2006 WATER RESOURCES YEAR IN Review

Grand Valley State University | R. B. Annis Water Resources Institute | Winter 2006 | Volume 19, Number 2

The foundation and our future

Dr. Alan Steinman, Director

The Annis Water Resources Institute has faced numerous challenges ever since its start in a basement office some 20 years ago. But thanks to the vision, persistence, and support of several people and organizations both within and outside of the University, the Institute is flourishing.

Yet, even after 20 years, in many ways we've only just begun. Because the need is so great, the possibilities for our future growth and program expansion are nearly limitless.

I am thankful for the individuals who have worked hard to make the Institute what it is today — our first director, Dr. Ron Ward; GVSU's prior two presidents, Arend (Don) Lubbers and Mark Murray; Dean P. Douglas Kindschi; our staff, many of whom have been with us for over half of AWRI's existence; our undergraduate and graduate students; the scientific community; the general public; and our financial supporters. I am indebted to all those who believed in our mission and contributed their best to bring us to the point we are now.

As the Institute's director, it's exciting for me to participate in shaping our future. Our strategic plan calls for us to pursue three new areas of scientific investigation — urban ecology, aquatic molecular ecology, and environmental economics.

Population growth and increased development have certainly impacted our environment and will continue to do so in the years ahead. It is critical that we as a society not only study those impacts, but also create sustainable practices that will minimize those impacts. With our expertise in watershed restoration research, and the tools and partnerships developed by AWRI's Information Services Center over the years, the Institute is well suited to provide essential data and practical solutions to the problems associated with urban environments.

Aquatic molecular ecology is an emerging field. Adding this expertise to AWRI would result in new research avenues for our work on algal toxins, invasive species, native fish, and microbial pathogens.

(continued on page 2)

As President of the West Michigan Strategic Alliance, I can see how water resources and other environmental issues are critical to our quality of life. I also know that the many people we work with in our seven-county region agree that the quality of our water and other aspects of our environment impact a variety of issues. It's exciting to me that this agreement comes from people with a variety of perspectives, including business leaders, government officials and nonprofit executives. This collaboration is the essence of what the Alliance does in its projects that seek to sustain our environment, develop our economy and revitalize our communities. In the year ahead, we look forward to a continued partnership with the Annis Water Resources Institute, particularly as we develop a set of quantified indicators and economic evaluation tools that will help us assess and improve various aspects of the West Michigan region for years to come.

Greg Northup,
West Michigan Strategic Alliance

20 Years

Integrating research, education, and outreach to enhance and preserve freshwater resources

2006 Institute Highlights

- Restoration of the Field Station continues—in 2006, we overhauled the exterior shell of the building, providing a more functional and attractive exterior. In addition, we installed a davit at the Lake Michigan Center to launch small research boats.
- Received a $396,000 federal grant to continue improvement at our site. This funding will be used to construct a storage facility that will house the Institute's boats and vehicles, freeing up space in the field station for future office expansion and research laboratories.
- Science Advisory Board updates: Claire Schelske, from the Department of Geological Sciences at the University of Florida, stepped down as board member; Claire is being replaced by Don Scavia, Director of the Michigan Sea Grant Program and Professor of Natural Resources and Environment at the University of Michigan.
- AWRI received a State of the Lakes Ecosystem Conference (SOLEC) award for our work on the Ruddiman Creek clean up project. AWRI scientist Rick Rediske worked for many years on this project providing technical expertise.
- Matt Cooper, a graduate student of Don Uzarski, received a prestigious graduate fellowship from the U.S. Environmental Protection Agency, which will fund his research on Great Lakes coastal wetlands.
- Mark Luttenton, who holds a half-time position at AWRI, received GVSU's Outstanding Educator Award.
- AWRI celebrated four anniversaries in September: 1) the Lake Michigan Center, home of the Annis Water Resources Institute (5 years); 2) the *W.G. Jackson*, AWRI's second research vessel (10 years); 3) the launching of the *D.J. Angus*, AWRI's first research vessel (20 years); and 4) the founding of the Annis Water Resources Institute (20 years). See photos to the right.
- The *D.J. Angus* now has a permanent home—thanks largely to the efforts of Tony Fiore, Mike Sanders, and Jim Winks, a new dock was constructed this year. Funds provided by the Grand Haven Area Community Foundation allowed us to install informational displays on the local natural history and standing binoculars; many thanks to Roger Tharp and Janet Vail for helping to develop the displays.
- AWRI faculty and staff were awarded over $1,000,000 in grants and contracts in 2006.
- AWRI faculty and staff made over 90 public presentations in 2006.
- Almost 100 events were held at the Lake Michigan Center in 2006, including a visit from foreign correspondents working at the U.S. State Department, several public meetings on behalf of Congressman Pete Hoekstra, and a sustainability workshop.
- AWRI faculty members were once again asked to provide expert testimony in environmental matters before state and federal legislators, and served on numerous local, state, and federal scientific committees and panels.

Images from AWRI's 20th Anniversary event on September 6, 2006









continued from front cover

There are also a number of critical issues facing the Great Lakes that blend environmental integrity and economic science, such as lake levels, invasive species, and eco-recreation; having in-house expertise in environmental economics would allow us to pursue these projects.

I feel privileged to oversee an organization at this juncture in its history. The goals and accomplishments during the Institute's first 20 years have created an entity that is ready and able to embrace the opportunities and the challenges that lay ahead.

From where we've been…

Donald J. Angus donated his 50-foot diesel-powered boat, the *Angus*, to the college.

With four of the five Great Lakes touching its borders and 36,000 miles of streams, 11,000 inland lakes, and vast underground aquifers, Michigan can lay claim to being a very water-rich state.

Fifty years ago, no one fully appreciated or understood the significance of a ready and abundant supply of freshwater. Yet in the last 30 or 40 years, more individuals are realizing how much our planet and its people depend on this natural resource. We are becoming more aware of how our actions can impact and alter delicately balanced ecosystems, and we are awakening to the fact that in order to protect and preserve this vital resource, we must learn and do more.

This past year, the Robert B. Annis Water Resources Institute celebrated its 20th anniversary. In this issue of Year in Review, we'll briefly take a look at how its origins have charted a course that has changed how we understand, perceive and handle information about our freshwater resources. [For a more complete and detailed account of the Institute's history, please read "Dedicated to Our Aquatic Resources," a History of the Robert B. Annis Water Resources Institute by Gordon L. Olson. Contact the Institute at (616) 331-3749 for a copy.]

