

NRRI NOW

A publication of the Natural Resources Research Institute
Spring 1992



Expansion brings
NRRI Wood Products Pilot Plant
to the forefront of new
technology

NRRI NOW

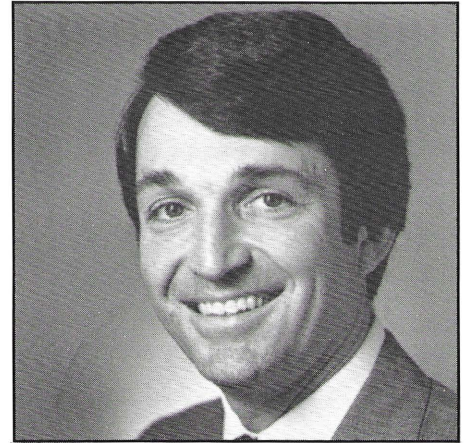
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NRRI moves forward on regional initiatives

By Michael J. Lalich
Director



The past several months, to say the least, has been an extremely challenging period for NRRI and its employees. Now that Governor Carlson and the State Legislature have restored NRRI's State Special operating funds, however, the Institute is again positioned to concentrate all its efforts on moving forward.

The NRRI staff is buoyed by the tremendous outpouring of community, legislative and University support on behalf of the Institute. It has been particularly gratifying to witness the keen interest and excitement of the many visitors who learn about NRRI programs and projects by reading about or touring the Institute. To all of our friends, thank you.

At the same time, I would be remiss not to express my deep appreciation to NRRI employees for pulling together as a supportive team and maintaining a positive environment under difficult circumstances.

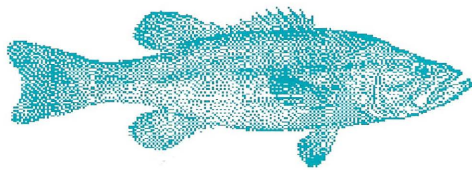
In retrospect, with all the recent attention on funding problems, Institute project and program development initiatives emerged relatively unscathed. The \$2.5 million Phase V building initiative, which will provide badly needed office and laboratory space to accommodate NRRI growth, was not one of the bonding projects held up by Governor Carlson and consequently is very close to being on schedule. With the planning effort well in hand, construction should begin later this year and be completed in mid-year 1993.

Recently NRRI was one of several collaborators with the Blandin Foundation to sponsor and participate in a regional Economic Leadership Conference Series involving over 70 business and community leaders. The region's strengths, weaknesses and opportunities were evaluated, eight economic development strategy areas were targeted and task forces were established to develop the strategies. NRRI is postured to

play a leading role in at least four of these strategy areas: mining, forest products, the Global Freshwater Capital initiative and entrepreneurial development.

In mining, NRRI's Coleraine Minerals Research Laboratory will be invaluable in attaining the principal goal of insuring the future health of the taconite industry in the face of increased competitive and economic threats. In the forest products area, a secondary network of value-added producers is steadily being encouraged by NRRI and will be supported by the composite wood pilot and wood prototype facilities at the Institute. Regarding efforts to make Duluth a Global Freshwater Capital, research by NRRI, the U. S. Environmental Protection Agency and proposed University Institute for Lake Superior Research can be coupled with the Lake Superior Center effort and private sector

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lakes & aquaculture

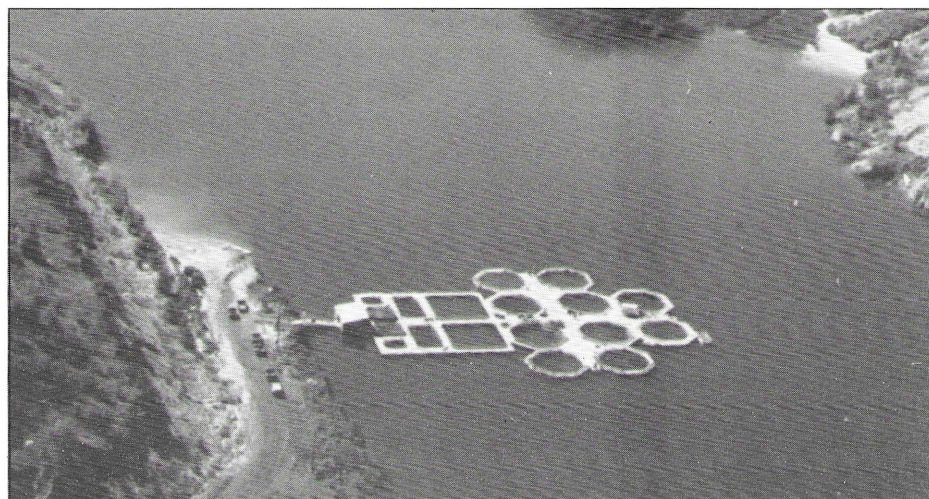
NRRI research represents a balanced approach

Mine pit

Iron mine pits abandoned decades ago have filled to become nearly 200 lakes used for recreation and drinking water in northeastern Minnesota. Since 1988, two such lakes near Chisholm have accommodated the fish production activities of Minnesota Aquafarms, Inc. As several other companies have expressed similar interests, controversy over how mine pit lakes should be used has become a familiar news topic.

