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AN INTEGRATED WATER-MONITORING NETWORK FOR WISCONSIN

By the Team for Evaluating the Wisconsin Water-Monitoring Network

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PREFACE

In March 1996, a cross-section of concerned water-resources data collection agencies, educators, and industry formed a team to address the declining data-collection networks in Wisconsin. Team membership included:

Herb Garn, U.S. Geological Survey, (USGS), Madison, Wis.
Warren Gebert, USGS, Madison, Wis.
Dale Patterson, Wisconsin Dept. of Natural Resources, (WDNR), Madison, Wis.
Paul Strom, WDNR, Madison, Wis.
Jeff Gagler, Environmental Protection Agency, Chicago, Ill.
Brian Hahn, National Weather Service, Sullivan, Wis.
Bill Koellner, Corps of Engineers, Rock Island, Ill.
Jim Kaap, Natural Resources Conservation Service, Madison, Wis.
Jamie Robertson, Wisconsin Geological and Natural History Survey (WGNHS), Madison, Wis.
Bill Oliva, Wisconsin Dept. of Transportation, Madison, Wis.
Bob Biebel, Southeastern Wisconsin Regional Planning Commission, Waukesha, Wis.
Sam Morgan, Wisconsin Valley Improvement Company, Wausau, Wis.
Chris Magruder, Milwaukee Metro Sewerage District, Milwaukee, Wis.
Steve Born, University of Wisconsin-Madison (UW-Madison), Madison, Wis.
Ken Potter, UW-Madison, Madison, Wis.
Jonathan Reed, The University Group Ltd., Facilitator, Hartland, Wis.

The following problems were to be addressed by the team:

1. Decline of streamflow-gaging stations operated by USGS. The number of long-term gaging stations operated in Wisconsin was diminishing sharply with the phase-out of all WDNR-funded stations beginning in 1996. The network consisted of about 90 long-term stations, which could be reduced to about 70 with the loss of the WDNR program if other cooperator funding was not found. The loss of these stations would leave a marginal network throughout the State for assessment of its water resources.
2. Decline of water-quality monitoring stations by WDNR and loss of USGS NASQAN stations. All 9 long-term USGS NASQAN water-quality stations were discontinued as of October 1994.
3. Potential loss of the observation well network due to funding cuts at WGNHS, which contributed toward the support of monitoring ground-water conditions at about 200 wells.
4. The desirable levels of surface-water, ground-water, and water-quality monitoring networks for Wisconsin have not been clearly defined.
5. Lack of knowledge about the long-term water-data requirements and needs for Wisconsin.

The team's mission was to:

1. Identify long-term data requirements that better integrates and meets the information needs of multiple agencies, partnerships, and interests of water-data users in Wisconsin.
2. Define what a desirable core baseline monitoring network for regional purposes would consist of to meet the needs of multiple data users in Wisconsin for surface water, ground water, and water quality.
3. Determine new, innovative ways to maintain a long-term and consistent statewide network of surface water, ground water, and water-quality stations; identify new partnerships and more stable funding mechanisms.

This report describes Wisconsin's existing long-term water-resources data-collection network, problems and impacts of an inadequate network, purposes and benefits of a long-term network, and recommended network and its costs. The report is intended to improve the understanding and management of Wisconsin's water resources by providing an adequate data base for decisionmaking.

NOTICE: This report proposes a base-level monitoring network for the State of Wisconsin and represents the efforts of a team representing various levels of government, education, and commerce. The proposed network is not meant to address all monitoring needs or requirements of those represented nor does this proposal constitute a commitment for funding on the part of the participants. Rather, it presents an opportunity and a framework to begin discussions to work together to achieve a common goal.

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AN INTEGRATED WATER-MONITORING NETWORK FOR WISCONSIN

By Team for Evaluating the Wisconsin Water-Monitoring Network

EXECUTIVE SUMMARY

Problems:

- Decline in and the low number of long-term streamflow gaging stations operated in Wisconsin by the U.S. Geological Survey (USGS).
- Decline in the number of water-quality monitoring stations operated by the Wisconsin Department of Natural Resources (WDNR), and loss of all nine long-term USGS National Stream Quality Accounting Network (NASQAN) stations.
- Loss of 43 observation wells from the ground-water network by decreased funding to the Wisconsin Geological and Natural History Survey.
- Desirable level of surface- and ground-water quantity and quality monitoring networks are not clearly defined.
- Insufficient knowledge about Wisconsin's long-term water-data needs.

Mission:

- Identify long-term data requirements that better meet the information needs of multiple users in Wisconsin.
- Describe the dimensions of a desirable base-line monitoring network for regional purposes. The network would meet the needs for surface-, and ground-water quantity, and water-quality data by multiple data users in Wisconsin.
- Determine innovative ways to maintain a long-term, consistent, statewide network of surface- and ground-water, and water-quality stations through the identification of new partnerships and stable funding mechanisms.

Purposes:

Data are needed for general management of Wisconsin's water resources and for management of specific river basins. Stations may be used to define current hydrologic conditions.

Data are used to conduct trend analysis and build a long-term record to evaluate changes in streamflow caused by changes in land-use or climate. The data can be used to develop regionally transferable information on streamflow and basin characteristics.

Data are used continually for forecasting the threat of floods for specific river reaches. The data must be available on a real-time basis. Long-term data are needed for the effective operation of dams and reservoirs, water-supply facilities, hydro-power plants, wastewater treatment facilities, or water diversions. Again, data must be real-time in nature.

Data are needed to develop statistical relationships with regional or other characteristics, to analyze the frequency and probability of low and high flows, and provide input to numerical computer models.

Water-quality and flow data are used for interpretation of water quality and to compute the loadings of contaminants to receiving bodies of water. Long-term trend analyses are used to identify changes in the resource with time, and can be used to evaluate the effectiveness of environmental management and pollution control programs.

Monitoring data are used to plan and design specific projects or structures such as dams, levees, bridges, navigation systems, water supply diversions, hydropower plants, and wastewater treatment facilities.

The networks will be organized by Geographic Management Units (GMU) in conformance with the Wisconsin Department of Natural Resources' mode of operation. Essentially, the GMUs mimic the boundaries of watersheds and allow evaluation of watersheds on a holistic basis with the minimal amount of monitoring.

Conclusions:

The hydrologists and scientists who drafted this report believe the reduction in Wisconsin's water-monitoring networks will cause serious risk to the residents of Wisconsin by increasing the uncertainty of water-resources plans and decisions, and ultimately increasing the costs for construction of water-related facilities and damages from extreme events.

Water-resources management and planning requires an adequate long-term data network. Present water-data networks in Wisconsin are less than optimum for most State and Federal agencies to make decisions and probably are not adequate for the specific needs of many local government units, industry, utilities, and recreational users.

Recommended Networks:

A network of 139 stations for monitoring streamflow is proposed to provide up-to-date information for management of Wisconsin's water resources; provide the necessary streamflow data for large-scale watershed management; provide real-time information for flood forecasting, droughts, pollutant spills, contamination, and dam breaks; obtain up-to-date data for operation of dams, power plants, wastewater treatment plants, and public water supplies; and evaluate long-term trends in streamflow for the major river basins of the state.

A minimum statewide water-quality monitoring network of 43 sites is proposed to provide fixed-station, long-term, water-quality monitoring in each GMU; ensure that long-term water-quality data are linked to flow data to provide information on pollutant loading; provide cost-effective base-line water quality information for use in making GMU management decisions; and evaluate long-term trends.

A statewide network for monitoring ground-water levels enables resource managers to systematically study the natural regime of ground water in the various hydrologic conditions in the state. The data are needed to determine ground-water fluctuations, their causes, dimensions, and trends, and to relate these trends to precipitation and storage changes in ground-water reservoirs. The statewide observation well network will reflect the state's geology and areas of special interest, and will include 75 primary wells monitoring natural water-level fluctuations: 43 would be in sand and gravel aquifers, eight in Silurian dolomite aquifers, seven in Galena/Platteville aquifers, and 17 in sandstone aquifers. Forty-five secondary wells will monitor natural fluctuations in water levels and 25 special-purpose wells will be located in the Green Bay area, Southeastern Wisconsin, and Dane County.

Data management, storage, and dissemination from the recommended networks would continue to be handled by the respective data collection organizations. Coordination amongst the parties involved should be improved and integrated along the lines of the recommendations made by the Intergovernmental Task Force on Monitoring Water Quality in 1995.

Cost Factors:

- Total cost of the recommended statewide integrated network described here and which consists of three parts (surface-water quantity, surface-water quality, and ground-water levels) would be $1,610,000 in 1997 terms, an additional $620,000 over the current network of $990,000. Costs were derived from cost accountings of individual stations. Total implementation is intended to be completed by the year 2000.
- The operating cost of the recommended streamflow gaging network is $1,108,000 in 1997 terms. Additionally, there is an initial construction cost of $233,000 for purchase of equipment and installation of 30 additional gaging stations, bringing the total cost to $1,341,000. The cost of operating the proposed network is an additional $306,000 over the current network cost.
- The total cost of the recommended minimum water quality monitoring network is $136,000 for 1997. The recommended network would consist of 43 sites; an addition of 14 new sites to the network. This is still a major reduction, however, from the 60 to 70 stations previously operated by the WDNR.
- The total cost of the recommended ground-water level monitoring network is $133,000 in 1997 terms. This would include the cost of 44 observation wells added to the network of 126 wells that are currently funded. The additional cost of the 44 wells is approximately $40,000 annually.

Although the collected data would have many uses, many users have a single purpose or program that depends on the data. Data users therefore, rely heavily

on the availability of this "publicly available" data and do not pay directly for their portion of data collection, operation, and maintenance expenses. At this time, many of the people probably do not know how the network is funded and that it is being reduced. Respondents to a 1996 survey of Wisconsin water users indicated the relative proportion of funding that each party should contribute to support a long-term monitoring network for Wisconsin. The distribution was 41 percent by Federal agencies, 32 percent by State agencies, 12 percent by local government, 8 percent industry, and 3 percent other. All parties must work together to support a stable network. If such a distribution of funding could be effected, the Wisconsin water-monitoring network could be improved and fulfill the needs of data users.

INTRODUCTION

Wisconsin has always had a national reputation for its excellent water-resource management programs. It has been recognized for tough regulatory standards as well as innovative programs and commitment to reducing pollution from point and nonpoint sources. Many of these programs were based on the water data collected and disseminated by State and Federal agencies. Presently, Wisconsin is losing much of its current network for water-data collection, including surface-water, ground-water, and water-quality sites. Funding support for the network has been significantly reduced from 1995 to 1997. This report outlines the problem, describes the current and a proposed statewide water-resources data network, and presents a plan to coordinate and equitably share the costs of the proposed network. Elements included in this statewide monitoring network are streamflow-gaging stations, water-quality stations, and observation wells for ground-water levels.

Water-resources management and planning requires an adequate long-term data network. The network must describe surface water, ground water, and water quality, and it must be readily available to a large variety of users. Present water-data networks in Wisconsin are less than optimum for most State and Federal agencies to make decisions and are not adequate for the specific needs of many local government units, industry, utilities, and recreational users. Wisconsin's present data-collection network is not a planned, coordinated network but a result of several agencies' different needs, special projects, or compliance monitoring. This has resulted in a fragmented network that lacks an overall goal, consistency, and adequate areal coverage. As a result, the U.S. Geological Survey facilitated the formation of a team of concerned water resources professionals to address Wisconsin's network.

Present data systems include a complex collection of methods and computer data bases operated by a number of agencies in a variety of forms that may not be available to many users. At present, most of the data is stored on either the USGS National Water Information System, USEPA STORET data base, or data bases on personal computers. The data are intended to be public; in reality, the data are poorly disseminated. Not every water user in the State is aware of the various data systems, and most data bases are not readily accessible by others. A fair amount of computer sophistication, training, and access rights are required to use the data. During the past year, having USGS streamflow data available on the Internet has significantly improved access.

Wisconsin is fortunate to have an abundant supply of good quality water in lakes, streams and underground. This valuable resource is frequently taken for granted until an emergency threatens either the quality or quantity of water available to the residents of the State. The waters of the State are influenced by natural forces such as weather patterns and human activity that can alter the quality and quantity of surface and ground water. The State has 33,000 miles of rivers and streams; about 15,000 lakes; and coastlines on two of the Great Lakes. The ground-water supply, most of which is potable, is abundant and approximately equivalent to one-third the amount of water in Lake Superior. Protection of these vital resources is important to the people of Wisconsin for their consumption, health, recreation, and economic benefit.

The State's economy is dependent on its water resources. The three biggest contributors to Wisconsin's gross state product are manufacturing, agriculture, and tourism. Manufacturing contributes $88.6 billion annually, and agriculture and tourism contribute $5.4 billion each to the State's economy. All of these businesses are dependent on sufficient quantity and quality of water.

Floods, droughts, and pollution are examples of crises to Wisconsin's water resources that have occurred several times in the last 20 years and will continue to occur at unpredictable intervals. When a water-related crisis occurs, proper action on the part of State and local governments and its citizens is vital to minimize negative impacts. Decisions must be made on the

basis of accurate information. One of the best sources of information that managers can rely on is long-term historical water-data records. These records are vital for understanding and managing the State's diverse water resources, especially during times of crisis. Long-term records allow prediction of future trends and extreme events, and allow time to develop good emergency planning and contingencies. Furthermore, many decisions are made everyday by State and local agencies that are influenced by our understanding of hydrology. Land-use development decisions are being made by local governments, which depend on the availability of sound information on flood plains. Millions of dollars are spent each year on nonpoint-source pollution control, farm programs, wastewater treatment plants, drinking-water supply management, discharge permits, bridge and culvert construction, and dam spillways. As an example, wastewater treatment plants are designed to protect water quality during extreme drought flows, and highway bridges are designed to withstand severe floods. Inaccurate predictions of these extreme events are costly to the citizens of the State either due to failure or overdesign of the facility.

Estimation of extreme events is the hydrologist's most important and challenging problem. There is no substitute for good long-term records for this purpose, since extreme event prediction is highly related to the length of historical records. Short or inadequate data records lead to great uncertainty in the prediction of both low- and high- flow extremes and thus increase the chances of underdesign or overdesign of facilities. Uncertainties of several hundred percent are not uncommon if flow records are limited. A single bridge or dam failure can cost millions of dollars to repair or replace (let alone the potential danger to human life), whereas less than $1 million could fund flow monitoring at 10 sites for 10 years. Estimated low flows that are less than the actual could cause a single community to spend millions more than needed on wastewater treatment to protect the local stream. Such costs are particularly hard to cover by smaller communities that discharge near the headwaters of streams where low flows are the least and subject to the most uncertainty.

Few think about water conditions until a pollution problem occurs. Recent examples include:

- the *Cryptosporidium* infection in Milwaukee in 1993 that affected hundreds of thousands of people,
- toxic chemical spill of benzene in 1992 into the Nemadji River by a train derailment near the Duluth/Superior harbor, which forced the evacuation of thousands from Duluth and Superior,
- the 1976 and 1988 droughts,
- the 1993 and 1996 floods.

Long-term water data are vital during these flood, drought, or pollution crises for making precise and cost-effective water-resource management decisions to protect the health and safety of residents and protect other resources.

Long-term data are also needed for planning purposes due to changing land-use conditions and population growth. An adequate monitoring system provides an early warning system of changing conditions to help identify and prevent problems before expensive corrective measures are necessary. The quality of life that we enjoy in Wisconsin is closely tied to the fish, wildlife, and recreational uses that are dependent on the quality and wise management of water resources. Although Wisconsin is fortunate to have an abundant supply of good-quality water, the proper use and protection of Wisconsin's water resources are critical for continued health, safety, and growth in the future.

PURPOSES AND BENEFITS OF A LONG-TERM NETWORK

What are monitoring stations and why are they important to the residents of Wisconsin? A monitoring station provides critical information about current water conditions, often automatically recorded and remotely accessed, for a wide variety of applications and interpretations affecting resources. Data from a long-term network has many benefits and uses. The importance of long-term data 25–50 years into the future, along with some of the current potential uses, are:

- Forecasting, warning, and control of floods; prevention of flood damages
- Forecasting trends in ground-water level fluctuations
- Managing and protecting drinking-water supplies
- Planning and design of structures to avoid overdesign or underdesign of bridges, culverts, dams, sewage-treatment plants
- Identifying, monitoring, and controlling water pollution
- Detecting problems early before costly solutions are needed
- Evaluating current hydrologic conditions (regional indicators)

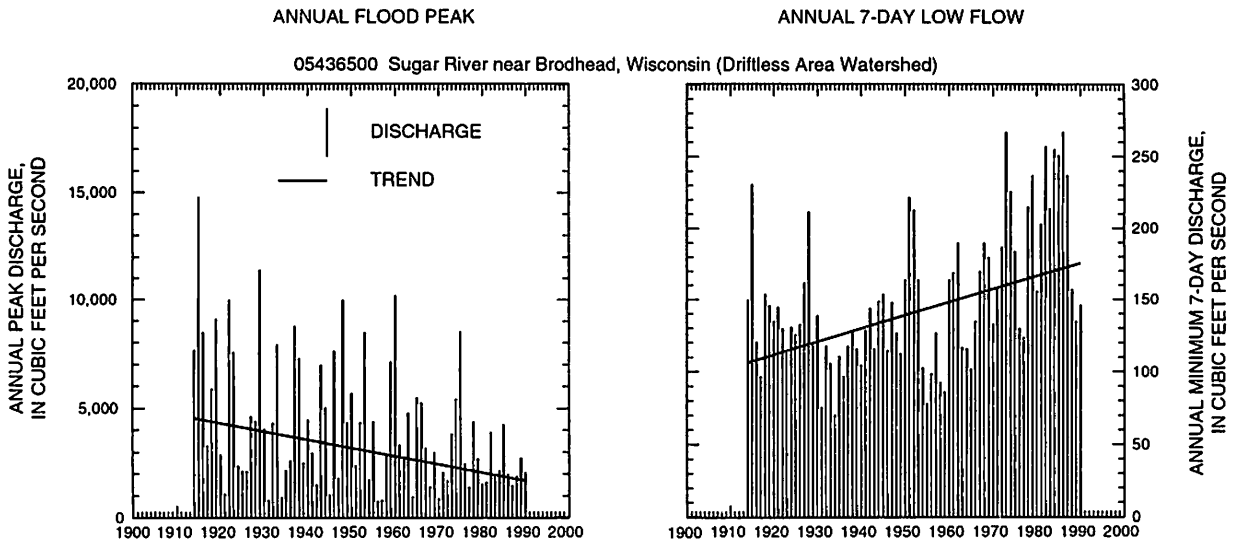

Figure 1. Relation of annual flood peak and annual 7-day low flow with time for Sugar River near Brodhead, Wisconsin.