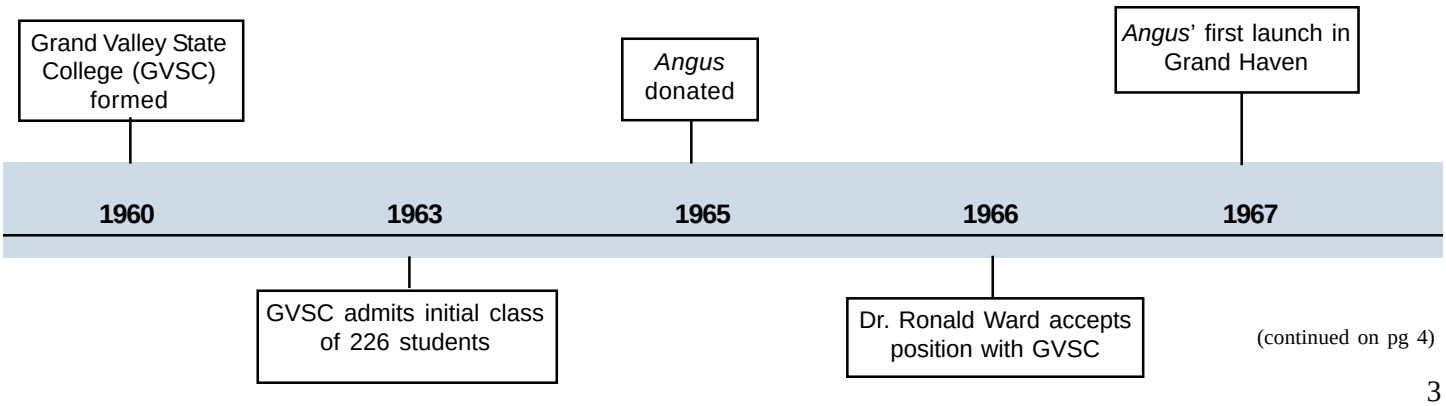
An idea germinates

In the early 1960s, Grand Valley State College emerged as the first public, four-year institution of higher education in lower West Michigan north of Kalamazoo. Its president, Dr. James Zumberge, recognized that the college's close proximity to bodies of water, such as the Grand River and Lake Michigan, could help define its mission.When Indianapolis businessman Donald J. Angus offered to donate his 50-foot diesel-powered boat, the *Angus*, to the college, Zumberge recognized that the gift was a tangible way to implement the college's broader vision by utilizing the vessel to develop an aquatic research and education program. He accepted the gift on behalf of the college, and the search for a director began.

In 1966, Grand Valley's Biology Department advertised a faculty position that would include responsibilities for managing a teaching vessel program. Dr. Ron Ward, a graduate of Johns Hopkins University with significant experience in aquatic research, was offered and accepted the position.

Early on, Dr. Ward recognized the exciting possibilities that lay ahead. He immediately set into motion plans for not only launching the 25-year-old vessel, but also initiating a vision that would guide the Institute to where it is today. With the help of Don Lautenbach and a modest National Science Foundation grant, the rejuvenated *Angus* set off from its port in Grand Haven in the spring of 1967. Its maiden voyage as a teaching and research vessel was the first of many to come.

(continued on page 4)



(continued on pg 4)

D. J. Angus and *W. G. Jackson* at Government Basin in Grand Haven, Michigan

A floating classroom and laboratory

Although Grand Valley was small with a student body under 1,000 at the time, the acquisition of the *Angus* meant the school could offer its students a unique experience — hands-on education on board a floating classroom. Undergraduate and master-level education students were the first to use the boat's modest technology to collect, study, and observe aquatic life. The Biology Department expanded its course offerings to include terrestrial ecology, aquatic ecology, and animal behavior classes. Faculty and students used the *Angus*, captained by Leonard Lamb who was a part of the program from 1968 until his death in 1997, to collect samples and conduct experiments.

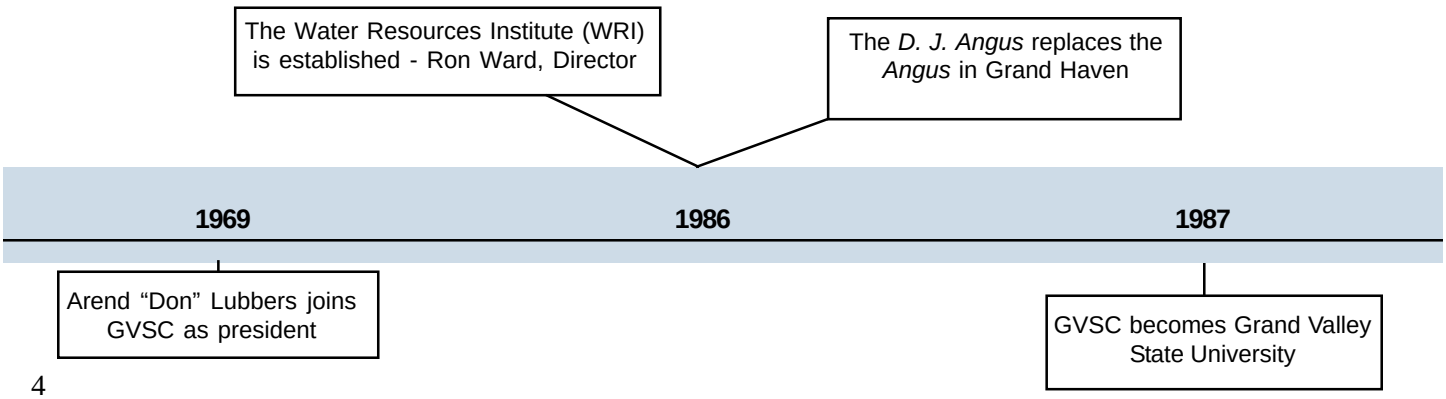
The list of participants increased even more when Gus Unseld III, a workshop attendee and later a long-time instructor in the program, suggested that the learning excursions would appeal to area high schools. When the country turned its attention to saving the environment in the 70s, the vessel program became even more popular. Teachers from all grade levels were interested in offering their students a once-in-a-lifetime experience on board a research vessel, knowing that the hands-on lessons could make a lasting impression.

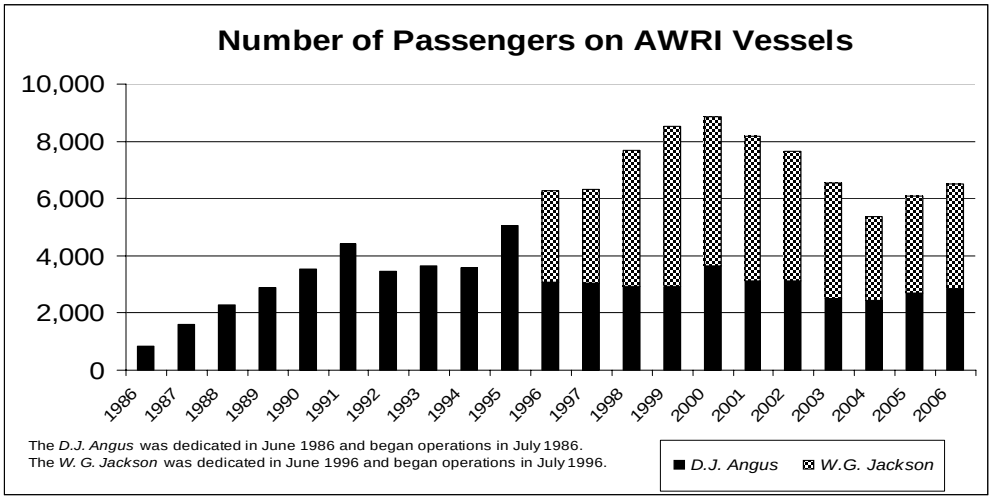
When it was clear the aging *Angus* could not keep up with increasing demand, plans were made to provide a replacement vessel. Those plans became reality, and the *D.J. Angus* was launched in 1986. The 45-foot-long boat, outfitted with sophisticated laboratory equipment, increased the program's capabilities and further cemented its future.

