



Water Resources Center

*Biennial
Report
1996-98*



From the Directors:

We are pleased to present the first biennial report of the Water Resources Center. The Center unites three separate and long-standing water programs on the St. Paul campus: the Water Resources Research Center, the Center for Agricultural Impacts on Water Quality, and the Extension Water Quality Program. In 1996, after much discussion among ourselves and the deans of the colleges to which these programs report, we concluded that the programs could be more effective and more efficient if they joined forces. As this report describes, the product of this decision, the Water Resources Center, has been very productive in its first biennium. The Center has developed active research and outreach programs on a wide range of water problems, and the Water Resources Science graduate program, which the Center administers, has continued to mature and grow. We look forward to a period of continuing growth and productivity in the coming biennium.

We would like to express our thanks to Deans Al Sullivan (College of Natural Resources), Mike Martin (College of Agricultural, Food, and Environmental Sciences) and Kathy Fennelly (University of Minnesota Extension Service) for endorsing our initial proposal to develop the Center and for their continuing support of our activities during this formative period. We also express our sincere thanks to the WRC staff for their hard work and spirit of cooperation in developing an efficient and integrated office. Finally, we acknowledge with great appreciation the efforts of Shandor Szalay, our student editor, in assembling this document.



Patrick L. Brezonik
Co-Director



James L. Anderson
Co-Director

Cover image

Leif Olmanson

Satellite image showing trophic status of lakes in the Twin Cities Metropolitan Area.

Editing and layout

Shandor Szalay

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Student Editor and
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Associate Administrator**



**Shandor Szalay,
Student Editor and
Webmaster, 1995-1998**



**Tony Kaster,
Administrative Fellow**

From sponsoring wetlands indicator research, to a major interdisciplinary collaboration on the Minnesota River, to advances in on-site sewage treatment, it has been an outstanding biennium for WRC research.



Over the past two years, the WRC research program has grown tremendously. Currently, the WRC has ties to over 60 ongoing projects in a wide variety of disciplines, as well involvement in several interdisciplinary efforts—more than ever before. But more than the number of projects has changed.

We've expanded the number of ways by which we get involved in water resources research. Not only have we successfully sponsored five research efforts within the University over the last biennium through the federally-funded Water Resources Research Institutes (WRII) Program, but our faculty and staff have been active in securing grants and conducting original research in a number of areas. In addition, WRC staff act as managers or consultants on other projects.

1996-1998 Research highlights

- Major WRC-led interdisciplinary effort on the Minnesota River funded through EPA-NSF Water and Watersheds program.
- Over \$1 million in projects conducted through the WRC.
- Five projects sponsored through the WRII program.
- Projects totalling over \$2 million conducted in the WRC-managed pesticide laboratory.
- Participation in an interagency task force to assess the implications of hypoxia in the Gulf of Mexico.
- Three projects funded through the 319 non-point source grant program.



WRC-funded facilities such as the Analytical Pesticide Lab have played an important role in many major research efforts.

Productive **P**artnerships

Research partnerships are critical for solving complex problems. Many of the Center's recent research endeavors have been in the context of multi-agency partnerships. For example, the WRII program represents a strong and long-lasting partnership with the USGS. Other partnerships, such as research collaborations with the USDA-Agricultural Research Service, improve the quality of WRC research through sharing emerging methodology, historical data sets, and ideas.

Actualizing ideas

The WRC has met great success in supporting local research through the federally-funded WRRRI program. Each year, the WRC conducts a local grants competition and forwards up to 4 proposals from Minnesota to a regional competition. In the last three years, five of these projects have been approved. As result, the WRC has been able to contribute more than \$300,000 to Minnesota water re-search over that time.



Andrea Plevan is one of several graduate students funded through the WRRRI program.



1996-1998 WRRRI ongoing and completed projects

Assessing the effects of land use on wetland quality: development of biotic indicators

Susan Galatowitsch, Department of Horticultural Science & Landscape Architecture and John Tester, Department of Ecology, Evolution, and Behavior.

Particulate transport of mercury through forested watersheds

Edward Nater and David Grigal, Department of Soil, Water, and Climate.