Potential impacts of aquaculture on current and future beneficial uses of mine pit lakes, as well as its effect on the regional groundwater aquifer are areas of public concern. Critical questions include: How can aquaculture loads be predicted? What are the potential impacts of aquaculture on mine pit lakes? And simply, what are the basic characteristics of these bodies of water?

Since 1989, NRRI scientists have been working to provide answers to these and other water quality questions as part of a limnological assessment of mine pit lakes funded by Minnesota Technology Inc. and the Iron Range Resources and

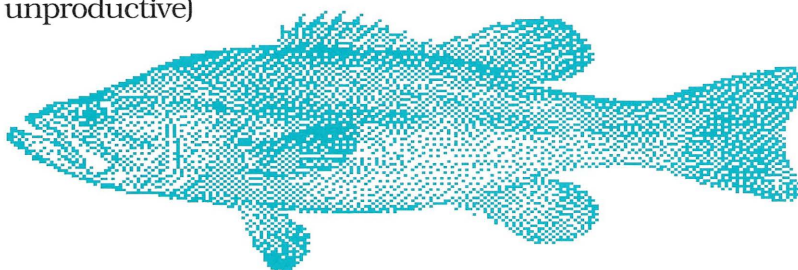


An aerial view of Minnesota Aquafarms' net pen aquaculture operation on Twin Cities South Lake near Chisholm, 1988.

Rehabilitation Board (IRRRB). A draft report was recently released by Rich Axler, Mike McDonald, Chris Larsen, Craig Tikkanen and George Host.

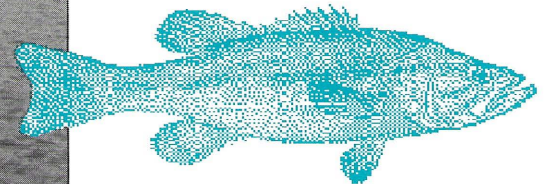
due to low phosphorous concentrations. Intensive aquaculture has increased nutrient and algae levels, greatly reduced

The group found that the mine pit lakes near Chisholm are typically oligotrophic (i.e., unproductive)

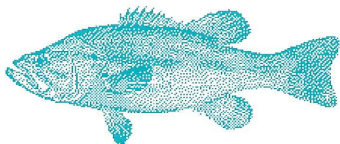




Aquatic scientist Craig Tikkanen measures dissolved oxygen and temperature while recording the data to make a profile of the water column. Mine pit lakes such as this one, Sherman Lake, have a depth of 20-100 meters with just 5° Celsius as the average year-round temperature beneath the warmer surface layer.



oxygen in the water column and increased the rate of organic matter accumulation on the bottom.



Minnesota Aquafarms, Inc. aerates their lakes to provide oxygen to the fish; the resulting circulation reduces algal

growth and prevents blooms of scum-forming algae.

According to Axler, “Although lakes with aquaculture have clearly shifted to a more eutrophic state, our data do not suggest a threat to public health or long-term impairment should fish farming be stopped. We have seen no effects on nearby Fraser Lake, the source of Chisholm’s drinking water.” He added that since groundwater movements are extremely complex and poorly

understood, the group has argued the need for a comprehensive hydrogeologic study of the regional aquifer.

The study also evaluated water quality models and developed models for predicting potential aquaculture impacts. Another model was developed to estimate the nutrient loads and oxygen demand from an intensive aquaculture operation. This model will be useful to fish producers,

