3. {**STREAMS**}

Contact: Mike Miller and Streams Technical Team members  
Last updated: 7-2006  [Note: Streams monitoring designs will likely be restructured in 2009.]

**Status: Currently in Place**  
This program has been in place since 1999. A number of program gaps have been identified and further funds would be needed to address these.

**Monitoring Objectives**

**Clean Water Act Objectives**
- Determining water quality standards attainment  
- Identifying impaired waters  
- Supporting the evaluation of program effectiveness  
- Establishing, reviewing and revising water quality standards

**Fisheries Objectives**
- Developing quantitative management objectives for waters  
- Identifying populations not meeting objectives  
- Compiling input for identifying problem causes  
- Compiling input for developing management recommendations  
- Analyzing general responses to management actions

**Public Trust Doctrine Objectives**
- Developing environmental objectives  
- Monitoring impacts of permitting decisions at the general water level

**Other Specific objectives**
- Establish geographic trends in stream quality  
- Develop an objective stream classification system to develop expectations for different stream types  
- Refine physical, chemical and biological assessment tools, to improve stream resource characterization and sensitivity to detect impairment  
- Set gamefish management objectives, identify streams where gamefish populations are not meeting management objectives, and identify sources of impairment to gamefish populations  
- Designate water uses and determine use attainment (305(b) Report)  
- Provide input for developing Total Maximum Daily Loads (TMDLs)  
- Develop a rigorous data quality assurance and quality control system  
- Improve electronic data capture and automated reporting

**Monitoring Design**

From 2000-2004, the Baseline Wadeable Streams Monitoring Program incorporated a targeted sampling design where Region biologists picked assessment sites to disperse the sampling effort among streams of differing size (stream order) and temperature regimes (cold water and warm water fish communities). Beginning in the 2005 field season, a probability-based sampling design was incorporated to randomly select stream assessment reaches from stream classes (groupings of streams with similar ecological potential). WDNR's goal is to achieve comprehensive assessment of all of the state’s stream resources. Given the large number of small streams in Wisconsin, it is necessary to sub-sample these populations of streams, where as it may be possible to census populations of higher order streams (Table 3). Data gathered from sub-sampled 1st
and 2nd order streams will be used to make inferences for all small streams within their respective classes. If necessary, third order and larger stream populations will be sub-sampled and inferences made of physical, chemical, and biological integrity for all larger streams as well. Sub-sampling designs will be developed to meet specific data quality objectives for the Department’s multiple resource assessment and management objectives. Intermittent streams are not sampled at this time due to limited resources (see Program Gaps). Geographic Information System (GIS) technology will be used to characterize land use, and other measures of factors impacting stream integrity, to proportionally direct greater sampling effort to stream classes where environmental health is at greatest risk.

The basic sampling unit will be assessment reaches within stream classes. These reaches are best described as: 1) small (1st order) coldwater; 2) small (1st and 2nd order) warmwater; 3) large (2nd order and larger) coldwater; and 4) large (3rd order and larger) warmwater.

The fiscal and staff support made available for the Baseline Streams Monitoring Program will be dependent upon the various method quality and data quality objectives needed to address multiple program information needs. A long-term stream monitoring design is currently being developed to identify the number of stream sites to be sampled annually, as well as long-term, to characterize all of the State’s stream resources in a timely fashion (Table 3).

Table 3. Number and miles of perennial streams in Wisconsin* (1:24K hydrography layer).

<table>
<thead>
<tr>
<th>Total Number of Perennial Streams: 22,613</th>
<th>Total Miles of Perennial Streams: 41,464</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Streams by Order</td>
<td>Miles of Streams by Order</td>
</tr>
<tr>
<td>Stream Order 1</td>
<td>14,744</td>
</tr>
<tr>
<td>Stream Order 2</td>
<td>5,313</td>
</tr>
<tr>
<td>Stream Order 3</td>
<td>1,858</td>
</tr>
<tr>
<td>Stream Order 4</td>
<td>540</td>
</tr>
<tr>
<td>Stream Order 5 or more</td>
<td>148</td>
</tr>
</tbody>
</table>

*Note: This analysis does not include intermittent streams.

