as well as selected additional water types. Monitoring work under this initiative will be synced with related program activities including assessments, planning, and implementation, all of which will be conducted through a rotating HUC framework and will be integrated into staff's daily work activities through work planning.

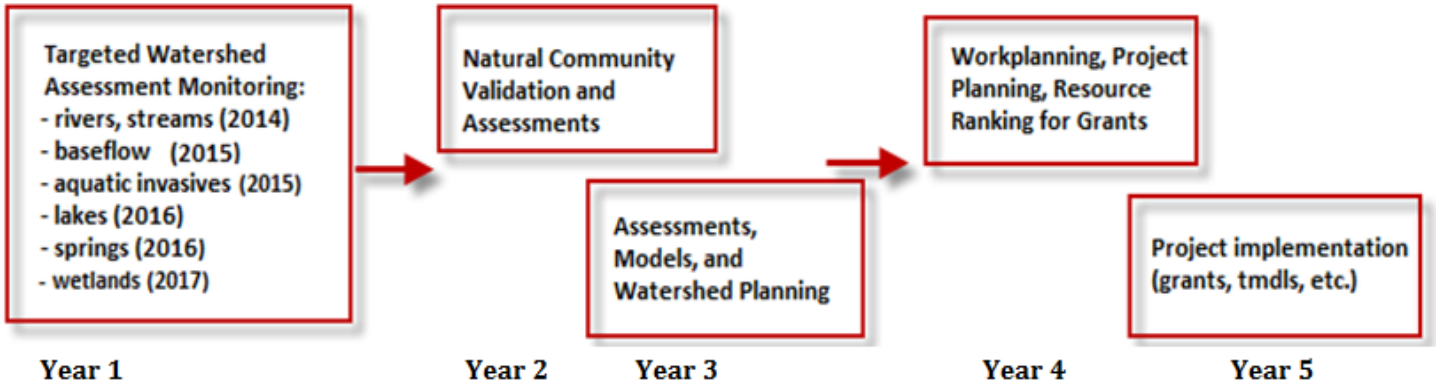


Figure 7: flow of Targeted Watershed Assessments and Directed Lakes Elements

Figures 6 and 7 above illustrate a structured sequence of work elements to monitor, assess, and manage waters within targeted 'hydrologic unit code (HUCs)'units at one or more spatial scales. Both the Targeted Watershed Assessment (streams, rivers) and Directed Lakes study designs are the new foundation for Wisconsin's cross resource integration work. The Water Resources Program will identify high priority watersheds and areas based on water condition, program availability, and partnership readiness. Custom monitoring designs will be created for individual watersheds to reflect the primary purpose of the study. The initial guidance requests that the projects fall within one or more of the following categories:

Figure 8: Types of Targeted Watershed Assessment Projects

Category	Rationale
Stressor Identification	"Poor" IBI scores where usual stressor may not indicate a problem (TP, TN, TSS, or Qual. Habitat).
Nutrient Impacts	High priority WTs in Nutrient Reduction Strategy or site specific nutrient study
Watershed Planning	Updates to HUC10 level watershed /water quality plans or to assess management actions
Protection	Baseline data on "Healthy but Vulnerable" watersheds in the Healthy Watersheds Assessment
Evaluation/Success	Evaluate the effectiveness of NPS BMPs, one WT in partnership with NRCs NWQI

Directed Lakes Studies

Directed lakes is a new concept that provides a parallel work effort for statewide lakes monitoring and assessment by DNR staff and partners to support assessments and lake management. Directed Lakes involves collecting chemical, physical and biological data; the prescriptive nature of the study helps with coordination of cross-program field surveys. At minimum, each lake survey will include Plant Point Intercept Survey, Shoreland Habitat Survey, and at least one or more 1 water chemistry samples. This study design will be implemented initially in 2015 -16 and will grow over time.

Section 319/Runoff Management Monitoring Studies

Section 319 monitoring studies are designed to focus on evaluating the effectiveness of best management practices. These studies are similar to the Targeted Watershed Assessment studies, but the network of sampling sites are more concentrated and focused on sites where practices have been implemented. The work on these sites are tied in to the Wisconsin Statewide Nonpoint Source Management Plan, approved by USEPA.

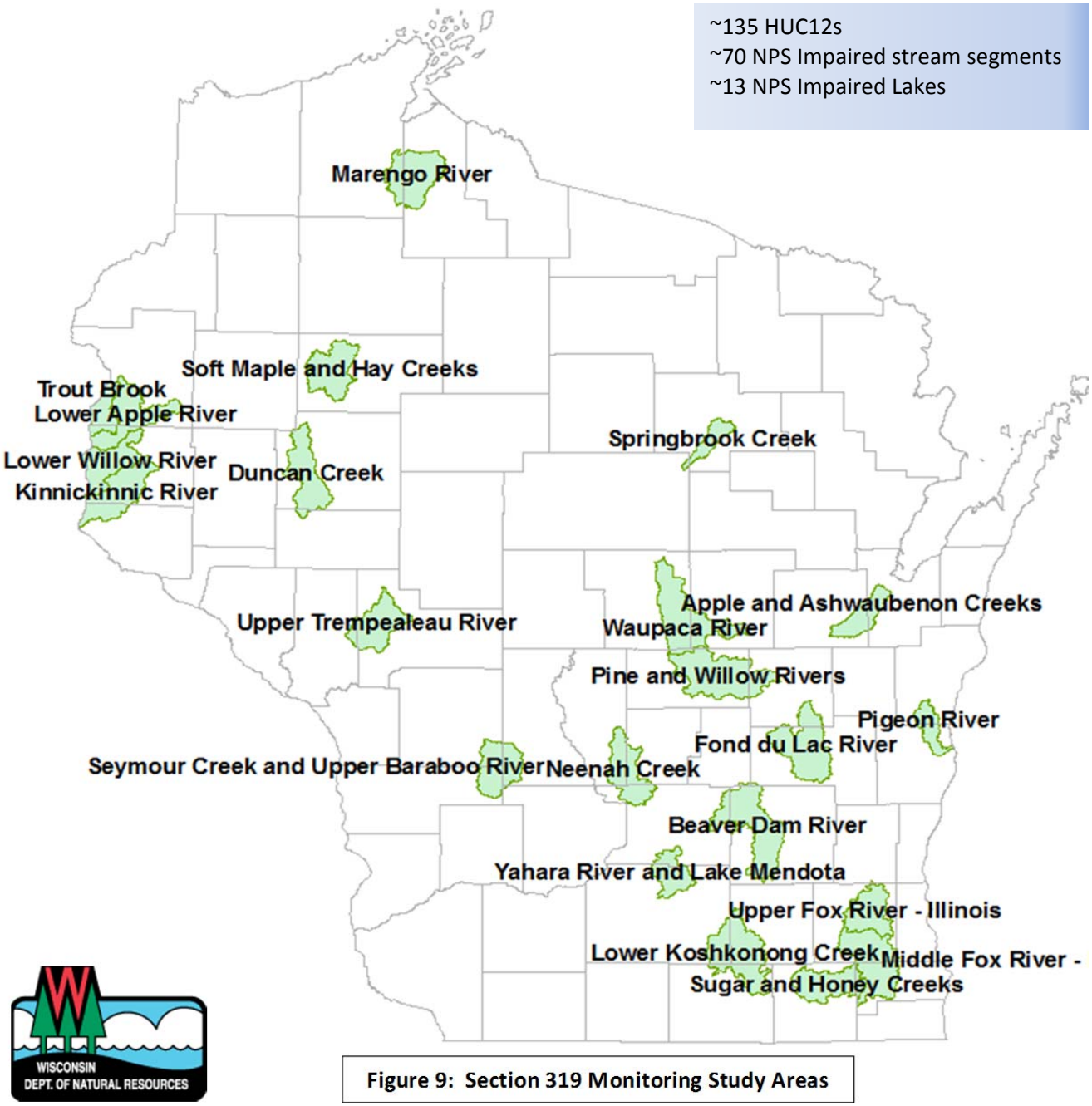


Figure 9: Section 319 Monitoring Study Areas

Follow Up Monitoring

Where indicated, follow-up studies will be conducted on targeted waters to determine the success of management actions. These projects are critical to the delisting of impaired waters, the de-listing of beneficial use impairments (BUIs) in Great Lakes Areas of Concern (AOCs), and in creating success stories which convey positive systematic movement toward clean water in the State of Wisconsin. For example, filling gaps for total phosphorus assessment processes that are used in the state's Water Quality Report to Congress can be completed in in targeted watersheds (the "Tier II element"). This type of matching of gap filling for assessment parameters with baseline monitoring work is fundamental for cost-effective programs. Identifying assessment program needs and "plugging in" capturing those needs in the TWA program is a logical approach to address multiple program goals in a single integrated sampling program. This cross-program integration and cooperative work is fundamental to the program's success.

"Local Needs" - District Initiated

Local needs monitoring are designed to address specific data gaps for closing up open questions related to attainment decisions, permit evaluation or other pressing needs.

This strategy is designed to be a dynamic document, with continuing investment in research to better understand our aquatic resources and timely update of when and how gaps are addressed as documented online and as amendments to the state's Water Quality Monitoring Strategy. This 2015-2020 Monitoring Strategy is formally the 4th Water Program update of previous versions in 2008, 2006, and 2004. This strategy will be advanced as a formal amendment to the state's Areawide Water Quality Management Plan.

Section 2.0 Resource or Media-Based Monitoring Study Descriptions

To help states fulfill federal requirements, USEPA produced ***Elements of a State Water Monitoring and Assessment Program (U. S. Environmental Protection Agency, 2003),*** which identifies the 10 basic elements of a state water quality monitoring program. The USEPA document referred to as USEPA "Elements" serves as a tool to determine whether a monitoring program meets the prerequisites of Clean Water Act Section 106 (e)(1). This Strategy outlines Wisconsin's activities in each of the 10 basic USEPA elements.

This document is organized by water type (rivers, streams, etc.) to reflect the agency's monitoring team oriented approach. However, in each of the media sections, USEPA's strategy elements will be addressed to some degree. Each media area will reports the current status of the program relative to Clean Water Act statutory requirements, then activities and plans to protect and restore Wisconsin's water quality, emphasizing those actions that must be taken to have a technically defensible program. Full implementation of our Strategy will take 10 years and will require significant additional resources.

Section 2.1 Monitoring Strategy for Rivers

Table 2: River Monitoring Studies		
Study Name	**Purpose**	**Supports**
Long-Term Trend Water Quality Monitoring Network	Historic chemistry data at 42 (43rd site added in 2014) river sites. Provides large river water quality trends over time.	Provides site specific condition assessment and attainment. Provides large scale view of major constituent loading and broad perspective on landscape such as climate change.
Biotic Index Baseline Study	Large river macroinvertebrate index of biological integrity designed to evaluate variation in Large mIBI over time to help with metric development and biologic assessments.	Provides site specific biological assessment and attainment. Provide water quality information to support 305(b) reporting and the TMDL/303(d) program
National Rivers and Streams Assessment	The NRSA is one of a series of surveys being implemented to periodically generate statistically-valid and environmentally relevant reports on the condition of the nation's water resources.	These collaborative assessments are also intended to improve monitoring across jurisdictional boundaries and to enhance the ability of states and tribes to assess and manage water quality.

Study Descriptions

Long Term Trend River Water Quality Monitoring Network

The Long Term Trends (LTT) Rivers monitoring program is a baseline monitoring activity conducted by the Wisconsin DNR Water Quality Bureau. The LTT Rivers program was developed to track and analyze water quality trends over time in Wisconsin's rivers. The current version of the network, initiated in 2001, now consists of 43 sites, with a minimum of one site per major river basin, generally located near the mouth of each river located at or near a USGS stream flow gauge. An additional site on the Grant River in SW Wisconsin was added to the network in 2014 to increase the site total to 43. Most of these sites are part of an earlier trend monitoring efforts that contribute historic record of water quality data tracing back to the 1970s and 80s.

Monitoring Objectives

• Collect basic water quality information on Wisconsin rivers.
• Establish long-term trends in ambient water quality across the state.
• Provide program-specific data at a large river sites where the combined watersheds drain the majority of the state to track and document changes in water quality over time.
• Provide water quality information to support 305(b) reporting and the TMDL/303(d) program.

Monitoring Design

The general stream monitoring strategy limits sampling to streams that are larger, mostly nonwadeable Rivers. These rivers are generally more likely than smaller streams to receive full body contact recreational use, have a WPDES discharge, and provide at least some information as down gradient indicators of water quality for upstream land and water management practices. Sample sites are identified to incorporate as many of the data needs of the monitoring objectives as possible.

Programs that will benefit from this monitoring effort include:

1. Water quality standards development.

2. Effluent limits development – provides data for determining local effluent limits and eventual revision of basin default values currently used in effluent limit development.
3. Water quality standards attainment – provides bacterial and chemical data which can compared with water quality standards. Non-attainment areas would be identified on the 303(d) impaired waters list.

Site Selection

There are 43 LTT Rivers sites located throughout the state, generally at the mouth of larger rivers within and bordering the State. Some sites are located upstream from the mouth on some of the larger rivers (i.e. Wisconsin River) as one location at these rivers would not adequately capture the general condition of those rivers (Figure 10).

Figure 10: Long Term Trend River Monitoring Network

Sampling Frequency

Field sampling for the LTT Rivers occurs on a monthly basis for ~3/4 of the sites and quarterly at ~1/4 of the sites (See Table 2). Sampling for this program consists solely on water quality parameters including chemistry grabs and field measurements. Some water quality parameters at select sites are collected on a sub-monthly/quarterly frequency.

Sampling is scheduled at least one week in advance to avoid bias from weather conditions. Samples are collected during the second week of the month for the monthly and quarterly scheduled sampling locations. Monthly samples are collected at 30 day intervals. Quarterly sampling sites should occur in January, April, July and October in order to roughly coincide with seasonality.

Water Quality Indicators

Table 3: River Monitoring Study Water Quality Indicators

Parameter	Analysis Location	Database	Assessment Indicator
Field Data – Dissolved Oxygen, Temperature, pH, Conductivity and Transparency Tube	In-field analysis	SWIMS – Data Entry	DO daily mean, max, min Temp Daily mean max min Conductivity, Transparency graphs (WisCALM Assessment)
Nutrients – Ammonia, Nitrate + Nitrite, Total Kjeldahl Nitrogen, Total Phosphorus and Diss. Ortho Phosphorus Sediments – Total Suspended Solids, Turbidity Algae – Suspended Chlorophyll a Other – Chloride and Alkalinity	State Laboratory of Hygiene	Horizon (SLOH) To LDES to SWIMS	Total phosphorus package with WisCALM documented thresholds. (WisCALM Assessment)
E. coli Low Level Metals – Cadmium, Copper and Mercury Hardness Dissolved Silica Triazine	State Laboratory of Hygiene	Horizon (SLOH) To LDES to SWIMS	Pathogen contamination (USEPA criteria exceedance) and E. coli package threshold exceedance. (WisCALM Assessment)

Quality Assurance - Protocols

Chemistry Grab Samples

a. Nutrients
b. Sediments
c. Chlorophyll a
d. Chloride/Dissolved Silica
e. E. coli
f. Low Level Metals
g. Triazine

Field Measurements

a. Dissolved Oxygen, Temperature and Conductivity probes (not yet updated)
b. Transparency Tube (not yet updated)

QAQC Measures

In general parameter-specific QAQC measures can be found in the parameter specific SOPs. If no QAQC procedure is listed in this section specific to the LTT Trend Rivers program, the generic QAQC protocol should be followed.

Low Level Metals

The LTT Rivers monitoring program requires that field blanks are collected for low level metals (Cd, Cu and Hg) are taken every two years at each site metals are routinely collected. At the same time a field duplicate should be taken using the same protocols as the original sample. This will result in one field blank and one duplicate every 8 samples which falls within the State Lab of Hygiene's recommended frequency of one field blank at 10% of total samples.

Low Level metals field blanks will be collected every other October at all sites across the State. Half of the sites will collect QA/QC samples every odd year and half every even year. QA/QC schedules will be distributed to the affected staff September of every year by Central Office staff.

Total Phosphorus

The LTT Rivers program requires a duplicate sample taken once a year from monthly frequency sites and every other year from quarterly frequency sties. This will result in 30 duplicates samples per year which is nearly 10% of all samples. All duplicate samples will be taken in October and QA/QC schedules will be distributed to the affected staff September of every year by Central Office staff. If duplicate samples are returning significantly different from each other trip blanks or additional laboratory QAQC procedures will be required to determine the source of the discrepancy.

Other Parameters

All other chemical parameters will have QAQC samples taken on an as needed basis as determined by the SLOH Lab Manager, SWIMS Database Manager or LTT Workgroup representatives. As none of the other chemical parameters are processed in the field (i.e. field filtered) the chance of sample contamination is low.

Additional QAQC Elements include:

- Written and accessible field study protocols parameter collection methods (SOPs)
- In field Quality Assurance during data collection
- Written and accessible Sampling and transmittal procedures
- State Laboratory of Hygiene QA Processes
- SWIMS Data transfer, data import QA checks
- SWIMS Data Management Checks

Field Instruments

Field instruments capture grab samples for water temperature, dissolved oxygen concentration, water temperature, specific conductivity and pH at each of the sites. The instruments shall be operated, calibrated and maintained according to the manufacturer's specifications for the particular model and individual probes.

Hard copies of calibration records should be kept by staff. Data from instruments shall be recorded on the SLOH lab slip and turned in with the water chemistry grab samples. Field staff may choose to retain a hard copy for their records however; the SLOH will enter parameters recorded onto the labslip into SWIMS.

Data Management

All data collected will be stored in SWIMS or the Fish Management Database (FMDB). All LTT sites are located in SWIMS. Fieldwork Events are generated with requisite labslips for the pertinent laboratory analyses. Field chemistry is entered into the SLOH database, transferred to the DNR's Laboratory Data Exchange System (LDES) and is then transferred to the SWIMS system. Field parameters are keyed in by the SLOH if they are recorded on the labslip.

Reporting

Collected data are summarized at five year intervals. A report is forthcoming from Science Services in 2014.

Programmatic Evaluation

In 2013-14 Water Quality Biologists have begun analyzing the program and providing input into how the program should change or stay the same in the coming years.

Biotic Integrity River Sites

Currently, 108 sites on 36 rivers annually sampled over 5 years for fish, habitat and macroinvertebrates for nonwadeable macroinvertebrate biologic integrity. This study provides statewide coverage of nonwadeable biological integrity to complement previously collected fish IBI data and LTT Rivers chemical data.

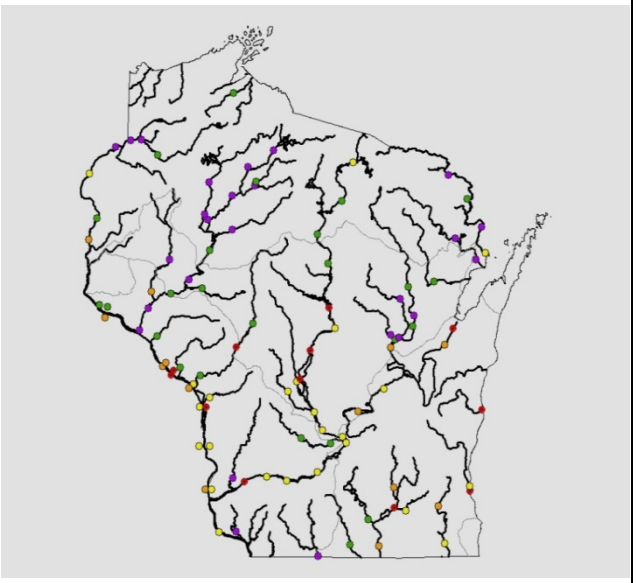


Figure 11: Biotic Integrity River Sites

Monitoring Objectives

The data from this program is used to assess biologic integrity in nonwadeable rivers as well as the impacts of regulatory or management decisions. Guidance is being developed on integrating parameters to evaluate water condition.

Monitoring Design

This program samples 108 sites over a 5-year cycle and includes a trend component where seven locations are sampled annually. About 30 sites were established at or near existing Long-Term Trend (LTT) river monitoring stations. Ambient water quality data are added to the suite of biological parameters sampled at those sites that are not already being sampled as part of the LTT network. The monitoring locations match those used for fish IBI development and validation because they represent the variety of rivers, and stressors acting upon those rivers, statewide. This effort will yield at least 1 site per 15 river miles on each river in Wisconsin

Water Quality Indicators

Large River Macroinvertebrate Index of Biological Integrity (Large mIBI) is the primary water quality indicator gathered and analyzed for this study.

Table 4: Biotic integrity Parameter(s)

Parameter	Analysis Location	Database	Assessment Indicator
Macroinvertebrate Substrate Sample	UW Stevens Point Entomology Laboratory	UWSP to SWIMS	Large River Macroinvertebrate Index (WisCALM Assessment)

Quality Assurance

Sampling Protocols:

- Introduction to Standardized Collection and Assessment of Macroinvertebrates in Nonwadeable Rivers of Wisconsin, Brian Weigel, June 2011.

- Weigel, Brian M. and Jeffrey J. Dimick, 2011. Development, validation, and application of a macroinvertebrate based Index of Biotic Integrity for Nonwadeable Rivers of Wisconsin. J. N. Am. Benthol. Soc., 2011, 30(3):665–679, 2011 by The North American Benthological Society, DOI: 10.1899/10-161.1

In-field QA Elements

No in-field quality assurance elements are designed in this study.

Analytical QA Procedures

Macroinvertebrate samples are analyzed at UW Stevens Point Entomology Laboratory, which is certified and one of the leading laboratories in the United States. Taxonomic count data is entered by graduate student staff and reviewed by the UWSP Lab's lead entomologist. The user interface has quality controls embedded in the input features and individual taxonomic species are selected from a set domain. The data is transmitted to the WDNR where validation tools are run against the taxonomic master table (reference table) and the individual counts must match existing taxonomic domain elements.

River Macroinvertebrate Hester-Dendy Sampling Device

Data Management

Data are entered into SWIMS by UW Stevens Point Aquatic Biomonitoring Laboratory where component metrics and Large River Macroinvertebrate IBI are stored.

Reporting

Collected data will be summarized at five year intervals. The first five year cycle of this program will end in 2015; with up to a year wait for results from the UW SP ABL a report on the program should be completed sometime in 2017.

Programmatic Evaluation

Collected data will be summarized at five year intervals. In 2016 the program will be reevaluated to determine rotation and trend sites for the next five year cycle.

Fox River Water Quality Monitoring

National Rivers and Streams Assessment – Probabilistic Study

The NRSA is a statistical assessment of the condition of the Nation's 3.5 million miles of flowing waters sponsored by the U.S. Environmental Protection Agency (EPA) and is designed to:

- Assess the condition of the Nations perennial streams and rivers;
- Assess the extent and impact of major environmental stressors of flowing water;
- Evaluate changes in conditions of the Nation's rivers and streams over time:
- Help build State and Tribal capacities for monitoring and assessment, and promote collaboration across jurisdictional boundaries.

Monitoring Objectives

The primary objectives of the NRSA surveys are to generate statistically-valid reports on the conditions of the Nation's streams and rivers, identify key factors (stressors) impacting the physical, chemical, and biological conditions of flowing waters in the U.S., and assess changes in the condition of these resources over time.

Monitoring Design

The NRSA is conducted on a 5 – year cycle, using nationally – consistent field protocols and data interpretation. The most recent survey period was 2013 – 2014. A total of 1,800 sites randomly-distributed across the 48 contiguous states were selected to characterize the Nations streams and rivers. The sites are stratified by 9 national ecoregions and by waterbody size (wadeable and boatable). For NRSA 2013-2014, Wisconsin was assigned 25 wadeable and 31 boatable sites to be samples as part of the national survey population. To develop a statistically-robust sample size for Wisconsin, an additional 25 randomly – selected wadeable stream sites, (for a total of 50 wadeable sites), and an additional 10 boatable sites were also surveyed (total of 41 boatable sites).

Physical, chemical, and biological parameters measured

Core Indicators

- Physical habitat (in-stream and riparian)
- Water temperature, pH, conductivity, and dissolved oxygen
- Water chemistry grab samples (nutrients, sediment, etc.)
- Benthic macroinvertebrates
- Fish assemblage data

Supplemental Indicators

- Algal toxins (*Microcystin*)
- Fecal Indicators (*Enterococci*)
- Fish Tissue Plugs (methylmercury)
- Whole Fish (legacy pollutants such as poly-chlorinated biphenyls)

Field Samples and Data Management

NRSA physical habitat data are recorded on field forms developed by EPA. Completed forms are sent to EPA and scanned to capture these field data. EPA subsequently distributes these data and interpretations electronically to the states. Water chemistry samples including algal toxins and enterococci were processed by the Wisconsin State Laboratory of Hygiene and results are captured in SWIMS and reported to EPA. Macroinvertebrate samples are processed by a Wisconsin university lab and data are also captured in SWIMS and reported to EPA. Fish assemblage data are entered in to the department's Fisheries Program database that is linked to SWIMS. Fish tissue plugs and whole fish are processed by an EPA contract lab and will be captured in SWIMS.

Reporting

EPA releases a nationwide report following each NRSA survey. WDNR researchers present Wisconsin-specific results in the form of oral presentations and posters at statewide meetings and national conferences. NRSA results are also included in the Integrated Report. In the future, NRSA results will also be reported on the WDNR website.

Programmatic Evaluation

Apart from EPA evaluations, WDNR will assess probabilistic monitoring every five years.

Section 2.2 Monitoring Strategy for Streams

An estimated 88,000 stream miles encompassing 54,000 discrete rivers and streams drain the lands we call Wisconsin. Many of these streams (the majority) are small intermittent and perennial headwater steams. This section describes the state's monitoring strategy for these resources.

Table 5: Stream Monitoring Studies

Study Name	Purpose	Supports: Fish and Aquatic Life Uses
Wadeable Trend Reference Streams	Long-term variation in biological indices over time at reference sites to understand natural variation and broad scale impacts of climatic extreme events on biologic communities.	Regionally based reference sites provide trend data for biologic indices. Data are used to refine expectations and understand to local impacts of extreme weather events.
Natural Community Stratified Random Sample Design	Provides an assessment of the physical, chemical & biological quality of the overall population of wadeable, perennial streams across the State.	Probabilistic sites provide statistically valid understanding of populations of natural communities statewide.
Targeted Watershed Approach	A streams element of a TWA includes collection of macroinvertebrate, chemistry, habitat (qualitative), and fisheries data to provide an intensive sample collection per HUC 12.	Will be predominant monitoring for attainment and condition assessments, watershed approach and precursor to protection and restoration planning.
Citizen Based Stream Monitoring Sites	Volunteer monitoring is conducted to provide educational benefits to participants and help fill gaps for baseline or tier II monitoring as needed, for example, for phosphorus, base flow monitoring or culvert verification.	Stream flow, gap filling for TP and temperature thermistor deployments for future assessments.
Stream Baseflow Monitoring	Monitor stream baseflow to gain an understanding of stream flow conditions and to manage change in response to existing and proposed catchment alterations.	Natural community validation, model validation, impacts assessments for permits (hi cap) and may result in listing criteria in future.

Study Descriptions

Wadeable Trend Reference Streams

Monitoring Objectives

The major goal of this monitoring program is to track long term variation in biological indices over time at regionally based reference sites to understand natural variation and broad scale impacts of climatic extreme events on biologic communities. Secondarily, a suite of physical and chemical parameters are monitored over time to understand natural variation.

Monitoring Design

The Wadeable Trend Reference Sites monitoring program samples 44 regionally based, least-disturbed (hereafter, reference) stream locations distributed throughout the State. Stream locations were selected from a combination of the 2008-2009 reference stream project and best professional judgment based on regional expectations of reference condition and stratified among natural communities.

Site Selection and Design

Stream monitoring locations were selected from a dataset of previously monitored reference sites and by best professional judgment. Although sites are meant to represent least-disturbed conditions because of the non-uniform distribution of land uses within the State the amount of agriculture and urban land uses in a specific reference watershed may vary across the State.

Monitoring for the Wadeable Trend Reference Sites requires multiple site visits to sample during the appropriate index periods. Temperature loggers should be deployed in spring as soon as the water levels are safe to work and removed in fall. Fish, chemical, physical habitat and flow monitoring should take place during the fish sampling summer index period avoiding recent rainfalls. The macroinvertebrate monitoring should occur during the fall sampling index period.

Water Quality Indicators

Table 6: Wadeable Trend Reference Streams Indicators

Parameter	Analysis Location	Database	Assessment Indicator
Chemical – total phosphorus, total suspended solids, total nitrogen, nitrate+nitrite and ammonia	State Laboratory of Hygiene	Horizon (SLOH) to SWIMS	Total phosphorus (TP) analysis against WisCALM Assessment thresholds.
Macroinvertebrate IBI	UW Stevens Point Entomology Laboratory	UWSP to SWIMS	Wadeable Macroinvertebrate Index (WisCALM Assessment)
Fish Electroshock – Fish species present, count	In Field and Fish DB	Fisheries Database	Fish IBI (dependent on natural community). (WisCALM Assessment)
Habitat (quantitative) Metrics; quantitative for trend reference sites	In Field and Fish DB	Fisheries Database	Qualitative physical habitat

Quality Assurance

- Field protocols
- In field Quality Assurance during data collection
- Sampling & transmittal procedures
- UWSP QA Processes
- SLOH QA Processes
- SWIMS Data flow QA checks
- SWIMS Data Management Checks
- Fish DB Data Quality Checks

Data Management

All data collected for the Wadeable Trend Reference Sites will be stored in SWIMS or the Fish and Habitat Database (FH). Quantitative habitat and fish community results are entered into the FH database maintained by the Bureau of Fisheries management. All other data are stored in SWIMS. Field chemistry data is entered directly by the State Lab of Hygiene as long as the data are recorded on the labslip. Macroinvertebrate data is transferred to SWIMS via a data flow between the UW Stevens Point Aquatic Biomonitoring Laboratory after taxonomic analysis and identification. Summary metric generation is conducted in SWIMS and is available upon request.

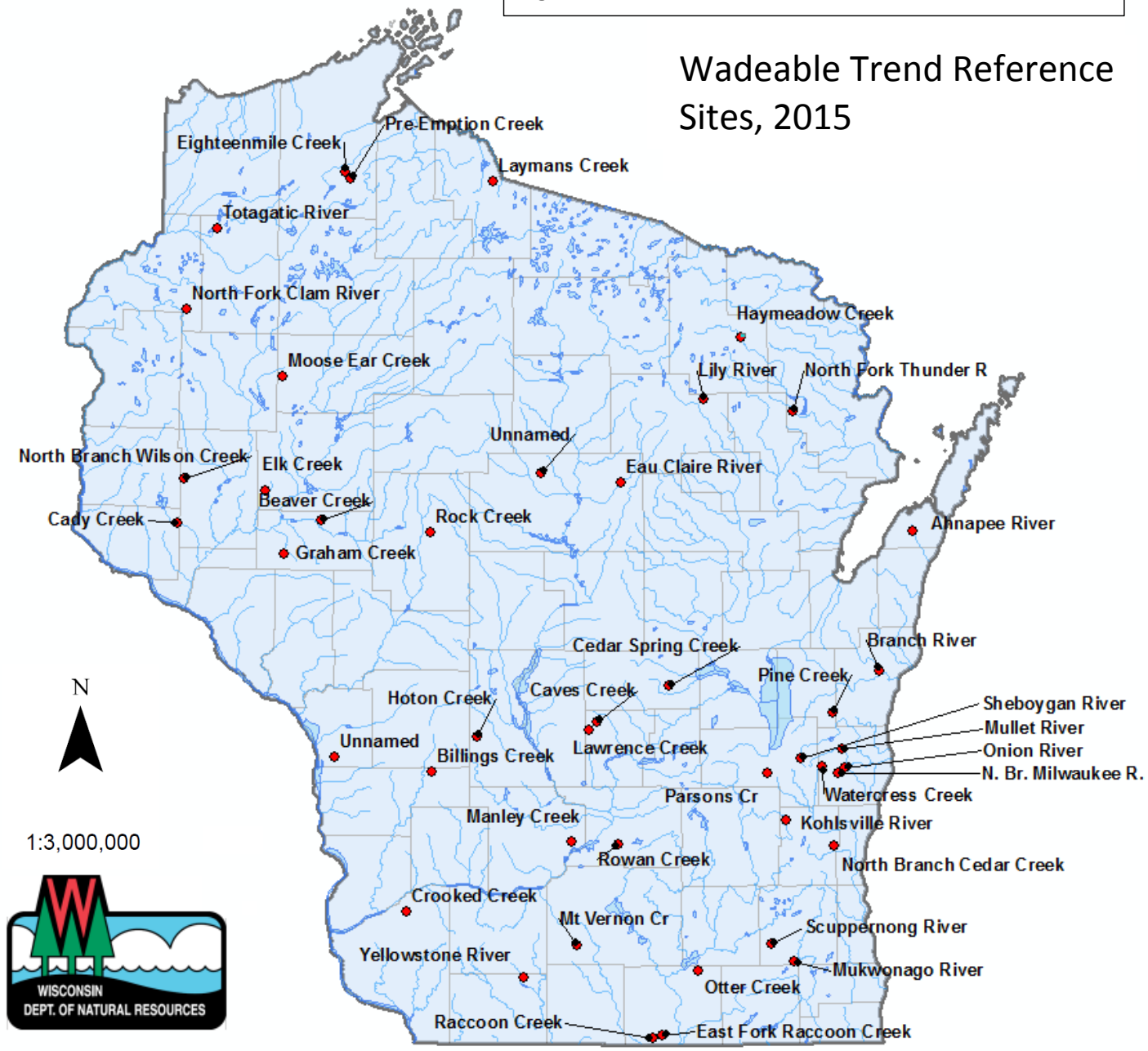
Reporting

Collected data will be summarized on a biennial basis for the purpose of reporting on the status of the state's waters for the Integrated Water Quality Report to Congress (every two years). The next reporting period is 2016. The data will also be used for key parameter package analyses and statewide condition summaries. A report on the status of the project will be completed once 5 years of biologic data for fish and macroinvertebrates are finalized. The report will likely come out in 2016.

Programmatic Evaluation

Periodic reviews to this study design will be made at two and five year intervals to determine if additional sites or subsequent monitoring is needed.

Figure 12 Wadeable Trend Reference Sites, Wisconsin DNR



Natural Community Stratified Random Monitoring Program

To assess the condition of all of Wisconsin's 45,000 miles of perennial streams a probability based stream monitoring program was developed. Probabilistic survey designs provide statistically-valid estimates of conditions large, hard to sample resources with a known confidence.

In 2010-2013 the Wisconsin DNR began a monitoring program to assess the condition of wadeable streams across the State using a probabilistic design called the Natural Community Stratified Monitoring program (NCSR). The Wisconsin monitoring design included sampling 550 sites over four years that were spatially stratified to cover the entire stream, geographic and Natural Community types found throughout the State.

Monitoring Objectives

By using a probabilistic design the State was able to determine the condition of Wisconsin's wadeable streams in a statistically valid manor. The results of this analysis provide an assessment of the physical, chemical & biological quality of the overall population of wadeable, perennial streams across the State. From the results of the 2010-13 NCSR program future versions of the project will consist of 50 sites per year and data will be analyzed every two years (100 sites per cycle starting 2014 & 2015). (http://dnr.wi.gov/topic/surfacewater/monitoring/ncsrmp.html)

Monitoring Design

Stream monitoring locations were selected using a probability based random selection stratifying by DNR District and Natural Community type. Sites locations are located on the Monitoring Activity Sheets for each District and can be accessed through the monitoring intranet site.

There are 50 sites indicated as "Priority 1" sites which must be sampled first. As sites are randomly selected the exact stream locations may not have been visited before and therefore not be familiar to local biologists. If a site is not accessible (non-wadeable, intermittent stream, access issues, etc.) the next highest priority site (labeled as Over Sample) in the same Natural Community should be selected for sampling.

Monitoring for the Natural Community Stratified Random Sites requires a minimum three site visits. One filed reconnaissance and two visits to sample during the appropriate biotic index periods. Fish, chemical, physical habitat and flow monitoring should take place during the fish sampling summer index period avoiding recent rainfalls. The macroinvertebrate monitoring should occur during the fall sampling index period.

Red Cedar River Photo Credit: WDNR

Water Quality Indicators

Table 7: Natural Community Stratified Random Monitoring Program Indicators			
Parameter	**Analysis Location**	**Database**	**Assessment Indicator**
Chemical – total phosphorus, total suspended solids, total nitrogen, nitrate+nitrite and ammonia	State Laboratory of Hygiene	Horizon (SLOH) to LDES to SWIMS	TP Package, chlorides package, other (WisCALM Assessments)
Macroinvertebrate Substrate Sample	UW Stevens Point Entomology Laboratory	UWSP to SWIMS	Wadeable Macroinvertebrate Index (WisCALM Assessment)
Fish Electroshock – Fish species present, count	In Field and Fish DB	Fisheries Database	Fish IBI (dependent on natural community) (WisCALM Assessment)
Physical parameters	In Field	Fish DB or SWIMS	Physical (flow) Data
Habitat (qualitative) Metrics	In Field	Fisheries Database	Qualitative Physical Habitat Index

Quality Assurance

- Field protocols
- In field Quality Assurance during data collection
- Sampling & transmittal procedures
- UWSP QA Processes
- SLOH QA Processes
- SWIMS Data flow QA checks
- SWIMS Data Management Checks
- Fish DB Data Quality Checks

Data Management

All data collected for the NCSR program will be stored in SWIMS or the Fish Database. Staff creates SWIMS locations for each sampling event as they are not pre-made due to the chance that some of the sites will be dropped. Quantitative habitat and fish community results are maintained by the Bureau of Fisheries management. All other data is stored in SWIMS. Field chemistry will be entered directly by the State Lab of Hygiene as long as the data are recorded on the labslip. Macroinvertebrate data is transferred to SWIMS via a data flow between the UW Stevens Point Aquatic Biomonitoring Laboratory after taxonomic analysis and identification.

Reporting

Collected data will be summarized on a biennial basis for the purpose of reporting on the status of the state's waters for the Integrated Water Quality Report to Congress (every two years). The next reporting period is 2016. The data will also be used for key parameter package analyses and statewide condition summaries. A report on the NCSR monitoring program will be released every two years analyzing the current status of Wisconsin's wadeable streams as well as incorporating a tired element in future years.

Programmatic Evaluation

Periodic reviews to this study design will be made tp determine if additional sites or subsequent monitoring is needed.

Targeted Watershed Approach – Streams, Lakes, Wetlands, and more

Targeted Watershed Approach monitoring provides a rotating watershed approach for baseline data collection that blends baseline work with targeted and effectiveness monitoring.

Monitoring Objectives

The goal of targeted watershed assessments across lakes, streams, and wetlands is to identify attainment status and changes in water quality in response to land management practices. Initially, the focus of monitoring will be on streams, but lakes and wetlands will also be monitored in some targeted watersheds. The Targeted watershed approach aligns resource monitoring by watershed at HUC 12 or HUC 10 scale to provide a more holistic perspective on water resources in a watershed system context. The design is a targeted approach and its value is enhanced through alignment with cross program monitoring activities and needs. An additional value of this type of monitoring is the prospect of aligning volunteer monitoring with staff work to fill in gaps (spatial, temporal), conduct follow-up monitoring (TP sampling, AIS monitoring), collect strategic data (such as near permit outfalls, etc.) and to gather data that results in prioritization of new sites based on results. This approach can involve alignment and sequencing of monitoring, assessment, planning, implementation (i.e. watershed planning framework).

Monitoring Design

The TWA design involves monitoring at the HUC 12 scale (~29-mi2). Approximately five to six sites may be sampled per watershed (HUC 12) (1 site/5-mi2), at which chemistry, macroinvertebrates, fish, habitat, and flows/water levels. These core indicators will be supplemented by intensification areas at pour point including six grabs samples, one per month from May through October. Lakes will also be monitored in the Targeted Watershed when nutrient loading is a concern and/or when land management practices are in play. Water quality issues in lakes will often drive the interest in monitoring the condition of streams in the watershed and TWAs will integrate these two waterbody types.

Water Quality Indicators

Table 8: Targeted Watershed Approach Indicators

Parameter	Analysis Location	Database	Assessment Indicator
Chemistry Data – Analytes dependent on monitoring design	State Laboratory of Hygiene	Horizon (SLOH) To LDES to SWIMS	TP Package, chlorides package, and other… (WisCALM Assessment)
Macroinvertebrate IBI Substrate Sample	UW Stevens Point Entomology Laboratory	UWSP to SWIMS	Wadeable Macroinvertebrate Index (WisCALM Assessment)
Physical parameters	In Field	Fish DB or SWIMS	Physical (flow) Data
Fish Electroshock – Fish species present, count	In Field and Fish DB	Fisheries Database	Fish IBI (dependent on natural community). (WisCALM Assessment)
Habitat (qualitative) Metrics	In Field and Fish DB	Fisheries Database	Habitat Suitability Index

Lake water quality indicators will depend in part on the management practices in the watershed. Typical sampling will include: temperature, dissolved oxygen, and conductivity profiles, Secchi depth, total phosphorus, chlorophyll a during spring overturn and three times during a summer index period (15 July - 15 September). Other parameters are collected based on situational factors, such as site specific discharges. Additional parameters include conductivity, pH, alkalinity, color, and the nitrogen series. In addition, plant point-intercept surveys and habitat surveys may be conducted. Given resources, lake sediment cores, in-stream permit compliance, and intermittent/ephemeral stream will be sampled. As needed, a lake water budget will be developed to understand nutrient loading.

Quality Assurance

- Field protocols
- In field Quality Assurance during data collection
- Sampling & transmittal procedures
- UWSP QA Processes
- SLOH QA Processes
- SWIMS Data flow QA checks
- SWIMS Data Management Checks
- Fish DB Data Quality Checks

Data Management

Field data is directly entered into the SWIMS system. Each HUC will be developed as its own "project" in the SWIMS system (data management design) and under each project fieldwork events with laboratory and field data are collected. Project set up and station creation is conducted in SWIMS by Rivers and Streams Program Coordinator or the SWIMS file manager. Field data is entered subsequent to the field data collection. The data entry into SWIMS follows the generation of labslips and the establishment of fieldwork events. Most analytical work is conducted at the State Laboratory of Hygiene and transmitted through the LDES to the SWIMs system.

Fisheries and habitat data is entered directly into the USGS supported Fisheries Database. Macroinvertebrate data is collected in the field and transmitted to the UWSP Entomology Laboratory for analysis. This data is then entered into a local computer and send to a contractor for the SWIMS system where it is entered into the SWIMS system and metrics are created. Currently, SWIMS does not store aquatic plant, habitat, sediment core, and water budget data on lakes. Plans to store aquatic plant and lake habitat data in SWIMS are under development and the system has the capacity to store sediment core and stream and lake level and baseflow data.

Reporting

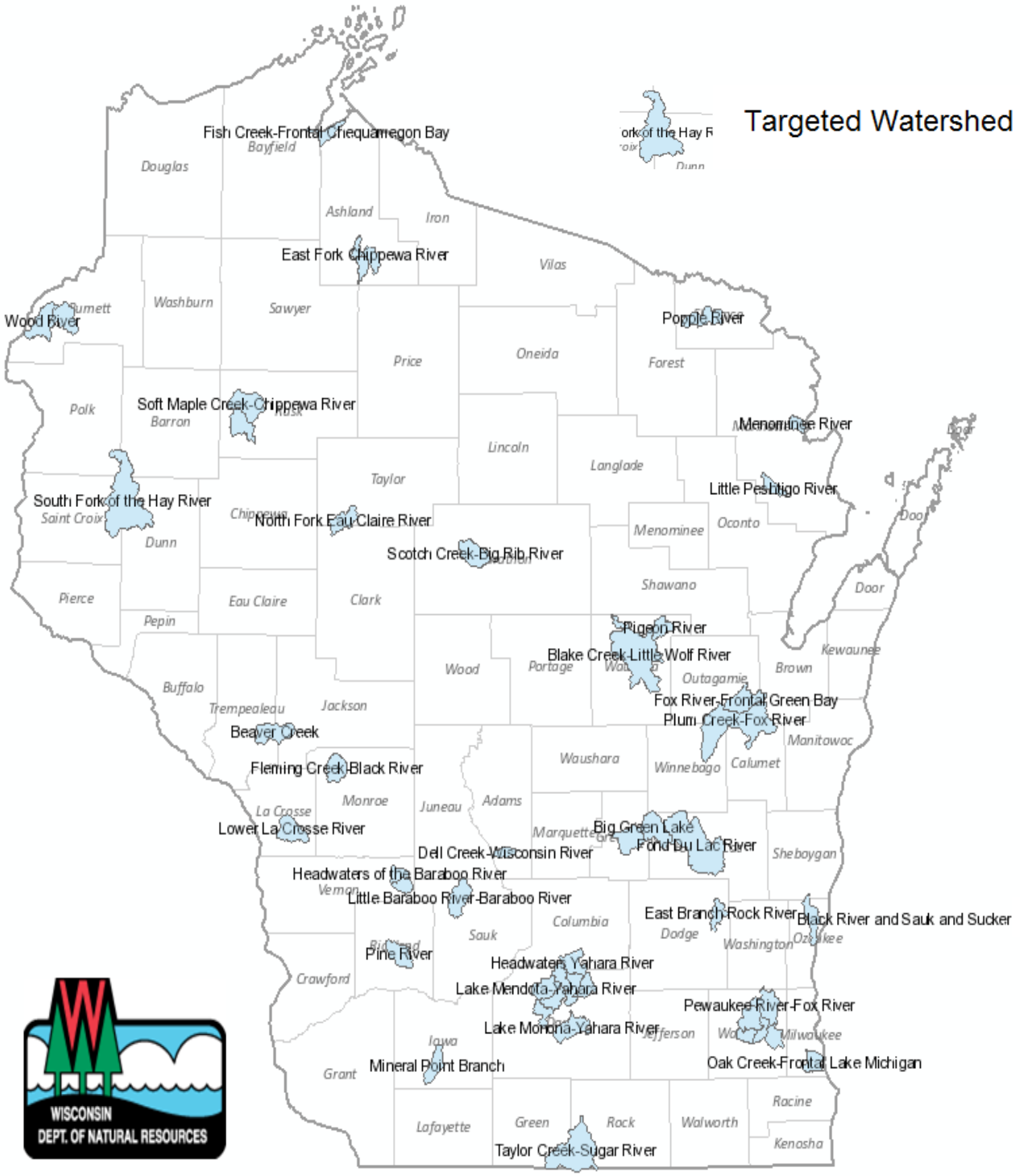
Collected data will be summarized on a biennial basis for the purpose of reporting on the status of the state's waters for the Integrated Water Quality Report to Congress (every two years). The next reporting period is 2016. The data will also be used for key parameter package analyses and statewide condition summaries. Of critical importance, all data from the Targeted Watershed Assessments (TWA) work will be rolled into the watershed planning assessments, narrative descriptions and recommendations will be entered and archived in the WATERS data on an ongoing basis. Biologists are responsible for completing reports for each Targeted Watershed on a schedule created by regional and central office.

Programmatic Evaluation

Periodic reviews to this study design will be made at two and five year intervals to determine if additional sites or subsequent monitoring is needed.

Strickers Pond, Middleton, Wisconsin. L. Helmuth 2015

Figure 13 Targeted Watershed Assessments 2015



Water Action Volunteers - Stream Monitoring

The Water Action Volunteers Stream Monitoring Program (WAV) incorporates three levels of participation for citizen scientists who are interested in monitoring local streams: Introductory (Level 1), Status and Trends (Level 2), and Special Projects Monitoring (Level 3).

Monitoring Objectives

A primary objective of introductory monitoring is to increase public understanding of watersheds and how human uses of the land impact stream quality, while building a baseline of basic water quality information. Data collected help to identify acute issues in wadeable streams. Since everyone initiates participation at this level, volunteers are able to gauge interest in becoming more involved, and trust is able to be built with DNR staff who commonly partner with volunteers at other levels. For the subset of volunteers who choose to carry out Status and Trends Monitoring, their primary objective is to obtain long-term (3-5 years minimum) data to characterize trends in continuous temperature over time, as well as to continue to monitor for acute issues for other parameters routinely monitored by DNR water quality biologists such as dissolved oxygen and pH. Monitoring objectives of Special Projects vary as these projects change year to year. Efforts for special projects have included collecting chloride, specific conductance, total phosphorus, and E. coli data to characterize conditions and generate data that may be used to help determine if impaired waters listings are warranted.

Monitoring Design

In Introductory Monitoring, dissolved oxygen, temperature, transparency, and streamflow are monitored monthly between April (or May) and October. Macroinvertebrates are monitored in spring and fall, and habitat is assessed once per year in summer. In Status and Trends Monitoring, dissolved oxygen, pH and transparency are monitored monthly between April (or May) and October on pre-determined dates. Continuous temperature monitoring devices are deployed in the spring and retrieved in the fall so that water temperature data can be downloaded and entered into the SWIMs system. Meters for monitoring pH and dissolved oxygen must be calibrated by the citizen monitors on each sampling day.

Prairie School students checking turbidity at the Wingspread Ponds outflow (Prairie Stream North)

Current Special Research Projects include a road salt monitoring effort in which specific conductance and chloride are assessed in urban areas of the state, and total phosphorus monitoring to assist DNR water quality biologists. For the road salt monitoring project, volunteers monitor monthly April-November and twice per month or more frequently between December and March, as they carry out triggered monitoring during storm events in winter months.

For total phosphorus monitoring, volunteers follow WisCALM guidance for streams, monitoring monthly May through October no fewer than 15 days apart and about 30 days apart.

Water Quality Indicators

Water quality indicators monitored by volunteers in streams of Wisconsin include dissolved oxygen, pH, temperature, transparency, stream flow, habitat, macroinvertebrates, specific conductance, chloride, total phosphorus, and E. coli.

Table 9: WAV Program Description

WAV Level	Parameter	Analysis Location	Database
Level 1: Introductory Monitoring	Dissolved Oxygen (DO)	In Field	Water Action Volunteers Project in SWIMS database
	Temperature		
	Transparency		
	Streamflow		
	Macroinvertebrates		
	Habitat		
Level 2: Status and Trends Monitoring	Dissolved Oxygen (DO)	In Field	SWIMS (WisCALM Assessment)
	pH		
	Temperature (point in time)		
	Transparency		
	Continuous Temperature	Data downloaded in the office	
Level 3: Special Projects Monitoring	Specific Conductance	In Field	SWIMS (WisCALM Assessment)
	Total Phosphorus	In Field collection; WI State Lab of Hygiene analyzed	
	Chloride	In Field collection; WI State Lab of Hygiene analyzed	

Quality Assurance

Introductory Monitoring: All volunteers who participate attend a hands-on training to learn methods. They are also provided written methods and short refresher training videos to reinforce learning. Local coordinators often (though not always) monitor with new volunteers on their first site visit. Data are also quality assured.

Status and Trends Monitoring: All volunteers who participate attend a hands-on training to learn calibration and field monitoring methods. They are also provided written methods at the training session and short refresher training videos were developed in 2014 to reinforce learning throughout the monitoring season. An EPA-approved Quality Assurance Project Plan defines quality assurance procedures. In addition, ten percent of volunteers are selected each year to be included in a side-by-side methods and equipment check by a WAV staff person or local coordinator. The person administering the QA/QC check observes the volunteers as they calibrate meters and as they carry out field monitoring. Volunteers are provided guidance if methods are not being followed and steps are taken to perform maintenance on equipment if data results between the QA/QC administrator and the volunteer fall outside of expected ranges. Data are also quality assured.

Special Projects Monitoring: All volunteers who participate attend a hands-on training to learn calibration methods, in field monitoring methods, and proper chain of custody, storage and shipping procedures (as appropriate for each project).They are also provided written methods at the training session to reinforce learning. Quality Assurance Project Plans have been developed for both the road salt and total phosphorus monitoring projects. The general methodology followed is described below. Data are also quality assured.

Quality Assurance for Volunteer Stream Monitoring

The Water Action Volunteers Stream Monitoring Program (WAV) is implementing a protocol to document the accuracy and precision of data collected by volunteers. Water samples collected by DNR field staff go through a similar quality

assurance/quality control (QA/QC) protocol. These tests document the accuracy and precision of the data collected and look at natural variability and sampling error. Each year, ten percent of sites to be monitored for each special project are randomly selected to have quality assurance/quality control (QA/QC) samples collected by the volunteer monitoring that site. Two types of QA/QC samples are collected by volunteers: field blank and field replicate (duplicate) samples. These are shipped along with the volunteer's regular sample to the Wisconsin State Lab of Hygiene for analysis.