See [Aquaculture](#), page 13

Wood Products Pilot Plant expands

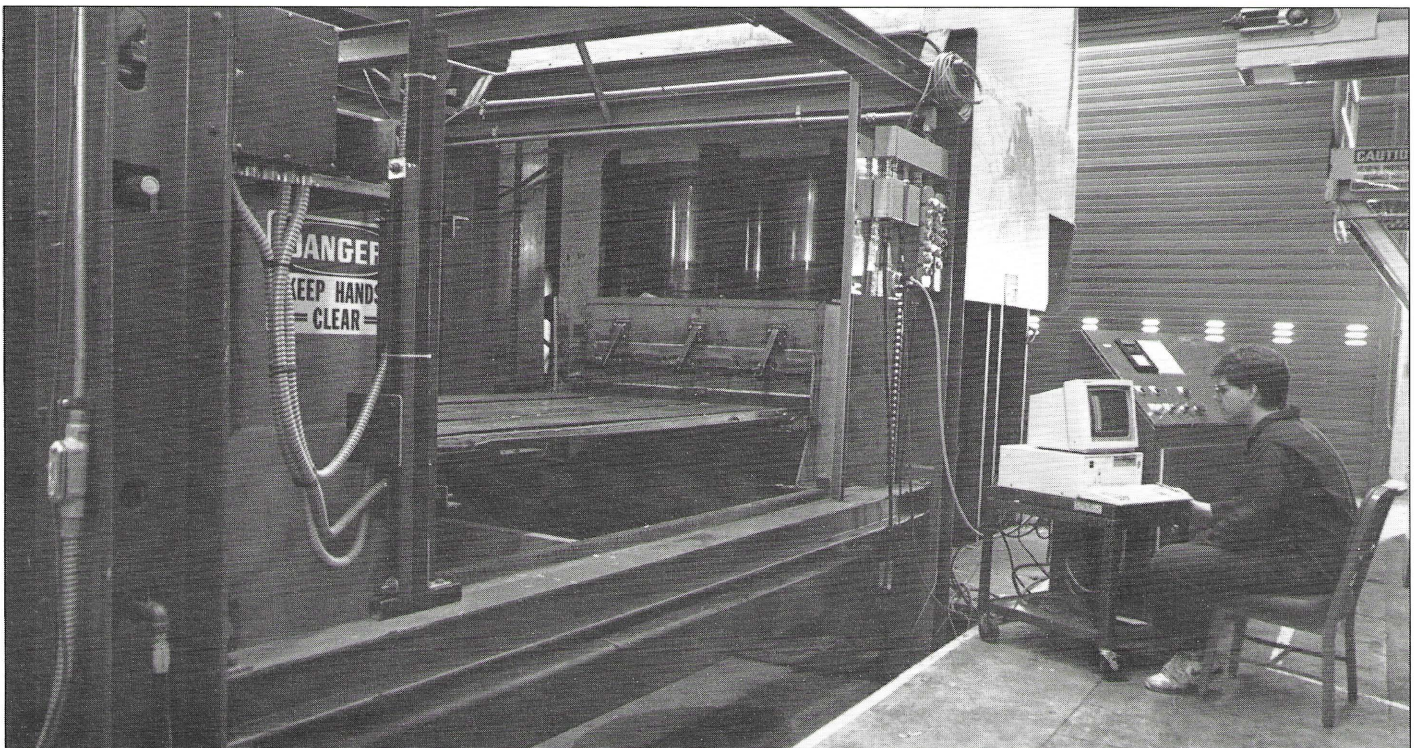
New technology steams pilot plant into position for the future

As one of only three research and development facilities with a full scale computer-controlled steam injection press and the only one publicly available, NRRI's Wood Products Pilot Plant is at the forefront of new technology for the creation of composite wood products such as parallel strand lumber, a thicker version of oriented strandboard (OSB).

The steam injection technique of pressing wood strands into board is successful because the rapid transfer of heat to the center allows thick products to be manufactured

economically. While conventional methods produce one-inch thick boards, steam injection composite products can be pressed faster, in thicknesses of up to five inches. This new technology requires greater control of pressing parameters such as time, pressure and length of steam injection. "Only one other research and development facility in North America has this capability," noted Chris Edwardson, senior scientist in charge of the pilot plant.

New equipment combined with the plant's waferizing, drying, blending and



NRRI's computer controlled steam injection press is the only full-scale facility of its kind in North America available for public use. Services provided by the BioProducts Division enable wood products companies to test new processes and products used in the manufacture of oriented strandboard, from raw logs to the finished product. Assistant scientist Brian Brashaw operates the controls.