**Core and Supplemental Water Quality Indicators**

Physical, chemical, and biological measures will be used singly, or in concert to assess stream health. Certain water quality parameters, such as *E. coli*, ammonia, phosphorus, total suspended solids, and hardness will be monitored at only a subset of stream sites according to the season’s sampling design. As resources are available, additional metrics may be added on a case-by-case basis as identified during workplanning. Each parameter is measured only once per site; however, because some parameters must be sampled during different time periods to achieve representative results, sites are usually visited more than once per summer.

**Core Indicators for Large Streams (> 2nd Order)**

- **Fish Community Characteristics:** Fish indices of biotic integrity (IBIs), developed for Wisconsin’s streams, provide valuable measures of stream integrity, productivity, and the quality of sport fisheries. Standard field protocols, designed and calibrated for Wisconsin’s cold and warmwater streams, are used for sampling fish communities in streams. This effort consists of daytime electrofishing of a stream assessment reach 35 times the mean stream width, during baseflow conditions in late spring through early autumn. Fish data collections from this effort are sufficient to compute stream IBI and gamefish population metrics.
• **Gamefish Population Dynamics**: Relative abundance of all fish species sampled, as well as recruitment and population size-structure of targeted gamefish populations are estimated.

• **Water Chemistry**: In-situ water temperature, dissolved oxygen, pH, conductivity, and turbidity are measured prior to fish sampling or habitat assessment. In addition, a statewide water quality strategy is currently being developed for select parameters that will be measured with laboratory-analyzed grab samples (see the Surface Water Quality section of the *Strategy*). These data will be assessed periodically to determine trends and to assist in the development of appropriate water quality criteria and in the establishment of proper water quality-based effluent limitations for WPDES permits.

• **Macroinvertebrates**: A subset of small and large stream reaches are sampled for macroinvertebrates using Department standard protocols. Field staff currently collect one riffle kick sample of macroinvertebrates in the fall for analysis from each stream station. The Department is currently evaluating the rigor of current field and laboratory protocols for macroinvertebrate sampling to improve the quality of information generated by collecting these data.

• **Habitat Assessment**: The Fish Habitat Suitability Index (FHSI) is used at a subset of large stream sites (~25% of sites) to assess channel morphology, flow, bank features, fish cover, substrate, and riparian land cover within the fish assessment station.

**Core Indicators for Small Streams (1st and 2nd Order)**

• **Macroinvertebrate communities**: Sampling of fish and macroinvertebrate assemblages will continue to be the primary biotic indicator for monitoring small streams. A number of macroinvertebrate community attributes and biotic indices are used as measures of stream health. Field staff currently collect one riffle kick sample of macroinvertebrates in the fall for analysis from each stream station. The Department is currently evaluating the rigor of current field and laboratory protocols for macroinvertebrate sampling to improve the quality of information generated by collecting these data.

**Supplemental indicators for large and small streams**

Technical Teams working with streams may decide that certain sites need to be sampled for additional parameters to meet specific objectives. The following are examples of the most common additional objectives and the supplemental indicators that would be added to address them.

• Nutrient analysis (see Surface Water Quality section)
• Fish Tissue Contamination

**Quality Assurance**

The WDNR has a quality management plan (QMP) and an Evaluation System Manual Code (MC 9314.1) in place that establish processes and protocols that the state’s monitoring program must meet. The QMP is scheduled for review and revision by 6/30/05, and quality assurance processes may be added or modified as needed.