- Operating and managing wastewater treatment plants, hydroelectric power sources, dams, and reservoirs
- Watershed management and planning, measuring program effectiveness of practices
- Improving drought preparedness by determining minimum ground-water levels on a regional basis
- Urban planning and stormwater management to address increasing development and land-use changes
- Identifying long-term trends due to development or land-use changes
- Flood-plain planning and management, mapping of 100-year flood plain
- Estimating flood frequencies and developing regional equations
- Determining low-flow frequencies (index sites)
- Enforcing regulations, permits (legal requirements)
- Designing and interpreting short-term or project-specific studies

To illustrate the importance of just one monitoring station, consider the streamflow-gaging station on the Sugar River near Brodhead, Wis., in Green County. This station monitors a drainage area of 523 mi^2 and has a continuous record of stage and discharge since 1914. Data from this station have been used for:

- planning and design (hence cost) of wastewater treatment plants at Mt. Vernon, New Glarus, Verona, Belleville, Monticello, Albany, Brodhead, Brooklyn and Monroe
- flood forecasting by the National Weather Service and project regulation by the Corps of Engineers,
- construction of numerous bridges and culverts,
- disaster response by Wisconsin and Illinois State governments,
- operation and management of dams and reservoirs on the Sugar River by several municipalities and downstream by the Corps of Engineers,
- studies by the Geological Survey that have evaluated long-term changes in flow conditions, regional low-flow relationships, and flood-frequency characteristics,
- description of current streamflow conditions in the drainage basin for planning purposes by local and state agencies,
- mapping of the 100-year flood plain and management and local zoning of the flood plain for Verona, Belleville, and Brodhead,
- development of a watershed management plan for water-quality control from point and nonpoint sources of pollution as part of the WDNR water-quality management basin plans and priority watersheds,
- access to real-time data through the Internet by boaters, canoeists, and fishermen to determine current flow conditions for recreational use.

An example of how this station has been used to see whether trends are occurring in Wisconsin is shown in figure 1. As indicated, there is a significant decrease in annual flood peaks and a significant increase in annual 7-day low flow that would have an effect on

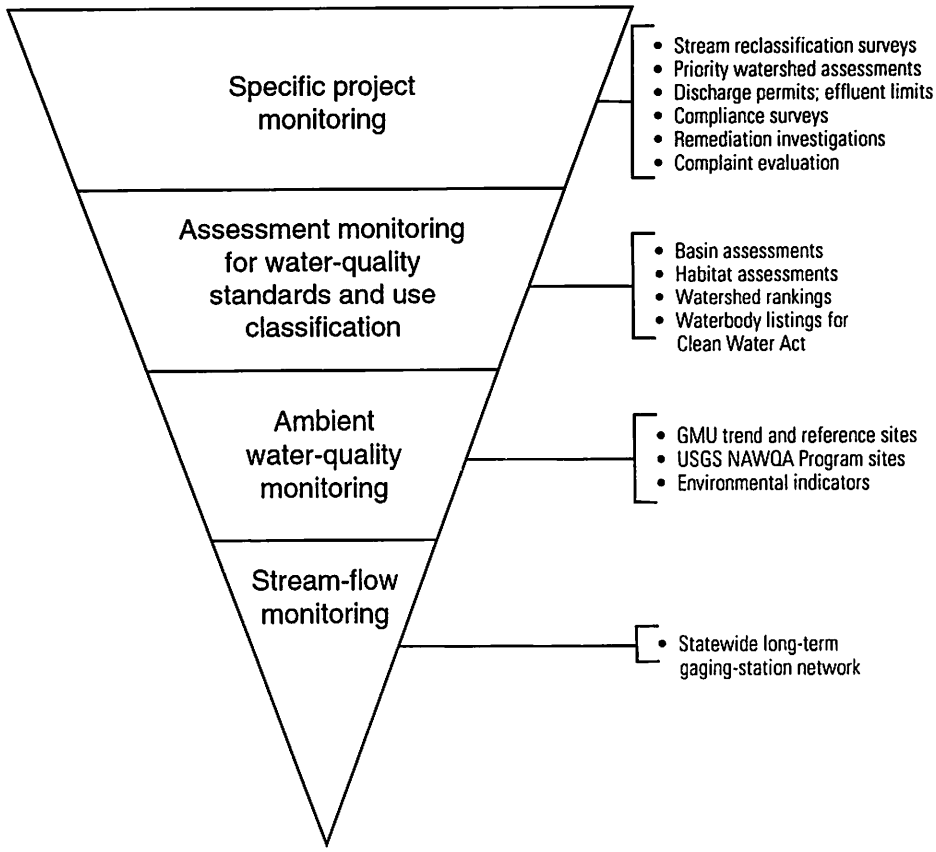

Figure 2. Pyramid of surface-water monitoring levels and activities.

design of facilities and structures (Gebert and Krug, 1996). State funding for this station was eliminated and long-term funding to continue its operation is in jeopardy.

Water monitoring may be thought of as an inverted pyramid, or hierarchy of monitoring, resting on the most basic data requirement. For example, the pyramid of surface-water monitoring levels and supported activities shown in figure 2 illustrates the dependence of upper levels on basic long-term streamflow monitoring. Each level supports those above it and weakness in the lower levels can result in failure of the entire system. Data in the lowest levels is the most crucial and often the least expensive portion of the monitoring budget. Yet it is often this fundamental data that is the least appreciated and thus the first to be eliminated during budget cuts. This results in uneven funding, especially during tight budgets that can jeopardize other components of the water program.

Streamflow quantity is the foundation that allows accurate determinations of flow characteristics for many uses as indicated in this report. This information is basic and many watershed managers take it for granted until streamflow-gaging stations disappear and managers find themselves unable to perform many of their fundamental responsibilities like determining aquatic community types or transport of pollutants.

Moving up the pyramid, the next level is basic water-quality information derived from long-term monitoring sites used to characterize large drainage areas typical of WDNR Geographic Management Units (GMUs). These stations provide basic water-quality trend data at GMU scales and watershed scales. Data at this level are required to reveal subtle but important trends due to management actions, population changes or agricultural practices. For example, declining total phosphorus concentrations in the Lower Fox River indicate a response to phosphorus controls implemented in the mid-1970s. Also, development taking place in areas of northern Wisconsin may have long-

range impacts on water quality. Only with long-term monitoring can major demographic shifts be observed. Without GMU trend-monitoring sites, these changes will not be observed and potential management options poorly assessed. In addition, reference sites at these scales are used to develop background water quality for setting regulatory goals. This report addresses the need for these basic levels of water monitoring.

The third tier of the pyramid consists of more detailed GMU assessment monitoring for the purpose of establishing water-quality standards and use classifications. These determinations are based on reference sites, cultural modifications and general water-quality trends. Activities consist of basin assessments on a rotating 5-year basis, Aquatic Terrestrial Resources Inventory, habitat assessments, and fish population assessments. This information is obtained at as many sites as possible in a GMU-sized area. individual watersheds are subsequently ranked for priority watershed selection and individual waterbodies can be listed in various federal programs such as section 304(l) (point-source toxics), 305(b) (waters not attaining uses), 319(a) (NPS impacts) and 303d (TMDL sites). GMU basin plans detail these findings and make recommendations on management activities and funding priorities needed in the basin such as designations of priority watershed projects, application of water-quality based effluent limits, stream classification and designation of total maximum daily load (TMDL) sites.

The fourth level of the pyramid consists of all of the monitoring activities implemented as part of a specific project. These can range from monitoring for a priority watershed assessment, stream classification update at a particular waterbody, development of water-quality based effluent limits for a point source, development of allocations for a TMDL site, remedial investigation at contaminated sediment sites, etc. Monitoring at this level is normally short term and site specific to develop and implement management actions and evaluate results.

IMPACTS OF AN INADEQUATE NETWORK

Because of cutbacks in the Federal and State budgets detailed in the following section, the current data network will be greatly reduced next year and possibly more so in subsequent years. These cutbacks will further impact the availability of data to the point where the network will be grossly inadequate to meet future needs of water-data users. In addition, many of the 9 surface-water stations that may be discontinued are stations with records of 50–100 years, stations that are the most critical to understanding the trends and variability of streamflow and water quality in the State. Because of the cuts in funding of the ground-water network, large parts of northeastern and northwestern Wisconsin will be without observation wells. Wisconsin could potentially see substantial changes in its water resources during the next decade. Decision-makers will not have the information to warn of impending problems.

Five examples of the impacts of an inadequate network are described below. These examples were selected to represent a cross section of data users and programs that may be harmed by a substantially decreased network.

Water Management, Regulations, and Grants

Major Congressional actions have resulted in laws designed to protect and improve water quality. Most notable are the Clean Water Act and Safe Drinking Water Act. The Federal government has entered into partnerships with states and has delegated authority to the states for managing and implementing programs dependent on water data. As a result, states are responsible for assessing the "use attainment" of their water bodies and reporting the findings in the 305(b) Water Quality Report to Congress. The Water Quality Reports are designed to give an overall status of the water quality within a state. In order for this document to be both accurate and useful, it is vitally important that there be accurate and sufficient water data. This includes the need for long-term trend data to assess the effectiveness of the Federal and State water program activities by identifying improvements in overall use attainment.

Two major activities that cannot function without a commitment to a long-term water-monitoring network are Environmental Indicators and Total Maximum Daily Loads (TMDLs). With water managers beginning to realize the need to have better mechanisms available to assist in improved, cost-effective water program management, environmental indicators and TMDLs are being recognized as a new water-resource management tool. Without good long-term flow data, the TMDL process along with the supporting modeling and wasteload allocation process cannot be done. Even more critical is the environmental indicator process. Environmental indicators have been classified

into three categories or tiers: condition indicators, stressor indicators, and program indicators. The key is in understanding the linkages from program management to stressor control and prevention to environmental condition response. The binding component is in having good long-term data that has the ability to allow for identification of long-term trends in water-resource conditions. Without a long-term water-monitoring network, there will not be the necessary data to support an environmental indicators process.

As water-monitoring networks decline, the ability to identify trends in water-resource conditions and responses is lost. The result is that water-resource managers are in a reactive mode of damage assessment with costly water-resource cleanup or misidentified management actions. By maintaining and improving long-term water-monitoring networks, water-resource managers will be able to become more proactive rather than reactive. The use of a long-term monitoring network and the environmental indicators process will enable water-resource managers to be better equipped to implement cost-effective management solutions to improve and protect water resources.

Biological and physical monitoring have become equally as important as chemical and flow monitoring as new concepts in environmental management have become more widespread. The use of "environmental indicators" as a measuring tool for program effectiveness under new state/EPA performance partnerships (U.S. Environmental Protection Agency, 1996) depends on the use of long-term water-quality and flow data, as well as monitoring data on the health of aquatic and terrestrial organisms and the quality of their habitat. Currently, water data are critical to the design of wastewater treatment facilities using State Revolving Fund loan programs, the establishment of permit limits, the prioritization of watersheds for nonpoint source control activities, and many other Federally required program elements. In the future, efficient and effective resource-management decisions will increasingly be based on long-term biological, chemical, and physical water-monitoring data.

Finally, states use the data they collect to document conditions and identify additional needs in order to seek program and research grant funding to further improve knowledge of, and the condition of, the resource. The better a state can describe an environmental problem and identify what is needed to correct the problem, the better the chance of obtaining the remediation resources. Similarly, where a gap in environmental knowledge exists, a better definition of the question means a better chance of obtaining necessary research funds. Water-monitoring data are critical to the states in both instances.

Flood Forecasting

The loss of important long-term stream gaging stations has an irreversible impact on the river forecasting system. Models developed by both the National Weather Service and the Corps of Engineers require data from long-term gaging stations. Without these stations, river forecasting capabilities would be reduced. Flood-forecast thresholds have been established at many locations on interior Wisconsin streams as well as on the Mississippi River. Residents and local governments have relied on the upstream forecast information in planning for a flood fight, evacuation from a flood plain, or removal of government structures. As a result, without adequate information, flooding of water-supply and wastewater-treatment systems could occur, and the proper operation of water-control and flood-control structures could be jeopardized.

Reductions of the gaging-station network to save funds can ultimately cost taxpayers more in rehabilitation costs of flooded areas. Eight out of every ten Presidential Disaster Declarations are for floods. The National Weather Service (NWS) estimates that, on a national basis, flood forecasts based on adequate streamflow data save 10 percent of the potential flood damage costs. Adequate streamflow data will become even more important to NWS flood forecasting operations in the future with the advent of Quantitative Precipitation Forecasting (QPF) and Probabilistic QPF. The QPF program of the NWS incorporates expected future rainfall amounts into the flood forecasting process. It is incumbent on local governmental agencies, especially the emergency management agencies, to advocate continuing the operation of gaging stations. The Federal government cannot solely pay for gages where local or state entities have a greater need.

Wastewater Treatment Facilities

The following hypothetical example demonstrates the potential cost savings that could result from having adequate long-term stream-gaging data available when designing wastewater treatment facilities and establishing permit limits.

A community of 5,000 in Southwestern Wisconsin discharges to a stream with a 7-day, 10-year low-flow estimate of 1 ft^3/s. Design flow of the treatment plant is 0.7 mgd or about 1.08 ft^3/s. BOD and ammonia limits for the facility using the 1 ft^3/s low flow results in limits of 9.3 mg/L and 4.6 mg/L, respectively (assuming pH of 7.5 and temperature of 75°F). This community will have to build an advanced secondary or a tertiary plant to meet these limits, at an estimated cost of $7.0 million. The low-flow estimate is largely based on 10 years of flow gaging in a nearby stream that was gaged during the 1950s and not since. Uncertainty on the low-flow estimate is greater than 500%. Inspection of the flow records at gages in southwestern Wisconsin indicate that the low-flow estimate at this site may be higher today than in the 1950s (see fig. 1). If the stream had been gaged directly from 1950 to the present, uncertainty of the low-flow estimate would be much less and could result in a better estimate, perhaps as high as 5 ft^3/s. With a receiving streamflow of 5 ft^3/s, limits for BOD and ammonia would be increased to 27 mg/L and 13 mg/L, respectively. **Both of these limits are routinely met with well-operated secondary plants and do not require advanced treatment. Cost savings to the community would have exceeded $1.2 million.**

Recreation

Many streams in southwestern Wisconsin are making a remarkable recovery from their once abused condition and becoming trout streams again. According to a study by the University of Wisconsin, this recovery has produced fishing-related income of $300,000 per year in the Kickapoo River Valley alone. In addition to habitat management practices in the stream, long-term streamflow for the past 50–90 years at seven gaging stations show that base flow has been increasing and flood peaks decreasing since the 1950s. This change has reduced habitat damage from floods and provided more stable and cooler base flow for fish holding water. Without the network of long-term streamflow records, it would not have been possible to determine what changes had helped produce this fisheries renewal.

Comprehensive Watershed Planning

Comprehensive watershed planning incorporates floodland and water-quality management with land use and park and open-space planning. The watershed is the logical water-related resources planning unit. However, such planning can be effectively accomplished only if sound data are available to accurately describe the hydrologic, hydraulic, and water-quality characteristics of the watershed. Such data can only be developed through long-term monitoring programs. For example, in Southeastern Wisconsin, comprehensive watershed plans have been prepared for the Milwaukee River, Menomonee River, Oak Creek, Kinnickinnic River, Pike River, and Oak Creek watersheds. These plans provide a basis for local decisions relating to flood-plain zoning, flood-control actions, and water-quality improvement programs. Significant resources are being allocated to reduce point and nonpoint sources of pollution and for floodland management in these watersheds. However, there is a need to periodically review and refine the planning program and to assess the effectiveness of actions taken to improve the water resources. Without a continuing monitoring program, the effectiveness of costly management programs cannot be measured and improvements in program efficiency cannot be made.

PRESENT DATA-COLLECTION NETWORKS

Wisconsin is fortunate to have some stations that have a long period of record—some of the longest record in the country, for both surface- and ground-water quantity and quality. Two streamflow-gaging stations have more than 100 years of record, and 15 have record back to the early 1900s. A statewide ground-water observation network was established 50 years ago, but record for some wells goes back to the 1930s. This provides a unique data base for Wisconsin to evaluate the effect of land-use changes like deforestation, changes in farming practices, and the effect of urbanization and population growth. In addition, long-term records are also necessary to evaluate changes in weather patterns.

Surface-Water Quantity

The 1996 long-term streamflow network operated by USGS in Wisconsin consisted of 92 long-term stations. The stations are shown in figure 3 and included as existing stations in table 1 of the Appendix. For the purpose of this report, a "long-term" station is one that is operated as an automatic-recording stream-gaging

Figure 3. Location of long-term continuous-record streamflow-gaging stations in Wisconsin, 1996.

station and is scheduled to provide data for an indefinite time period greater than 3 years. Almost all stations have real-time data that can be accessed through the Internet. Another 47 short-term stations are operated in the State by the USGS that are not included in this network because they are project-specific. Ten stations are operated by neighboring USGS Districts on bordering streams. Some discharge and stage stations are also operated by the Wisconsin Valley Improvement Company and others on major rivers and reservoirs in the State.