Ten years later, the Institute launched yet another vessel, the *W.G. Jackson*, named in honor of long-time supporter Dr. William G. Jackson. With even more equipment and on-board living facilities, the *W.G. Jackson* offered a greater range for scientific research and educational outreach. Capable of traveling to ports of call throughout Lake Michigan, the *W. G. Jackson* has enabled the Institute to conduct valuable research within the Great Lakes and bring its message of stewardship to thousands of participants each year.

The vessel program, part of the education and outreach initiative, has been a huge success. Since 1986, over 100,000 students and adults have taken trips on the *D.J. Angus* and the *W.G. Jackson*. (Refer to chart on page 5). Currently, approximately 6,000 passengers each year climb on board to learn about our aquatic resources. The "Making Lake Michigan Great" tour, funded by the U.S. Environmental Protection Agency, allows the *W.G. Jackson* to visit ports of call throughout Lake Michigan. This program has not only allowed scientists to conduct essential research on the aquatic environment, it also has helped reach out to the general public and to young people who will one day be responsible for our environment's care.

(continued on page 5)





Seizing an opportunity

For nearly 20 years Grand Valley's Biology Department ran a successful and growing research and education vessel program under the direction of Dr. Ward. The program could have continued in this way for many years to come, but in the early 1980s, Dr. P. Douglas Kindschi, Dean of the Division of Science and Mathematics, saw an opportunity for the school to pursue a targeted niche in aquatic science.

With Dr. Ward's program and the water-related research conducted by faculty members, he believed Grand Valley was in a good position to establish an aquatic research institute. With the support of Grand Valley's president Arend D. Lubbers, he appointed a 20-member faculty task force to investigate this option.

In its extensive report to the Board of Control in 1985, the group proposed that Grand Valley initiate the Water Resources Institute "dedicated to the protection, development and improvement of our aquatic resources." In May 1986 the Board voted unanimously to approve the proposal, naming Dr. Ward as the Institute's first director.

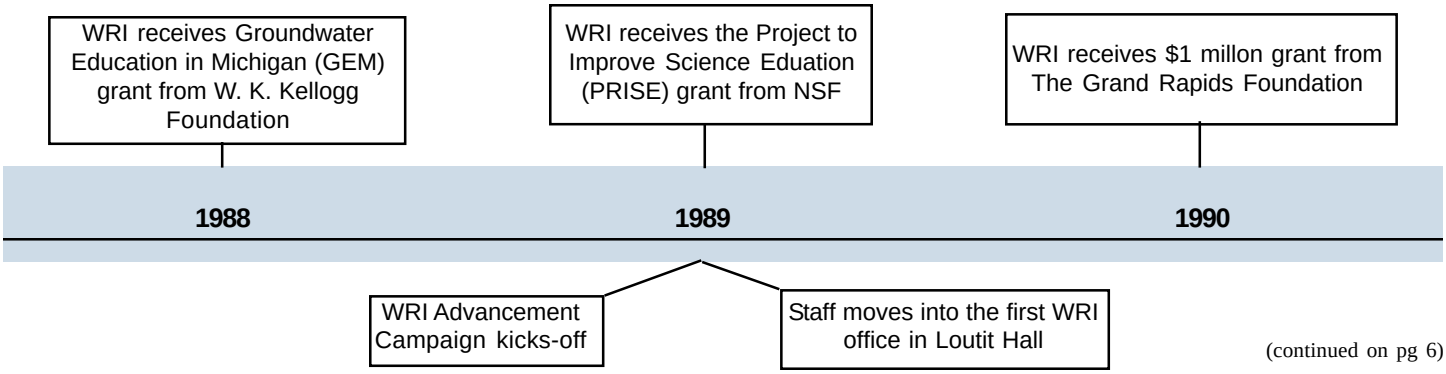
Supporting the vision

Since day one, the Institute has focused its energy, resources, and talent on pursuing scientific excellence and disseminating important findings to the community where true change can take place.

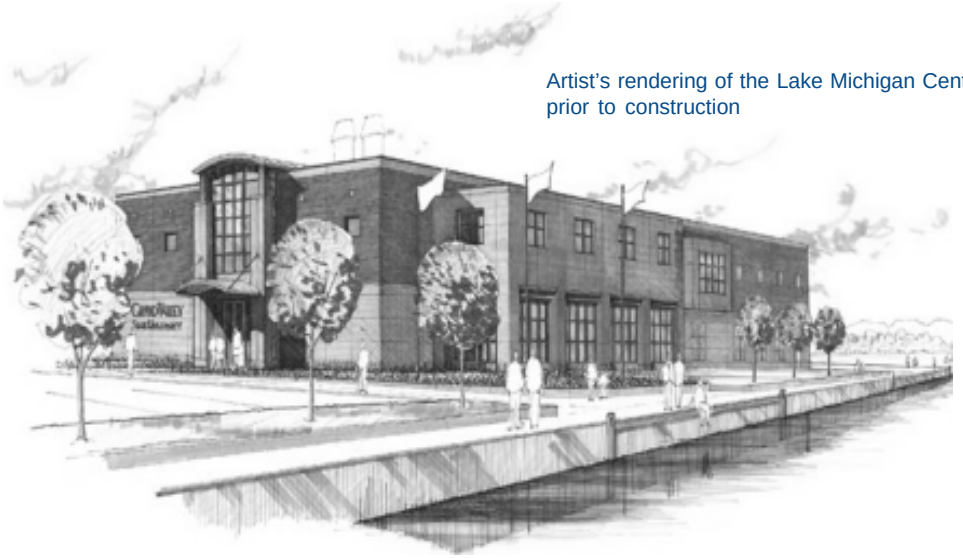
Funding to fuel such an ambitious vision is the heartbeat of any organization, and the search for financial

(continued on page 6)

Top: Donald J. Angus, Middle: Robert B. Annis, Bottom: Kathleen and William G. Jackson



(continued on pg 6)



Artist's rendering of the Lake Michigan Center prior to construction

support began early for the young Institute. Major funding helped jumpstart growth at the Institute.

In 1988 the W.K. Kellogg Foundation awarded the Institute a $580,680 Groundwater Education in Michigan grant, designating Grand Valley as one of six groundwater education regional centers in the state and allowing the Institute to hire additional staff.

Since then, the Institute has continued to receive support necessary to fund research projects and ensure continued development of the Institute itself. The external dollars, as well as the number of awards, received by Institute faculty and staff continues to increase.

Support from the community has also been there at crucial times in the Institute's history. At the start of its Advancement Campaign in 1989, the Institute received a $1 million grant from the Grand Rapids Foundation to help fund the Grand River Watershed Project. The D. J. Angus Endowment Fund, established to support operation of the research vessel, approached $1 million by the mid-1990s. Gifts from the community helped the "Making Waves In Michigan" campaign successfully reach its $1.6 million goal in 1995. Most recently, a $5 million campaign helped give the Institute a permanent home at the Lake Michigan Center in Muskegon.

All these gifts — whether small or large, from public organizations, foundations, or interested members of the community — have enabled the Institute to pursue with passion and perseverance its mission of integrating research, education, and outreach to enhance and preserve our freshwater resources. Through this kind of support, the Institute is fulfilling its mission.

