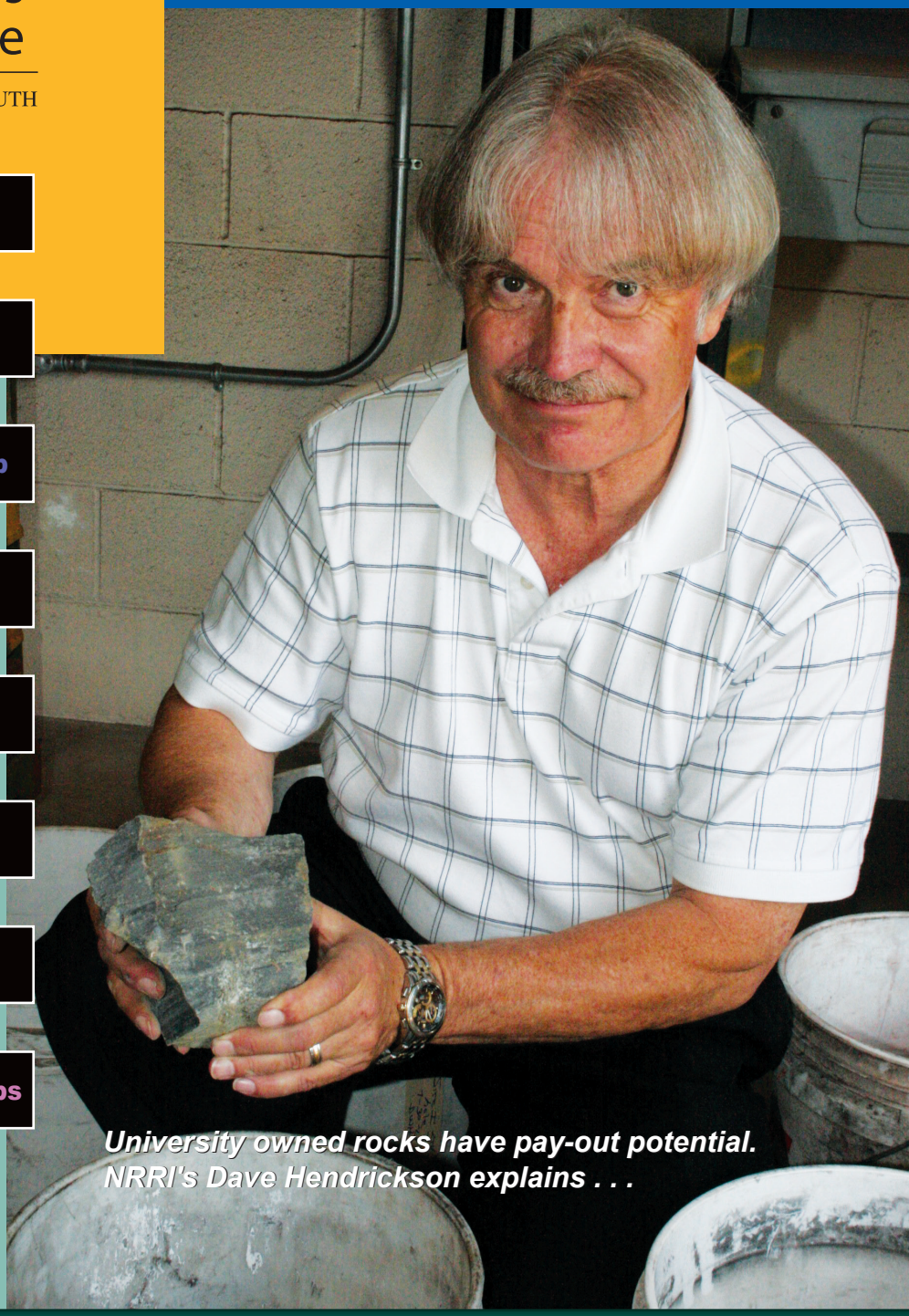
NRRI *Now*

Autumn 2013

Natural Resources Research Institute

University of Minnesota Duluth

Driven to Discover

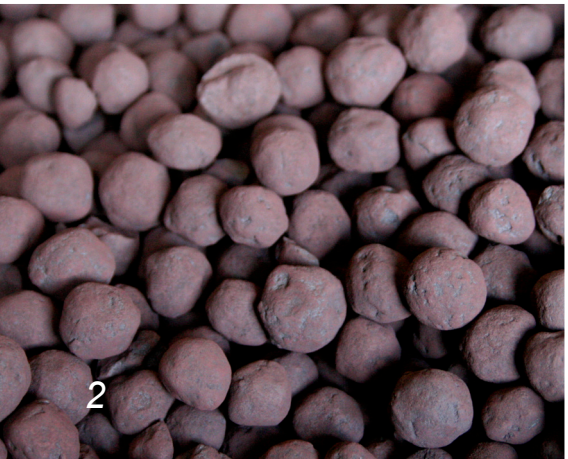


University owned rocks have pay-out potential. NRRI's Dave Hendrickson explains . . .

~Growing Strong Industries
~Developing New Ideas
~Nurturing Natural Resources

Getting more from the ore

University owned stockpiles have pay-out potential



Iron ore – a finite resource no matter how you slice it – is hard to call sustainable. But there are ways to use Minnesota's mineral resources in the most efficient way possible. One obvious way is to make sure all value is taken from ore already mined. NRRI has developed a plan to do that with lean ore stockpiles owned by the University of Minnesota on the Mesabi Iron Range.

"As higher grades of iron ore were mined in the early days, the lower grade ore was put aside in stockpiles," explained Dave Hendrickson, NRRI director of strategic development. "That lower grade ore, or lean ore, has the same iron content as what is being mined today to produce taconite pellets, and it's already been blasted and stockpiled. It's ready for further processing."

The University owns stockpiled ore on the western side of the Range near Nashwauk (mostly hematite) and stockpiled ore on the eastern edge near Hoyt Lakes (mostly magnetite). With some careful research, Hendrickson found that the University owns a total of approximately 100 million tons of stockpiled lean ore. With the right logistics, the ore could potentially make 25 million tons of taconite pellets.

To understand how this extensive resource came to be owned by the University, we have to go back to 1862. It was the year President Abraham Lincoln passed the Morrill Act, establishing federal funding for higher education in every state in the country with a focus on applied research and skills for the growing nation. The University of Minnesota was given parcels of land that would provide a source of ongoing revenue.