Remediation of atrazine contamination in municipal drinking water

Michael Sadowsky, Department of Soil, Water, and Climate, and Biological Process Technology Institute; and Lawrence P. Wackett, Department of Biochemistry and Biological Process Technology Institute.

Controls on biomass: nutrient ratios in streams and rivers

Robert Sterner, Department of Ecology, Evolution, and Behavior.

Organic matter binding and photoreduction of mercuric ion and methylmercury in surface water

Paul Bloom, Department of Soil, Water, and Climate; and Patrick Brezonik, Department of Civil Engineering.



Edward Nater and David Grigal conducted research on how mercury moves through forested watersheds in northern Minnesota. Their efforts will help protect some of Minnesota's most beautiful rivers.

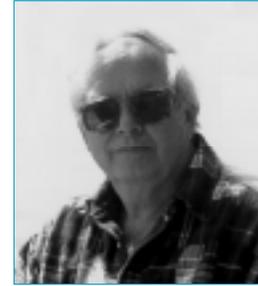
Development of biotic indicators for Minnesota wetlands.

Faculty investigators Sue Galatowitsch and John Tester created tools for assessing the success of wetland restoration efforts. Their approach was to explore over 100 Minnesota wetlands, from highly pristine to extremely degraded, in search of indicator organisms—communities of birds, amphibians, insects, and plants that reveal the health of a wetland.



Sue Galatowitsch

John Tester



Major findings .

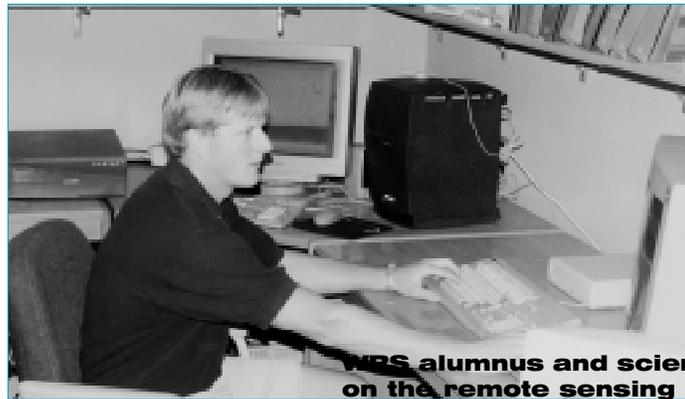
- Approximately 65% of potential indicators may have assessment value.
- Non-calcareous littoral wetlands are an exception, however, with approximately 30% of the indicators having possible assessment value.
- The most useful scale for wetland assessment varies among wetlands and among organismal groups, with plants tending to respond to land use degradation locally (within 500 m of sites) and vertebrates often responding at larger scales (within 2500 m of sites).
- Birds and plants are more generally useful as biotic indicators for Minnesota wetlands than amphibians, fish and invertebrates. These aquatic animals cannot be sampled reliably or consistently in wetlands that are not persistently flooded.



A researcher on the project collects leeches on a riverine wetland on the Shell River.

High-tech lake assessment.

A new WRC project, funded by the Metropolitan Council, is using satellite imagery to estimate trophic conditions in Twin Cities lakes. This new technology may greatly reduce the effort needed to assess the affect of landuse and landscape alteration on lake water quality. The project is headed by WRC Director Patrick Brezonik, and also involves Forest Resources Professor Marvin Bauer, and Geography Professor Dwight Brown.



WRS alumnus and scientist on the remote sensing project, Leif Olmanson. Leif's M.S. work was on a similar topic.

In 1996, the WRC took the lead on a major faculty collaboration to investigate the role of scale in watershed management in the Minnesota River Basin.

A few years ago, University of Minnesota professor Jim Perry provided a fundamental insight into watershed science and watershed management—the scale-conundrum. While scientists are recognizing the need to study aquatic systems at larger scales, management of these systems is occurring on increasingly smaller scales.