Data Management

Field data are directly entered into the WAV Level 1 or the DNR SWIMS online database systems as appropriate. For Introductory Monitoring, volunteers or local coordinators submit basic required information about a site to the database enabling WAV staff to approve proposed sites and to complete the site registration process. Volunteers enter data results following field monitoring. Expected data ranges are defined in the online database, and volunteers are immediately alerted if data fall outside the defined range for each parameter so they can make corrections to their data entry. Additionally, each volunteer is linked with a local data coordinator who must review and approve all data entered to the database before they are available to data users. For Status and Trends Monitoring and Special Project Monitoring in which field data are collected by volunteers, the SWIMS database is used. In SWIMS, volunteers must initially obtain Wisconsin Access Management user identification (WAMs ID) and then contact WAV staff or a SWIMS file manager to gain access to SWIMS. Once contacted, the SWIMS file manager sets up each station as a project and link the volunteer with that project to enable volunteers to enter data to SWIMS. Volunteers enter data results following field monitoring. When there is a laboratory component of a monitoring project, State Laboratory of Hygiene staff transmits results through the Lab Data Entry System to the SWIMs database. Ongoing data quality checks are made by WAV staff to assess data entered to the SWIMS database.

Reporting

Collected data are summarized through the SWIMS database, the DNR's website and the WAV Program website, where summary reports and graphs from SWIMS are available for downloading and review. The WAV data collected for Tier II and III work will also be summarized on a biennial basis for the purpose of reporting on the status of the state's waters for the Integrated Water Quality Report to Congress (every two years). The next reporting period is 2016. The data will also be used for key parameter package analyses and statewide condition summaries. For highly trained volunteers following established protocols for ambient water chemistry, there is no differentiation between data collected by volunteers and water quality biologists.

Programmatic Evaluation

Program reviews of citizen volunteer initiatives are made on an ongoing basis due to the need to continually evaluate the state's expenditures of resources. New and creative ways to work with partners and volunteers in the monitoring program are of great interest. The work of Wisconsin streams, lakes and wetland volunteers is tremendously valued.

Stream Baseflow Monitoring

Stream baseflow helps resource managers identify potential threats or problems associated with human actions or to document the severity and extent of variation in weather pattern impacts such as drought or severe rainfall events.

Monitoring Objectives

Monitor stream baseflow will be incorporated into existing projects and studies to gain an understanding of stream flow conditions and to manage change in response to existing and proposed catchment alterations. This data may be used for the Water Use Section in Groundwater Management for permit decisions, as well as to evaluate changes or trends in water availability in response to human-induced landscape changes. This monitoring may involve reconnaissance work that will document intermittent or ephemeral streams.

Monitoring Design

A stream baseflow monitoring program is currently under development to better understand ambient stream flow conditions throughout the state. Special intensification work would be conducted in areas of high permit activity for high capacity wells and other permit actions. Volunteer monitoring may use manual methods, while DNR staff monitoring of flow uses metered methods. Additionally, natural community validation work for flow monitoring may include monitoring stream flow upstream and downstream during baseflow conditions.

Water Quality Indicators

Table 10: Stream Baseflow Monitoring Parameter

Parameter	Analysis Location	Database	Assessment Indicator
Stream flow measures (meter based for DNR)	In Field	SWIMS	Instantaneous flow data; model calibration data.

Quality Assurance

- Field protocols
- In-field Quality Assurance during data collection
- SWIMS Data Management Checks

Data Management

Field data are directly entered into the SWIMS system. Each flow sampling site will be connected to a SWMS stations and will be available under a project entitled, "Stream Flow Study". If chemistry or additional biological data are gathered, they will be stored under the study.

Project set up and station creation is conducted in SWIMS the project manager or a SWIMS file manager. Field data are entered subsequent to the field data collection. The data entry into SWIMS follows the identification of or establishment of a station.

Reporting

Collected data will be summarized in a final report and will be available on the DNR's website and through special reports. Data may also be displayed in high capacity well viewers and other DNR tools.

Programmatic Evaluation

An end-of-study review of the project design will be conducted and recommendations made on whether this element should be incorporated into the TWA process as a routine element.

Baseflow monitoring identifies the levels and flows of streams.

Section 2.3 Monitoring Strategy for Lakes

Table 11: Lake Monitoring Studies

Study Name	Purpose	Supports: Fish and Aquatic Life Uses and Recreational Uses
Probabilistic Surveys (National Lakes Assessment)	Determine lake health and how lake characteristics are changing over time statewide	National surveys and provides single point data with national methods for further analysis. Single point data *may* be used toward attainment decisions.
Long-Term Trend (LTT) Lakes	Document long-term trends in lakes, provide context for other lakes, answer questions from the public, and evaluate long-term effectiveness of management actions	Overall state lake trend data for condition statements regarding Wisconsin's lakes; used for attainment decisions.
Aquatic Plant Reference Lakes	Monitor natural variability in healthy aquatic plant communities	Aids lake biocriteria development including minimum data requirements and thresholds.
Citizen Lake Monitoring Network (CLMN)	Determine lake trophic status and monitor trends in trophic status over time; citizen engagement and education	Provides the primary source of data for site specific data statewide in conjunction with satellite imagery modeling, resulting in over 6,000 lakes assessed.
Satellite Secchi Monitoring	Infer lake water quality for assessment from satellite data	In conjunction with the CLMN program site specific data statewide resulting in over 6,000 lakes assessed
Directed Lake Surveys	Collect lake information needed for assessment (e.g., 303(d) reporting) and lake management (e.g., aquatic plant management, shoreland zoning, restoration projects, and critical habitat designations) and survey lakes in Targeted Watersheds.	New category of lake monitoring to directly address attainment / condition questions for a host of parameters specific to lake ecosystems. Supports attainment, as well as biocriteria development and implementation.
Lake Level Monitoring	Long-term monitoring to understand natural fluctuations in lake levels and guide lake management, particularly on lakes impacted by drought or groundwater withdrawals.	Addresses management questions regarding lake levels and supports the groundwater program (well permits, etc.).

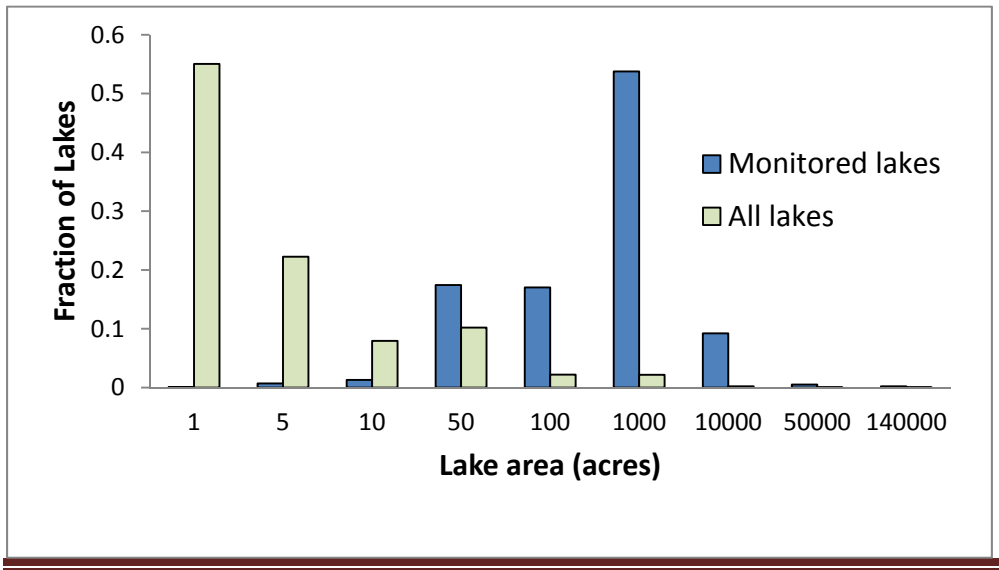


Figure 14. Chart of lake size versus lakes monitored. WDNR monitors lakes that range in size from 1 to 132,000 acres. The majority of lakes in the state are <10 acres, but most monitored lakes are >50 acres. Here, "monitored lakes" had Secchi depth readings in 2014 or 2015.

Study Descriptions

Probabilistic Survey (National Lakes Assessment)

Monitoring Objectives

The objective of the probabilistic survey is to determine statewide lake condition across all lake types and sizes. By repeating the survey over time, changes in statewide lake condition over time will also be determined.

Monitoring Design

The probabilistic surveys will be completed in conjunction with the National Lakes Assessment (NLA), a monitoring effort led by the Environmental Protection Agency (EPA). The NLA is conducted once in a 5-year period. Fifty lakes will be sampled once within a single summer field season, which is a sufficient sample size for a statewide assessment. Lakes > 1 meter deep and > 2.5 acres area are randomly selected from a sample stratified by ecoregion and weighted by lake size. NLA surveys were conducted in 2007 and 2012; the next survey will be in 2017.

If additional funding is secured, the WDNR's goal is to sample a total of 100 lakes within a 2-year period on the NLA cycle in order to characterize lake condition in northern and southern Wisconsin.

Water Quality Indicators

At the deepest point in the lake, samples are collected for a wide variety of parameters: depth profiles of temperature, pH, and dissolved oxygen (DO), Secchi depth, water chemistry (NH_4, NO_3, major anions and cations, alkalinity, dissolved organic carbon, total suspended solids, silica, conductivity), chlorophyll *a*, nutrients, phytoplankton assemblage, zooplankton assemblage, triazine pesticide screen, and algal toxins. In addition, a sediment core is taken, dated, and analyzed for diatoms and mercury. At ten littoral sites located equidistantly around the lake, benthic macroinvertebrates and shoreline habitat are sampled. Aquatic macrophytes are also surveyed at five of the littoral sites. At a single littoral site, chlorophyll *a*, algal toxins, and phytoplankton are collected.

Given funding to monitor an additional 50 lakes, WDNR will scale back the NLA protocol to do fewer metrics at more sites, omitting the triazine pesticide screen, benthic macroinvertebrate, zooplankton, and sediment mercury sampling from analysis. Instead of following the NLA macrophyte protocol, WDNR will do full aquatic macrophyte point-intercept surveys on all lakes. Monitoring will be conducted by a centralized crew based at the Science Operations Center in Madison.

Data Management

To date, data has been collected on tablets and given directly to EPA. EPA screens the data and then sends back to WDNR after approximately two years. The data are then stored on personal computers of the WDNR research staff. In the future, the NLA data should also be stored in SWIMS. Data from the additional 50 lakes will be entered directly into SWIMS. The SWIMS database will need to be set up for new types of data (e.g., lakeshore habitat inventories).

Reporting

EPA releases a nationwide report following each NLA survey. WDNR researchers present Wisconsin-specific results in the form of oral presentations and posters at statewide meetings and national conferences. NLA results are also included in the Integrated Report. In the future, NLA results shall also be reported on the WDNR website. These data not used for statewide assessments, but trigger further monitoring and assessment when SWIMS capture USEPA data.

Programmatic Evaluation

Apart from EPA evaluations, WDNR will assess probabilistic monitoring every five years.

Long Term Trend Lakes (LTT Lakes)

Sixty-two lakes have been monitored annually as part of the LTT Lakes program since approximately 1986. Some lakes have records dating back to 1968 whereas others were added more recently (as late as 2000).

Monitoring Objectives

The primary objective of LTT Lakes monitoring is to document long-term trends in water chemistry within lakes. This data set also provides context for water chemistry in other lakes in terms of intra and inter-annual variability. These lakes help regional lake biologists answer questions from the public. Finally, given that each lake was included in the program due to a management action, data may evaluate management action effectiveness.

Monitoring Design

These lakes are distributed across all four ecoregions, all five DNR management regions (west central, south east, south central, north, northeast), and most lake natural communities. "Small lakes" (< 10 acres area) are not represented. The smallest, median, and largest LTT lakes are 38, 382, and 132,000 acres in area, respectively. The LTT lakes were not chosen to be reference lakes with minimal human disturbance. In fact, most lakes had been chosen based on societal value and management actions taking place. Currently, an evaluation of the LTT Lakes monitoring program is underway. Lake selection can be improved by including reference lakes from each ecoregion and small lakes.

Water Quality Indicators

Long Term Trend Lakes are sampled annually for water quality. During spring turnover, temperature and dissolved oxygen profiles are taken along with Secchi depth and an epilimnetic Total Phosphorus sample. Three times during the summer index period (15 July - 15 September), the following parameters are collected: temperature, dissolved oxygen, and possibly conductivity profiles, Secchi depth, epilimnetic Total Phosphorus and chlorophyll *a*. In addition, conductivity, pH, alkalinity, color, nitrate+nitrite and Total Kjeldahl Nitrogen are collected from the epilimnion once each summer. Every five years, calcium and magnesium are sampled. On some lakes in the west and north, aquatic plant point-intercept surveys are conducted every three years. Fifty-five of the LTT lakes are also on the fisheries management rotation. These lakes are sampled for the abundance and size of game fish every 1 – 12 years depending on the lake.

The LTT protocol is currently under revision. Proposed changes include: adding a June sampling event, collecting hypolimnetic samples for nutrients and related parameters, changing Total Kjeldahl Nitrogen to Total Nitrogen, and sampling additional parameters: NH_4, chloride, Soluble Reactive Phosphorus (SRP), Sulfate, Iron, Dissolved Organic Carbon (DOC). Other surveys under consideration include: aquatic plant point-intercept surveys on all LTT lakes at least once every five years, shoreland habitat every five years, rapid assessments of Aquatic Invasive Species (AIS), lake levels (survey gage in spring and fall and record lake level at each sampling event), water budgets, three phytoplankton surveys per summer including tests for blue green algae, microcystin, and phycocyanin, three zooplankton samples per summer, and beach seines for fish species. More frequent monitoring of temperature profiles on select lakes as indicators of climate change has also been suggested. Given limited resources, a handful of "sentinel lakes" may be selected among the LTT lakes for expanding indicators and frequency of sampling.

Table 12: Long Term Trend Lakes (LTT Lakes) Indicators

Parameter	Analysis Location	Database	Assessment Indicator
Chemistry Data	State Laboratory of Hygiene	Horizon (SLOH) To LDES to SWIMS	Trophic Status Index (TSI) (WisCALM Assessment)
Game fish*	In Field and Fish DB	Fisheries Database	TBD (WisCALM Assessment)
Aquatic Plant Surveys*	In field and Herbarium for validation	Bureau of Research, SWIMS	Aquatic Macrophyte Community Index (AMCI)

*A subset of LTT lakes are surveyed for these parameters.

Quality Assurance

- Field protocol including duplicate and replicate samples
- LTT Lakes Field Sampling Procedures

Data Management

Water chemistry samples are analyzed at the State Laboratory of Hygiene and then uploaded to the SWIMS database. WDNR field staff writes additional lake data (sample depths, thermal profiles, etc.) on the lab slips, which are then entered by State Laboratory of Hygiene into SWIMS. In some instances, field staff enter data directly into SWIMS.

Reporting

Collected data are summarized in the SWIMS database and the DNR's website where summary reports and graphs from SWIMS are available for downloading and review. These data shall also be summarized for the Integrated Water Quality Report to Congress (every two years). The next reporting period is 2016. The data will also be used for key parameter package analyses and statewide condition summaries. There is a need to routinely analyze and report long-term trends in these lakes.

Programmatic Evaluation

The LTT Lakes program is currently under review (2014), and will continue to be evaluated every five years.

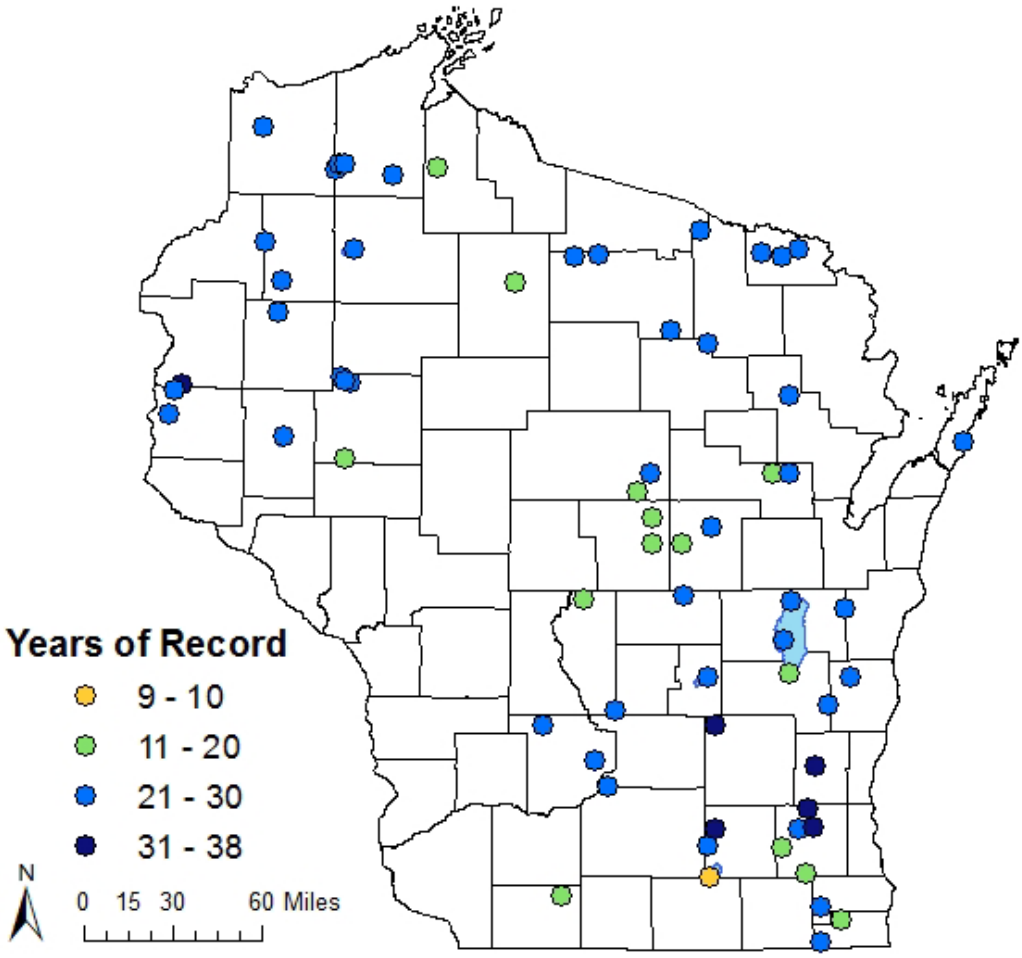


Figure 15: Distribution of LTT Lakes including the number of years of record.

Aquatic Plant Reference Lakes

Aquatic plants, similar to biological data for streams and rivers, integrate a variety of ecological signals, providing an indicator of stressors in the micro-system in which the plants are found.

Monitoring Objectives

The objective of Aquatic Plant Reference Lakes is to document the variability in healthy aquatic plant communities in the absence of management actions. This information will then be used to refine the new aquatic plant biocriteria for lakes and will also serve as a benchmark as we begin assessing aquatic plant communities in lakes.

Monitoring Design

Three lakes will be selected in each of four lake categories for which a distinct biocriteria has been developed. The categories include: northern seepage lakes, northern drainage lakes, southern seepage lakes, southern drainage lakes. The break between north and south occurs at 44.84707°N. Each lake will be sampled annually. An effort will be made to select LTT Lakes, but only a handful of LTT lakes have plant communities in the best possible condition and do not have ongoing aquatic plant management. Monitoring will begin on some lakes in 2015. Final lake selection needs to be completed and staff capacity needs to be built before we are able to monitor all 12 lakes.

Water Quality Indicators

A plant point-intercept survey will be conducted on each lake annually. If not an LTT lake, efforts will be made to initiate water chemistry monitoring on the lake following WisCALM guidance (perhaps by initiating citizen-based monitoring on these lakes).

Quality Assurance

- Field Protocols (PI-Protocol-2010.pdf)
- Herbarium voucher specimens
- Field survey trainings (annual training exists, but more in-depth training is needed for select WDNR staff)

Data Management

Plant Point Intercept data are currently stored on individual desktop computers. An effort to build the capacity to house plant data in SWIMS has been initiated and must be completed. Second, there is a need to develop a program that will calculate plant biocriteria from raw plant point-intercept data.

Reporting

Reporting templates need to be developed. Eventually, plant point intercept data will be reported on the Lakes pages and will be incorporated into the Integrated Report.

Programmatic Evaluation

This program will be evaluated annually as it is being developed.

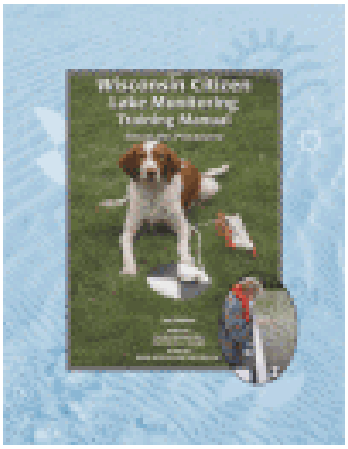
Citizen Lake Monitoring Network

Monitoring Objectives

The Citizen Lake Monitoring Network, the core of the Wisconsin Lakes Partnership, creates a bond between over 1000 citizen volunteers statewide and the Wisconsin DNR. The goals are to collect high quality trophic status data, to complete water

quality assessments on lakes, to educate and empower volunteers, and to share this data and knowledge.

Monitoring Design



Lake selection has primarily been driven by volunteer interest. Approximately 900 lakes are monitored each year for Secchi depth, and the number of "Secchi lakes" continues to increase. Approximately 550 lakes are sampled for water chemistry, and 360 lakes for dissolved oxygen. Water chemistry lakes range in area from 6 – 23,000 acres, with a median area of 213 acres.

Given the costs associated with water chemistry analysis, lake selection for water chemistry is under review. Currently, once a lake begins monitoring water chemistry, it continues indefinitely. Although long-term data are useful, WDNR recommends freeing up resources to allow water chemistry sampling on more lakes. A subset of lakes will be retained for long-term records and the remaining lakes will be committed for 2 years of sampling (minimum needed for assessment) with the possibility to extend monitoring for more years. This will enable WDNR to assess more lakes and align CLMN more closely with other lake monitoring activities (e.g., Directed Lakes and Targeted Watersheds Assessments). Capacity to train and coordinate new volunteers, volunteer satisfaction, record length, and management activities on individual lakes must be considered to decide how many lakes will be monitored short-term. For example, 277 of CLMN lakes with at least 10 years of data could be retained for long-term monitoring (Figure 16). All volunteers collecting Secchi data should continue their efforts as long as possible.

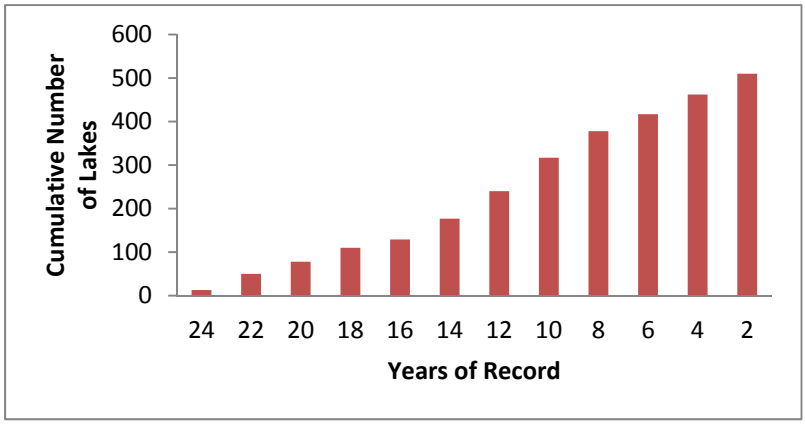


Figure 16
Cumulative number of CLMN lakes that have been monitored for Total Phosphorus. This distribution may be used to determine how many lakes to retain for long-term water chemistry monitoring.

Water Quality Indicators

Volunteers measure water clarity using a Secchi disk. This information is then used to determine the lake's trophic state. A subset of volunteers also collects water temperature and dissolved oxygen profiles, and total phosphorus and chlorophyll *a* from the epilimnion. They adhere to the same protocols as the LTT Lakes program, but do not collect a spring water sample. In addition, volunteers on approximately 300 lakes watch for the first appearance of AIS such as Eurasian Water Milfoil and zebra mussels.

Table 13: Aquatic Plant Reference Lake Study Indicators

Parameter	Analysis Location	Database	Assessment Indicator
In field data collection	In Field	SWIMS	TSI (WisCALM Assessment)
Chemistry Data	State Laboratory of Hygiene	Horizon (SLOH) To LDES to SWIMS	TSI and related (WisCALM Assessment)

Quality Assurance

- Field Protocols
  - Wisconsin Citizen Lake Monitoring Manual - Water Quality (3rd Edition revised 2009)
  - Wisconsin Citizen Lake Monitoring Manual - Chemistry Procedures (3rd Ed revised 2013)
  - Wisconsin Citizen Lake Monitoring Manual - AIS monitoring (revised 2014)
- Replicates and blanks on 10% of samples
  - Quality Assurance Sampling Protocol – CLMN – 2013
- Training
- SLOH QA Processes
- SWIMS Data flow QA checks and Data Management

Data Management

Field data from the Citizen Lake Monitoring Network is hand-entered into the SWIMS database by the collector. Chemistry data analyzed in the laboratory is sent to the State Laboratory of Hygiene and entered by staff at the lab. These data are reviewed and proofed by the CLMN database file manager as well as the collectors of the data.

Reporting

Citizen Lake Monitoring Network data are accessed from Wisconsin DNR's Lakes Pages where cumulative datasets, downloads, and summary graphs and reports are available as soon as the data are entered into the SWIMS database. All CLMN data are also used in the biennial Water Quality Report to Congress.

Programmatic Evaluation

The CLMN program is undergoing a thorough review during 2014-2015. The Advisory Panel includes WDNR staff, UW-Extension staff, and board members from the Wisconsin Lakes Association, county, tribal staff, and citizen volunteers.

Satellite Monitoring - Secchi

Monitoring Objectives

The monitoring objective is to assess lake water quality on approximately 8000 lakes in Wisconsin by inferring water clarity from satellite imagery on an annual basis. This information is freely available to the public as well as the scientific community for understanding lake dynamics.

Monitoring Design

This effort has been built on a successful collaboration between UW-Madison, WDNR and the Citizen Lakes Monitoring Network. Landsat satellite imagery is used in conjunction with citizen-collected Secchi depths to develop models that estimate water clarity in lakes > 5 acres statewide. This WDNR-Science Services activity, performed annually, now has 25 years of record. At least two water clarity values from within a 3-year period in summer are averaged to determine lake trophic status.

Water Quality Indicators

Secchi depth and Trophic State Index are inferred from the LANDSAT imagery. These parameters are used in WisCALM assessments.

Data Management

All database records and image files are archived at the Science Operations Center. A file containing the Secchi estimates is sent annually to the lakes program. Data are also stored in the SWIMS data base.

Quality Assurance

- Field Protocols & Training
- Data and Image processing
- SWIMS Data flow QA checks
- SWIMS Data Management Checks

Reporting

Generated data are summarized through the SWIMS database and the DNR's website (http://dnr.wi.gov) where summary reports and graphs from SWIMS are available for downloading and review. These data are also summarized for the Integrated Water Quality Report to Congress (every two years). The next reporting period is 2016. The data will be used for key parameter package analyses and statewide condition summaries.

Programmatic Evaluation

This monitoring is funded, and hence evaluated, annually by the Lakes program. This effort has proved to be an extremely cost effective (12K annual) and efficient method to produce a sizable database for the agency as well as the public and scientific community. In addition, General Purpose Revenue is funding a project position from 2014-2016 that focuses on this work.

Directed Lake Surveys

Monitoring Objectives

The objective of directed lake surveys is to strategically collect holistic lake information needed for assessment (303d reporting) and lake management needs on a two-year planning cycle. The focus of this work is to collect biological, physical, and chemical data on lakes with a statewide perspective, but also to address local lake management issues including: aquatic plant management, shoreland zoning, high capacity wells, lake restoration projects, dam regulations, and blue green algae blooms. Lakes shall be selected both for protection and restoration.

Monitoring Design

Lakes will be selected on a 2-year cycle by regional biologists and the statewide lake monitoring coordinator to balance local and statewide needs. For assessment purposes, lakes are prioritized if trophic status indicators (from satellite imagery or initial water chemistry) suggest impairment but data for impairment listings are insufficient. Lakes are revisited to obtain sufficient data for listing purposes. Soon aquatic plants will routinely be surveyed on follow-up monitoring lakes, but currently only water chemistry samples are taken. All lakes targeted for lake management purposes must have public access. Specific management objectives determine which lakes are targeted and which parameters are monitored (see table below). The most prevalent management needs vary across the state. Therefore, allocation of resources to monitoring objectives varies by DNR region. Lakes are further prioritized for monitoring if they are on the fisheries management monitoring rotation, if they are being monitored for AIS, and if they lack a lake organization (lake organizations often provide alternative means of data collection through lake grants).

Figure 17: Monitoring Objectives, Targeted Water, and Monitoring Parameters

Objective	Lake Target	Chemistry	Plants	Habitat	Lake level
303(d) assessments	Satellite or chemistry suggest impairment	x	x	x	
Aquatic Plant Mgmt.	Eurasian Water Milfoil (EWM) lakes	x	x	x	
Shoreland zoning	Developed shorelines			x	
High capacity wells	Proximity to wells; Groundwater-dominated	x	x	x	x
Dam regulations	Dammed lakes	x	x	x	x
Blue Green Algae	High chlorophyll *a*; Harmful algal bloom reports	x			

Water Quality Indicators

At a minimum, monitoring surveys will include: water chemistry samples for the Trophic Status Index, an aquatic plant point-intercept survey, and a shoreland habitat survey. The water chemistry group of parameters follows WisCALM guidance at a minimum. This includes Secchi depth, water temperature and dissolved oxygen profiles, and an epilimnetic sample of total phosphorus and chlorophyll *a* taken three times during the summer index period (July 15 – September 15) for two years. If lakes are targeted for blue green algae management, then blue green algae counts, microcystin, and phycocyanin are also sampled.

Aquatic plant point-intercept data are collected according to methods detailed in the following protocol: PI-Protocol-2010.pdf. Aquatic plant management relies heavily on this data. Plant-based biocritera metrics and rules are currently in development and will hopefully be codified by 2017. Thus, lake condition assessments will soon rely on plant point-intercept data in addition to the Trophic Status index and shall become a routine monitoring parameter.

Littoral and riparian habitat degradation is one of the major stressors to Wisconsin lakes. A shoreland habitat monitoring protocol was developed by the National Lakes Assessment, and will be used more broadly in Wisconsin lakes. Because the NLA shoreland habitat method can be implemented in a short period of time, the future goal is to routinely conduct one survey on all lakes that are monitored, independent of the monitoring objective. A more detailed shoreland habitat survey is needed for lake-specific management actions (e.g., zoning permits, critical habitat designations, habitat restoration efforts, dam regulation, high capacity well permits, etc.). A variety of techniques have been used in Wisconsin, but WDNR does not have a standardized protocol for detailed habitat surveys. A future goal is to establish intensive shoreland habitat monitoring protocols and metrics for management purposes.

Protocols for monitoring lake levels are in development (see Lake Level Monitoring below). On select lakes, gages will be surveyed and installed in spring and then surveyed and removed in fall. Citizen volunteers will monitor water levels at least monthly. In areas with homogenous geology, piezometers near the lake shore may be monitored as indicators of lake levels instead (e.g., Central Sands). Water levels of reservoirs are also monitored as part of the dam permitting process.

Data Management

As with the LTT Lakes and CLMN programs, water chemistry data are stored in SWIMS. Plant point-intercept data are currently stored on individual computers. Capacity in SWIMS for storing this data is planned. Capacity to house two types of shoreland habitat data is also on the list for programming into SWIMS. Water level data is captured in SWIMS.

Reporting

Water chemistry data are summarized from the SWIMS database and the DNR's Lakes website, where summary reports and graphs from SWIMS are available for downloading and review. The data collected for lakes is also summarized on a biennial basis for the purpose of reporting on the status of the state's waters for the Integrated Water Quality Report to Congress (every two years). The next reporting period is 2016. The data will also be used for key parameter package analyses and statewide condition summaries. New reports need to be developed for plant and habitat surveys and water level data.

Programmatic Evaluation

Directed Lake Surveys will be re-evaluated each work planning cycle.

Lake Level Monitoring

Monitoring Objectives

The objective is to monitor statewide lake-levels over time to address growing concern for health of aquatic life in surface waters due to drought, changing climate, and groundwater withdrawals. Record low water levels in some areas of the state affect both the health of aquatic life and designated use of lakes. As water levels decline, critical littoral habitat for fish and aquatic life is stranded above water in lakes. In some lakes, low water levels have left piers hundreds of feet from shore and rendered boat landings unusable. Although long-term water level records exist, monitoring efforts do not cover all areas of the state.

Monitoring Design

In 2015, WDNR added lake level monitoring to the Citizen Lake Monitoring Network. Professionals (e.g., county surveyors) survey and install staff gages to lakes shortly after ice-out in spring and then survey and remove staff gages in late fall. Citizen volunteers record and report lake levels preferably weekly, but at least monthly. Seventeen lakes began monitoring water levels in summer 2015 as a pilot (Figure 18), and WDNR plans to expand the program. Lakes were prioritized for lake level monitoring based on the following criteria: 1. seepage lakes, 2. regions with little to no existing lake level monitoring data, 3. regions vulnerable to groundwater withdrawal (deep layers of sand and gravel), and 4. lakes monitored by volunteers or WDNR for other parameters. Lake levels have been monitored separately by a variety of entities, including: Citizen Lake Monitoring Network (CLMN), University of Wisconsin (UW) Long Term Ecological Research Program, United States Geological Survey (USGS), USGS index lakes (seepage lakes chosen to represent different regions of the state), county-led projects in the Central Sands area, and monitoring led by the North Lakeland Discovery Center in Vilas County (Figure 18).

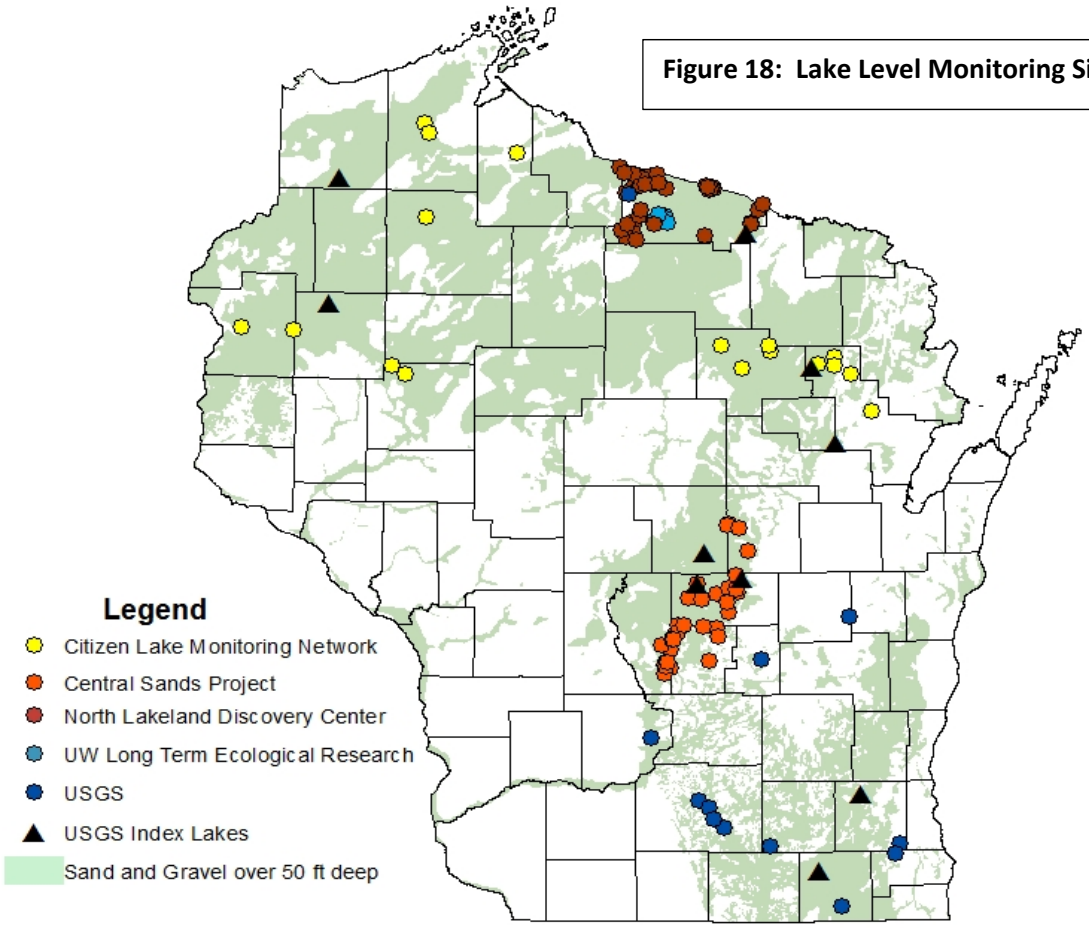


Figure 18: Lake Level Monitoring Sites

Water Quality Indicators

The sole indicator is the water level reading from the staff gage.

Quality Assurance

All staff gages will be surveyed to at least three reference marks and tied to a datum. This ensures that the data record may continue long into the future even if all reference marks are lost. Water level readings from the staff gage will be converted to feet above sea level to ensure that data are comparable between years. Other elements of the quality assurance plan include:

- Minimum concordance measures when surveying in the staff gages
- Repeat staff gage surveys on 10% of lakes by a qualified WDNR staff member
- Verification of citizen-reported water level data (which may entail side-by-side readings, photos of the staff gage and associated water level, independent water level readings by WDNR staff)
- Trainings for surveying and installing staff gages
- Trainings for reading water levels on staff gages
- Data analysis in SWIMS

Data Management

Metadata and water level data will be documented in SWIMS. Metadata will include survey information, GPS locations and datum of reference marks, contact information for surveyors and volunteers, maps, and calculations to convert to feet above sea level. Water level data will be entered into SWIMS by volunteers or by regional coordinators. One challenge will be automating the conversion of raw water level readings to standardized feet above sea level.

Reporting

Water level graphs will be added to the individual lakes pages, and a WDNR water level monitoring webpage will be created. We will also tie our data into a webpage hosted by UW-Madison that graphs and maps lake level data collected by all entities (https://lter.limnology.wisc.edu/lakeinfo/lake-levels-WI).

Programmatic Evaluation

The first program evaluation will be in spring of 2016.

Photo from WDNR, R. Lathrop, depicts stranded woody habitat due to low water levels in Fallison Lake, Vilas County.

Section 2.4 Monitoring Strategy for Wetlands

Table 14: Wetland Monitoring Studies	
Study Name	**Purpose – Supports: Fish and Aquatic Life, Public Health & Welfare, Wildlife**
Wetland Condition: Floristic Quality Assessment (FQA) Benchmark Surveys	Level 3*[1] – Site Level Biological Condition. Intensive, expert–based, assessment of the floristic quality of a given wetland site to document the biological condition of the wetland, based on its plant community. Surveys are being conducted to set benchmarks along a biological condition gradient for wetland plant communities, for each of the 4 major Omernik Level 3 Ecoregions. When all ecoregions are surveyed, the total dataset will be analyzed to determine statewide standards where possible.
Wetland Condition and Function: Wisconsin Wetland Rapid Assessment Methodology (WRAM v.2)	Level 2*- Site Level Rapid Assessment. Provides a standardized process for the professional to evaluate the extent to which a specific wetland performs a given function, and evaluate condition, using a stressor checklist. The method is used to support regulatory decision making.
Wetland Function: Watershed Approach Wetland Functional Assessments (WAWFA)	Level 1* - Evaluate significance of wetland functional values for a given watershed or other planning area provided by wetlands at a given point in time. GIS Functional Assessment Tools are being developed in partnership with The Nature Conservancy through a new Wetland Grant. These Tools will be used in 9-key Element Plan and TMDL Plan development, In-Lieu Fee program, compensatory mitigation program and wetland conservation planning.
Targeted Watershed Approach – Wetland Element (3 legged stool)	▶ FQA surveys can be conducted as the wetland plant community condition element of TWA using a probabilistic design, stratified by community type. ▶ WAWFA – based functional assessments will be conducted as part of the wetland function element of TWA. All wetlands in a watershed will be assessed using this Level 1 tool. ▶ WRAM v.2 site evaluations will be used to calibrate and validate the WAWFA functional analysis. These will be selected to represent the range of NWI+ wetland types found in the watershed (NWI+ is a hydrogeomorphic classification system). ▶ In addition WRAM v.2. assessments conducted as part of the permit process can be opportunistically collected to support the wetland element of TWA and provide information for non-target watersheds.

Study Descriptions

Floristic Quality Assessment (FQA) Benchmark Surveys

The surveys and data analysis to support development of FQA benchmarks for Wisconsin is expected to be completed at the end of 2017, if sufficient funding is secured. Survey design and methods are provided in detail in the current QAPP for the Northern Lakes and Forests Ecoregion. This Ecoregion was surveyed in 2014 by the University of Wisconsin-Superior, and data analysis will be completed under an Agreement with WDNR. In 2015 the Department is conducting the survey and data analysis of the North Central Hardwood Forests. Current plans call for conducting surveys of the remaining two ecoregions in 2016 and 2017.

[1] *Levels refer to EPA's *Core Elements of a Wetland Monitoring Program*. Level 1 – Landscape Scale Assessment, Level 2 – Site Level Rapid Assessment, Level 3 – Site Level Intensive Assessment (IBI Equivalent)

When all ecoregions are surveyed, the total dataset will be analyzed to determine statewide benchmarks where possible, and to finalize plant community definitions to be used in the applications of benchmarks. Current Wetland Grant Funding is sufficient for surveying the 2 northern ecoregions. Subsequent funding will be sought to complete the remaining two and conduct the statewide analysis. Incorporating FQA benchmarks into Tiered Aquatic Life Use standards will commence in 2018, and is anticipated to be completed by 2020.

Monitoring Objectives

Develop Floristic Quality Assessment benchmarks to assess the condition of all commonly occurring wetland plant communities in the 4 major Omernik ecoregions of Wisconsin. Benchmarks will discriminate between different condition categories along the biological condition gradient and can be used to support designation of Tiered Aquatic Life uses. These need to be tailored to the plant community type and ecological setting.

Monitoring Design

Separate surveys will be conducted within each Ecoregion. Sites will be identified and stratified by wetland type as inferred from WI Wetland Inventory (WWI). Researchers will seek good spatial representation of the type throughout the ecoregion. Best available GIS Land Cover layers will be used to conduct a buffer analysis to identify "least disturbed" and "most disturbed" sites. Landowners and land managers will be contacted to request access permission. The target is to survey 10 "least disturbed" and 10 "most disturbed sites for each wetland plant community. Timed meander surveys and a Disturbance Factor Checklist will be completed at each site (or Assessment Area) from which FQA and site disturbance parameters will be generated. Some of the "least disturbed" sites will be wetlands within State Natural Areas, managed by the Natural Heritage Inventory program. The results of the 2014 field season in the Northern Lakes and Forests Ecoregion will be analyzed by the University of Wisconsin-Superior team and reviewed by the Department. FQA thresholds for setting Tiered Aquatic Life Uses for specific wetland plant communities in the Northern Lakes and Forests Ecoregion will be recommended as part of the study.

Water Quality Indicators

Data analysis will establish the relationship of the FQA indicator parameters to independent measures of disturbance (GIS buffer analysis of land cover, Field Disturbance Factors Checklist); assess plant community independence vs overlap; assess distribution of indicator metrics by plant community; and set benchmarks where justified. FQA is based on the a priori expert assignment to all species in a regional flora of a "coefficient of conservatism" on a scale from 0 to 10, based on each species' site fidelity and tolerance of anthropogenic disturbance. The parameters to be explored are

- N, species richness, the total number of vascular plant species in an Assessment Area
- $\overline{C}$, the Mean Coefficient of Conservatism, is the average coefficient of conservatism for all species in an Assessment Area.
- $w\overline{C}$, the Weighted Mean Coefficient of Conservatism, is $\overline{C}$ weighted by the abundance of each species as measured by percent cover.
- FQI, or Floristic Quality Index: $FQI = \overline{C} \times \sqrt{N}$.
- *w*FQI, or Weighted Floristic Quality Index: $FQI = w\overline{C} \times \sqrt{N}$.

Quality Assurance

Quality Assurance measures are outlined in detail in the Northern Lakes and Forests QAPP. After data analysis is complete for the Northern Lakes and Forests Ecoregion, the QAPP will be reviewed by WDNR and UW-Superior staff in light of the experience from the survey work to date, 2012-2014, and any needed modifications will be discussed. It is expected that the same procedures will be followed, and modifications will be minor.

Data Management

Data collection, data entry, error-checking, record keeping, electronic data security and backup procedures for the surveys are also outlined in the Northern Lakes and Forests QAPP. In 2015 the responsibility for these procedures will shift to the Department for the North Central Hardwood Forests and the subsequent two ecoregions. Data will be housed in the SWIMS system.

Reporting

The results of each ecoregional survey and proposed benchmarks will be reported to the EPA, through Wetland Grant reports and these will be referenced in the Clean Water Act Water Quality Report to Congress. As benchmarks are adopted for Tiered Aquatic Life Uses in our wetland water quality standards, they can form the basis for conducting probabilistic surveys to assess wetland condition on a watershed scale. It is a goal of the program to comprehensively incorporate wetland condition assessments into watershed-scale water quality reports to Congress and use the results to inform the setting of regional/location-based water resource goals.

Program Evaluation

During the research phase to set FQA benchmarks, the study for each ecoregion will be peer-reviewed by scientists within and outside the Department. When all ecoregions are completed an analysis will be conducted on the total statewide dataset to determine where plant communities can be lumped and where ecoregions can be combined for benchmark setting.

It is anticipated that implementation will consist of probabilistic watershed surveys at the scale consistent with other water resource monitoring. It is intended that FQA surveys will be integrated into the larger water resource monitoring effort. It is expected that watershed-scale wetland condition assessment will inform the development of wetland conservation actions to be taken within the watershed. As these are begun, the extent to which wetland condition surveys inform watershed based water resource reporting, and conservation planning should be assessed.

FQA benchmarks and metrics are also expected to be used in the wetland and waterway regulatory program to provide a more intensive assessment of wetland floristic integrity where needed. FQA can also be useful in setting performance measures for compensatory mitigation projects and measuring their progress. As wetland restorations are conducted through Clean Water Act, Great Lakes Restoration Initiative, Joint Venture of the North America Waterfowl Conservation Act and other funding sources, FQA metrics and benchmarks will be essential for objectively evaluating the effect of restoration and management activities on wetland plant communities. FQA can also be a valuable tool to monitor the condition of high quality wetlands, such as those preserved in State Natural Areas, to signal the need for management actions, as well as future compensatory mitigation projects that involve preservation. It is recommended an evaluation of program usefulness of FQA in all sectors of the Department where it is deployed, be conducted after 2-3 years of implementation, and subsequently every 5 years.

Wisconsin Wetland Rapid Assessment Methodology of Function and Condition v.2 (WRAM v.2)

Wisconsin's current water quality standards for wetlands are based on wetland functional values, and regulatory decision making ultimately rests on protecting these values. CWA 104(b)1 Review

process emphasizes avoidance, minimization, analysis of practicable alternatives and significance of impacts to functional values.

The Wisconsin Rapid Assessment Methodology was first developed to assess functional values for projects which required determining the significance of impacts. Recent changes to Wisconsin water law include a requirement that a functional assessment be performed for every wetland permit that is issued. WRAM v.2 has been produced to provide Department field staff with an improved tool for functional assessment and now also includes a section for condition assessment.

Monitoring Objectives

The Wisconsin Wetland Rapid Assessment Methodology (WRAM) version 2 is a qualitative method developed to provide a standardized process for the professional to evaluate the extent to which a wetland performs a given function. It is based on best professional judgment guided by a series of questions about an assessment area in the context of its aquatic connectivity, adjacent land cover and habitat and watershed conditions. WRAM v.2 also contains a condition assessment, based on a stressor checklist.

Monitoring Design

The presence or absence of specific characteristics is used to determine the importance of each functional value for a site, relative to the watershed in which it occurs. The method documents the best professional judgment of the evaluator and can typically be completed with an hour of office search and preparation and a 1-2 hour field visit. The WRAM consists of two components.

WRAM data form [PDF] , WRAM user guide [PDF]
This guide gives explanations for each of the questions asked in the WRAM data form. The user guide also includes three Appendices and one template.

1. Appendix A – Wisconsin Priority Townships [PDF]
2. Appendix B – Wetland Characteristics for 12–Digit Watersheds
    1. Microsoft Excel format (for electronic viewing) [XLS]
    2. Adobe PDF format (for printing) [PDF]
3. Appendix C – Storm and Floodwater Storage Example [PDF]
4. Template for Storm and Floodwater Storage Calculation [XLS]

An implementation plan for deploying the WRAM in the water quality program is still under development as of this writing. It is expected that the WRAM and the Watershed Approach to Wetland Functional Assessment (WAWFA) (described as the next study below) will be used together in targeted watersheds to provide a Level 1 assessment of the general condition and performance of a suite of wetland functions throughout the watershed. The WRAM will be used as a Level 2 method to field-calibrate the WAWFA tool. The sampling design would be stratified by hydro geomorphic class as represented in the NWI+ system. This could be accomplished by converting the Wisconsin Wetland Inventory GIS layers into the National Wetland Inventory system, and then assigning "NWI+" modifiers based on landform, landscape position, waterbody type and water flow path, to each mapped wetland.

In addition we can opportunistically collect WRAM assessments as they are completed by staff in the water regulatory program and store the output in SWIMS such that assessment conclusions can be accessed by water quality staff in compiling targeted watershed reports.

Water Quality Indicators

The WRAM allows the evaluation of the following wetland functions: human use values, wildlife habitat, fish and aquatic life habitat, shoreline protection, storm and floodwater storage, water quality protection, groundwater processes and floristic integrity. The presence or absence of specific characteristics that can be evaluated with existing GIS data and a field visit is used to determine the importance of each functional value for a site. Where a more intensive assessment of floristic integrity is required an FQA survey should be utilized.

The WRAM also contains a condition assessment section that utilizes a stressor checklist approach. The user evaluates the qualitative level of current impacts of each stressor present in the assessment area and a 100m buffer around it. Historic impacts that are evident but no longer affecting the wetland are noted. The relative frequency in the watershed (the default scale is the 12 –digit HUC) in which the wetland occurs is also noted.

Quality Assurance

The method documents the best professional judgment of the evaluator and requires one field visit and office preparation. Wetland Functional Value evaluations provide relative levels of functional performance (or significance) for each function for each assessment area. Functions are considered separately; they are not summed or averaged for an assessment area.

A plan for using the WAWFA and WRAM v.2 in the Targeted Watershed system is being developed. As the implementation plan is developed the proper Quality Assurance measures will need to be addressed, particularly issues of consistency and comparability across watersheds and ecological regions. At a minimum periodic staff training will be required. Experience with staff training sessions to date indicates that consistency among observers is an achievable goal, but this will have to be demonstrated on a continuing basis.

Data Management

WRAM consists of questions answered by BPJ to guide overall qualitative assessment. Assessment decisions can be supported by a narrative when necessary. Currently the data is generally stored in SharePoint files and not integrated into a larger Oracle or GIS database that would be available to DNR staff or partners. The Department is developing a plan to import or gather data from WRAMs completed by water regulatory field staff and import into SWIMS.

Reporting

Currently the data used in this work is made available for onsite and site specific decision making and is not shared or stored in a location available to other DNR staff.

Programmatic Evaluation

The wetland datasets and monitoring results need to be moved to a shared location and better integrated with the SWIMS system and SDE feature class environment so that staff may use the fruits of the wetlands evaluation and assessment tools more readily. Further, wetland site level functional assessments need to be integrated into the water resource monitoring system, with staffing and training needs assessed.

Watershed Approach Wetland Functional Assessment (WAWFA)

WRAM v.2 is complete, but operates at the site level. A tool is needed for conservation planning uses that operates at a watershed scale, utilizing available GIS data. The Department has recently been awarded a Wetland Grant (from Oct 2014 – September 2016) to develop a suite of GIS Functional Assessment Tools to conduct watershed scale assessment of the wetland functions covered in the WRAM. The tools will be developed in partnership with The Nature Conservancy and will be designed to

be used in Water Quality Plans, Nine-Key Element Plans, and TMDL Implementation Plans, In-Lieu Fee and compensatory mitigation program implementation, and for wetland conservation planning by land trusts and local governments.