"As these parcels are mined, the university receives royalties which are put into the Permanent University Trust Fund," Hendrickson explained. "It has been a tremendous funding source for endowed professor chair positions, scholarships for students and mining research."

The challenge for Hendrickson is figuring out the best way to take advantage of the stockpiled resources by getting the right quality of ore to a pellet-making plant at the right price. If the cost to transport the ore is too high, the pellet plants won't purchase it.

Hendrickson noted that one of the University's largest stockpiles, containing almost 10 million tons of magnetite ore, is within 10 miles of an existing taconite plant's mine site. Ultimately the University stockpiled ore could be used by taconite operations and offer a financial win/win situation to both parties involved.

"A lot of work remains to bring the University stockpiled ore to market," he said. "But this huge opportunity is being advanced at a time when the University of Minnesota seeks to make the best use of its resources, and in this case, iron ore resources."

Besides using the iron ore as a resource to existing taconite operations, NRRI is also evaluating other uses for this valuable commodity.

This project also dovetails with the Laurentian Vision Partnership which is promoting landscape options for post-mining uses. Funding to develop and implement the strategic plan for the University lean ore piles comes from the mining portion of a federal Jobs and Innovation Accelerator Challenge grant appropriated in the fall of 2011.

Massive algae blooms on Lake Erie

What can the lake's history tell us?

When does "dead" mean "abundantly alive"? When "dead" is used to describe a lake that is so choked with algae – a prolific aquatic plant – that other forms of lake life are threatened. As the algae decomposes it uses up more than its fair share of oxygen. In the late 1960s, Lake Erie was declared "dead" for just that reason.

"People didn't want to swim in it, drink it... it was teeming with life but the wrong kind of life by normal human standards." explained NRRI Aquatic Scientist Euan Reavie. "Blue-green algae, that scum on the surface of the lake, is a real problem for Lake Erie, and some of it is also toxic."