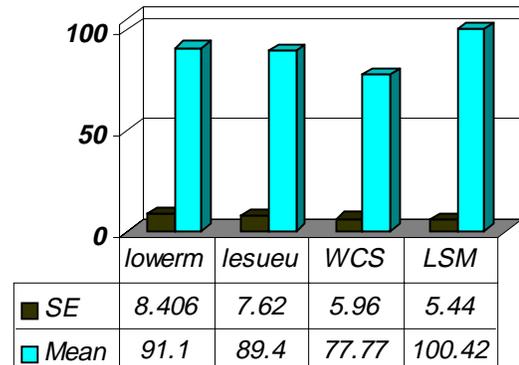


Perry’s articulation of the scale-conundrum led to the development of a proposal to test the validity and implications of, and potential solutions to, this phenomenon. This effort, led by professors Pat Brezonik, Bill Easter, Dave Mulla, and Jim Perry, incorporates aquatic, terrestrial, and socioeconomic studies to address scale explicitly as a key issue in successful watershed management, and specifically to determine at what scale management efforts will be most effective.

Greater than 85% of the land in the 40,000-km² Minnesota River Basin is in agricultural use. The Minnesota River is considered one of the most polluted rivers in the U.S.



The Agroecoregion concept.



This figure shows mean and standard error for stream habitat scores. Agroecoregions (WCS, LSM) show more pronounced differences in mean scores and lower standard errors than watersheds. This indicates that agroecoregions may be more responsive units of management with respect to stream habitat.

One of the hypotheses this study is testing is that the intersection of watersheds (hydrological delineations) and agroecoregions (land-use and climatic delineations) is a more appropriate scale for managing water quality than is the watershed alone.

Project researchers are testing this hypothesis on a wide range of physical and biological variables including nutrient retention, aquatic invertebrate diversity, and habitat quality.

What are agroecoregions?

Soils professor Dave Mulla headed the effort to divide the Minnesota River Basin into agroecoregions. Agroecoregions are not defined hydrologically like watersheds. Instead they represent areas of similar soil types, landscapes, climate, and crop and animal productivities.

The U of M pesticide lab, cooperatively managed by the WRC and USDA-Agricultural Research Service, continues to make significant contributions to one of Minnesota's most critical areas of research—the influence of agriculture on water quality.

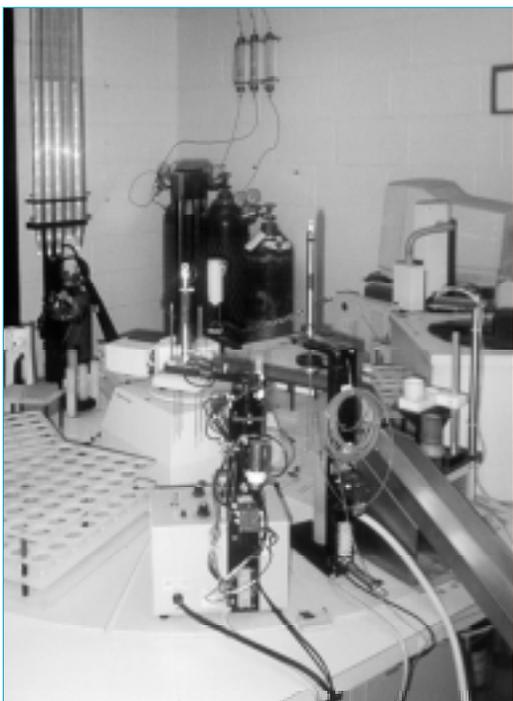
The WRC is also helping to find new ways to maintain profitable agricultural systems while improving water quality.

Over the past two years, the pesticide lab has provided analytical support and the latest technology in pesticide chemical analysis to support over \$2 million in agricultural research. The addition of this facility to the WRC represents an important new way in which we are helping to strengthen the University's contributions to water resources research, and to Minnesota's water quality.



Seeking solutions .

Currently the pesticide lab is using a state-of-the art robotics system to support a WRC project on site-specific herbicide management for preserving water quality and two USDA-ARS projects to improve tillage practices and residue management systems. Through these efforts, researchers are trying find ways to reduce reliance on herbicides while allowing farmers to maintain profitability. Specifically, these projects seek to identify and solve problems associated with reduced tillage systems that prevent their acceptance by farmers and develop integrated strategies for herbicide and carbon management and tillage.