Monitoring Objectives

Assess how wetlands function within the watershed they occur in based on wetland position, landform, water flow path, and watershed and ecological landscape context (considering surrounding land use, % wetlands in watershed, soils, geology, and hydrology). Functional assessment at the watershed scale is limited to available GIS layers rather than field work. This is what differentiates it from the field-based WRAM v. 2. As such it is considered a Level 1 – Landscape Level Assessment.

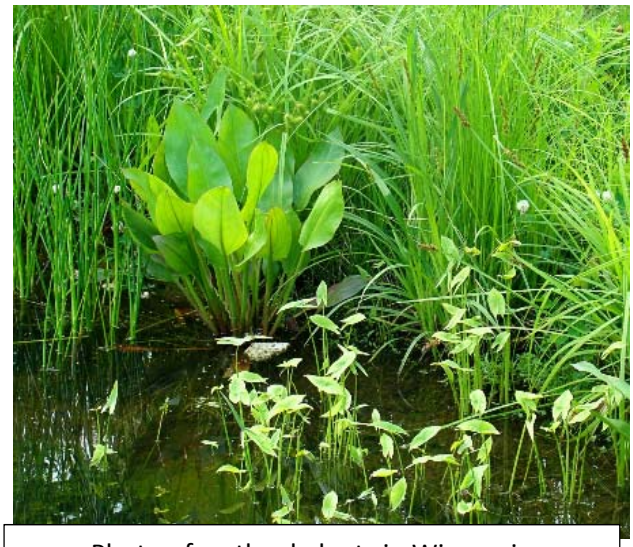


Photo of wetland plants in Wisconsin

Monitoring Design

Currently the tools are under development and there is as yet no specific design. It is expected that WRAM v 2 site assessments will be used to calibrate and validate the WAWFA tools. The result will be a qualitative functional assessment for every wetland in the targeted watershed.

Water Quality Indicators

Relative performance of the wetland functional values listed in Wisconsin's narrative Wetland Water Quality Standards (NR 103, Wis. Adm. Code) are the indicators for this approach.

Quality Assurance

Develop QA/QC checks for GIS layers (use WWI or other accepted GIS QA/QC process). Design WRAM v.2 site evaluations to calibrate and validate the WAWFA tool. QA/QC plans will need to be developed for each targeted watershed in the initial projects. As lessons are learned a set of best practices and QA/QC processes can be standardized for producing NWI+ classifications and functional performance assessment.

Data Management

Input layers would be those already managed within Water Division's infrastructure (SWIMS/SWDV/WATERS). WAWFA output would be part of integrated watershed planning GIS storage and maintained as part of the Department's GIS library. Data architecture will be designed to integrate WAWFA output with existing surface water GIS layers.

An essential step in the WAWFA process is the conversion or cross-walk of Wisconsin Wetland Inventory (WWI) mapping classifications to the NWI+ system. The US Fish and Wildlife Service's Status and Trends program has developed a protocol for conducting this conversion and parts of the state have been converted to NWI. The WAWFA tool project is also developing automated methods to apply NWI+ classifications to the WWI wetland polygons using the best available GIS data.

Reporting

Wetland functional assessment could be done at a watershed scale as part of the "watershed approach" to compensatory mitigation and to inform watershed plans. Further watershed analysis can be conducted by using WAWFA tools for planning projects to prioritize specific functional improvements.

Program Evaluation

Assessment would be based on the NWI+ classification system and GIS-Functional Assessment Tools that are being developed through a Wetland Grant. During the period this Strategy covers, we would expect to have several 8-digit pilot watersheds completed. Assessment would be based on the NWI+ classification system and GIS-Functional Assessment Tools that are being developed through a Wetland Grant. During the 5 year period this Strategy covers, we would expect to have several 6-digit pilot watersheds completed within the first 3 years.

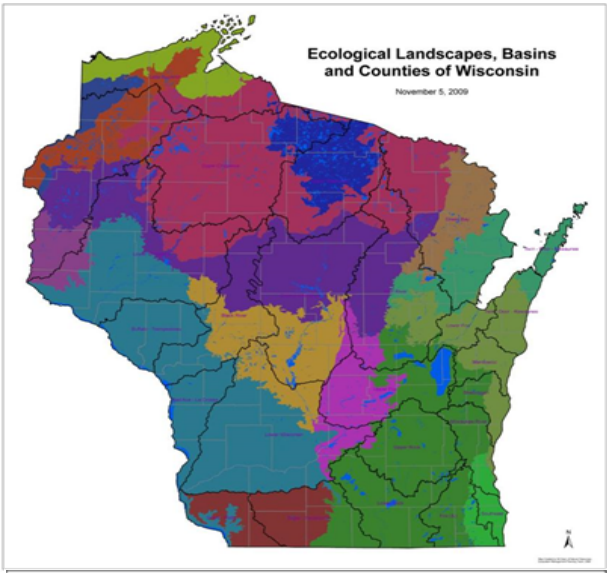


Figure 19 Geographic Areas for Wetland Bioassessment

Wetland Program – Gaps and Program Priorities

Wetland Condition Bioassessments

Develop Routine FQA Monitoring and Incorporate into Clean Water Act reporting.

As FQA benchmarks are linked to Tiered Aquatic Life Uses the Department will be in a position to incorporate FQA surveys into the water resources monitoring program, with staffing and a funding structure. At this point in time we envision applying FQA to provide a measure of wetland condition at a watershed scale through the use of probabilistic survey design.

Apply benchmarks s in NWCA and in probabilistic surveys. Survey areas to be determined – Omernick ecoregions would be the most efficient or clusters of Water Basins. Results would be reported in "report card" format. Disturbance analysis would be used to assess cause of results. Methodological questions and additional research questions that arise from peer review can be addressed in future surveys.

"Rapid FQA" – After 2017 we will have a large data set in the neighborhood of 700 sites. Through data analysis and an expert group process we may be able to select a subset of species that can be tested for use in a "Rapid FQA" as MN has done. FQA metrics would be calculated using the subset of species to see if they yield similar results compared to the full species list. A list of 200-300 species would allow practitioners to focus on learning these rather than the full WI wetland flora.

Wetland Functional Assessment Program Priorities

- Train staff in the use of the WRAM v. 2
- Opportunistically gather WRAM v. 2 assessments from water regulatory staff. Continue to provide training to water regulatory staff. Incorporate the assessment data into SWIMS.
- Train water quality staff in the use of WRAM v. 2.
- Complete the conversion of the Wisconsin Wetland Inventory to National Wetland Inventory system. Design a sampling scheme based on hydro geomorphic (NWI+) class for calibrating WAWFA tools when assessing wetland functional performance in targeted watersheds.
- Develop Watershed Approach to Wetland Functional Assessment (WAWFA) GIS Decision Support Tools through 2 year Wetland Grant (Dec 2015). Apply the Tools within the framework of the In-lieu Fee compensatory mitigation program.
- Integrate the watershed scale and the site scale functional assessments. Use WAWFA for coarse level planning uses and as a screen for selecting Assessment Areas for on the ground WRAM v.2 functional assessments. WRAM v 2

Assessments can serve as ground truth for watershed scale assessments. Apply this approach to pilot targeted watershed in 2017-2019. Evaluate results of pilot project and refine methods.

Drowned Mouth Estuary. Sand Bay, Wisconsin.

Section 2.5 Monitoring Strategy for Groundwater

Table 15: Groundwater Monitoring Studies	
Study Name	**Purpose: Public Health & Welfare, Fish and Aquatic Life**
Groundwater Monitoring Quantity and Quality	Groundwater monitoring includes the groundwater level monitoring network maintains long term data on groundwater levels across the state. This network is maintained by the USGS and WGNHS with additional support from WDNR. The data are used for a variety of purposes including understand impacts of water use, climate change and groundwater levels for planning purposes.
Groundwater/Surface Water Interactions Stream baseflow monitoring	Stream baseflow measurements are used to understand the potential impact to a stream from proposed new groundwater withdrawals. Determinations of significant environmental impact rely on models and data (such as baseflow data) to determine if groundwater withdrawals will deplete stream flow in nearby streams.

Study Descriptions

Groundwater Monitoring – Quantity and Quality

Monitoring Objectives

- Provide and maintain sufficient, high quality groundwater data to evaluate spatial and temporal trends in groundwater quality, quantity and use
- Provide high quality data for a more complete understanding of groundwater systems
- Provide tools to make groundwater data accessible to citizens, policy makers and managers

Monitoring Design

The state has a comprehensive monitoring program design and rationale for selection of monitoring sites that incorporate several approaches (e.g., fixed station, intensive and screening level monitoring, rotating basin, judgmental, and probability design) to meet the range of program objectives.

1. Fixed network of groundwater level monitoring locations
2. Statewide assessment for quality
3. Fixed network for quality [Future]
4. Fixed network [Future]
5. Water use reporting
6. Data intake and data delivery IT systems

Water Quality Indicators

To be determined.

Quality Assurance

Quality assurance elements are described in the groundwater monitoring study design and protocols.

Data Management

Monitoring data are managed through individual programs that oversee data collection and data sharing.

Reporting

Specific reporting requirements are established for individual programs.

Programmatic Evaluation

Program evaluation occurs through matching implementation progress with meeting program objectives.

Section 2.6 Monitoring Strategy for Springs

Table 16: Springs Monitoring Studies

Study Name	Purpose	Supports: Fish & Aquatic Life
Springs Inventory	A three year study is underway to inventory springs with an expected discharge of greater than 0.25 cfs. The primary goals of this assessment are to document location, spring discharge, and hydrogeological setting for each spring. The inventory will also identify approximately 6 reference springs to monitor on a semi-annual basis. Once this inventory project is complete ongoing monitoring could include inventory of additional springs identified through routine field work. In addition, reference springs could be monitored on a regular schedule to be determined.	Source water programs, threatened headwater areas, hydrologic modifications, aquifer drawdowns, fisheries habitat concerns.
Targeted Watershed Approach-Springs Element	Collect surface water / groundwater interaction indicators at areas assessed under the TWA program. This would include reviewing data from the state's springs inventory through incorporating presence/absence of headwaters, wetlands, springs, and baseflow monitoring.	Groundwater/ surface water interaction data (proposed)

Study Descriptions

Springs Inventory

Monitoring Objectives

Identify the location of active springs throughout the state of Wisconsin. This inventory builds upon historical datasets and current information gathered through trout stream surveys, stream surveys and wetland surveys.

Monitoring Design

Field sheets to document the location, size, and general characteristics of springs identified during routine field work.

Water Quality Indicators

Surface indicators of springs include:

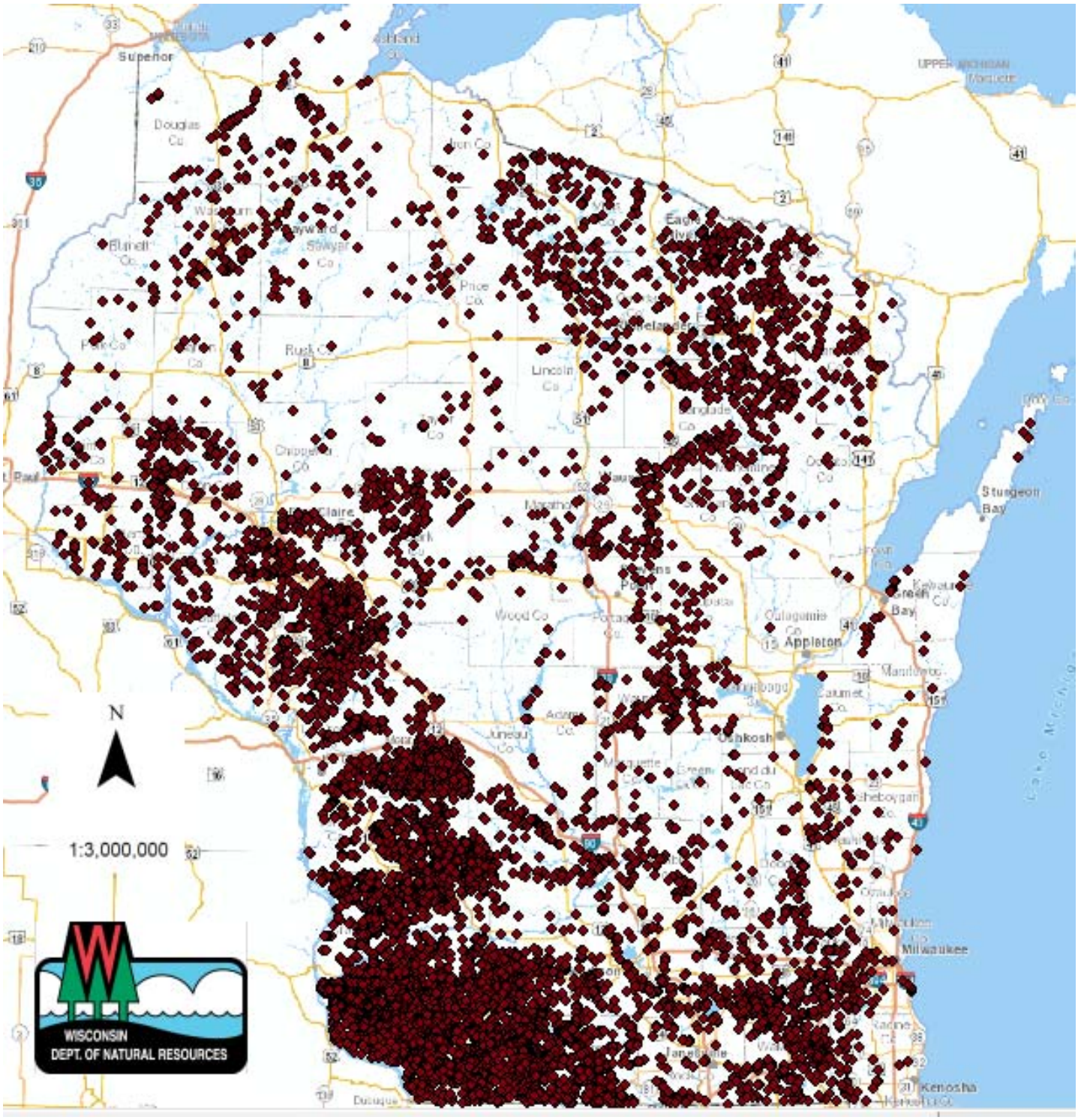
Quality Assurance

Photo documentation, mapped size/location, and brief narrative description of springs will help ground truth the data and document the resource.

Data Management

The Wisconsin Geological and Natural History Survey (WGNHS) manage a database of springs. Data from this study will be added to the WGNHS database as well as the WDNR's Register of Waterbodies and the Water Assessment, Tracking and Electronic Reporting System (WATERS). Geolocating springs in the WATERS database is a component of the state's surface water assessment work.

Figure 20: Springs Inventory Map – Historic Locations



Section 2.7 Monitoring Strategy for Beaches

Table 17: Beaches Monitoring Studies		
Study Name	**Purpose**	**Supports: Recreation**
Public Beach Health Surveys– Coastal Surveys	County Health Surveys to determine beach advisories and closings	Impaired waters listings, antidegradation standards.
Inland Beaches - County Beach Health Surveys and WDNR State Parks	County Health Surveys to determine beach advisories and closings and parks program.	Impaired waters listings, antidegradation standards.

Study Descriptions

Public Beach Health Surveys– Coastal Surveys

Monitoring Objectives

EPA is required under Clean Water Act section 406(a) to publish performance criteria for monitoring and assessment of coastal beaches and for promptly notifying the public of any exceedance of water quality standards. Section 406(b) authorized EPA to award grants to states to implement monitoring and notification programs at coastal beaches that meet the criteria in EPA's National Beach Guidance and Required Performance Criteria for grants. In July 2014, EPA revised the recreational water quality criteria for determining attainment and incorporated the concept of a Beach Action Value (BAV), a not-to-exceed threshold value for determining whether to issue public notifications of beach advisories. The regulation gave states choices in selecting specific recreational water quality criteria, the selected indicator and alternatives, measurement method, and implementation of the BAV. In addition, EPA is currently revising its National Beach Guidance and Required Performance Criteria. Wisconsin has established a schedule for revising its water quality criteria to reflect the EPA's 2014 revisions.

Two main objectives drive the monitoring strategy:

- Manage risk of human illness associated with exposure to pathogens and recreational water use
- Determine whether water quality at beaches attains recreational use criteria

Wisconsin developed its Beach Monitoring Program in accordance with 2002 EPA performance criteria, adjusting and adapting specific elements based on technological advances and available resources. Coastal beaches funded through EPA grants are required to meet specific performance criteria. Use of the performance criteria are strongly encouraged at other beaches that are monitored voluntarily. This document identifies performance criteria for the following:

(1) Monitoring (sampling and modeling)
(2) Promptly notifying the public of water quality standard exceedance
(3) Reporting

Wisconsin's Beach Program is in transition, incorporating new tools for monitoring, modeling, and public notifications and adapting program specifics in response to revisions to EPA's National Beach Guidance and Required Performance Criteria for grants published in July, 2014 (expected release in August 2014).

Monitoring Design

Coastal beaches are placed into a three- tiered monitoring plan based on a risk assessment that considers number of people using the beach, potential sources for contamination, type of recreational usage, monitoring or impairment history, and participation by local public health organization. The intensity of monitoring is prescribed by the assigned tier (High, Medium, or Low) and resources available through the grant and locality. Low priority beaches may be monitored as part of the Wisconsin Beach Program, monitored voluntarily, or may not be monitored. Important

considerations in whether low priority beaches are included in the Wisconsin Beach Program are identification as an impaired water and accessibility. Tier placement and minimum monitoring requirements are reviewed and adjusted annually.

For the purposes of public health notifications associated with the BEACH Act, monitoring may include any combination of direct sampling and analysis of beach water, collection of beach conditions (e.g. waves, weather, turbidity, and bird counts) associated with a sanitary survey, or the use of a predictive model. The minimum number of water samples collected is specified by the assigned tier and may be adjusted at individual beaches to facilitate or consider predictive modeling. The absolute minimum monitoring frequency is once per week. The monitoring plan also addresses when basic sampling should be conducted, when additional samples should be collected, where and how to collect samples and the approved methods for analysis.

Sample data generated for compliance with the BEACH Act using approved culture-based methods is used for assessing water quality and determining whether an impairment of recreational use exists. Additional sample data may be considered in this assessment based on a data quality assessment that considers sample location, timing, if the sampling and analysis methods are comparable, and consideration of representativeness. As part of the implementation of the revised water quality standards the assessment program plans to consider whether equivalency of real-time methods like qPCR can be established. Additionally, a number of sanitary surveys conducted at several beaches over the past 5 years indicate that wildlife are significant contributors to water quality exceedance so the program will also need to consider whether source tracking monitoring results will be considered in recreational water quality assessments.

Water Quality Indicators and Standards

The Clean Water Act recognized both enterococci and E. coli as water quality indicators in fresh water. Historically, E. coli sample results have been the main fecal indicator pathogens used to assess beach water quality and describe and manage beach health in Wisconsin. Beach managers have the discretion to use predictive modeling (e.g. nowcast or rainfall) as water quality indicators for public health notifications.

For Great Lakes beaches, DNR implements the federally-promulgated Bacteria Rule for Coastal and Great Lakes Recreation Waters. For Great Lakes waters, the "Advisory" standard of 235 CFU/100mL (E.coli in water) was adopted based upon data from three US EPA studies conducted in the late 1970s (2-4) and reaffirmed in 2002 (1). These studies indicate that E.coli and/or Enterococci are the best bacterial indicators to assess the risk of acquiring a gastrointestinal illness as a result of using recreational waters. These studies are detailed in the following reports and are available from the EPA website (www.epa.gov):

1) USEPA, 2002. Implementation Guidance for Ambient Water Quality Criteria for Bacteria. U.S. Environmental Protection Agency. EPA-823-B-02-003. May 2002 Draft.
2) USEPA, 1986. Ambient Water Quality Criteria for Bacteria–1986. U.S. Environmental Protection Agency. EPA-440/5-84-002.
3) USEPA. 1984. Health Effects Criteria for Fresh Recreational Waters. U.S. Environmental Protection Agency. EPA-600/1-84-004.
4) Cabelli, V. J. 1983. Health effects criteria for marine recreational waters. U. S. Environmental Protection Agency, Cincinnati, OH. EPA-600/1-80-031.

The "Closure" level of 1000 CFU E. coli /100mL was adopted by DNR based upon data from the studies mentioned above and represent a risk of approximately 14 cases of gastrointestinal illness per 1000 recreational water users. For the purposes of public health notifications, the "advisory" and "closure" standards function as threshold values, similar to the Beach Action Value in the 2012 revisions to Clean Water Act.

For the purposes of determining attainment of the recreational water quality criteria, the assessment methodology includes evaluation of the E. coli monthly geometric mean concentration against a criterion of 126 CFU/100 mL. Other than in the beach notification and closure decision context, the geometric mean is the more relevant value for ensuring

that appropriate actions are taken to protect and improve water quality because it is a more reliable measure, being less subject to random variation, and more directly linked to the underlying studies on which the 1986 bacteria criteria were based. The single sample maximum values in the criteria are best used for making beach notification and closure decisions; however, they may also play a role in implementing other Clean Water Act programs. Beach advisory and closure information, as well as additional indicators (e.g. qPCR, source tracking, etc.), may be used in the future to inform impaired waters listing decisions and prioritize restoration efforts.

Following the 2012 revision to the recreational water quality standards that changed the basis for determining illness rates and recommended that states evaluate whether the rates of 32 or 36 illnesses/1000 recreational users are appropriate for waters of the state, Wisconsin is doing a risk analysis that will consider both the information presented in EPA's rule and available results from sanitary surveys at our beaches. If the risk analysis results in selecting the higher rate, the state standards will be adjusted to incorporate a statistical threshold value (STV) of 410 CFU/100 mL. If the lower rate is selected, all standards including the BAV will need to be adjusted. During the rule-making process to incorporate the revised recreational water quality criteria into Wisconsin's administrative rules, the program will reevaluate enterococci and E. coli as fecal indicators. Preliminary communications with Dr. Julie Kinzelman, Research Scientist/Laboratory Director, City of Racine Health Department, suggest that E. coli continues to be an appropriate fecal indicator for Wisconsin beaches.

Quality Assurance

Sampling protocols, sampling methods and analytical methods are clearly documented in the beach program Quality Assurance Project Plan (QAPP) for the Great Lakes Beach Program for Coastal Waters. The QAPP was revised in 2012 to incorporate program changes made at that time. We anticipate another revision in 2015 or 2016 to incorporate criteria for using qPCR, routine sanitary surveys, and refining the monitoring protocols when now casts are a primary tool for determining whether public health notifications are necessary.

Data Management

Generally beach analyses for Great Lakes/Coastal Waters are handled by local laboratories certified by the Department of Agriculture, Trade, and Consumer Protection Data are entered into Wisconsin's Beach Health website hosted by USGS which also serves as our primary tool for public health notifications, a repository for sanitary survey data, and making data available to the public through mobile applications and downloads, This system is integrated with other tools used for nowcasting beach conditions. Annually, the data are transmitted to the Lab Data Entry System (LDES) which is linked to the SWIMS system. DNR places a high priority on flowing beach pathogen data from USGS and county health departments to the SWIMS system so that this data may be used in its Biennial Report to Congress.

Reporting

During the beach season, beach managers post colored signs at the beaches indicating the condition or advice about swimming conditions. Wisconsin's Beach Health public website also displays beach status, reasons for advisory or closure and making current and historic monitoring data publicly available. Annually, this data undergoes a quality assurance review prior to reporting to EPA beach database through the Exchange Network. BEACON, EPA's Beach Advisory and Closure On-line Notification Tool, an interactive map interface which shows beaches that have been monitored and provides summary and detail reports of beach data, advisories and closures during the swimming season. EPA aggregates data collected by local, county, and federal data collection programs and prepares summary reports of coastal beaches. Wisconsin prepares an annual report summarizing program activities as part of BEACH Act grant reporting. This report is posted on the Department's website.

The second primary use for beach monitoring data is to identify recreational use impairments for beaches using an E. coli assessment package. These listings are updated every two years and are available on DNR's website.

Programmatic Evaluation

The Beach Program is a mixture of Great Lakes Beaches (coastal, funded beach program work) and inland beach monitoring (local and county monitoring, reported to county and USGS databases). Work between USGS and DNR to flow beach data to the SWIMs system and then to the Water Quality Exchange Network (to save USGS from having to carry out this identical task) is in its first year and an evaluation of the progress of this initiative will be available in 2015.

Inland Beaches - County Beach Health Surveys and WDNR State Parks

Monitoring Objectives

Inland beach monitoring occurs voluntarily at the discretion of local beach managers. The primary objective for this monitoring is to determine if local beaches should be closed or should remain open for primary contact recreation. State statute give health departments responsibility for issuing public health advice so local groups may coordinate their monitoring programs through county health departments. These surveys are designed and conducted locally and the data sharing aspect of this program remains voluntary. At inland state parks with beaches, DNR collaborated with county health departments regarding monitoring and public health notifications. For popular State Parks, DNR's objective is to manage risk to park visitors swimming at the beaches.

Monitoring Design

By collaboration with the Wisconsin Department of Health, counties are encouraged to design their monitoring programs similarly to the BEACH Act program for coastal beaches. WDNR has provided guidance for E. coli monitoring to meet recreational use assessment needs and posted program information on the website. Some coastal counties integrate the inland beach monitoring into their programs. Sampling may be done by county or city health department staff, local park managers, or lake associations. Local programs are not obliged to meet the monitoring frequency of once per week. Small pass-through grants are available through the Bureau of Research and the Water Program for sample analyses, but the funds available are very scarce. The number and location of samples collected are strictly up to the local agency collecting the data.

In 2013, DNR did a risk assessment of inland State Parks with beaches. Park attendance was used as a surrogate for beach use. Location, type of beach, and historic monitoring data was considered in establishing the monitoring frequency. The schedule considered transportation and the State Laboratory of Hygiene's operational hours. For parks in the northern part of the state, the assessment considered the logistics for transportation to the State Laboratory and the potential for samples to be analyzed by a laboratory in the area.

Water Quality Indicators and Standards

For inland waters, the state's current fecal coliform bacteria water quality criterion is applicable to all waters of the state for the protection of their recreational use. The following recreational use criteria in Chapter NR 102 of Wisconsin Administrative Code apply: "As bacteriological guidelines, the membrane filter fecal coliform count may not exceed 200 colonies per 100 ml as a geometric mean and may not exceed 400 colonies per 100 ml in more than 10% of all samples during any month. Samples shall be required at least 5 times per month." However, most beach sites are now monitored for E. coli, rather than fecal coliform bacteria. The decision to change indicators was informed, in part, by the results of epidemiological studies conducted by EPA that have demonstrated a poor correlation between fecal coliform concentrations and number of swimmer-related illnesses.

DNR is also currently implementing the federally promulgated Bacteria Rule for Integrated Reporting to EPA by applying the E. coli geometric mean criterion of 126 CFU/100ml to inland beaches, in addition to Great Lakes coastal beaches. The Bacteria Rule criteria do not supersede the existing state criteria in NR 102; currently, they both apply to Great Lakes coastal beaches. DNR is also reviewing the criteria proposed in EPA's 2012 Recreational Water Quality Criteria guidance and plan to replace our current state-promulgated fecal coliform bacteria criteria with criteria for one or both of EPA's proposed indicators: E. coli or Enterococci.

DNR's monitoring and assessment program has evolved with the science, and currently uses E. coli as the main indicator to assess the recreation use of waters of the state. DNR is actively collecting E. coli data and may begin to more broadly incorporate E. coli and/or Enterococci monitoring, and associated water quality criteria, into our water quality programs. As we accomplish this, we may phase out the use of fecal coliform as an indicator to protect primary contact recreation.

Quality Assurance

The Department of Agriculture, Trade, and Consumer Protection operates a laboratory certification program for bacterial analyses. Many of the city and county health departments maintain certification for their operations, particularly those with public health sanitarians that do restaurant, pool, and milk handling inspections. No known QA samples: blanks, dups, or spikes, are analyzed or reported to the WDNR, although this work may be carried out. The DNR is not aware of any QA measures in the inland beach monitoring program.

Data Management

The Wisconsin Beach Health website (www.wibeaches.us) can be used for any inland beach and a number of counties take advantage of this opportunity. Sample results posted to Beach Health are available to the public in a separate section of the website. Similar to sample results for coastal beaches, results posted to this website operated by USGS are transmitted to the Lab Data Entry System (LDES) which is linked to the SWIMS system. Samples analyzed by the State Laboratory are transmitted directly into LDES. Locations that do not use Beach Health or the State Laboratory of Hygiene manage their own data and DNR requests the data which, when submitted is sent in a spreadsheet format. DNR places a high priority on flowing beach pathogen data from USGS and county health departments to the SWIMS system so that this data may be used in its Biennial Report to Congress.

Reporting

Beach condition derived from state, local and county monitoring is used in two primary venues. The first is for public notification of advisories or closures during the swimming season. DNR does not know how many jurisdictions monitor inland beaches and there is no required reporting process. There is no comprehensive listing of inland beaches within the state and possible locations vary from urban settings to remote sites. Some counties post data to Beach Health to take advantage of the public reporting capabilities. For beaches where analyses are performed by the State Laboratory of Hygiene, alternate public notification mechanisms are used. At inland state parks, data posted to Beach Health and notification includes posting signs at the park .Some jurisdictions post conditions on their own websites. At some locations, beach managers post signs of beach condition which may mirror the design of the coastal beach program. The

second primary use for beach monitoring data is to identify recreational use impairments for beaches using an E. coli assessment package. As indicated in the data management section, DNR requests locally-managed data from counties or municipalities for use in the assessment and listing process. The data sharing is voluntary and some communities are reticent to send their data to DNR if it is used for impairment listings.

Programmatic Evaluation

The Beach Program is a mixture of Great Lakes Beaches (coastal, funded beach program work) and inland beach monitoring (local and county monitoring, reported to county and USGS databases). Work between USGS and DNR to flow beach data to the SWIMs system and then to the Water Quality Exchange Network (to save USGS from having to carry out this identical task) is in its first year and an evaluation of the progress of this initiative will be available in 2015. SWIMS does not currently hold all of required information associated with the beach schema (e.g. advisory and closure data and reasons) which needs to be considered in the evaluation.

Section 2.8 Monitoring Strategy for Sediment Condition

Sediment screening under NR347 to evaluate condition based on requested permits for action, and to ensure that the location and initial extent of contamination is identified for further study.

Table 18: Sediment Monitoring Studies

Study Name	Purpose: Public Health & Welfare, Recreation, Fish & Aquatic Life
Sediment Screening for 347 Permits	Sediment Screening Inventory for dredging permits
Sediment Remediation and Evaluation Projects	Large scale projects for remediation, inland and in the Great Lakes and post-remediation monitoring to evaluate long-term environmental restoration of water quality standards and sediment chemistry concentrations to background.

Study Descriptions

Sediment Screening, Monitoring

Sediment screening under NR347 to evaluate condition based on requested permits for action, and to ensure that the location and initial extent of contamination is identified for further study. These are generally custom studies designed based on the dredging work requested.

Monitoring Design

Each study design is customized to the project under collection.

Water Quality Indicators and Standards

Sediment quality guidelines are used to evaluate sediment condition for acute and chronic toxicity.

Quality Assurance and Data Management

Detailed quality assurance plans are developed for sediment contamination studies. Data is managed in SWIMS.

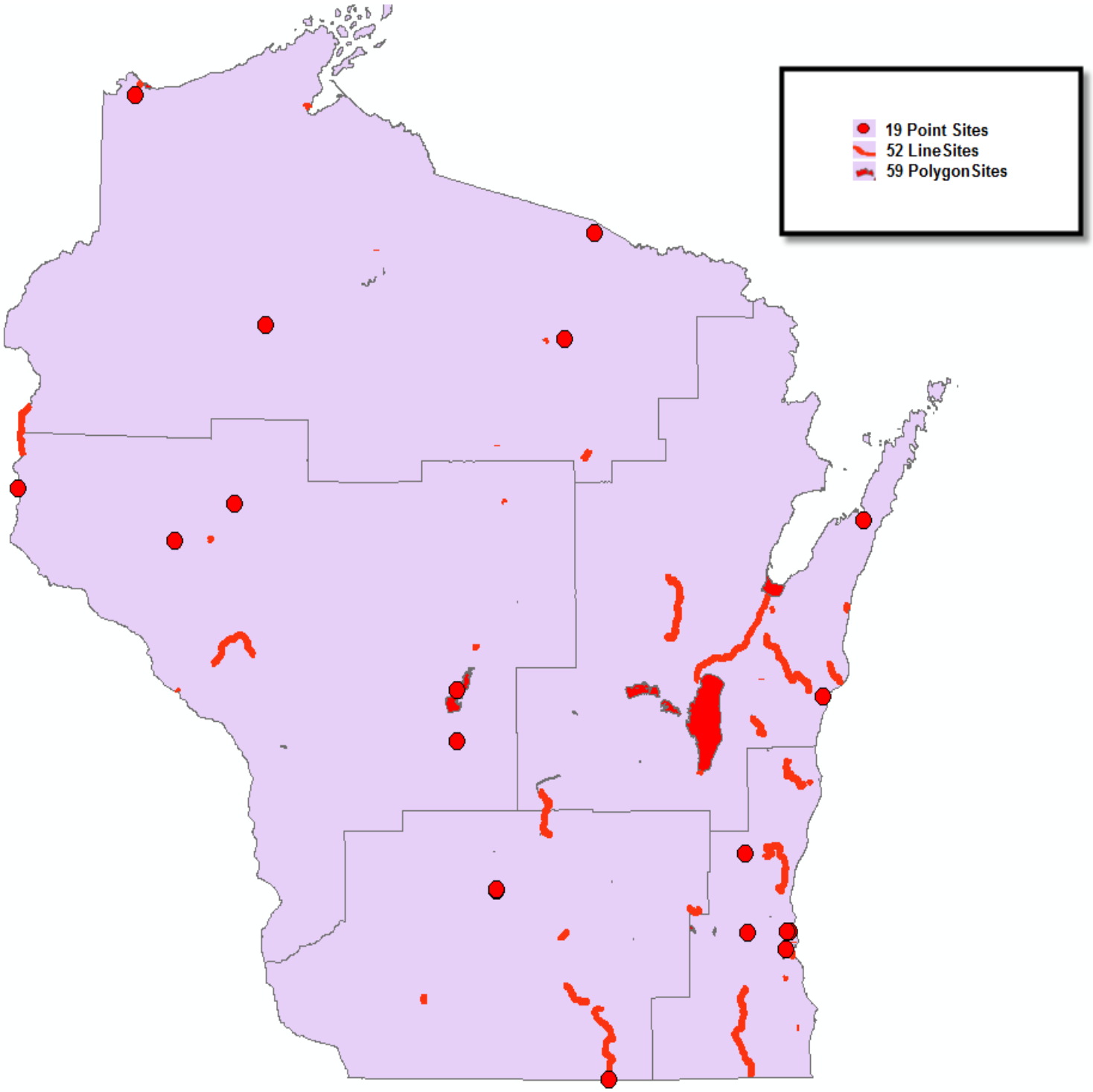
Reporting

Reporting on contaminated sediment remediation work is likely conducted through state and federal reports on sediment management progress as well as through program objective reporting at WDNR.

Programmatic Evaluation

Sediment program evaluation is ongoing through annual and biennial work planning and Office of the Great Lakes evaluation of progress within the program and projects conducted in conjunction with the Remediation and Redevelopment program.

Figure 21 Contaminated Sediment Inventory Sites in Wisconsin



Section 3.0 Program-Specific and Cross-Program Monitoring

The Water Division has a number of critical programs that require specific data collection and analysis to meet program evaluation and targeting needs. The data collection may be addressed in the media specific work described in Section 4.0. However, certain requirements are met through individual program funds or through collaborative work with partners and stakeholders, which may help design and support custom monitoring. The table below describes these critical program areas and the source of data needed to properly carry out the program. Programs with new elements or areas that are new initiatives are indicated as well.

Table 19: Cross-Program Monitoring Studies

Program Area	Description	Monitoring Studies
3.1 Aquatic Invasive Species	• Incidental occurrence for distribution, early detection • Distribution, early detection and rate of species spread to evaluate efficacy of prevention. • Pilot project to monitor road crossing for aquatic invasive species, including organisms in trade.	AIS specific studies by DNR biologists, grant-funded expert and volunteer monitoring. [5.1 below]
3.2 Fish Tissue	Monitoring of advisory sites and some new site monitoring for PCBs and mercury.	Fish Tissue Contamination Studies [5.2 below]
3.3 Runoff Management	Monitoring to evaluate the success of pollutant load reductions in a structured setting. This type of work involves ambient monitoring as well as outfall or point of discharge monitoring. Each study design is customized. Monitoring to create a nine key element plan. Monitoring to create a runoff-dominated TMDL.	Best Management Practice Evaluation Monitoring , Nine Key Element Plan Development, and TMDL Development (Runoff Dominated) [Baseline Plus Special Studies- Future TWA Element]
3.4 Total Maximum Daily Load Analyses for TMDL Development	Monitoring to determine concentrations and mass loads associated with a pollutant identified as a driving factor in an impaired water - one that is not meeting water quality standards and is listed as impaired.	Total Maximum Daily Load Analyses for TMDL Development [Special Initiatives, Partners]
3.5 Water Quality Standards	Proposed updates to the state's water quality standards program are based on utilizing natural community delineations, validation of those categories, and analyzing attainment based on a secondary set of measures.	Utilizing the ALUS approach, the state intends to reconfigure its WQS program.
3.6 Monitoring Strategy for WPDES Program	Monitoring conducted by WPDES permittee or DNR to determine if existing or proposed limits or permit decisions are protective and if the decisions maintain water quality standards.	Permit Compliance, Innovations in Effluent Limit Determination
3.7 Mississippi River Studies	Federal and state monitoring studies that adds to the collective knowledge and resource management by interstate researchers and program managers on the Mississippi River.	River LTT, LTRMP, EMAP-GRE, Zebra Mussels, Sediment, habitat
3.8 Great Lakes Studies	Great Lakes studies are largely conducted through partners, as WDNR is a major pass through agency for millions of project dollars. However, many hundreds of thousands of dollars are funneled to DNR staff to conduct AOC status and remediation monitoring each year.	The work conducted varies depending on the Beneficial Use Impairment being evaluated for restoration.
3.9 Source Water Monitoring	Monitoring of surface waters to support drinking water use assessments, especially with regard to Lake Winnebago as a surface water source water area.	Monitoring Initiative funding will be used to develop a monitoring plan for Lake Winnebago.

Section 3.1 Monitoring Strategy for Aquatic Invasive Species

Table 20: Aquatic Invasive Species Studies		
Study	**Purpose**	**Supports: Recreation, Wildlife**
Aquatic Invasive Species – Incident Reports	Track incidental occurrence for distribution and early detection	Evaluate effectiveness of programs.
Probabilistic Aquatic Invasive Species Monitoring– (Baseline Statewide Monitoring – Aquatic Invasive Species Early Detection)	Track distribution, early detection and determine the rate of aquatic invasive species spread to evaluate efficacy of prevention.	Identify key areas for intervention.
Aquatic Invasive Species – Water Quality Biologist Stream Monitoring	Distribution and early detection	Identify key areas for intervention.
Citizen Lake Monitoring Network – Aquatic Invasive Species	Distribution and Early detection	Identify key areas for intervention.
Aquatic Invasive Species – Project Riverine Early Detection	Distribution and early detection	Identify key areas for intervention.
Aquatic Invasive Species Snapshot day (pilot)	Pilot project to monitor road crossing for aquatic invasive species, including organisms in trade.	Evaluate cost effective monitoring strategies.

Study Descriptions

AIS Incident Reporting

Monitoring objectives

Staff and volunteers report occurrences of aquatic invasive species to update distribution lists and initiate rapid response action, when appropriate. Future uses include but are not limited to water condition assessments.

Monitoring design

Incidental observations during routine field work or outdoor activities are conducted.. There are two processes used to report: to the local DNR Lake Coordinator (http://dnr.wi.gov/topic/Invasives/report.html) or implementing the DNR Aquatic Invasive Species protocol (http://dnr.wi.gov/lakes/invasives/AISDiscoveryCommunicationProtocol.pdf).

Water quality indicators

Location (e.g. Lake Name, water body identification code, latitude/longitude, etc.) is provided in reports. Water quality data may or may not be reported with these incidental reports.

Quality Assurance

Volunteers or staff may or may not have received training. All aquatic invasive species reports must be verified by an expert prior to making the information public. Our communication protocol identifies appropriate chain of custody for specimens (http://dnr.wi.gov/lakes/invasives/AISDiscoveryCommunicationProtocol.pdf).

Data management

An incident report will be completed and entered into SWIMS. There are two types of incident reports:

- Plant (http://dnr.wi.gov/lakes/forms/3200-125-plantincident.pdf) or
- Animal (http://dnr.wi.gov/lakes/forms/3200-126-animalincident.pdf).

Central office staff creates an electronic record to identify whether and where the occurrence has been verified by an expert.

Reporting

Collected data are shared on the DNR website:

- list of species locations (http://dnr.wi.gov/lakes/invasives/BySpecies.aspx)
- Lakes and Aquatic Invasive Species Viewer (http://dnr.wi.gov/lakes/viewer/)
- Significant discoveries are shared on the DNR Lakes Blog (http://lakes-l.blogs.govdelivery.com/) and/or news releases.

Programmatic evaluation

Twice each year, the DNR host a forum with federal, state, county, tribal, university, and private stakeholders to summarize and discuss aquatic invasive species reports, monitoring improvement, and response actions. Staff has requested to be made aware of reports and when Resources of Interest are created in their work area. We will begin providing weekly or monthly reports to staff. Staff has also requested to be made aware of follow-up efforts in their work area.

AIS Probabilistic (Baseline Statewide Monitoring–Early Detection)

Monitoring objectives

The statewide monitoring strategy outlined below will provide DNR and partners with the information needed to:

1. Establish baseline data on statewide AIS distribution.
2. Track the rate of AIS spread in a number of vulnerable waterbodies that will represent the state as a whole.
3. Evaluate the effectiveness of outreach and education efforts aimed at stopping the spread of AIS.

Monitoring design

Sampling timeframe is from June 15 to September 15. Monitor 200 randomly selected lakes throughout the year using boat landing searches, snorkel searches, shoreline meander, plankton tows.

Water quality indicators

Secchi disk depth and conductivity data are collected.

Quality Assurance

Each spring, there is an annual field protocol review and identification and disinfection training. Specimens of all occurrences are collected and submitted for identification verification by the appropriate taxonomic expert. Vouchers are prepared and sent to the appropriate herbarium or museum.

Data management

Staffs enter their data into SWIMS. Data is proofed by a second staff to ensure accurate entry. Data sheets are scanned and saved. Central office staff creates a Resource of Interest and identify whether the occurrence has been verified by an expert.

Reporting

Throughout the season, significant discoveries will be shared with monitoring staff. Updates are provided at the fall and spring AIS Coordinator meeting. Each spring, results are summarized and shared through a local press release or incorporated into a statewide press release.

Collected data are shared on the DNR website:

- list of species locations (http://dnr.wi.gov/lakes/invasives/BySpecies.aspx)
- Lakes and Aquatic Invasive Species Viewer (http://dnr.wi.gov/lakes/viewer/)
- Significant discoveries are shared on the DNR Lakes Blog (http://lakes-l.blogs.govdelivery.com/).

Programmatic evaluation

Fall meeting with monitoring staff to review protocols and identify issues to improve following year. Twice each year, the DNR host a forum with federal, state, county, tribal, university, and private stakeholders to summarize and discuss aquatic invasive species reports, monitoring improvement, and response actions. Staff has requested to be made aware of reports and when Resources of Interest are created in their work area. We will begin providing weekly or monthly reports to staff. Staff has also requested to be made aware of follow-up efforts in their work area. Protocols are articulated in the WDNR Aquatic Invasive Species Early Detection Monitoring SOPs, Draft June 9, 2014.

AIS Water Quality Biologist Stream Monitoring

Monitoring objectives

Track the distribution of aquatic invasive species in streams and early detection of pioneer populations.

Monitoring design

Water quality biologists report presence/absence during routine field work.

Water quality indicators

Stream flow, pH, and temperature data are collected. Macroinvertebrates and fish data are collected to determine stream index of biotic integrity.

Quality Assurance

Biologists are trained to identify AIS, complete/submit the field datasheet, collect specimens, and disinfect equipment. Specimens or photographs are submitted to DNR AIS staff for verification and vouchering. Some species may be verified with photographs. If specimens are collected, vouchers are prepared for an herbarium or museum. If no specimen is collected for a species that needs voucher verification, the record will be flagged and specimen collected.

Data management

Either the data collector or staff enter the data into SWIMS, which is proofed by second staff to ensure accuracy. Data sheets are scanned and saved. Central office staff creates a Resource of Interest and identify the occurrence verified location.

Reporting

Collected data are shared on the DNR website:

- List of species locations (http://dnr.wi.gov/lakes/invasives/BySpecies.aspx)
- Lakes and Aquatic Invasive Species Viewer (http://dnr.wi.gov/lakes/viewer/)
- Significant discoveries are shared on the DNR Lakes Blog (http://lakes-l.blogs.govdelivery.com/) and/or news releases.

Programmatic evaluation

Fall meeting with monitoring staff to review protocols and identify issues to improve following year. Twice each year, the DNR host a forum with federal, state, county, tribal, university, and private stakeholders to summarize and discuss

aquatic invasive species reports, monitoring improvement, and response actions. Staff has requested to be made aware of reports and when Resources of Interest are created in their work area. We will begin providing weekly or monthly reports to staff. Staff has also requested to be made aware of follow-up efforts in their work area. Aquatic Invasive Species Monitoring Data Form 3600-532A (R 2/14).

Citizen Lake Monitoring Network – Aquatic Invasive Species

Monitoring objectives

Track the distribution of aquatic invasive species in lakes and early detection of pioneer populations.

Monitoring design

Volunteers are recruited and trained to identify AIS. Volunteers on lakes set up monitoring teams to divvy up the work. Species monitored and protocols used will depend on the volunteer's interest/abilities. The methods are available on-line: http://www.uwsp.edu/cnr-ap/UWEXLakes/Documents/programs/CLMN/SecchiManual-2014web.pdf

Water quality indicators

Water quality data is not collected for this project.

Quality Assurance

County coordinators receive annual refresher trainings. Volunteers are trained how to identify AIS, complete the datasheet, enter data into SWIMS, and disinfect equipment. Volunteers are encouraged to collect AIS specimens or photographs for each location where it is observed. Volunteers deliver specimens to local experts. Local experts prepare vouchers and send them to the herbarium or museum.

Data management

Volunteers complete the following forms:

- Aquatic Invasives Surveillance Monitoring Report End of Season Report, Form 3200-133
- Aquatic Invasives Surveillance Monitoring Multiple Locations, One Date, Forms 3200-130

Volunteers complete the following forms, if plankton tows are collected:

- Mussel Veliger Tow Monitoring Report, Form 3200-135
- Water Flea Tow Monitoring Report, Form 3200-128

If AIS are observed for the first time on a lake, volunteers complete:

- Aquatic Invasive Plant Incident Report, Form 3200-125
- Aquatic Invasive Animal Incident Report, Form 3200-126
- Purple Loosestrife Volunteer Watch Report, Form 3200-11

For established population monitoring, report your results using the:

- Plant Bed Density Report, Form 3200-132.
    - At this time, there is no computer data entry option for this form. Online data forms will be created as time allows. The data collected with this form will be very useful in tracking the spread of EWM throughout the lake if EWM does spread and is necessary in tracking success of your management option. Keep hard copies for your reference and/or submit them to your local DNR Aquatic Plant Management Coordinator.
- Crayfish (Quantitative) Monitoring Report, Form 3200-12
- Zebra/Quagga Mussel (Quantitative) Report Requires use of substrate plates, Form 3200-127

Volunteers use the following forms if they participate in purple loosestrife biocontrol project:

- Purple Loosestrife Cultivation Authorization and Biocontrol Insect Application, Form 3200-11

Forms are either entered directly into SWIMS by the volunteer or submitted to the local DNR AIS contact, local AIS Coordinator, or mailed to Jennifer Filbert.
UW Extension and DNR will work to streamline the CLMN AIS reporting.

Reporting

Collected data are shared on the DNR website:

- list of species locations (http://dnr.wi.gov/lakes/invasives/BySpecies.aspx)
- Lakes and Aquatic Invasive Species Viewer (http://dnr.wi.gov/lakes/viewer/)
- Significant discoveries are shared on the DNR Lakes Blog (http://lakes-l.blogs.govdelivery.com/), news releases.

Programmatic evaluation

Feedback is provided during annual train-the-trainer trainings. Twice each year, the DNR host a forum with federal, state, county, tribal, university, and private stakeholders to summarize and discuss aquatic invasive species reports, monitoring improvement, and response actions. Staff has requested to be made aware of reports and when Resources of Interest are created in their work area. We will begin providing weekly or monthly reports to staff. Staff have also requested to be made aware of follow-up efforts in their work area. Annual reviews should be conducted either statewide or by regional coordinators to share discoveries with volunteers and receive feedback.

Aquatic Invasive Species–Project Riverine Early Detection

Monitoring objectives

River Alliance of Wisconsin and DNR would like to identify AIS locations along rivers.

Monitoring design

Volunteers are trained to identify AIS. Volunteers paddle or wade a stretch of stream and look for AIS. See the protocols which are described in Project Red Protocols Document.

Water quality indicators

Water quality data is not collected for this project.

Quality Assurance

County coordinators receive annual refresher trainings. Volunteers are encouraged to collect AIS specimens or photographs for each location where it is observed. Volunteers deliver specimens to local experts. Local experts prepare vouchers and send them to the herbarium or museum.

Data management

Volunteers complete the Project RED Field Data Collection Sheet. Volunteers either mail datasheets to the partners who enter the data into SWIMS. Data Entry form for Project Red.

Reporting

Collected data are shared on the DNR website:

- List of species locations (http://dnr.wi.gov/lakes/invasives/BySpecies.aspx)

- Lakes and Aquatic Invasive Species Viewer (http://dnr.wi.gov/lakes/viewer/)
- Significant discoveries are shared on the DNR Lakes Blog (http://lakes-l.blogs.govdelivery.com/) and/or news releases.

Programmatic evaluation

Twice each year, the DNR host a forum with federal, state, county, tribal, university, and private stakeholders to summarize and discuss aquatic invasive species reports, monitoring improvement, and response actions. Staff have requested to be made aware of reports and when Resources of Interest are created in their work area. We will begin providing weekly or monthly reports to staff. Staff has also requested to be made aware of follow-up efforts in their work area. Annual reviews should be conducted either statewide or by regional coordinators to share discoveries with volunteers and receive feedback.

Aquatic Invasive Species–Snapshot Day (pilot)

Monitoring objectives

River Alliance of Wisconsin and DNR would like to identify AIS locations, especially organisms-in-trade releases, at road crossings.

Monitoring design

Local county AIS coordinators identify targeted locations, recruit volunteers and host a one-day event. Volunteers are trained to identify species in the morning and visit targeted locations to assess presence/absence of AIS. AIS Bridge Snapshot Day Local Coordinators Handbook September 13, 2014 AIS Bridge Snapshot Day Protocols.

Water quality indicators

Water quality data is not collected for this project.

Quality Assurance

County AIS coordinators will receive annual refresher trainings. Volunteers collect AIS specimens or photographs for each location where it is observed. The specimens are submitted to the local coordinator. The local coordinator verifies the identification and will submit a voucher specimen to the herbarium. If there are multiple locations reported along a stream, then the coordinator will select just one specimen to voucher that will represent each population observed along that stream.

Data management

Volunteers complete the AIS Bridge Snapshot Datasheet and submit to the local coordinator. The local coordinator provides the datasheet to the River Alliance of Wisconsin to enter the data. Central office staff creates a Resource of Interest and identify whether the occurrence has been verified by an expert. AIS Bridge Snapshot Datasheet

Reporting

Collected data are shared on the DNR website:

- list of species locations (http://dnr.wi.gov/lakes/invasives/BySpecies.aspx)
- Lakes and Aquatic Invasive Species Viewer (http://dnr.wi.gov/lakes/viewer/)
- Significant discoveries are shared on the DNR Lakes Blog (http://lakes-l.blogs.govdelivery.com/) and/or news releases.