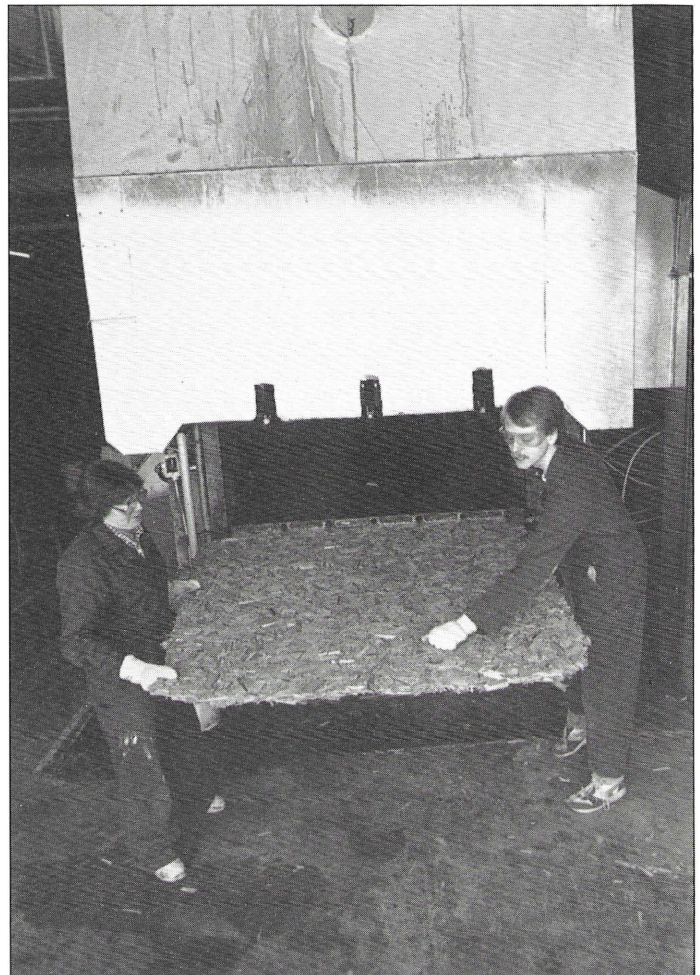
orienting capabilities means that all phases from raw logs to finished oriented strandboard can be manufactured continuously in the pilot plant. "Our pilot plant gives us the ability to replicate industry conditions to manufacture full size, 4 by 8 foot oriented strandboard for field testing, making prototypes or even supplying customers with products not readily available," said Edwardson.

Current projects include adhesive testing for performance, blender studies (conditions affecting board properties), and strand geometry studies (how size/length affect board properties). Future studies may include wood species studies, manipulation of pressing schedules by modifications to length of time, temperature and pressure required for making OSB and potential introduction of preservative/fire retardant chemicals into the process.

"One of our key operating strategies has been to fill a niche between the lab bench and industry," said BioProducts director Roy Adams. "Our pilot facility is crucial to help us do this in the wood products area."

Minnesota is the number one oriented strandboard producer because its plentiful aspen supply makes an ideal wood for the process. Aspen also lends itself to a new composite wood product, parallel strand lumber. For these reasons, Trus Joist MacMillan has located a plant in Minnesota to manufacture the new type of lumber. "Our new technology enables us to produce parallel strand lumber, which uses a longer length of strand than OSB," said Edwardson. "We already have a cooperative project with Trus Joist MacMillan and look forward to continuing our relationship."

NRRI's Wood Products Pilot Plant has been used by other large companies such as U. S. Borax, Minnesota Power, Dyno Overlays and Potlatch. Smaller firms such as American Furniture Craftsmen and World Power, Inc. are benefiting from the pilot plant's flexibility, too.



Scientist Ken Roos checks a test run of oriented strandboard with senior lab technician Michelle O'Neil.

"We've worked with members of the wood products industry in Minnesota from large OSB plants to much smaller manufacturers who have specific engineered product needs," said Edwardson. "Our new facilities put us in a position to provide services aimed at continued growth of the wood products industry."

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Machine Shop News

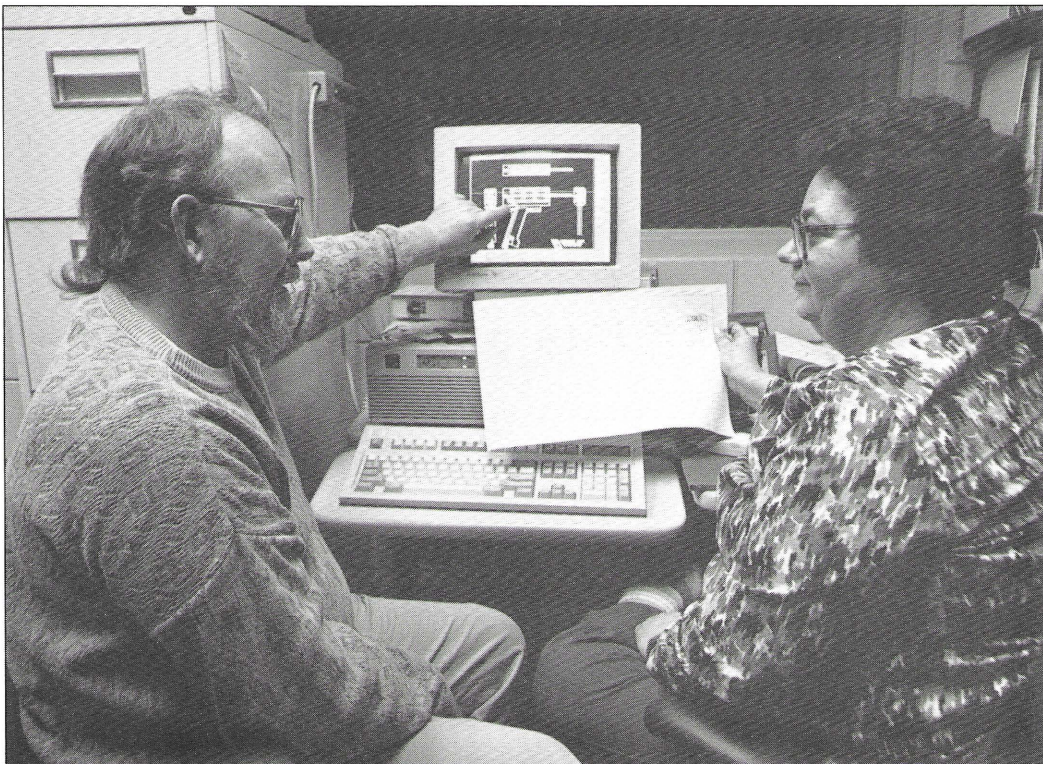
From machining prototypes of cryogenic surgical tools to computer-aided designs of kitchen utensils, the NRRI Machine Shop helps people bring their ideas to the marketplace.