Science that doesn't sit on the shelf

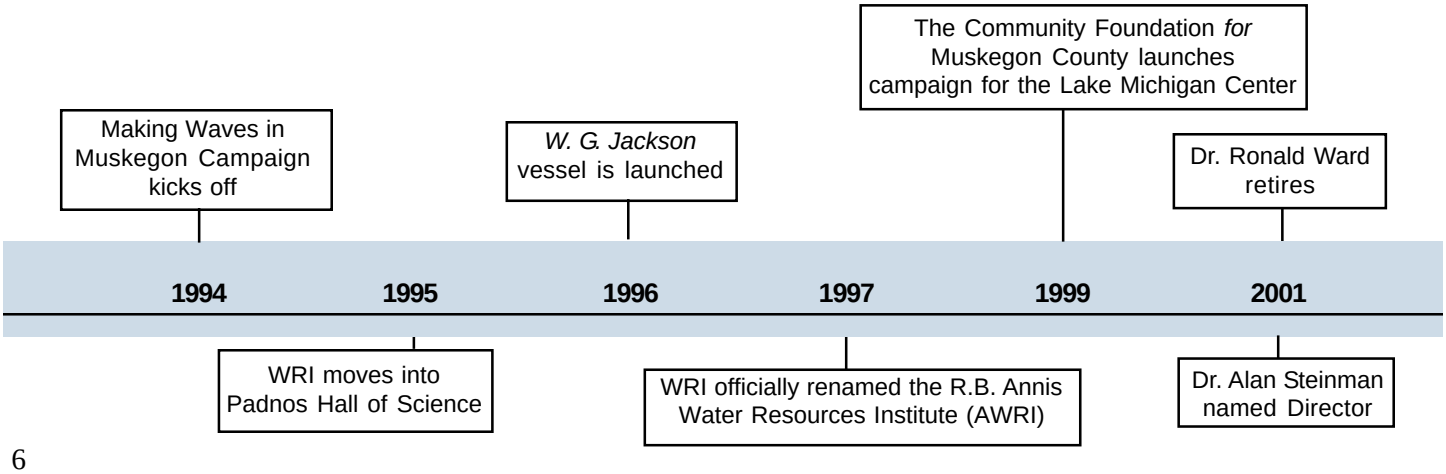
Scientific research is a critical step in any effort to assess and change how we interact with our environment, but the Institute has always supported the belief that science should not sit on the shelf. What scientists learn about our environment has to be understood by those who need to use it. Research findings should be disseminated in understandable language, and tools developed for using the data, if the science is to have a demonstrable impact in society.

Early on, members of the Institute's task force understood this need and created the Information Services Center (ISC), headed by John Koches, the Institute's first full-time staff member. John is still with the Institute today.

In a nutshell, the ISC collects and analyzes data from environmental research projects, condenses these data into interpretable information, and then provides the information to those who make decisions about managing our natural resources. The technology and tools it has developed over the years has helped decision makers in local businesses, industry, government, and community groups understand research findings and apply them in practical ways.

The Institute also has made sure that important research findings go beyond the walls of the laboratory through its Outreach and Education initiative, headed by Dr. Janet Vail. Thousands of students, teachers, decision makers, and concerned community members learn about our water resources through the vessel program and through the workshops conducted at the Lake Michigan

(continued on page 7)



Center. Targeted curriculum and technical reports have contributed immensely to young people's, and the general public's, understanding of our environment.

Research finds its way

When the Institute moved into its new quarters in the Padnos Hall of Science in 1995, for the first time it had the facilities to foster its vision - sufficient office space, ample room for its growing database, and well-equipped laboratory space. The Institute has always been grounded in rigorous scientific research, but with the Robert B. Annis Analytical Laboratories, headed by Dr. Rick Rediske, scientists were able to do more in the way of serious aquatic investigations and research.

Since 2001, the Institute has stepped up its pursuit of scientific research with greater financial, physical, and human resources. When Dr. Ward retired in 2001, closing out 35 years as head of the vessel program and the Water Resources Institute, the University hired Dr. Alan Steinman to serve as the next director. Four new principal investigator positions were added to the staff, allowing the Institute to broaden its research efforts. Drs. Donald Uzarski, Carl Ruetz, Bopaiah Biddanda, and Xuefeng (Michael) Chu joined Drs. Mark Luttenton, Rediske, and Steinman in conducting experiments in their particular areas of specialty.

What each one brings to the table in terms of background and expertise is invaluable. Together, their work gives us a broader understanding and knowledge of our environment and its water resources.

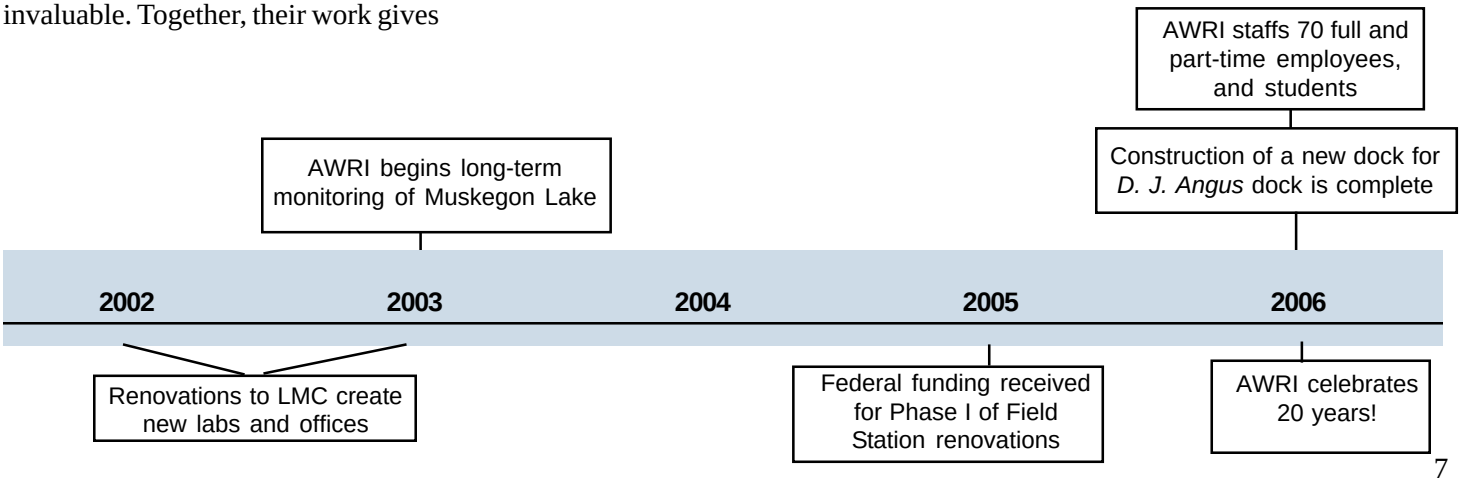
From here onward

In closing out its 20th year, the Institute has grown from only 1 staff member who served as part time director to 9 principal investigators, 24 full-time staff, and 31 support personnel. Through its newly instituted graduate degree program, approximately 14 master-level students contribute important support to research projects each year, and more than 423 undergraduate students throughout the years have provided invaluable assistance.