The 92 stations in the network represent an average density of about 610 square miles (mi^2) per station for Wisconsin, with a total area of 56,154 mi^2. Wisconsin is rich in the number of perennial streams in the State, with about 30,000 miles of perennial streams (WDNR, 1992); therefore, each station represents about 350 miles of stream. Comparable densities of station networks in nearby states are as follows and show that Wisconsin has far fewer gaging stations with long-term funding commitments, especially when considering the number of square miles per station:

State	No. of long-term stream-flow-gaging stations	State area (mi^2)	Density (mi^2/station)
Indiana	166	36,291	219
Illinois	155	56,400	364
Michigan	148	58,216	393
Wisconsin (1996)	92	56,154	610
(1997)	88		638
(projected, 1998)	83		677

The optimum number of gaging stations that should be operated in a state cannot be precisely established. Comparing the density of stations between similar states provides some feeling as to what an adequate network may be. Density is also an important indicator because decision-makers are required to provide information in areas where no data are available. A reduction in area per station generally means increased reliability of estimates and less area where no data are available. The last evaluation of Wisconsin's stream-gaging program was done in 1984 (Walker and others, 1987).

Because of reduced Federal and state budgets, the network for Federal fiscal year (FY) 1997 was reduced by 4 stations and, in 1998, potentially by 9 stations (from 92 to 83, a 10-percent reduction) if long-term continued funding is not found. The stations that could be lost in the near future are identified in figure 3 and table 1. Temporary funding was found for most of the stations in table 1 to continue their operation in FY 1997.

Figure 4 shows the number of scheduled, long-term gaging stations operated in Wisconsin since before 1890, along with State water use since 1950 (Ellefson and others, 1997). As illustrated, the number of long-term stations and amount of data being collected to make informed decisions peaked in the 1950s and late 1970s and is projected to decrease to a level similar to that of the 1940s, while water use has continued to increase. Other concerns indicated are the trends toward more short-term project stations monitoring smaller drainage areas and fewer stations monitoring

Table 1. Gaging stations with no long-term funding commitment and probability of being discontinued in FY 1998

Station number	Station name	Record began (water year)
04024430	Nemadji River nr South Superior	1974
04071858	Pensaukee River nr Pensaukee[1]	1973
04085200	Kewaunee River nr Kewaunee[1]	1964
04085281	East Twin River at Mishicot[1]	1972
04085427	Manitowoc River at Manitowoc[1]	1972
04086000	Sheboygan River at Sheboygan	1916–24, 51
04086360	Milwaukee River at Waubeka[2]	1968–81, 94
05333500	St. Croix River nr Danbury	1914
05381000	Black River at Neillsville	1914
05403500	Lemonweir River at New Lisbon[2]	1944–87, 94
05408000	Kickapoo River at LaFarge	1939
05426031	Rock River at Jefferson[2]	1978

[1]Discontinued October 1, 1996.
[2]Discontinued October 1, 1995.

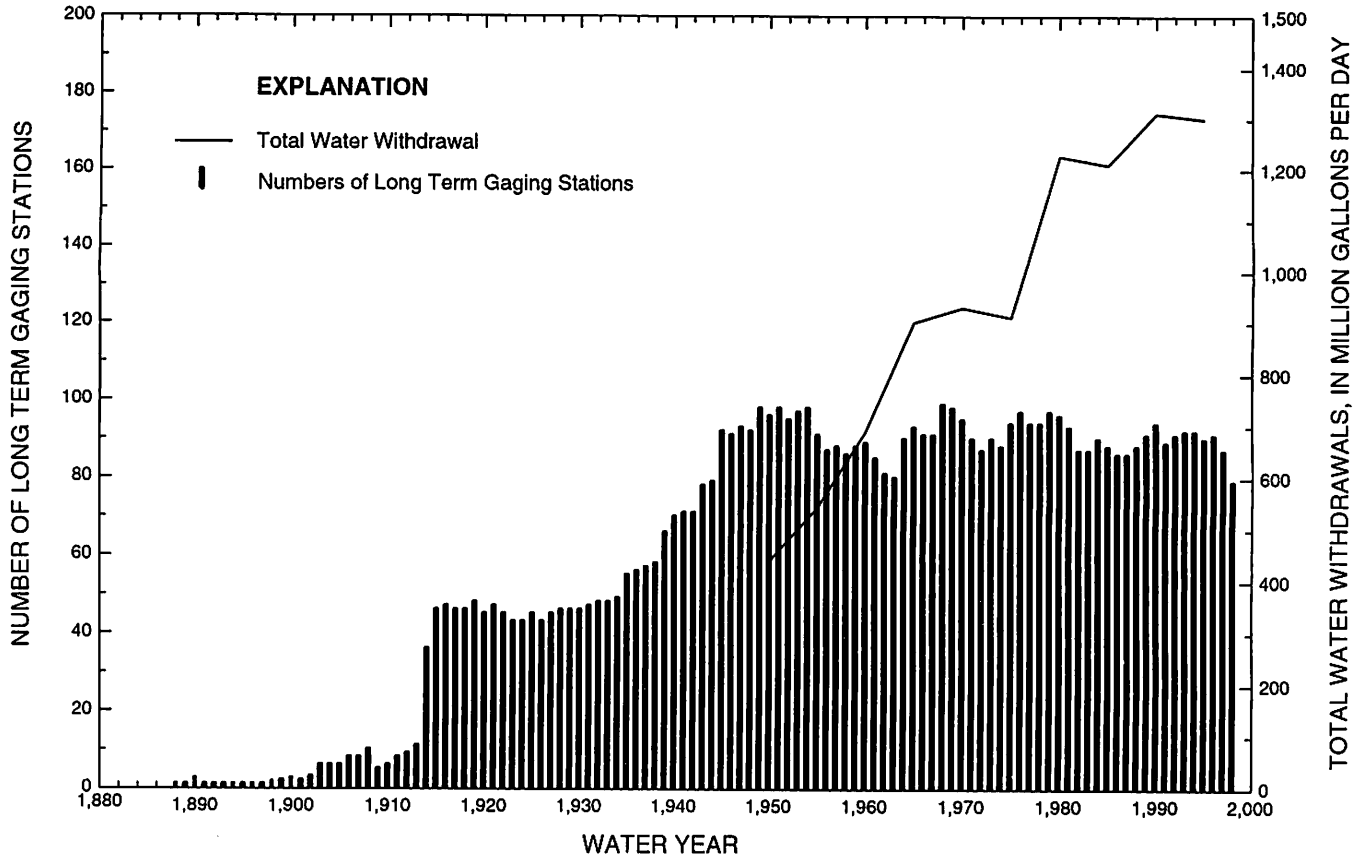

Figure 4. Trends in Wisconsin water use, 1950–95 (millions of gallons per day), and number of long-term continuous-record streamflow-gaging stations operated in Wisconsin, 1888–1998.

Following is the cost of the streamflow network operated by the USGS in Federal FY1995–97:

	1995		1996		1997 (planned)	
	Funds	Percent	Funds	Percent	Funds	Percent
USGS coop matching funds	340,000	36.2	354,000	35.7	295,000	34.0
USGS Federal funds	66,000	7.0	72,000	7.2	71,000	8.1
Corps of Engineers	143,000	15.1	161,000	16.1	170,000	19.4
FERC licensees	92,000	9.7	90,000	9.0	93,000	10.6
Wisconsin DNR	111,000	11.8	83,000	8.4	20,000	2.3
SEWRPC	58,000	6.2	59,000	5.9	61,000	7.0
Dane County	31,000	3.3	44,000	4.4	50,000	5.8
Municipalities, sewage districts, Indian tribes and others	90,000	9.5	120,000	12.1	98,000	11.3
National Weather Service	9,000	1.0	8,800	.9	9,600	1.0
Total	940,000	100.0	992,000	100.0	867,000	100.0

intermediate-sized drainage basins of about 300–1,000 square miles.

A 1996 survey of 247 water users in Wisconsin (see summary of the survey results in the Appendix) asked the question, "Who do you think should fund a Wisconsin water data network?" A summary of the pooled recommendations of responses to this question from over 150 users is shown below; a comparison to the current funding is also shown.

	1996 Survey recommendation (percent)	Current 1997 funding (percent)
Federal agencies	41	63
State	32	2
Local government	12	24
Industry	8	11
Other	3	--
Total	100	100

Surface-Water Quality

Similar to the flow-gaging network, the water-quality monitoring stations are a collection of sites chosen to meet a variety of local or regional needs. The current network does not provide comprehensive coverage of the State and is not necessarily coordinated with the flow-gaging network, although in many locations both water-quality and flow data are collected.

The 1996 water-quality monitoring network consists of 39 stations operated by the WDNR and one station operated by the USGS. As many as 70 stations monitored by WDNR have substantial periods of record, and several others are monitored infrequently on a project-specific basis, but funding limitations have forced reductions in the number of stations in recent years. The USGS previously operated 12 long-term NASQAN (National Stream Quality Accounting Network) stations that were discontinued year by year starting in 1993; in FY 1995, the USGS network was reduced from nine stations to one benchmark (reference) station.

Wisconsin contains parts of three USGS National Water Quality Assessment (NAWQA) Program study units— the Upper Mississippi River Basin (UMIS), the Western Lake Michigan Drainages (WMIC), and the Upper Illinois River Basin (UIRB). There are 3 fixed water-quality sites associated with the UMIS, 10 fixed sites associated with the WMIC, and perhaps 1 or 2 fixed sites associated with the UIRB (that study begins in FY 1998) in Wisconsin. These sites are sampled monthly for three consecutive years during the intensive data-collection phase, and a subset is sampled monthly during the low-intensity sampling phase as well. Sampling includes chemical, biological and flow measurements.

The WDNR had operated a network of continuous monitoring analyzers on the Fox and Wisconsin Rivers since 1971. The system consisted of 11 stations; however, all State funding for these stations ceased in 1995 as a result of budget reductions. The Lower Fox River Dischargers Association has funded on an annual basis the continuation of four Fox River stations. No continuous monitoring remains on the Wisconsin River, and the future of the Fox River stations is uncertain. These stations provide continuous information with hourly average values for dissolved oxygen, temperature, pH, and specific conductance stored on-site in dataloggers and retrievable by modem, making real-time water-quality data available. The information is summarized by the WDNR in the form of monthly and annual plots for each site and water-quality characteristic.

The WDNR collects water-quality data on 50 long-term trend lakes to evaluate water quality and ecological changes over time, to educate and enlist volunteer support, and to provide a factual basis for management decisions and policy development. These lakes have been monitored since 1986. The USGS also collects project-specific water-quality data at more than 50 sites on lakes and streams. Some sites are equipped to continuously record water temperature and dissolved oxygen to provide real-time data by remote access. Project-specific water-quality data are also collected by the Wisconsin Valley Improvement Company (WVIC), other power companies, and various sanitary districts. The Milwaukee Metropolitan Sewerage District collects long-term data on water temperature, dissolved oxygen, and specific conductance at four sites on the Milwaukee and Kinnickinnic Rivers. The Madison Metropolitan Sewerage District operates a network of 15 sites in Dane and Rock Counties for which extensive data are available. Green Bay Metro and many other local agencies collect data as well. These local data-collection efforts are not included in the network at this time.

The current statewide network of long-term streamwater-quality stations is shown in figure 5. For 1997, the ambient monitoring network operated by WDNR may be further reduced if sufficient monitoring funds are not available to meet programmatic needs. At

Figure 5. Location of water-quality trend stations operated in Wisconsin, 1996.

this time, no real-time data are available from the ongoing stations.

Funding (1995–97) for the current long-term network of water-quality sites is distributed as follows:

	1995	1996	Planned 1997
USGS - NAWQA	400,000	175,000	250,000
USGS Federal	28,300	4,900	4,900
Corps of Engineers	8,700	7,800	7,800
Wisconsin DNR (streams)	186,380	84,400	52,100
(lakes)	97,510	88,480	88,480
Lower Fox River Discharger's Association	0	32,000	28,000
Total	720,890	392,580	431,280

Ground-Water Levels

The ground-water observation well network is operated and maintained by the USGS and Wisconsin Geological and Natural History Survey. The 1996 network consisted of 170 wells. The number of network wells was reduced by 43 wells in 1995 as a result of State funding cuts. Observation-well location, aquifer tapped, and the frequency of water-level measurement for the 1996 network are shown on figure 6 and listed in table 3 of the Appendix. In addition, table 3 lists the period of record for each well in the 1996 network and the cost per well per year. The cost per well for unfunded wells (wells discontinued in 1997) is higher than for funded wells (wells measured in 1997) because observers cannot be found to measure the unfunded wells. Twenty-two observation wells are equipped with continuous recorders, and 15 of the wells provide real-time data through the Internet. Two wells not indicated on the map are monitored by the WVIC.

Costs of the 1995–97 ground-water level monitoring network are given below:

	1995		1996		1997 (planned)	
	Funds	Percent	Funds	Percent	Funds	Percent
USGS Federal	$13,600	9.0	$11,500	9.5	$11,500	12.6
WGNHS	68,500	45.5	55,000	45.2	40,000	43.7
USGS matching	68,500	45.5	55,000	45.2	40,000	43.7
Total	$150,600	100.0	$121,500	100.0	$91,500	100.0

Ground-Water Quality

Wisconsin's ambient ground-water-quality data consist largely of provided data. Most of the ground-water-quality data available for evaluating the condition of the State's ground water is gathered from community and private drinking-water supply wells. Additional data are gathered from monitoring projects aimed at answering questions about ground-water resource management and protection. Also, the State's Bureau of Drinking Water and Groundwater funds nitrate and triazine sampling in new nonpoint priority watershed projects.

Data Management

Currently, surface- and ground-water data are stored primarily in the USGS National Water Information System (NWIS) data bases. Although available to other agencies, NWIS data bases are not readily accessible to other users. The Corps of Engineers, WVIC, power companies, and Milwaukee Metropolitan Sewerage District, as well as others, also maintain data bases for surface waters they monitor.

Water-quality data collected by WDNR are stored in the USEPA STORET data base. Water-quality data collected by USGS are stored in both the NWIS data base and STORET. The USGS data bases are generally not readily accessible by outside users, but STORET is widely accessible.

Distribution of data:

- WWWeb Internet—USGS real time and historical streamflow data and some ground-water data are available.
- Diskette, CD-ROM—All data published by USGS are available on diskette or CD-ROM.
- Paper copy—USGS publishes annual data reports containing most data collected during year. Annual water-quality data were published by the WDNR during 1965–86. Data since 1986 are available through STORET only.
- Data collected by WVIC, power companies, and sanitary districts are available on diskette, paper copy, or microfiche by request.

RECOMMENDED NETWORKS

The team felt strongly that a properly planned water-monitoring network that is easily accessed with

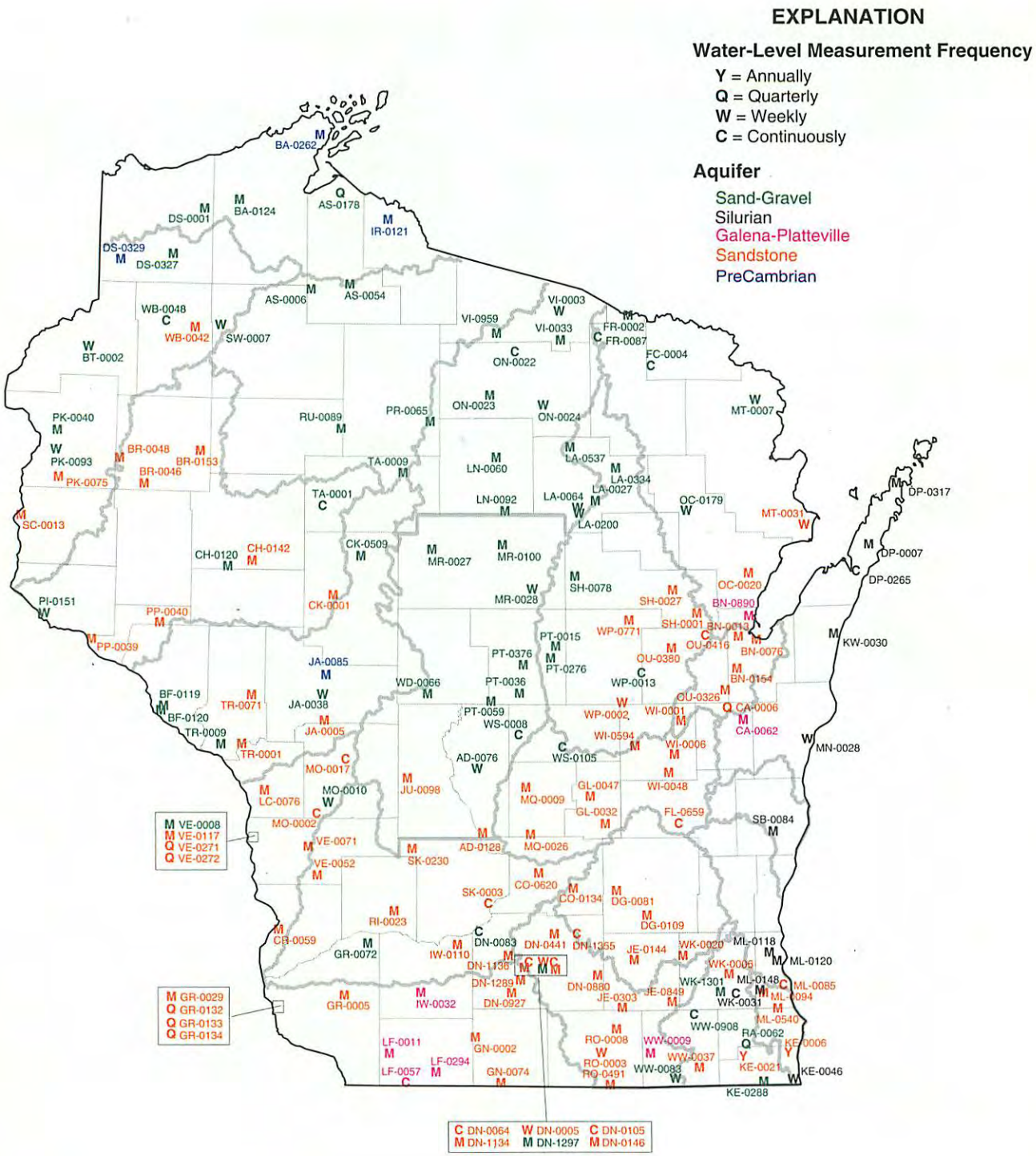

Figure 6. Observation well network, 1996, U.S. Geological Survey and Wisconsin Geological and Natural History Survey.

consistent water data is required to meet the long-term needs of Wisconsin. In order to provide the data for present and future needs, a stable level of funding and commitment from a variety of sources is required. The proposed data networks stress partnership among public agencies, power utilities, industry, and environmental and recreational user groups. The proposed networks also reflect the 22 new Geographic Management Units (GMU), which have been established by the WDNR as a basis for environmental program planning and management.