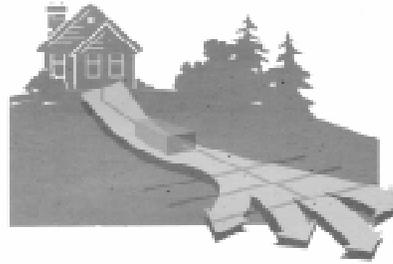


Innovations, such as this robotic system for measuring pesticides in sediments, are one way of making agricultural research more efficient.

Practical Alternatives .

Finding alternatives to traditional on-site sewage systems has been an area of active research at the WRC over the past two years, through a research partnership with the Legislative Commission on Minnesota Resources, Minnesota Pollution Control Agency, and Natural Resources Research Institute. Each year, thousands of septic systems in rural Minnesota contribute to ground and surface water pollution. By finding ways to make safer, more efficient systems, the WRC is helping to improve owner satisfaction while lowering the risk of septic system leakage into sensitive water resources.

Our research on septic system alternatives, led by WRC Director Jim Anderson, is complemented by a number of outreach programs designed to promote proper operation and maintenance of existing systems. These outreach programs reach thousands of Minnesotans each year. In the last two years, we've produced several publications and videos to teach Minnesotans about septic system care, including a 24-page, fully-illustrated septic system owners guide. In 1998, we organized a satellite conference on alternative on-site sewage systems and responsible septic system ownership. The conference reached over 6,000 septic system owners across the nation. The new structure of the WRC has resulted in an enhanced interaction between research and septic system programs for on-site sewage waste treatment. Because educators have faster access to the latest research information, they are able to communicate this information to the public with greater speed and accuracy. Outreach educators who work directly with the public in turn provide critical feedback to researchers concerning future research needs.



Part of the WRC solution to improving on-site sewage treatment is the installation and testing of alternative systems. The Center transfers information on research results to the public through a variety of media including videos, print publications, and video conferences.



A major achievement for the University of Minnesota water community was the establishment of an interdisciplinary graduate major in water resources in 1995.

In the 1980s, a group of faculty recognized the need to integrate water-related programs at the University, and organized a graduate minor in water resources. Then, in 1995, the same group of faculty, led by Patrick Brezonik, director of the WRC, formed a new graduate program, called Water Resources Science. Today, the program brings together more than 80 faculty, representing a wide range of disciplines and 24 departments on the Twin Cities and Duluth campuses of the University.

Making disciplines connect.

The program has grown rapidly since 1995, in many ways exceeding the goals and aspirations of its founders. The program began with 12 students. Today, the WRS is home to 59 students (45 in the Twin Cities 14 in Duluth). To date, 9 WRS students have graduated from the program with M.S. degrees. WRS has attracted applicants from 17 states and 8 countries.

Statistics compiled by the WRC show a steady increase in the quality of applicants and new students. The average undergraduate GPA of applicants is 3.54, and WRS applicants compete successfully for University-wide graduate student fellowships. Most full-time WRS students are supported by research or teaching assistantships.



A community of scholars.



In 1996, WRS students formed Water Resources Students in Action. This year, the group begins its third year of water quality monitoring with Twin Cities neighborhoods.

One of the challenges for the new program has been finding ways to turn a group of faculty and students from many departments into a true community of scholars.

A two-week field course at Itasca Field Station introduces WRS students to many disciplines, and most importantly, to each other.



Education

Education

A supporting role .

The WRC has played an important role in the inception and growth of the WRS program. Center director, Patrick Brezonik, continues to serve as Director of Graduate Studies for the Twin Cities portion of the program. The Center provides a physical home for WRS program administration, and Maria Juergens, WRC associate administrator, serves as the WRS graduate secretary. Supporting the WRS program is an essential part of the Center's commitment both to continued excellence in water resources education and to the integration of water resources research and education across traditional disciplinary boundaries.



WRS student Anne Gleason works with nine faculty and eight other graduate students as a part of the WRC-funded Minnesota River Project. Through her work on the project, Anne not only develops skill in her own discipline, but learns how to interface with other scientists in other disciplines to solve complex problems.