Faculty and staff continue to make strides in furthering the Institute's mission. This past year, the Institute was involved with more than 20 different projects with a total value of more than $2 million. While the number of in-house technical reports and products continues to remain strong, the number of articles in peer-reviewed publications has grown substantially in the last five years (see chart on page 11), furthering the Institute's reputation at the national and international levels.

Yet with all that has been accomplished in the last 20 years, one fact is certain. The work of the Institute is far from done. The need for our community and region to protect and preserve its precious water resources is still there. And as long as that need exists, the Institute, along with the dedication and support of all the people who stand behind it, will continue to do this work for the next 20 years and beyond.

Lake Michigan Center, home of the Annis Water Resources Institute



Thomas G. Sanders, Jr. on board the NOAA vessel R/V *Huron Explorer* getting a remotely operated vehicle (ROV) ready for underwater exploration of submerged sinkholes during an expedition in September 2006 in Lake Huron. He is a graduate student working with Dr. Bopi Biddanda to study food web linkages in these newly- discovered submerged sinkhole ecosystems.

AWRI Faculty and Staff Highlights for 2006

Ecological Research Group

Dr. Bopi Biddanda (biddandb@gvsu.edu)

- Explored submerged sinkhole ecosystems in Lake Huron. Published a paper in *Ecosystems* (2006), and obtained NSF funding (2006-08).
- Continued long-term collaborative work on pelagic metabolism in Lake Michigan using NOAA ship time, and studied the fate of land carbon in a West Michigan watershed. Results were presented at the annual meeting of the American Society of Limnology and Oceanography in June 2006.
- Conducted a preliminary inventory of contributions of nutrients and carbon from four major west Michigan rivers to Lake Michigan. Funded by Allen Hunting Internship.
- Completed fourth year of AWRI's long-term study of Muskegon Lake, and participated in the Muskegon River Watershed Non-Point Source pollution impact study.
- Member of AWRI Seminar Committee, and College of Liberal Arts and Sciences Staff Advisory Council. Supervisor of Water Quality Event, Regional Science Olympiad (3/06).
- Editorial board of *Journal of Plankton Research* and *Aquatic Microbial Ecology*.

Dr. Michael Chu (chux@gvsu.edu)

- Conducted hydrologic monitoring and modeling in the Mona Lake watershed and predicted nutrient loading to Mona Lake. Funded by MDEQ.
- Developed a metal-sediment transport model in a complex stream-wetland system and examined fate and transport of cadmium and sediments in Little Black Creek. Funded by U.S. EPA.
- Continued hydrologic modeling for the Tamarack Creek Watershed. Funded by MDEQ.
- Set up three monitoring sites and conducted hydrologic studies in Bear Creek. Funded by U.S. EPA.
- Upgraded the Windows-based hydrologic modeling software: HYDROL-INF.
- Member of EWRI Groundwater Management Committee, ASCE (American Society of Civil Engineers), and Hydrology & Watershed Management Committee, AWRA (American Water Resources Association)

Dr. Mark Luttenton (luttentm@gvsu.edu)

- Examined the impact of zebra mussels on aquatic invertebrates in the Muskegon River below Croton Pond.
- Continued biological monitoring and assessment of the Henry's Fork River, Idaho. Funded by Henry's Fork Foundation.
- Evaluated the use of mitochondrial DNA to identify hatchery strains of brown trout (collaboration with Dr. Alex Nikitin, GVSU).
- Continued nutrient loading study of White Lake. Funded by MDEQ.
- Appointed to the American Fisheries Society - Michigan Chapter, Rivers and Streams Advisory Committee.
- Member of GVSU's Graduate Council and Chair of Graduate Council Policy Subcommittee

Dr. Rick Rediske (redisker@gvsu.edu)

- Analyzed 200 samples from 7 west Michigan lakes for cyanobacteria toxins, phytoplankton species composition, nutrients, and chlorophyll. Funded by MDEQ.
- Obtained a cooperative grant to work with the Great Lakes Environmental Research Laboratory and conduct an investigation of factors that influence microcystin production in Lake Erie and Saginaw Bay. Funded by NOAA.
- Obtained grants to assess the accumulation of Polybrominated Diphenyl Ethers and PCBs in fish from multiple trophic levels in Michigan and survey the benthic communities in the Muskegon Lake Area of Concern. Funded by MDEQ.
- Analyzed over 1,100 water samples for *E. coli* as part of Great Lakes beach monitoring programs for the Muskegon County and District 10 (Oceana, Mason, and Manistee Counties) Health Departments.

• Member of the Michigan Environmental Monitoring Review Board, the Federal Detection and Quantitation Limit Advisory Committee, the GVSU Safety Committee, chairman of the Allendale Township Planning Commission.

Dr. Carl Ruetz (ruetzc@gvsu.edu)

• Continued long-term monitoring of fish populations in Muskegon Lake. Funded by Muskegon Lake Research Fund.

• Examined distribution of round gobies in coastal habitats of Great Lakes (collaboration with Dr. Uzarski). Funded by MDEQ.

• Evaluated the use of internal tags for tracking movements of round gobies shallow-water habitats. Funded by the Michigan Space Grant Consortium.

• Worked to set delisting targets for fish habitat and population beneficial use impairments for Muskegon and White lake AOCs. Funded by GLNPO and National Fish & Wildlife Foundation.

• Monitored fish populations in Lake Okeechobee, Florida. Funded by South Florida Water Management District (subcontract from Malcolm Pirnie, Inc.).

Dr. Alan Steinman (steinmaa@gvsu.edu)

• 10 new grants funded as PI or co-PI (~$620,000); 7 continuing grants as PI or co-PI (~$841,000).

• 7 peer-reviewed articles or book chapters published or in press.

• 15 Presentations (4 Technical, 11 Community Service).

• Member of MI Groundwater Conservation Advisory Council and MDEQ's Phosphorus Advisory Committee.

• Co-Editor of *Journal of the North American Benthological Society.*

• Member of Stormwater Exploratory Team for Water Environment Research Foundation.

• Invited testimony to U.S. House of Representatives Subcommittee on Environment, Technology, and Standards.

• Steering committee member for Workshop on Pathogens in Michigan's water.

• Elected to Muskegon Rotary Board of Directors and Land Conservancy of West Michigan.

• Education Division Co-Chair for United Way of Muskegon 2006-2007 Campaign.

Dr. Don Uzarski (uzarskid@gvsu.edu)

• Submitted more than 10 manuscripts to peer-reviewed journals in 2006 (Dr. Uzarski and students).

• Gave 16 presentations at national and international conferences in 2006 (Dr. Uzarski and students).

• Provided invited expert testimony to the Michigan State Senate Committee on Natural Resources and Environmental Affairs and Michigan State House Committee on Natural Resources, Great Lakes, Land Use and Environment at several Joint Committee Meetings.

• Delivered the plenary lecture at the Association of State Wetland Managers (ASWM) International Symposium 'Wetlands 2006: Applying Scientific, Legal, and Management Tools for the Great Lakes and Beyond'. Traverse City, Michigan August 28-31.

• Served on the Project Management Team (PMT) of the Great Lakes Coastal Wetlands Consortium made up of 150 Great Lakes scientists, managers, and NGOs.

• Named Co-Chair of the Great Lakes Coastal Wetland Consortium Science Committee.