To get to the bottom of the problem, quite literally, Reavie and fellow NRRI Scientist Lisa Allinger used their paleolimnology skills to piece together the history of Lake Erie's water quality. (See sidebar for how that's done.) They hope to understand the recent, unprecedented algal blooms observed in the lake by looking at the drivers of water quality change – primarily us humans.

NRRI is researching the ecological history of all of the Great Lakes with funding from the U.S. Environmental Protection Agency's Great Lakes National Program Office. Initial findings for Lake Erie will be published in an upcoming issue of the Journal of Great Lakes Research.

Lake Erie is an important freshwater commercial fishery, one of the world's largest, with abundant fish populations – steelhead, walleye, smallmouth bass and others. The Great Lakes generate approximately $7 billion annually in commercial and sport-fishing businesses.

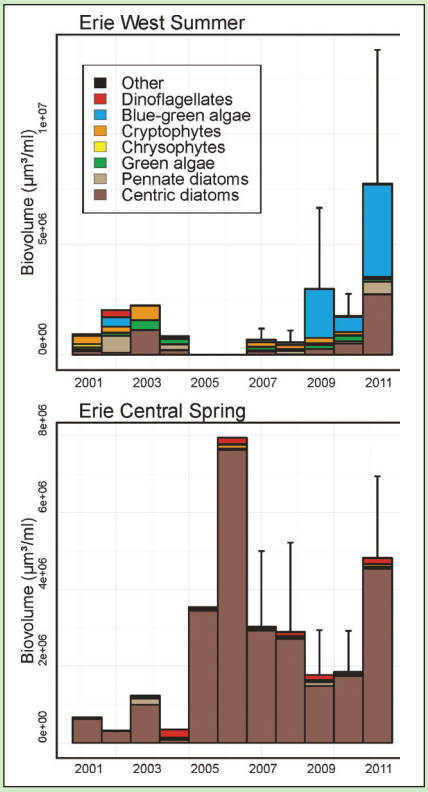
What kinds of changes affect the lake's water quality? "Deforestation and swamp draining in the 1800s and then detergents and fertilizers in the 1900s really started the problem of excessive nutrients," said Allinger. "Regulation via the Clean Water Act in the 1970s helped a lot."

Water quality improved through the 1980s and 1990s; then invasive species arrived, changing the lake ecosystem yet again. Zebra mussels, native to Eastern Europe and Western Russia, came to the U.S. Great Lakes in the ballasts of freighters. The mussels feed on plankton, except for some of the toxic, unpalatable blue-green algae. This makes the water cleaner, but the cascading effect is that aquatic vegetation grows at deeper depths and more densely.

"The system keeps changing, changing, changing," said Reavie. "It's complex. Despite the water clarifying effect of the mussels, we are once again seeing massive spring and summer algal blooms."

The scientists are trying to figure out why Erie is experiencing these recent blooms. What is the natural variability for this lake? Is this a totally new thing? Studying the long-term ecological history of the lake should provide clues.

"These recent changes are unexpected. At the same time, Lakes Huron and Michigan have massive mussel blooms and disappearing algae, and it's happening so rapidly," said Allinger. "We hope to sort out what's going on."



Summer in the western basin of Lake Erie and spring in the central basin are particularly troublesome times and areas for high algae and diatom blooms.

Scientists Lisa Allinger and Euan Reavie

What is paleolimnology?

Algae are just a fraction of a millimeter long and very sensitive to changes in water quality. They also live a very short life, usually less than a week. If something happens in their environment – the pH balance changes or nutrients increase – a new algal community that is tolerant of the disturbance will quickly replace the less tolerant species.

Although their life is short, algae leave clues behind that scientists can read later – even thousands of years later. Diatom algae have intricate "glass house" cell walls made of biogenic silica, and each species' cell wall exhibits a unique architecture (see photos). Long after the diatom algae die, those resilient cell walls accumulate in the sediments of a lake, preserving an archive of past ecological conditions.