WRS student, Tony Kaster, helps with preparation for a WRC conference. Tony is one of several WRS students who have found funding and valuable work experience at the WRC.

The WRC has supported the graduate program's growth in a number of other ways. During the last biennium, the Center helped to produce several publications for the WRS program, including a program brochure, student manual, and two-year progress report. The Center provides computer facilities to maintain the WRS web-site, a valuable resource for attracting students to the program, and for providing information on program activities, job opportunities, upcoming seminars and other items to WRS students.

The WRC's commitment to the continued success of the program includes involving WRS students in Center activities. Over the last biennium, the WRC has supported 14 WRS students through employment at the Center, or through Center-funded research efforts. The Center also provides a place for WRS students to gather for social events, seminars, and small group meetings, and computer facilities for students to check e-mail, work on classwork, or access the internet. WRS students who do not yet have office space in their home departments can use one of several WRC offices with computer and telephone facilities.

Addition of the Extension water quality program to the WRC in 1996 has meant a much stronger commitment to outreach education.

Outreach has become a critical component of the WRC in the last two years. Our work in this area has been diverse. Major initiatives include the highly successful Shoreland Volunteer Project, led by Barb Liukkonen, several projects in manure management, education, and research, and an extensive program on septic system education.

Most important, however, this biennium has been about finding new ways to reach people. Over the last two years, we've branched out from classroom presentations and fact-sheets. From internet web-sites to satellite video conferences, we're taking advantage of today's technology to put more Minnesotans in touch with water-resources information.

Another way we're providing Minnesotans with quality information about water resources problems is the Minnesota Water Line, a multi-agency-funded water resources call-in service available throughout Minnesota. The water line receives calls on a wide variety of topics, including well safety, water treatment methods, and fertilizer management.



Manure management .

In 1995, two Extension education positions in manure management were established as a line item in the Minnesota Department of Agriculture. Outreach activities associated with these two positions have been coordinated and managed through the WRC.

Goals of the program have focused on helping livestock and crop producers better utilize manure on cropland while minimizing environmental concerns, and providing coordination and leadership within the University of Minnesota Extension Service and with other state and federal agencies. Our educators have worked toward these goals using a wide variety of approaches such as presentations to producers, manure management workshops, calibration clinics, and establishment of demonstration plots. Other ongoing efforts include integrating manure utilization plans into existing agency nutrient management programs through interagency support meetings and Manure Application Planner training, and reviewing manure management information products.

Outreach

Getting the word out.

To link the WRC more effectively with other researchers and educators in Minnesota, the Center developed a web site in 1996. The site currently attracts about 200 visitors per week. Visitors to the site can order WRC publications on-line, search a directory of water expertise in Minnesota colleges and universities, check on upcoming conferences and symposia and read our newsletter, *Minnegram*.

We've also redesigned our newsletter. In addition to improving the visual appeal of the newsletter, we expanded the content of the *Minnegram* to include feature-length coverage of important water resources issues. Recent articles include an in-depth analysis of urban stream restoration and protection in the Twin Cities, a look at how University researchers are responding to the floods of '97, and an overview of Minnesota's connection to the hypoxia problem in the Gulf of Mexico.



Shoreland Education.

Educating and involving Minnesota's citizens in protecting and monitoring nearby lakeshores has been the focus of the WRC Shoreland Education Program. While the WRC coordinates the various elements of the program and produces educational materials such as fact-sheets and videos, much of the credit for the success of the program belongs to the local commitment of shoreland volunteers. To date, over 200 Minnesota shoreland volunteers have worked to improve lakeshore quality through active stewardship, educating friends and neighbors, and conducting community service projects.

Volunteer power **What shoreland volunteers have done**

- \$100,000 revegetation and demonstration project
- Increased lake association membership by 200%
- Comprehensive septic system survey
- Arranged with co-op to mix fertilizers formulated for specific shoreland areas.



Minnesota Water '98

Protecting Minnesota's Water Supplies

In May 1998, the WRC sponsored *Minnesota Water '98*, focusing on Minnesota drinking water supplies, the sixth in a series of biennial conferences.