• Authored U.S. EPA State of the Lakes Ecosystem Conference (SOLEC) Great Lakes Indicator reports on (1) Coastal Wetland Fish Community Health and (2) Coastal Wetland Invertebrate Community Health.

• Member of Association of State Wetland Managers (ASWM) Regional Advisory Committee and the MDEQ Michigan Wetland Rapid Assessment Development Committee.

• Member GVSU's Research Integrity Task Force and College of Liberal Arts and Sciences Faculty Development Committee.

Information Services Center (ISC)

John Koches (kochesj@gvsu.edu) and ISC Staff

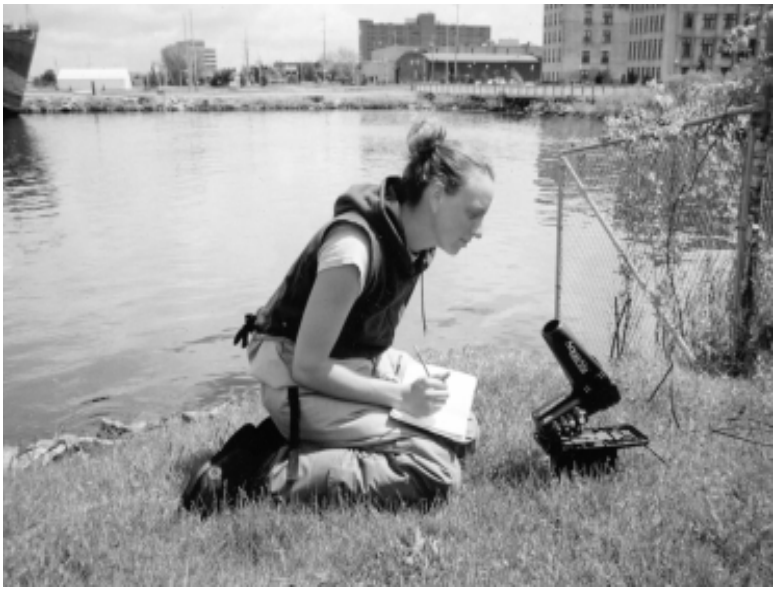
• Constructed a stormwater bioretention (rain garden) BMP at the City of Walker Library for the Sand Creek CMI Project. Funded by MDEQ/EPA.

• Completed work with the MDNR on a Forest Stewardship Grant. ISC and project partners were able to begin work with nine non-industrial private forestland owners within our two pilot Townships of Vergennes in Kent County and Lee in Allegan. Funded by USDA Forest Service.

• Completed work on a set of maps for the West Michigan Trails and Greenways Coalition for their Capital Campaign. Funded by WMTGC.

• Completed work on a set of maps for Timberland RC&D for their Stream Care project. Funded by TRC&D.

• Began compilation of land use and cover inventory and



Herbert VanderMey Intern, Melissa Reneski, studying round gobies with an underwater observation system.

hydrologic analysis for Bear Lake Watershed Project. Funded by EPA.

• Began to link GIS analysis for 7 county region of the West Michigan Strategic Alliance as part of their Economic Valuation of Ecosystems Project. Funded by Land Policy Institute, MSU.

• Assisted in the development of Environmental Indicators for the West Michigan Strategic Alliance Regional Indicators Project. Funded by The Grand Rapids Community Foundation, Steelcase Foundation, and others.

• Completed the Muskegon Area Sustainability Project with assistance from the Kellogg Foundation and the Land Policy Institute, MSU.

• Continued investigation of hydrology condition of Upper Tamarack Creek (Muskegon River Watershed). Funded by MDEQ/EPA.

• Continued work on the Muskegon River Watershed Transition Grant to implement BMPs, including installation of a rain garden at McBain School and the purchase of conservation easements in farmlands. Funded by MDEQ/EPA and the Wege Foundation.

• Continued work on the Muskegon River Watershed Education Project to create a Social Profile for one subwatershed, and continued work with four townships in this critical area to review and revise existing master plans and zoning ordinances. Funded by MDEQ, the Wege Foundation, and the Muskegon River Watershed Assembly Board.

Outreach and Education Initiatives

Janet Vail (vailj@gvsu.edu) and Science Instructors

• Provided educational opportunities for over 6,500 people on the *D.J. Angus* and the *W.G. Jackson* research and education vessels.

• Presented educational cruises and teacher workshops in Chicago, IL for Shedd Aquarium, Hammond, IN for the Indiana Department of Environmental Management, Burns Harbor, IN for the Indiana Dunes National Lakeshore, and White Lake as part of the Making Lake Michigan Great Tour of the *W.G. Jackson*. Funded by the U.S. EPA Great Lakes National Program Office.

• Provided a special series of educational cruises for the general public on the *D.J. Angus*. Funded by the Grand Haven Area Community Foundation through its Youth Advisory Council and the Robert B. and Muriel R. Mersereau Fund.

• Facilitated activities for over 700 students and others in the LMC's Education Classroom. Supported by the R.B. Annis Educational Foundation Outreach Program Endowment and the Michigan Space Grant Consortium.

• Hosted ten Michigan Environmental Education Curriculum Support (MEECS) workshops at the Lake Michigan Center in cooperation with the Muskegon Area Intermediate School District Regional Mathematics & Science Center.

• Facilitated eight MEECS Air Quality workshops and presented at the EPA National Air Quality Conference in San Antonio, TX.

• Conducted educator training at venues such as the Global Change Workshop at Michigan Tech, the Michigan Alliance for Environmental and Outdoor Education conference, Michigan Department of Natural Resources workshop, and the Michigan Science Teachers Association conference.

Dr. Richard Rediske accepts a SOLEC award for GVSU AWRI for exceptional performance and dedication to the Ruddiman Creek Great Lakes Legacy Act Sediment Remediation Project. Photo by Gale Nobes.

• Partnered with GVSU Regional Math & Science Center for GLOBE and MEECS workshops.

• Helped facilitate Michigan Project WET water festivals, and trained new facilitators for Michigan Project WET. Funded by Nestle Waters and Project WET, USA.

• Obtained funding from MDEQ for the Chemical Management in Schools project.

• Organized the Annual Hazardous Waste Management Workshop in partnership with MDEQ and the West Michigan Chapter of the Air & Waste Management Association (A&WMA).

• Co-chair of the U.S. EPA Lake Michigan Forum, Board of Directors of the Michigan Alliance for Outdoor and Environmental Education, Air & Waste Management Association West Michigan Chapter, and Great Lakes Association of Science Ships. Member of GVSU Grant Leadership Advisory Team, and Center for Excellence in Science and Mathematics Education and the Regional Math and Science Center advisory boards (Dr. Vail).

Peer - Reviewed Publications (AWRI staff in bold)

Biddanda, B.A., D.F. Colemen, T.H. Johengen, S.A. Ruberg, G.A. Meadows, H.W. VanSumeren, **R.R. Rediske** and **S.T. Kendall**. 2006. Exploration of a submerged sinkhole ecosystem in Lake Huron. *Ecosystems* 9:828-842.

Biddanda, B.A. 2006. Respiration in aquatic ecosystems (Book Review). *Journal of Plankton Research* 28:113-114.