Programmatic evaluation

Twice each year, the DNR host a forum with federal, state, county, tribal, university, and private stakeholders to summarize and discuss aquatic invasive species reports, monitoring improvement, and response actions. Staff have requested to be made aware of reports and when Resources of Interest are created in their work area. We will begin providing weekly or monthly reports to staff. Staff has also requested to be made aware of follow-up efforts in their work area. Annual reviews should be conducted either statewide or by regional coordinators to share discoveries with volunteers and receive feedback.

Section 3.2 Monitoring Strategy for Fish Tissue

Table 21: Fish Tissue Monitoring Studies	
Study Name	**Purpose: Recreation, Public Health & Welfare**
Fish Tissue Contamination Studies	Monitoring of advisory sites and new sites for PCBs and mercury.

Study Description

Contaminants in Fish Tissue

This program has been in place since the mid-1970s. Current funding allows for return monitoring of advisory sites and some new site monitoring for PCBs and mercury. Current funds allow for limited monitoring of dioxin/furan and emerging chemicals. Overall, fish are collected from approximately 50 to 100 sites each year. Analyses completed each year include about 600 samples analyzed for mercury, 350 for total PCBs, 30 for banned pesticides, 20 for dioxin/furan analysis and 20 for other chemicals. Collection of fish for contaminants is not funded through the fish contaminant program funds but is achieved through fieldwork conducted for baseline, treaty, or other fisheries surveys.

Monitoring Objectives

The objectives of the fish contaminant program include but are not limited to protection of fish consumers, resource management, and environmental protection.

Clean Water Act Objectives:

- Determining water quality standards attainment – determine 'fishability'
- Identifying impaired waters – identify waters with bioaccumulative chemicals
- Identifying causes and sources of water quality impairments – fish tissue monitoring assists in determining sources or location of contaminated sediments.
- Evaluating program effectiveness information to evaluate remediation of sediment. Fish tissue monitoring has in the past reflected efforts to control direct discharges of bioaccumulating chemicals. Fish tissue monitoring may also be helpful in evaluating success of control of other sources of pollutants.

Specific Objectives:

- Protection of fish consumers
- Resource Management
- Environmental Protection

Monitoring Design

The monitoring design consists of different components depending on the purpose of the monitoring, the area of the state or the waterbody type (inland lakes, rivers, Great Lakes), and also varies depending on the contaminant (mercury, PCBs, pesticides, dioxin/furans, and emerging chemicals). Each year, a specific sample collection schedule is formulated to provide guidance to field staff on locations where fish samples are needed to fulfill the monitoring design.

- "Baseline" fish contaminant monitoring focuses on sampling new sites (not previously assessed for contaminants) and sites where contaminant data are old (more than 15 years old) or limited, or where existing data suggests that concentrations may be high and additional data would be beneficial to determine advisory needs. In general, top-level predator species are first selected for contaminant monitoring and additional species may be added depending on the site characteristics and availability of past contaminant data, or statewide general advisory needs.
- Advisory fish contaminant monitoring refers to monitoring fish for contaminants where special fish consumption advice is in place (site-specific advice more stringent than the general advisory) and data are needed to update consumption advice. This monitoring is generally conducted in major industrial rivers and locations where remediation may be necessary or underway. The goal is to return to inland (non-Great Lakes or non-border waters) locations with PCB-based special advice every five years in order to update the data for advisories and for trend monitoring. The goal for inland waters with mercury-based special advice is to return every 10 to 15 years. More frequent sampling can occur in areas where remediation is imminent. In addition, specific biennial monitoring designs are defined for Lakes Superior and Michigan.
- In addition, the Department has been cooperating with the EPA Great Lakes National Program Office since the late 1980s to determine trends and geographic patterns of contamination, to provide information for health advisories and for tracking contaminant levels in composite samples of key salmon species. The Department participates in some components of this monitoring by collecting fish, processing of samples, and shipping samples as defined in inter-agency agreements. This includes collection of coho or chinook salmon at three Great Lakes tributaries according to the inter-agency agreement (these samples are also analyzed as individual fillets for advisory purposes). In addition, WDNR collects lake trout from Lake Superior every other year for EPA. EPA provides the analytical services for PCBs, chloro-organic and other compounds. The data generated by this program are used for trend analysis and consumption advisories when the results are shared with WDNR.

Water Quality Indicators

Fish tissue concentrations of mercury and PCBs are core indicators as is resulting consumption advice; however, tissue concentrations are difficult to portray as indicators because of the complexity of confounding factors like fish age, growth and migration. Tissue concentrations may vary as a result of non-water quality factors and therefore appropriate analyses must be conducted to use tissue concentrations as an indicator of water quality. In addition, data for some parameters like dioxin/furan, banned pesticides and some emerging chemicals are limited.

Quality Assurance

Quality assurance processes may be found in sampling and procedure documents describing the fish contaminant monitoring program, in the procedures for each of the analytical laboratories that provide analytical services, and in Department quality assurance documents. The Wisconsin State Lab of Hygiene, a certified laboratory with approved quality assurance procedures, completes most fish contaminant analyses.

Data Management

Contaminant data are stored in the Department's fish-sediment contaminant database consisting of a series of Oracle tables and managed on a web-based system, recently updated. Data are available to the public through the Surface Water Data Viewer and through the online query tool, as well as upon verbal or written request after field verification and Department analyses are completed.

Data Analysis

Each year, the Department reviews newly obtained contaminant data in the context of existing data and advisories. The WDNR, in a cooperative effort with the Wisconsin Division of Public Health in the Dept. of Health and Family Services (DHFS), determine whether a sample is of public health significance. When concentrations of contaminants exceed

health guidelines, WDNR and WDHFS jointly issue a fish consumption advisory for the appropriate water body. Data are shared and advisories are determined for boundary waters in coordination with other Great Lakes states. The process of collection, data management and interpretation, and policy development is outlined in Department manual code 3611.1.

Reporting

The following reports are updated each year after new data are evaluated:

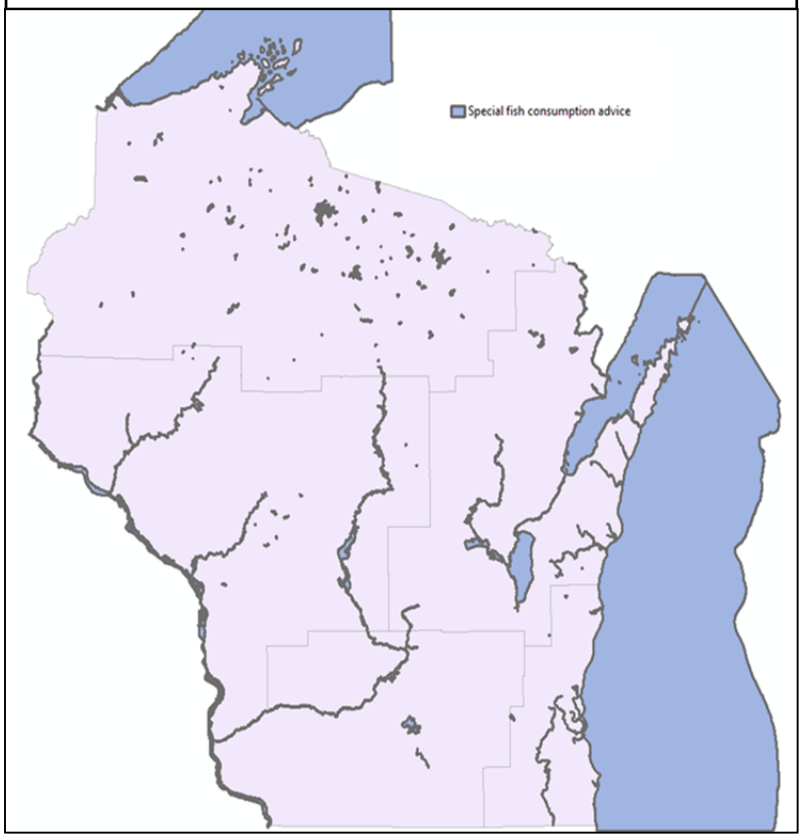
- Annual review of new data in context of existing data, advisories and other information to determine necessary advisory updates and publication of the advice.
- Data summaries for specific advisory or remediation sites or for specific fish contaminants on a statewide or regional basis on an as needed basis.
- Annual update of Wisconsin's Fish Contaminant Monitoring Program and Advisory Summary.
- Reporting is included in the biennial 305b report to congress.
- Completion of EPA's annual survey for the Listing of Fish and Wildlife Advisories
- Reporting to EPA Region V through the ENPPA program.
- Reporting of accomplishments through the Department's biennial work planning process.

In addition, the data and reports from the fish contaminant monitoring are used by various programs including reporting of information necessary for the 303d and other Clean Water Act requirements and sediment remediation programs.

Programmatic Evaluation

The fish contaminant monitoring program operates within the framework of the Water Division biennial work plan. Any changes to the protocol or strategy are recommended to the Fisheries Board. Reviews of work plan performance are completed annually, to evaluate job completion. In addition, program staff participates in regional and national workshops and evaluations of fish contaminant monitoring programs. Overall review of monitoring programs occurs each time a component of the program is evaluated (e.g. Great Lakes trend monitoring, baseline monitoring, advisory updates). Review of state monitoring programs is also a part of the Department-EPA ENPPA process. These processes allow annual and biennial work planning goals to be established. In addition, ongoing discussions of monitoring occurs with other groups like the Division of Health, the Great Lakes National Program office and EPA programs, contacts with other fish contaminant monitoring coordinators including coordinators from the states adjacent to Wisconsin.

Figure 22 Specific Fish Advice Sites in Wisconsin



Section 3.3 Monitoring Strategy Runoff Management

Table 22: Runoff Management Monitoring Needs	
Study	**Purpose: Fish and Aquatic Life Use**
Runoff Management	**BMP Evaluation** Monitoring to evaluate the success of best management practices.
	Nine Key Element Plan Development Monitoring to collect data for the development of a Nine Key Element Plans.
	TMDL Development – Runoff Dominated Monitoring to develop TMDLs for runoff dominated catchments with waters impaired primarily due to diffuse pollutant sources.

Study Descriptions

BMP Evaluation

Monitoring objectives

Monitoring to evaluate the success of best management practices for Section 319 compliance is incorporated into the prescriptive monitoring element of the state's work plan. The objectives are to conduct a basic assessment to identify if improvements or degradation can be ascertained from evaluating best management practices installed in a watershed.

Monitoring design

Intensive monitoring is required to evaluate the effectiveness of BMPs. For WQ10 Performance measures (restoring an impaired waterbody) monitoring could be completed at the reach scale. For WQ-SP12 performance measures a watershed wide (HUC 12) monitoring design would be needed in order to show watershed wide improvements. In either case the best chance of showing improvements would be to identify watersheds where multiple BMPs and multiple landowners have installed practices over a relatively short time period. Gathering data on BMP installation with accurate locational and temporal data is a key element in order to best target monitoring activities in watersheds where there is the best chance of documenting success.

Frequency of measurements for delisting will be based on WisCALM methodologies for delisting requirements for specific pollutants. In order to show load reductions biweekly chemical and flow samples may be required. For more intensive studies spatially intense sampling with continuous flows may need to be captured (USGS flow gauge or pressure transducers) along with event based WQ samples.

Priority watersheds for monitoring would include sites that had pre implementation data and high density BMP installation. Watersheds with approved TMDLs would meet both of these criteria and likely be good candidates. Other watersheds with high densities of BMPs installed that are not in TMDL watersheds could also be good candidates for showing watershed wide improvement and/or delisting. In order to show improvement it is important to select a performance measure(s) and stick to it through time at each location.

Water quality indicators

There are many entities (USGS, UW, etc.) working on showing the efficiency of BMPs with edge of field monitoring. We should be focusing on BMP effectiveness monitoring through in-stream water quality measures. Delisting streams as a result of BMP success is going to depend on the specific pollutant that was initially listed. The most likely pollutants will be total phosphorus and total suspended solids. To show whole watershed improvements, other water quality measures could be used such as biology, load reductions, and sediment metrics within the habitat quality measures.

Quality Assurance

In order to show load reductions biweekly chemical and flow samples may be required. For more intensive studies spatially intense sampling with continuous flows may need to be captured (USGS flow gauge or pressure transducers) along with event based WQ samples.

Data management

Monitoring would be done by DNR staff but multiple organizations are involved in BMP installation and funding including DNR, DATCP, NRCS, Counties, etc.

Reporting

Reporting will occur both in final reports as well as in data used in the SWIMS data system to evaluation attainment.

Programmatic evaluation

Annual evaluation of data collection and the efficacy of results will be conducted.

Nine Key Element Plan Development

Monitoring objectives

This includes monitoring to collect data for the development of a Nine Key Element Plans.

Monitoring design

Spatially and temporally intense targeted watershed (TWA) monitoring is required for developing Nine Key Element plans. Some measures of frequent flows are needed but can be estimated at the watershed scale so they are not necessary at all locations sampled. Performance of Nine Key Element plans can be measured through modelling the improvements of BMP installation but intensive monitoring at specific locations can be included in order to achieve WQ10 or SP12 performance measures.

Initially targeting of approved TMDL watersheds would lead to the development of Nine Key Element plans that would not require additional data. Secondarily, data collection to develop a Nine Key Element plan should be conducted at the HUC 12 level at sites where Counties or other partners have expressed interest in collaborating. Watersheds in Counties with lower interest could still be targeted for developing Plans but would likely be a lower priority. Using 106 monitoring funds for the development of Nine Key Element plans should be prioritized as once Plans are approved those areas are available to receive 319 project funds for future monitoring activities. Currently there are limited watersheds in WI that have approved Plans that are available to use 319 project funds for monitoring activities.

Water quality indicators

Indicators to be monitored would include phosphorus, nitrogen and sediment associated with some in stream flow measurements. Loads can be estimated in order to establish a baseline for Nine Key Element plans so continuous flows may not be necessary in all areas of a watershed. Baseline data on land use is also critical in developing Nine Key Element plans.

Quality Assurance

Monitoring work would be conducted by DNR staff, possibly with the help of volunteers. Collaboration with Counties is critically in determining areas to prioritize for monitoring and Plan development.

Data management

Monitoring data management work will be conducted by DNR staff.

Reporting

Reporting will occur both in final reports as well as in data used in the SWIMS data system to evaluation attainment.

Programmatic evaluation

Annual evaluation of data collection and the efficacy of results will be conducted.

TMDL Development – Runoff Dominated Watersheds

Monitoring objectives

Monitoring to develop TMDLs for runoff dominated catchments with waters impaired primarily due to diffuse pollutant sources.

Monitoring design

Targeted watershed monitoring is required with a focus at monitoring sites at the pour points of major watersheds, sub-watersheds or tributaries. Scale for monitoring is dependent on scale of the TMDL. Recently TMDLs have been conducted at the HUC 8 scale but the future direction is unknown. Sampling frequency is at minimum biweekly water quality and flow measurements. However, in many situations more frequent monitoring, event based water quality samples or continuous flow monitoring may be necessary.

Water quality indicators

Phosphorus, nitrogen and/or total suspended solids are required along with flow monitoring.

Quality Assurance

DNR and partners are responsible for incorporating appropriate quality assurance measures and ensuring that these elements are adhered to,

Data management

DNR staff along with possible partners would be responsible for data management.

Reporting

Reporting would be through final reports.

Programmatic evaluation

Annual evaluation of data collection and the efficacy of results will be conducted.

Section 3.4 Monitoring Strategy for TMDLS

Monitoring for TMDLs reflects the state's highest priorities for restoration. Data collection is needed to characterize pollutants identified as a driving factor in impairment under Section 303d of the Clean Water Act. This work reflects the state's TMDL Vision Process in partnership with USEPA.

Table 23: TMDL Monitoring Projects	
Study	**Purpose: Fish and Aquatic Life Use, Recreation, Public Health & Welfare**
TMDL Monitoring	TMDL Monitoring for Model Creation: Wisconsin River, Upper Fox/Wolf, Milwaukee
	TMDL Implementation Monitoring: Rock River, Lower Fox River

Study Descriptions

Total Maximum Daily Load (TMDL) Development [Modeling, Load Allocation]

TMDL development (which varies depending on the size, intensity and fiscal resource availability for a given TMDL) across the state has resulted in an increased level of monitoring to help determine pollutant load reductions necessary to meet water quality criteria. The monitoring associated with each TMDL varies widely and depends on the pollutant(s) of concern, the existing monitoring data, the geographic scale of the TMDL, and other factors. Often DNR leads the monitoring efforts associated with TMDL development but a number of other entities contribute. County Land & Water Conservation Departments, USGS, wastewater treatment facilities, local citizen groups, and others have contributed to DNR or third party TMDL development efforts.

Monitoring Objectives

Each TMDL monitoring project differs depending on the unique resources listed, the area included in the study, the pollutants and impairments for which the water is listed and the sources of contamination. The primary objective of this type of study is to understand the extent of impairment, the specific causes of impairment, relevant pollutant concentrations, loading rates, and assimilative capacity. These data help set limits for point and nonpoint sources of the given pollutant.

Monitoring Design

Each TMDL development monitoring design will be uniquely designed for the needs of the project at hand. In general, data collection to write a TMDL is a time consuming, expensive, collection intensive task, often requiring at least one complete field season of multiple parameters covering the suite of physical, chemical, habitat and biological parameters.

Water Quality Indicators

The water quality indicators selected for a given TMDL study will reflect the end points for which the TMDL is created to restore – macroinvertebrate health, fish community assemblage, total phosphorus ambient concentrations, etc.

Quality Assurance

Sampling Protocols should be clearly documented and quality assurance elements should be incorporated into TMDL study designs.

Data Management

To the maximum extent possible, all entities conducting water or sediment chemistry monitoring or Biomonitoring for acute or chronic toxicity should use the State Laboratory of Hygiene (SLOH) for analytical work. If data collection is conducted by organizations or individuals outside of the DNR, the flow of data back into the SWIMS system should be required whenever possible.

Section 3.5 Monitoring Strategy for Water Quality Standards

Table 24: Water Quality Standards Monitoring Needs		
Study	**Purpose**	**Supports**
Water Quality Standards (WQS) Development, Revision, or Evaluation	**Waterbody Use Designation** Waters are monitored to determine use designations. In the absence of field data and a full assessment, rivers and streams are classified as default - fish and aquatic life communities. Warm or Cold Default Waters may be used (more discussion needed).	WQS Attainment, WPDES Permits, CWA Reporting, WQM Planning
	Natural Community Validation Monitoring fish assemblage to validate or identify correct stream natural community which influences assessment and water quality standards programs.	WQS Attainment, WPDES Permits, CWA Reporting, WQM Planning
	Standards Attainment Monitoring to determine if the waterbody is meeting designated uses as well as quantitative ambient water quality standards, such as phosphorus. Waters in non-attainment are listed as "impaired".	WQS Attainment, WPDES Permits, CWA Reporting, WQM Planning
	Use Attainability Analysis To be developed. Monitoring and guidance for Use Attainability Analysis will be needed.	WQS Attainment, WPDES Permits, CWA Reporting, WQM Planning
	Bioassessment Criteria Development This area is under development but additional indicators are in evaluation. Desktop analysis and possible additional data collection are being used to develop biocriteria tools for water quality standards.	WQS Attainment, WPDES Permits, CWA Reporting, WQM Planning

Study Descriptions

WQS Development, Revision, or Evaluation

Monitoring objectives

1. **Update waterbody use designations** using new protocols. (See Next Section; priority given to receiving waters of existing WWTPs) These protocols incorporate bioassessment techniques and involve the verification of stream natural communities, a step necessary before applying the fish Index of biological integrity). (This involves **verifying the Natural Community model determinations).** Natural communities are not synonymous with designated uses.
2. **Evaluate Standards Attainment** for existing qualitative and quantitative standards; those waters not meeting standards are listed as "impaired" under Clean Water Act Section 303(d).

Monitoring design

Updated guidance and rule promulgation are needed for using the natural communities as designated uses or water quality standards use categories. However, monitoring is needed to verify modeled stream natural communities both to apply the fish IBI to evaluate water quality standards attainment and to advance the use of the streams natural community data layer for the state's use designations. This work is in progress. WDNR is automating the data analysis steps for the natural community verification process. The monitoring work for waterbody use designations, evaluation of standards attainment, and special studies work is prioritized based on existing data age, likelihood for change, permit expiration or new permits coming online, and existing funding.

Water quality indicators

- Bioassessment tools are the primary driver for characterizing receiving water designated uses, validating natural communities, and determining if standards are met. Bioassessment metrics for assessing overall community health for streams include the fish index of biological integrity (FIBI) and the macroinvertebrate index of biological integrity (mIBI). Bioassessment metrics for lakes are currently under development and are likely to include macrophytes and possibly other metrics such as phytoplankton.
- WDNR is in the process of developing a suite of metrics that will be used as Phosphorus Response Indicators, to help determine whether a waterbody is experiencing degradation due to ambient phosphorus concentrations. For flowing waters, these will likely include measures of primary productivity, macroinvertebrates, and dissolved oxygen. For lakes, they will likely include chlorophyll a, specific plant and or algae taxa, and dissolved oxygen.
- Chemistry or background monitoring for specific parameters involves analysis of concentrations and/or mass loading depending on the unit of study.
- For permit-specific or outfall-specific questions, site-specific concentrations of the pollutant of interest would be the water quality indicator.
- In addition potential WET testing (acute or chronic toxicity testing) may be used for the water quality indicator.

Quality Assurance

As new staff is hired into water quality biologist positions, they will receive training for the variety of monitoring studies described in this paper. In addition, biologists will work closely with wastewater staff to identify specific locations and make determinations for WPDES specific studies.

All use designation decisions are documented in the SWIMS system as well as in the WATERS database. The use designation, attainable use, current use and use support are updated in WATERS and shared on the Surface Water Data Viewer. Generally, central office staffs create electronic records documenting the decision made by regional biologists; these electronic records are reviewed during the watershed planning process and through special project monitoring.

Reporting

Summary assessment data are shared on the DNR website on the Surface Water Data Viewer, as well as on various online pages:

- Surface Water Data Viewer (http://dnr.wi.gov/topic/surfacewater/swdv/)
- Explore Wisconsin Waters! (http://dnr.wi.gov/water/)
- Wisconsin Surface waters Water Quality Report to Congress: http://dnr.wi.gov/topic/surfacewater/IR2014.html

Programmatic evaluation

Through the Triennial Standards Review process, the Wisconsin DNR identifies areas for significant work. This public input process is a significant source of feedback and program evaluation and guides work planning for staff and management in the Standards Program. In addition, the Permits Section and Wastewater Section have oversight Policy and Management Team activities that help guide and evaluate work conducted on an ongoing basis.

Waterbody Use Designation

This program was established in the 1970s to meet EPA requirements. An effort is currently underway to promulgate changes to ch. NR102, Wis. Adm. Code to utilize key features of each waterbody type to define "natural communities" to describe use designations and drive assessment protocols for Wisconsin's surface water communities. Any revisions promoted by WDNR in the coming years will be focused on improving the public understanding of water quality

standards, increasing consistency in evaluation of water condition, and efficiently deploying staff and fiscal resources to maximize monitoring efforts statewide.

Monitoring Objectives

Clean Water Act Objectives

1. Establishing, reviewing and revising water quality standards
2. Determining water quality standards attainment
3. Identifying impaired waters
4. Identifying causes and sources of water quality impairments
5. Supporting the implementation of water management programs
6. Supporting the evaluation of program effectiveness

Specific objectives

Objectives of the Use Designation program are:

1. Collect information on the water quality of Wisconsin waterbodies
2. Appropriately designate use(s) of waterbodies in order to accurately assign WPDES effluent limits
3. Appropriately designate potential use of surface waters to protect water quality under the Clean Water Act.
4. Monitor to assess water quality conditions in relation to nonpoint source management projects.
5. Monitor water quality to support Wisconsin's Impaired Waters Program and the integrated 303(d)/305(b) Report.
6. Determine Use Designations to be used in the construction of accurate stream classifications.
7. Systematically identify candidate waters for special designation as Outstanding or Exceptional Resource Waters.

Monitoring Design

Water bodies throughout Wisconsin are monitored on an as-needed basis to determine their use designations. In the absence of field data and a full assessment, rivers and streams are classified as full fish and aquatic life communities by default. In years past, Wisconsin default designations were used to protect for a balanced warm water fish community. However, a decision is now made to protect for a cold water community if a given water body is actively being managed as a trout community.

Reviews of classifications are completed on a priority basis, most often focused on streams with a WPDES permitted discharger discharging to the waterbody. Within this category of streams with permitted discharges, monitoring and assessment work is prioritized by activities such as WWTP facility planning/upgrade, 303(d) listing, waters with sensitive species (endangered/threatened), etc. Over time, it is anticipated that Baseline Tier 1 efforts will allow for a more rapid and complete establishment of use designations throughout the state regardless of whether or not a point source is located on or planned for any given water body.

Water Quality Indicators

Core and Supplemental Water Quality Indicators

Core indicators of this program consist primarily of Fish and Aquatic Life parameters, including biological community condition (fish and macroinvertebrates), dissolved oxygen (DO), temperature, flow, and even habitat. More extensive data are collected if necessary, often in order to clarify a classification or to answer a site-specific question. Metrics vary by waterbody type.

- Fish community: assessed to gain an understanding of what fish species and community composition are found in a waterbody, and to aid in the decision process of assigning a use designation to a stream segment.

- Macroinvertebrate community: assessed when a robust fish population is not present in a waterbody (or often even when a robust community is present). The types of macroinvertebrates found can indicate the quality of the water at a specific site.
- Habitat characteristics, including stream width, depth, and flow, are assessed to help in determining the potential aquatic community a surface water could support.
- Water quality assessments are conducted to determine possible characteristics that may be limiting aquatic populations, as well as to help determine the type of aquatic life that could be attained in a specific water body. Water quality parameters that are routinely collected are dissolved oxygen and temperature. Parameters such as suspended solids, ammonia and other toxic substances can also impact aquatic communities, and may be sampled as necessary.
- Additional assessments that may be conducted include, but are not limited to, sediment chemistry, ambient water chemistry, and effluent toxicity tests.

Quality Assurance

Sample Protocols

Chemical, biological and physical sampling/assessment, as well as analytical procedures are to follow established protocols. These protocols are the following:

Database Quality Protocols

Many of the historical surveys are stored as PDFs in the WATERS system on the actual waterbody extent or stream "segment" on which the old survey was conducted.

Analytic Methods Quality Protocols

Most of the data collected historically have been fish surveys. Fish survey methods are described in the appendix.

Data Management

Data collected are analyzed collectively to determine the appropriate use designation of surface waters. Fish data are utilized for the Index of Biotic Integrity (IBI) to evaluate the environmental quality of the water body. Macroinvertebrate data analyzed uses the macroinvertebrate Index of Biological Integrity (MIBI) for wadeable streams. A large river MIBI is also available for large river systems. Historically, analysts used the Hilsenhoff Biotic Index (HBI) value, which gives an idea of the pollution tolerance of the organisms found. Chemical, physical and biological data are analyzed according to the WDNR Field Procedures Manual and/or standard operating procedures at laboratories Guidance on how to interpret data to assign a use designation is found in the Guidelines for Designating Fish and Aquatic Life Uses for Wisconsin Surface Waters, Wisconsin Department of Natural Resources, and December, 2004. As noted above, an effort is underway to implement the use of natural communities with a code revision and new procedures (to be developed).

Reporting

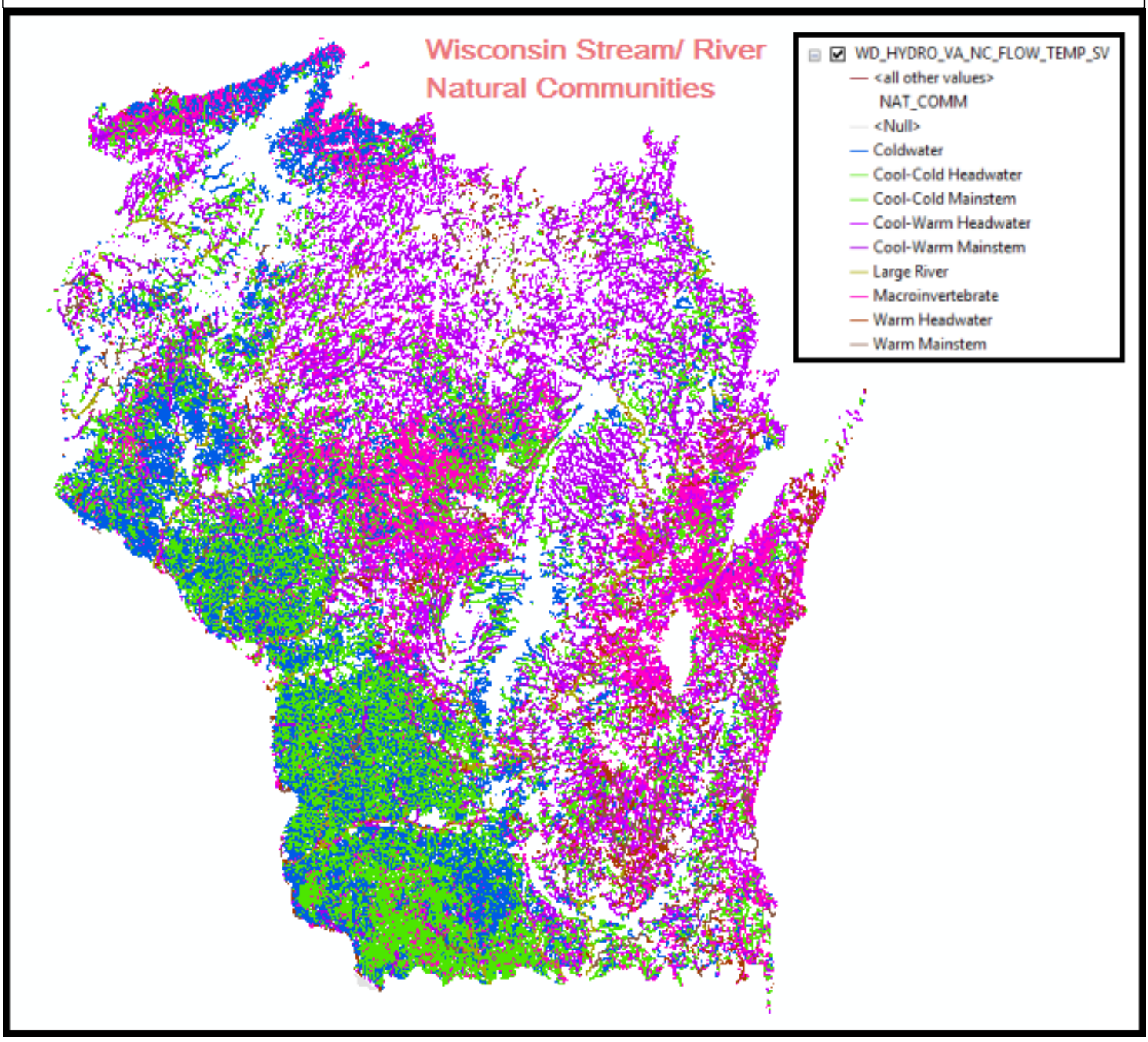
Collected data are summarized in the form of a Stream Classification Report. These data are referred to in 303(d)/305(b) Report as well as water quality plans for each water basin in Wisconsin. As needed, use designations are also promulgated in Chapter NR 104 of the Wisconsin Administrative Code. Summary assessment data are shared on the DNR website on the Surface Water Data Viewer, as well as on various online pages:

- Surface Water Data Viewer (http://dnr.wi.gov/topic/surfacewater/swdv/)
- Explore Wisconsin Waters! (http://dnr.wi.gov/water/)
- Wisconsin Water Quality Report to Congress: http://dnr.wi.gov/topic/surfacewater/IR2014.html

Programmatic Evaluation

Redirection of this program has occurred when needed to account for changes. As noted above, an effort is currently underway to determine if changes in the uses and the assessment techniques should be recommended.

Figure 23 Stream Natural Communities



Section 3.6 Monitoring Strategy for WPDES Program

Table 25: WPDES Monitoring Needs		
Study	**Purpose**	**Supports: FAL, REC, PHW**
WPDES Specific Monitoring including special studies, background, compliance, and enforcement/ spills/kills	**Effluent Limit Determination** • Complex (and simple) downstream point of standard application issues including pollutant decay or wetland attenuation studies. • Site specific phosphorus criteria development - This work may involve a joint DNR/WPDES permittee data collection effort. Guidance is underway.	WPDES permit decisions, policy determination / guidelines for statewide programs.
	Background Concentrations Upstream chemistry sampling to determine background concentration involving more than minimal effort water quality sampling.	WQBEL, WPDES permit limits
	Baseflow data collection Collection of flow measurement to refine 7Q10 estimates critical for effluent limit calculations as well as for protecting or managing surface and groundwater resources.	WQBEL, WPDES permits, site specific criteria
	Permit Compliance Evaluate effect of existing discharges on receiving waters (e.g. upstream/downstream studies).	WPDES Program evaluation, permit effectiveness evaluation
	Enforcement Investigation monitoring to determine the extent and severity of stochastic events including onsite WPDES permit or runoff management violations, accidental spills and situations where fish kills has occurred. These are custom studies. Enforcement, Spills and Kills [special studies]	Site specific evaluation for runoff events, permit effectiveness, and related

Study Descriptions

Permit Compliance, Innovation in Effluent Limit Determination

Monitoring conducted by WPDES permittee or DNR to determine if WPDES limits (or permit decision) are sufficient to protect or maintain water quality standards. These are custom studies.

Background Concentrations

Monitoring conducted by DNR or Permittee to determine background concentrations of specific ambient contaminants for the purpose of calculating effluent limits and potential synergistic effects. Here is an example of a background concentration study. The purpose of this project is to collect background phosphorus data for the development of water quality based effluent limitations. http://dnr.wi.gov/water/projectDetail.aspx?key=39277395

Baseflow data collection

Collection of flow measurement by DNR or Permittee to refine 7Q10 estimates critical for effluent limit calculations as well as for protecting or managing surface and groundwater resources. Baseflow characteristics are used to calculate effluent limits and WQBELs. Historic information recorded here:

Permit Compliance

Evaluate WPDES dischargers to determine effect on receiving waters (e.g. upstream/downstream studies).

Enforcement, Spills and Kills

Investigation monitoring to determine the extent and severity of stochastic events including onsite WPDES permit or runoff management violations, accidental spills and situations where fish kills has occurred. These are custom studies. Enforcement, Spills and Kills [special studies]

Section 3.7 Monitoring Strategy for the Mississippi River Program

Table 26: Mississippi River Monitoring Studies

Study	Purpose	Supports
Wisconsin's Long Term Trend (LTT) program	Wisconsin's Long Term Trend (LTT) program monitors at Locks and Dams 3 (Red Wing, MN), 4 (Alma, WI), 8 (Genoa, WI) and 9 (Lynxville, WI).	Provides site specific condition assessment and attainment. Provides large scale view of major constituent loading and broad perspective on landscape such as climate change.
Environmental Management Program (EMP) Long Term Resource Monitoring Program (LTRMP)	Bimonthly and monthly fixed station sampling and quarterly stratified random sampling (SRS) of water quality of Pool 4 (Sampled by Minnesota WDNR) and Pool 8. SRS provides a comprehensive pool-wide evaluation of aquatic areas including main channel, side channels, impounded and backwater areas. Monitoring components included water quality, fish, invertebrates (1992-2004 only), and aquatic vegetation. Periodic aerial photo interpretation measurements of changes in land use and land cover.	National program datasets and river system specific data provides trend, long-term change and current status information.
U.S. EPA's Great Rivers Ecosystems Environmental Monitoring and Assessment Program (EMAP-GRE)	Probabilistic sampling design with sites selected randomly within pre-defined study reaches. There are a total of 33 sites sampled each year in Wisconsin waters of the Mississippi River.	National program datasets and river system specific data provides trend, long-term change and current status information.
Zebra Mussels Longitudinal Studies	Longitudinal zebra mussel sampling began in 1998, with water quality and bacteria added in 2004.	Resource specific program with results shared regionally and locally.
Large River Soft Sediment Macroinvertebrate Sampling	Multi-agency soft-sediment macroinvertebrate sampling in selected backwater areas is conducted during the fall period.	National program datasets and river system specific data provides trend, long-term change and current status information.
Habitat Project Evaluation	Evaluation of habitat rehabilitation projects constructed as part of EMP or Channel Maintenance Plans is conducted using general limnological (DO, temperature, conductivity, transparency, velocity) and hydrologic (velocity/discharge) monitoring (Weaver Bottoms, Pool 5).	National program datasets and river system specific data provides trend, long-term change and current status information.
Clean Water Act Monitoring Strategy	WDNR use the results from the planned pilot program with Minnesota, and when will those results be available.	To be determined.

Study Descriptions

Wisconsin's Long Term Trend Monitoring

Wisconsin's Long Term Trend (LTT) program monitors Locks and Dams 3 (Red Wing, MN), 4 (Alma, WI), 8 (Genoa, WI) and 9 (Lynxville, WI). Site-specific variables include general chemistry, field measurements (DO, temperature, pH conductance, and turbidity), low-level metals, light penetration and contaminant analysis of time-integrated composite suspended sediment samples. Sampling frequency ranges from biweekly to semi-annually depending upon the monitoring site and variable measured.

Environmental Management Program (EMP) Long Term Resource Monitoring Program (LTRMP)

Wisconsin conducts water quality monitoring on the Mississippi River with state-funded programs and federal funding as part of the U.S. Corps of Engineers Environmental Management Program (EMP) Long Term Resource Monitoring Program (LTRMP) and U.S. EPA's Great Rivers Ecosystems Environmental Monitoring and Assessment Program (EMAP-GRE). http://www.umesc.usgs.gov/ltrmp.html

Bimonthly and monthly fixed station sampling and quarterly stratified random sampling (SRS) of water quality of Pool 4 (Sampled by Minnesota WDNR) and Pool 8 are conducted as part of the LTRMP (Soballe and Fischer 2004). SRS provides a comprehensive pool-wide evaluation of aquatic areas including main channel, side channels, impounded and backwater areas. Monitoring components included water quality, fish, invertebrates (1992-2004 only), and aquatic vegetation. Periodic aerial photo interpretation provides measurements of changes in land use and land cover.

Zebra Mussel Longitudinal Studies

Longitudinal water quality synoptic surveys assess main channel water quality and zebra mussel infestation problems during the summer months (July-September). Longitudinal sampling provides a 'snapshot' assessment of the entire main river channel by sampling at nine locations during a single day. Longitudinal zebra mussel sampling began in 1998, with water quality and bacteria added in 2004.

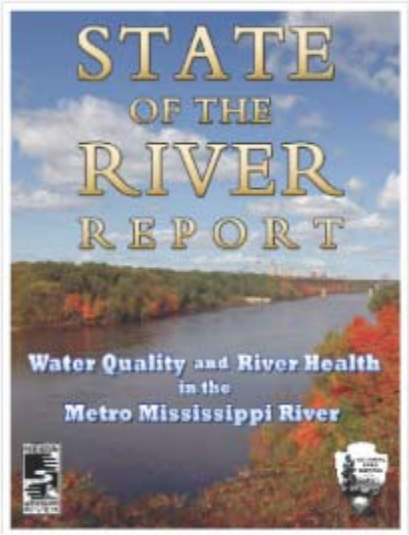
Large River Soft Sediment Macroinvertebrate Sampling

Multi-agency soft-sediment macroinvertebrate sampling in selected backwater areas is conducted during the fall period.

Habitat Project Evaluation

Evaluation of habitat rehabilitation projects constructed as part of EMP or Channel Maintenance Plans is conducted using general limnological (DO, temperature, conductivity, transparency, velocity) and hydrologic (velocity/discharge) monitoring (Weaver Bottoms, Pool 5).

Monitoring Objectives:



Mississippi River Clean Water Act

- Determine attainment of WQS
- Identify Impaired Waters
- Identify Causes of Impairment
- Support Water Management Programs
- Support Evaluation of Program Effectiveness
- Identify Targets/WQS Interstate TMDLs

UMR Restoration - EMP LTRM

- Develop Better Understanding of the UMRS Ecology & Problems
- Monitoring Resource Change
- Develop Management Alternatives for UMRS
- Manage Monitoring Information
- Develop tools and models to support decision makers and better understand complex problems.

Monitoring Design

CWA Monitoring

- Fixed Station (LTT sites, Sediment Traps, habitat project evaluation)
- Intensive (point source impact evaluations, sediment contamination)
- Synoptic (longitudinal WQ surveys)
- Screening-Level (emerging contaminants of concern)
- EMAP-GRE (probabilistic survey (fish, inverts, veg, WQ algae, zooplankton, habitat, other)

LTRM Monitoring

- Fixed Station (WQ)
- Stratified Random Sampling (fish, WQ & Veg in Pools 4 and 8)

Water Quality Indicators

The monitoring strategy defines a core set of monitoring indicators (e.g., water quality parameters), including physical/habitat, chemical/toxicological, and biological/ecological endpoints that states use to assess attainment.

CWA Monitoring

- Core: DO, pH, temp, toxics, nutrients, fish (IBI), bacteria, algae (chl a), fish tissue
- Supplemental: sedimentation, current velocity, light penetration, turbidity, transparency

Note: EMAP-GRE has identified Fish, Invertebrate and Submersed Veg IBIs that are expected to be used in the future for interstate WQ assessments.

LTRM Monitoring

Similar to above core & supplemental indicators with the exception that they do NOT collect contaminants and they do conduct much more GIS-based habitat work.

Quality Assurance

- State-sponsored training at meetings and hands-on review of DNR field monitoring procedures.
- Federal-sponsored training provided by EMAP-GRE and LTRM following field monitoring and QA/QC protocols.
- Detailed procedures manuals for water quality, vegetation and fisheries sampling.

Data Management

- State-sponsored work carried out by MR WQ Spec with assistance of MR staff (WQ planner, FH and WM staff).
- LTRM work carried out by La Crosse Field Station which is 100% federally funded by UMR Restoration Environmental Mgt. Program
- Team Leader, WQ spec, Fish spec, Veg spec. and 1 or 2 Techs/LTEs.
- Extensive data QA/QC conducted on an annual basis.
- User-friendly data browser and graphical tools accessible to both professionals and the public.

Program Gaps

While coverage of the main channel is generally comprehensive, thousands of acres of backwaters are not regularly monitored. The LTRMP sampling of Pools 4 and 8 provide a detailed assessment of the state of those specific backwaters as indicator sites. Through what is learned in from the LTRMP, EMAP-GRE, and the Department's lakes, nonwadeable rivers, and wetlands monitoring, a more comprehensive sampling design for the river may be constructed in the future if additional resources become available. Specifically, the following gaps have been identified. An implementation plan for the Mississippi River Monitoring is beyond the scope of this document.

- Need to implement the 2014 coordinated Clean Water Act Monitoring Strategy was endorsed by all five UMRS states (IA, IL, MN, MO and WI).
- Coordinated and consistent monitoring among the states will lead to more consistent and unified assessment and listing of impairment among the states.
- Funding mechanisms need to be identified for this effort.
- Insufficient funding for contaminant monitoring.
- Improvements to enhance the SWIMS and Fisheries data management systems and greater emphasis on training and knowledge to make better use of monitoring data by agency staff and the public.
- WQ assessment procedures need to be developed for off-channel aquatic areas including impounded, backwaters and wetlands.
- Need an improved process for capturing LTRM data and using it for state CWA assessments, including the Section 3.8 Monitoring Strategy for the Great Lakes Program.

Section 3.8 Monitoring Strategy for the Great Lakes

Table 27: Great Lakes Program Primary DNR Monitoring Studies	
Study	**Purpose: Public Health & Welfare, Fish and Aquatic Life, Recreation, Wildlife**
Lake Michigan Major Tributary Phosphorus Loading	The sampling is needed to allow calculation of nutrient loads to Lake Michigan http://dnr.wi.gov/water/projectDetail.aspx?key=590070
Lake Superior Tributary Loading	The sampling is needed to allow calculation of nutrient loads to Lake Superior. http://dnr.wi.gov/water/projectDetail.aspx?key=62786687
Great Lakes Fishery Assessment	Example, Area of Concern: http://dnr.wi.gov/water/projectDetail.aspx?key=100696597
Pathogen Indicator Monitoring	Pathogen Monitoring on Great Lakes Beaches (see Beach Section).
Contaminated Sediment	Evaluation Monitoring and is widespread in the Great Lakes.
Cladophora/Nutrient	Monitoring of near shore waters of Lake Michigan is also conducted as a targeted program.
Public Water Intake monitoring	Lakes Superior and Michigan have 15 public water intakes are monitored using the same protocols as Public Drinking Water Well Monitoring.

Study Descriptions

Lake Michigan Major Tributary Phosphorus Loading

Lake Superior Phosphorus Loading Study is designed to study Phosphorus loads to Lake Superior from major tributaries. Four tributaries will be monitored for nutrients and total suspended solids. These tributaries represent various land uses and a portion of Wisconsin's drainage areas in the Lake Superior basin. DNR staff will collect up to 25 water samples annually from locations towards the mouth of each tributary for analysis of at the Wisconsin State Lab of Hygiene (WSLH).

The objective is to obtain long term information about trends in phosphorus loading to Lake Superior from the tributary rivers in Wisconsin. Where discharge data is available it has been used to establish a combination of monthly sampling with flow proportional sampling protocol.

The project collects samples for the Lake Superior Tributary Phosphorus project year round, including during spring months and high flow events. The project design is detailed in the Lake Superior Phosphorus Loading project. The sampling is needed to allow calculation of nutrient loads to Lake Superior. http://dnr.wi.gov/water/projectDetail.aspx?key=62786687

Great Lakes Shoreline

Lake Michigan Phosphorus Loading Study is designed to study Phosphorus loads to Lake Michigan from major tributaries. Approximately 24 samples are collected on a flow weighted basis from 5 major tributaries. Rivers included in the study are the Menominee, the Fox, the Manitowoc, the Sheboygan and the Milwaukee. The objective is to have long term information about the trends in phosphorus loading to Lake Michigan from the rivers contributing the majority of the phosphorus. Data collection began in 2006. We are working with the USGS to calculate initial phosphorus load calculations for the tributaries included in the study. http://dnr.wi.gov/water/projectDetail.aspx?key=590070

Great Lakes Fishery Assessment

Monitoring conducted to ascertain the health of the Great Lakes fishery.

- http://dnr.wi.gov/topic/fishing/lakesuperior/
- http://dnr.wi.gov/wnrmag/2012/12/salmon.htm
- http://dnr.wi.gov/news/weekly/article/?id=1649
- http://dnr.wi.gov/wnrmag/2011/10/gift.htm

Pathogen Indicator

http://dnr.wi.gov/topic/beaches/

Monitoring data collected through the Beach Health Program, state parks monitoring and through local, state and federal partners provides the basis for assessment of beach conditions in relation to the state's water quality standards. Wisconsin lists and delists beach sites based on assessment protocols outlined in its Wisconsin Assessment and Listing Methodology (WisCALM) [PDF]. The DNR uses these procedures to determine whether a beach is impaired.

Contaminated Sediment

- http://dnr.wi.gov/topic/surfacewater/swims/greatlakesdata.html

Cladophora/Nutrient

In spring 2004, the Wisconsin DNR initiated a Cladophora Working Group to address the nuisance algal problem on Lake Michigan. The group's objectives include researching environmental factors causing the algal blooms to assist with developing long-term management plans, identifying short-term beach clean-up and odor mitigation options, and addressing public information needs. The Cladophora Working Group collaborates with others, including the University of Wisconsin-Extension, University of Wisconsin-Milwaukee's WATER Institute, UW Sea Grant, county health departments, and Centerville Cares, a Manitowoc County citizen's organization. This monitoring depends on the available resources and positions allocated through state and federal funding.

Public Water Intake Monitoring

- http://dnr.wi.gov/topic/drinkingwater/ereportpublic.html

Section 3.9 Source Water Assessment Monitoring

Table 28: Source Water Assessment Monitoring Studies	
Study	**Purpose, Supports: Public Health & Welfare, Fish and Aquatic Life**
Lake Winnebago Assessment Monitoring	Develop a plan to routinely assess drinking water uses of Lake Winnebago, which was a recommendation from the US EPA Region 5 sponsored Public Water Supply Designated Use Assessment Workshop with Wisconsin DNR staff held in fall 2014. Meet the goals and requirements of the CWA as they relate to the Public Health and Welfare Designated Use.
Public Water Intake monitoring (See Great Lakes Monitoring)	Lakes Superior and Michigan have 15 public water intakes that are monitored according to the Safe Drinking Water Act, using the same protocols as Public Drinking Water Well Monitoring.

Study Descriptions

Lake Winnebago

Study objectives

The goal of this project is to develop a long term monitoring and assessment strategy for Lake Winnebago that addresses recreational, public health, and drinking water uses of the lake, with a particular focus on Harmful Algal Blooms and associated toxins. This work will also allow DNR to explore how to implement results from various studies that demonstrate linkages with commonly measured nutrient parameters, specifically Chlorophyll-a, to post-

treatment generation of disinfection byproduct and presence of cyanotoxins.

Monitoring design

The monitoring and assessment strategy is expected to draw on data generated by the DNR, water utilities, and researchers working on Lake Winnebago, as well as results from the US EPA Region 5 sponsored Public Water Supply Designated Use Assessment Workshop with Wisconsin DNR staff held in fall 2014. The primary focus of the project will be to develop a monitoring and assessment strategy for determining risk of exposure to algal toxins from lake water used by public water utilities based on the US EPA's health advisory levels for microcystin and cylindrospermopsin, and to help guide treatment strategies to reduce these risks in finished water.

Water quality indicators

State guidance for public water utilities based on US EPA health advisory levels for microcystin and cylindrospermopsin will be developed, as well as a state response and communication plan for events in which source or finished water exceed advisory levels for cyanobacterial toxins. The Lake Winnebago Public Water Supply Designated Use assessment methodology will be adapted to include the EPA's microcystin and cylindrospermopsin health advisory levels, released in May 2015. Recreational guidelines will also be drafted that can later incorporate federal recreational advisory levels when those are developed by the US EPA. USEPA would like Wisconsin to explore how to implement results from various studies that demonstrate linages with commonly measured nutrient parameters, specifically chlorophyll a, to post treatment generation of disinfection byproduct and presence of cynotoxins.

Outcomes

Additional monitoring and assessment of Lake Winnebago for harmful algal blooms and associated toxins will hopefully lead to additional endpoints for the ongoing TMDL development efforts in the Upper and Lower Fox River, and potentially lead to additional resources for implementation of best management practices in the watershed to protect human health, as well as other surface waters used for drinking water in Wisconsin.

Data management

Data collected from this project will be stored in the SWIMS data management system and reported assessments will be stored in the WATERS database.

Reporting

Collected data are shared on the DNR website, transmitted through the ATTAINS reporting network as well as provided in the biennial Integrated Clean Water Act Report to Congress.

Section 4.0 Partner Agency Monitoring

Partner Agencies Conducting Monitoring Critical to WDNR Mission

Federal Energy Regulatory Commission (FERC) Licensed Operator Monitoring

Several operators around the state are licensed through the FERC program. Each license identifies recommended monitoring to ascertain impacts to aquatic systems. Often cooperative reviews and design of recommended monitoring works provide an opportunity to obtain baseline, trend, and impact analyses over the lifetime of the permit. . http://www.ferc.gov/

USGS Flow Gaging and Water Quality Monitoring

The USGS is active in water quality monitoring and research across Wisconsin. USGS maintains a large network of flow gaging stations, including many long-term sites across the state that provide information used in a number of water

quality programs, such as for calculating nutrient loads and point source permit effluent limits. Additional water quality monitoring sites are maintained through partnerships with DNR and others as part of various studies. These partnerships take advantage of USGS's equipment, expertise, and historical involvement in Wisconsin.
[Daily Streamflow: http://waterdata.usgs.gov/wi/nwis/sw] http://wi.water.usgs.gov/data/streamflow.html

Natural Resource Conservation Service (NRCS) Monitoring

The Natural Resource Conservation Service (NRCS) in collaboration with the U.S. Geological Survey (USGS), has organized monitoring efforts primarily through the Mississippi River Basin Initiative (MRBI). This three-tiered approach supports efforts to reduce nutrient loading from fields to waterways. The three tiers include edge-of-field monitoring, small watershed monitoring, and large watershed monitoring. These three tiers are intended to examine the impact field-level nutrient reduction practices have on loadings to adjacent waterways while also examining in-stream water quality at a number of scales. NRCS does not conduct monitoring itself but works with multiple partners to provide that service. http://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/

Multi-Partner Monitoring

A number of additional monitoring efforts that are collaborative between multiple agency and organizational partners generate substantial water quality data for Wisconsin.