“I believe that Minnesota’s most abundant and underdeveloped resource is people and their ideas for new products,” says machine shop foreman Gene Betts. “We help with processes from designing products for safety or manufacturability to fabricating prototypes.”

Archie Hamilton of ACH Project Management Team developed a new surgical device sponsored by a grant from the National Institutes of Health. “The NRRI Machine Shop saved me time and money so I could stay within my budget,” said Hamilton. “Sometimes with a prototype you need to make changes and head in a different direction.”

Machinist Dave Anderson’s versatility in working with different materials helped Hamilton’s project stay under budget. “Dave’s skills in working with materials from stainless steel to silicon rubber allowed us to create a part for the surgical tool for about \$250; low bid from a job shop was over \$3,000. Since this part was only used once due to modifications, the savings was considerable,” said Betts.

Donna Heise generates computer drawings for the shop using Autocad 386, Autosolid, Autofast and Autoanimator to design



From computer-aided design to prototype model creation, the NRRI Machine Shop helps products get to market. Gene Betts and Donna Heise design three-dimensional models before parts are machined.

and assemble models in three-dimension, knowing that parts will fit before they are machined. Computer design allows flexibility to react immediately to changes.

Janet Webber is a registered nurse who came to NRRI with an idea for a health care aid to specifically and accurately measure the size of a wound. "I knew there was definitely a market for my product, but I wasn't sure what to do next," said Webber. "With Donna Heise's help, my product went from a handmade idea to a complete design. Now, I'm looking for the proper materials so I can get quotes from manufacturers for my product."

Another local inventor came up with an idea for a new kitchen tool. With Heise's help, his product has been designed and is now ready for the bidding process.

To distinguish the NRRI Machine Shop from commercial service providers, Betts explained, "Our design capability allows us to look at a project differently than a regular job shop. We are an information resource to people from product and patent searches to checking product safety regulations. We deal not only with drawings and prototypes but also with concepts recorded only in the brains of clients. When a project reaches the production stage, we refer the client to a commercial shop."

The Machine Shop keeps grinding away at the challenge of creating new products. "Our specialty is really at digging out answers. If we don't know the answer, we'll find someone who does," said Betts.

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Peat products update

With two new loose-filled peat products, one for absorbing oil on land and one for water, the Peat group is now working to help ensure continued marketability of the new products by making improvements.

"Customer feedback indicated both products were well received, with one complication," said Tim Hagen, engineer for the peat group. "Dustiness was a major factor in consumer dissatisfaction."

Other oil sorbent products on the market had quality control problems, which included excessive dustiness due to particle size. Cooperative research between NRRI and Mat, Inc. produced a formula which reduced the problem while maintaining quality control of particles. The product is being market tested by consumers to assess strengths and weaknesses.

"The Peat Group's function has expanded from pure research to applied research for existing companies to make better products," said peat program director Tom Malterer. "With our technical assistance, a new advanced formula has just been released."

Currently the group is also working on the development of prototype mats made of natural wood fibers in addition to peat to maximize oil sorbent quality. The pads, for use on land or water, are being cooperatively manufactured by Mat, Inc. and the Duluth Lighthouse for the Blind. As an organic product, disposal is possible by incineration or burning with other fuels.

"Our cooperative research with Mat, Inc. is an on-going relationship, which will not only benefit the company but ultimately the consumer," said Malterer.