Chu, X. and M.A. Marino. 2006. Improved compartmental modeling and application to three-phase contaminant transport in unsaturated porous media. *ASCE Journal of Environmental Engineering* 132:211-219.

Chu, X. and M.A. Marino. In press. IPTM-CS: A Windows-based integrated pesticide transport model for a canopy-soil system. *Environmental Modeling & Software*.

Chu, X. and M.A. Marino. In press. Simulation of infiltration and surface runoff - a Windows-based hydrologic modeling system HYDROL-INF, 2006 May 21-25; Omaha NE. *ASCE 2006 World Environmental and Water Resources Congress Proceedings*.

Luttenton, M. and C. Baisden. 2006. The relationship among disturbance, substratum size and periphyton community structure. *Hydrobiologia* 561:111-117.

Luttenton, M., S. Hendricks, and S.W. Hunt. 2006. Benthic diatom species list and environmental conditions in the Little River basin, western Kentucky, USA. *Journal of the Kentucky Academy of Science* 67:22-38.

Madenjian, C.P., D.V. O'Connor, S.A. Pothoven, P.J. Schneeberger, **R.R. Rediske, J.P. O'Keefe**, R.A. Bergstedt, R.L. Argyle, and S.B. Brandt. 2006. Evaluation of a lake whitefish bioenergetics model. *Transactions of the American Fisheries Society* 135:61-75.

Carter G.S., T.F. Nalepa and **R.R. Rediske.** 2006. Status and trends of benthic populations in a coastal drowned river mouth lake of Lake Michigan. *Journal of Great Lakes Research* 32:578-595.

Isely, E., C. Griffin, and **R. Rediske**. In press. Michigan's Natural Rivers Act: conflict and coordination in multi-jurisdictional natural resource management. *Society & Natural Resources* 20:85-92.

Pothoven, S.A., T.F. Nalepa, C.P. Madenjian, **R.R. Rediske**, P.J. Schneeberger, and J.X. He. 2006. Energy density of lake whitefish *Coregonus clupeaformis* in Lakes Huron and Michigan. *Environmental Biology of Fishes* 76:151-158.

Breen, M.J. and **C.R. Ruetz III.** 2006. Gear bias in fyke netting: evaluating soak time, fish density, and predators. *North American Journal of Fisheries Management* 26:32-41.

Ruetz, C.R., III, M.J. Breen, and **D.L. VanHaitsma.** 2006. Habitat structure and fish predation: effects on invertebrate colonization and breakdown of stream leaf packs. *Freshwater Biology* 51:797-806.

Ruetz, C.R., III, D.G. Uzarski, D.M. Krueger, and E.S. Rutherford. In press. Sampling a littoral fish assemblage: comparing small-mesh fyke netting and boat electrofishing. *North American Journal of Fisheries Management.*

Ruetz, C.R., III, B.M. Earl, and S.L. Kohler. 2006. Evaluating passive integrated transponder tags for marking mottled sculpins: effects on growth and mortality. *Transactions of the American Fisheries Society* 135:1456-1461.

Hong, Y., A.D. Steinman, B.A. Biddanda, R.R. Rediske, and G. Fahnenstiel. 2006. Occurrence of the toxin-producing cyanobacterium *Cylindrospermopsis raciborskii* in Mona and Muskegon Lakes, Michigan. *Journal of Great Lakes Research* 32: 645-652.

Steinman, A.D. and P.J. Mulholland. 2006. Phosphorus limitation, uptake, and turnover in benthic stream algae. Pages 187-212. In: *Methods of Stream Ecology* (Eds. Hauer, F. R. and G. A. Lamberti). Academic Press, New York.

Steinman, A.D., G.A. Lamberti, and P. Leavitt. 2006. Biomass and pigments of benthic algae. Pages 357-379. In: *Methods of Stream Ecology* (Eds. Hauer, F.R. and G.A. Lamberti). Academic Press, New York.

Steinman, A.D. and **M.E. Ogdahl**. 2006. Environmental conditions. *Water Resources IMPACT* 8:39-40.

Steinman, A.D., R.R. Rediske, X. Chu, R. Denning, L. Nemeth, D.G. Uzarski, B.A. Biddanda, and **M. Luttenton.** 2006. An environmental assessment of an impacted, urbanized watershed: the Mona Lake Watershed, Michigan. *Archiv fuer Hydrobiologie* 166:117-144.

Steinman, A.D., R.R. Rediske, E. Nemeth, and **L. Nemeth**. 2006. Factors influencing internal P loading in a western Michigan, drowned river-mouth lake. *Journal of the North American Benthological Society* 25:304-312.

Pietro, K.C., M.J. Chimney, and **A.D. Steinman**. 2006. Phosphorus uptake by the *Ceratophyllum*/periphyton complex in a south Florida freshwater marsh. *Ecological Engineering* 27:290-300.

Cooper, M.J., D.G. Uzarski, T.M. Burton, and **R.R. Rediske**. 2006. Macroinvertebrate community composition relative to chemical/physical variables, land use and cover, and vegetation types within a Lake Michigan drowned river mouth wetland. *Aquatic Ecosystems Health and Management* 9:463-479.

Gyekis, K.F., M.J. Cooper, and **D.G. Uzarski**. 2006. A new high-intensity LED light source for larval fish and aquatic invertebrate floating quatrefoil light traps. *Journal of Freshwater Ecology* 21:621-626.

Technical Reports & Manuals 2006

Denning, R. L. 2006. Mona Lake Watershed Resource Atlas, Version 2. MR-2006-1.

Denning, R. L. 2006. FLESA project atlas Vergennes Township. MR-2006-5.

Denning, R. L. 2006. FLESA project atlas Lee Township. MR-2006-6.

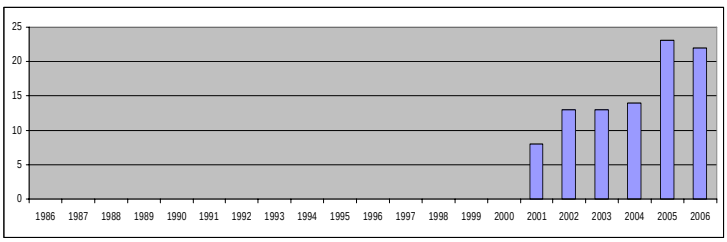
Hanson, B. S. 2006. A Mona Lake Watershed road/stream crossing inventory report. MR-2006-3.

Koches, J. K. , J. Conzelmann, R. L. Denning, B. S. Hanson, K. J. Thompson, M. VanPortfliet, and M. Lelli. 2006 Population Allocation Model User's Manual. MR-2006-2.

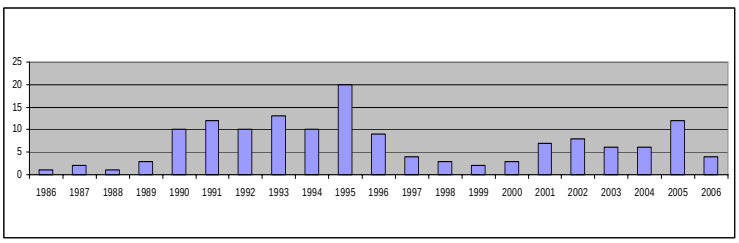
Koches, J. K. 2006. A sustainability strategy for the city of Muskegon and its urban areas. MR-2006-4.