- Municipal wastewater treatment facilities often partner with county Land & Water Conservation Departments to conduct the monitoring for adaptive management and water quality trading for meeting nutrient standards.
- County Land & Water Conservation Departments also frequently partner with agencies for other water quality monitoring efforts, including for TMDL development.
- Permitted wastewater discharge facilities (municipal and industrial) individually collect water quality data, and as a group, they provide data for selected urban areas of the state.
- Volunteer monitoring program guided by DNR and UW-Extension is another set of monitoring that provides water quality data for the state. Volunteers are trained in techniques to ensure that the data they collect adheres to agency standards and is pertinent to statewide monitoring goals. Volunteer monitoring is often conducted by non-profit groups and individuals. An additional outcome of volunteer monitoring programs is increased awareness of water quality issues statewide.
- Regional Planning Agencies may conduct monitoring as a component of their Areawide Water Quality Planning Program. In particular, Dane County's Capital Area Regional Planning Agency (CARPC) and the Southeast Wisconsin Regional Planning Agency (SEWRPC) have staff biologists who conduct and interpret water quality results and share those results with DNR.
- Metropolitan Sewerage Districts such as Madison, Green Bay, and Milwaukee, conduct detailed monitoring programs that provide a large volume of ambient chemistry and, in some cases, biological data for assessments and evaluation.
- County Health Departments conduct monitoring for Beach Openings; this data is discussed in detail in the Beaches section of this strategy.
- Public Water System facility raw water monitoring.

Section 5.0 Laboratories

Laboratory analysis, data flows to DNR systems, and Data management are critical for using monitoring information wisely in decision making processes. Currently, data from WDNR water monitoring programs is stored in several databases, some (but not all) of which are accessible to the public via the internet. The WDNR introduced a new internet accessible tabular and spatial data system in 2007, the Surface Water Integrated Monitoring System (SWIMS). This section describes SWIMS and other databases currently in use, including their related websites, and is followed by a table indicating which monitoring programs store data in each database

State Laboratory of Hygiene

The Wisconsin State Lab of Hygiene (SLH) is the state's public health and environmental laboratory which performs a broad array of analysis for the WDNR including organic, inorganic, and toxicological testing for water, fish tissue, and sediment. http://www.slh.wisc.edu/

Biomonitoring

The SLOH's Biomonitoring Laboratory, housed within the SLOH provides whole effluent toxicity (WET) testing, ambient (surface water) toxicity testing, and sediment toxicity testing at the request of DNR staff. The cost of this testing is covered by an annual contract and does not require individual payment per test. WET (effluent) testing is normally requested by wastewater staff and is used to supplement existing permit data sets or to support enforcement or other data collection needs.

Ambient and sediment toxicity testing is most often performed, at the request of field biologists or other staff, in response to a known or suspected problem (suspected spills, illicit discharges, historical contamination sources, etc.) and may be conducted on samples collected downstream of a wastewater outfall or any other suspected source (including nonpoint) that is suspected of potentially causing toxicity. WET tests (those conducted by the permittee or DNR) can trigger the need for ambient toxicity testing, since WET tests include the use of receiving water (collected upstream and outside of the influence of the discharge) as diluent and control in each test. If receiving water controls exhibit toxicity, staff can use ambient toxicity testing to investigate potential causes.

University of Wisconsin – Stevens Point Aquatic Biomonitoring Laboratory

The Aquatic Biomonitoring Laboratory, affiliated with the Wisconsin Cooperative Fishery Research Unit [http://www.coopunits.org/Wisconsin_Fish/], is housed in the College of Natural Resources [http://www.uwsp.edu/cnr/Pages/default.aspx] at the University of Wisconsin – Stevens Point. The Aquatic Biomonitoring Laboratory analyzes benthic macroinvertebrate samples to assess the ecological condition and environmental quality at sampled locations. The Aquatic Biomonitoring Laboratory was established in 1985 under the guidance of Dr. Stanley W. Szczytko (retired 2012) to provide benthic macroinvertebrate sample processing to the Wisconsin Department of Natural Resources and other regional resource management agencies. http://www.uwsp.edu/cnr-ap/biomonitoring/Pages/default.aspx

Dimick supervises the Aquatic Biomonitoring Laboratory. His 27 years of experience with benthic macroinvertebrates, aka bottom-dwelling water bugs, provides him with the background to understand the ecology of these unique organisms. The environmental clues hiding in the presence and abundance of macroinvertebrates in a benthic community are the bases for developing inferences to the ecological condition of a sample location. Undergraduate students perform many of the sample processing services in the Aquatic Biomonitoring Laboratory. Student opportunities exist as direct employment, financial aid assistance through the work study program, for-credit experience and volunteerism. These opportunities develop settings to train future aquatic ecology professionals and conduct stream ecology research.

University of Wisconsin – Superior Entomology Laboratory

Dr. Schmude, Assistant Professor at the University of Wisconsin-Superior, conducts analysis of aquatic macroinvertebrates for the WDNR on a regular basis. Dr. Schmude's information is available on the UW Superior's Website. Dr. Schmude often supports the analysis of special studies and partnership macroinvertebrate data collection and analysis work. Dr. Schmude's research focuses on aquatic invertebrates, especially aquatic insects. Over the past 28 years, Dr. Schmude and his colleagues have completed research on a variety of subjects, bringing in several million dollars' worth of research funding, which has helped employ numerous student assistants on many projects. The

research has included:

- surveys for rare and endangered species in state-owned properties
- biomonitoring streams, lakes, and wetlands
- examining the effects of contaminants and other chemicals

More about Kurt Schmude: [http://bit.ly/1TrjzgC]

University of Wisconsin – Center for Limnology

Trout Lake Station (TLS)

The Center for Limnology operates two field stations. Arthur D. Hasler Laboratory of Limnology (Hasler Lim Lab) is a working research station on the shores of Lake Mendota within the University of Wisconsin-Madison campus. Trout Lake Station (TLS) is a year-round field station operated by the Center for Limnology at the University of Wisconsin-Madison. Located in the

Northern Highland Lake District in northern Wisconsin, the station provides access to a wide variety of aquatic ecosystems and their surrounding landscapes. More than 2500 lakes are within 50km of the station.
http://limnology.wisc.edu/

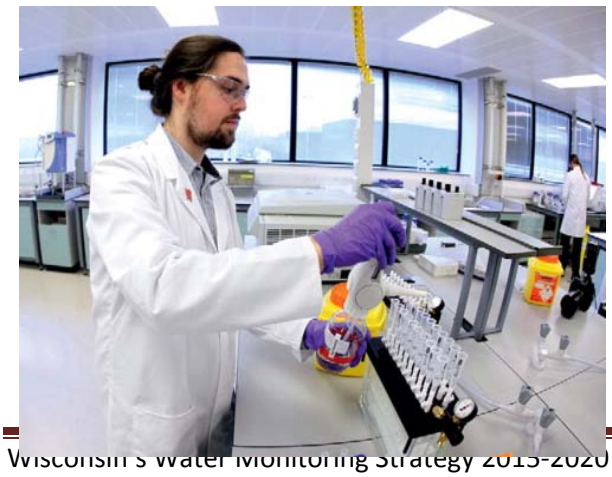
University of Wisconsin – Stevens Point Water and Environmental Analysis Lab

The UWSP "WEAL" lab offers analytical, research, and educational services to the public.
•Homeowner's drinking water analyses and interpretation
•Groundwater management practices for groundwater protection
•Educational homeowner drinking water programs "Outreach"
•Lake, river, and watershed water resource studies, planning, and recommendations

The Water and Environmental Analysis Laboratory is Wisconsin DNR certified and a state-of-the-art facility capable of analyzing a wide range of constituents including metals, nutrients, and pesticides. WEAL was founded in 1972 to serve Wisconsin citizens, train future water quality professionals, and conduct water quality research.
http://www.uwsp.edu/cnr-ap/weal/Pages/Homeowner.aspx

Additional Laboratories

Additional laboratories may be used by DNR staff, and in particular, partners, to support water quality studies – in particular work conducted under "pass through grants" and Office of Great Lakes Grants. In these instances, DNR or DNR's grant recipients may contract with local or regional laboratories. This type of situation is idea for expedited work.



Section 6.0 Information Technology – Database Infrastructure, Adequacy

Surface Water Integrated Monitoring System (SWIMS)

Historically, data from different WDNR water monitoring programs had been stored in a number of disparate databases, each used by specific staff. In July of 2004, a 104(b)(3) grant was secured through EPA to develop a unified system to house and extract data from these various systems where possible. The Surface Water Integrated Monitoring System (SWIMS) enables all staff, as well as the public, to access comprehensive sets of data for each waterbody, and to view monitoring results geographically using Web mapping applications called Surface Water Data Viewer (SWDV). Users can access the system via the Internet using a user ID and password. SWIMS creates efficiencies by allowing monitors to click and print field forms, allowing automatic generation of station numbers and mailing forms for the State Lab of Hygiene, and thereby enabling timely entry of results into the EPA Water Quality Exchange (WQX) Network. An important precursor to the development of SWIMS was the cleaning of backlogged STORET station data. Data from SWIMS is now sent to the EPA WQX, in place of sending it to the old STORET system, on a regular basis.

Data sets in SWIMS include:

- Sediment
- Aquatic Invasive Species
- Continuous monitoring data
- Lake Water Quality data
- Rivers and Lakes Long Term Trends data
- Macroinvertebrates
- Satellite water clarity
- Plants (UW-Herbarium & Lakes, starting 2008)
- Rivers
- Citizen Based Stream Monitoring Network data
- Miscellaneous Lakes data

More information about SWIMS is available on the internal WDNR website
http://dnr.wi.gov/topic/surfacewater/swims/

Fisheries Database

The Statewide Fisheries Management Database (FMDB, formally the Statewide Fish and Habitat Biology Database) is a centralized database for all statewide fish surveys, wadeable stream habitat surveys, fish propagation information, fishing tournament permits, and fish kill investigations. Raw data and summary reports are available for exporting and analysis. Historical data integration is ongoing. The Fisheries database receives approximately $350,000 in maintenance funds per year through license fees and other funding sources.

BROOK TROUT- *(Salvelinus fontinalis)*

Wisconsin DNR contracts server space, development and maintenance services through the Center for Integrated Data Analysis (CIDA) at the US Geological Survey (USGS) office in Middleton, WI.

The FMDB is accessible to all DNR staff and analyzed data in the form of reports are available to the public. . DNR staff has access to the data entry forms and reports on the internal website. The public website is available for other state agency staff and members of the public. Statewide data are also available upon request from the database manager,

and regional fisheries data requests are handled by district fisheries biologists.
https://infotrek.er.usgs.gov/wdnr_biology/metadata.htm

STORET and related websites

STORET (short for STOrage and RETrieval) is a national EPA repository for water quality, biological, and physical data and is used by state environmental agencies, EPA and other federal agencies, universities, private citizens, and many others. STORET consists of two data management systems: the STORET Legacy Data Center (LDC), and Modernized STORET. The LDC is a static, archived database and Modernized STORET is an operational system actively being populated with water quality data.

The LDC contains historical water quality data dating back to the early part of the 20th century and collected up to the end of 1998. Modernized STORET contains data collected beginning in 1999, along with older raw biological, chemical, and physical data on surface and ground water. Each sampling result in the LDC and in Modernized STORET is accompanied by information on where the sample was taken (latitude, longitude, state, county, Hydrologic Unit Code and a brief site identification), when the sample was gathered, the medium sampled (e.g., water, sediment, fish tissue), and the name of the organization that sponsored the monitoring. In addition, STORET contains information on why the data were gathered; sampling and analytical methods used; the laboratory used to analyze the samples; the quality control checks used when sampling, handling the samples, and analyzing the data; and the personnel responsible for the data. Both the LDC and Modernized STORET are web-enabled and available to the public. With a standard web browser, both systems can be browsed and queried interactively and files can be created for download. The website is currently located at http://www.epa.gov/storet.

WDNR 24K Hydrography Layer

The WDNR 1:24,000 scale Hydrography layer is the base building block structure that supports the integration of all of our water-related data (e.g. outfalls, 303d waters, Outstanding and Exceptional Resource Waters, assessment units, stream order, etc.). Everything we collect related to surface water is located against this structure. This allows us to support a "one stop shop" environment from which to serve water-related data to WDNR staff as well as external customers in either map form or tabular reports. It is a digital representation of the blue lines and polygons that represent surface water on the USGS 7.5 minute topographic maps. The 24K Hydrography data layer:

- Serves as the "backbone" for locating all of our water related data (e.g. monitoring locations, assessment units, outfalls, engineering studies, dams etc. through the use of the embeddable Locator Tool);
- Allows us to provide "one stop shopping" for water-related data (SWIS Query Interface, Surface Water Data Viewer);
- Serves as the base surface water layer for all mapping applications in the department (DNR Web View,
- WT Viewer, SWIS Query Interface, WDNRVIEW, DV_MAP, Surface Water Data Viewer); and
- Enhances our ability to communicate/share information with others who use our hydrography layer for their activities (e.g. counties, Regional Planning Commissions, federal agencies, etc.).

WDNR uses the hydro layer to "integrate", bringing all of our water-related data together in one place so we can view it, analyze it and map it. We share it with counties, educational institutions, other state and federal agencies, and the general public, as it is the only statewide representation of surface water for Wisconsin at this scale or better. It is used in a broad variety of WDNR programs for specific program needs. .

Register of Waterbodies (ROW)

The Register of Waterbodies is the database that manages inventory information about our state's surface water. Unique numeric identifiers called waterbody ID codes (WBICs) are assigned to each stream/river, lake, pond, reservoir

etc. as it is defined by users. WBICs are an important piece of information used by monitoring databases for linking data across tabular datasets. WBICs are also encoded into the statewide hydro layer.

Water Assessment Tracking and Electronic Reporting System (WATERS)

WATERS supports water quality standards and assessment work, the Water Division's Goals Reporting System, and Electronic Watershed Planning. WATERS holds decisions and information regarding the status of rivers, streams, and lakes, as well as Great Lakes shoreline miles including a variety of use designation, assessment, and management uses, and linkages to documents or reports supporting decisions about a waterbody.

WATERS, an intranet-based tabular and spatial assessment database, supports implementation and reporting under the Federal Clean Water Act. This database holds Clean Water Act Section 305(b) and 303(d) data, designated uses, codified uses, and other data describing the quality of Wisconsin's rivers, lakes, and Great Lakes shoreline. WATERS uses the table structure and the reporting requirements identified in USEPA's integrated reporting strategy and programmed into the ADB V 2.0 and also includes additional enhancements specific to the state's water management needs. Data from this system is sent to EPA periodically in fulfillment of our Clean Water Act 305(b), 303(d), and 314 grant reporting requirements. WATERS can be accessed internally at http://dnrx.wisconsin.gov/wadrs/

UW-Stevens Point Aquatic Entomology Laboratory/SWIMS

WDNR macroinvertebrate results analyzed at the UW Stevens Point Aquatic Entomology Laboratory are stored in the Surface Water Integrated Monitoring System (SWIMS). Data include listings of aquatic macroinvertebrate presence and their known associated tolerance values, and calculation of 15 commonly used macroinvertebrate community metrics. This database is supported by *The Macroinvertebrate Data Interpretation Guidance Manual*, which is designed to assist WDNR staff in interpreting macroinvertebrate data. Macroinvertebrate summary scores are now also available by station in the Surface Water Data Viewer (internal) and WATERS as the assessment unit level. The DNR and UWSP are working to migrate all taxonomic data management and metric calculation directly into SWIMS by the end of 2015.

USGS National Water Information System (NWIS) and related websites

As part of the U.S. Geological Survey's (USGS) program of disseminating water data to the public, the USGS maintains a distributed network of computers and fileservers for the storage and retrieval of water data collected through its activities at approximately 1.5 million sites around the country. This system is called the National Water Information System (NWIS). Many types of data are stored in this NWIS network, including: site information, time-series (flow, stage, precipitation, chemical), peak flow, ground water, and water quality.

Data are accessible to the public through NWIS Web, at http://waterdata.usgs.gov/nwis . Its goal is to provide both internal and external users of USGS water information with an easy to use, geographically seamless interface to the large volume of USGS water data maintained on 48 separate NWIS databases nationwide. Data are updated from the NWIS sites on a regularly scheduled basis; real-time data are transmitted to NWIS Web several times a day. NWIS Web provides several output options: real-time streamflow, water-levels and water quality graphs, data tables and site maps; tabular output in html and ASCII tab delimited files; lists of selected sites as summaries with reselection for details. Data are retrieved by category of data, such as surface water, ground water, or water quality; and by geographic area. Further refinement is possible by selecting specific information and by defining the output desired. NWIS data comes from all 50 states, selected territories and border stations, from 1896 to present. Of the 1.5M sites with NWIS data, 80% are wells; 350,000 are water quality sites; and 19,000 are streamflow sites, of which over 5,000 are real-time. NWIS Web contains about 4.3 million Water Quality Samples; and 64 million Water Quality Sampling Results.

USGS Great Lakes Beach Health database and related websites

Created in 2000, the USGS Great Lakes Beach Health database stores data from WDNR, various local cooperators throughout the state, and the public. It stores data on water quality samples from Great Lakes swimming beaches and other related information. Data are available to the public through the WDNR Beach Health website: http://www.epa.gov/beaches http://greatlakesbeaches.usgs.gov/data.html

System for Wastewater Applications, Monitoring, and Permits (SWAMP)

The SWAMP is an Oracle-based computer system designed to assist with management of the Wisconsin Pollutant Discharge Elimination System (WPDES) Permit Program. This system has the capability to generate WPDES permit applications, store facility information, generate and issue WPDES permits, determine whole effluent toxicity requirements, generate monitoring forms, store permittee monitoring data and analyze compliance, generate/store permit-related documents, track compliance events, and calculate annual environmental fees based on reported discharges. The database became active in January 1999; permitting capability became active in 2000.

For monitoring purposes, SWAMP has the capability to track sample point and monitoring requirements, display data and documents, compare reported data to reporting requirements and display apparent violations, warnings, and exceedance, and produce reports. Discharge, groundwater, sludge, and land application self-monitoring data are stored and available for downloading. Electronic reporting of discharge data is currently being implemented. Monitoring data that is held in SWAMP is downloaded, manipulated, and displayed as annual loading in the FACTs system, available on the WDNR website.

Drinking Water System (DWS)

The purpose of the Drinking Water System is to enforce Safe Drinking Water Act regulations covering public water systems. The DWS is a data system created and maintained by the WDNR's Bureau of Drinking Water and Groundwater. It contains the monitoring and reporting requirements for each public water system and their drinking water sampling results. It also includes violations for any missing requirements and exceedance of the maximum contaminant levels (MCLs). This system is used to report public water supply data to USEPA as required by the Safe Drinking Water Act. The DWS also contains information on public and private well construction and high-capacity well approvals. A subset of data is available on the Internet for public access at http://dnr.wi.gov/topic/drinkingwater/

Groundwater Retrieval Network (GRN)

The Groundwater Retrieval Network acts as a central hub for accessing well information and groundwater quality data from various WDNR program databases. It contains information on public and private drinking water wells and monitoring wells and their associated water quality results. Data covers the period from the early 1970s to present for the Public Water data, 1988 to present for the Private Water Supply, priority watershed and special study data, and from the mid-1970s to present for the GEMS database. Not all programs that currently generate groundwater-related data are linked into the GRN system. Data from the Bureau of Remediation and Redevelopment (LUST, spills, or remediation sites) as well as data from the Bureau of Watershed Management (wastewater treatment facilities and land spreading sites) is not currently retrievable through the GRN system. A subset of data is available on the Internet for public access at http://prodmtex00.dnr.state.wi.us/pls/inter1/grn$.startup

Surface Water Data Viewer (SWDV)

The Surface Water Data Viewer is an interactive web mapping application that serves GIS data to DNR staff and the public. The incredibly popular and heavily used SWDV has multiple themes that support a broad range of high priority programs including of datasets dam safety, floodplain management, fish consumption advice, construction permits, designated waters review (Act118), and wetland and wetland indicators. http://dnrmaps.wi.gov/sl/?Viewer=swdv

Water Condition Viewer (WCV)

The Water Condition Viewer is designed to supplement the SWDV by providing summary assessment data and various themes related to Water Quality Program-specific work functions including Clean Water Assessments, Watershed and Quality Planning, Targeted Watershed Assessments, Monitoring Studies and Results, and Fisheries and Habitat. http://dnrmaps.wi.gov/sl/?Viewer=Water Condition Viewer

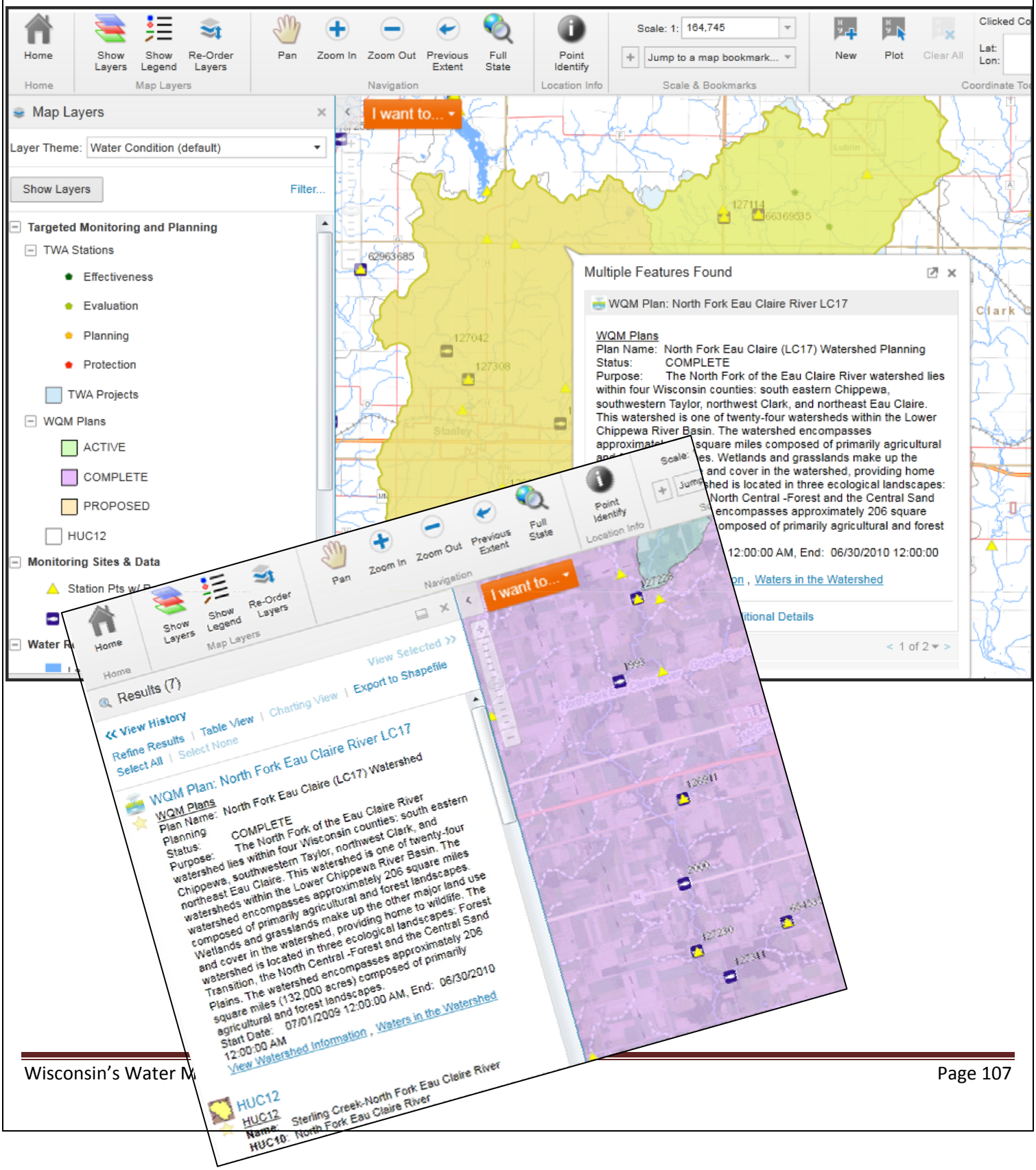
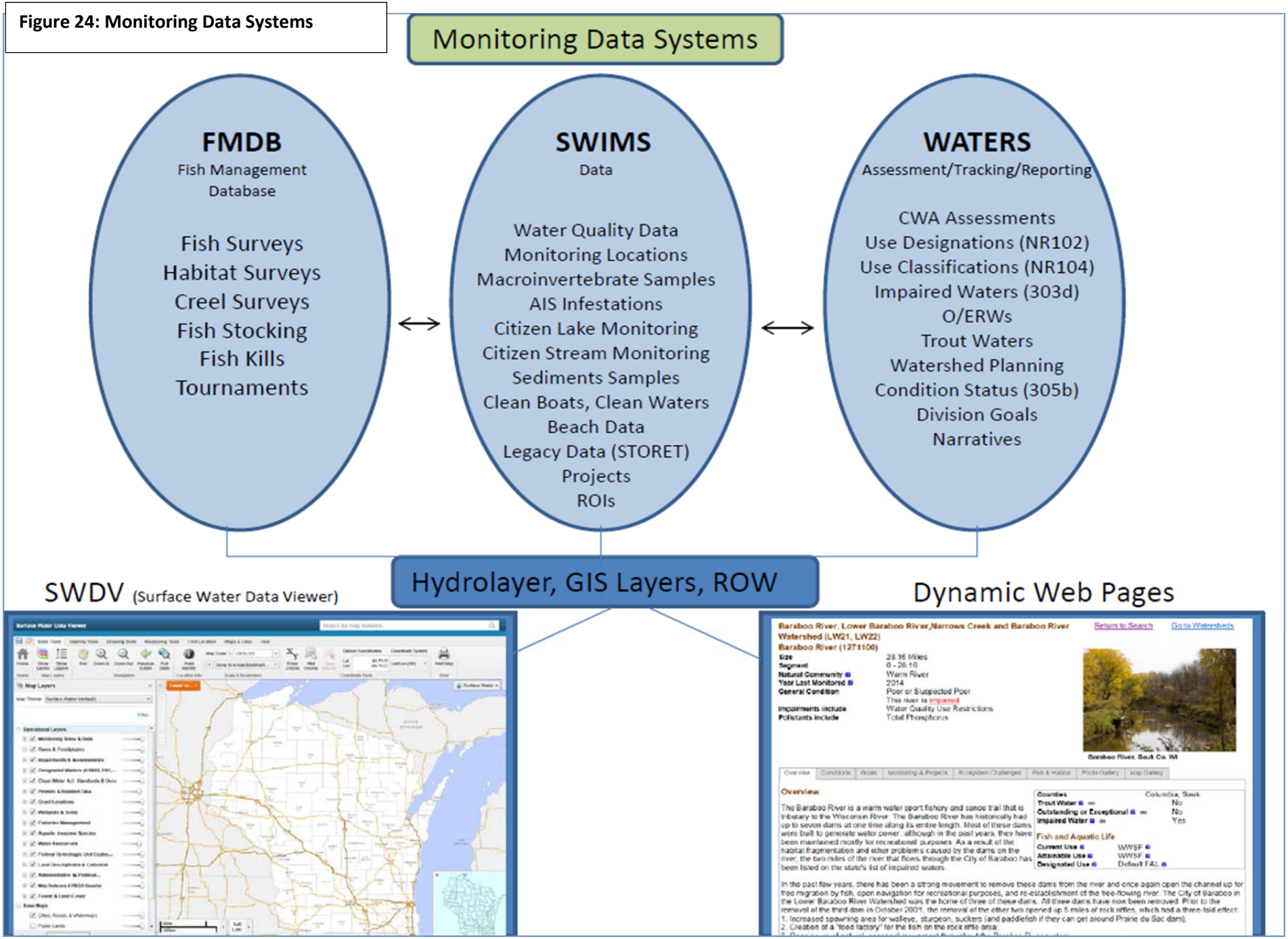


Figure 24: Monitoring Data Systems



Section 7.0 Resource Allocation and Strategic Priorities and Gaps

Perhaps the most difficult step in outlining a strategic plan is pulling together disparate pieces and defining strategically based resource allocations and potential future priorities and program gaps. Throughout this document, various needs and "gaps" in staff, funding, training, equipment, written sampling procedures, data analysis protocols, information technology maintenance funding, etc. have been identified. This section pulls these needs together and outlines short-term and long-term needs for strategic planning and resource acquisition in the future.

Current Staff:
Creation of the **Monitoring Section** to centrally coordinate and manage the state's data collection endeavors was a significant step forward.

Creation of this **monitoring strategy** is the second significant step in implementing the state's vision for better organizing, managing and tracking resource condition.

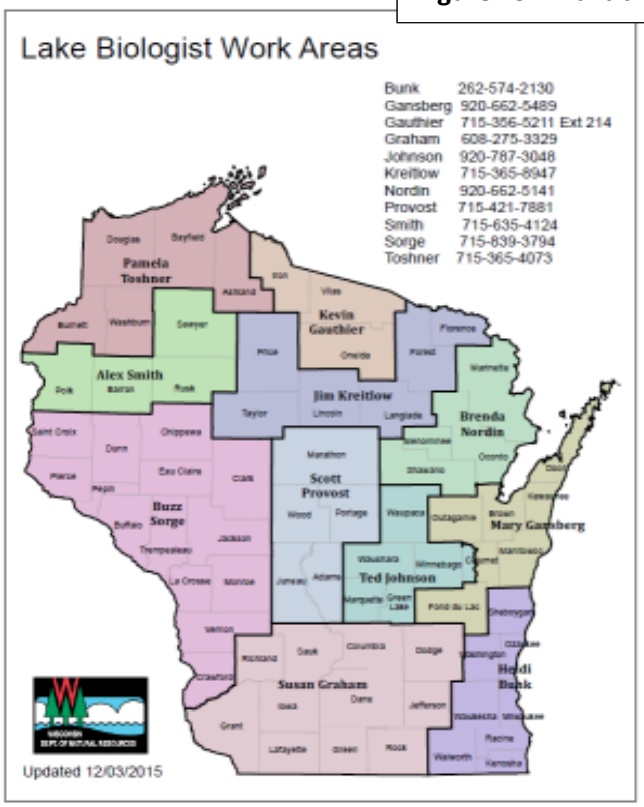
Creation of **implementation strategies** that incorporate prescribed monitoring, integration with key programs, enhanced documentation, quality control, and accountability metrics is the third major area that will be completed from 2015-2020.

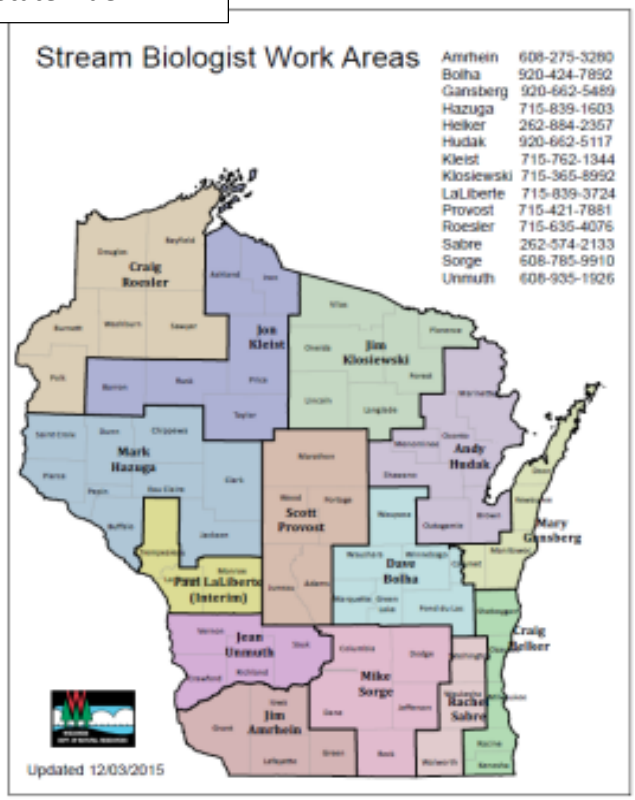
Staff Resources

The creation of the Monitoring Section in the Bureau of Water Quality in 2013 was a decisive step to improve oversight, budgeting, coordination, and implementation of Wisconsin's Water Resource Monitoring Program. Excellent leadership has set the stage for an outstanding water quality monitoring program into the future. Existing partnerships within the agency and with stakeholders, partner agencies and the public adds dimension and the ability to achieve more data collection and analysis with fewer state agency resources.

- Section creation and staff generalized roles,
- Regional complement (diverse functions, monitoring is one)
- Develop strategic ideas for advanced positions and possible addition of monitoring tech positions.
- Potential consideration of data entry data support positions

Figure 25: Available Staff Statewide

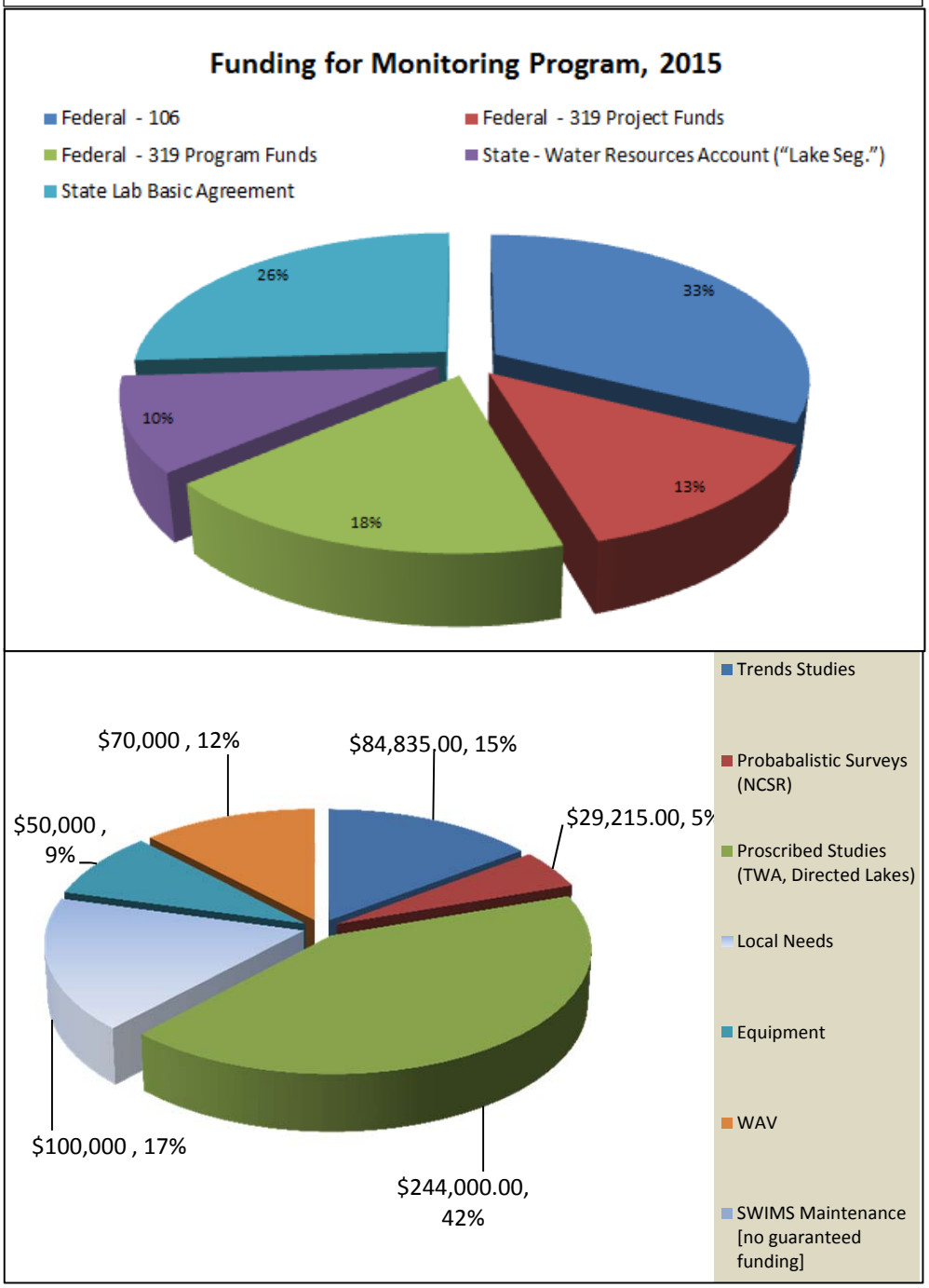




Funding

Strategic funding allocations for monitoring allow the Monitoring Section to work with programs to create scientifically based study designs (developed in cooperation with and to support the needs of critical programs) including Runoff Management, Wastewater Permits, Water Evaluation, Fisheries, Wetlands and Waterways, and more.

Figure 26: Pie Chart of Monitoring Plan Funds and Expenditures



Breakdown of Fund Usage by Resource Area Project Type

The table below breaks down the detail of how the WI program distributes its scarce resources. A major shift in resource allocation occurred with this budget cycle in that approximately 50% of the allocable funding for projects were awarded to targeted watershed assessments and Section 319/Runoff monitoring projects. This shift reflects program directives and a desire to implement a long-term study design with more centralized planning of fieldwork.

Table 29: Breakdown of Fund Usage by Resource Area Project Type		
FY15 Amount Available	**Non-Lab Costs $713,932**	**Lab Costs: $250,000**
Category A – Baseline	**$149,932**	**$141,100**
Trends	**$84,835**	**$135,400**
Lakes	$32,500	$20,000
Rivers (LTT)	$21,050	$110,000
Streams (Wadeable)	$31,285	$5,400
Prob. Surveys	**$29,215**	**$5,700**
Streams (NCSR)	$29,215	$5700
Statewide Project	**$35,882**	0
Rivers Macro	$19,382	
Satellite	$12,000	
Lakes Plants	$4,500	
Category B – Prescribed	**$344,000**	**$48,000**
Targeted Watersheds (TWAs)	$84,000	$18,000
Follow-up	$35,000	$15,000
Directed Lakes	$100,000	$15,000
PI Surveys	*$60,000*	
Habitat Assessment	*$20,000*	
Lake Assessment (TSI)	*0*	
319 Project	$125000	
TWA		
Waterbody Specific		
Category C – Local Needs	**$100,000**	**$60,900**
Category D – Miscellaneous*	**$120,000**	
Equipment	$50,000	
Water Action Volunteer Program (Streams)	$70,000	
SWIMS Maintenance Budget	[$45,000 –Wisconsin Waters Initiative]	0
Surface Water Data Viewer and Water Condition Viewer	[$20,000 Wisconsin Waters Initiative]	
Water Assessment, Tracking and Electronic Reporting System	[$37,000 Wisconsin Waters Initiative]	
Online Waters/Watersheds/Projects Pages	[$20,000 Wisconsin Waters Initiative]	
TOTAL	**$713,932**	**$250,000**

Strategic Planning Goals and Performance Measures

Biennial work planning for FY16-17 provided a unique opportunity to implement the core strategic changes derived from and presented in this monitoring strategy update process. The following key monitoring related goals and performance measures are of critical note:

Program Implementation

Goal: High quality, science-based water quality monitoring, assessment and protection work is advanced through implementing an effective Water Resources Monitoring Strategy.

Performance Measures:

- → *Review and update the Water Resources Monitoring Strategy (2014) annually to refine streams, rivers, lakes, wetlands and springs monitoring to incorporate new science and tools, water condition needs, water quality and watershed program priorities, and USEPA expectations. Prepare an annual report on the implementation success of the Monitoring Strategy by January 1st of each year. [Prioritized Actions 1.1]*
- → *Assemble **strategy implementation workgroup** to identify and oversee implementation of key priorities and work products with goals, specific staff/teams, timelines, and accountability measures on an ongoing basis and update these priorities and accomplishments through online tools. [Prioritized Actions 1.2]*
- → *Build upon existing - and create new - lines of communication within the program and with partners to succeed in implementing a successful monitoring program. [Prioritized Actions 1.3]*

The strategy implementation workgroup will assemble in the summer, annually, to inventory progress on strategy priorities, identify appropriate tracking and communication tools, update the DNR's internal and public facing websites with the updated monitoring message, and create a calendar/schedule for coordination work in the coming biennium. *[Prioritized Actions 1.4]*

Goal: Water quality protection is supported by implementing an <u>annual monitoring work plan</u> that reflects the monitoring strategy and its associated implementation plan that incorporates probabilistic, fixed site, targeted/ directed, evaluation/effectiveness, and response monitoring needs for the agency in a balanced and cost effective manner.

Performance Measures:

- → *Complete and document the status of work for **statewide probabilistic and fixed site monitoring** as described in the monitoring strategy and as required in annual work plan for Field Season 2015-16 including: Natural Community Random and Long Term Trend (LTT) Streams; Long Term Trend Rivers and River Macroinvertebrates and Lake Satellite, Long Term Trend Lakes, and Reference Aquatic Plant Lakes. [Prioritized Actions 1.5]*
- → *Complete **Prescribed Monitoring** (Targeted Watershed, Follow-up, and Directed Lakes) projects that are approved and funded. Projects are created and maintained in SWIMS and data is entered and reviewed for completeness (stations, labslips, field data, methods/ procedures, equipment, data quality, and final reports). Each year, final reports are linked in SWIMS and new findings are incorporated into the WATERS system through watershed planning and/or narrative updates. [Prioritized Actions 1.6]*
- → *Complete **Local Needs and CWA Section 319 Project Eligible monitoring** as approved and funded. Data is entered in SWIMS and reviewed for completeness (stations, data quality, and applicable final reports). Each year, final reports for projects are linked in SWIMS and new findings are incorporated into the WATERS system in a timely manner. [Prioritized Actions 1.7]*
- → *Complete **response monitoring and evaluation activities** as appropriate, such as responding to fish kills, storm events, spills, harmful algal blooms, etc., or responding to requests for evaluation of water quality data to support permit issuance and compliance (APM, Chapter 30, WPDES, high capacity wells, FERC, etc.). [Prioritized Actions 1.8]*

Below are media specific write-ups (rivers, lakes and wetlands) that support the initial achievement or progress on the performance measure. Each media area has or will soon have a technical team that will handle the short term identification of work products and oversee the conduct of work to meet strategic goals in their respective areas. For example, the streams technical team has already made progress on project selection, study design enhancement and standard operating procedure (SOP) documentation, storage and accessibility. This type of progress will be documented in periodic updates on meeting strategic goals.

Goal: Water quality protection is achieved by supporting and enhancing capacity for monitoring and assessment activities within the DNR and with external partners.

→ *Continue to develop a comprehensive Water Action Volunteer (WAV) Stream Monitoring program and continue to support the state's Citizen Lake Management Network (CLMN) to support Department Priorities*

Recent work in this area includes migration and consolidation of water action volunteer monitoring stations field data collection into the Surface Water Integrated Monitoring System (SWIMS), which reduces overhead and administrative costs and streamlines program support. The WAV program continues to advance its support of DNR programs with significant contributions to the state's follow up monitoring for phosphorus data collection and inroads into training for and collecting biological and habitat monitoring.

Resource-Specific Implementation

Monitoring Strategy Implementation: Streams [Prioritized Actions 1.9-2.10; 9.0]

The streams and rivers monitoring program has begun implementation of the Monitoring Strategy starting in the 2015 field season. Priorities developed by the Monitoring Success Workgroup were presented to the Streams and Rivers Technical Team (STT). The STT prioritized items to be either adopted immediately into streams and rivers monitoring program or create sub teams to begin working on technical details of implementation. The following items from the Monitoring Strategy have been adopted into the streams and rivers monitoring program in 2015 or are currently being worked on for implementation in the next two years:

1) Targeted Watershed Assessments: TWAs were adopted into the streams and rivers monitoring program beginning in 2014. For 2015 and beyond Wisconsin proposes to monitor eight HUC12 watersheds as part of the TWAs. Incorporate more media sampling as resources allow
2) 319 Project TWAs: 319 Project TWAs were adopted into the streams and rivers monitoring program beginning in 2015. Wisconsin proposes to monitor six watersheds with approved Nine Key Element Plans in order to determine if NPS remediation practices have been successful.
3) Flow monitoring: Results from the Monitoring Strategy Workgroup indicated the need to collect more stream flow data, both spatially and temporally. Flow monitoring data are needed for a variety of programs including but not limited to, TMDL load calculation, high capacity well reviews, development of a biologic stressor, etc. Wisconsin is dedicated to collecting more and better quality flow data and the STT designated a sub-team to review and update wadeable stream monitoring protocols. The sub-team is currently formed and working on writing and finalizing the updated Flow Monitoring SOP in preparation for the 2016 field season.
4) Determine spatial representativeness of a sample/stream reach: For monitoring and assessment purposes it is often difficult to determine what spatial extent along a stream network a single sample represents. The Targeted Watershed Site Selection Tool (TWSST) was developed in order to classify like stream reaches into homogenous groups. The TWSST model is being used for site selection in TWAs in field season 2015 and its applicability will be tested for assessments in upcoming assessment cycles.

5) Large river fish community monitoring: The Monitoring strategy recognizes that although Wisconsin has protocols for collecting and assessing large river fish communities (large river fish IBI) it lacks the capacity to do so on a consistent basis. The STT formed a sub-team that is developing a technical and safety training program for District biologists in order to increase the capacity to collect large river fish community data. An initial monitoring project is tentatively scheduled to begin in 2016.
6) SOP development: Wisconsin has updated and finalized SOPs for nutrient grab sampling, low level metal grab sampling, benthic diatom collections. Wisconsin has also finalized study designs form numerous projects that capture the monitoring purpose, design, SOPs needed and safety for Natural Community Stratified Random Sampling, Wadeable Trend Reference, Follow-Up Monitoring, Long Term Trend Rivers and Large River Macroinvertebrate monitoring.

The following items from the Monitoring Strategy are identified as areas to implement in years 3-5 of the Monitoring Strategy:

→ SOP Development: Continue to update SOPs and Study Designs as needed.
→ Habitat and Sedimentation: Refine or develop monitoring and assessment measures for physical habitat and sedimentation in streams and rivers.
→ Flow monitoring: Increase capability to collect high frequency and event based flow monitoring.
→ Wadeable Trend Reference Sites: Review network and determine if adding addition or rotating sites are necessary. Add high frequency chemical data collection to reference site network.
→ Follow Up monitoring: refine monitoring protocols when following up on "Poor" biologic scores including protocols to detect less frequent or less widespread stressors.
→ Reporting: Increase frequency of reporting on Baseline and TWA monitoring programs.

Monitoring Strategy Implementation: Lakes [Prioritized Actions 3.1-3.10]

We have initiated steps to formalize a technical team and to outline a statewide strategy for garnering funding and staff time for a strategic approach to lake monitoring. Historically the DNR's lakes program has focused on lakes grants and partnership endeavors, primarily. These strategic areas will continue in importance but we intend to focus resources and result in a more parallel set of activities and functions as the Streams Technical Team. The various ongoing programs for baseline monitoring were included in the formalized work planning guidance including satellite secchi monitoring, Long-Term Trend Lakes and Reference Plant Lakes (this is a new area).

1) Reference Plant Lakes: Continued monitoring of reference lakes (based on urban and agricultural land cover and trophic status) is needed on an annual basis in order to document inherent variability in plant communities. Funds for plant point-intercept surveys will be allotted to each district based on the number of reference lakes selected in each district. Over the next 2 years, conducting plant PI surveys on these reference lakes may require a gradual transition from Science Services to district staff (e.g., 1 Science Services employee partnering with FTE's or LTE's in each district). The budget is a rough estimate for monitoring 10 small lakes, but is subject to change depending on final lake selection. The goal is to select and begin monitoring all reference lakes by 2016.

2) Directed Lakes: is a new category that includes a suite of standard monitoring procedures on "new" lakes. This monitoring will address the need to systematically sample lakes around the state that lack data. Furthermore, it will monitor aquatic plants and shoreland habitat in addition to standard trophic status indicators. Approximately half of the WDNR lakes biologists will implement Directed Lakes sampling in 2015, with the goal to fully implement by 2017. Although monitoring funds were allocated to this endeavor, staff time was a barrier in terms of implementing this part of the monitoring strategy. The Citizen Lake Monitoring Network may enable staff to achieve the goal of

sampling new lakes, with volunteers collecting TSI samples and WDNR staff conducting the plant and habitat surveys.

The following items from the Monitoring Strategy are identified as program gaps.
Implement in years 1-5 of the Monitoring Strategy:

- → Data Management: give SWIMS the capacity to capture new types of data (e.g., aquatic plant, shoreland habitat, and National Lakes Assessment) and calculate new biocriteria metrics
- → Parameter creation: develop and refine lake assessment parameters (e.g., aquatic plant biocriteria, diatom biocriteria, shoreland habitat health, etc.) for both the integrated reporting process and designated uses.
- → Reporting: improve and expand on lake reports (e.g., new parameters, analyze long-term data every 5 years)
- → Satellite Monitoring: develop new indicators that can be assessed with remote sensing data (e.g., Dissolved Organic Carbon, water color, surface skin water temperature)

Implementation uncertain due to funding and time constraints:

- → Harmful Algal Blooms: develop a monitoring program on inland lakes and develop evaluation standards
- → Inland Lake Beach Monitoring: develop a monitoring program for human pathogens
- → Nearshore Water Quality Monitoring: develop a monitoring program at nearshore stations in addition to traditional water testing at the deepest point of the lake

Monitoring Strategy Implementation: Wetlands [Prioritized Actions 4.1-4.21]

The wetlands program has made substantial progress in the past year during the creation of the strategic plan. Recently the wetlands technical team was formed to address the wetlands components of the monitoring strategy. The following items have been initiated by the Wetlands Technical Team in 2014-15 and this work will continue into the coming biennium.

1. Team Formation The team mission, membership and structure encompass both ambient monitoring as well as site specific evaluation of impacts on wetlands. Staff needed to seek approval for the team creation, write up an issue brief and receive supervisor approvals for participation on the team.

2. Groundwater and Wetland Issues in the Central Sands: Progress to support wetland impact evaluation and groundwater drawdowns from high capacity well permits have been initiated through a collaborative project between the wetlands staff and the Water Use Section of the Groundwater and Drinking Water Bureau. The proposal includes plans to add a wetland component to an ongoing hydrologic study of wetlands by installing wells/piezometers and gathering baseline vegetation data.

3. Wastewater Wetland Impacts This work involves analyzing potential impacts from wastewater discharges on wetlands, which has long been a concern for wetland biologists and ecologists. A small group was formed to create training and guidance on stormwater impacts to wetlands.

4. Collecting WRAM Results to characterize wetland condition and function: The area of analyzing WRAM (wetland rapid assessment methodology results from site assessments where wetland permits have been issued is a new area of study for the wetland group. This initiative involves ensuring that WRAMs are completed for all individual and general permits by train water quality biologists and stormwater staff to use WRAM and by exploring efficient ways to capture WRAM surveys for storage and access in an accessible database.

5. Floristic Quality Assessment Development The continuation of this critical wetland assessment and function tool continues. The team is working on developing Floristic Quality Assessment Benchmarks during 2016

research and is developing an outline for implementing FQA bioassessment as a routine part of watershed condition monitoring.

The following items from the Monitoring Strategy are identified as areas to implement in years 3-5 of the Monitoring Strategy:

- → SOP Development: Continue to update wetland monitoring and assessment procedures and study designs and outcomes to be published and shared.
- → Restoration assessment: Assess whether the restoration/ mitigation projects meet restoration or ecosystem goals.
- → Reporting: Increase frequency and accessibility of wetland assessment or condition data.

Safety and Training [Prioritized Actions 5.0+]

Goal: The safety of DNR staff and volunteers is enhanced during monitoring and other routine field procedures through safety training and awareness tools.

- → ***Performance Measure:*** *Design and implement a regular safety and training program for water quality biologists that may include modules related to bioassessment, aquatic plant identification, fluvial geomorphology, water quality monitoring and modeling, statistical analyses, and related.*

Technical and generalized work function training is a strategic implementation area for the coming biennium. Creating core, standardized technical training elements for new employees and ongoing training opportunities for veteran employees is a critical goal. This training strategy, an outgrowth of the monitoring strategy, is a strategic implementation area for the program.

A Water Resources Safety and Training Team was established to identify existing and potential needs, beginning with safety training The Water Resources Safety and Training Team is comprised of Water Quality program biologists, WR Supervisors, other water resources staff and the Water Quality safety/training coordinator. The Safety and Training Team is delegated the authority to develop recommendations for safety standard operating procedures (SOPS), safety training and program technical training. The work of the Water Resources Safety and Training Team is directed by the Water Resources Policy and Management Team (WR PMT). Safety and Training Team recommendations will be reviewed and acted upon by the WR PMT, as appropriate, to ensure that safety policies and training recommendations are sound and consistently implemented in a manner that will lead to adherence of the Water Division's goals and objectives. Approval of safety SOPs and required/recommended training and training plans are subject to concurrence by the WR PMT.