Input to the design from a variety of interests was gathered from a questionnaire that was sent to 250 known water data users. Responses from more than 50 percent of the users were evaluated and summarized for input in shaping the type of networks that are proposed.

Proposed Networks

Surface-Water Quantity

A network for monitoring streamflow is proposed by the team to meet the following primary purposes:

- Provide current data for management of the water resources in the State.
- Provide the necessary streamflow data for each GMU so that current conditions can be evaluated for management decisions and so that the effect and success of GMU management decisions can be assessed.
- Provide real-time data for flood forecasting and other critical management decisions that need to be made during times of crisis (e.g., droughts, contamination, dam breaks, spills).
- Provide current data for operation of dams, powerplants, wastewater treatment plants, and public water supplies.
- Provide a long-term data base suitable for computer modeling and for statistical analysis to determine design flow for bridges, highways, flood-plain delineation, sewage-treatment facilities, etc.
- Evaluate long-term trends in streamflow of major river basins in the State.

The proposed network started with the 1990 WDNR/USGS basin-monitoring plan that was developed as part of the FERC licensing process. That plan was adapted to fit the WDNR reorganization using GMUs as the basis for future natural-resource management activities in Wisconsin. The basin plan modified to GMUs was further changed by the members of the team to incorporate the needs not only of the represented agencies but also other groups not represented on the team.

The recommended streamflow-gaging station network for Wisconsin is presented in figure 7 and in table 1 of Appendix. The recommended long-term network consists of 139 stations including 7 stations operated by adjacent states on border streams (Mississippi and Menomonee Rivers) and an addition of 30 new stations to the network. Stations are listed by GMU; the table also includes the purposes of data use for each station, status (whether it is a proposed station or an existing one), the sources of funding for existing stations, and the 1997 cost of operation. The relevance or importance of a gaging station may be defined by the uses of the data produced by that station.

Surface-Water Quality

First and foremost, it should be emphasized that biological and physical monitoring components of a statewide network are as important to Wisconsin's overall resource management activities as chemical monitoring. However, the nature of a statewide "network" for biological monitoring is somewhat different than that of a chemical/ flow network. Wisconsin needs to fully develop and implement a biological, reference-site based, monitoring network in order to accurately characterize the different ecosystems throughout the State. This is not to imply that biological data at gaging-station network sites are not useful, but rather that to appropriately use biological information as a reference by which to assess the quality and character of other streams, the biological reference sites must be independently selected to reflect the unique characteristics of a particular ecoregion or subecoregion of the State. In this manner, biological information from any site, including the gaging-station sites, becomes more useful because the biological reference sites provide a measure for comparison. Therefore, biological monitoring at the statewide network sites is recommended only if, in the opinion of GMU staff, the site is appropriate for biological monitoring and additional or local funds are available for the analyses.

A minimum statewide water-quality monitoring network is proposed to meet the following primary purposes:

Figure 7. Recommended long-term streamflow-gaging station network for Wisconsin.

- Provide fixed-station long-term water-quality monitoring in every GMU.
- Select sites that will represent as much of the GMU drainage area as possible.
- Maximize the use of existing long-term water-quality monitoring stations.
- Ensure that long-term water-quality data are linked to flow information in order to provide pollutant-loading data.
- Provide cost-effective baseline water-quality and pollutant-loading information for use in making GMU management decisions and evaluating long-term trends.

The minimum monitoring network is proposed with the knowledge that additional special project monitoring and GMU monitoring may be necessary at other sites and that certain sites in the minimum network may require additional analyses or more frequent sampling. Flexibility is given to GMU staff to modify recommended locations if other sites are determined to be more appropriate to meet the above-stated purposes.

The recommended network consists of 43 sites, including 14 new sites to be added to the network. This proposed water-quality monitoring network (fig. 8 and table 2 of the Appendix) reflects only a minimum water-quality monitoring network for Wisconsin. As described previously, the WDNR has structured its organization around GMUs, which closely align with the major drainage basins in the State. Each GMU will have substantial water-quality monitoring needs that cannot be fulfilled solely through a statewide network. In addition to the network, GMUs will need to accomplish detailed assessment and evaluation monitoring for water chemistry, biology, and physical habitat on a periodic basis through the use of other GMU test and reference sites and special projects where necessary.

The monitoring network proposed here represents a minimum baseline statewide network. It links water-quality and flow data in order to be able to provide pollutant-loading data as well as long-term trend information for every GMU. A minimum of one or two sites per GMU have been identified as "statewide network" sites. The proposed network corrects the current situation where an ambient water-quality station is completely lacking (the case for several GMUs), or the existing station is not located so as to represent most of the GMU. Wherever possible, existing gaging-station sites and water-quality sites have been selected to minimize changes and startup costs associated with new sites. Existing sites that were not selected as part of this statewide network are still valuable monitoring sites on a local basis and are recommended for continuation as periodic basin sites, to be sustained through local funds or other means if at all possible. The location and siting of the individual stations are subject to revision by the GMU staff if the proposed location does not meet local needs.

The statewide network sites would be monitored for selected water-quality properties and constituents at least quarterly every year, be the same as or closely associated with flow-gage sites, and be located so as to represent as much of the GMUs drainage basin as possible. In this manner, these sites will provide baseline pollutant-loading information for every GMU. Water-quality characteristics and constituents to be monitored at a minimum include field measurements, bacteria, nitrogen and phosphorus, chloride, BOD and COD, suspended solids, and hardness. These were selected based on characteristics most commonly measured at existing sites statewide. Frequency of monitoring is proposed as quarterly, based on limited statistical analyses indicating that most trends over the past 20 years would be identifiable with quarterly sampling.

It is also important that a more intensive monitoring program be conducted at least once every 5 to 10 years in each major watershed. This more intensive water-quality and streamflow monitoring would be directed toward defining the relations between water quality, water quantity, climate, and pollution sources. The program would, by design, have to include additional stations.

Ground-Water Levels

A statewide network for monitoring ground-water levels should enable resource managers and scientists to do the following:

- Systematically study the natural regime of ground water in the various hydrogeologic conditions in the State.
- Determine ground-water fluctuations and their causes, range, and trends.
- Determine short-term changes and long-term trends in ground-water levels and to relate these determinations to precipitation and to changes in storage in the ground-water reservoirs.
- Obtain current data for efficient design of wells, water-supply facilities, and waste-disposal facilities.

Figure 8. Recommended minimum ambient water-quality monitoring network for Wisconsin.

- Access a long-term data base suitable for land-suitability assessment, hydrogeologic studies, and water-quality studies.
- Obtain data needed for water-related planning and management decisions, especially during times of crisis (drought, flooding).

It is not practical to monitor ground-water levels beneath all areas and within all water-bearing formations (aquifers) of the State. Observation wells will be located in order to be representative of the major Wisconsin aquifers. A representative observation-well network for monitoring ground-water levels could be built around several groups of primary stations (key observation wells), distributed areally and by aquifer, to ensure uniform spatial coverage and proportional coverage of natural fluctuations in water-table and confined aquifers. Observation wells also will be located in areas of heavy pumpage to monitor human-caused fluctuations and the gradual decline of water levels around the major pumping centers of Green Bay, metropolitan areas of southeastern Wisconsin, and Dane County.

The key wells will be measured indefinitely and will serve as primary reference stations with which records of other wells can be correlated. If irreparably damaged or destroyed, a key well would be replaced immediately by a new well drilled in the closest proximity with the same specifications (depth, construction) to insure an uninterrupted record. The network of key wells (about 75 observation wells) will be complemented by secondary stations (about 45 observation wells) measured for a prescribed period of time to provide better spatial variability of water-level measurements and supplement record of primary stations. In addition, the statewide network will include 25 special-purpose wells monitoring the decline of water levels around major pumping centers.

The statewide observation-well network will reflect the State's geology and areas of special interest and will include the following stations:

75 primary wells monitoring natural fluctuations
- Sand and gravel aquifers: 43 wells
- Silurian dolomite aquifer: 8 wells
- Galena/Platteville aquifer: 7 wells
- Sandstone aquifer: 17 wells

45 secondary wells monitoring natural fluctuations (all aquifers)

25 special-purpose wells
- Green Bay area: 10 wells
- Southeastern Wisconsin: 9 wells
- Dane County: 6 wells

The distribution of wells is shown in figure 9. The proposed network could include some of the currently-monitored wells in the State observation network. Table 3 of the Appendix lists the 170 currently-monitored wells that could be incorporated in the proposed network.

Ground-Water Quality

No changes for the collection of ground-water-quality data are being recommended at this time.

Data Management

Data management, storage, and dissemination from the recommended networks would continue to be handled by the respective data-collection organizations; however, coordination of these roles among parties would be improved and integrated along the lines of the recommendations made by the Intergovernmental Task Force on Monitoring Water Quality (1995), in their "The Strategy for Improving Water Quality Monitoring in the United States." Key recommendations include:

- Using collaborative teams composed of monitoring organizations from all levels of government and the private sector to plan and implement monitoring improvements.
- Using metadata to document and describe information holdings and to help secondary users judge whether data are useful for their applications.
- Linking information systems to provide easier access by various users.

This ITFM effort is being continued under the National Water Monitoring Council. It is vital that Federal, State, and other partners work collectively in supporting an effective long-term data network and improving data collection and management.

The USGS provides national leadership in organizing and managing water data and other earth science data, developing technologies and methods for data collection that can be widely applied and serve as a standard for others, and ensuring that data are credible and impartial. These activities are central to the mission of the USGS. As part of this overall mission, the USGS, along with WDNR, will play a lead role in maintaining the recommended Wisconsin data network. It will be the goal of the USGS to:

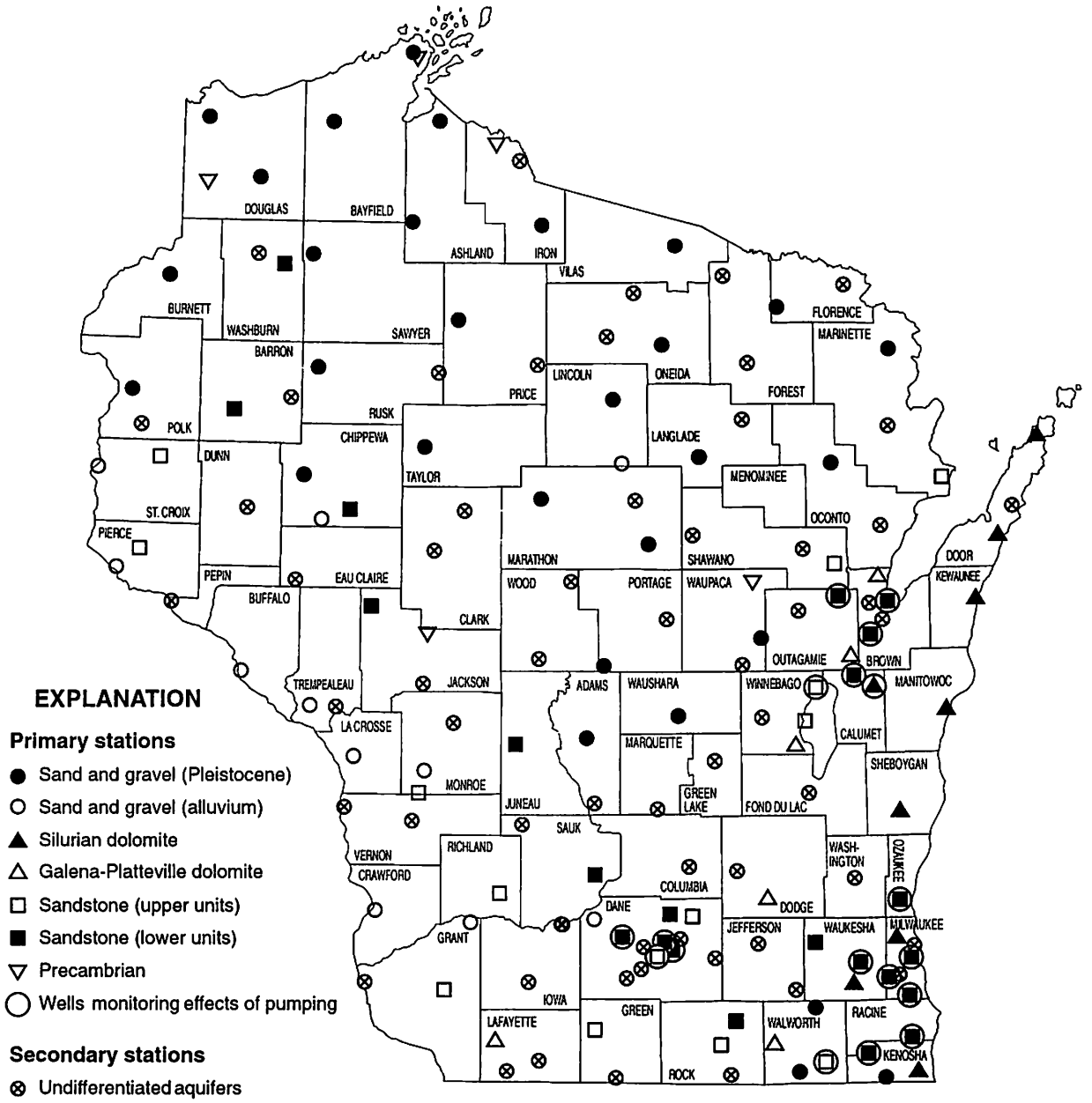

Figure 9. Proposed ground-water-level observation network for Wisconsin.

- Supplement the national USGS-maintained data bases by storing data collected by other organizations. To help accomplish the goal of making these data bases as comprehensive as possible, the USGS will encourage, collaborate with, and train other organizations to collect data equivalent to USGS standards or adopt standards of other agencies where appropriate.
- Strive to serve as a clearinghouse to ensure the quality and accessibility of all collected water data in the State. Develop indexes by watershed or GMU to describe the availability and sources of all types of data. Relate to existing systems, such as USEPA's Waterbody System, in accomplishing this effort.
- Ensure access and use of USGS data bases and information by all interested users, public and private.
- Strive to make most data available through the World Wide Web and other features of the Internet. In addition, continue to make all data available in other formats, such as CD-ROM, diskettes, and paper copy (62 percent of respondents in the Wisconsin Water-Data Users Survey still preferred to receive data in hard-copy format).
- Collaborate and network with other agencies and organizations to collect, store, and disseminate data and link data-storage systems where possible. Transfer technologies and improve outreach activities by educating and training public and private organizations in monitoring.
- Target products and services to meet the needs of partners and the public.

IMPLEMENTATION

Proposed Network Costs

The total cost of the statewide integrated network (table 2), consisting of its three parts, is estimated to be $1,610,080 in 1997; an additional $620,640 over the cost of the current network of $989,440. The costs of the proposed network were derived from the cost distribution of individual stations listed in tables 1–3 in the Appendix. Implementation is intended to be phased in over a 2- to 3-year period for full funding by about 2000.

Surface-Water Quantity

The operating cost of the recommended streamflow-gaging network (table 2) is $1,107,860 for FY 1997. In addition, there would be an initial construction cost of $233,000 for purchasing equipment and installing 30 additional gaging stations, bringing the total cost for FY 1997 to $1,340,860. The cost of operating the proposed network is an additional $305,900 over the current network costs. Costs are summarized in table 2.

Surface-Water Quality

The total cost of the recommended minimum water-quality monitoring network is $136,380 for 1997. The recommended network consists of 43 sites, an addition of 14 new sites to the network, but is a reduction from the 60-70 stations that were previously operated by the WDNR. The cost of the new sites is $42,140.

Ground-Water Levels

The total cost of the recommended ground-water-level monitoring network (table 3 of the Appendix) is $132,840 for 1997, which includes the cost of 44 unfunded observation wells added to the network of 126 wells that are currently funded. The additional cost of the 44 wells is $39,600 annually.

Sources of Funding

Although collected data have many uses, many data users have a single purpose or program that depends on the data. Data users rely on the availability of this "public" data and do not pay directly for their portion of data collection, operation, and maintenance expenses; they probably do not realize how the network is funded and that it is being reduced. Many of these users rely on the lead role and responsibility of Federal and State agencies for funding and maintaining data-collection networks.

Respondents of the 1996 survey of Wisconsin water users indicated the following relative proportion (pooled responses) of funding that each party should contribute toward supporting a long-term monitoring network for Wisconsin.