Ogdahl, M.E., A. D. Steinman, K. Thompson, and D.G. Uzarski. 2006. A Methodology for Assessing Erosion Control Best Management Practice (BMP) Effectiveness. TM-2006-4.

Number of AWRI Peer-reviewed Publications



Number of AWRI Technical Reports/Map Atlases



2006 AWRI Staff

Director:
Alan Steinman

Staff/Administrative:
Tonya Cnossen, AWRI Assistant
Heidi Feldpausch, Office Coordinator
Roxana Taylor, Secretary
Macy Al-Shatel, Temporary Part-time Clerical

Information Services Center:
John Koches, Associate Professor (Land Use Change; Watershed Management)
Jean Conzelmann, Research Assistant
Nichol De Mol, Research Assistant
Rod Denning, Research Associate
Betty Gajewski, Technical Call-in
Brian Hanson, Research Assistant
Michelle Lelli, Technical Call-in
Lea Markowski, Volunteer
Beth Osterink, Volunteer
Kurt Thompson, Research Associate
Matt VanPortfliet, Technical Call-in

Outreach & Education:
Janet Vail, Associate Professor (Outreach & Education)
Paula Capizzi, Science Instructor
Bonnie Cowles, Science Instructor
Leslie De Vries, Science Instructor
Candi Goldman, Science Instructor
John Gort, Science Instructor
James Muller, Science Instructor
Roger Tharp, Science Instructor
Chuck Vanderlaan, Science Instructor

GVSU Vessels/Field Station Operations:
Anthony Fiore, Jr., Fleet Captain
Ronald Brown, Captain WGJ
Dan Czinder, Deckhand WGJ
William Frost, Deckhand DJA
Roger Hillstead, Maintenance
Dan McCormick, Captain DJA
Brad Nieboer, Marine Electrician
Robert Pennell, Deckhand DJA
Jim Rahe, Deckhand WGJ
Michael Sanders, Technical Call-in
Jim Winks, Captain and Deckhand

Ecological Research, Environmental Chemistry:
Richard Rediske, Professor (Environmental Toxicology & Chemistry)
Macy Al-Shatel, Technical Call-in
Jen Gradisher, Technical Call-in
Ying Hong, Adjunct Research Assistant
Allyson Karaba, Technical Call-in
Brent Kasza, Volunteer
Michelle Lelli, Technical Call-in
Jim O'Keefe, Research Associate
Kate Rieger, Technical Call-in
Brian Scull, Adjunct Research Assistant
Gail Smythe, Technical Call-in
Anthony Straley, Technical Call-in

Ecological Research, Environmental Biology:
Bopaiah Biddanda, Assistant Professor (Microbial Ecology)
Scott Kendall, Technical Call-in
Xuefeng (Michael) Chu, Assistant Professor (Hydrologic & Environmental Modeling)
Mark Luttenton, Associate Professor of Biology (Aquatic Ecology)
Carl Ruetz III, Assistant Professor (Fisheries Ecology & Management)
Kristin Nelson, Technical Call-in
Melissa Reneski, Technical Call-in
Alan Steinman, Professor (Aquatic Ecology)
Pete Hrodey, Adjunct Research Assistant
Elaine Sterrett Isely, Adjunct Research Associate
Scott Kendall, Technical Call-in
Lori Nemeth, Research Assistant
Mary Ogdahl, Research Assistant
Kelly Wessell, Post-Doctoral Research Associate
Don Uzarski, Assistant Professor (Wetland, Stream & Lake Ecology)
Adam Bosch, Technical Call-in
Matt Cooper, Adjunct Research Assistant
Aaron Parker, Technical Call-in

Graduate Students:
Matt Breen, AWRI Assistantship
Melissa Conte
Jennifer Cymbola, AWRI Assistantship
Keto Gyekis, AWRI Assistantship
Janel Hager, AWRI Assistantship
Kenneth Royce Hughes, AWRI Assistantship
Stephanie Januchowski
Jennifer Jermalowicz-Jones
Kristin Nelson, AWRI Assistantship
Aaron Parker, AWRI Assistantship
Thomas G. Sanders Jr., NSF Assistantship
Michael Shoemaker, AWRI Assistantship
Nancy Taylor
Allison Trumble Altman

Undergraduate Student Assistants:
Megan Cookingham
Jonathan Ginka
Michelle Lelli
Michael Rediske
Matt VanPortfliet
Alex Wieten

AWRI Science Advisory Board:
Stephen Brandt, NOAA-GLERL
Carol Johnston, South Dakota State University
Gary Lamberti, University of Notre Dame
Peter Meier, University of Michigan (emeritus)
Don Scavia, University of Michigan, MI Sea Grant

AWRI provides opportunities for students to pursue their interests in our environment. The following students received internships during 2006:

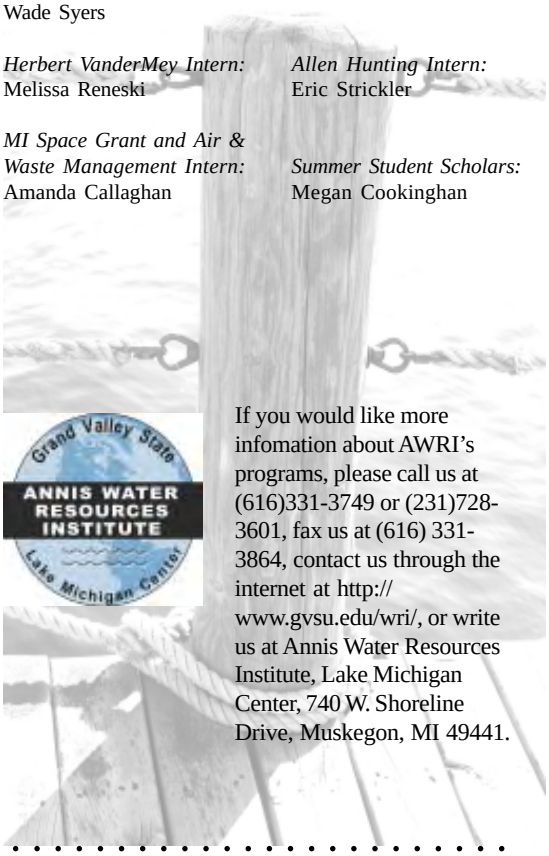
D. J. Angus-Scientech Educational Foundation Interns:
Rob Recknagel
Betsy Schafer
Wade Syers

Herbert VanderMey Intern:
Melissa Reneski

Allen Hunting Intern:
Eric Strickler

MI Space Grant and Air & Waste Management Intern:
Amanda Callaghan

Summer Student Scholars:
Megan Cookinghan



If you would like more infomation about AWRI's programs, please call us at (616)331-3749 or (231)728-3601, fax us at (616) 331-3864, contact us through the internet at http://www.gvsu.edu/wri/, or write us at Annis Water Resources Institute, Lake Michigan Center, 740 W. Shoreline Drive, Muskegon, MI 49441.

GRAND VALLEY STATE UNIVERSITY

Non Profit Org
U.S. Postage
PAID
Grand Valley
State University

R. B. Annis Water Resources Institute
Lake Michigan Center
740 West Shoreline Drive
Muskegon MI 49441

ADDRESS SERVICE REQUESTED