The Water Resources Safety and Training Team is responsible for:

- Developing safety SOPs;
- Identifying safety training requirements and recommendations;
- Identifying technical training recommendations; and
- Developing a safety and training plan for Water Resources program staff.

The Safety and Training Team will coordinate with the Monitoring Technical Teams to identify and develop training recommendations for water quality biologists including basic training plans for new hires or transfers. This work may be expanded to incorporate specific tracts:

- field methods and procedures
- safety procedures
- study design fundamentals
- data management and analysis

Water Program Information Technology Support [Prioritized Actions 6.0]

Goal: Support information technology tools that store, analyze, and display water monitoring data, assessment data, planning results, and management recommendations to ensure that DNR can meet timely reporting, evaluation, and decision-making activities for Department programs.

- → *Maintain professional high-level infrastructure tools including SWIMS, WATERS, SWDV, intranet SWDV, Water Condition Viewer, dynamic webpages, and statistical packages such as R and custom tools such as the Targeted Watershed Site Selection Tool.*
- → *Update the Water Quality Bureau Information Technology plan from 2008 with specific emphasis on adapting the plan to new technologies and program changes and needs and incorporating specific attention to training and help guides for supported IT products.*

The **monitoring, water evaluation, runoff management, permits and lakes and rivers sections** have initiated working in concert to identify existing IT tools and needed tools and technology to meet current and future public education, information and reporting requirements. The multi-program group is updating its strategic plan by asking the questions:

- What Information Technology tools are in place for monitoring?
- What Information Technology tools are needed now and in the future?
- How data/information (summary) is delivered and is that delivery effective?
- What written data analysis protocols and procedures are in place for monitoring (that can be or are automated?)
- Which automated data analysis protocols and procedures are needed in the future?
- Is there sufficient GIS capability, access to models and results, statistical packages, and other decision support tools. What is needed to provide adequate support?

Additional Implementation Needs:

Equipment

Documenting, managing and planning for current and future equipment needs is a strategic implementation area for the monitoring program. Inventories of current equipment and future needs (even "wish list" items) will be documented. These exercises will help better allocate resources in future years or plan for large scale purchases.

- What equipment is in place for monitoring?
- What equipment is needed now and in the future?
- Gage stations? Where do we go from here?
- Thermistors, flow, pressure t?
- Automatic profiling stations in lakes,
- Do we have enough equipment to support our current and planned strategy? What do we need???

Written Sampling Procedures, Methods

The monitoring section will work with technical teams to support the development and production of professionally published sampling procedures and collection methods. Key priorities for creating and producing documentation of standard operating procedures, collection methods and related will be supported by the Monitoring Section. The following questions will be asked of each of the key media areas.

- What written procedures or methods are in place for monitoring?
- What written procedures or methods are needed now and in the future?

Support Key CWA Standards, Assessment and Monitoring Programs [Prioritized Actions 7.0, 8.0]

Goal: Work closely with WES, WW, Permits, Runoff (WT Bureau), Fisheries (Fish Bureau) and Water Use (DG Bureau) to provide critical field data collection for resource issues of great importance including the storage, analysis, display, assessment, planning, and management to ensure that DNR can meet timely reporting, evaluation, and decision-making activities for Department programs.

- → Support biocriteria, TALU, and WQ Standards updates, Triennial Standards Review Priorities, Biocriteria, Database Interaction, Tool Development, work as needed and possible.
- → Support Mississippi River and Great Lakes program needs as possible including centralized coordination, IT system support, assessment support, and program implementation.

Provide Management Budget and Program Communication Work Across Agencies, Collaborative Partners, Programs and the Public [Prioritized Actions 10.0]

Goal: Extend invitations and work closely with partners including UW Extension, USGS, WGNHS, regional planning commissions, counties developing, DATCP, and Administration to address stable funding, partnerships, processes, and information systems.

- → *USGS Gage station contracts in place annually; USGS monitoring study continuity and results.*
- → *Citizen Water Monitoring work with UW Extension (1 FTE support), annual negotiations.*
- → *Seek base program funding for IT systems to ensure stability.*
- → *Seek and retain skilled professionals to maintain data systems and provide oversight of contract support.*
- → *Seek appropriate funding allocations for biological program staff and wage increases to maintain high quality professionals and to support exceptional products for Wisconsin's Resource Management.*

Create and Maintain a Quality Assurance / Data Integrity Initiative [Prioritized Actions 11.0]

Goal: Identify key quality assurance, quality control measures in place for data collection, storage and sharing and build upon those efforts with a well-documented, sharable and accessible living plan to help make Wisconsin's monitoring and assessment data transparent to management, staff, partner agencies, USEPA, and the public.

- → *Carry forward the SWIMS Data Integrity Plan of 2013.*
- → *Update a Water Quality Bureau Strategic Plan (update from 2011).*
- → *Work with agency quality assurance program officer to ensure that projects and programs are in compliance with federal guidelines and rules.*
- → *Fully implement SWIMS quality assurance automated documentation records to capture critical information about each study including: study purpose, design, data collectors, equipment, methods, staff training and more.*

Kayaking in the North
L. Helmuth

Appendix A: Evaluation of Monitoring Strategy and USEPA 10 Key Elements

First Element: Monitoring Strategy

Self-Assessment:

Meets or exceeds Level 4 Elements

Elements of a State Water Monitoring Program

1. Monitoring Program Strategy
2. Monitoring Objectives
3. Monitoring Design
4. Core Indicators of Water Quality
5. Quality Assurance
6. Data Management
7. Data Analysis/Assessment
8. Reporting
9. Programmatic Evaluation
10. General Support and Infrastructure

USEPA 10 Elements of a Comprehensive Monitoring Strategy

Wisconsin's vision is that water quality is comprehensively measured to protect beneficial uses and that protection and restoration efforts are adequately evaluated. This will require a comprehensive strategy to meet the water quality management needs of the state waters including streams, rivers, lakes, reservoirs, Great Lakes shorelines, groundwater, and wetlands.

The monitoring strategy outlines a framework that can be extended to a long-term plan with a 5 to 10-year schedule for complete implementation. The strategy is comprehensive in scope, covering monitoring objectives, study design, water quality indicators, quality assurance, data management, data analysis/assessment, reporting, programmatic evaluation, general support, and infrastructure planning.

Second Element: Monitoring Objectives

Self-Assessment:

Wisconsin's Water Monitoring Team has identified a set of monitoring objectives based on the range of regulatory responsibilities and water quality programs with special emphasis on designated use attainment. In 2008, the Water Division Monitoring Team (a precursor to the Water Resources Monitoring Team) identified monitoring objectives critical to the design of a monitoring program that is efficient and effective in generating data that serve management decision needs.

Monitoring objectives include:

- Establishing, reviewing and revising water quality standards,
- Determining water quality standards attainment,
- Determining water quality status and trends,
- Identifying impaired waters,
- Identifying causes and sources of water quality problems,
- Implementing water quality management programs, and
- Evaluating program effectiveness.

Consistent with the Clean Water Act, monitoring objectives reflect decision needs relevant to the range of waters found in the state. See above for Clean Water Act monitoring objectives.

Third Element: Monitoring Design

Self-Assessment:

Wisconsin's strategy reflects media-specific variable designs to maximize the state's ability to meet monitoring objectives with existing resources. The primary design frameworks utilized include:

- Statewide status and trends data collection through long-term trend and reference-site based networks,
- Random stratified sample designs primarily focused on natural communities to establish temporal and spatial variation, identify primary stressors, and to inform future effectiveness studies.
- Reference site monitoring to establish and calibrate course-scale models for extrapolation of condition information;
- Data collection to close of data gaps for assessment studies focused on for phosphorus, chlorophyll a, E. coli, and chlorides and TSI assessment packages;
- Prescriptive monitoring designs (targeted watershed assessments, directed lakes, runoff management/319 studies, and local monitoring needs);

- Intensification monitoring to initiate TMDL model development, calibration or validation;
- Watershed condition monitoring to support integrated reporting and watershed planning;
- Site-specific monitoring to identify and characterize water quality problems.
- Evaluation monitoring to determine the effectiveness of best management practices or restoration progress outlined in resource recovery initiatives.

These key study designs are supplemented by data gathering from lake and stream volunteers, whose data efforts have grown and evolved into gap filling and key assessment data collection work. In the case of lakes monitoring, TSI data is combined with modeled satellite imagery interpretation to provide far greater assessment coverage than what would be available without the citizen volunteers.

The designs mentioned above are explicitly blended with fixed station work for intensive and screening-level monitoring, rotating or "targeted watershed approach", basin monitoring, and targeted and probability designs to meet the full range of information and decision needs.

In the recent past, Wisconsin has carried out some probability-based network design studies for statistical inferences regarding general condition and associated pollutants and other drivers behind quality variation.

Fourth Element: Water Quality Indicators

Self-Assessment:

Wisconsin has a variety of aquatic condition indicators used in various program areas. This strategy inventories what indicators are fully functional and which indicators need more research, development and implementation.

Our vision is to develop a complete set of monitoring indicators and assessment tools with clearly articulated thresholds (measurable standards that we must meet or exceed) to track the status and trends of water quality and to evaluate the effectiveness of management actions to improve water quality in the state. These indicators must be site specific yet reflective of a population of resources geographically and/or categorically.

The Water Quality Program uses water quality standards designated use assessments conducted for the biennial Water Quality Report to Congress ("Integrated Reporting for Sections 305b/303d") to provide statewide summaries of overall condition. Refinements or creation of key indicators within each of these designated use assessments could be developed and advanced on a more fine-scale basis for condition assessments for water type statewide, regionally, and at a local level.

Core indicators are used to assess attainment with applicable water quality standards. In addition, supplemental indicators can be used when there are reasonable expectations that a specific pollutant is present in a watershed, when core indicators suggest impairment, or they can be used to support a special study, such as screening for potential pollutants of concern. The primary parameters used to assess waterbodies are listed in table___ . Generally, key indicators include:

Rivers:

- Chemical/toxicological (TP concentration, chlorides, etc.) and biological/ecological endpoints (large river macro invertebrates and large river fish IBI, fish community assemblage).

Streams

- Physical/habitat (percent embeddedness, turbidity, cover), chemical/toxicological (TP concentration, chlorides, etc.), and biological/ecological endpoints (macro invertebrates and fish community assemblage and indices of biological integrity) .

Lakes

- Catchment development index
- Lake macrophyte index
- In-lake Secchi depth, phosphorus or chlorophyll a (Trophic Status Index)
- Riparian shoreland development factors.

Wetlands

- Floristic Quality Index
- Quantitative Wetland Condition Integrity Index
- Qualitative Wetland Condition Integrity Index

DNR intends to refine core indicators to develop those that accurately indicate water system health at the state, watershed, and project (site-specific) scales. In addition, core indicators can be used to better inform resource managers of the relationship between water quality and land use activity in the surrounding area and the effects of landscape change. An emerging activity is development of Water Quality Standards that include biocriteria to supplement chemical and qualitative criteria to determine water condition are underway. Future monitoring efforts will address these emerging monitoring needs. Development of monitoring designs to support development and implementation of bio-indicators is essential.

Fifth Element: Quality Assurance

Quality assurance covers a broad range of activities from the inception of the study design to the final report write up and publication. The following key areas cover quality assurance aspects throughout the life cycle of study proposal through data sharing and data delivery.

A number of quality assurance elements are in place in Wisconsin's Monitoring Program. However, several enhancements can be incorporated into ongoing activities to improve the value of monitoring data for long-term DNR and data sharing with other agencies and partners. Quality assurance elements currently in place or - ones that are needed (*) identified with an asterisk - are listed below. Quality assurance is covered in greater detail in the body in the document and in the appendix.

Quality Assurance Ongoing Initiatives

The Surface Water Integrated Monitoring System (SWIMS) Database Team is designing a data integrity plan for entry, storage and distribution or sharing of data that will be completed in 2015. The team is also working on completing the automated quality assurance project plans that can be generated the system by project managers.

Key information to be included in automated quality assurance plan:

project purpose, objective, outcome, study design description (random sample design versus targeted study etc.), collection equipment, planned parameters, written protocols, data collectors and project roles, monitoring stations, planned versus collected fieldwork events, flagged data from the study and why, summary information on project timeliness or problems encountered, hyperlinks to relevant documents, photos, or other information, the lab where the

analysis took place and contact information if available. These are but a few of the examples of data that can readily be incorporated into automated reports as long as the project manager ensures that the data is entered into the system.

Database Integrity Plan which will include:

- System documentation procedures including enhanced database backup and journaling procedures.
- Enhanced security features for tracking work by multiple backend system users (three file managers).
- Data entry screen quality control tools and enhanced error messaging.
- Greater documentation of errors and user guides on how to solve issues when confronted with problems.
- Long-term data integrity plan by December 2015.
- Finalization of generic quality assurance project plan for all studies in the SWIMS system Spring 2016.

Data Management Procedures:

- Database stored documentation of collectors, training received, and equipment used, methods / protocols employed, QA samples like duplicates, blanks and spikes, and study design description.
- Standard use of locational data standards for GIS data including stations, monitoring locations, resources of interest, and actions.
- Three file managers on SWIMS database with three to four high-level database architects and programmers and GIS analysts support the system.
- In addition, water program managers and users receive database support and training to maximize the appropriate use and consumption of data

Recommended Quality Assurance Work

- *Update quality assurance management plan and quality assurance program plan,* both established in accordance with USEPA policy, to ensure the validity of monitoring and laboratory activities and fulfillment of state reporting requirements with credible and comparable data.
- The updated quality assurance management plan should be updated to include new study designs, project manager perspectives, database capabilities, and requirements from federal, state and local entities.
- Develop quality assurance guidelines for each study design. Recommendations will work through technical teams and will be incorporated into database "controls" to reinforce data entry rules and ability to more readily fill out information.
- Consult with quality assurance project plan officer consultation when *creating quality assurance project plans for large studies.*

Quality assurance project plans (for large studies) or quality assurance checklist (to be developed) could be submitted with project proposals as a prerequisite for funding. The quality assurance program plan may solicit input from partner groups including other state programs, non-profit environmental organizations, and USEPA Region V. The quality assurance program plan should be flexible and well documented and may include a "Quality Assurance Toolbox," a Web site and quality assurance elements put in place for the Surface Water Integrated Monitoring Program (SWIMS), the Fish Management Data base (FMDB), and other relevant database systems.

Sixth Element: Data Management

DNR's vision is to make credible ambient monitoring data available to all customers, stakeholders, and partners in a timely manner. Multiple databases support the state's monitoring and assessment work including:

- Fish Management Database
- Fish Contaminants Database → *SWIMS (2015)*
- Bio monitoring Toxicity Laboratory Data → SWIMS
- Sediment chemistry → SWIMS
- Microbiology →SWIMS
- Habitat/biological data → Fish and SWIMS
- Aquatic Invasives→ SWIMS

→ Water Quality Exchange → **USEPA STORET**

All tables in systems that hold monitoring data should have appropriate metadata (consistent with recommendations of the National Water Quality Monitoring Council) and geo-locational standards. DNR oracle systems conduct "journaling" to provide greater auditing functionality; enhanced security for backend users of database tools; and more frequent backups to restore data in the case of catastrophic data loss.

Specific emphasis on communication between data systems has been enhanced over the years, due to mutual dependencies surrounding shared datasets and the bioassessment criteria initiative. With this effort and the clear need for detailed, systematic management of a shared riverine natural community dataset between at least two agencies in multiple IT environments, integration is quite challenging.

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Surface Water Integrated Monitoring System

The Wisconsin DNR stores its ambient water quality data in its Surface Water Integrated Monitoring System (SWIMS), a project based, comprehensive data system which holds chemical, physical, habitat water and sediment chemistry, and aquatic invasive and macroinvertebrate data (and more). Detailed documentation of the SWIMS system is available upon request.

The SWIMS Team has several ongoing sub team initiatives to enhance the quality and completeness of this work including:

- Outreach, help guidance and support team.
- Data integrity and quality assurance.
- System enhancement technical design sub team.
- Short-term user interface improvement team to help with ease of system use.
- Long-term vision team to modernize and enhance system accessibility including mobile options, tablet forms, infield data entry, topical search and display and more.

Water Assessment Tracking and Electronic Reporting System

The Water Assessment Tracking and Electronic Reporting System (WATERS) stores water quality standards, trout classifications, O/ERW designations, and assessment information for Clean Water Act Section 305(b) reports and 303(d)

reporting. Additional fields include narratives regarding basin, watershed and waterbody narratives, priorities and goals for management, and recommendations for management actions. The (GIS) Geospatial data for stations and for assessment units is stored in Wisconsin's GIS Spatial Database Engine "SDE" environment. The SDE environment includes sufficient descriptive metadata for the data to be shared and compared among managers and the public.

Additionally, DNR makes its data available to the public through the Water Quality Exchange Network, online pages, and direct downloads from publicly available interface as well as through the Surface Water Data Viewer maintained by the Department of Water Resources.

DNR FISHERIES PROGRAM

Fish Management Database

The Fisheries Management Database holds a variety of fish, habitat and physical data relating to fisheries surveys. The database is hosted by USGS and is interconnected with the SWIMS system through sharing stations, fish kill locations, and fish stocking sites. The fish program creates parameter calculations that are critical for Clean Water Act reporting and serves those data up through a query tool. The database's reporting mechanism is currently under redesign.
Of critical importance is the role the FMDB has in supporting the validation of streams natural community delineations: through setting up expected fish community assemblages and comparing those species against sample data, the database will provide a critical first step in helping to confirm temperature and flow based community assignments.

Data Management / Database Connectivity

As described above the state's major databases and staff work are integrated. The table below describes some of the cross program efforts to achieve this integration among the Fisheries Database, the Surface Water Integrated Monitoring System (SWIMS), the Waterbody Assessment Tracking and Electronic Reporting System (WATERS), the Register of Waterbodies (ROW), the Hydrolayer (23K Hydrography Database) and other related systems.

Table of Data Management Integration

Element	Description	Outcome
Database Training	Employees are trained in both the Fish DB and SWIMS. Fisheries, Watershed and Water Quality program staff all receive this training.	Standardized protocols are created and used to create uniform stations against the 24K hydrolayer.
Monitoring Protocols	Cross program database station establishment, naming and data entry protocols. Baseline fish data collection monitoring protocols; Safety measures; Equipment preparation and maintenance.	Data integrity for use across programs and bureaus is enhanced.
Station Establishment	Monitoring stations for SWIMS/Fisheries are established using the SWIMS Mapping Tool and cross referenced between the databases. This integration helps tremendously with assessment / condition evaluation.	More readily available datasets on one station helps ensure more time effective condition analyses and gap evaluation for standards attainment.

Monitoring Projects	Specific Monitoring Projects are established in SWIMS and fisheries data collection elements are articulated in the project description.	Monitoring Projects are available online with attached protocols, datasets (DNR staff available) and summary analyses as these are created.
Fieldwork Events	FW Events (sampling events) are electronically established in SWIMS and connected through stations. Users can identify if the FW event with a particular suite of chemistry or macroinvertebrate data has a coincidental fish and/or habitat element.	Users are more aware of additional data within a project that is stored in the fish database and there are electronic "buttons" that can send the users to the fish data on a given station.
Data storage and final reports	Chemistry, Macroinvertebrate, Aquatic Invasive Species, and related – SWIMS; physical parameters, habitat and fisheries datasets – Fish DB. Fish Contaminant monitoring – Fish Contaminant Database.	Final reports are posted online or stored as reports in the database. Data downloads are universally available to water staff and linked to SWIMS, WATERs and Websites.

Seventh Element: Data Analysis/Assessment

Wisconsin DNR's goal is to provide a consistent defensible framework for the evaluation of monitoring data relative to state and regional standards, the protection of water quality standards and beneficial uses, and for tracking the effectiveness of management actions.

Water Quality Biologists and central office professional staff are responsible for preparation of technical reports that summarize the findings of watershed assessments and special studies. The Water Management structure transmits these reports to the USEPA for certification as part of the state's Areawide Water Quality Management Plan after a required public review and comment period. The Water Monitoring Section staff is responsible for technical reports that summarize the findings of statewide assessments.

This information is used in the preparation of Wisconsin Water Quality Report to Congress through the "Integrated Reporting Process" under the Clean Water Act Section 305(b) reports and 303(d) listings.

The Water Quality Bureau biennially publishes updates to its Wisconsin Consolidated Assessment and Listing Methodology (WisCALM) which may change to reflect new scientific findings or other changes required by state resources or USEPA. WisCALM outlines how to assess attainment of water quality standards based on analysis of various types of data (chemical, physical and biological) from various sources, for all state waters. The Water Evaluation Section through WisCALM establishes listing and delisting criteria for the Section 303(d) list of Impaired Waters. The WES Section also contains criteria to assist in establishing priorities for developing total maximum daily loads, guidelines for acceptability of data, and other measures necessary to facilitate the completion of total maximum daily loads.

Eighth Element: Reporting

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Wisconsin's vision is to provide all collected data in a usable format, and in a timely and publicly accessible manner. A variety of reports are used to convey the results of Wisconsin's work by the Water Monitoring, Evaluation, and Implementation Program projects.

Most reports are available to the public in electronic format online. The types of reports include fact sheets, monitoring study summary reports, data downloads and reports, quality assurance reports, interpretative reports, and the 305(b)/303(d) Integrated Report.
http://dnr.wi.gov/topic/surfacewater/ir2014.html

These reports provide analyses and interpretation of the data collected. The technical reports have written descriptions of the study design, methods used, graphical, statistical, and textual descriptions of the data, and interpretation of the data including comparisons to relevant water quality goals. These reports are available to all interested parties through the DNR's website "Explore Wisconsin's Water" at
http://dnr.wi.gov/water/

Self-Assessment:

The state has worked to produce timely, complete, and technically valid water quality reports and lists called for under the Clean Water Act Sections 305(b) and 303(d). The current emphasis on updating the state's strategic monitoring plan and the 'rebranding' of the water resources program to convey the continuity of the monitoring, assessments, planning and implementation work should facilitate this. The state also submits monthly data submittals through the Water Quality Exchange Network to STORET in support of the federal Clean Water Act 106 grant. The monthly transfer of monitoring data to the national STORET database via the Wisconsin Environmental Data Exchange Network satisfies this requirement.

Ninth Element: Programmatic Evaluation

Wisconsin intends to conduct periodic reviews of each aspect of the monitoring program to evaluate its scientific validity, whether the program is being implemented as designed, and how well the program serves water resources decision needs of the state.

Self-Assessment:

The Monitoring Section in consultation with the Water Resources Policy and Management Team (WR PMT) and Environmental Management Division leadership will initiate a formal review in FY2018 (July 1, 2017 – June 30, 2018) to determine how well the monitoring program serves its water quality decision needs. This review will involve evaluating the monitoring program and all its constituent elements to determine how well each of the elements is being addressed and determining how to incorporate necessary changes and additions into future monitoring cycles, and potential updates to the strategy in 2020.

Core Implementation Tactics

- Develop and promote the use of multiple monitoring tools, such as statistically based surveys, judgmental surveys, predictive modeling, risk assessments, expert analyses, and newer information and monitoring technologies.

- Continue working with partnership monitoring and linking with federal partners through the Environmental Data Exchange Network hosted by the Water Division to increase data comparability, increase potential for collaboration with other entities collecting ambient water quality information, and make data available to the public.

- Build stronger partnerships with agencies, watershed groups, volunteer monitors, and others to facilitate the sharing of information, the collection of comparable data, and the use of monitoring tools.

Study Design Documentation – Protocols, Methods, Procedures

A major element of Monitoring Strategy implementation work will involve completion of an ongoing inventory and strategic gap analysis of monitoring protocols, methods and procedures. Not only will the presence of a documented procedure be evaluated but the training and implementation of that documented procedure will be evaluated to ascertain whether sufficient training and support is provided for new and veteran staff to carry out their work successfully.

Laboratory Analyses - Contract Labs for State Monitoring Analysis Work

WDNR contracts with a variety of laboratories for analysis work. The primary labs used for surface water are described in the Laboratory Systems, Section 7. As contracts are renewed each year, the DNR programs should evaluate the work received against the proposed scope of work to identify any issues for improvement. This process regularly occurs for USGS, SLOH, UWSP, and other contract labs.

Tenth Element: General Support and Infrastructure

Wisconsin's vision is to provide funding and support needed to implement a coordinated and comprehensive monitoring and assessment program conducted by citizens, state staff, stakeholders, and federal and state agency partners. Wisconsin receives a mix of federal and state funding amounting to approximately $700,000 (down from nearly $900,000 in previous years) that is used for monitoring and analysis work. This annual allocation covers everything from lab analysis for chemical, biological, toxicological data to data interpretation and research of satellite data to funding USGS gage stations, LTE support, equipment, supplies and travel.

Many items that are perceived as important or fundamental Wisconsin's water management do not have a dedicated funding source. The following, for example, are funded through the Clean Water Act 106 "extra" allocation above the base funding level or other ad hoc sources.

- Volunteer stream monitoring
- Biocriteria development
- Enhancements to NARS (shoreland assessment, wetland condition)
- Pilot Watershed projects
- Lake temperature methods evaluation
- Nitrogen stream monitoring project
- Enhancing remote sensing of lakes
- Monitoring Strategy support
- Bioassessment Program Review
- Database maintenance and enhancements.

The following items are listed as monitoring program needs based on the lack of a reliable or stable funding source or have been listed due to historical budget reductions. These items are not listed in priority order.

Mississippi River CWA Collaborative Interstate

This initiative is a one-time pilot-project to implement portions of the UMR CWA monitoring strategy and would be coordinated with similar efforts proposed by the Minnesota Pollution Control Agency. This proposal builds on existing Mississippi River budget allocations, and is tiered to allow flexibility in allocation of budget resources.

Citizen-based Water Quality Monitoring Data

Provide stable funding and support for volunteer water monitoring to ensure that the data being collected are useful for Department decision-making. This work is currently supported by LTE employees through the EPA Monitoring Initiative funding.

Water Resources Monitoring Technicians

- This request would create 4 new technician level positions to conduct baseline and targeted monitoring of lakes, wetlands, streams, and rivers throughout the state.
- Having dedicated permanent staff to develop expertise and capacity to conduct monitoring activities where needed will provide efficiency, consistency and quality assurance, free up time for biologists to be project managers, and reduce the need for LTE retraining. This funding would supplement or replace current spending on LTEs.

Support for Water Quantity Information

- Support existing contracts with USGS, UW Extension volunteer monitoring programs, and LTE support to increase the capacity for lake and wetland water level and stream flow monitoring, and identify and upload historical data.
- This funding would build capacity for water quantity information required under the Great Lakes Compact and to assist with water withdrawal permitting decisions - water levels, stream flows and springs)

Water Information Systems enhancements

- This request funds programming support to implement needed integration and upgrades to core water information systems used for federal and state reporting, permit decisions, and condition information (SWIMS, WATERS, SWDV)
- Supplemental to existing funding (WWI) which has been static and not keeping up with increased demands.

Baseline water quality monitoring for lakes, wetlands, and streams

- Additional funding will allow WI to move toward a targeted watershed approach, address emerging monitoring needs, and enable more waterbodies and watersheds to be sampled on an annual basis.
- These funds would be used to augment existing funds for lab analysis, contracts, equipment and supplies, travel, and LTE support.

Appendix B: Prioritized Recommended Actions and Gap Analysis

Tracking	Responsible Group	Area	H, M, L	Date (or Gap)	Recommendation
1.0 Strategy Maintenance and Implementation – Core Monitoring Team					
1.1	Monitoring Section and Tech Team Coordinators	Core Program	High	**December** – Annual Progress report	• Review and update Water Resources Monitoring Strategy (2015) annually to incorporate new science and tools, program needs, water resources priorities, and USEPA requirements. Prepare annual report on the implementation success of the Monitoring Strategy by January 1st of each year.
1.2	Monitoring Section	Program Performance Measure	High	2015-2016	• Assemble **strategy implementation workgroup** to identify and oversee implementation of priorities and products with goals, specific staff/teams, timelines, and accountability measures on an ongoing basis and to update these priorities and accomplishments through online tools
1.3	Strategy Work Group	Performance Measure	High	2015-2016	• Build upon existing lines of communication with other agencies and partners through regular liaison positions, meetings, & workshops for success. Share strategy and build collaborative relationships.
1.4	Strategy Work Group	Tracking & Communication	High	2015-2016	• **Document progress on strategy priorities**, identify tracking and communication tools, update the DNR's internal and public facing websites with the updated monitoring strategy, and create a calendar/schedule for coordination work in the coming biennium.
1.5	Monitoring Section and Tech Team Coordinators	Tracking & Communication	High	Check in w/biologists in Winter 2015 and May 2016	Complete FY15 reports and closeouts for and document the status of work for **statewide probabilistic and fixed site monitoring** as described in the monitoring strategy and as required in annual work plan for Field Season 2015-16 including: • Natural Community Random and Long Term Trend (LTT) Streams, • Long Term Trend Rivers and River Macroinvertebrates and Lake Satellite, • Long Term Trend Lakes, and • Reference Aquatic Plant Lakes.
1.6	Monitoring Section and Tech Team Coordinators Database Coordinators (Shupryt, Helmuth, Hein)	Tracking & Communication	High	Check in w/biologists in Winter 2015 and May 2016	• Complete FY15 reports and closeouts for **Prescribed Monitoring** (Targeted Watershed, Follow-up, and Directed Lakes) projects that are approved and funded for FY16. • Projects are maintained in SWIMS and data is entered and reviewed for completeness (stations, labslips, field data, methods/ procedures, equipment, data quality, and final reports). **Final reports are linked in SWIMS** and new findings are incorporated into the WATERS system through watershed planning and/or narrative updates.
1.7	Monitoring Section and Tech Team Coordinators Database Coordinators (Shupryt, Helmuth, Hein)	Tracking & Communication	High	Check in w/biologists in Winter 2015 and May 2016	• Complete FY15 reports and closeouts for **Local Needs and CWA Section 319 Project Eligible monitoring** as approved and funded. Data is entered in SWIMS and reviewed for completeness (stations, data quality, and applicable final reports). Each year, final reports for projects are linked in SWIMS and new findings are incorporated into the WATERS system in a timely manner.
1.8	Monitoring Section and Tech Team Coordinators Database Coordinators	Tracking & Communication	High	2016	• Complete FY15 reports and closeouts for **response and evaluation activities** including response to fish kills, storm events, spills, harmful algal blooms, etc., or responding to requests for evaluation of water quality data to support permit issuance and compliance (APM, Chapter 30, WPDES, high capacity wells, FERC, etc.).
1.9	Monitoring Section	TWA Development	Medium	GAP	• A formal schedule for incorporating key resource areas as into the work planning process and follow through by technical teams and WR PMT Managers. • Streams, Rivers (2013-14) • Aquatic Invasive Species (2014-15) • Lakes (2015-16) • Wetlands (2016-17) • Springs (2016-17)
1.10	Monitoring Section	Reporting	High	2016-17	• Wisconsin should annually publish the results of monitoring in online reports that are easily accessible to the public.

Tracking	Responsible Group	Area	H, M, L	Date (or Gap)	Recommendation
2.0 Rivers / Streams Technical Team Products – Mike Shupryt					
2.1	Rivers / Streams Technical Team	**River Study Designs**	High	2015-2016	Continue to update **study designs:** • Long Term Trend Rivers v2.2, WQ Monitoring 2015 • River Macroinvertebrate Monitoring (v2.0), WQ Monitoring 2015 • Follow Up Monitoring (V 1.1) , WQ Monitoring 2015 [see below] • National Rivers and Streams Assessment 2016
		Stream Study Designs	High	2015-2016	• Wadeable Trend Reference Sites (LTT Streams) V 1.1 Study Design, WQ Monitoring 2015 • Natural Community Stratified Random Monitoring Study Design (V1.1), WQ Monitoring 2015 • Targeted Watershed Site Selection Tool 2015 • Water Action Volunteers Stream Monitoring (Review Existing) • Targeted Watershed Approach 2016
2.2	Rivers / Streams Technical Team	Assessment metrics and standard operating procedures	High	2015-2016	• Refine monitoring protocols for **follow up monitoring** when following up on "Poor" biologic scores including protocols to detect less frequent or less widespread stressors.
			High	2016	• Refine or develop monitoring and assessment measures (metrics) and collection protocols (SOPs) for physical habitat and sedimentation in streams and rivers. • Update additional SOPs including:
			Medium	2016	• Increase capability (documentation, training, protocols) to collect high frequency and **event-based flow monitoring.**
2.3	Rivers / Streams Technical Team	Study design, capacity, and site selection	Medium	2016	• Review **wadeable trend Reference site** network and determine if adding addition or rotating sites are necessary. Add high frequency chemical data collection to reference site network.
2.4	Shupryt, Miller, Diebel, and Tech Team	Reporting	Medium	2015-2016 Winter	• Develop **calendar** and **long-term plan for Baseline and TWA monitoring** programs.
2.5	Watershed Planning/ Streams Tech Team	TWA/WQ Planning	High	2015-2016 Winter	• Create/ **update guidance for blending planning and river/stream and lake monitoring** processes and outputs/final reports.
2.6	Rivers / Streams Technical Team and Monitoring Section	Study Design	High	TWSST Tool 2015	• **Target land use to determine stream monitoring locations**. We should target land uses and practices to determine where we have the greatest monitoring needs.
2.7	Rivers / Streams Technical Team	study design, capacity, and site selection	Medium	GAP	• Develop a **"toolbox" of stressors to monitor f**or when following up on a "Poor" biologic sample. May be different stressors regionally.
2.8	Rivers / Streams Technical Team and Assessment Team	study design, capacity, and site selection	Medium	GAP	• Develop a **protocol to determine what length of stream** is represented by a single station (may be parameter specific) using scientific justification.
2.9	Rivers / Streams Technical Team	study design	Medium	GAP	• Collect more **event based samples** at targeted sites
2.10	Stream Baseflow Monitoring	study design, capacity, and site selection	Medium	GAP	• **Monitor stream baseflow** in existing projects and studies to gain an understanding of stream flow conditions and to manage change in response to existing and proposed catchment alterations.
3.0 Lakes Technical Team Products – Katie Hein					
3.1	Lakes Technical Team	Data Management	Medium	GAP ($$$)	• Update SWIMS capacity to capture **aquatic plant data and calculate biocriteria metrics** [Request Funding for FY17 Contracts]
3.2	Lakes Technical Team	Levels and Flows	Medium	2016	• Lake level monitoring by volunteers (partnered with professional surveyors) initiated on approximately 20 lakes in 2015. **Complete monitoring and summarize data**.
3.3	Lakes Technical Team	Parameter creation	Medium	2016	• Work on developing and refining **lake assessment parameters** (e.g., aquatic plant biocriteria, diatom biocriteria, shoreland habitat health, etc.) for both the integrated reporting process as well as the designated use/biocriteria refine monitoring protocols when following up on "Poor" biologic scores including protocols to detect less frequent or less widespread stressors.
3.4	Lakes Technical Team	Reporting	Medium	2016	• Continue to work on providing improved and accessible data for lakes both through online system and consistent reports.

Tracking	Responsible Group	Area	H, M, L	Date (or Gap)	Recommendation
3.5	Lakes Implementation Team - Groundwater	Lakes, GW Teams	High	2016	• Develop **a groundwater quantity and quality monitoring program** including water level and flow to assess groundwater / baseflow quantity information needs. Additional parameters related to groundwater quality could also be developed.
3.6	Monitoring and Evaluation Sections	Monitoring	high	GAP	• Develop a monitoring program and develop standards for Harmful Algal Blooms.
3.7	Monitoring and Evaluation Sections	Monitoring	high	GAP	• Develop a monitoring program for human pathogens on inland beaches.
3.8	Monitoring and Evaluation Sections	Monitoring	low	GAP	• Develop a monitoring program at near shore stations in addition to traditional testing at the deepest point of the lake.
3.9	Monitoring and Evaluation Sections	Monitoring	Medium	GAP	• Develop second biocriteria indicator for lakes and new monitoring design to collected necessary data
3.10	Monitoring Section	Data management	high	GAP	• Funding and staff to integrate new monitoring programs into existing databases
4.0 Wetlands Technical Team Products - Tom Bernthal					
4.1	Monitoring Section and Management	Communication	High	Begin in 2015 – plan by 2016	• Team Formation The team mission, membership and structure encompass both ambient monitoring as well as site specific evaluation of impacts on wetlands. Staff needed to seek approval for the team creation, write up an issue brief and receive supervisor approvals for participation on the team.
4.2	Monitoring and Groundwater Programs	Resource integration	High	2015-2017	• Groundwater and Wetland Issues in the Central Sands: Progress to support wetland impact evaluation and groundwater drawdowns from high capacity well permits have been initiated through a collaborative project between the wetlands staff and the Water Use Section of the Groundwater and Drinking Water Bureau. The proposal includes plans to add a wetland component to an ongoing hydrologic study of wetlands by installing wells/piezometers and gathering baseline vegetation data.
4.3	Monitoring and Wastewater program	Resource integration	High	2015-2017	• Wastewater Wetland Impacts This work involves analyzing potential impacts from wastewater discharges on wetlands, which has long been a concern for wetland biologists and ecologists. A small group was formed to create training and guidance on stormwater impacts to wetlands.
4.4	Wetlands Technical Team	standard operating procedures	High	2015-2017	• Continue to update wetland monitoring and assessment procedures and study designs and outcomes to be published and shared. • Share existing procedures and SOPs and put in consistent format for storage and accessibility on DNR's SWIMS application, EGAD guidance system and DNR's website. • Identify specific documents that are "done" and which are planned for the coming year.
4.5	Wetlands Technical Team	restoration assessment	Medium	2015-2017	• Assess whether the restoration/ mitigation projects meet restoration or ecosystem goals. • Identify how these goals intersect with Clean Water Act Reporting Assessments.
4.6	Wetlands Technical Team	Reporting	Medium	2015-2017	Increase frequency and accessibility of wetland assessment or condition data through migration into IT infrastructure. • Location of wetlands assessments in WATERS. • Location of wetland monitoring in SWIMS. • Wetland restorations loaded and used in SWDV, WCV • Potentially restorable wetland areas in SWDV, WCV • Identify additional surveys WRAPs, FQIs and others and where and how they should be stored and used in programs.
4.7	Wetlands Technical Team	Assessments	Low	2016	• A plan for using the Wisconsin Wetland Rapid Assessment Methodology of Function and Condition (WRAM) in the water quality program needs to be developed.
4.8	Wetlands Technical Team	Assessment and reporting	Low	2016	• Develop Routine FQA Monitoring and Incorporate into Clean Water Act reporting.
4.9	Wetlands Technical Team	Study design and assessments	Medium	2017	• As FQA benchmarks are linked to Tiered Aquatic Life Uses the Department will be in a position to incorporate FQA surveys into the water resources monitoring program, with staffing and a funding structure. At this point in time we envision applying FQA to provide a measure of wetland condition at a watershed scale through the use of probabilistic survey design.

Tracking	Responsible Group	Area	H, M, L	Date (or Gap)	Recommendation
4.10	Wetlands Technical Team	Study design and assessments	Very High Priority	2015-2018	• The wetland datasets and monitoring results need to be moved to a shared location and better integrated with the SWIMS system and SDE feature class environment so that staff may use the fruits of the wetlands evaluation and assessment tools more readily. Further, wetland site level functional assessments need to be integrated into the water resource monitoring system, with staffing and training needs assessed.
4.11	Wetlands Technical Team	Study design and assessments	Low	2017	• "Rapid FQA" – After 2017 we will have a large data set in the neighborhood of 700 sites. Through data analysis and an expert group process we may be able to select a subset of species that can be tested for use in a "Rapid FQA" as MN has done. FQA metrics would be calculated using the subset of species to see if they yield similar results compared to the full species list. A list of 200-300 species would allow practitioners to focus on learning these rather than the full WI wetland flora.
4.12	Wetlands Technical Team	Study design and assessments	Low	2016	• The program evaluation of the usefulness of Floristic Quality Assessment in all sectors of the Department where it is in use should be conducted after 2-3 years of implementation, and subsequently every 5 years.
4.13	Wetlands Technical Team	Training and Outreach	Low	2017	• Train staff in the use of the WRAM v. 2
4.14	Wetlands Technical Team	Training and Outreach	Medium	2016	• Opportunistically gather WRAM v. 2 assessments from water regulatory staff. Continue to provide training to water regulatory staff. Incorporate the assessment data into SWIMS.
4.15	Wetlands Technical Team	Study design and assessments	Low	GAP	• Complete the conversion of the Wisconsin Wetland Inventory to National Wetland Inventory system. Design a stratified random sampling scheme based on hydro geomorphic (NWI+) class for targeted watersheds.
4.16	Wetlands Technical Team	Study design and assessments	Medium	GAP	• Integrate the watershed scale and the site scale functional assessments. Use WAWFA for coarse level planning uses and as a screen for selecting Assessment Areas for on the ground WRAM v.2 functional assessments. WRAM v 2 Assessments can serve as ground truth for watershed scale assessments. Apply this approach to pilot targeted watershed in 2017-2019. Evaluate results of pilot project and refine methods.
4.17	Wetlands Technical Team	Study design and assessments	Medium	GAP	• Collecting WRAM Results to characterize wetland condition and function: The area of analyzing WRAM (wetland rapid assessment methodology results from site assessments where wetland permits have been issued is a new area of study for the wetland group. This initiative involves ensuring that WRAMs are completed for all individual and general permits by train water quality biologists and stormwater staff to use WRAM and by exploring efficient ways to capture WRAM surveys for storage and access in an accessible database.
4.18	Wetlands Technical Team	Study design and assessments	Medium	GAP	• Floristic Quality Assessment Development The continuation of this critical wetland assessment and function tool continues. The team is working on developing Floristic Quality Assessment Benchmarks during 2016 research and is developing an outline for implementing FQA bioassessment as a routine part of watershed condition monitoring.
4.19	Wetlands Technical Team	Study design and assessments	Medium	GAP	• The following items from the Monitoring Strategy are identified as areas to implement in years 3-5 of the Monitoring Strategy: SOP Development: Continue to update wetland monitoring and assessment procedures and study designs and outcomes to be published and shared.
4.20	Wetlands Technical Team	Study design and assessments	Medium	GAP	• Restoration assessment: Assess whether the restoration/ mitigation projects meet restoration or ecosystem goals.
4.21	Wetlands Technical Team	Study design and assessments	Medium	GAP	• Reporting: Increase frequency and accessibility of wetland assessment or condition data.
5.0 Safety Training Program					
5.1	WR PMT Training Coordinator and Technical Teams	Safety and Training Coordinator	Medium	2016-2017	• Design and implement a **safety and training program for water quality biologists** that may include modules related to bioassessment, aquatic plant identification, water quality monitoring, statistical analyses, and related.
5.2	Monitoring Section	Quality Assurance	Medium	GAP	• Top quality training for biologists and accessible documentation of training records for each employee;
6.0 Information Technology and Data Integrity					
6.1	Information Technology Workgroup	System maintenance	High	2015-2016	• Maintain oracle/GIS databases including SWIMS, WATERS, SWDV, intranet SWDV, Water Condition Viewer, dynamic webpages, and custom tools such as the Targeted Watershed Site Selection Tool.
6.2	Information Technology Workgroup	System maintenance	High	2016	• Update the Water Quality Bureau Information Technology plan from 2008 with emphasis on new technologies, program

Tracking	Responsible Group	Area	H, M, L	Date (or Gap)	Recommendation
					changes, and training and help guides for IT products that support monitoring.
6.3	SWIMS Integrity Group	It Systems	High	GAP	• Help ensure stable systems with adequate backup, adequate memory, 'bug/error' monitoring and journaling of actions to identify problem actors, users.
6.4	SWIMS Integrity Group	It Systems	High	GAP	• Long-term vision team to modernize and enhance system accessibility including mobile options, tablet forms, infield data entry, topical search and display and more.
6.5	SWIMS Integrity Group	IT Systems	Low	2016/17	• Continue working with **partnership monitoring programs** linking with federal partners through the Environmental Data Exchange Network and hosted by the Water Division to increase data comparability, increase the potential for collaboration with other entities collecting ambient water quality information, and make data available to the public.
6.6	Monitoring/Assessment Staff	Assessment Evaluation	High	2015/16	• Wisconsin should provide a summary report regarding what percentage of waters in **WATERS are navigable and assessed in its Integrated Report on online**.
6.7	Information Technology Workgroup	IT System Managers	High	Winter/Spring 2016	• Update help guides, videos, and skype outreach with focus on special groups: Great Lakes, Volunteers, Mississippi River Teams, etc.
7.0 Clean Water Act Standards, Assessment, and Monitoring – WQ Bureau					
7.1	Biocriteria Designated Use Assessment Team	Designated Use Biocriteria	High	GAP	• Create user interface data entry pages, parameter code programming, statistical packages for assessments for **algal biomass and diatom taxa assessment** in our databases at some point.
7.2	Triennial Standards Review	CWA assessment procedures	Medium	GAP	• Implementing consistent CWA assessment procedures for the **Upper Mississippi River** that may follow protocols developed by the UMRBA WQ Task Force or which may influence UMRBA recommendations.
7.3	Biocriteria Designated Use Assessment Team	WES Assessment Designated Use Biocriteria	High	2015-2016	• Design the template for tiered aquatic life uses and numeric biological criteria for wadeable streams and test their application in the two pilot watersheds that were assessed in 2010 and 2011.
7.4	Biocriteria Designated Use Assessment Team	WES Assessment Designated Use Biocriteria	High	2015-2017	• Apply the Natural Communities model to determine the appropriate class and as validated by the ambient biological, chemical, and physical data; Supports WPDES • Determine the appropriate TALU tier that applies to each stream and stream segment; • Complete an aquatic life use assessment using the appropriate TALU tier biocriteria for each assemblage as the primary basis for attainment or non-attainment; • Use the accompanying chemical/physical and other stressor data to determine the proximate causes and sources of impairment and threat; • Use the results of the attainment and stressor analyses to determine how to assign appropriate management recommendations and/or actions to include WPDES permitting, TMDLs, nonpoint source management, or any other management program; and, • Utilize this experience to determine what tools are needed and if any existing tools need additional development.
7.5	Monitoring, Fisheries and Assessment Staff	Database Infrastructure, Management	High	2015-16	• Integration of new findings and model results, including modeled natural communities based on flow and temperature projections, into database infrastructure to identify specific biological potential of a stream or river or lake. (John Lyons, Methodology for Streams Natural Communities, 2013).
7.6	WES Staff	Standards and Assessments	High	2015-16	• Procedures to validate or change modeled natural community/temperature classes for flowing waters. (John Lyons, Methodology for Streams Natural Communities, 2014).
7.7	Monitoring Section	Technical Tool Development		GAP	• Develop relationships between the habitat assessment tool and the biocriteria indices as this will be needed in the determination of the appropriate TALU tier within the Natural Community class in which it applies. Habitat is a critical factor in the attainability of aquatic life uses for warm water streams and rivers. Supports WPDES
7.8	Bioassessment Review	Technical Tool Development	Medium	GAP	• When a biological impairment exists habitat is the key variable in the determination of use attainability absent the confirming evidence of biological attainment. As part of this approach strong consideration needs to be given to using a quantitative or qualitative habitat evaluation index (QHEI) given its practical-to-apply characteristics and its demonstrated use for this purpose elsewhere.

Tracking	Responsible Group	Area	H, M, L	Date (or Gap)	Recommendation
7.9	Bioassessment Review	Technical Tool Development	Medium	GAP	• Develop relationships between key chemical/physical and other common stressors and the biological indices and their attributes. This specifically refers to the use of biological assessment data to develop relationships between measures of biological response and anthropogenic stressors. This includes the exploration of developing biological response signatures in addition to correlative analysis with chemical/physical parameters and indicators.
7.10	Bioassessment Review	Technical Tool Development	Medium	GAP	• A capability for developing these relationships extends the use of biological assessments from assessing condition to informing identification of causes and sources of a biological impairment at multiple scales.
7.11	Bioassessment Review	Technical Tool Development		GAP	• The association of biological response with stressors and their sources affecting aquatic systems requires a comprehensive database that should include: o Biological, chemical, physical, and Whole Effluent Toxicity (WET) data and information; o Detailed watershed and land use information; o Locations of discharges and discharge monitoring; o Geographic Information System (GIS) capability to assemble watershed and discharge information and relate them to the correct sampling sites.
7.12	Bioassessment Review	Technical Tool Development		GAP	• Creation of paired biological and other relevant environmental data support developing quantitative stress-response relationships is needed along with a relational database that enables data export and analysis via query.
8.0 Mississippi River Monitoring Activities – Asplund & Designee					
8.1	Mississippi	Program Development	Medium	GAP	• Insufficient field support to carry out system-wide CWA assessments following new biological assessment procedures/methods.
8.2	Mississippi	Triennial Standards Review	Low	GAP	• WQ assessment procedures need to be developed for off-channel aquatic areas including impounded, backwaters and wetlands.
8.3	Mississippi	Monitoring assessments	Medium	GAP	• Need an improved process for capturing LTRM data and using it state CWA assessments, including the derivation of Fish and SAV IBIs.
8.4	Mississippi	Triennial Standards Review	Medium	GAP	• UMR States need to develop consistent assessment procedures for the Mississippi River rather than having five state assessment procedures for the river.
8.5	Mississippi	*Funding issues on hold*	Low	GAP	• The Mississippi River Unit needs to obtain funding to support implementation of the UMRBA WQ Task Force WQ Monitoring Strategy for the UMR.
8.6	Mississippi	assessments	Medium	GAP	• Future monitoring assessments should not focus solely on 305b/303d evaluations but be supportive of more WQ program needs.
8.7	Mississippi	Triennial Standards Review	Medium	GAP	• Future WQ standards, sediment criteria and FCAs for the UMR should be consistent between states where appropriate.
9.0 Cross Program Recommendations – WQ, WT, FH and DG Programs					
9.1	Runoff / Monitoring	BMP Team	High	2015-2016	• Implement **runoff management monitoring studies** for BMP Evaluation (Monitoring to evaluate the success of best management practices); Nine Key Element Plan Development (Monitoring to collect data for Nine Key Element Plans)
9.2	TMDLS / Monitoring	WARP and TMDL Teams	High	GAP	• Implement runoff management monitoring for **TMDL Development** – Runoff Dominated (Monitoring to develop TMDLs for runoff dominated catchments with waters impaired primarily due to diffuse pollutant sources).
9.3	Monitoring Program/ USEPA Program	Reporting	Medium	GAP	• Wisconsin to amend the Environmental Performance Partnership Agreement (EnPPA) between the State and EPA to reflect the changes that this strategy recommends.
9.4	Monitoring Section	TWA/Watershed Planning	High	2016	• Confirm a TWA/WQ Planning formal schedule, complete with study design, protocols, funding, and implementation schedule to incorporate key resource areas into the work planning process using technical teams and WR PMT Managers.
9.5	Monitoring Section	TWA/Watershed Planning	High	2015-2016	• Support **Intra-bureau communication plan** to ensure program guidance is developed to implement all or a portion of the TWA processes. Guidance would include planning, implementation, analysis of results and sharing those results through water quality planning and other means.