By collecting deep sediment samples from the study areas, paleolimnologists can look at the algae cell walls from years, decades and centuries ago to understand how water quality has changed and likely causes of the disturbances.

New research team brings new skills and energy to minerals lab

Basak and Jack

What do you get when you combine a chemical and mineral processing engineer with a materials science and mechanical engineer? A big idea person and someone to make the big ideas happen.

That's what NRRI's Coleraine Minerals Lab has now with two recent hires: Basak Anameric with a PhD and master's degree in Chemical Engineering and a bachelor's degree in Mining and Mineral Processing Engineering, and Jack Grochowski with a bachelor's degree in Mechanical Engineering and master's in Materials Science and Engineering.

The synergy of their experience is proving to be beneficial to the lab's ongoing research to improve Minnesota's access to, and efficient use of, its varied ore deposits. And the fact that they're married to each other helps them tap into each other's skills even more.

"I can say to Jack, 'I want to gather up some data,' and a day later he will have everything set up. He'll say, 'Here is the equipment. This is how you do it.' It comes to him so naturally," said Anameric.

"You have to be able to apply your research," said Grochowski. "I've worked maintenance long enough and have experience in production and mineral processing. It's a good fit for NRRI's research goals."

The couple moved to Coleraine with their two young daughters from Pittsburg, Penn., where they both worked for U.S. Steel. Anameric's hometown is Anakara, Turkey, and Grochowsky hails from Alpena, Mich. Both engineers are excited about the minerals and mining potential of Minnesota's ores, especially with copper, nickel and ilmenite on the horizon, as well as Minnesota clays as pellet binders.

"We were fat, dumb and happy for so long. We had the best ore and we could process it in the blast furnace plants. Now those plants are getting old and our ore isn't as good anymore," said Anameric. "We pushed aside a lot of ores in the 1940s and 50s, now we have to look at those again and see which are profitable today."

In her role to advance the lab's high temperature processing program, Anameric is evaluating Canadian ores for their potential to produce iron ore pellets, the parameters that influence the quality of Direct Reduced Iron (DRI), a new way to process ilmenite ores and some testing for a Minnesota glass maker. "They want to know what was causing the bubbles in their glass," said Anameric. "I like that there's a lot of variety. I'm lucky to have a good boss who will listen to my ideas."

Grochowski stepped into the Coleraine Lab as, literally, a Jack-of-all-trades. He started his career in the cement plant his dad worked at for 40 years and he was hesitant to get into the iron and steel industry. But when he did, he jumped all the way in proving to his skeptical college advisor that, yes, he could make dual-phase, high strength steel with AISI 4037 alloy steel. "That was fun because I made the equipment," said Grochowski. "I like challenges."

He's kept busy making test equipment for DRI which will be one of only a handful of such test furnaces in the world. "DRI is much more efficient considering the availability of natural gas," he said. "But you have to have test results before you can sell the product."

"The Coleraine Lab is positioning itself for the future," said Lab Director Dick Kiesel. "Basak's background and experience with reduced iron, coupled with more ideas than any one person can grasp, and Jack's can-do attitude has brought an interesting and refreshing combination of talents to our facility. We're looking for the best ways to harness this newfound energy and funnel it."

Abnormal hormonal

NRRI studies smallmouth bass for adverse effects of chemical

It might be helpful to start this story with a short science refresher. First, a little physiology: The endocrine system is a system of hormone glands in people and animals.

Next, a bit of chemistry: Endocrine disruptors are chemicals that, when ingested or absorbed, can have an adverse effect on the endocrine system. They are found in a wide range of substances – from birth control pills to plastics – and have been detected in aquatic environments.

Finally, some biology: Some male aquatic species, like alligators, frogs and fish, have been found to have abnormalities in their testes, such as the presence of egg cells.

NRRI Scientist Jennifer Olker has studied the problem extensively in frogs, noting gonadal abnormalities across the upper Midwest. She and fellow NRRI colleague Patrick Schoff are now conducting research in the field and in the laboratory to find out if people and their chemicals are causing malformations in smallmouth bass.