	Pooled responses (percent)
Federal agencies	41
State	32
Local government	12
Industry	8
Other	3
Total	100

Table 2. Distribution of current and added costs (1997 basis) of the recommended network for Wisconsin

Networks	Operating expense—added stations	Operating expense—current stations	One-time equipment and installation costs	Total cost of proposed network
Surface water	$305,900	$801,960	$233,000	$1,340,860
Water quality	42,140	94,240	0	136,380
Ground water	39,600	93,240	0	132,840
Total	$387,640	$989,440	$233,000	$1,610,080

Cost sharing of annual operating expenses of proposed network as derived from cost distribution of individual stations

	Surface-water stations		Water-quality stations		Ground-water sites			
Funding sources	Existing	Proposed additions	Existing	Proposed additions	Existing	Proposed additions	Total network	Percent of total
USGS	$359,035	$140,100	$31,960	$8,000	$46,620	$19,800	$605,515	44.0
WDNR	20,360	74,850	38,280	19,140	0	0	152,630	11.1
Corps of Engineers	142,790	8,300	0	0	0	0	151,090	11.0
National Weather Service	8,700	43,500	0	0	0	0	52,200	3.8
WGNHS	0	0	0	0	46,620	19,800	66,420	4.8
Sewerage districts	69,600	34,800	0	15,000	0	0	119,400	8.7
Other local agencies	97,875	4,350	0	0	0	0	102,225	7.4
Industry	101,800	0	24,000	0	0	0	125,800	9.1
Other	1,800	0	0	0	0	0	1,800	.1
Total	$801,960	$305,900	$94,240	$42,140	$93,240	$39,600	$1,377,080	100.0

Cost sharing of one-time equipment and installation costs of proposed surface-water network stations

Funding sources	One-time costs	Percent of total
USGS	$121,000	51.9
WDNR	54,000	23.2
Sewerage districts	34,000	14.6
National Weather Service	16,000	6.9
Other local agencies	4,000	1.7
Industry	4,000	1.7
Corp of Engineers	0	0
WGNHS	0	0
Other	0	0
Total	$233,000	100.0

These percentages may be used as a guide for identifying relative support. Potential sources of funding are identified in the Appendix tables and relative breakdown of costs for the proposed network are summarized in table 2.

The potential sources of funding identified in tables in the Appendix is not a commitment to funding. If these sources are unable to obtain funding, then we hope that other sources will be found.

In order to maintain a stable network and funding, participants should focus on long-term agreements in 5–10 year blocks of time to commit funds to a long-term network, rather than tie network operation to annual agreements that are subject to yearly fluctuations. An example of a long-term agreement document by Milwaukee Metropolitan Sewerage District is included in the appendix.

The USGS ongoing Federal-State Cooperative Program is a long-standing partnership between the USGS and state and local governments to provide a balanced approach to funding data collection and water-resources investigations. Under the provisions of this program, the USGS Water Resources Division may provide up to one-half of the total funds to collect hydrologic data and conduct interpretive investigations or research for cooperators. Participants in the program have included State, county, and city agencies; sanitary, lake, conservation, and flood-control districts; regional planning commissions; State universities; and other similar organizations. The participating organization(s) must provide at least one-half of the funds; Water Resources Division personnel do most of the work. At times, the cooperator's contribution to the program may be partly in the form of personnel time, equipment, or other support toward the effort, rather than as all direct funds. In this case, dollar-value credit is given by the USGS and is matched with funds for work or material contributions provided by the cooperator in support of mutually agreed upon program objectives.

In FY 1996, about $1.5 million was available in the USGS Wisconsin District to match funding provided by cooperators for work under the Cooperative Program. About $410,000 was used to match basic data-collection work in support of monitoring networks. A balance in funding should be sought between Federal, State, local agencies and industry. A goal is to bring the network costs more toward the users of the data.

Recommended new mechanisms and strategies to consider for obtaining reliable long-term funding of the networks may include

- Developing a monitoring consortium of data users by GMU or watershed to share the costs of the networks,
- Creating a user fee associated with treatment-plant permits, industrial-discharge permits, or other license fees,
- Establishing an assessment fee for organizations that impact water resources–perhaps have the organizations do the data collection or provide funds in lieu of,
- Creating additional water-management districts or stormwater/utility districts similar to the drainage districts, lake districts and sanitary districts in the state that can assess fees.

Future Considerations

Other major issues remaining to be addressed by the team include

- Roles of agencies
- Data collection, volunteer monitoring, compatibility of data
- Data storage, sharing, and access
- Outreach/education

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APPENDIX

Results of the Wisconsin Water-Data Users Questionnaire

By:

Wisconsin Water-Resources Monitoring Team

Dated: June 12, 1996

Prepared By:

The University Group, Ltd.
625 Walnut Ridge Drive, Suite 103
Hartland, WI 53029
414/367-4642

Executive Summary of the Wisconsin Water-Data Users Questionnaire

51% Response Rate to Questionnaire
(247 mailed–126 returned)

The following results are percentages of all respondents. The sum of percentages for some questions does not equal 100% because some respondents did not answer all questions.

Impact to agency or firm of reducing or eliminating monitoring network:

Severe 29% Moderate 35% Slight 23% No impact 6%

Relative proportion of funding that each organizational category should contribute to maintain the WI monitoring network:

Federal agencies	**41%**
State agencies	**32%**
Local govt. agencies	**12%**
Industry	**8%**

Percentage of organizations indicating use of certain types of water data:

Stream flow	**83%**
Precipitation	**74%**
Surface-water quality	**63%**
Groundwater levels	**54%**
Groundwater quality	**42%**

Longest record of data that respondents needed:

Long term (>10 yr.)	**78%**
Medium term (3-10 yr.)	**13%**
Short term (<3 yr.)	**5%**

Responses to "What is the longest lag time in "real time" data that would meet your data requirements?"

24 hours 64% 8 hours 6% 4 hours 7% 1 hour 7%

80% of respondents indicated that an agency or firm should share in the cost of a monitoring station if it is the primary user of data.

73% of respondents would like to learn more about accessing data on the Internet.

Background of the Wisconsin Water-Data Users Questionnaire

A team of individuals representing public and private organizations was formed in early 1996 to address the need for maintaining an adequate network of water-resource monitoring stations in Wisconsin. This team recognizes that Wisconsin is in danger of losing surface and ground water monitoring stations. Some of these stations scheduled for closure have some of the longest records of continuous water data in the nation. The U.S. Geological Survey, Wisconsin DNR, and Wisconsin Geological and Natural History Survey are experiencing funding shortfalls that will impact the network of water monitoring stations in the state.

The team sought information from users of water data in Wisconsin. In May, 247 questionnaires were mailed and 126 were returned. The University Group, Ltd., a private management consulting firm in Hartland, WI assisted in developing the questionnaire and compiling the results.

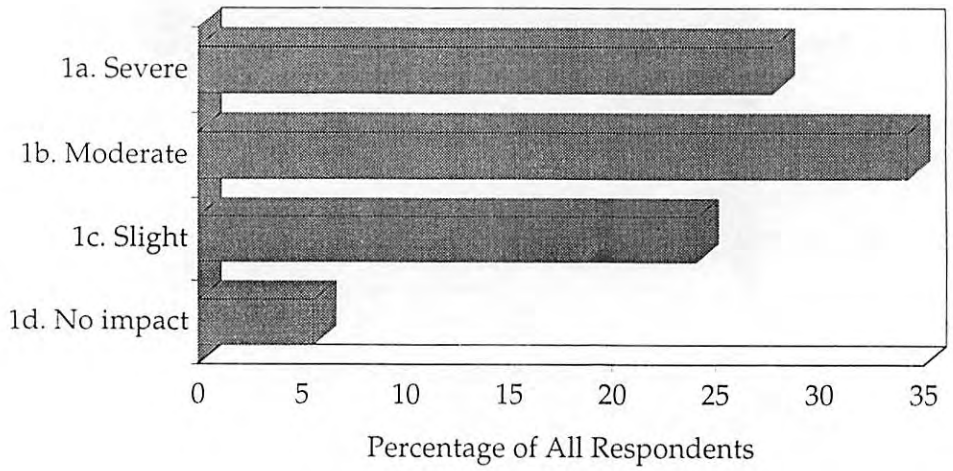
For further information contact:

District Chief
Wisconsin District
U.S. Geological Survey
6417 Normandy Lane
Madison, WI 53719
608/274-3535

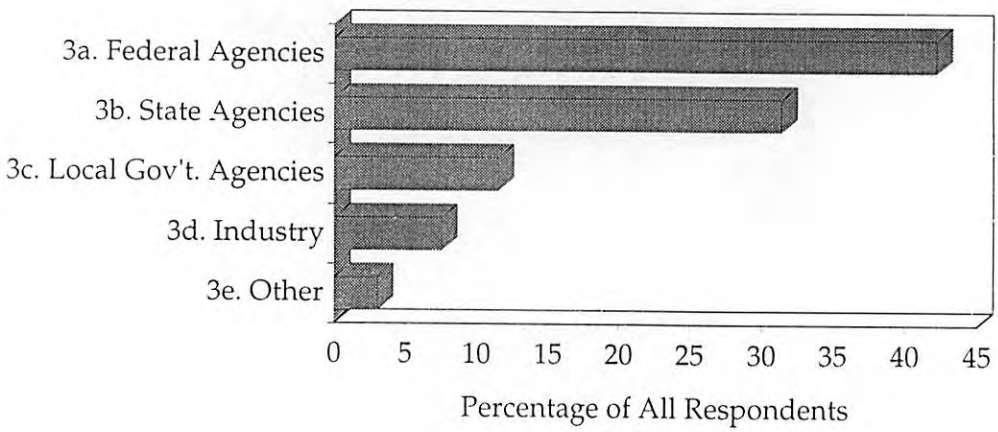
Team Members

Warren Gebert, USGS
Dale Patterson, DNR
Ken Potter, UW
Brian Hahn, NWS
Bill Oliva, DOT
Bob Biebel, SEWRPC
Steve Born, UW
Jim Kaap, NRCS
Herb Garn, USGS
Paul Strom, DNR
Jamie Robertson, WGS
Jeff Gagler, EPA
Sam Morgan, WVIC
Chris Magruder, Milwaukee Metro SD
Bill Koellner, US COE
Jonathan Reed, The University Group

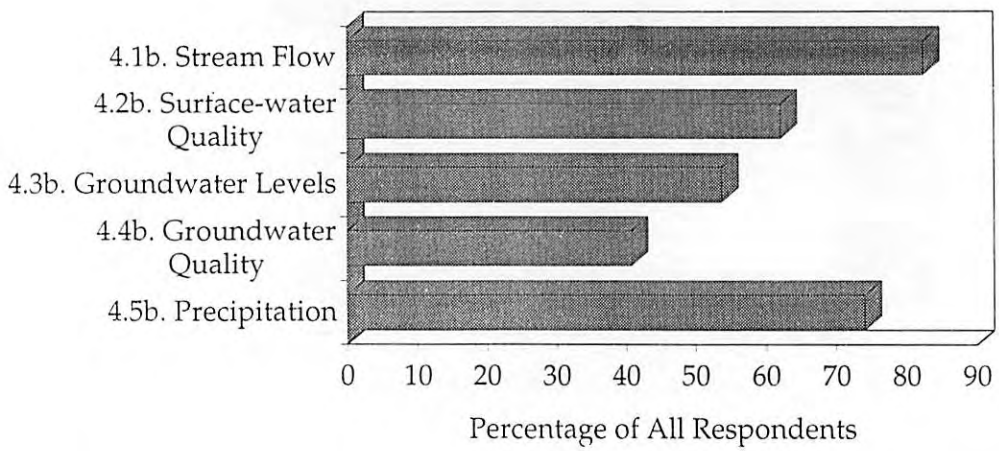
Impact on Reducing or Eliminating WI Water-Monitoring Network



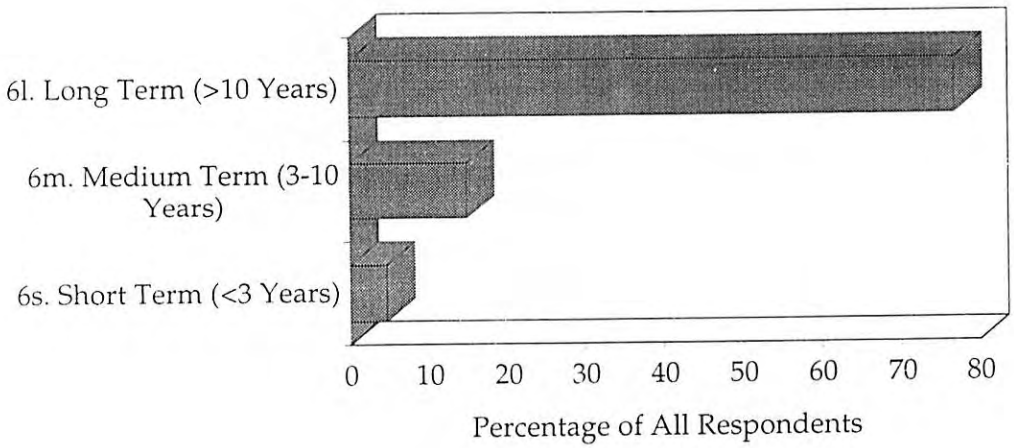
Relative Contribution of Funding the Network (Average of All Responses)



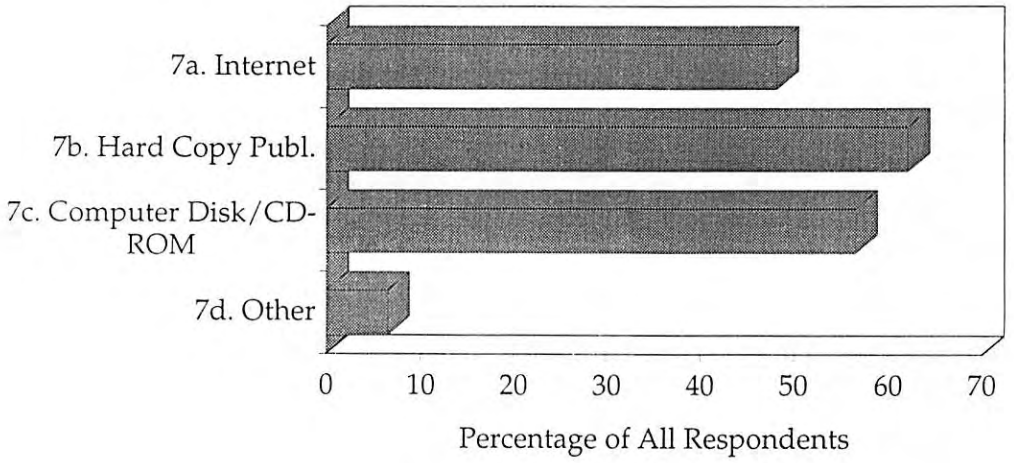
Data that Respondents Use or Need



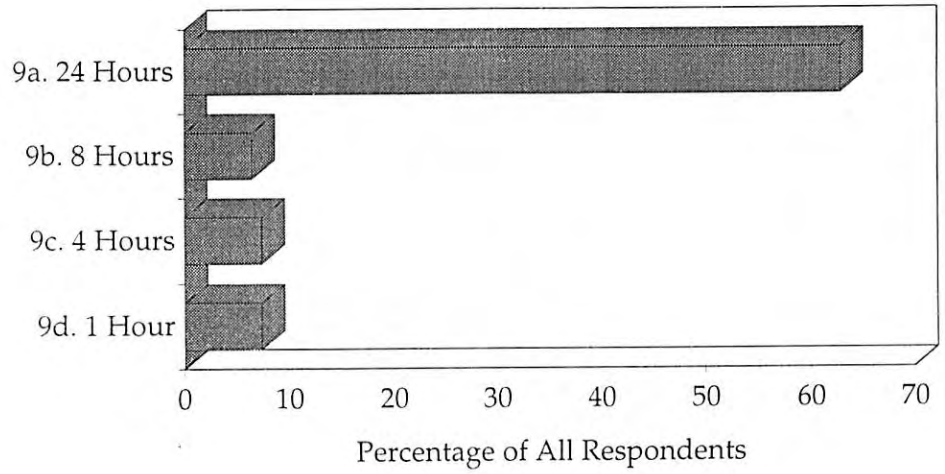
What Is the Longest Record of Data that You Need?



In What Form Would You Like to Receive the Data?



What Is the Longest Lag Time in "Real Time" Data that Would Meet Your Data Needs?



WI WATER-DATA USERS QUESTIONNAIRE RESULTS

Please return to:
The University Group, Ltd.
625 Walnut Ridge Drive, Suite 103
Hartland, WI 53029 (☎ 414/367-4642, FAX 414/367-8864)

Number of Respondents by Category (126 Respondents/247 questionnaires mailed):

15 Federal, 24 State, 2 County, 19 City Agency, 1 Lake District, 1 Sanitary District, 6 Planning Commission, 7 Power Company, 3 Indian Tribe, 28 Consulting Firm, 10 Educational Institution, 7 Private Company, and 3 Other.

Results represent the percentage of responses relative to total number of questionnaires (126.) Therefore, the sum of percentages for some questions does not equal to 100% because some respondents did not answer all questions.

1. If the surface and ground water monitoring network was reduced or eliminated, what impact would it have on your agency or firm? (Check one)

29% Severe 35% Moderate 23% Slight 6% No impact

2. Listed below are possible uses for water-resource data. Please check your three most important uses. (If you only use the data for one or two purposes, just check the one or two subjects that apply.)

21% a. Regional/area assessment	11% f. Problem assessment	31% k. Modeling
22% b. Evaluate current conditions	18% g. Evaluating trends	8% l. Forecasting
18% c. Evaluating impacts	6% h. Water supply	23% m. Baseline data
23% d. Effects of floods/droughts	6% i. Legal obligations	21% n. Planning
11% e. Research	20% j. Design	
3% o. Other (please list) _____	1% p. Other (please list) _____	

3. Who do you think should fund a WI Water Data Network? *(Try to avoid the "Anyone but my agency or firm" response.)* Please fill in what you consider *fair* percentages for categories listed below such that the sum of the percentages totals 100%.