Standard monitoring protocols are distributed to all staff participating in monitoring. Protocols and data sheets are also accessible at any time on our network and web-based database. Training of field staff for consistency in data collection and recording is critical to the success of the monitoring program. Training in taxonomy, deployment of field gear, and general program implementation is periodically made available to all staff. A layer of quality assurance to maximize data integrity through a data screening process is built into the statewide database. All monitoring protocols employed, at a minimum, meet the Department’s data standards as developed by the Aquatic and Terrestrial Resources Inventory (ATRI) Team.
Data Management
An internet-based electronic data storage system following state geo-locational standards is used to manage fish and habitat data (http://infotrek.er.usgs.gov/wdnr_bio/). In 2005-06, the SWIMS project (through a potential NEIEN Grant) will facilitate the flow of data from the USGS server through SWIMS to USEPA STORET. Macroinvertebrate data are maintained through a contract with Aquatic Entomology Laboratory, University of Wisconsin, Stevens Point (http://www.uwsp.edu/water/biomonitoring/index3.htm), and these data will be migrated to the SWIMS database in 2006. Contaminant data are managed on a client-server system and are available upon request. Program reviews are conducted every biennium to review progress on completion of monitoring and data entry.

Data Analysis and Assessment
For streams and rivers, rankings for fish assemblage IBI scores have been developed and calibrated for Wisconsin waters. These IBI rankings have been fitted to waters statewide using a scale of 0 – 100, where waters are in poor, fair, good, or excellent ecological condition. Similar rankings for the Hilsenhoff Biotic Index and other macroinvertebrate metrics are available to rank macroinvertebrate assemblage condition.

In the near future, as more Baseline Monitoring data are gathered, biotic core indicator rankings will be developed for our more precise stream classes. We will then be able to refine our standards of attainment scale, calibrating stream potential within each class to environmental settings.

In addition, probability-based subsampling of core indicators from all waterbody classes within the geographical scale of interest will allow inferences to be made for all waters within the area on a basin, ecoregional, or statewide scale.

Reporting
Baseline Streams data are used to develop the integrated 303(d)/305(b) Report. Biennial administrative reports are produced on the work accomplishments of the monitoring program. Local reports on the health and condition of waterbodies and their fisheries are sometimes produced, but more consistent data entry and data proofing will be required to enable a more systematic approach to this reporting.

Programmatic Evaluation
The Baseline Monitoring Program operates within the framework of the Water Division biennial workplan. Each Technical Team meets annually to review the protocol, strategy, and products of the sampling program to ensure that it is meeting the needs of resource managers. Any changes to the protocol or strategy are recommended to the Water Division Monitoring Team. Reviews of workplan performance are completed annually, to evaluate job completion.

General Support and Infrastructure Planning
Staff & Training – The staff support for streams monitoring is dependent on the various data and data quality objectives needed to address multiple program information goals. The wadable streams program may be a good match for citizen data collection. Volunteers will be considered to conduct some of the monitoring for this program.

Laboratory resources – Not applicable.
Funding – This program is funded under an EPA 106 grant. During the last two biennia, the 106 amount allocated to streams monitoring has been $210,000 annually, which includes estimated support, including permanent salaries, fringe benefits, and other indirect costs, but does not include FTEs. Starting with the 2005 field season, a portion of 106 funds will be reallocated to water quality sampling; the final amount for this reallocation is yet to be determined.
Program Gaps

- Determine sampling effort on individual streams. Fundamental questions that need to be addressed are how many assessment reaches need to be surveyed per stream to adequately characterize the entire stream thread for fish assemblage and gamefish, and how long do these reaches need to be? Preliminary analyses of fish community (Fish Index of Biotic Integrity) and stream habitat indices data from Wisconsin streams, suggests that first and second-order streams have relatively high within-stream variability, necessitating sampling more sites per stream to detect desired levels of change. Higher order streams show less inherent within-stream spatial-variability, and as a result fewer assessment sites need to be sampled to adequately characterize the overall condition of larger individual streams.

- An EPA National Wadeable Stream Assessment was received to begin developing reference conditions in 2006. Establishment of reference conditions is important to provide expectations for what healthy streams look like. Reference conditions are the physical, chemical, and biological criteria or “expectations” the Department will use to determine whether aquatic resources are meeting their potential. Data gathered from “least-impacted” streams provide the information necessary to develop reference conditions. It should be recognized that reference conditions (resource expectations) will vary among geographic regions, and stream types.