"What we're doing is very basic biology research on these fish," explained Schoff, the project's principal investigator. "They're a widespread species across the U.S. and observations of these reproductive tract abnormalities have been showing up for 10 years or more."

Estrogens and other kinds of endocrine disrupting chemicals have been found in water samples collected in the St. Louis River Estuary and in Lake Superior, and scientists have shown that estrogen can cause feminization in males of some species.

NRRI Research Assistant Sarah Hoheisel is a PhD student in UMD's Integrated Biosciences Graduate Program in charge of rearing smallmouth bass for this project. "What we don't know, because they just haven't been studied much, is what normal adult male testes look like for smallmouth bass," she said. "When we find reproductively mature males with a few female cells in them, we don't know if that's from exposure to estrogen or just natural cells."

Hence, the two-pronged approach to the research that got underway this spring. Hoheisel is monitoring the growth of smallmouth bass in 12 tanks – four tanks have clean lake water, four are spiked with a low dose of endocrine disrupting chemicals and four have high doses. The low dose reflects levels sometimes found in the environment. The high dose has been shown to cause feminization in other male aquatic species in lab experiments. The lab work is taking place at the U.S. Environmental Protection Agency Mid-Continent facility in Duluth.

Olker is coordinating the field portion of the research. She is using NRRI's Geographical Information Systems lab to identify pristine lakes where smallmouth bass are least likely to be exposed to endocrine disrupting chemicals. For comparison, she'll also identify lakes and rivers that are most likely to contain the chemicals.

How does the estrogen get into the water systems? One known source is from oral contraceptives.

"Many pharmaceuticals that we ingest, including birth control pills, contain more active ingredients than can be absorbed by our bodies," explained Olker. "The unused portion can go right through your body into the wastewater treatment systems."

The two-year research project is funded by Minnesota Sea Grant to understand the emerging concern of endocrine active chemicals in the St. Louis River and Lake Superior.

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Still seeking answers to moose population decline

By Cheryl Reitan, UMD Associate Director for External Affairs

The northeastern Minnesota moose population is in danger, and NRRI is working with county, state, tribal, and Federal agencies, to determine the cause of the decline.

The most shocking statistic is the low number of moose remaining in Minnesota. NRRI scientist Ron Moen, a lead investigator on the research, said the aerial surveys of moose taken by the Minnesota Department of Natural Resources paint a drastic state. "In the past 8 years, the estimate of the northeast Minnesota moose population has decreased from 8,500 to less than 3,000," he said.

Another problem is that moose calves are not surviving as well as they used to. "For every 100 cows, about 100 calves are born each year," said Moen. A decade ago, 40 to 50 percent of the calves would live through January. In recent years, only 20 to 30 percent of calves made it that long." Adult moose are also dying at an unusually high rate compared to other moose populations. "The high mortality rate in both adult and calf moose is too high to sustain the population," said Moen.

And the moose are moving north. Only ten years ago, moose were seen in the Pequaywan Lake area and even closer, about 15 miles north of Duluth. "I used to see them regularly," said Moen. I haven't seen a moose that close to Duluth in years, although we do get occasional reports from the Fox Farm Road area." Now, the southernmost edge of sightings is about 25 miles north of Two Harbors, about 10 miles further north than in the past.

It's puzzling and NRRI is teaming up with numerous organizations to research the problem from every possible angle. Undergrad and grad students, along with UMD faculty and researchers, have taken on nearly a dozen approaches. They are looking for optimal habitat from the macro and the micro perspective, from viewing aerial photographs and satellite imagery, to measuring moose feeding in foraging areas. Other students are examining wolf scat, collaring and tracking moose, and recovering moose remains to identify cause of death.

NRRI Scientist Richard Barnes is mapping the state's moose habitats using LiDAR imagery from low-flying airplanes. LiDAR (the name comes from the combination of 'light' and 'radar') is a method of high-resolution mapmaking that, in this case, detects the density of vegetation. Moen will use the LiDAR maps to find habitat conducive to a healthy moose population.