NR I

Marketing Training Program achieves high ratings from participants



Joan Burke, Joan Burke Realty

"From the positive comments we received it is apparent that the Marketing Training Program fulfills an important need for its northeastern Minnesota participants and has a real impact on the way they think about marketing. We're looking forward to continuing this strong program and responding to the changing needs of entrepreneurs."

According to the evaluation report, participants were enthusiastic about the impact of the program in their business lives. Some 27 communities were represented among participants, who judged all areas of the program to be 'quite useful' or 'very useful.' Those implementing their marketing plan totalled 81 percent.

A high percentage of participants expressed an interest in participating again or recommending the program to others, and 41 percent received additional help from the Center for Economic Development. Many desired an extended marketing program, and some even formed a marketing club.

The Marketing Training Program will continue in 1992 with financial support from IRRRB and next will be offered in Grand Marais Mar. 23 - May 11. For more information about future opportunities to apply and participate, call UMD's Center for Economic Development, 218/ 726-7298.

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The UMD Center for Economic Development Marketing Training Program has been offered since Spring 1989 in targeted locations throughout the seven-county northeastern Minnesota region. Recently, evaluations by participants were compiled in a report that summarized the value of the program from its inception through Spring 1991. Six, eight-week, four-hour sessions plus six-month follow-ups were implemented during that time with the assistance of the Blandin Foundation and logistic support of the Arrowhead Community College Region. Participants developed a marketing strategy in a highly interactive setting with 10 team participants and an instructor.

Lee Jensen, director of the NRRI Business Group, summarized the program evaluation.

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environmental industries to constitute a significant economic impact for the region. To promote entrepreneurial development, NRRI continues to offer technical assistance, funding support through its idea evaluation program sponsored by Minnesota Technology, Inc., and entrepreneurial training and business planning assistance through the Center for Economic Development.

There will be challenges as we attempt to assist our region in moving ahead with these strategies. Some of these challenges will relate directly to obtaining necessary funding to move forward with these initiatives in the face of projected across the board budget cuts that will be imposed on state programs in order to balance the state's budget. I'm confident, however, that well-planned programs, coupled with creative proposals and prudent cooperative use of resources, will allow NRRI to play a leading role in implementing the objectives of these strategies.

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Taconite forecast

Political, industry, research and economic development leaders assembled at NRRI last month upon request of U.S. Congressman James Oberstar to assess how the Minnesota taconite industry can respond to future demands of steel producers for lower cost, higher quality pellets and also higher valued products such as DRI or hot briquetted iron, iron carbide or pig iron.

In order for Minnesota companies to supply these products, continued efforts to reduce silica content as well as new technology developments are necessary. Advancements would require additional federal funding and a dedicated research and development facility.

Scientists and engineers at NRRI's Coleraine Minerals Research Laboratory (CMRL) already have a record of successfully assisting Minnesota taconite pellet producers in their efforts to reduce silica content, improve quality and lower production costs.

According to NRRI Center for Applied Research and Technology Development director Thys Johnson, "Efforts to lower cost and improve pellet quality will continue into the 90s. Because direct steel making is almost a certainty in the future for integrated steel producers and the demand for DRI will apparently increase, we must make certain Minnesota ore products are compatible with and competitive for the new technology of steelmaking."

Economical lower silica concentrates are a prerequisite for direct steelmaking and are also needed if Minnesota ores are to qualify for manufacturing direct reduced iron or "pig iron" used by mini-mills.

The group meets again in Eveleth this month to develop formal proposals.

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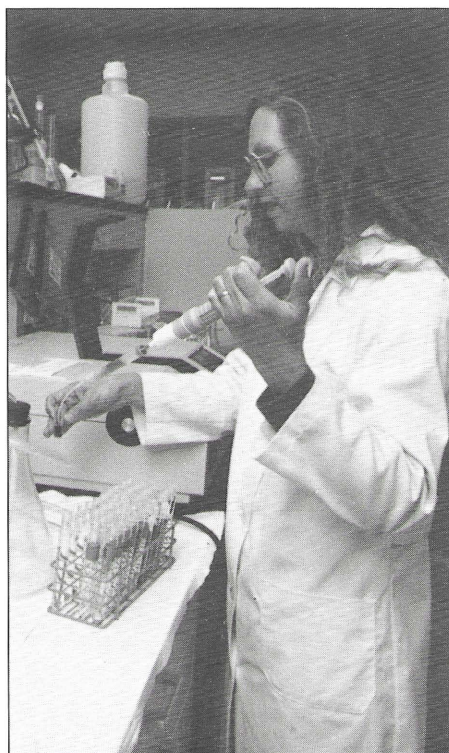
From lake to lab

New grants for Lake Superior research

In addition to ongoing studies of Lake Superior, several new projects which focus on water quality and the Great Lakes are currently underway by scientists at NRRI's Center for Water and the Environment and other groups.