41% a. Federal agencies
32% b. State agencies
12% c. Local governmental agencies
8% d. Industry
3% e. Other (please specify) _____

100% = Total of above percentages

4. The following table is organized into columns in the following manner:

Column A lists types of data.

Column B should be checked if you use or need the data listed to the left in that row.

Column C: For data categories that you have checked in Column B, please indicate

if the data that is currently available is sufficient for your needs with a "Y" (Yes, it is sufficient.) or "N" (No, it is not sufficient.)

Column D-L: Please check the source(s) of the data that you use in each category.

				Sources of Data								
A. Data Types	B. ✓ if you use data	C. Sufficient?–Yes	C. Sufficient?–No	D. You collect it	E. USGS	F. WI DNR	G. Local agencies	H. Other fed. agencies	I. Power companies	J. Planning agencies	K. WGNHS*	L. Other sources
4.1 Stream flow	83	48	25	21	71	26	8	9	13	6	6	6
4.2 Surface-water quality	63	26	25	31	41	42	7	6	3	6	5	6
4.3 Groundwater levels	54	24	21	21	33	22	7	2	3	5	21	6
4.4 Groundwater quality	42	16	19	20	21	26	6	2		1	12	6
4.5 Precipitation	74	52	12	17	20	11	16	23	6	2	20	8

WGNHS* is the Wisconsin Geological & Natural History Survey and State Climatologist.

If you checked column L, please indicate the source. _____

5. If an agency or firm is the primary user of data from a monitoring station, do you think that it should share in the cost of the station?

80% Yes 14% No

6. What is the longest record of data that you need? (Check longest that applies)

5% Short term (<3 years) 13% Medium term (3-10 years) 78% Long term (>10 years)

7. In what form would you like to receive the data? (Check those that apply)

48% Internet 62% Hard copy publication 60% Computer disk or CD-ROM
6% Other (please specify) _____

8. Would you like to learn more about accessing water data on the Internet?

73% Yes 25% No

9. The term "real time" in reference to accessing water data on the Internet is a bit misleading because there is a lag time of several hours to one day. What is the longest lag time that would meet your data requirements?

64% 24 hours 6% 8 hours 7% 4 hours 7% 1 hour

10. Do you have any comments or suggestions for funding the collection of basic water data in Wisconsin?

Table 1.—Recommended Streamflow-Gaging Station Network for Wisconsin, by Geographic Management Units

The purposes of data collection were categorized into seven classes as defined below. The primary purpose is the purpose for which the gaging station was funded and instituted.

Management of water resources–Data for the general management of the water resources of the state or specific river basin. Stations may be used to define current hydrologic conditions and inflows and outflows of water through hydrologic systems.

Trend analysis/long-term record–Data are used to monitor changes in streamflows and stream channels caused primarily by changes in land use and climate. Stations in this category are also used to develop regionally transferable information on streamflow and basin characteristics.

Forecasting–Data are regularly used for flood warning or flood forecasting for a specific river reach. It is important that data used for this purpose be available on a real-time basis.

Operations–Data are used for the operation of dams and reservoirs, water-supply facilities, hydropower facilities, wastewater treatment plants, or diversions. For this purpose, it is important that data are available on a real-time basis.

Statistics–Data are used to develop statistical relations with regional or other characteristics, analyze frequency and probability of low and high flows, and provide input for computer models.

Water-quality monitoring–Flow data are used for the interpretation of water-quality data and to compute loads. Flow data are used in conjunction with water-quality data to compute pollutant-loading and evaluate the status and health of the resource. Long-term trend analyses are used to identify changes in the resource over time and can be used to assess the effectiveness of environmental-management and pollution-control programs.

Planning and design–Data are used for the planning and design of specific projects or structures (for example, dams, levees, bridges, navigation system, water-supply diversion, hydropower plant, waste treatment facility).

Table 1. RECOMMENDED STREAMFLOW GAGING STATION NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown in Fig.7)

		Purpose: P(rimary), S(econdary)							*Status*					*Operating Cost-1997*	
USGS station number	Station name & location	Management	Trends	Forecasting	Operations	Statistics	Water Quality	Planning	Existing	Recommended	Drainage area (sq. miles)	Period of record	Existing or potential funding sources	Funded	Unfunded
Lake Superior GMU															
04024430	Nemadji R - South Superior	P	S	P		S	P		√		420	1974-	WDNR/USGS	8,700	
04025500	Bois Brule R - Brule	S	P	S		P		P	√		118	1943-81, 1984-	USGS	8,700	
04027000	Bad R - Odanah	P	P	P		P	P	P	√		597	1914-22, 1948-	Bad River Chippewa/USGS	8,700	
04027500	White R - Ashland			S	P			P	√		301	1948-	NSPC/USGS	5,630	
04029990	Montreal R - Saxon Falls				P			S	√		262	1987-	NSPC/USGS	5,630	
Green Bay GMU															
04060993	Brule R - Florence	P			P	S		S	√		366	1914-16, 1944-	WEPC/USGS	*	
04062011	Brule R - Commonwealth	P			P			S	√		1020	1989-	WEPC/USGS	*	
04063700	Popple R - Fence		P	S		S	P	P	√		139	1964-	USGS	8,700	
04063500	Menominee R - Twin Falls	P			P	S		S	√		1800	1914-	WEPC/USGS	*	
04064500	Pine R - Florence	S			P	S			√		533	1924-76, 1996-	WEPC/USGS	8,700	
04065106	Menominee R - Niagara	S		S	P				√		2,470	1993-	Niagara Paper/USGS	8,700	
04065722	Menominee R - Vulcan, MI	P			P			S	√		2,900	1987-	MDNR/USGS	*	
04066003	Menominee R - Pembine	S		S	P				√		3,140	1950-	WEPC/USGS	8,700	
04066500	Pike R - Amberg	S				P		P		√	253		USGS		8,700
04067500	Menominee R - McAllister	S	S	P		P	P	S		√	3,920	1945-61, 1979-86, 1988-90, 1993	WDNR/MDNR/NWS		8,700

Table 1. RECOMMENDED STREAMFLOW GAGING STATION NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown in Fig.7)

		Purpose: P(rimary), S(econdary)							*Status*					*Operating Cost-1997*	
USGS station number	Station name & location	Management	Trends	Forecasting	Operations	Statistics	Water Quality	Planning	Existing	Recommended	Drainage area (sq. miles)	Period of record	Existing or potential funding sources	Funded	Unfunded
04069500	Peshtigo R - Peshtigo	S	S	S	P		P	P	√		1,080	1953-	City of Peshtigo/USGS	8,700	
04071000	Oconto R - Gillett	S	P	S		P	S	P	√		705	1906-09, 1914-	USGS	8,700	
04071765	Oconto R - Oconto	S	P			P	P			√	966	1989-90	WDNR/USGS		8,700
04071858	Pensaukee R - Pensaukee	P	S	S		P		S	√		134	1972-96	WDNR/USGS		8,700
	Peshtigo R - Sandstone Rapids	S			S	P		S		√	643		WDNR/USGS		8,700
Lower Fox GMU															
04072150	Duck Creek - Howard	P	P	S		S		S	√		108	1988-	Oneida Tribe of WI/USGS	8,700	
04084445	Fox R - Appleton	S		S	P		S		√		5,950	1986-	C of E-Detroit	10,500	
04084500	Fox R - Rapide Croche Dam - Wrightstown	S	P		S	P	P	P	√		6,010	1896-	LFRDA/USGS	3,600	
Upper Fox GMU															
04073500	Fox R - Berlin		S	P	P	S	P	P	√		1,340	1898-	C of E-Detroit	8,700	
04082400	Fox R - Oshkosh	S		P	S		S		√		5,310	1991-	Mercury Marine/USGS	10,500	
Wolf GMU															
04074950	Wolf R - Langlade	P	S	S		P	S	P	√		463	1966-79, 1981-	Menominee Tribe of WI/ USGS	8,700	
04077400	Wolf R - Shawano	S		S	P				√		816	1907-09, 1911-	WPL/USGS	8,700	

Table 1. RECOMMENDED STREAMFLOW GAGING STATION NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown in Fig.7)

		Purpose: P(rimary), S(econdary)							*Status*					*Operating Cost-1997*	
USGS station number	Station name & location	Management	Trends	Forecasting	Operations	Statistics	Water Quality	Planning	Existing	Recommended	Drainage area (sq. miles)	Period of record	Existing or potential funding sources	Funded	Unfunded
04077630	Red R -Morgan	P				P	P	P	√		114	1993-	Stockbridge-Munsee Chippewa	8,700	
04078092.65	Middle Br Embarrass R Wittenberg	S			P		S	P	√		76.3	1990-	Village of Wittenberg/ USGS	8,700	
04078500	Embarrass R - Embarrass	S	P	S	S	P		P	√		384	1919-85, 1994-	USGS	8,700	
04079000	Wolf R - New London	S		P	P		P	P	√		2,260	1896-	C of E-Detroit	8,700	
04080000	Little Wolf R - Royalton	S		P		P		S		√	507	1914-70, 1983-85	NWS		8,700
04081000	Waupaca R - Waupaca	S		P		P		P		√	265	1916-66, 1983-85	NWS		8,700
Lakeshore GMU															
04085200	Kewaunee R - Kewaunee	P	P	S		S	P	P		√	127	1964-96	WDNR/USGS		8,700
04085281	East Twin R - Mischicot	P		P		S			√		110	1972-96	NWS		8,700
04085427	Manitowoc R - Manitowoc	P	P	P		P	P	P	√		526	1972-96	WDNR/USGS		8,700
Sheboygan GMU															
04086000	Sheboygan R - Sheboygan	P	P	P		P	P	P	√		418	1916-24, 1951-96	WDNR/USGS	8,700	
Milwaukee GMU															
04086500	Cedar Cr - Cedarburg	P		S		P	S	P	√		120	1930-70, 1973-81, 1983-87, 1991-	WDNR/USGS	8,700	
04086600	Milwaukee R - Cedarburg	P		S	S		S	P	√		607	1982-	SEWRPC/USGS	8,700	

Table 1. RECOMMENDED STREAMFLOW GAGING STATION NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown in Fig.7)

		Purpose: P(rimary), S(econdary)							*Status*					*Operating Cost-1997*	
USGS station number	Station name & location	Management	Trends	Forecasting	Operations	Statistics	Water Quality	Planning	Existing	Recommended	Drainage area (sq. miles)	Period of record	Existing or potential funding sources	Funded	Unfunded
04087000	Milwaukee R - Milwaukee	P	P	P	S	P	P	P	√		696	1914-	SEWRPC/USGS	8,700	
04087030	Menomonee R - Menomonee Falls	P			S			P	√		34.7	1975-77, 1979-	SEWRPC/USGS	8,700	
04087088	Underwood Creek - Wauwatosa	P			S			P	√		18.2	1975-	SEWRPC/USGS	8,700	
04087120	Menomonee R - Wauwatosa	P		P	S			P	√		123	1962-	SEWRPC/USGS	8,700	
04087160	Kinnickinnic R - Milwaukee	P		P	S		S	P	√		20.4	1976-	SEWRPC/USGS	8,700	
04087204	Oak Creek - South Milwaukee	P			S	S		P	√		25	1964-	SEWRPC/USGS	8,700	
	Milwaukee R - Newburg	S			P			P		√	-	-	SEWRPC/Local/USGS a		8,700
Root-Pike GMU															
04087220	Root R - Franklin	P		S	S	P		P	√		49.2	1964-	SEWRPC/USGS	8,700	
04087233	Root R Canal - Franklin	P		S	S			P	√		57	1964-	SEWRPC/USGS	8,700	
04087240	Root R - Racine	P		P	S	P	P	P	√		190	1963-	SEWRPC/USGS	8,700	
04087257	Pike R - Racine	P			S	P		P	√		38.5	1972-	SEWRPC/USGS	8,700	
St. Croix GMU															
05331833	Namekagon R - Leonard	P				S	P		√		126	1996-	USGS-NAWQA/NPS	8,700	
05332500	Namekagon R - Trego		S	S	P			S	√		488	1928-70, 1988-	NSPC/USGS	5,630	
05333500	St. Croix R - Danbury		S	S	S	S	P	P	√		1,580	1914-81, 1985-	USGS-NAWQA(MN)	8,700	

Table 1. RECOMMENDED STREAMFLOW GAGING STATION NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown in Fig.7)

		Purpose: P(rimary), S(econdary)							*Status*					*Operating Cost-1997*	
USGS station number	Station name & location	Management	Trends	Forecasting	Operations	Statistics	Water Quality	Planning	Existing	Recommended	Drainage area (sq. miles)	Period of record	Existing or potential funding sources	Funded	Unfunded
05340500	St. Croix R - St. Croix Falls			S	P	S	P	S	√		6,240	1902-	NSPC/USGS	5,630	
05341500	Apple R - Somerset		S	S	P	S		P	√		579	1901-70, 1987-	NSPC/USGS	5,630	
05344500	Mississippi R - Prescott	P	S		P	S		S	√		44800	1928-	C of E-St. Paul		
	Kinnickinnic R - River Falls	S			P	S		P		√	138		City/Utility/USGS		8,700
Upper Chippewa GMU															
05356000	Chippewa R - Winter		S		P				√		790	1912-	NSPC/USGS	8,700	
05356500	Chippewa R - Bruce			S	P		P		√		1,650	1914-	NSPC/USGS	8,700	
05357335	Bear R - Manitowish Waters	P				S		P	√		81.3	1991-	Lac Du Flambeau Chippewa/USGS	8,700	
05359500	S. Fork Flambeau R - Phillips	P	S			P		P		√	609	1929-75	USGS		8,700
05360500	Flambeau R - Bruce			S	P		P		√		1,860	1951-	NSPC/USGS	8,700	
05362000	Jump R - Sheldon		P	S		P	S	P	√		576	1915-	USGS	8,700	
	W. Fork Chippewa R - Chippewa Flowage	S			S	P				√	577		WDNR/USGS		8,700
	Chippewa R - Holcombe Dam	P			S		S	S		√			WDNR/USGS		8,700
Lower Chippewa GMU															
05364000	Yellow R - Cadott	S	S			P		S		√	364	1943-61	WDNR/USGS		8,700
05365500	Chippewa R - Chippewa Falls	S	S		P				√		5,650	1888-1983, 1987-	NSPC/USGS	8,700	

Table 1. RECOMMENDED STREAMFLOW GAGING STATION NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown in Fig.7)

		Purpose: P(rimary), S(econdary)							*Status*					*Operating Cost-1997*	
USGS station number	Station name & location	Management	Trends	Forecasting	Operations	Statistics	Water Quality	Planning	Existing	Recommended	Drainage area (sq. miles)	Period of record	Existing or potential funding sources	Funded	Unfunded
05365707	N. Fork Eau Claire R - Thorp			S	P			P	√		51	1986-	City of Thorp/USGS	8,700	
05366500	Eau Claire R - Fall Creek	P		P		P		S		√	760	1943-55	NWS		8,700
05367446.4	Yellow R - Barron				P		S	P	√		153	1991-	City of Barron/USGS	8,700	
05368000	Hay R - Wheeler		P	S		P			√		418	1951-	USGS	8,700	
05369000	Red Cedar R - Menomonie		S	S	P	S			√		1,770	1907-08, 1913-	NSPC/USGS	8,700	
05369500	Chippewa R - Durand	S	S	P	P		P		√		9,010	1928-	C of E-St. Paul	9,210	
05370000	Eau Galle R - Spring Valley	S		S	P	S			√		64.1	1944-	C of E-St. Paul	7,400	
	Red Cedar R - Rice Lake	S				P				√	371		WDNR/USGS		8,700
Black-Buffalo-Trempealeau GMU															
05372000	Buffalo R - Tell	S	S			P		S		√	406	1933-51	WDNR/USGS		8,700
05378500	Mississippi R - Winona, MN	P			P			S	√		59200	1928-	C of E-St. Paul		
05379500	Trempealeau R - Dodge		S		P	S	P		√		643	1914-19, 1934-	C of E-St. Paul, WDNR	9,360	
05381000	Black R - Neillsville	P		P	S	P			√		749	1905-09, 1914-96	C of E-St. Paul	4,600	4,100
05382000	Black R - Galesville	P		P	P		P	P	√		2,080	1932-	C of E-St. Paul, WDNR	10,110	
La Crosse-Bad Axe GMU															
05382325	La Crosse R - Sparta	S		S	P	S		P	√		167	1992-	City of Sparta/USGS	8,700	

Table 1. RECOMMENDED STREAMFLOW GAGING STATION NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown in Fig.7)