Tracking	Responsible Group	Area	H, M, L	Date (or Gap)	Recommendation
9.6	WQM planning program staff	AWQM Planning		GAP	• Wisconsin DNR also has a goal to coordinate a statewide framework of high quality, consistent, and scientifically defensible methods and strategies to improve the monitoring, assessment, reporting, implementation and most importantly, the condition, of Wisconsin's water. This framework is part of the state's continuous planning process (CPP) Plan, which should be updated every five to ten years.
9.7	WPDES Program	Study Design		GAP	• Develop a rotational monitoring program within TWA to support WPDES needs.
9.8	WPDES Program	Quality assurance		GAP	• Train staff on utilization of WET testing and other methods to support enforcement actions using case studies
9.9	WPDES Program	Quality Assurance		GAP	• Limit calculators need access to wetland data and expertise.
10.0 Management Budget and Program Communication - Asplund, WR PMT					
10.1	Management Team	Partnership funding	Medium	GAP	• Support existing contracts with USGS, UW Extension volunteer monitoring programs, and LTE support to increase the capacity for lake and wetland water level and stream flow monitoring, and identify and upload historical data.
10.2	Management Team	Monitoring Volunteers	Medium	GAP	• Citizen-based Water Monitoring Data Quality Funding Increase Coordinator (1 FTE): $~90,000 annually. This position would provide stable funding and support for volunteer water monitoring to ensure that the data being collected are useful for Department decision-making. This work is currently supported by LTE employees through the EPA Monitoring Initiative funding.
10.3	Management Team	TMDLS Funding	Medium	GAP	• A stable funding source is needed for TMDL monitoring and model development, particularly for large scale projects.
10.4	Management Team	Intrabureau IT support Base Program Support	Medium	GAP	• Water Information Systems enhancements Funding Increase $100,000 annually. Funds programming support to implement needed integration and upgrades to core water information systems used for federal and state reporting, permit decisions, and condition information (SWIMS, WATERS, SWDV). This funding supplements existing funding (WWI) which has not kept up with increased demands.
10.5	Management Team	TWA Development	Medium	GAP	• Baseline water quality monitoring for lakes, wetlands, and streams funding increase $400,000 annually. Additional funding for the targeted watershed approach, address emerging monitoring needs, and enable more waterbodies and watersheds to be sampled on an annual basis. These funds would be used to augment existing funds for lab analysis, contracts, equipment and supplies, travel, and LTE support.
10.6	Management Team	Monitoring capacity	Medium	GAP	• Water Resources Monitoring Technicians Funding Increase (4 FTE): ~$225,000 Annually. This would create 4 new technician level positions to conduct baseline and targeted monitoring of lakes, wetlands, streams, and rivers throughout the state.
10.7	Management Team	Partnership Outreach	Medium	GAP	• Work closely with stakeholders to develop and implement the most effective data collection, evaluation, and reporting tools so that we can communicate a consistent message regarding Wisconsin's water quality.
10.8	Monitoring Section	Partnership Outreach	Medium	GAP	• Wisconsin also emphases improving intra-agency, inter-agency, and stakeholder coordination of programs and data sharing.
10.9	WQ Management	It Systems	Medium	GAP	• Water Division should provide base program support for IT system maintenance funding and upgrades for monitoring and assessment program protocols results (WisCALM) and monitoring strategy (2015-2020) compliance.
10.10	Monitoring Section	Partnership Outreach	Medium	GAP	• Build stronger partnerships with agencies, watershed groups, volunteer monitors, and others to facilitate the sharing of information, the collection of comparable data, and the use of monitoring tools.
10.11	Monitoring Section	Partnership Outreach	Medium	GAP	• Develop and evaluate measures to determine the effectiveness of our program activities and make modifications to improve that effectiveness.
11.0 Quality Assurance/Data Integrity – Helmuth & Core Team					
11.1	Quality Assurance Workgroup	Data Integrity	Medium	2016-17	• Carry out SWIMS Data Integrity Plan developed in 2013 (incorporate the plan elements into the Bureau's strategic IT plan)
11.2	Quality Assurance Workgroup	Data Accessibility	Medium	2015-2017	• Ensure that data is easily accessible as well as product reports and summary information for use in final product [reports, maps, analyses, published studies] (*)
11.3	Quality Assurance Workgroup	Quality Assurance Reporting and Document Generation	Medium	2016-2017	• Update quality assurance management plan and quality assurance program plan, both established in accordance with USEPA policy, to ensure the validity of monitoring and laboratory activities and fulfillment of state reporting requirements with credible and comparable data. The updated quality assurance management plan should be updated to include new

Tracking	Responsible Group	Area	H, M, L	Date (or Gap)	Recommendation
					study designs, project manager perspectives, database capabilities, and requirements from federal, state and local entities.
11.4	Quality Assurance Workgroup	Technical Team documentation	Medium	GAP	• Develop specific quality assurance guidelines for each study design. Recommendations will work through technical teams and will be incorporated into database "controls" to reinforce data entry rules and ability to more readily fill out information.
11.5	Quality Assurance Workgroup	QA Process with QA Program Coordinator	Medium	2016-2017	• Consult with quality assurance project plan officer consultation when creating quality assurance project plans for large studies. [how often does this happen, when does it happen, where are they stored, EGAD?]
11.6	Quality Assurance Workgroup	QA Process with QA Program Coordinator	Medium	GAP	• Quality assurance project plans (for large studies) or quality assurance checklist (to be developed) are submitted with project proposals as a prerequisite for funding
11.7	Quality Assurance Workgroup	Quality Assurance	Medium	2016 (DUP?)	• Ensure all studies have completed quality assurance aspects documented (see QA Checklist and/or SWIMS REPORT)
11.8	Quality Assurance Workgroup	Quality Assurance	Medium	2016 (DUP SEE 11.13)	• Complete an ongoing inventory and strategic gap analysis of monitoring protocols, methods and procedures.
11.9	Quality Assurance Workgroup	Springs - Data (See also IT group)	Medium	2017-2018	• The Wisconsin Geological and Natural History Survey (WGNHS) manage a database of springs. Data from this study will be added to the WGNHS database as well as the WDNR's Register of Waterbodies and the Water Assessment, Tracking and Electronic Reporting System (WATERS). Geolocating springs in the WATERS database is a component of the state's surface water assessment work.
11.10	Quality Assurance Workgroup	Study Design& SOP Documentation	Medium	2015-2016 (IN PROGRESS)	• Create Targeted Watershed Approach (TWA) procedures and methods and store them in the SWIMS system.
11.11	Quality Assurance Workgroup	Quality Assurance in Strategy and Updates	Medium	2015-2016 (IN PROGRESS)	• Wisconsin's strategy update includes a thorough section on quality assurance measures to be incorporated in the monitoring program and throughout the project planning, as well as a template for detailed QAPP documents for large monitoring projects and an auto generated "QAPP" for all projects in the SWIMs database.
11.12	Quality Assurance Workgroup	Quality Assurance Subteam (to be developed)	Medium	GAP	• Wisconsin will include in its five-year implementation strategy **creation of a quality assurance program initiative** that will address the three legs of this quality assurance goal.
11.13	Quality Assurance Workgroup	Quality Assurance Documentation (Technical Teams and IT Teams)	Medium	2015-2016 (IN PROGRESS)	• **Completed high-quality, easily accessible, documented methods and protocols for all core media studies.** [A major element of Monitoring Strategy implementation work will involve completion of an ongoing inventory and strategic gap analysis of monitoring protocols, methods and procedures. Not only will the presence of a documented procedure be evaluated but the training and implementation of that documented procedure will be evaluated to ascertain whether sufficient training and support is provided for new and veteran staff to carry out their work successfully.]
11.14	Quality Assurance Workgroup	Training and Outreach	Medium	GAP [design, plan, conduct, write up]	• Top quality training for biologists and accessible documentation of training records for each employee.
11.15	Quality Assurance Workgroup	In field Quality Assurance via Technical Teams	Medium	GAP	• Evaluation of how methods have been carried out in the field through follow up procedures including surveys, discussions, focus groups or technical team reminders and check ins.

Appendix C: Monitoring Strategy Five and Ten Year Plan

Monitoring studies and support material for short and mid-range planning	Study Design	SOPs	2015 (FY16)	2016 (FY17)	2017 (FY18)	2018 (FY19)	2019 (FY20)	2020 (FY21)	2021 (FY22)	2022 (FY23)	2023 (FY24)	2024 (FY25)
Statewide	**Status**	**Status**	**#sites**	**#sites**	**#sites**	**#sites**	**#sites**	**#sites**	**#sites**	**#sites**	**#sites**	**#sites**
Rivers												
Long Term Trend River Water Quality Monitoring Network	FINAL	50% Complete	44	44	44	44	44	44	44	44	44	44
Biotic Integrity River Sites	FINAL	100% Complete	22	0	0	0	0	0	0	0	0	0
Holistic Large River Monitoring Network	In Develop ment	50% Complete	0	20	20	20	30	30	30	30	30	30
National Rivers and Streams Assessment – Probabilistic Study	FINAL		0	0	0	50	40	0	0	0	50	40
Streams												
Wadeable Trend Reference Streams	FINAL	50% Complete	44	44	44	44	44	44	44	44	44	44
Natural Community Stratified Random Monitoring Program	FINAL	50% Complete	50	50	50	50	50	50	50	50	50	50
Targeted Watershed Approach – Streams	DRAFT	50% Complete	48	48	48	48	48	48	48	48	48	48
Targeted Watershed Approach - 319 Projects - Streams	DRAFT	50% Complete	72	72	72	72	72	72	72	72	72	72
Water Action Volunteers - Stream Monitoring	FINAL	100% Complete	200	100	100	100	100	100	100	100	100	100
Stream Baseflow Monitoring	DRAFT	50% Complete										

Monitoring studies and support material for short and mid-range planning	Study Design	SOPs	2015 (FY16)	2016 (FY17)	2017 (FY18)	2018 (FY19)	2019 (FY20)	2020 (FY21)	2021 (FY22)	2022 (FY23)	2023 (FY24)	2024 (FY25)
Lakes												
Probabilistic Survey (National Lakes Assessment)	2012, 2016	2012, 2016 (100%)	0	0	50	0	0	0	0	50 (100)	0	0
Long Term Trend Lakes (LTT Lakes)	100%	50% Complete	62	62	50	50	50	50	50	50	50	50
Sentinel Lakes among the LTT Lakes	0% (new)	0% (new)	0	0	8	8	8	8	8	8	8	8
Aquatic Plant Reference Lakes	New	100% Complete	0	12	12	12	12	12	12	12	12	12
Citizen Lake Monitoring Network	100%	100% Complete	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Satellite Monitoring - Secchi	100%	50% Complete	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000
Directed Lake Surveys (and follow-up monitoring)*	New	30% Complete	31	40	40+	40+	40+	40+	40+	40+	40+	40+
Lake Level Monitoring	New	90% Complete	85	105	115	120	120+	120+	120+	120+	120+	120+
Wetlands												
Planned Floristic Quality Assessment (FQA) Benchmark Surveys (W1)	FINAL	(W1) 100% Complete	200	100	140							
Planned Floristic Quality Assessment (FQA) Benchmark Surveys (W2)	FINAL	2016 W2										
Planned Floristic Quality Assessment (FQA) Benchmark Surveys (W3)	FINAL	2018 W3				Bench Marks						
Future FQA Surveys in Targeted Watershed Assessments (assume 3 TWAs with 50 sites each)	NA	50% Complete	NA	NA	NA	NA	150	150	150	150	150	150
Watershed Approach Wetland Functional	PARTIAL	50% Complete	50	100	Finalize method	NA	NA	NA	NA	NA	NA	NA

Assessment (WAWFA) - Ground truth Surveys												
Monitoring studies and support material for short and mid-range planning	**Study Design**	**SOPs**	**2015 (FY16)**	**2016 (FY17)**	**2017 (FY18)**	**2018 (FY19)**	**2019 (FY20)**	**2020 (FY21)**	**2021 (FY22)**	**2022 (FY23)**	**2023 (FY24)**	**2024 (FY25)**
Future Watershed Approach Wetland Functional Assessment Surveys in TWAs	NA	NA	NA	NA	NA	150	150	150	150	150	150	150
Planned National Wetland Condition Assessment (2016) - Probabilistic	FINAL	50% Complete		21	NA	NA	NA	NA	21	NA	NA	NA
AIS												
AIS Incident Reporting												
AIS Probabilistic (Baseline Statewide Monitoring–Early Detection)												
AIS Water Quality Biologist Stream Monitoring												
Citizen Lake Monitoring Network – Aquatic Invasive Species												
Aquatic Invasive Species–Project Riverine Early Detection												
Aquatic Invasive Species–Snapshot Day (pilot)												
Mississippi River												
Wisconsin's Long Term Trend Monitoring												
Environmental Management Program (EMP) Long Term Resource Monitoring Program (LTRMP)												

Monitoring studies and support material for short and mid-range planning	Study Design	SOPs	2015 (FY16)	2016 (FY17)	2017 (FY18)	2018 (FY19)	2019 (FY20)	2020 (FY21)	2021 (FY22)	2022 (FY23)	2023 (FY24)	2024 (FY25)
Zebra Mussel Longitudinal Studies												
Large River Soft Sediment Macroinvertebrate Sampling												
Habitat Project Evaluation												
Great Lakes												
Cladophora/Nutrient												
Contaminated Sediment												
Great Lakes Fishery Assessment												
Lake Michigan Major Tributary Phosphorus Loading												
Pathogen Indicator												
Public Water Intake Monitoring												
Cross Program Monitoring or Special Study Projects												
Background Concentrations - Permits												
Baseflow data collection												
BMP Evaluation												
Contaminants in Fish Tissue												
Enforcement, Spills and Kills - Permits												
Groundwater Monitoring – Quantity and Quality												
Nine Key Element Plan Development												

Monitoring studies and support material for short and mid-range planning	Study Design	SOPs	2015 (FY16)	2016 (FY17)	2017 (FY18)	2018 (FY19)	2019 (FY20)	2020 (FY21)	2021 (FY22)	2022 (FY23)	2023 (FY24)	2024 (FY25)
Permit Compliance - Permits												
Permit Compliance, Innovation in Effluent Limit Determination - Permits												
Public Beach Health Surveys– Coastal Surveys												
Sediment Screening, Monitoring												
Source Water Assessment Monitoring												
Springs Inventory												
TMDL Development – Runoff Dominated Watersheds												
Total Maximum Daily Load (TMDL) Development [Modeling, Load Allocation]												
Waterbody Use Designation												
WQS Development, Revision, or Evaluation												

** Indicates number of sites sampled, whether Study Design Document is complete and if all SOPs are written up and complete.

"Complete" means the write ups are final and the documents are publicly available.

*Directed Lakes surveys included 19 lakes for follow-up chemistry monitoring and 12 lakes that included plant and habitat surveys

Appendix D: Crosswalk of Monitoring Studies and WisCALM Parameters

Table indicating which parameters are sampled and if these parameters are used for the WisCALM Assessment Methodology. (**Green** (In WisCALM), **Yellow** (Future WisCALM), **Blue** (Additional Data)). "X" indicates that the monitoring program fully meets WisCALM data requirements, and "P" means that the program partially meets data requirements (e.g. 1 TP sample) or that the program may collect the parameter but does not always do so. Waterbodies with insufficient data are flagged and prioritized for additional required monitoring by other programs such as Follow Up, Directed Lakes, and Targeted Watersheds.	Total Phosphorus	Chlorophyll *a*	Secchi Depth	Chlorides	TSS	Continuous Dissolved Oxygen	Continuous Temperature	Dissolved Oxygen	Temperature	pH	Qualitative Habitat	Quantitative Habitat	Macroinvertebrates	Fish Community	Sediment Chemistry	Aquatic Plants	Aquatic Invasive Species	Flow Monitoring	E. coli	Fecal Coliform	Zooplankton
Rivers																						
Long Term Trend River Water Quality Monitoring Network	X	X		P	X			P		X								X	X			
Biotic Integrity River Sites													P									
National Rivers and Streams Assessment – Probabilistic Study	P	P		P	P					P									P			
Streams																						
Wadeable Trend Reference Streams	P				P	P	X	P		P		X	X	X			X	X				
Natural Community Stratified Random Monitoring Program	P							P		P	X		P	P			X	X				
Targeted Watershed Approach – Streams	X				P	P	P	P		P	X	P	P	P			X	X				
Water Action Volunteers - Stream Monitoring	X			X			X															
Follow Up Monitoring	X			P		P	X			P		X	X	X								
Lakes																						
Probabilistic Survey (National Lakes Assessment)	P	P	P					P	P	P	P		X		X		P					X
Long Term Trend Lakes (LTT Lakes)	X	X	X					X	P	X	X					P	P					
Aquatic Plant Reference Lakes			X													X	P					
Citizen Lake Monitoring Network^	X	X	X					X	P								P					
Satellite Monitoring - Secchi~			X																			
Directed Lake Surveys (and follow-up monitoring)	X	X	X					P	P	P	X					X	P					
Wetlands																						
Floristic Quality Assessment (FQA) Benchmark Surveys																						
Watershed Approach Wetland Functional Assessment (WAWFA)																						

Table indicating which parameters are sampled and if these parameters are used for the WisCALM Assessment Methodology. (Green (In WisCALM), Yellow (Future WisCALM), Blue (Additional Data)). "X" indicates that the monitoring program fully meets WisCALM data requirements, and "P" means that the program partially meets data requirements (e.g. 1 TP sample) or that the program may collect the parameter but does not always do so. Waterbodies with insufficient data are flagged and prioritized for additional required monitoring by other programs such as Follow Up, Directed Lakes, and Targeted Watersheds.	Total Phosphorus	Chlorophyll *a*	Secchi Depth	Chlorides	TSS	Continuous Dissolved Oxygen	Continuous Temperature	Dissolved Oxygen	Temperature	pH	Quan. Habitat	Qualitative Habitat	Macroinvertebrates	Fish Community	Sediment Chemistry	Aquatic Plants	Aquatic Invasive Species	Flow Monitoring	E. coli	Fecal Coliform	Zooplankton
AIS																					
AIS Incident Reporting																	X				
AIS Probabilistic (Baseline Statewide Monitoring–Early Detection)			P														X				
AIS Water Quality Biologist Stream Monitoring																	X				
Aquatic Invasive Species–Project Riverine Early Detection																	X				
Aquatic Invasive Species–Snapshot Day (pilot)																	X				
Mississippi River																					
Wisconsin's Long Term Trend Monitoring																					
Environmental Management Program (EMP) Long Term Resource Monitoring Program (LTRMP)				`																	
Zebra Mussel Longitudinal Studies																					
Large River Soft Sediment Macroinvertebrate Sampling																					
Habitat Project Evaluation																					
Great Lakes																					
Lake Michigan Major Tributary Phosphorus Loading																					
Great Lakes Fishery Assessment																					
Pathogen Indicator																					
Contaminated Sediment																					
Cladophora/Nutrient																					
Public Water Intake Monitoring																					
Cross Program Monitoring or Special Study Projects																					
Source Water Assessment Monitoring																					
WQS Development, Revision, or Evaluation																					
Waterbody Use Designation																					
Permit Compliance, Innovation in Effluent Limit Determination																					
Background Concentrations																					

Table indicating which parameters are sampled and if these parameters are used for the WisCALM Assessment Methodology. (Green (In WisCALM), Yellow (Future WisCALM), Blue (Additional Data)). "X" indicates that the monitoring program fully meets WisCALM data requirements, and "P" means that the program partially meets data requirements (e.g. 1 TP sample) or that the program may collect the parameter but does not always do so. Waterbodies with insufficient data are flagged and prioritized for additional required monitoring by other programs such as Follow Up, Directed Lakes, and Targeted Watersheds.	Total Phosphorus	Chlorophyll *a*	Secchi Depth	Chlorides	TSS	Continuous Dissolved Oxygen	Continuous Temperature	Dissolved Oxygen	Temperature	pH	Quan. Habitat	Qualitative Habitat	Macroinvertebrates	Fish Community	Sediment Chemistry	Aquatic Plants	Aquatic Invasive Species	Flow Monitoring	E. coli	Fecal Coliform	Zooplankton
Baseflow data collection																						
Permit Compliance																						
Enforcement, Spills and Kills																						
Total Maximum Daily Load (TMDL) Development [Modeling, Load Allocation]																					X	
BMP Evaluation																						
Nine Key Element Plan Development																						
TMDL Development – Runoff Dominated Watersheds																						
Contaminants in Fish Tissue																						
Public Beach Health Surveys– Coastal Surveys																				X		
Springs Inventory																						
Groundwater Monitoring – Quantity and Quality																						
Sediment Screening, Monitoring															X							
Partner Monitoring																						
USGS	X			X	X																	
County Health Surveys (beach monitoring)																				X		
^subset of CLMN lakes monitored for water chemistry																						
~satellite data are used for assessments, but additional chemistry data is needed to list as impaired																						

Appendix E: Small Group Monitoring Strategy Study Teams

I. WPDES Related Monitoring – Paul LaLiberte

Monitoring done by DNR involving a significant staff effort and can be foreseen sufficiently to be incorporated into work plans

- Update use designations for receiving waters of existing WWTPs using new protocols. Committee currently meeting to formulate guidance.
    - Natural Community Verification guidance to be posted in EGAD.
    - Additional sections and rule promulgation are also needed.
    - Automation of verification process underway. Work is underway to verify communities in summer 2014.
    - Prioritize NC verification fieldwork based on data age, likelihood for change and permit expiration.
- Evaluate effect of existing discharges on receiving waters (e.g. upstream/downstream studies). WDNR does not currently conduct this work systematically.
    - Develop guidance for including a point source element in TWA studies.
- Toxicity special investigations.
    - Inform staff by sharing examples of past experience using receiving stream WET data to follow-up on effluent WET problems.
        - Guidance is available for staff use when performing toxicity testing in response to a spill or suspected illicit discharge, at: http://dnr.wi.gov/topic/wastewater/documents/Chap1x13SpillsToxTesting.pdf.
        - Other WET guidance (sampling for WET tests, toxicity identification studies, etc.) can also be found at: http://dnr.wi.gov/topic/wastewater/WETguidance.html.
- Complex downstream point of standard application issues (pollutant decay, wetland attenuation, etc)
    - Use a team clearinghouse approach rather than guidance document due to pending phosphorus court cases. Make limit calculators aware of WR local needs project planning system.
    - Limit calculators group needs access to wetlands expertise.
- DNR initiated upstream chemistry sampling to determine background concentration involving more than minimal effort water quality sampling. Adverse consequences of the current approach of using regional default values are probably minimal both environmentally and economically in most cases.
    - Might need an effort in the future due to new standards (TSS, nitrogen, E coli) or existing standards mercury, chloride, arsenic regulation.
        - Update the datasets used to identify default concentrations for some parameters.
- Flow measurements for systematic update of 7Q10 estimates (climate change?)

Monitoring done by DNR in response to developing circumstances that typically does not involve significant time or expense.

- Simple downstream point of standard application issues or upstream background issues that can be settled with minimal effort water quality sampling. Utilize WPDES SLOH sampling account code WW014.
    - Update the datasets used to identify default concentrations for some parameters. Flow measurement to refine 7Q10 estimates **[HIGH PRIORITY]**
    - Consultation on monitoring plans from WPDES permit holders

Monitoring done by DNR in response to developing circumstances that involves significant time or expense (extensive water quality sampling or biological monitoring)

- Use designations for proposed new outfalls. Guidelines for designating Fish & Aquatic Life Uses for WI Surface Waters (2004) This pertains primarily to designations of wetland or effluent ditch. Other designations are by default until NC use designation system is better developed.
    - Need clarification of current practice of waterbody use designations related to recent changes. [DONE]

        - Lisa, Diane and Kristi will compile a history of the history of this issue. [DONE]
- Site specific phosphorus criteria development. (likely a joint DNR / permitee effort) guidance document under development (draft available soon).
    - The guidance document may identify the need for DNR to get ahead of the effort with some limited biological recon sampling or evaluation of existing data.
- Monitoring in support of enforcement actions. No guidance available other than manure spills. Some guidance exists for WET.
    - Develop example case studies to share with WW and WR staff in lieu of more guidance.

Receiving water monitoring primarily done by WPDES Permittee

- Permittee initiated upstream sampling to refine effluent limits:
    - Guidance for thermal limits and thermal mixing zones are in http://dnr.wi.gov/topic/surfacewater/documents/ThermalGuidance2edition8152013.pdf.
    - Guidance for phosphorus limits are in http://dnr.wi.gov/topic/SurfaceWater/documents/Phosphorus_Guidance_Signed.pdf

- Dissipative cooling investigations and alternative effluent limitations for temperature (usually a facility effort with minimal assistance from DNR staff)
    - Guidance in http://dnr.wi.gov/topic/surfacewater/documents/ThermalGuidance2edition8152013.pdf

- Mixing zone investigations for other parameters.
    - Mixing Zone Guidance (1992); Effluent Limits Calculation Guide: Water Quality Rules Implementation Plan, PUBL-WT-511-98
- Chemistry sampling to support regulation of dissolved metals
    - Effluent limits calculation guide. Water Quality Rules Implementation Plan, PUBL-WT-511-98; Dissolved-Based Special Monitoring Requirements In Permits, Thoughts by Tom Mugan 2/10/00.
- WET testing of receiving waters
    - http://dnr.wi.gov/topic/wastewater/wetguidance.html
- Section 316(b) of the Clean Water Act requires that permitting authorities ensure that the location, design, and capacity of cooling water intake structures reflect the best technology available to minimize harmful impacts on the environment.
    - EPA promulgated regulations in 2001-2006 and 2014 at 40 CFR Parts 122 and 125 (Subparts I, J, and N) that require facilities with intake structures (in Wisconsin, mostly power plants and paper mills) to collect biological data (fish and shellfish types & abundance) in the area around their intake.
    - Some guidance is available at: http://dnr.wi.gov/topic/wastewater/intakestructures.html. Additional guidance to address the new 2014 federal rule is under development.

(9/25/2014)

II. Levels and Flows Related Monitoring

Topical Area: Water Quantity -- Levels and Flows Monitoring		
Leadership:	Tim Asplund	
Small Team Members:	Shaili Pfeiffer	Jeff Helmuth
	Kris Stepenuck	Katie Hein
	Mark Hazuga	Matt Diebel
	Tom Bernthal (Wetlands)	Lori Tate (Fisheries)
Charge:	Group is charged with identifying specific monitoring work to fulfill program requirements. Funding/work will change with the change to program and project-based funding.	
Monitoring Objectives:	Water Quantity Data is needed for multiple management purposes: • Stream Flow Monitoring – August/Baseflow, Q7/10, other • Lakes – Lake Level Monitoring • Surface Water Assessments – High Cap Well Reviews (wetlands, springs, stream and river impacts)	
Overall Monitoring Approach/Design best suited to achieve each objective (targeted, random, fixed sites, etc)	Streams: -long-term, fixed monitoring stations -target streams not monitored by other entities (e.g., USGS monitors about 600 sites, none of which are <10 cfs) -target headwater streams, low flow periods, frac sand mine areas, the central sands, and better statewide coverage in general Lakes: -long-term, fixed monitoring stations -target seepage lakes -add lakes for better statewide coverage (e.g., northwest Wisconsin)	
Indicators/ Parameters	Streams: stream flow (cubic feet per second) 1. Flow meter across a stream cross-section 2. Install staff gage and develop rating curve? 3. WAV float method Lakes: lake stage (meters above sea level): 1. staff gage installed in spring and surveyed in spring and fall 2. piezometer near lake shore – only to be used near lakes with homogenous, porous geology	

Scale and Frequency of sampling	Streams: Unknown? Lakes: At least monthly during ice-free season, as frequently as possible
Prioritization of waterbodies/watersheds	Streams: • Small streams and headwater streams • Areas of the state deemed high priority (in regards to data needs and gaps) by DNR staff representing various waters programs • Areas of the state sensitive to groundwater withdrawals (e.g., for irrigation or sand mining) • Areas of the state where there are active volunteer stream monitors Lakes: 1. Seepage lakes 2. Regions with little to no existing lake level monitoring data (northwest, north central, northeast, central east) 3. Higher priority for regions vulnerable to groundwater withdrawal (sand and gravel) 4. Higher priority to lakes currently monitored for water quality by dedicated volunteers
Who does it (DNR staff, partners, volunteers, etc)	Streams: 1. County staff (Central Sands area) 2. WAV 3. DNR stream biologists 4. DNR fisheries staff 5. George Kraft – UW Steven's Point 6. USGS Lakes: 1. DNR staff on selected Long Term Trend Lakes 2. County staff – coordinators, surveyors 3. Citizen Lake Monitoring Network volunteers – make lake level observations; select individuals may be able to do surveys 4. Consultants – survey staff gages 5. Non-profits – survey staff gages and coordinate volunteers 6. Other? There is a need to find qualified staff who can survey staff gages in spring and fall. The hope is to fund network hubs in various parts of the state that can be responsible for coordinating volunteers and surveying gages. For example, North Lakeland Discovery Center does so for Vilas County. 7. UW Center for Limnology – monitors lake levels in Vilas and Dane Counties 8. USGS – monitors 10 seepage lakes across the state in addition to several large lakes (e.g. Green Lake, Lake Geneva)

III. Quality Assurance Quality Control Elements

Topical Area: Quality Assurance Quality Control Elements		
Leadership:	Lisa Helmuth	
Small Team Members:	Donalea Dinsmore	Molli MacDonald
	Kris Stepenuck	Katie Hein
	Mike Shupryt	Lori Tate (Fisheries)
	Filbert, Jennifer M - DNR	Miller, Michael A - DNR
	Person, Ruth A - DNR	Bernthal, Thomas W - DNR
	Arneson, Ronald C - DNR	
Charge:	Group is charged with identifying specific quality assurance control issues, existing tools, and gaps for the 2014 update of the Monitoring Strategy. In particular, the group identified items to address during strategy implementation.	
Team Objectives:	• Monitoring Program Quality Assurance Project Plan (Surface Waters) • Monitoring Program QAPP Detailed Template(s) • Monitoring Program Auto-Generated Template for QAPP. • Creating rolling list of issues that might be addressed through implementation.	
Overall Approach	**Specifically:** • Identify ongoing quality control processes for all WDNR monitoring including data integrity plans for databases. **An QAQC Inventory Matrix was created for this.** • Create QAPP Template for projects and flow of review and signoff for complex projects. **Multi-Agency Projects to use formal protocol. Others program generated qaap, requiring specific data filled into SWIMS.** • Identify key elements to include in QAPP generated by SWIMS (required fields, logic). • Create template/format/storage location and routine tasks for creating and accessing **study protocols, parameter collection methods**, and **equipment management** protocols / preparation, etc. • Create recommendations on training, storage of training records, and association of quality assurance information in SWIMS, Fish Management Database, and other pertinent databases.	
Indicators/ Parameters	o Study purpose, objectives and design filled out in SWIMS field. o Final report or conclusions filled out or attached on swims project.	
Prioritization of Work	• After a comprehensive list is created, priorities will be identified with media teams and QAQC Implementation Team.	
Who does it (DNR staff, partners, volunteers, etc)	DNR staff – biologists, project managers, grant managers – all dnr staff who manage projects and oversee monitoring work will help ensure the completeness of datasets with descriptions, purpose, collectors, study design, protocols, methods, equipment, results analyses and final report.	

IV. Runoff/Best Management Plan Evaluation

Topical Area: Nonpoint Source Program Monitoring Needs (CWA Section 319)		
Leadership:	Mike Shupryt	
Small Team Members:	Jim Amrhein	Corinne Billings
	Andrew Craig	Kevin Kirsch
	Mike Miller	Theresa Nelson
	Aaron Ruesch	Greg Searle
Charge:	Group is charged with identifying specific monitoring work to fulfill program requirements. Funding/work will change with the change to program and project-based funding. Note there are **three** objectives addressed by this group.	
Monitoring Objectives:	Monitoring to evaluate the success of best management practices.	
Overall Monitoring Approach/Design best suited to achieve each objective (targeted, random, fixed sites, etc)	Targeted, intensive monitoring is required in order to evaluate the effectiveness of BMPs. For WQ10 Performance measures (restoring an impaired waterbody) monitoring could be completed at the reach scale. For WQ-SP12 performance measures a watershed wide (HUC 12) monitoring design would be needed in order to show watershed wide improvements. In either case the best chance of showing improvements would be to identify watersheds where multiple BMPs and multiple landowners have installed practices over a relatively short time period. Gathering data on BMP installation with accurate locational and temporal data is a key element in order to best target monitoring activities in watersheds where there is the best chance of documenting success.	
Indicators/ Parameters	There are many entities (USGS, UW, etc.) working on showing the efficiency of BMPs with edge of field monitoring. We should be focusing on BMP effectiveness monitoring through in-stream water quality measures. Delisting streams as a result of BMP success is going to depend on the specific pollutant that was initially listed. The most likely pollutants will be total phosphorus and total suspended solids. In order to show whole watershed improvements other water quality measures could be used such as biology and load reductions.	
Scale and Frequency of sampling	Frequency of measurements for delisting will be based on WisCALM methodologies for delisting requirements for specific pollutants. In order to show load reductions biweekly chemical and flow samples may be required. For more intensive studies spatially intense sampling with continuous flows may need to be captured (USGS flow gauge or pressure transducers) along with event based WQ samples.	
Prioritization of waterbodies/watersheds	Priority watersheds for monitoring would include sites that had pre implementation data and high density BMP installation. Watersheds with approved TMDLs would meet both of these criteria and likely be good candidates. Other watersheds with high densities of BMPs installed that are not in TMDL watersheds could also be good candidates for showing watershed wide improvement and/or delisting. In order to show improvement it is important to select a performance measure(s) and stick to it through time at each location.	
Who does it (DNR staff, partners, volunteers, etc)	Monitoring would be done by DNR staff but multiple organizations are involved in BMP installation and funding including DNR, DATCP, NRCS, Counties, etc.	

Monitoring Objectives:	Monitoring to collect data for the development of a Nine Key Element Plans.
Overall Monitoring Approach/Design best suited to achieve each objective	Targeted watershed wide monitoring is essential for the development of Nine Key Element plans.
Indicators/ Parameters	Indicators to be monitored would include phosphorus, nitrogen and sediment associated with some in stream flow measurements. Loads can be estimated in order to establish a baseline for Nine Key Element plans so continuous flows may not be necessary in all areas of a watershed. Baseline data on land use is also critical in developing Nine Key Element plans.
Scale and Frequency of sampling	Spatially and temporally intense monitoring is required for developing Nine Key Element plans. Some measures of frequent flows are needed but can be estimated at the watershed scale so they are not necessary at all locations sampled. Performance of Nine Key Element plans can be measured through modelling the improvements of BMP installation but intensive monitoring can be included in order to achieve WQ10 or SP12 performance measures.
Prioritization of waterbodies/watersheds	Initially targeting of approved TMDL watersheds would lead to the development of Nine Key Element plans that would not require additional data collection. Secondarily, data collection in order to develop a Nine Key Element plan should be conducted at the HUC 12 level at sites where Counties or other partners have expressed interest in collaborating. Watersheds in Counties with lower interest could still be targeted for developing Plans but would likely be a lower priority. Using 106 monitoring funds for the development of Nine Key Element plans should be prioritized as once Plans are approved those areas are available to receive 319 project funds for future monitoring activities. There are limited watersheds in WI that have approved Plans for 319 project funds for monitoring activities.
Who does it (DNR staff, partners, volunteers)	Monitoring work conducted by DNR staff with the help of volunteers. Collaboration with Counties is critically in determining areas to prioritize for monitoring and Plan development.
Monitoring Objectives:	Monitoring to develop TMDLs for runoff dominated catchments with waters impaired primarily due to diffuse pollutant sources.
Overall Monitoring Approach/Design	Targeted watershed monitoring is required with a focus at monitoring sites at the pour points of major watersheds, sub-watersheds or tributaries.
Indicators/Parameters	Phosphorus, nitrogen and/or total suspended solids are required along with flow monitoring.
Scale and Frequency of sampling	Scale for monitoring is dependent on scale of the TMDL. Recently TMDLs have been conducted at the HUC 8 scale but the future direction is unknown. Sampling frequency is at minimum biweekly water quality and flow measurements. However, in many situations more frequent monitoring, event based water quality samples or continuous flow monitoring may be necessary.
Prioritization of waterbodies/watersheds	Prioritization of future TMDLs is unknown at this time.
Who does it (DNR staff, partners, volunteers, etc.)	DNR staff along with possible partners would be responsible for monitoring.

Appendix F: Recommendations from 2013-14 Bioassessment Report for TALU Implementation and Biocriteria Development

Based on the results of an evaluation of Wisconsin's compliance with the recommended USEPA's critical elements of a successful monitoring strategy, the Midwest Biological Institute (MBI) examined the capacity of the state's monitoring, assessments, and water quality standards programs to support the development and implementation of a Tiered Aquatic Life Use (TALU) - based approach in Wisconsin.

Major Recommendations

Based on the results of the critical elements evaluation and the examination of the capacity of both the M&A and WQS programs to support the development and implementation of a TALU based approach in Wisconsin the following are recommended as immediate considerations:

1. Determine the technical tasks that are needed to elevate the technical elements to the maximum score for each.

2. Consider a shift in emphasis from the Tier 1 statewide assessment to a Tier 2 watershed assessment scale at the 10-12 Huc scale of spatial resolution. While the importance of the WIDNR commitment to statewide reporting is recognized, that alone will not lead to the development of a credible TALU based approach.

3. Design the template for tiered aquatic life uses and numeric biological criteria for wadeable streams statewide considering the example in Figure 3.

4. Test their application in representative settings to include the following:

    - Apply the Natural Communities model to determine the appropriate class and as validated by the ambient biological, chemical, and physical data;
    - Determine the appropriate TALU tier that applies to each stream and/or stream segment;
    - Complete an aquatic life use assessment using the appropriate TALU tier biocriteria for each assemblage as the primary basis for attainment or non-attainment;
    - Use the accompanying chemical/physical and other stressor data to determine the proximate causes and sources of impairment and threat;
    - Use the results of the attainment and stressor analyses to determine how to assign appropriate management recommendations and/or actions to include WPDES permitting, TMDLs, nonpoint source management, or any other management program; and,
    - Utilize this experience to determine what new tools are needed and if any existing tools need additional development.

This should allow WIDNR to better determine and understand how a TALU based approach can be applied statewide and how the outcomes would be different than at present. We feel that this exercise will be useful to the eventual implementation statewide.

The following additional recommendations are made knowing that these will be needed for any state that would be implementing TALUs and biocriteria in the M&A and WQS programs:

5. Develop relationships between the habitat assessment tool and the biocriteria indices as this will be needed in the determination of the appropriate TALU tier within the Natural Community class in which it applies. Habitat is a critical factor in the attainability of aquatic life uses for warm water streams and rivers. Furthermore, when a biological impairment exists habitat is the key variable in the determination of use attainability absent the

confirming evidence of biological attainment. As part of this approach strong consideration needs to be given to using the QHEI given its practical-to-apply characteristics and its demonstrated use for this purpose elsewhere. WIDNR has been trained in this procedure so it makes sense to follow through in developing it further.

6. Develop relationships between key chemical/physical and other common stressors and the biological indices and their attributes. This specifically refers to the use of biological assessment data to develop relationships between measures of biological response and anthropogenic stressors. This includes the exploration of developing biological response signatures in addition to correlative analysis with chemical/physical parameters and indicators. A capability for developing these relationships extends the use of biological assessments from assessing condition to informing identification of causes and sources of a biological impairment at multiple scales. The association of biological response with stressors and their sources affecting aquatic systems requires a comprehensive database that should include:

   - biological, chemical, physical, and Whole Effluent Toxicity (WET) data and information;
   - detailed watershed and land use information;
   - locations of discharges and discharge monitoring;
   - Geographic Information System (GIS) capability to assemble watershed and discharge information and relate them to the correct sampling sites.

   Paired biological and other relevant environmental data support developing quantitative stress-response relationships is needed along with a relational database that enables data export and analysis via query. Based on the CE evaluation this should be readily available for Wisconsin rivers and streams.

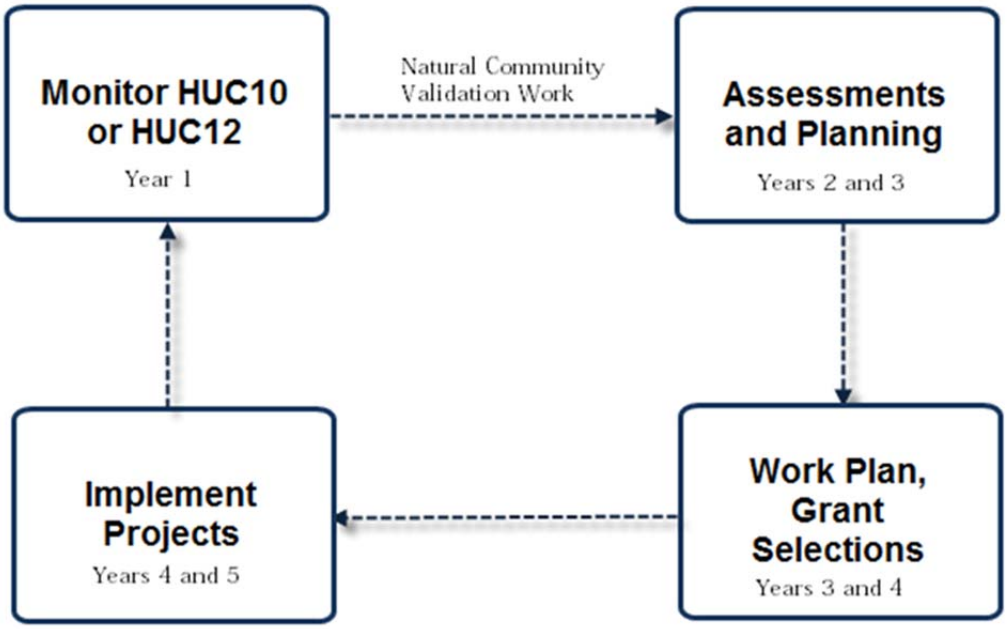
Appendix G: Wisconsin's Targeted Watershed Approach

Targeted Watershed Assessment (TWA) Approach is a new study design proposed as the foundation for Wisconsin's cross-program water integration work. This approach is designed to reinforce the flow of work that the water program conducts on a daily basis. Figure 3 below visually depicts the connectivity and flow between monitoring, assessments, and management/reporting.

The TWA strategy advances an integrated monitoring-assessment-planning-management approach that hinges on conducting specific work in a defined areal extent on a rotating basis – i.e., the "rotating watershed approach" for water resources management. This concept is not new to Wisconsin. In the 1980s, WDNR used a basin ("HUC 8 equivalent") rotation schedule on a five-year cycle for monitoring, assessments, planning and management.

The Monitoring Section proposes introducing a Targeted Watershed Approach (TWA) as an organizing framework for the FY16-FY18 work planning cycle for monitoring, assessment, planning and implementation work. The TWA holds significant promise for enhancing horizontal integration among dependent programs through providing a sequential cycle of standard actions that advance core water resources program work. One of the more prominent advantages of using the TWA as an organizing framework is the advanced scheduling of fieldwork and desktop analysis, preferably by biennium, which may help improve resource allocation, fieldwork efficiencies, and partnership collaboration success.

The TWA is an organizing framework that utilizes a flexible watershed selection process, a USEPA promoted network monitoring design, statistical and site specific assessment and planning tools to target high priority resources for key implementation work. This process can also tie in pass-through grant scoring criteria to help guide implementation work toward high priority areas, such as nine key element plan watersheds (TMDL Implementation areas), watersheds with a preponderance of data gaps related to water quality standards attainment/impairment listings, high priority catchments identified in the nutrient reduction strategy, as well as protection/restoration areas identified through the healthy watersheds initiative and related work. Monitoring is the first of a series of specific activities that experts will carry out for the given hydrologic area. The specific work and time needed in each of the five "modules" will vary depending on the resources involved and the type of TWA (BMP effectiveness, baseline, impairment evaluation, etc.).



What is involved in each element of the TWA process?

Targeted Watershed Assessment Monitoring – Year 1

1. Select watershed study area(s) based on priority variables.
2. Design study based on watershed / resources (intensity, parameters, sites etc.).
3. Create project/stations in SWIMS.
4. Generate fieldwork event labslips.
5. Prepare equipment, review protocols.
6. In spring, summer, fall collect samples and send to labs.
7. Begin fisheries data entry and habitat data entry (probably 5-6 up to 10, 15? fish/habitat combinations surveys at minimum per watershed?)

Natural Community Validation & Assessments – Year 1 – 2

1. Return to watershed to conduct follow up monitoring as necessary
2. Review natural communities for all waters in monitored watersheds.
3. Request and update NC data layers as per protocols.
4. Run fIBIs against updated natural communities.
5. Ensure GIS data reflects FIBI data (in CWA Viewer).

Assessments, Models, Watershed Planning – Year 2- 3

1. Receive macroinvertebrate data from UWSP in SWIMS (mIBI and other metrics).
2. Run fIBI, mIBI, chemistry, habitat reports and analyze data using multi-parameter Integrated Reporting 5-part assessment categorization protocols.
3. Enter assessment decisions into WATERS.
4. Document resource issues, goals, recommendations for monitoring projects, future work (WATERS)
5. Public Review/Comment period on watershed plan.
6. Transmit plan to USEPA for approval.

Work Plan with Watershed Plan Recommendations – Year 3- 4

1. Review recommendations from watershed plans (geolocated, mapped) and identify/create implementation projects.
2. Prepare work plans with items from #1 above in mind.
3. Document in WATERS/SWIMS which items will be followed up/conducted.

Implement or Fund Projects identified in previous year – Year 4- 5

(From recommendations based on funds and resource needs)

1. Work on projects stemming from monitoring and analysis, including: impaired waters listings/delistings, nine key elements planning, funding of grants (rivers, lakes, runoff, etc.).
2. Document updates in water quality or work implemented in SWIMS Actions on the Assessment Unit. (Note all these are reportable to USEPA).
3. List key waters/watersheds to track over time for follow up monitoring, actions or other work.

Is the TWA a baseline study or a targeted study?

The monitoring element of the TWA approach is a blend of both baseline and targeted resources. The Water Resources Program will *identify high priority watersheds based on water condition, program priorities, and partnership readiness variables*. Individualized monitoring study designs will be created for watersheds to reflect both "baseline" elements as well as the additional needs of the resources. This may involve targeted or effectiveness monitoring depending on the resource issues and conditions. The local needs of the watershed will drive the content of the intensification areas.

Is the TWA just for streams and rivers or all water resources?

The Targeted Watershed Approach is envisioned as an integrated framework that will initially involve monitoring streams and which will gradually add lakes and wetlands. However the TWA study design may more efficiently and effectively address collection of AIS, baseflow and springs inventory data in the future. The following is a proposal for adding these types of elements to the TWA design.

- Streams, Rivers (2013-14)
- Aquatic Invasive Species (2014-15)
- Base flow (2015-16)
- Lakes (2015-16)
- Wetlands (2016-17)
- Springs (2016-17)

In many of the media-specific monitoring strategy sections, a placeholder for addressing the TWA framework is identified. As protocols and methods are developed to address the additional resource data gathering processes, and as trained staff expertise becomes available, formal TWA procedures and methods will adapt to include the collection of additional data for these additional resources of interest.

Key Steps to implement the Targeted Watershed Approach

➔ Create Targeted Watershed Approach (TWA) procedures and methods and store them in the SWIMS system.

➔ Confirm a formal schedule, complete with study design, protocols, funding, and implementation schedule to incorporate key resource areas into the work planning process using technical teams and Water Resources Policy and Management Team (WR PMT) Managers. The following are suggested years for rolling resource monitoring into the TWA approach.

- Streams, Rivers (2013-14)
- Aquatic Invasive Species (2014-15)
- Base flow (2015-16)
- Lakes (2015-16)
- Wetlands (2016-17)
- Springs (2016-17)

➔ Support Intra-bureau communication plan to ensure program guidance is developed to implement all or a portion of the idealized TWA processes as described above. The guidance would include planning, implementation, analysis of results and sharing those results through water quality planning and other means.

Appendix H: Water Resources in Wisconsin – Overview of Resources

Resource Descriptions

Rivers and Streams

The state contains an estimated 88,000 stream miles from approximately 54,000 discrete rivers and streams; however, fewer stream miles (42,468) are delineated and documented in the Department's WATERS database. However, the database contains a majority of the larger streams and rivers in the state.

Fish and aquatic life (FAL) use is the primary assessed use in streams/rivers – 19,625 stream miles (46% of stream miles in the WATERS database) have been assessed for FAL use support. Of the stream miles assessed, approximately 70% are supporting FAL uses. The FAL use assessments are primarily based on Indices of Biotic Integrity calculated from macroinvertebrate sample and fish survey data. A very small amount of stream miles have been assessed for fish consumption and recreational uses, as these assessments are often conducted in response to a known problem or specific program need, such as a county health department monitoring program for swimming uses.

Lakes

Recreation and fish and aquatic life (FAL) uses are the primary designated uses assessed for lakes (Table 2 and Figure 4). WDNR assessed FAL use of 793,899 lake acres using a combination of in-lake water quality samples and water clarity data gathered from satellite imagery. Wisconsin's Citizen Lake Monitoring Network data, combined with satellite imagery analysis developed by the WDNR's Bureau of Science Services, contributed greatly to the 2014 assessments. Over 1,200 volunteers who sample 800 lake stations each year; this data is extrapolated based on modeling techniques with satellite data to provide assessments for over 6,000 lakes in the state. Based on these assessments, approximately 69% of assessed lake acres are supporting the FAL use. The recreation use of over 50,000 acres of additional lakes was assessed in this reporting cycle.

The number of assessed waters in Wisconsin reflects the use of automated analysis and investments in information technology tools. For example, the Department uses a customized "assessment package" that generates trophic state index values (TSI values) for lakes in the state. TSI values are usually ascertained by comparing the results of sample data against a set of condition thresholds derived from Carlson's Trophic Status Index. However, as in other states such as Michigan and Minnesota, Wisconsin routinely processes TSI values extrapolated from satellite imagery correlated with Secchi depth readings gathered by Citizen Lake Monitoring Network volunteers. These data are used to calculate general assessments for lake fish and aquatic life use. This method provided the state with significantly more lake assessments in 2014, bringing the number of lakes assessed for fishable, swimmable waters to over 80%. This is a significant accomplishment, particularly given the magnitude of waters in the state and the technical work involved in the analysis.

Impoundments

Impoundments are bodies of water created by structures (dams) which hold water either permanently or in a controlled fashion. Many of Wisconsin's large impoundments provide electricity service, controlled through the FERC process. Similar to natural lakes, WDNR primarily assesses the recreation and fish and aquatic life (FAL) uses for impoundments. Due to landscape and morphological features of impoundments (sediment transport, collection of nutrients and algal debris, a majority of impoundments assessed do not support fishing and swimming and are listed as impaired (75,139 acres, 63%) and a large majority of impoundments assessed (83,064 acres or 95%) do not support recreation use (Table 3). Due, in part, to the accumulation of sediment behind riverine structures and proclivity of pollutants (organic contaminants and metals) to attach to sediment, a large proportion of impoundments (80,906 acres or 89%) do not support fish consumption (i.e., these waters have specific advise that recommend strict limits on the number and type of fish consumed).

Beaches

Wisconsin's beaches provide wildlife habitat, recreation areas and tourist destinations. Beaches are especially vulnerable to agricultural, urban and industrial land uses, and some of our beaches are showing the effects of improper land management practices. Still, of the approximately 55 miles of Great Lake and inland beaches assessed, 39 miles (71%) supported recreation use. Conversely, 16 miles (29%) of beaches did not support recreation use, primarily due to elevated levels of E. coli – a bacterial indicator of potential risks to human health.

Great Lakes Shoreline

Wisconsin has roughly 1,000 miles of Great Lakes Shoreline, with only a fraction of those shoreline miles considered assessed for Fish and Aquatic Life uses (see Table 5 and Figure 9). Many of these waters' fish and aquatic life uses are impaired due to sediment contamination from historic discharges or "legacy" pollutants. As staff and fiscal resources allow, WDNR will conduct a more comprehensive assessment of the Great Lakes shorelines in the future.

Multi-State Resources and Programs

Mississippi River

Wisconsin's Mississippi River reach runs 230 miles from the confluence of the St. Croix to the Illinois Border and includes a diverse array of aquatic and terrestrial habitat within this corridor. Eighty percent of this reach (182 miles) is part of the Upper Mississippi River National Wildlife and Fish Refuge, which runs from the Chippewa River mouth to Rock Island, Illinois. The U.S. Corps of Engineers dredges (roughly 1 million yd^3 annually) to maintain a 9-ft navigation channel and operates 10 locks and dams to facilitate commercial and recreational navigation traffic through Wisconsin's reach.

In 1986, Congress recognized the Upper Mississippi River System (UMRS) as a nationally significant ecosystem and navigation system (Public Law 99-662). Wisconsin shares its water resource management responsibilities on the Mississippi River with adjoining states (Iowa and Minnesota) and federal agencies and participates in numerous interagency work groups, committees and associations. The Department carries out water quality, fisheries and wildlife management program functions on the Mississippi River through the operation of the Mississippi River Team at La Crosse, Wisconsin (WDNR 1992).

Wisconsin conducts water quality monitoring on the Mississippi River with state-funded programs and federal funding as part of the U.S. Corps of Engineers Environmental Management Program (EMP) Long Term Resource Monitoring Program (LTRMP). Monitoring conducted with federal support is primarily conducted by the Department's field station at Onalaska, Wisconsin.

Mississippi River water quality monitoring is established through the development of work plans as directed by the Water Division. Monitoring efforts conducted by the LTRMP follow operational plans, cooperative agreements and scopes of work prepared by USGS with input from federal-state partners (EMP Coordinating Committee and LTRMP Analysis Team) (USFWS, 1992).