The U.S. EPA recently funded a \$23,000 project in which acute toxicity values are being calculated for various chemicals in fresh and salt water ecosystems. While state agencies often lack sufficient data to calculate final acute toxicity values, study results indicate that many advisory concentrations used in the Lake Superior area exceed the intended level of protection by one to several orders of magnitude. These results will influence future policy for defining advisory acute toxicity values. NRRI's George Host and Ron Regal (UMD) are principal investigators with Charles Stephan (EPA).

A \$159,000 grant from the U.S. EPA is funding a toxicological assessment of freshwater sediments and associated water. Possible consequences of sediment contamination are the incidence of tumors in fish and



As one of many water quality testing procedures, senior laboratory technician Connie Host pipettes water samples for spectrophotometry analysis to determine the concentration of dissolved phosphorous in lake water.

deformities in birds in certain regions of the Great Lakes, but the link between sediment contamination and higher organisms is tenuous at best. This study will supply to regulatory agencies needed information about the transport of contaminants so that wise decisions can be made regarding the costly process of sediment clean-up. Keith Lodge is principal investigator with research collaborators Sarah Kohlbry, also from NRRI, and Phil Cook (EPA).

In another project funded by \$140,000 from the U.S. EPA, NRRI scientists are determining the effectiveness

of using tree swallows as wildlife sentinel species for detecting areas of high or low sediment contamination. Along with other organisms, tree swallow eggs have been gathered from Michigan study sites and are being analyzed at the EPA laboratory in Duluth. A wildlife data base will be established to enable modeling of environmental contaminant effects. NRRI's Gerald Niemi, Michael McDonald (UMD) and Donald Beaver (Michigan State University) are working on the project with Bob Hunter of NRRI.

Scientists are developing standard methods for the creation of biocriteria in Upper

Midwest stream watersheds through a \$248,000 grant from the U.S. EPA. The project uses novel combinations of Geographic Information Systems technology and conventional assessments of stream communities to examine potential ways in which *biocriteria* can be related to land use characteristics of watersheds. Biocriteria use natural communities such as fish, invertebrates and algae to indicate the relative health of a stream. Field data from 47 streams have been collected by EPA personnel and are being analyzed at NRRI. Carl Richards, George Host and Lucinda Johnson are principal investigators with research collaborators Jane Keyport, Frank Kutka and Jim Westman.

A two-year \$207,000 grant from the U.S. EPA funds a study of the mechanisms which generate ammonia toxicity, a problem in many contaminated sediments. While it is known that ammonia toxicity adversely affects fish and fauna, and bacteria play a major role in causing ammonia to become toxic, the question remains whether excess ammonia production is due to the effect of added toxins or naturally occurring eutrophication. NRRI's Joseph Schubauer-Berigan is the principal investigator working with Gerald Ankley from the Environmental Research Lab in Duluth.

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Aquaculture, from page 5

resource managers and regulatory managers in selecting sites, setting production goals and estimating water quality changes from either net pen or land-based aquaculture.

Use of the Minnesota Aquafarms site led to more than a little public confusion over NRRI's role, according to Center for Water and the Environment director Gerald Niemi.

"Our scientists worked to learn more about the resource and the effects of aquaculture activity, not specifically to promote the private company's activities," said Niemi. "NRRI's role is to provide public decision makers, private regulatory agencies and

industries with data required to make well-informed choices." As impartial, scientific advisors, Axler, Tikkanen and McDonald participated in two groups that will help form aquaculture regulations, the Aquaculture Discharge Permitting Workgroup and the Aquaculture Rules Advisory Group.

NRRI scientists continue to monitor Chisholm area mine pit lakes and will expand sampling. Models will be refined to better understand short term versus potential long term impacts due to intensive aquaculture. Questions will be addressed regarding post-aquaculture lake recovery and likely benefits of treatment technologies.

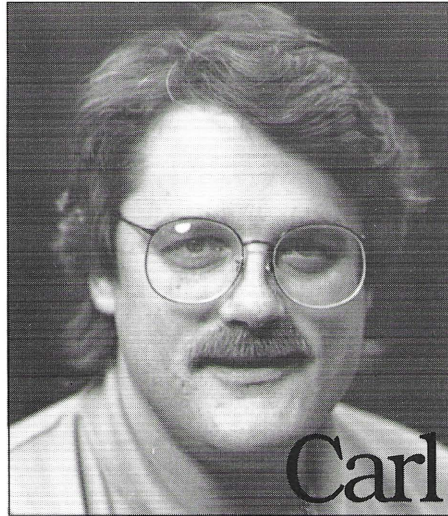
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Sediment samples are scooped up from the bottom of lakes using an Ekman dredge. The material is divided and placed into plastic tubes, kept cool as the mine pit waters and returned to the laboratory for analysis.