Minnesota Water '98 focused on the pressing issue of drinking water quality. In a series of plenary sessions, experts provided a range of perspectives on drinking water; although perspectives varied, one thing was clear—though the effort to provide safe drinking water for all Minnesotans is well underway, it's far from over.



Over 300 attendees from state, federal and local agencies, and the private sector listen to the first plenary session.

Over 300 people attended "Protecting Minnesota's Water Supplies," the sixth biennial Minnesota Water conference sponsored by the Minnesota Water Resources Center. Speakers represent federal, state and local government agencies and non-government organizations came together in Minnesota for the 2-day conference held May 5-6. Plenary speakers addressed a broad



Phil Singer, Professor, University of North Carolina, answers questions following his plenary talk on disinfection by-products.

While issues such as septic system maintenance and operation loom on the rural front, urban centers such as the Twin Cities and Rochester face new challenges such as carcinogenic by-products of disinfection and emerging pathogens such as *Cryptosporidium*.

Although *Minnesota Water '98* didn't solve these problems, the exchange of ideas, business cards, and experiences made the conference a valuable step toward achieving clean drinking water throughout Minnesota.

Outreach

Active citizenship .

Complementing WRC research efforts on the Minnesota River is a new WRC outreach initiative in the basin. The project, which brings together the Met Council, the WRC, the Minnesota River Basin Joint Powers Board, and county officials, focuses on “civic organizing,” a paradigm that champions active citizenship and relies on mutual responsibility of individuals and institutions to effect change.

The two-year project will build on existing technical work in water quality in the watershed. The idea is not to move away from technical solutions, but to give citizens in the basin a framework through which scientific knowhow can be put to use within their communities.



Small watersheds , major changes .

Funded in 1998 under the Section 319 non-point source grant program, *Achieving major change in small watersheds* is a WRC project led by Jim Anderson that is making a real difference. BMPs designed to protect water quality are useful only if they are implemented correctly. This requires working closely with individual landowners and local government to create tailor-made BMP plans for each farm, feedlot, and pasture.

The project's success is rooted in the understanding that BMPs are only general guidelines. Providing individualized attention to landowner needs, unique landscapes, and concerns of local government is the key to achieving long-term quality results.



Looking ahead.

Although the recent biennium has brought much success, the WRC faces bold challenges in the coming years. Most urgent is to realize our commitment to greater integration and collaboration among outreach, education, and research programs. We are proud of the progress made by the combined Center since 1996. In the next biennium we seek to build upon these achievements by enhancing communication between programs, and pursuing collaborative grants that will allow outreach and research personnel to work on common projects.

While a strong foundation of wide-ranging faculty participation and enrollment of high-caliber students has been laid, the WRS program faces several challenges, including the need to develop new interdisciplinary coursework for the program instead of relying only on courses already taught in various departments. Finding innovative ways of teaching students to blend biophysical, engineering, and sociocultural knowledge to understand and solve complex problems is an ongoing goal for the program. In the coming years, the Center will continue to support the continuing development of the WRS program through strong administrative and financial assistance.

On the research front we face the challenge of actively engaging more of the faculty to work cooperatively on complex water-related issues. We also face a responsibility to do more to help faculty who are already involved in water research, education, and outreach. Another goal is to improve communication among researchers so that information from ongoing projects can enhance all programs. This will require a more comprehensive outreach effort on existing grants and projects.

The WRC and its predecessor components have focused historically on biophysical research and technological aspects of water resources. The recent addition of to the Center's staff of Professor Steve Taff, Department of Applied Economics, gives the WRC increased capability in the areas of water policy and socioeconomic aspects of water resources and will allow the Center to increase its research and outreach activities in these important areas during the coming years.

Over the next biennium, new Center initiatives will reflect a more integrated approach to solving water resources problems. Our goal is for each new project to have a work-group made up of research, education and outreach staff. This will allow us to achieve integration throughout all phases of project development, data collection and analysis, and information dissemination. Our efforts towards integrated problem solving will be enhanced by the involvement of WRS graduate students in work-groups and project proposals.