- The Department is currently evaluating the sensitivity of a small stream fish IBI. Preliminary results suggest that fish communities in small streams are species-poor and dominated by environmentally-tolerant taxa regardless of watershed and overall stream physical condition. These results suggest fish sampling may be useful for some purposes, but indicate other physical or biological measures may be needed to accurately assess the integrity of small streams.

- Studies need to be completed that evaluate whether single habitat (riffle) or multiple-habitat macroinvertebrate samples provide greater discriminatory power when evaluating impaired streams.

- Additional measures of physical habitat quality need to be developed for more accurate assessments of stream habitat quality.

- A multi-metric scale of stream health that combines, physical, chemical, and biological data needs to be developed for Wisconsin streams to provide an overall measure of stream integrity that combines multiple, disparate, measures of stream integrity.

- Intermittent streams are currently not being sampled due to the difficulty in identifying and tracking the large numbers of intermittent streams. Ideally, these would be included in our comprehensive coverage of streams, but with the budget realities this is not possible at this time.
WATER ACTION VOLUNTEERS STREAM MONITORING PROGRAM

Contact: Kris Stepenuck
Last updated: 10-2007

Status: Currently in Place
Water Action Volunteers (WAV) is run jointly between WDNR and University of Wisconsin-Extension, in cooperation with local partners. Established in 1997, it is funded through EPA 319 funds and US Department of Agriculture (USDA) Cooperative State Research, Education, and Extension Service (CSREES) 406 funds. WAV is an educational component of Level 1 of the Citizen-Based Water Monitoring Network described in Appendix A of the Strategy, and focuses on stream monitoring.

Monitoring Objectives
WAV is a primarily educational program that helps to assess the chemical, physical, and biological quality of selected wadable Wisconsin streams and rivers statewide.

Clean Water Act Objectives
This program is primarily educational.

Specific Objectives
- Give Wisconsin citizens the opportunity to monitor stream and river health.
- Support data sharing for educational purposes.
- Provide a network for volunteer monitoring groups, individuals, and schools to interact.
- Provide support for civic conservation and environmental groups to conduct stream monitoring.
- Increase linkages between volunteer monitoring efforts and public resource protection programs.

Monitoring Design
Over 400 adults and 1,400 students in 42 locally operated programs currently monitor monthly at over 587 stream sites statewide on a seasonal basis (May-October) through the WAV Program. Water quality monitoring locations for this program are determined locally. In some instances volunteers are directed to sites to monitor by local WDNR or County biologists, while in other cases, volunteers are allowed to choose their monitoring location based on interest/accessibility.

Volunteers are requested to monitor each site once a month for transparency, temperature, stream flow, and dissolved oxygen from April through October. Habitat is monitored annually in late spring or summer, and biotic index is monitored twice a year, in the spring and in the early fall (late September/early October).

Core and Supplemental Water Quality Indicators
- Transparency (using a transparency tube calibrated in inches or centimeters and then converted to nephelometric turbidity units (NTUs) using an empirically derived calibration),
- Temperature (using a hand-held thermometer)
- Stream flow (by measure average depth across a transect, width across the transect, and surface velocity)
- Dissolved oxygen (using a Hach dissolved oxygen test kit, Model OX-2P)
- Habitat (using a subjective 10 question data recording form based on EPA volunteer stream monitoring methods (EPA 841-B-97-003))
- Biotic index (a modified Hilsenhoff Biotic Index in which organisms are identified to order)
- Various field observations
Quality Assurance
Although there is no QAPP or written quality assurance procedure for WAV monitoring, several quality components are in place. Annual training is done for new and interested returning volunteers, using standard methods and data sheets provided in the Volunteer Monitoring Fact Sheet Series. The Fact Sheet Series is also available on the web at http://watermonitoring.uwex.edu/wav/monitoring/methods.html (fact sheets) and http://watermonitoring.uwex.edu/wav/monitoring/sheets.html (data sheets). An educational DVD set was completed in 2006 and is distributed to newly trained volunteers. Volunteers can use the DVDs to refresh their training, learn about program results, and obtain additional information about stream ecology. There are approximately 45 trained local coordinators for WAV programs, some of whom conduct follow-up field visits after the training sessions. These coordinators enter all data into the WAV database to ensure its consistency and validity. The database will soon be updated to allow citizens to enter their own data online. The information will be stored in a holding location until an approved data coordinator reviews and accepts the information, at which point it will be fully stored in the database.