		Purpose: P(rimary), S(econdary)							*Status*					*Operating Cost-1997*	
USGS station number	Station name & location	Management	Trends	Forecasting	Operations	Statistics	Water Quality	Planning	Existing	Recommended	Drainage area (sq. miles)	Period of record	Existing or potential funding sources	Funded	Unfunded
05383000	La Crosse R - West Salem	S	S			P	P	S		√	396	1914-20	WDNR/USGS		8,700
05389500	Mississippi R - McGregor, IA	P			P		P	S	√		67500	1936-	C of E-St. Paul	*	
Upper Wisconsin GMU															
05391000	Wisconsin R - Lake Tomahawk			S	P			S	√		757	1936-	WVIC/USGS	8,700	
05392000	Wisconsin R - Whirlpool Rapids				S		S	P	√		1,200	1906-61	WVIC	1,000	
05393500	Spirit R - Spirit Falls			S	P				√		81.6	1942-	WVIC/USGS	8,700	
05394500	Prairie R - Merrill	P	S	S	S	P			√		184	1914-31, 1939-	WVIC/USGS	8,700	
05395000	Wisconsin R - Merrill	S		P	P		P		√		2,760	1903-	WVIC/USGS	8,700	
	Wisconsin R - Otter Rapids	S			S	P				√	543		WDNR/USGS		8,700
Central Wisconsin GMU															
05396000	Rib R - Rib Falls			S	P			P	√		303	1925-57	WVIC	1,000	
05397500	Eau Claire R - Kelly	P	S			P			√		375	1914-27, 1939-	WVIC/USGS	8,700	
05398000	Wisconsin R - Rothschild			S	P		S		√		4,020	1945-	WVIC/USGS	8,700	
05399500	Big Eau Pleine R - Stratford		S	S	P	P			√		224	1914-24, 1937-	WVIC/USGS	8,700	
05400500	Plover R - Stevens Point	S	S			P		S		√	145	1914-20, 1944-52	WDNR/USGS		8,700
05400760	Wisconsin R - Wisconsin Rapids	S			P		P		√		5,420	1914-50, 1958-	WVIC/USGS	4,350	

Table 1. RECOMMENDED STREAMFLOW GAGING STATION NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown in Fig.7)

		Purpose: P(rimary), S(econdary)							*Status*					*Operating Cost-1997*	
USGS station number	Station name & location	Management	Trends	Forecasting	Operations	Statistics	Water Quality	Planning	Existing	Recommended	Drainage area (sq. miles)	Period of record	Existing or potential funding sources	Funded	Unfunded
05401050	Tenmile Creek - Nekoosa	P	S			P		P	√		73.3	1963-79, 1987-94	WDNR/USGS		8,700
05402000	Yellow R - Babcock	S		P	S	S			√		215	1944-96	WVIC/USGS	8,700	
05403500	Lemonweir R - New Lisbon	S	S	S		P		P		√	507	1944-87, 1994	USGS		8,700
05404000	Wisconsin R - Wisconsin Dells	S		S	P		P		√		8,090	1935-	WVIC/USGS	8,700	
05404116	S. Br. Baraboo R - Hillsboro	S		S	P	S		P	√		39.1	1988-	City of Hillsboro/USGS	8,700	
Lower Wisconsin GMU															
05405000	Baraboo R - Baraboo	S	P	P		S			√		609	1914-22, 1943-	USGS	8,700	
05406500	Black Earth Cr - Black Earth	P	S			P		P	√		45.6	1954-	DCRPC/USGS	8,700	
05407000	Wisconsin R - Muscoda		S	P	P		P		√		10,400	1903-04, 1914-	C of E-St. Paul	9,620	
05408000	Kickapoo R - La Farge	P	S	P	S	P			√		266	1939-	C of E-St. Paul	4,600	4,200
05410490	Kickapoo R - Steuben	S		P	P	S			√		687	1933-	C of E-St. Paul	9,360	
	Pine R - Gotham	S	S			P		P		√	320		WDNR/USGS		8,700
Grant-Platte-Sugar-Pecatonica GMU															
05413500	Grant R - Burton	S	S	P	P	S	P		√		269	1935-	C of E-Rock Island	8,700	
05414000	Platte R - Rockville		S	P	P	S			√		142	1935-	C of E-Rock Island	8,700	
05432500	Pecatonica R - Darlington	S		P	P	S			√		273	1939-	C of E-Rock Island	8,700	

Table 1. RECOMMENDED STREAMFLOW GAGING STATION NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown in Fig.7)

		Purpose: P(rimary), S(econdary)							*Status*					*Operating Cost-1997*	
USGS station number	Station name & location	Management	Trends	Forecasting	Operations	Statistics	Water Quality	Planning	Existing	Recommended	Drainage area (sq. miles)	Period of record	Existing or potential funding sources	Funded	Unfunded
05433000	East Br. Pecatonica R Blanchardville			P	P	S			√		221	1939-86, 1988-	C of E-Rock Island	8,700	
05434500	Pecatonica R - Martintown	S		P	P	S	P		√		1,034	1940-	C of E-Rock Island/WDNR	8,700	
05436500	Sugar R - Brodhead	S	S	P	P	S	P	S	√		523	1914-	C of E-Rock Island/WDNR	8,700	
Upper Rock GMU															
05423500	S. Br. Rock R - Waupun	S			P			P	√		63.6	1948-69, 1987-	City of Waupun/USGS	8,700	
05424082	Rock R - Hustisford	S	S			P		S		√	511	1978-85	NWS		8,700
05425500	Rock R - Watertown			S	P	S	S		√		969	1931-70, 1977-	C of E-Rock Island/WDNR	8,700	
05425912	Beaverdam R - Beaver Dam			S	P			P	√		157	1984-	City of Beaver Dam/USGS	8,700	
05426000	Crawfish R - Milford		S	S	P	S			√		762	1931-	Rock County/USGS	8,700	
05426031	Rock R - Jefferson	S		P	S	S	P			√	1,850	1978-94	WDNR/USGS		10,500
	Bark R - Hartland	S			P			P		√	-	-	SEWRPC/Local/USGS a		8,700
	Oconomowoc R - Monches	S			P			P		√	-	-	SEWRPC/Local/USGS a		8,700
	Oconomowoc R - Oconomowoc	S			P			P		√	-	-	SEWRPC/Local/USGS a		8,700
Lower Rock GMU															
05426250	Bark R - Rome	P		S				P	√		122	1980-	SEWRPC/USGS	8,700	
05427570	Rock R - Indianford	S		S	P				√		2,630	1975-	Rock County/USGS	8,700	

Table 1. RECOMMENDED STREAMFLOW GAGING STATION NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown in Fig.7)

USGS station number	Station name & location	Purpose: P(rimary), S(econdary)							Status		Drainage area (sq. miles)	Period of record	Existing or potential funding sources	Operating Cost-1997	
		Management	Trends	Forecasting	Operations	Statistics	Water Quality	Planning	Existing	Recommended				Funded	Unfunded
05427718	Yahara R - Windsor	P	S		S	S	P	P	√		73.6	1976-81, 1989-	DCRPC/USGS	8,700	
05427948	Pheasant Br - Middleton	P	S		S	S	P	P	√		18.3	1974-	DCRPC/USGS	8,700	
05429500	Yahara R - McFarland	P		S	P		S		√		327	1930-	DCDPW/USGS	8,700	
05430150	Badfish Creek - Cooksville	S			P		S	P	√		82.6	1977-	MMSD/USGS	8,700	
05430175	Yahara R - Fulton	S		S	P		S	P	√		517	1977-	MMSD/USGS	8,700	
05430500	Rock R - Afton	S	S	P	P		P		√		3,340	1914-	C of E-Rock Island	8,700	
05431486	Turtle Cr - Clinton		S	P	P	P		P	√		199	1939-	C of E-Rock Island/ WALCOMET/USGS	8,700	
Illinois Fox GMU															
05543800	Fox R - Watertown Rd Waukesha				P			P	√		77.4	1993-	City of Brookfield/USGS	8,700	
05543830	Fox R - Waukesha	P		S	P	S	S	P	√		126	1963-	SEWRPC/USGS	8,700	
05544200	Mukwonago R - Mukwonago	P		S	P	S		P	√		74.1	1973-	SEWRPC/USGS	8,700	
05545750	Fox R - New Munster	S		P	P	S	P		√		811	1940-	IL DOT/USGS	8,700	
	Nippersink Cr - Genoa City	S			P			P		√	-	-	SEWRPC/Local/USGS a		8,700
	Honey Cr - Burlington	S			P			P		√	-	-	SEWRPC/Local/USGS a		8,700
	Sugar Cr - Burlington	S			P			P		√	-	-	SEWRPC/Local/USGS a		8,700
	Des Plaines R - Bristol	S			P			P		√	-	-	SEWRPC/Local/USGS a		8,700
													TOTAL	801,960	305,900

Table 1. RECOMMENDED STREAMFLOW GAGING STATION NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown in Fig.7)

USGS station number	Station name & location	Purpose: P(rimary), S(econdary)							Status		Drainage area (sq. miles)	Period of record	Existing or potential funding sources	Operating Cost-1997	
		Management	Trends	Forecasting	Operations	Statistics	Water Quality	Planning	Existing	Recommended				Funded	Unfunded
	* Operated by adjacent states														
	a Assumes local government or utility cooperator will be forthcoming														
	Key:														
	C of E, Detroit	Corps of Engineers, Detroit, MI													
	C of E, Rock Island	Corps of Engineers, Rock Island, IL													
	C of E, St. Paul	Corps of Engineers, St. Paul, MN													
	DCPDW	Dane County Department of Public Works													
	DCRPC	Dane County Regional Planning Commission													
	Fontana/Walworth WPCC	Fontana/Walworth Water Pollution Control Commission													
	IL DOT	Illinois Department of Transportation													
	LFRDA	Lower Fox River Dischargers Association													
	MMSD	Madison Metropolitan Sewerage District													
	MPCA	Minnesota Pollution Control Agency													
	NPS	National Park Service													
	NWS	National Weather Service													
	NSPC	Northern States Power Co.													
	SEWRPC	Southeastern Wisconsin Regional Planning Commission, in cooperation with local government or utility													
	USGS	U.S. Geological Survey													
	WALCOMET	Walworth County Metropolitan Sewerage District													
	WDNR	Wisconsin Department of Natural Resources													
	WEPC	Wisconsin Electric Power Co.													
	WPL	Wisconsin Power & Light Co.													
	WVIC	Wisconsin Valley Improvement Co.													

Table 2.—Recommended Water-Quality Monitoring Network for Wisconsin By Geographic Management Units (GMU)

Table 2. RECOMMENDED WATER-QUALITY MONITORING NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (gmu) (Station Type: P = Primary GMU site, S = Secondary GMU site, N = NAWQA USGS site, A = Automatic monitoring site) (Location of sites shown in Fig. 8)

					Status					*Operating Cost-1997*	
Site number	Storet station number	USGS station number	Station name & location	Station type	Existing	Recommended	Drainage area (sq. miles)	Period of water quality record	Existing or potential funding sources	Funded	Unfunded
Lake Superior GMU											
1	163003	04024430	Nemadji R - South Superior	P	√		420	1974-94	WDNR	1,740	
2	023001	04027000	Bad R - Odanah	P	√		597	1961-94	WDNR	1,740	
Green Bay GMU											
18		04063700	Popple R - Fence	N	√		139	1964-	USGS	6,700	
19		04067500	Menominee R - McAllister	N, S		√	3,920	- -	WDNR, USGS		1,740
20	383001	04069500	Peshtigo R - Peshtigo	P	√		1,080	1961-93	WDNR	1,740	
21	433002	04071765	Oconto R - Oconto	P	√		966	1961-93	WDNR	1,740	
Upper Fox GMU											
23	243020	04073500	Fox R - Berlin	P		√	1,340	1977-96	WDNR		1,740
Lower Fox GMU											
24	053210	04085059	Fox R - De Pere	P	√		6,110	1977-96	WDNR	1,740	
		04085059	Fox R - De Pere Dam	A	√		6,110	1971-	LFRDA	6,000	
		- -	Fox R - Menasha	A	√			1971-	LFRDA	6,000	

Table 2. RECOMMENDED WATER-QUALITY MONITORING NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Station Type: P=Primary GMU site, S=Secondary GMU site, N=NAWQA USGS site, A=Automatic monitoring site)

					Status					*Operating Cost-1997*	
Site number	Storet station number	USGS station number	Station name & location	Station type	Existing	Recommended	Drainage area (sq. miles)	Period of water quality record	Existing or potential funding sources	Funded	Unfunded
		04084445	Fox R - Appleton	A	√		5,950	1971-	LFRDA	6,000	
		04084500	Fox R - Wrightstown	A, N	√		6,010	1971-	LFRDA, USGS	6,000	
Wolf GMU											
22	693035	04079000	Wolf R - New London	P	√		2,260	1977-96	WDNR	1,740	
Lakeshore GMU											
25	313038	04085200	Kewaunee R - Kewaunee	P	√		127	1977-94	WDNR	1,740	
26	363069	04085427	Manitowoc R - Manitowoc	P	√		526	1975-96	WDNR	1,740	
Sheboygan GMU											
27	603095	04086000	Sheboygan R - Sheboygan	P	√		418	1977-96	WDNR	1,740	
Milwaukee GMU											
28	413640	04087000	Milwaukee R - Milwaukee	N, P	√		696	1980-96	WDNR, USGS	7,740	
29		04087120	Menomenee R - Wauwatosa	S		√	123	- -	City/Utility/WDNR		5,000
30		04087204	Oak Cr - S. Milwaukee	S		√	25	- -	City/Utility		5,000

Table 2. RECOMMENDED WATER-QUALITY MONITORING NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Station Type: P=Primary GMU site, S=Secondary GMU site, N=NAWQA USGS site, A=Automatic monitoring site)

					Status					*Operating Cost-1997*	
Site number	Storet station number	USGS station number	Station name & location	Station type	Existing	Recommended	Drainage area (sq. miles)	Period of water quality record	Existing or potential funding sources	Funded	Unfunded
Root-Pike GMU											
31	523061	04087240	Root R - Racine	P	√		190	1977-96	WDNR	1,740	
32		04087257	Pike R - Racine	S		√	38	- -	City/Utility		5,000
St. Croix GMU											
3		05333500	St. Croix R - Danbury	N	√		1,580	1995-	USGS, NPS	15,000	
4		05340500	St. Croix R - St. Croix Falls	N, P	√		6,240	1995-	USGS, WDNR	6,000	
Upper Chippewa GMU											
5		05360500	Flambeau R - Bruce	P		√	1,860	- -	WDNR		1,740
6		05356500	Chippewa R - Bruce	P		√	1,650	- -	WDNR		1,740
Lower Chippewa GMU											
7	473008	05369500	Chippewa R - Durand	P	√		9,010	1961-76, 1994-96	WDNR	1,740	
8	483027	05344980	Mississippi R Dam #3 - Red Wing	P	√			1977-96	WDNR	1,740	

Table 2. RECOMMENDED WATER-QUALITY MONITORING NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Station Type: P=Primary GMU site, S=Secondary GMU site, N=NAWQA USGS site, A=Automatic monitoring site)

					Status					*Operating Cost-1997*	
Site number	Storet station number	USGS station number	Station name & location	Station type	Existing	Recommended	Drainage area (sq. miles)	Period of water quality record	Existing or potential funding sources	Funded	Unfunded
Black-Buffalo-Trempealeau GMU											
9		05379500	Trempealeau R - Dodge	P		√	643	- -	WDNR		1,740
10	623001	05382000	Black R - Galesville	P	√		2,080	1961-76, 1996	WDNR	1,740	
11	063029		Mississippi R Dam #4 - Alma	P	√			1977-96	WDNR	1,740	
La Crosse-Bad Axe GMU											
12		05383000	La Crosse R - West Salem	P		√	396	- -	WDNR		1,740
13	123016		Mississippi R Dam #9 - Lynxville	P	√			1976-96	WDNR	1,740	
39		05389500	Mississippi R - McGregor		√		67,500	1975-	USGS	*	
Upper Wisconsin GMU											
14	353068	05395000	Wisconsin R - Merrill	P	√		2,760	1977-96	WDNR	1,740	
Central Wisconsin GMU											
15	723002	05400760	Wisconsin R above Biron	P	√		5,420	1975-96	WDNR	1,740	
16	573052	05404000	Wisconsin R - Wisconsin Dells	P	√		8,090	1977-92	WDNR	1,740	

Table 2. RECOMMENDED WATER-QUALITY MONITORING NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Station Type: P=Primary GMU site, S=Secondary GMU site, N=NAWQA USGS site, A=Automatic monitoring site)

					Status					*Operating Cost-1997*	
Site number	Storet station number	USGS station number	Station name & location	Station type	Existing	Recommended	Drainage area (sq. miles)	Period of water quality record	Existing or potential funding sources	Funded	Unfunded
Lower Wisconsin GMU											
17		05407000	Wisconsin R - Muscoda	P		√	10,400	- -	WDNR		1,740
Grant-Platte-Sugar-Pecatonica GMU											
37		05434500	Pecatonica R - Martintown	P		√	1,034	- -	WDNR		1,740
38	233001	05436500	Sugar R - Brodhead	P	√		523	1988-92, 1995-96	WDNR	1,740	
Upper Rock GMU											
34		05425500	Rock R - Watertown	S		√	969	- -	WDNR		1,740
35		05426031	Rock R - Jefferson	P		√	1,850	- -	WDNR		1,740
Lower Rock GMU											
36	543001	05430500	Rock R - Afton	P	√		3,340	1977-92	WDNR	1,740	
Illinois Fox GMU											
33		05545750	Fox R - New Munster	N, P		√	811	- -	USGS, WDNR		9,740
									TOTAL	94,240	42,140

Table 2. RECOMMENDED WATER-QUALITY MONITORING NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Station Type: P=Primary GMU site, S=Secondary GMU site, N=NAWQA USGS site, A=Automatic monitoring site)

					Status					*Operating Cost-1997*	
Site number	Storet station number	USGS station number	Station name & location	Station type	Existing	Recommended	Drainage area (sq. miles)	Period of water quality record	Existing or potential funding sources	Funded	Unfunded
		*	Operated by USGS Iowa District								
		Key:									
		LFRDA	Lower Fox River Dischargers Association								
		NPS	National Park Service								
		USGS	U.S. Geological Survey								
		WDNR	Wisconsin Department of Natural Resources								

Table 3.—Recommended Ground-Water Level Monitoring Network for Wisconsin By Geographic Management Units (GMU)

TABLE 3. RECOMMENDED GROUND-WATER LEVEL MONITORING NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown on Fig.9)