Employee Profile:

NRRI research associate Carl Richards is an aquatic ecologist.



Carl Richards

Carl Richards' profession leads him to study water in many different locations, contributing his experience to a wide range of aquatic studies.

He completed his undergraduate work at the University of Southern Mississippi, earned an M.S. degree in biology at California State University, Los Angeles and Ph.D. in aquatic ecology at Idaho State University. He served as fisheries director for the Shoshone-Bannock tribe and as visiting assistant professor at Idaho State University, then joined NRRI in 1989.

Now as a research associate, Richards' studies take him across Minnesota and the Great Lakes Region as he

works to correct and prevent impaired water quality.

Currently a principal investigator for a three-year study of the Great Lakes watershed, Richards is developing biological indicators required for use by the nation's Clean Water Act. Lucinda Johnson, George Host, Jane Keyport, Frank Kutka and Jim Westman are also contributing to the research. Standardized methods of water quality assessment for use by resource managers will result from this project funded by a \$248,000 grant from the U.S. EPA.

"Although regional watersheds differ, the methods we identify and develop need to be designed for use anywhere," said Richards. "As a result, the state's and the region's

resource managers can identify healthy biological communities, and restoration efforts can be applied effectively."

And there are local sites to consider. Richards is surveying Miller Creek to define the creek's pollution problems and options for mitigation; analyzing the fish community in an effluent mixing zone of the Western Lake Superior Sanitation District's sewage treatment plant; and surveying fish populations in the Cloquet River to help the Fond du Lac tribe develop a long term monitoring program. Frank Kutka and Paul Tucker are research collaborators.

While urban development affects water quality nearby, the scenario may be different

in other parts of the state. Problems caused primarily by agricultural runoff have led Richards to study the Minnesota River. Supported by a \$35,000 grant from the state's Legislative Commission on Minnesota Resources, he is developing biological indicators, identifying problems and presenting solutions with the help of research collaborators Frank

Kutka and Chris Owen.

With previous experience as a fishery director, of course Richards' repertoire includes aquaculture. He just finished a two-year project sponsored by Minnesota Technology Inc. to raise walleye fry to fingerling size in man-made, drainable ponds. Working with Philip DeVore and the White Earth Tribe, overall production

results were "at or about our expectations," Richards said.

Now with research collaborators Michael McDonald, Jeff Gunderson, Frank Kutka and Philip DeVore, Richards is completing a feasibility study for crayfish production in Minnesota wild rice paddies -- another unique aquatic environment among all those Richards makes it his business to know.

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"The state's and the region's resource managers can identify healthy biological communities, and restoration efforts can be applied effectively."



Since types of aquatic life give one indication of water quality, Richards' field work includes collecting samples for identification. Here he scrapes algae and diatoms from a tile placed at a site in the Minnesota River.

Project Highlights

- The National Science Foundation has just awarded a three-year \$660,000 grant to continue the "Landscape Engineering by Beavers" project in the Center for Water and the Environment (CWE).

- The U. S. EPA Laboratory awarded a two-year \$207,000 grant to CWE to study the mechanisms generating ammonia toxicity in contaminated sediments.

- The Legislative Commission on Minnesota Resources (LCMR) funded two cooperative studies between CWE and the Minnesota Department of Natural Resources: "The Quantitative

Description of Minnesota Old Growth Forests" for \$150,000 and "Effects of Changes in Forest Ecosystems on the Biodiversity of Minnesota's Northern Forest Birds" for \$300,000 with a non-state match of \$200,000.

- NRRI's BioProducts division was awarded \$10,000 by U. S. Borax for development of chemical treatments for wood composites.

- BioProducts is installing prototype flooring at NRRI as part of Minnesota Technology Inc.'s fabricated hardwood flooring project. The material is being tested in room 227, the library and the lab.

- Trus Joist MacMillan awarded BioProducts with \$20,000 for development of truck flooring.

- The first full-scale commercial column flotation unit on the Mesabi Range will be installed at Minntac as a result of testing at NRRI's Coleraine Minerals Research Laboratory (CMRL).

- Through dry cobbing developments at CMRL, a local business increased by 100 percent its production of previously wasted iron units into two saleable products.

NRRI NOW

The Natural Resources Research Institute was established by the Minnesota Legislature in 1983 to foster economic development of Minnesota's natural resources in an environmentally sound manner to promote private sector employment.

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NRRI Now is published quarterly to provide information about programs and projects at the Institute. For information about the Institute, call 218/720-4294.

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