State-sponsored monitoring activities on the Mississippi River have primarily focused on fixed station, intensive, synoptic and screening-level sampling designs. The federal LTRMP utilizes a probabilistic sampling design (stratified random sampling) as part of its monitoring in Pool 8 (also Pool 4 by MDNR).

Great Lakes

The Great Lakes, including their bays and harbors, represent a water resource of major significance to Wisconsin's aquatic life, recreational uses, drinking water supply and economy. Monitoring of these vast water resources relates directly or indirectly to nearly every component of this monitoring strategy. As such, it is not possible to put all of the Great Lakes monitoring components in one section of this Strategy. However Section 5.8 provides an overview of the categories and goals of the core monitoring work directly related to the primary water quality program needs.

Baseline Monitoring for the Great Lakes includes three primary activities:

- Lake Michigan Major Tributary Phosphorus Loading.
- Great Lakes Fishery Assessment.
- Pathogen Indicator Monitoring on Great Lakes Beaches.

Great Lakes monitoring also involves other projects including:

- Contaminated Sediment is an Evaluation Monitoring and is widespread in the Great Lakes.
- Cladophora/Nutrient monitoring of near shore waters of Lake Michigan is also conducted as a targeted program.

- Lakes Superior and Michigan have 15 public water intakes that are monitored according to the Safe Drinking Water Act, using the same protocols as Public Drinking Water Well Monitoring.

Great Lakes monitoring generally represent activities conducted in conjunction with a variety of federal, state and local partners. A number monitoring and restoration projects are funded to address Area of Concern-specific issues in the five AOCs.

Great Lakes Restoration Initiative (GLRI)

The Great Lakes Restoration Initiative was launched in 2010 to accelerate efforts to protect and restore the largest system of fresh surface water in the world — the Great Lakes. During FY15 -19, federal agencies will continue to use Great Lakes Restoration Initiative resources to strategically target the biggest threats to the Great Lakes ecosystem and to accelerate progress toward long term goals for this important ecosystem.

GLRI Action Plan II summarizes the actions that federal agencies plan to implement during FY15-19.

These actions will build on restoration and protection work carried out under the first GLRI Action Plan, with a major focus on:

- Cleaning up Great Lakes Areas of Concern
- Preventing and controlling invasive species
- Reducing nutrient runoff that contributes to harmful/nuisance algal blooms
- Restoring habitat to protect native species

Implementation of Wisconsin's Great Lakes Strategy

Wisconsin's Great Lakes Strategy provides the necessary details to help support and implement the recommended action items of the Great Lakes Regional Collaboration Strategy. The Office of the Great Lakes facilitate role in project development for the restoration and protection of the Great Lakes in Wisconsin. As restoration monies become available, it will be important to promote and utilize existing mechanisms for accomplishing projects. Existing partnerships such as the Lake Superior Binational Forum will play a key role in striving to achieve the goals articulated in the Strategy. Specific examples of project proposals for implementing Wisconsin´s Great Lakes Strategy can be found in the 2009 updated strategy document below. Please note: this document is not intended to be a comprehensive list of implementation projects and is subject to change.

- 2013–2014 DNR Action Plan for Lake Superior [PDF]
- Wisconsin's Great Lakes Strategy 2009 update [PDF]
- 2006 Wisconsin's Great Lakes Restoration and Protection Strategy [PDF]
- DNR Testimony about Restoration Plan by Todd Ambs [PDF]
- Great Lakes Restoration Initiative
- Great Lakes Regional Collaboration Strategy [exit DNR]
- Wisconsin's Great Lakes Strategy Brochure [PDF]

Appendix I: Glossary

- **319 (Non-point) Project Evaluation –** The 1987 amendments to the Clean Water Act (CWA) established the Section 319 Nonpoint Source Management Program. Section 319 addresses the need for greater federal leadership to help focus state and local nonpoint source efforts. Under Section 319, states, territories and tribes receive grant money that supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects.

- **AIS – Aquatic Invasive Species –** Aquatic invasive species (AIS) (sometimes called exotic, invasive, nonindigenous or non-native) are aquatic organisms that invade ecosystems beyond their natural, historic range. Their presence may harm native ecosystems or commercial, agricultural, or recreational activities dependent on these ecosystems. They may even harm our health.

- **ALUS – Aquatic Life Use Suppor**t – A system of setting up, analyzing, and regulating ambient water quality based on the potential or attainable aquatic life use that is possible or achievable if human-induced pollution was removed.

- **Antidegradation –** A technical term referring to the CWA requirement that no degradation of waterbodies. The Department is expected to review discharges for antidegradation whenever limits increase, whether they're water quality-based or technology-based. Increases aren't prohibited under NR 207, but the Department is required to evaluate whether the increase is needed and whether it's socially and economically justifiable, even when it increases based on new criteria.

- **Attainment Decision** – Estimating the designated use (or compliance with water quality standards) attainment.

- **Baseflow** – Baseflow (also called drought flow, groundwater recession flow, low flow, low-water flow, low-water discharge and sustained or fair-weather runoff) is the portion of streamflow that comes from "the sum of deep subsurface flow and delayed shallow subsurface flow". It should not be confused with groundwater flow.

- **Beach Action Value (BAV)** – BAV stands for beach action value. The BAV is the marine recreational water quality standard used to determine if bacteria levels are unsafe for water contact. When a single marine water sample has bacteria levels at or above the BAV, a health advisory is issued. Once a health advisory is issued, people are asked to avoid water contact until the health advisory is lifted.

- **Bioassessment –** Biological assessments are evaluations of the condition of waterbodies using surveys and other direct measurements of resident biological organisms (macroinvertebrates, fish, and plants).

- **TALU** - **Tiered Aquatic Life Use Approach –**The TALU based approach includes tiered aquatic life uses (TALU) based on numeric biological criteria codified in WQS. Implementation is via an adequate ambient monitoring and assessment program that includes biological, chemical, and

physical measures, parameters, indicators and a process for stressor & source identification.

- **Biological Criteria** - The presence, condition and numbers of types of fish, insects, algae, plants, and other organisms provide important information about the health of aquatic systems.

- **BPJ - Best Professional Judgment** - At the foundation of professional judgment is a form of knowledge--called practical wisdom--which is not formally taught and learnt but is acquired largely through experience and informal conversations with respected peers. Wisdom develops through "the critical reconstruction of practice," including deliberation.

- **CFU- a colony-forming unit (CFU)** is a unit used to estimate the number of viable bacteria or fungal cells in a sample.

- **CLMN – Clean Lakes Monitoring Network** – Wisconsin's volunteer monitoring program for lakes.
- **Consistency Plans (Manual code 1210.1)** Each division produces guidance ("Consistency Plan") that details a process for ensuring consistency in developing and implementing policy and guidance applicable to program procedures, technical information, customer service and other core business functions. http://intranet.dnr.state.wi.us/int/mb/codes/MC1210-1.pdf

- **Cross program communication** – purposeful communication engaging the interests and needs of multiple programs across division and bureaus.

- **Directed Lake Assessment (including APM and Critical Habitat)** - Directed Lakes involves collecting chemical, physical and biological data; the prescriptive nature of the study helps with coordination of cross-program field surveys. At minimum, each lake survey will include Plant Point Intercept Survey, Shoreland Habitat Survey, and at least one or more 1 water chemistry samples.

- **Drainage Basin** -- A **drainage basin** or **catchment basin** is an extent or an area of land where surface water from rain, melting snow, or ice converges to a single point at a lower elevation, usually the exit of the basin, where the waters join another waterbody, such as a river, lake, reservoir, estuary, wetland, sea, or ocean.

- **Drinking Water System** (DWS) **--** A drinking water system is essentially a public water supply system and/or a private water supply system. A conduit through which potable drinking water is conveyed.

- **Effluent Limit --** An effluent limitation is a United States Clean Water Act standard of performance reflecting a specified level of discharge reduction achievable by the best available technology.

- F**loristic Quality Assessment (FQA) Benchmark Surveys** - Target is to set a benchmark between medium and high quality and between medium and low quality/condition based on distribution of test indicator metrics (Mean C and FQI) in each bin.

- **FMDB** – fisheries Management Database – an IT system holding fisheries taxonomic data, fish stocking, propagation records, historical records, summary metrics, fish health data and more.

- **Follow-up for Impaired Waters** - Follow up monitoring, linked to probabilistic, targeted or local needs studies, is now a specific type of work identified in strategy and budget under prescriptive monitoring that is purposefully conducted to help meet attainment decisions.

- **FQA benchmark** - Floristic Quality Assessment benchmarks assess the condition of all commonly occurring wetland plant communities in the four major Omernick ecoregions of Wisconsin. FQA Benchmarks will discriminate between different condition categories along the biological condition gradient and can be used to support designation of Tiered Aquatic Life uses. These FQA Benchmarks need to be tailored to the plant community type and ecological setting.

- **FQI** (**Floristic Quality Index)** - FQI, or Floristic Quality Index: $FQI = \overline{C} \times \sqrt{N}$. This index represents….

- **Future TWA Element** – Targeted Watershed Assessment element that may include but is not limited to, special studies for WPDES compliance, baseflow data collection, springs inventories, or other ecosystem measures that may be appropriate for the TWA process.

- **Groundwater Retrieval Network (GRN)** - The Groundwater Retrieval Network acts as a central hub for accessing well information and groundwater quality data from various WDNR program databases. It contains information on public and private drinking water wells and monitoring wells and their associated water quality results.

- **Voucher specimens** A 'voucher specimen' is any specimen, usually but not always a cadaver, that serves as a basis of study and is retained as a reference. 'Specimen' means the whole animal or a part thereof. (A voucher should be in an accessible collection; however, even if it is not, it remains a voucher.)

- **Hester-Dendy Sampling Device** Some substrate samplers sample over time as well as in a particular space. Where the substrate will not allow grab samplers or similar devices, organisms can be lured into samplers designed to mimic the substrate. The multiple-plate substrate sampler mimics substrates with narrow, openings, such as leaves or woody debris. These kinds of samplers are placed in the substrate for a period of time and recovered. The number and kind of insects which have colonized the surfaces are counted. Since the surface area of the plates or spheres is known, the multiple-plate samplers are quantitative samplers

- **HUC** A hydrological code or hydrologic unit code is a sequence of numbers or letters that identify a hydrological feature like a river, river reach, lake, or area like a drainage basin (also called watershed (in North America) or catchment.

- **Hydro Geomorphic (HGM) classification system.** The Hydrogeomorphic Approach to assessing wetland functions, or HGM Approach, is a method to assess the functional condition (Smith 1995) of a specific wetland referenced to data collected from wetlands across a range of physical conditions. It utilizes a wetland classification system based on geomorphic position and hydrologic characteristics to group wetlands into seven different wetland classes as defined by Brinson (1993).

- **Indicators --** Indicators are observations or calculations that can be used to track conditions and trends.

- **Index of Biological Integrity** -- An Index of Biological Integrity (IBI), also called an Index of Biotic Integrity, is a scientific tool used to identify and classify water pollution problems. An IBI associates anthropogenic influences on a water body with biological activity in the water body, and is formulated using data developed from biosurveys.

- **In-Lieu Fee and compensatory mitigation program** -- An in–lieu fee program involves the restoration, establishment, enhancement and/or preservation of aquatic resources through funds paid to a government or non–profit natural resources management entity to satisfy compensatory mitigation requirements for permits. An in–lieu fee program sells credits to permittees whose legal obligation to provide compensatory mitigation is then transferred to the sponsor of the in–lieu fee program upon receipt of an associated credit fee.

- **Legacy Data Center (LDC), and Modernized STORET** -- The STORET Legacy Data Center, or LDC, is an interim relational database that houses data migrated from the Legacy STORET system. The information contained in STORET LDC has been collected from all 50 states, tribal lands, U.S. Territories, and Canada over the past 30 years. The STORET LDC is not responsible for the quality of the data. As part of the STORET modernization project, this data has been migrated from the old mainframe application to the LDC. Some of the data will then be migrated to New STORET.

- **Mean Coefficient of Conservatism, is the average coefficient of conservatism for all species.** The concept of species conservatism is the foundation of floristic quality assessment. Each native species is assigned a coefficient of conservatism (C) following the methods described by Swink and Wilhelm (1994) and Wilhelm and Masters (1995). Coefficients of conservatism range from 0 to 10 and represent an estimated probability that a plant is likely to occur in a landscape relatively unaltered from what is believed to be a pre-settlement condition. For example, a C of 0, is given to plants such as Acer negundo, box elder, that have demonstrated little fidelity to any remnant natural community, i.e. may be found almost anywhere. Similarly, a C of 10 is applied to plants like Potentilla fructicosa (shrubby cinquefoil) that are almost always restricted to a pre-settlement remnant, i.e. a high quality natural area. Introduced plants were not part of the pre-settlement flora, so no C value is applied to these.

- **Metric** -- Metrics are parameters or measures of quantitative assessment used for measurement, comparison or to track performance or production or health.

- **National Hydrography Dataset** -- The National Hydrography Dataset (NHD) and Watershed Boundary Dataset (WBD) are used to portray surface water on The National Map. The NHD represents the drainage network with features such as rivers, streams, canals, lakes, ponds, coastline, dams, and stream gages. http://nhd.usgs.gov/

- **Natural Communities** -- A natural community is an interactive assemblage of organisms, their physical environment, and the natural processes that affect them.
- National Rivers and Streams Assessment The National Rivers and Streams Assessment (NRSA) is a collaborative survey that provides information on the ecological condition of the nation's rivers and streams and the key stressors that affect them, both on a national and an ecoregional scale.

- **National Wetlands Inventory (NWI)** - The National Wetlands Inventory (NWI) produces wetland maps and geospatial wetland data for the United States since the mid-1970s. The focus has been

on two fronts: 1) map or digital database preparation and delivery to the public, and 2) projecting and reporting on national wetland trends using a probability-based sampling design. The status of mapping has been made available through various media throughout NWI's 30-year history (e.g., state atlases, regional status maps, and now through the internet via the Wetlands Mapper online tool).

- **Parameter –** A parameter is a numerical value that states something about an entire population being studied.

- **Probabilistic surveys** -- a probability sampling method is any method of sampling that utilizes some form of *random selection*.

- **QAPP** -- QAPP details the methodology and evaluation procedures for collecting and analyzing samples.

- **qPCR –** Method A: Enterococci in Water by TaqMan Quantitative Polymerase Chain Reaction (qPCR) Assay April 2010

- **Quality Management Plan?** A Quality Management Plan (QMP) is a document that describes an organization's quality system. It identifies the organizational structure, policy and procedures, functional responsibilities of management and staff, lines of authority, and its processes for planning, implementing, documenting, and assessing all activities conducted under the organization's quality system. (In the context of EPA quality requirements, the focus is ensuring the quality of environmental data and decision-making.) http://www.epa.gov/quality/qs-docs/g1-final.pdf

- **QA Project Plan?** A QA Project Plan is a written document that describes the quality assurance procedures, quality control specifications, and other technical activities that must be implemented to ensure that the results of the project or task to be performed will meet project specifications. Primary data collection, secondary data usage, and data processing (such as modeling) project activities funded by EPA are described and documented in QA Project Plans. http://www.epa.gov/quality/faq6.html

- **Reference conditions** Reference conditions are important in developing biologically meaningful criteria to protect resources. The reference condition reflects the potential of biological communities in a variety of stream settings. These descriptions can be used to describe spatial and temporal trends, and to detect the effects of pollutants on invertebrate communities. These tests are precursors to establishing biological criteria which should take into account the variety of natural stream settings and extent of human impact present. We add new reference streams each year to our list as well as revisit a select group on an annual basis.
- **Register of Waterbodies (ROW)** The Register of Waterbodies is the database that manages inventory information about our state's surface water. Unique numeric identifiers called waterbody ID codes (WBICs) are assigned to each stream/river, lake, pond, reservoir etc. as it is defined by users.

- **WSLH** -- Wisconsin State Laboratory of Hygiene (WSLH) is the state's public and environmental health laboratory. As part of the University of Wisconsin-Madison, the WSLH is committed to exploring new ideas which benefit the state, the nation and the world

- **Statistical threshold value (STV) --** The STV approximates the 90th percentile of the water quality distribution and is intended to be a value that should not be exceeded by more than 10 percent of the samples taken.

- **STORET** (STOrage and RETrieval) -- STORET refers overall to "STORage and RETrieval", an electronic data system for water quality monitoring data developed by EPA. S TORET has taken various forms since the 1960's.

- **Stratified Random Monitoring Program** -- Survey design used on large or difficult to measure populations, Every discrete unit has some probability of selection, Stratifying ensures all types of the population are represented in the sample.

- **Surface Water Data Viewer (SWDV)** -- Surface Water Data Viewer (SWDV) provides interactive web mapping tools for water quality, sediment, biological data, aquatic invasive species data, and more.

- **SWIMS** -- Surface Water Integrated Monitoring System (SWIMS) is a water data system designed to ensure that staff and management have access to high quality surface water, sediment and aquatic invasive data in an accessible format.

- **Streams and Rivers Technical Team** (STT) **–** Technical team of individuals in DNR who steer the streams biology programs and activities from a staff perspective.

- **System for Wastewater Applications, Monitoring, and Permits (SWAMP)** -- SWAMP is an Oracle-based computer system designed to assist with management of the Wisconsin Pollutant Discharge Elimination System (WPDES) Permit Program.

- **Targeted Watershed Assessment (TWA) --** Targeted Watershed Assessment Approach is a study design employed by DNR to comprehensively assess the aquatic and The TWA design involves monitoring at the HUC 12 scale (~29-mi2).

- **Total Maximum Daily Load Analyses** (TMDL) - a regulatory term in the U.S. Clean Water Act, describing a value of the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards. Alternatively, TMDL is an allocation of that water pollutant deemed acceptable to the subject receiving waters.

- **Environmental Monitoring and Assessment Program (EMAP-GRE)** -- The Great River Ecosystem Environmental Monitoring and Assessment Program (EMAP) was a research program run by EPA's Office of Research and Development to develop the tools necessary to monitor and assess the status and trends of national ecological resources. EMAP collected field data from 1990 to 2006.

- **Water Condition Viewer (WCV)** - An interactive webmapping tool that focuses on water condition, monitoring and assessment data. Highlights include: Clean Water Act reporting datasets, Healthy Watersheds Assessments, Targeted Watershed Assesssments and Watershed Planning. Future themes will include detail on monitoring projects.

- **Water Quality Plan** - Watershed Plans document and summarize the condition of health of water resources within the area. Watershed plans incorporate information on current and changing land use,

population change, water resource potential and assessments of current conditions based on biological, physical and chemical data compared to water quality standards and quality thresholds established in guidance.

- **Water Assessment, Tracking and Electronic Reporting System (WATERS)** holds Clean Water Act Use Designations and Classifications (NR102, NR104), Outstanding and Exceptional Resource Waters Designations (NR102), Clean Water Act assessment data, including decisions regarding a waterbody meeting its attainable use or whether or not the waterbody is considered "impaired", Fisheries Trout Classifications (Administrative Code, NR 1.02(7)).

- **Coefficient of Conservatism** - The concept of species conservatism is the foundation of floristic quality assessment. Each native species is assigned a coefficient of conservatism (C) following the methods described by Swink and Wilhelm (1994) and Wilhelm and Masters (1995). Coefficients of conservatism range from 0 to 10 and represent an estimated probability that a plant is likely to occur in a landscape relatively unaltered from what is believed to be a pre-settlement condition.

- **WisCALM** (Consolidated Assessment & Listing Methodology (WisCALM) guidance) - Comprehensive guidance on the assessment of water resources under the Clean Water Act.

- **Wisconsin Geological and Natural History Survey (WGNHS)** - The Wisconsin Geological and Natural History Survey (WGNHS) has been working to serve Wisconsin for over 100 years. We provide objective scientific information about the geology, mineral resources, and water resources of Wisconsin.

- **Wisconsin Pollutant Discharge Elimination System (WPDES)** - The Department regulates the discharge of pollutants to waters of the state through the Wisconsin Pollutant Discharge Elimination System (WPDES) program. Wastewater permits contain all the monitoring requirements, special reports, and compliance schedules appropriate to the facility in question. Permits are issued for a five year term.

Appendix J: Parameters Collected in Major Studies

River Study Parameters

Long Term Trend Rivers Program Parameters	
DNR Parameter	Description
10	TEMPERATURE FIELD
20	AMBIENT AIR TEMPERATURE - FIELD
32	CLOUD COVER
94	CONDUCTIVITY FIELD
95	CONDUCTIVITY, UMHOS/CM @ 25C
300	DISSOLVED OXYGEN FIELD
301	OXYGEN, DISSOLVED, PERCENT OF SATURATION %
310	BOD 5 DAY
400	PH FIELD
403	PH LAB
410	ALKALINITY TOTAL CACO3
530	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)
608	NITROGEN NH3-N DISS
625	NITROGEN KJELDAHL TOTAL
631	NITROGEN NO3+NO2 DISS (AS N)
665	PHOSPHORUS TOTAL
671	PHOSPHATE ORTHO DISS
899	HARDNESS TOTAL RECOVERABLE CALCULATION
918	CALCIUM TOTAL RECOVERABLE
921	MAGNESIUM TOTAL RECOVERABLE
940	CHLORIDE
955	SILICA, DISSOLVED (MG/L AS SI02)
1113	CADMIUM TOTAL RECOVERABLE
1119	COPPER TOT REC
46492	TRIAZINE SCREEN
61190	TRANSPARENCY TUBE MEASUREMENT
71900	MERCURY TOTAL
82079	TURBIDITY, LAB NEPHELOMETRIC NTU
99188	E COLI COLILERT QUANTITRAY MPN
99296	PREP DIG TOTAL REC ICP-MS EPA 1638
99717	CHLOROPHYLL A, FLUORESCENCE (WELSCHMAYER 1994)

Wastewater Compliance Monitoring	
DNR Parameter	**Description**
10	TEMPERATURE FIELD
95	CONDUCTIVITY, UMHOS/CM @ 25C
136	TEMPERATURE AT LAB
300	DISSOLVED OXYGEN FIELD
310	BOD 5 DAY
340	COD HI LEVEL
400	PH FIELD
403	PH LAB
410	ALKALINITY TOTAL CACO3
530	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)
608	NITROGEN NH3-N DISS
610	NITROGEN NH3-N TOTAL
611	NITROGEN NH3-N
625	NITROGEN KJELDAHL TOTAL
627	NITROGEN KJELDAHL TOTAL
631	NITROGEN NO3+NO2 DISS (AS N)
665	PHOSPHORUS TOTAL
668	PHOSPHORUS
671	PHOSPHATE ORTHO DISS
899	HARDNESS TOTAL RECOVERABLE CALCULATION
900	HARDNESS TOTAL CACO3
916	CALCIUM TOTAL
918	CALCIUM TOTAL RECOVERABLE
921	MAGNESIUM TOTAL RECOVERABLE
927	MAGNESIUM TOTAL
929	SODIUM TOTAL
937	POTASSIUM, TOTAL
940	CHLORIDE
1003	ARSENIC
1008	BARIUM
1027	CADMIUM TOTAL
1028	CADMIUM
1029	CHROMIUM
1042	COPPER TOTAL
1043	COPPER
1045	IRON TOTAL
1051	LEAD
1052	LEAD
1067	NICKEL, TOTAL
1068	NICKEL

Long-Term Trend Wadeable Reference Streams	
DNR Parameter	**Description**
1074	NICKEL, TOTAL RECOVERABLE
1078	SILVER
1092	ZINC TOTAL
1094	ZINC TOTAL REC
1099	ZINC DIG
1105	ALUMINUM TOTAL
1113	CADMIUM TOTAL RECOVERABLE
1114	LEAD TOTAL REC
1119	COPPER TOT REC
1123	MANGANESE, TOTAL RECOVERABLE
1148	SELENIUM
31613	COLIFORM FECAL, MEMBRANE FILTER, MFC AGAR
31679	FECAL STREPTOCOCCI, MEMBRANE FILTER, KF AGAR
61509	ZINC
70318	SOLIDS PERCENT
71921	MERCURY
99197	TURBIDITY METALS SCREENING
99393	PREP DIG SOLIDS 750.1 SW846 3050B
99404	DIG TOTAL REC SW846 3005A
99405	DIG 730.1 ICP SW846 3010A
99406	DIG TOTAL REC AA FURN SM3030E
99407	DIG 740.1 FURNACE SW846 3020A

National Rivers and Streams Assessment (NRSA)	
DNR Parameter	**Description**
10	TEMPERATURE FIELD
32	CLOUD COVER
78	SECCHI DEPTH
80	COLOR
94	CONDUCTIVITY FIELD
95	CONDUCTIVITY, UMHOS/CM @ 25C
300	DISSOLVED OXYGEN FIELD
301	OXYGEN, DISSOLVED, PERCENT OF SATURATION %
400	PH FIELD
403	PH LAB
410	ALKALINITY TOTAL CACO3
530	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)
600	NITROGEN TOTAL
608	NITROGEN NH3-N DISS
631	NITROGEN NO3+NO2 DISS (AS N)
665	PHOSPHORUS TOTAL
681	CARBON DISS ORGANIC
918	CALCIUM TOTAL RECOVERABLE
921	MAGNESIUM TOTAL RECOVERABLE
923	SODIUM TOTAL RECOVERABLE
940	CHLORIDE
941	CHLORIDE DISS
945	SULFATE TOTAL
946	SULFATE DISS
955	SILICA, DISSOLVED (MG/L AS SI02)
49701	SECCHI DEPTH - FEET
50245	POTASSIUM TOTAL RECOVERABLE
70957	CHLOROPHYLL-A,PERIPHYTON
71851	NITRATE NITROGEN, DISSOLVED (MG/L AS NO3)
82079	TURBIDITY, LAB NEPHELOMETRIC NTU
98163	PERIPHYTON ASH-FREE BIOMASS/25ML
98437	MICROCYSTIN
99420	SECCHI DEPTH HIT BOTTOM
99717	CHLOROPHYLL A, FLUORESCENCE (WELSCHMAYER 1994)

Biotic Integrity River Sites

Core Water Quality Indicators

Core indicators of the Biotic Index Rivers program are specifically limited to these water quality parameters:

- Dissolved oxygen
- Temperature
- pH
- Conductivity
- Total Phosphorus
- Ammonia N
- Total Kjeldahl N
- Nitrite+nitrate N
- Chlorophyll *a*
- Turbidity
- *E. coli*

Supplemental Water Quality Indicators

- Alkalinity
- Conductivity
- Total Kjeldahl Nitrogen
- Dissolved Phosphorus
- Total Suspended Solids
- Chloride
- Hardness
- Total Rec. Low Level
- Metals (11+Hg)

Streams Study Parameters

- Wadeable Trend Reference Streams
- Natural Community Stratified Random Monitoring Program
- Targeted Watershed Approach
- Water Action Volunteers - Stream Monitoring
- Stream Baseflow Monitoring

Wadeable Trend Parameters – Long Term Trend

DNR Parameter	Description
95	CONDUCTIVITY, UMHOS/CM @ 25C
136	TEMPERATURE AT LAB
403	PH LAB
410	ALKALINITY TOTAL CACO3
530	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)
600	NITROGEN TOTAL
608	NITROGEN NH3-N DISS
625	NITROGEN KJELDAHL TOTAL
631	NITROGEN NO3+NO2 DISS (AS N)
665	PHOSPHORUS TOTAL
940	CHLORIDE
4160	Percent Sample Sorted
50002	PLECOPTERA CAPNIIDAE ALLOCAPNIA
50016	PLECOPTERA CAPNIIDAE PARACAPNIA ANGULATA
50045	PLECOPTERA NEMOURIDAE NEMOURA TRISPINOSA
50054	PLECOPTERA PERLIDAE ACRONEURIA
50066	PLECOPTERA PERLIDAE PARAGNETINA MEDIA
50088	PLECOPTERA PERLODIDAE ISOPERLA
50093	PLECOPTERA PERLODIDAE ISOPERLA LATA
50097	PLECOPTERA PERLODIDAE ISOPERLA SIGNATA
50098	PLECOPTERA PERLODIDAE ISOPERLA SLOSSONAE
50099	PLECOPTERA PERLODIDAE ISOPERLA TRANSMARINA
50101	PLECOPTERA PERLODIDAE CLIOPERLA CLIO
50103	PLECOPTERA PTERONARCYIDAE PTERONARCYS
50111	PLECOPTERA TAENIOPTERYGIDAE TAENIOPTERYX
50113	PLECOPTERA TAENIOPTERYGIDAE TAENIOPTERYX NIVALIS
50116	EPHEMEROPTERA BAETIDAE
50117	EPHEMEROPTERA BAETIDAE BAETIS
50118	EPHEMEROPTERA BAETIDAE BAETIS BRUNNEICOLOR
50120	EPHEMEROPTERA BAETIDAE BAETIS INTERCALARIS
50124	EPHEMEROPTERA BAETIDAE BAETIS TRICAUDATUS
50145	EPHEMEROPTERA BAETIDAE ACERPENNA PYGMAEA
50149	EPHEMEROPTERA BAETIDAE DIPHETOR HAGENI
50183	EPHEMEROPTERA CAENIDAE CAENIS
50184	EPHEMEROPTERA CAENIDAE CAENIS ANCEPS
50185	EPHEMEROPTERA CAENIDAE CAENIS HILARIS
50189	EPHEMEROPTERA CAENIDAE CAENIS LATIPENNIS
50205	EPHEMEROPTERA EPHEMERELLIDAE EPHEMERELLA
50209	EPHEMEROPTERA EPHEMERELLIDAE EPHEMERELLA INVARIA
50211	EPHEMEROPTERA EPHEMERELLIDAE EPHEMERELLA SUBVARIA

50243	EPHEMEROPTERA HEPTAGENIIDAE
50247	EPHEMEROPTERA HEPTAGENIIDAE EPEORUS VITREUS
50252	EPHEMEROPTERA HEPTAGENIIDAE RHITHROGENA
50258	EPHEMEROPTERA HEPTAGENIIDAE STENACRON INTERPUNCTATUM
50259	EPHEMEROPTERA HEPTAGENIIDAE MACCAFFERTIUM
50263	EPHEMEROPTERA HEPTAGENIIDAE MACCAFFERTIUM MEDIOPUNCTATUM
50279	EPHEMEROPTERA HEPTAGENIIDAE LEUCROCUTA
50286	EPHEMEROPTERA LEPTOPHLEBIIDAE
50288	EPHEMEROPTERA LEPTOPHLEBIIDAE LEPTOPHLEBIA CUPIDA
50290	EPHEMEROPTERA LEPTOPHLEBIIDAE PARALEPTOPHLEBIA
50295	EPHEMEROPTERA LEPTOPHLEBIIDAE PARALEPTOPHLEBIA MOLLIS
50297	EPHEMEROPTERA LEPTOPHLEBIIDAE PARALEPTOPHLEBIA PRAEPEDITA
50334	EPHEMEROPTERA LEPTOHYPHIDAE TRICORYTHODES
50351	EPHEMEROPTERA ISONYCHIIDAE ISONYCHIA
50397	ODONATA CALOPTERYGIDAE
50398	ODONATA CALOPTERYGIDAE CALOPTERYX
50400	ODONATA CALOPTERYGIDAE CALOPTERYX MACULATA
50407	ODONATA COENAGRIONIDAE ARGIA
50454	ODONATA CORDULEGASTRIDAE CORDULEGASTER
50455	ODONATA CORDULEGASTRIDAE CORDULEGASTER MACULATA
50615	TRICHOPTERA
50621	TRICHOPTERA BRACHYCENTRIDAE BRACHYCENTRUS AMERICANUS
50623	TRICHOPTERA BRACHYCENTRIDAE BRACHYCENTRUS NUMEROSUS
50624	TRICHOPTERA BRACHYCENTRIDAE BRACHYCENTRUS OCCIDENTALIS
50629	TRICHOPTERA BRACHYCENTRIDAE MICRASEMA GELIDUM
50639	TRICHOPTERA GLOSSOSOMATIDAE GLOSSOSOMA
50640	TRICHOPTERA GLOSSOSOMATIDAE GLOSSOSOMA INTERMEDIUM
50641	TRICHOPTERA GLOSSOSOMATIDAE GLOSSOSOMA NIGRIOR
50642	TRICHOPTERA GLOSSOSOMATIDAE GLOSSOSOMA -- PUPA
50643	TRICHOPTERA GLOSSOSOMATIDAE PROTOPTILA
50652	TRICHOPTERA HELICOPSYCHIDAE HELICOPSYCHE BOREALIS
50654	TRICHOPTERA HYDROPSYCHIDAE
50655	TRICHOPTERA HYDROPSYCHIDAE CHEUMATOPSYCHE
50667	TRICHOPTERA HYDROPSYCHIDAE HYDROPSYCHE
50668	TRICHOPTERA HYDROPSYCHIDAE HYDROPSYCHE BETTENI
50695	TRICHOPTERA HYDROPSYCHIDAE CERATOPSYCHE
50696	TRICHOPTERA HYDROPSYCHIDAE CERATOPSYCHE ALHEDRA
50697	TRICHOPTERA HYDROPSYCHIDAE CERATOPSYCHE ALTERNANS
50698	TRICHOPTERA HYDROPSYCHIDAE CERATOPSYCHE BRONTA
50699	TRICHOPTERA HYDROPSYCHIDAE CERATOPSYCHE MOROSA BIFIDA FORM SCHMUDE, HILSENHOFF 1986
50701	TRICHOPTERA HYDROPSYCHIDAE CERATOPSYCHE SLOSSONAE

50702	TRICHOPTERA HYDROPSYCHIDAE CERATOPSYCHE SPARNA
50711	TRICHOPTERA HYDROPTILIDAE
50715	TRICHOPTERA HYDROPTILIDAE HYDROPTILA
50743	TRICHOPTERA HYDROPTILIDAE LEUCOTRICHIA PICTIPES
50778	TRICHOPTERA HYDROPTILIDAE -- PUPA
50781	TRICHOPTERA LEPIDOSTOMATIDAE LEPIDOSTOMA
50795	TRICHOPTERA LEPTOCERIDAE CERACLEA
50821	TRICHOPTERA LEPTOCERIDAE MYSTACIDES
50831	TRICHOPTERA LEPTOCERIDAE OECETIS
50832	TRICHOPTERA LEPTOCERIDAE OECETIS AVARA
50843	TRICHOPTERA LEPTOCERIDAE TRIAENODES
50859	TRICHOPTERA LIMNEPHILIDAE
50860	TRICHOPTERA LIMNEPHILIDAE ANABOLIA
50871	TRICHOPTERA LIMNEPHILIDAE HESPEROPHYLAX DESIGNATUS
50877	TRICHOPTERA LIMNEPHILIDAE LIMNEPHILUS
50911	TRICHOPTERA LIMNEPHILIDAE PYCNOPSYCHE
50936	TRICHOPTERA LIMNEPHILIDAE -- PUPA
50950	TRICHOPTERA PHILOPOTAMIDAE
50951	TRICHOPTERA PHILOPOTAMIDAE CHIMARRA
50952	TRICHOPTERA PHILOPOTAMIDAE CHIMARRA ATERRIMA
50954	TRICHOPTERA PHILOPOTAMIDAE CHIMARRA OBSCURA
50957	TRICHOPTERA PHILOPOTAMIDAE DOLOPHILODES DISTINCTUS
50959	TRICHOPTERA PHILOPOTAMIDAE WORMALDIA MOESTA
50994	TRICHOPTERA POLYCENTROPODIDAE NEURECLIPSIS
51019	TRICHOPTERA POLYCENTROPODIDAE NYCTIOPHYLAX
51028	TRICHOPTERA PSYCHOMYIIDAE LYPE DIVERSA
51030	TRICHOPTERA PSYCHOMYIIDAE PSYCHOMYIA FLAVIDA
51033	TRICHOPTERA RHYACOPHILIDAE RHYACOPHILA
51034	TRICHOPTERA RHYACOPHILIDAE RHYACOPHILA FUSCULA
51035	TRICHOPTERA RHYACOPHILIDAE RHYACOPHILA VIBOX
51038	TRICHOPTERA RHYACOPHILIDAE RHYACOPHILA MAINENSIS
51052	TRICHOPTERA GOERIDAE GOERA STYLATA
51054	TRICHOPTERA UENOIDAE NEOPHYLAX
51070	MEGALOPTERA CORYDALIDAE NIGRONIA SERRICORNIS
51074	MEGALOPTERA SIALIDAE SIALIS
51132	COLEOPTERA ELMIDAE DUBIRAPHIA
51135	COLEOPTERA ELMIDAE DUBIRAPHIA QUADRINOTATA
51139	COLEOPTERA ELMIDAE MACRONYCHUS GLABRATUS
51142	COLEOPTERA ELMIDAE OPTIOSERVUS
51143	COLEOPTERA ELMIDAE OPTIOSERVUS FASTIDITUS
51144	COLEOPTERA ELMIDAE OPTIOSERVUS TRIVITTATUS
51145	COLEOPTERA ELMIDAE STENELMIS

51146	COLEOPTERA ELMIDAE STENELMIS CRENATA
51179	COLEOPTERA GYRINIDAE GYRINUS LECONTEI
51197	COLEOPTERA PSEPHENIDAE ECTOPRIA LEECHI/NERVOSA SNITGEN PERS. COMM.
51199	COLEOPTERA PSEPHENIDAE PSEPHENUS HERRICKI
51202	COLEOPTERA DYTISCIDAE LIODESSUS AFFINIS
51461	COLEOPTERA HYDRAENIDAE HYDRAENA
51714	DIPTERA ATHERICIDAE ATHERIX VARIEGATA
51740	DIPTERA CERATOPOGONIDAE BEZZIA/PALPOMYIA HILSENHOFF 1995
51741	DIPTERA CERATOPOGONIDAE CULICOIDES
51792	DIPTERA CERATOPOGONIDAE PROBEZZIA
51815	DIPTERA CERATOPOGONIDAE MALLOCHOHELEA
51831	DIPTERA CERATOPOGONIDAE DASYHELEA
51873	DIPTERA EMPIDIDAE CLINOCERA
51874	DIPTERA EMPIDIDAE HEMERODROMIA
51879	DIPTERA EMPIDIDAE NEOPLASTA
51888	DIPTERA EMPIDIDAE -- PUPA
51907	DIPTERA PSYCHODIDAE PERICOMA
51928	DIPTERA SIMULIIDAE SIMULIUM
51941	DIPTERA SIMULIIDAE SIMULIUM TUBEROSUM "COMPLEX"
51942	DIPTERA SIMULIIDAE SIMULIUM VENUSTUM "COMPLEX"
51944	DIPTERA SIMULIIDAE SIMULIUM VITTATUM "COMPLEX"
51945	DIPTERA SIMULIIDAE SIMULIUM VITTATUM "COMPLEX"
51960	DIPTERA SIMULIIDAE SIMULIUM LONGISTYLATUM
51961	DIPTERA SIMULIIDAE SIMULIUM FIBRINFLATUM
51962	DIPTERA SIMULIIDAE SIMULIUM -- PUPA
52034	DIPTERA TABANIDAE CHRYSOPS
52071	DIPTERA TIPULIDAE
52072	DIPTERA TIPULIDAE ANTOCHA
52076	DIPTERA TIPULIDAE DICRANOTA
52100	DIPTERA TIPULIDAE HELIUS
52104	DIPTERA TIPULIDAE HESPEROCONOPA DOLICHOPHALLUS
52135	DIPTERA TIPULIDAE PSEUDOLIMNOPHILA
52140	DIPTERA TIPULIDAE TIPULA
52317	DIPTERA PTYCHOPTERIDAE PTYCHOPTERA
52400	DIPTERA CHIRONOMIDAE
52409	DIPTERA TANYPODINAE 0
52439	DIPTERA TANYPODINAE 0 CONCHAPELOPIA
52461	DIPTERA TANYPODINAE 0 LABRUNDINIA PILOSELLA
52464	DIPTERA TANYPODINAE 0 LARSIA
52478	DIPTERA TANYPODINAE 0 NATARSIA BALTIMOREA
52482	DIPTERA TANYPODINAE 0 NILOTANYPUS
52489	DIPTERA TANYPODINAE 0 PROCLADIUS

52491	DIPTERA TANYPODINAE 0 PROCLADIUS (HOLOTANYPUS)
52531	DIPTERA TANYPODINAE 0 ZAVRELIMYIA
52539	DIPTERA TANYPODINAE 0 PARAMERINA
52543	DIPTERA DIAMESINAE 2 DIAMESA
52547	DIPTERA DIAMESINAE 2 DIAMESA -- PUPA
52548	DIPTERA DIAMESINAE 2 PAGASTIA
52552	DIPTERA DIAMESINAE 2 PAGASTIA -- PUPA
52580	DIPTERA PRODIAMESINAE 3 PRODIAMESA OLIVACEA
52581	DIPTERA ORTHOCLADIINAE 1
52582	DIPTERA ORTHOCLADIINAE 1
52591	DIPTERA ORTHOCLADIINAE 1 BRILLIA FLAVIFRONS
52601	DIPTERA ORTHOCLADIINAE 1 CHAETOCLADIUS
52603	DIPTERA ORTHOCLADIINAE 1 PARAKIEFFERIELLA
52607	DIPTERA ORTHOCLADIINAE 1 LOPESCLADIUS
52609	DIPTERA ORTHOCLADIINAE 1 CORYNONEURA
52614	DIPTERA ORTHOCLADIINAE 1 CORYNONEURA -- PUPA
52615	DIPTERA ORTHOCLADIINAE 1 CRICOTOPUS (CRICOTOPUS)
52623	DIPTERA ORTHOCLADIINAE 1 CRICOTOPUS -- PUPA
52640	DIPTERA ORTHOCLADIINAE 1 EUKIEFFERIELLA
52641	DIPTERA ORTHOCLADIINAE 1 EUKIEFFERIELLA BREHMI GROUP CRANSTON ET AL. 1983
52642	DIPTERA ORTHOCLADIINAE 1 EUKIEFFERIELLA CLARIPENNIS GROUP CRANSTON ET AL. 1983
52645	DIPTERA ORTHOCLADIINAE 1 EUKIEFFERIELLA DEVONICA GROUP CRANSTON ET AL. 1983
52646	DIPTERA ORTHOCLADIINAE 1 EUKIEFFERIELLA GRACEI GROUP CRANSTON ET AL. 1983
52648	DIPTERA ORTHOCLADIINAE 1 EUKIEFFERIELLA -- PUPA
52668	DIPTERA ORTHOCLADIINAE 1 HYDROBAENUS
52677	DIPTERA ORTHOCLADIINAE 1 LIMNOPHYES
52698	DIPTERA ORTHOCLADIINAE 1 NANOCLADIUS (NANOCLADIUS) SPINIPLENUS
52712	DIPTERA ORTHOCLADIINAE 1 ORTHOCLADIUS (ORTHOCLADIUS)
52716	DIPTERA ORTHOCLADIINAE 1 PARACHAETOCLADIUS
52721	DIPTERA ORTHOCLADIINAE 1 PARAKIEFFERIELLA -- PUPA
52722	DIPTERA ORTHOCLADIINAE 1 PARAMETRIOCNEMUS
52724	DIPTERA ORTHOCLADIINAE 1 PARAMETRIOCNEMUS -- PUPA
52729	DIPTERA ORTHOCLADIINAE 1 NANOCLADIUS (PLECOPTERACOLUTHUS) -- PUPA
52754	DIPTERA ORTHOCLADIINAE 1 RHEOSMITTIA
52763	DIPTERA ORTHOCLADIINAE 1 ORTHOCLADIUS (SYMPOSIOCLADIUS) LIGNICOLA
52765	DIPTERA ORTHOCLADIINAE 1 SYNORTHOCLADIUS
52767	DIPTERA ORTHOCLADIINAE 1 THIENEMANNIELLA
52770	DIPTERA ORTHOCLADIINAE 1 TVETENIA BAVARICA GROUP BODE 1983
52772	DIPTERA ORTHOCLADIINAE 1 TVETENIA -- PUPA
52774	DIPTERA ORTHOCLADIINAE 1 XYLOTOPUS PAR
52784	DIPTERA CHIRONOMINAE 4
52785	DIPTERA CHIRONOMINAE 4

52787	DIPTERA CHIRONOMINAE 4 CLADOTANYTARSUS
52806	DIPTERA CHIRONOMINAE 4 MICROPSECTRA
52808	DIPTERA CHIRONOMINAE 4 MICROPSECTRA -- PUPA
52809	DIPTERA CHIRONOMINAE 4 PARATANYTARSUS
52811	DIPTERA CHIRONOMINAE 4 PARATANYTARSUS SPECIES B HILSENHOFF, UNPUBL.
52812	DIPTERA CHIRONOMINAE 4 PARATANYTARSUS -- PUPA
52813	DIPTERA CHIRONOMINAE 4 RHEOTANYTARSUS
52820	DIPTERA CHIRONOMINAE 4 STEMPELLINELLA
52822	DIPTERA CHIRONOMINAE 4 TANYTARSUS
52823	DIPTERA CHIRONOMINAE 4 TANYTARSUS -- PUPA
52855	DIPTERA CHIRONOMINAE 4 CRYPTOCHIRONOMUS
52863	DIPTERA CHIRONOMINAE 4 CRYPTOTENDIPES
52885	DIPTERA CHIRONOMINAE 4 DICROTENDIPES
52897	DIPTERA CHIRONOMINAE 4 DICROTENDIPES -- PUPA
52943	DIPTERA CHIRONOMINAE 4 MICROTENDIPES PEDELLUS GROUP PINDER, REISS 1983
52944	DIPTERA CHIRONOMINAE 4 MICROTENDIPES RYDALENSIS GROUP PINDER, REISS 1983
52959	DIPTERA CHIRONOMINAE 4 PARACLADOPELMA
52977	DIPTERA CHIRONOMINAE 4 PARATENDIPES
52979	DIPTERA CHIRONOMINAE 4 PHAENOPSECTRA
53041	DIPTERA CHIRONOMINAE 4 STICTOCHIRONOMUS
53062	AMPHIPODA GAMMARIDAE GAMMARUS PSEUDOLIMNAEUS
53068	AMPHIPODA HYALELLIDAE HYALELLA
53072	ISOPODA ASELLIDAE CAECIDOTEA
53073	ISOPODA ASELLIDAE CAECIDOTEA INTERMEDIA
53074	ISOPODA ASELLIDAE CAECIDOTEA RACOVITZAI RACOVITZAI
53083	TROMBIDIFORMES LEBERTIIDAE LEBERTIA
53088	TROMBIDIFORMES SPERCHONIDAE
53091	TROMBIDIFORMES UNIONICOLIDAE NEUMANIA
53092	MERMITHIDA
53093	TRICLADIDA
53095	BASOMMATOPHORA ANCYLIDAE
53096	BASOMMATOPHORA ANCYLIDAE FERRISSIA
53111	BASOMMATOPHORA PHYSIDAE PHYSA
53113	BASOMMATOPHORA PLANORBIDAE GYRAULUS
53130	BASOMMATOPHORA LYMNAEIDAE FOSSARIA
53143	NEOTAENIOGLOSSA HYDROBIIDAE
53146	VENEROIDA PISIDIIDAE
53153	VENEROIDA PISIDIIDAE SPHAERIUM
53163	VENEROIDA PISIDIIDAE PISIDIUM
53300	HAPLOTAXIDA NAIDIDAE
53301	HAPLOTAXIDA TUBIFICIDAE
53310	ARHYNCHOBDELLIDA ERPOBDELLIDAE

53315	ARHYNCHOBDELLIDA ERPOBDELLIDAE DINA PARVA
53322	RHYNCHOBDELLIDA GLOSSIPHONIIDAE
53338	RHYNCHOBDELLIDA GLOSSIPHONIIDAE GLOSSIPHONIA COMPLANATA
53433	HEMIPTERA CORIXIDAE
53485	HEMIPTERA CORIXIDAE SIGARA MATHESONI
53551	DIPLOSTRACA DAPHNIIDAE
54403	DIPTERA DIAMESINAE 2 POTTHASTIA LONGIMANA
54420	DIPTERA ORTHOCLADIINAE 1 CRICOTOPUS (CRICOTOPUS) BICINCTUS
54430	DIPTERA ORTHOCLADIINAE 1 CRICOTOPUS (CRICOTOPUS) ANNULATOR "COMPLEX" EPLER 2001
54473	DIPTERA ORTHOCLADIINAE 1 NANOCLADIUS (PLECOPTERACOLUTHUS) SPECIES #5 JACOBSEN IN PRESS
54492	DIPTERA ORTHOCLADIINAE 1 ORTHOCLADIUS (ORTHOCLADIUS) FRIGIDUS
54501	DIPTERA ORTHOCLADIINAE 1 ORTHOCLADIUS (ORTHOCLADIUS) VAILLANTI
54557	DIPTERA ORTHOCLADIINAE 1 RHEOCRICOTOPUS ROBACKI
54584	DIPTERA ORTHOCLADIINAE 1 CRICOTOPUS/ORTHOCLADIUS FERRINGTON ET AL. 2008
54587	DIPTERA CHIRONOMINAE 4 RHEOTANYTARSUS EXIGUUS GROUP EPLER 2001
54605	DIPTERA CHIRONOMINAE 4 CHIRONOMUS
54681	DIPTERA CHIRONOMINAE 4 POLYPEDILUM
54682	DIPTERA CHIRONOMINAE 4 POLYPEDILUM -- PUPA
54693	DIPTERA CHIRONOMINAE 4 POLYPEDILUM (PENTAPEDILUM) SPECIES A EPLER 2001
54713	DIPTERA CHIRONOMINAE 4 POLYPEDILUM (POLYPEDILUM) ILLINOENSE GROUP EPLER 2001
54725	DIPTERA CHIRONOMINAE 4 POLYPEDILUM (TRIPODURA) HALTERALE GROUP EPLER 2001
54726	DIPTERA CHIRONOMINAE 4 POLYPEDILUM (TRIPODURA) SCALAENUM GROUP EPLER 2001
54729	DIPTERA CHIRONOMINAE 4 POLYPEDILUM (URESIPEDILUM) AVICEPS
54730	DIPTERA CHIRONOMINAE 4 POLYPEDILUM (URESIPEDILUM) FLAVUM
54732	DIPTERA CHIRONOMINAE 4 STENOCHIRONOMUS
54776	DIPTERA TANYPODINAE 0 THIENEMANNIMYIA GROUP
54780	DIPTERA ORTHOCLADIINAE 1 NANOCLADIUS (NANOCLADIUS) CRASSICORNUS/cf. RECTINERVIS EPLER 2001
54791	HAPLOTAXIDA LUMBRICIDAE
54799	DIPTERA ORTHOCLADIINAE 1 HELENIELLA
54823	TRICHOPTERA HYDROPSYCHIDAE CERATOPSYCHE -- PUPA
54826	TROMBIDIFORMES HYGROBATIDAE HYGROBATES
54827	EPHEMEROPTERA HEPTAGENIIDAE MACCAFFERTIUM VICARIUM/LUTEUM DIMICK, UNPUBL.
54878	HAPLOTAXIDA NAIDIDAE STYLARIA FOSSULARIS
54879	TROMBIDIFORMES HYGROBATIDAE ATRACTIDES
54943	TROMBIDIFORMES HYDRODROMIDAE HYDRODROMA
55060	BASOMMATOPHORA PHYSIDAE PHYSELLA
56097	DIPTERA SIMULIIDAE SIMULIUM FIBRINFLATUM/JENNINGSI/LUGGERI SCHMUDE UNPUBL.
56129	EPHEMEROPTERA BAETIDAE BAETIS FLAVISTRIGA GROUP
56276	BASOMMATOPHORA PHYSIDAE HAITIA ACUTA
56290	NEOTAENIOGLOSSA HYDROBIIDAE AMNICOLA LIMOSUS

56341	DIPTERA SIMULIIDAE SIMULIUM BRACTEATUM
56354	DIPTERA CHIRONOMINAE 4 PARATANYTARSUS LONGISTYLUS
56545	Simulium jenningsi Species Group
56546	Haplotaxida Tubificinae (without hairs)
56547	Haplotaxida Tubificinae (with hairs)
82079	TURBIDITY, LAB NEPHELOMETRIC NTU
99530	SUSPENDED SEDIMENT
99717	CHLOROPHYLL A, FLUORESCENCE (WELSCHMAYER 1994)

Citizen Lake Monitoring Networ (CLMN)	
DNR Parameter	**Description**
49701	SECCHI DEPTH - FEET
90000	WATER COLUMN APPEARANCE
90001	WATER COLOR (VISUAL)
90002	USER PERCEPTION OF WATER QUALITY
90003	WATER LEVEL (VISUAL)
99420	SECCHI DEPTH HIT BOTTOM