Local well identification	Aquifer	Frequency of measurement	Period of record	Operating Cost-1997	
County-Township/Range/Section-Sequence				Funded	Unfunded
Lake Superior GMU					
AS-48/03W/26-0178	Sand and gravel	Quarterly	1984-96		900
BA-47/08W/08-0124	Sand and gravel	Monthly	1968-96		900
BA-51/04W/26-0262	Precambrian	Monthly	1986-	740	
DS-47/10W/23-0001	Sand and gravel	Monthly	1937-	740	
IR-46/01E/04-0121	Precambrian	Monthly	1983-96		900
Green-Bay GMU					
OC-31/16E/25-0179	Sand and gravel	Weekly	1983-	740	
FC-39/15E/31-0004	Sand and gravel	Continuous	1967-96		900
FR-40/12E/21-0087	Sand and gravel	Continuous	1967-96		900
FR-41/14E/18-0002	Sand and gravel	Monthly	1948-96		900
MT-30/23E/15-0031	Galena-Platteville	Weekly	1970-	740	
MT-37/20E/34-0007	Sand and gravel	Weekly	1939-	740	
OC-27/20E/03-0020	Sandstone	Monthly	1968-96		900
Lower-Fox GMU					
BN-22/19E/01-0154	Galena-Platteville	Monthly	1966-	740	
BN-24/20E/24-0076	Sandstone	Monthly	1950-	740	
BN-24/28E/18-0013	Galena-Platteville	Monthly	1947-	740	
BN-25/20E/14-0890	Galena-Platteville	Monthly	1983-	740	
CA-20/19E/02-0006	Sandstone	Quarterly	1952-96		900
OU-21/19E/04-0326	Galena-Platteville	Monthly	1969-96		900
Upper-Fox GMU					
FL-14/17E/06-0659	Sandstone	Continuous	1995-	740	
GL-14/13E/06-0032	Sandstone	Monthly	1983-	740	
GL-16/12E/21-0047	Sandstone	Monthly	1974-	740	
MQ-14/09E/30-0026	Sandstone	Monthly	1965-	740	
MQ-16/08E/12-0009	Sandstone	Monthly	1949-	740	
WI-17/16E/15-0048	Galena-Platteville	Monthly	1967-	740	
WI-18/14E/02-0594	Sandstone	Monthly	1983-96		900
WI-18/16E/23-0006	Galena-Platteville	Monthly	1950-	740	
WI-20/17E/20-0001	Sandstone	Monthly	1946-96		900
WS-18/10E/01-0105	Sand and gravel	Continuous	1956-	740	
Wolf GMU					
LA-31/11E/29-0200	Sand and gravel	Weekly	1949-	740	
LA-31/12E/08-0027	Sand and gravel	Monthly	1952-	740	
LA-33/13E/17-0334	Sand and gravel	Monthly	1968-	740	
OU-24/18E/08-0416	Sandstone	Continuous	1995-	740	
OU-24/18E/34-0380	Sandstone	Monthly	1983-	740	
PT-23/10E/18-0276	Sand and gravel	Monthly	1958-	740	
SH-26/18E/30-0001	Sandstone	Monthly	1947-96		900
SH-27/11E/04-0078	Sand and gravel	Monthly	1983-96		900
SH-27/16E/34-0027	Sandstone	Monthly	1974-96		900
WP-21/13E/25-0002	Sandstone	Weekly	1950-	740	
WP-22/14E/12-0013	Sand and gravel	Continuous	1958-	740	

TABLE 3. RECOMMENDED GROUND-WATER LEVEL MONITORING NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown on Fig.9)

Local well identification	Aquifer	Frequency of measurement	Period of record	Operating Cost-1997	
County-Township/Range/Section-Sequence				Funded	Unfunded
WP-25/14E/17-0771	Precambrian	Monthly	1983-	740	
Lakeshore GMU					
CA-20/20E/22-0062	Galena-Platteville	Monthly	1974-96		900
DR-27/26E/05-0265	Silurian	Continuous	1971-96		900
DR-29/27E/30-0007	Silurian	Monthly	1946-96		900
DR-32/28E/15-0317	Silurian	Monthly	1983-	740	
KW-24/25E/10-0030	Silurian	Monthly	1974-96		900
MN-19/23E/35-0028	Silurian	Monthly	1968-96		900
Sheboygan GMU					
SB-14/21E/24-0084	Silurian	Monthly	1974-96		900
Milwaukee GMU					
ML-06/22E/20-0085	Sandstone	Monthly	1974-	740	
ML-07/22E/17-0120	Silurian	Monthly	1946-	740	
ML-08/21E/35-0118	Silurian	Monthly	1946-	740	
Root-Pike GMU					
KE-01/22E/13-0046	Silurian	Weekly	1963-	740	
KE-02/22E/11-0006	Sandstone	Annually	1946-	740	
ML-05/22E/30-0540	Sandstone	Monthly	1974-	740	
ML-06/21E/32-0094	Sandstone	Monthly	1946-	740	
St Croix GMU					
BT-39/16W/17-0002	Sand and gravel	Monthly	1937-	740	
PK-32/17W/07-0075	Sandstone	Monthly	1957-96		900
PK-34/18W-26-0093	Sand and gravel	Weekly	1966-	740	
PK-35/17W/08-0040	Sand and gravel	Monthly	1957-96		900
SC-30/20W/14-0013	Sandstone	Monthly	1983-96		900
SW-41/09W/28-0007	Sand and gravel	Weekly	1937-	740	
WB-40/11W/01-0042	Sandstone	Monthly	1968-96		900
WB-41/12W/26-0048	Sand and gravel	Continuous	1982-96		900
Upper Chippewa GMU					
AS-43/02W/21-0054	Sand and gravel	Monthly	1967-	740	
AS-43/04W/32-0006	Sand and gravel	Monthly	1957-	740	
PR-35/03E/04-0065	Sand and gravel	Monthly	1986-	740	
RU-35/03W/14-0089	Sand and gravel	Monthly	1957-	740	
VI-41/06E/36-0959	Sand and gravel	Monthly	1980-	740	
Lower Chippewa GMU					
BR-33/13W/21-0046	Sandstone	Monthly	1956-96		900
BR-33/14W/06-0048	Sandstone	Monthly	1969-96		900
BR-34/10W/22-0153	Sandstone	Monthly	1964-96		900
CH-28/07W/17-0142	Sandstone	Monthly	1968-	740	
CH-28/09W/25-0120	Sand and gravel	Monthly	1964-	740	
CK-26/03W/04-0001	Sandstone	Monthly	1953-96		900
PI-25/18W/18-0151	Sand and gravel	Weekly	1986-	740	

TABLE 3. RECOMMENDED GROUND-WATER LEVEL MONITORING NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown on Fig.9)

Local well identification	Aquifer	Frequency of measurement	Period of record	Operating Cost-1997	
County-Township/Range/Section-Sequence				Funded	Unfunded
PP-24/16W/26-0039	Sandstone	Monthly	1969-	740	
PP-25/12W/32-0040	Sandstone	Monthly	1968-	740	
TA-31/04W/13-0001	Sand and gravel	Continuous	1957-96		900
Black-Buffalo-Trempealeau GMU					
BF-20/12W/09-0119	Sand and gravel	Monthly	1984-	740	
BF-20/12W/16-0120	Sand and gravel	Monthly	1986-	740	
CK-28/02W/01-0509	Sand and gravel	Monthly	1983-	740	
JA-20/03W/30-0005	Sandstone	Monthly	1953-96		900
JA-21/04W/13-0038	Sand and gravel	Weekly	1981-	740	
JA-22/03W/08-0085	Precambrian	Monthly	1983-96		900
TA-33/02E/30-0009	Sand and gravel	Monthly	1965-96		900
TR-19/08W/35-0001	Sandstone	Monthly	1947-	740	
TR-19/09W/33-0009	Sand and gravel	Monthly	1953-	740	
TR-21/07W/17-0071	Sandstone	Monthly	1979-	740	
LaCrosse-Bad Axe GMU					
CR-09/06W/27-0059	Sandstone	Monthly	1966-	740	
LC-16/07W/14-0076	Sandstone	Monthly	1986-	740	
MO-15/03W/05-0010	Sand and gravel	Weekly	1934-	740	
MO-15/04W/34-0002	Sandstone	Continuous	1934-	740	
MO-18/02W/29-0017	Sandstone	Continuous	1950-	740	
VE-12/04W/34-0052	Sandstone	Monthly	1966-	740	
VE-13/04W/17-0071	Sandstone	Monthly	1966-	740	
VE-14/07W/28-0117	Sandstone	Quarterly	1982-	740	
VE-14/07W/28-0271	Sandstone	Quarterly	1982-	740	
VE-14/07W/28-0272	Sandstone	Quarterly	1982-	740	
Upper Wisconsin GMU					
LA-31/11E/20-0064	Sand and gravel	Weekly	1948-	740	
LA-34/10E/13-0537	Sand and gravel	Monthly	1983-	740	
LN-31/07E/28-0092	Sand and gravel	Monthly	1983-96		900
LN-34/06E/36-0060	Sand and gravel	Monthly	1944-96		900
ON-36/09E/09-0024	Sand and gravel	Weekly	1944-	740	
ON-37/06E/27-0023	Sand and gravel	Monthly	1944-96		900
ON-39/08E/18-0022	Sand and gravel	Continuous	1944-	740	
VI-40/10E/28-0033	Sand and gravel	Monthly	1965-	740	
VI-41/10E/09-0003	Sand and gravel	Monthly	1948-	740	
Central Wisconsin GMU					
AD-14/06E/21-0128	Sandstone	Monthly	1969-96		900
AD-17/06E/08-0076	Sand and gravel	Weekly	1969-	740	
JU-17/02E/28-0098	Sandstone	Monthly	1969-96		900
MR-27/09E/31-0028	Sand and gravel	Weekly	1944-	740	
MR-29/03E/24-0027	Sand and gravel	Monthly	1944-	740	
MR-29/07E/24-0100	Sand and gravel	Monthly	1984-	740	
PT-21/07E/31-0059	Sand and gravel	Monthly	1951-	740	
PT-21/08E/10-0036	Sand and gravel	Monthly	1950-	740	
PT-23-08E/25-0376	Sand and gravel	Monthly	1960-	740	

TABLE 3. RECOMMENDED GROUND-WATER LEVEL MONITORING NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown on Fig.9)

Local well identification	Aquifer	Frequency of measurement	Period of record	Operating Cost-1997	
County-Township/Range/Section-Sequence				Funded	Unfunded
PT-24/10E/28-0015	Sand and gravel	Monthly	1950-	740	
WD-21/03E/10-0066	Sand and gravel	Monthly	1981-	740	
WS-19/08E/15-0008	Sand and gravel	Continuous	1951-	740	
Lower Wisconsin GMU					
CO-12/19E/27-0620	Sandstone	Monthly	1974-	740	
DN-07/08E/25-1134	Sandstone	Monthly	1976-96		900
DN-09/06E/29-0083	Sand and gravel	Continuous	1953-	740	
GR-08/01W/10-0072	Sand and gravel	Monthly	1963-96		900
IW-08/05E/18-0110	Sandstone	Monthly	1968-	740	
RI-10/01E/26-0023	Sandstone	Monthly	1965-	740	
SK-10/06E/02-0003	Sandstone	Continuous	1989-	740	
SK-13/02E/14-0230	Sandstone	Monthly	1984-	740	
VE-14/07W/26-0008	Sand and gravel	Monthly	1934-	740	
Grant-Platte-Sugar-Pecatonica GMU					
DN-05/08E/06-0927	Sandstone	Monthly	1984-	740	
DN-06/08E/15-1289	Sandstone	Monthly	1986-	740	
DN-07/08E/06-1136	Sandstone	Monthly	1980-	740	
DN-07/09E/23-1297	Sand and gravel	Monthly	1978-	740	
GN-01/07E/33-0074	Sandstone	Monthly	1979-	740	
GN-03/06E/18-0002	Sandstone	Monthly	1946-	740	
GR-05/02W/06-0005	Sandstone	Monthly	1946-	740	
GR-05/06W/27-0029	Sandstone	Monthly	1982-	740	
GR-05/06W/27-0132	Sandstone	Quarterly	1982-	740	
GR-05/06W/27-0133	Sandstone	Quarterly	1982-	740	
GR-05/06W/27-0134	Sandstone	Quarterly	1982-	740	
IW-06/03E/32-0032	Galena-Platteville	Monthly	1957-	740	
LF-01/02E/33-0057	Galena-Platteville	Continuous	1952-	740	
LF-01/03E/01-0294	Galena-Platteville	Monthly	1970-	740	
LF-02/01E/04-0011	Galena-Platteville	Monthly	1947-	740	
Upper-Rock GMU					
CO-11/11E/16-0134	Sandstone	Monthly	1974-	740	
DG-10/15E/32-0109	Galena-Platteville	Monthly	1965-	740	
DG-11/13E/22-0081	Sandstone	Monthly	1964-	740	
DN-09/11E/34-1355	Sandstone	Continuous	1990-	740	
JE-07/14E/10-0144	Sandstone	Monthly	1965-96		900
Lower-Rock GMU					
DN-06/12E/02-0880	Sandstone	Monthly	1970-96		900
DN-07/09E/19-0064	Sandstone	Continuous	1977-	740	
DN-07/09E/23-0005	Sandstone	Weekly	1946-	740	
DN-07/10E/09-0105	Sandstone	Continuous	1974-	740	
DN-07/10E/21-0146	Sandstone	Monthly	1977-	740	
DN-09/10E/33-0441	Sandstone	Monthly	1959-	740	
JE-05/13E/25-0303	Sandstone	Monthly	1970-96		900
JE-05/16E/15-0849	Sandstone	Monthly	1984-	740	
RO-01/13E/32-0491	Galena-Platteville	Monthly	1979-	740	

TABLE 3. RECOMMENDED GROUND-WATER LEVEL MONITORING NETWORK FOR WISCONSIN BY GEOGRAPHIC MANAGEMENT UNITS (GMU)
(Location of sites shown on Fig.9)

Local well identification	Aquifer	Frequency of measurement	Period of record	Operating Cost-1997	
County-Township/Range/Section-Sequence				Funded	Unfunded
RO-02/12E/02-0003	Sandstone	Weekly	1947-	740	
RO-04/13E/27-0008	Sandstone	Monthly	1952-	740	
WK-07/17E/05-0020	Sandstone	Monthly	1946-	740	
WW-01/16E/10-0083	Sand and gravel	Monthly	1980-	740	
WW-03/15E/33-0009	Galena-Platteville	Monthly	1947-	740	
Illinois-Fox GMU					
KE-01/21E/29-0288	Sand and gravel	Monthly	1992-96		900
KE-02/02E/17-0021	Sandstone	Annually	1961-	740	
ML-06/21E/32-0148	Silurian	Monthly	1946-	740	
RA-03/20E/28-0062	Sand and gravel	Quarterly	1985-	740	
WK-05/19E/02-0031	Silurian	Continuous	1947-	740	
WK-06/19E/02-0006	Sandstone	Monthly	1970-	740	
WK-06/19E/13-1301	Sand and gravel	Monthly	1992-	740	
WW-02/17E/36-0037	Sandstone	Monthly	1963-	740	
WW-04/17E/02-0908	Sand and gravel	Continuous	1995-	740	
			TOTAL	$93,240	$39,600

Item 3

COMMISSION FILE NO. 97-043-3

Milwaukee Metropolitan Sewerage District

INTRODUCED BY: Executive Director

REVISED

DATE INTRODUCED: March 10, 1997

REFERRED BY COMMISSION CHAIRPERSON TO: Operations Committee

RELATING TO:

Continuation of Streamflow Gauging Cooperative Agreement

SUMMARY:

This 5 year agreement provides for the maintenance of eight streamflow gauges as follows:

1. Milwaukee River - Estabrook Park
2. Milwaukee River - Pioneer Road
3. Menomonee River - 70th Street
4. Underwood Creek - Hwy. 45
5. Kinnickinnic River - 11th Street
6. Oak Creek - Mouth
7. Root River Canal - Franklin
8. Root River - Franklin

Costs will be shared equally by the Milwaukee Metropolitan Sewerage District (MMSD) and the U.S. Geological Survey (USGS), with the administration being performed by SEWRPC. The data is needed by MMSD for flood control planning and design, and for making water quality assessments. If the data were not available, assumptions would have to be made and facilities would be underdesigned or overdesigned. Neither condition is desirable. The MMSD has supported this data collection program for 20 years and USGS would not continue to maintain these stations without MMSD's support. The cost of the 5 year agreement is not to exceed $186,000. The contract will include a clause allowing the District to withdraw from participation in future years, given 90 days advance notice.

ATTACHMENTS: KEY ISSUES ☐ RESOLUTION ☒ FISCAL NOTE ☒ BACKGROUND ☐

TS:WF:RM97091.CM
03/13/97

COMMITTEE ACTION _____ DATE _____

COMMISSION ACTION _____ DATE _____

On motion made by Commissioner Walsh and seconded by Commissioner Kaminski, the following resolution was presented:

RESOLUTION

Continuation of Streamflow Gauging Cooperative Agreement

RESOLVED, by the Milwaukee Metropolitan Sewerage Commission that the Executive Director be authorized to enter into a 5 year cooperative agreement with the Southeastern Wisconsin Regional Planning Commission for the maintenance of eight streamflow gauges for a cost not to exceed $186,000.

The above resolution was adopted by the following vote:

YES: Elliott, Grzezinski, Johnson-Odom, Kaminski, Payton, Schwerm, Voith, Vretenar, Walsh

NO: None

NOTE: Commissioners Burke & Krug were excused

I, Fran Ashley-Jordan Secretary of the Milwaukee Metropolitan Sewerage District do hereby certify that the above is a true and correct copy of a resolution adopted by the Milwaukee Metropolitan Sewerage District at a meeting held.

March 17 19 97

TS:WF:RM97091.CM
03/13/97