Data Management
All field-collected data will be entered by either trained local data entry coordinators or volunteers into the WAV database, an online Oracle database managed at the University of Wisconsin-Extension. Each data processing step is accompanied by a QA/QC check to ensure accuracy. All data are initially verified from original field sheets and data printouts, and will be checked by approved data coordinators before being stored in the database. Corrections are made, checked and the procedure repeated until an error-free copy is obtained. Additional data quality checks are made by the WAV Coordinator during data analyses. All chemical, biological, and physical data from the WAV program are considered public information and are available through the WAV Database online at: http://watermonitoring.uwex.edu/wav/monitoring/database.html. At this site, metadata are included that indicate methods followed for data collection, the range of scores able to be determined with WAV methodology, and a description of local programs, including their program goals and a general description of their volunteers.

It is expected that data from the WAV database will eventually be migrated to the WDNR's SWIMS datasystem. In summer 2007 Station IDs were requested for all WAV monitoring sites that lacked them. Once these IDs are assigned through the SWIMS station application module, these data can be integrated with other ecological data in mapping applications. Stream monitoring stations are documented by Hydrologic Unit Code (USGS), the Department’s unique Waterbody Identification Code (WBIC), County, and site descriptions. Latitude/longitude coordinates have been recorded for a majority of the 587 registered sites to date, with plans for all sites to have latitude and longitude entered eventually.

Data Analysis/Assessment
To date, the data collected through the WAV program have primarily been used educationally and locally by citizens involved in the program. In a few instances (i.e., Pigeon River WAV Program, and Nohr Network of Monitors), data collected by volunteers have been used in Basin reports. Data have also been used by WDNR Runoff Management staff for preliminary assessments of impaired waters based on dissolved oxygen measurements.

Reporting
Data are summarized to be meaningful to the volunteers who collect them. The WAV program provides occasional water monitoring data summaries in the form of monitoring brochures or fact sheets to the general public and these are available online at: http://watermonitoring.uwex.edu/wav/monitoring/databaseResults.html. To date (the database began
being populated in 2002), not all sites that have been monitored have data summary brochures or fact sheets created. Occasionally, WAV data are used in Basin reports.

**Programmatic Evaluation**

The WAV program recently undertook several major programmatic evaluations. In the Spring of 2003, a survey of volunteers was conducted to assess the level of learning and of networking improvements experienced by WAV participants. In the Spring of 2004, an evaluation of the WAV database was completed. Based on this survey, the database was reprogrammed to allow citizens to enter their own data and make other improvements. In 2006, a survey was conducted of all people who have been trained in the program’s methods since 2001 in an effort to determine how best to grow the program within the new Network framework. The results of this survey are posted at: [http://watermonitoring.uwex.edu/pdf/level1/news/2006WAVSurveyResults.pdf](http://watermonitoring.uwex.edu/pdf/level1/news/2006WAVSurveyResults.pdf). In addition, evaluation surveys are collected after each annual training session, and modifications are made to the program as appropriate.

**General Support and Infrastructure Planning**

*Staff & Training* – One half-time FTE is allocated to this program, funded by University of Wisconsin-Extension (UWEX). Part of the program budget is funded through WDNR. Approximately 45 local coordinators are funded through other sources such as grants, or volunteer their time.  

*Laboratory resources* – No laboratory analysis is required.  

*Funding* – Funding is provided through 319 funds and USDA CSREES 406 funds. Initial set-up of each new site costs $200 for equipment needs. Other expenses include publications and travel.

**References**