"Moose need the low growing shrubs and young trees found in relatively open areas," Moen said. "Logging, fire, and tree blow downs create good habitat for moose to forage in." As forests grow old light is unable to penetrate the canopy, making moose's preferred food – aspen, paper birch, mountain ash, willows, red-osier dogwood and beaked hazel – less available. Moose also need the old forests for thermal cover. Climate changes may also affect plant species. Collaborating with Lee Frelich in the Forest Resources Department at the UM-Twin Cities, Moen is measuring temperatures on Isle Royale in Lake Superior to predict future forest composition.

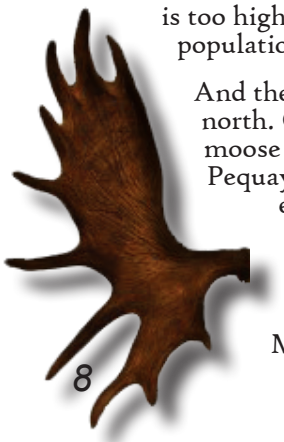
Climate change also increases heat stress on moose while helping deer to thrive – and that's another problem. Deer populations host parasites such as liver flukes and brain worm with minimal effects. When these deer parasites infect moose, however, the moose become sick or weakened and may die from the infection or from predation. Winter ticks pose a specific threat. Too many ticks on a moose can kill it, and moose have been found with some 30,000 ticks at a time.

Moen's student research team is invaluable for their work in collecting a wide variety of data for the research effort [see "Into the Wild" article, right].

The Minnesota Department of Natural Resources is leading two other research projects on moose. One of the most recent developments is a new type of collar, which allows for quick response times upon moose's death. The goal is to get to a moose carcass within 24 hours of death and a lot can happen in that time. The new collars have sensors for heart activity, and are directly connected to researchers' cell phones. Now, the DNR field teams are notified immediately when a moose dies.

"There is no one reason for the unprecedented decline in the adult and young moose population," said Moen. Disappearing habitat, deer encroachment on habitat, increased parasite populations, sustained warmer weather, and predators all take a toll on the population. "Individually, any one of these factors wouldn't be enough to cause such a major problem, but coming all at once, they are taking a serious toll on the moose," he added.

Major funding for this research is from Minnesota's Environment and Natural Resources Trust Fund, the USGS National Park Service, the Bureau of Indian Affairs through the Grand Portage Indian Reservation and the EPA Great Lakes Restoration Initiative.



Into the wild

Students get hands-on field research experiences

One goal of natural resource management is to understand the needs of the mammals that inhabit the forests we all share. It's a goal that keeps NRRI Biologist Ron Moen very busy – and this past summer has also kept 13 UMD undergraduate and 11 graduate students hard at work, conducting research and collecting data. The students were involved in research on many woodland creatures: moose, bats, American martens, ticks, wolves... all the way down to slugs and snails.

"Graduate and undergraduate students are an important part of my research program," said Moen. "It would be impossible for me to accomplish the project's goals without their help."

The experience is invaluable as the students develop their lab and field skills, as well as make decisions for future education or careers. The undergraduate students learned techniques for measuring the effects of moose foraging on plants, processing wolf scat to understand what they're eating, as well as preparing dead animals for the mammal collection at UMD. Last spring, five students helped to catalog the mammal collection. Students also maintained the dermestid beetle (skin beetles) collection used for cleaning skulls and bones. One student photographed the collection to incorporate images into the Minnesota Mammals website at www.gisdata.nrri.umn.edu/mnmammals.

Students also measure snowshoe hare pellet transects and use VHF telemetry to track martens and bats. Some students were also involved in observing the capture and collaring of moose and wolves to add valuable data to the research effort. Another student is collecting snails and slugs to test them for parasite larvae that moose may be ingesting and making them sick.

At the computer, students entered data, searched the literature, and conducted photo. They've used ArcGIS programs for identifying species ranges and for followed moose movements. This fall, some of the students combined many of their skills on a project to predict changes in birds, mammals and vegetation in the upper Midwest National Parks. Four of the students will also create media from the research that will be used in the UMD mammalogy course, future publications and NRRI webpages.

[NRRI Graduate Research Assistant Rachel Ward contributed to this story.]

Back left to right: Ashton Gronholz, Megan Gorder, Trevor Vannatta, Ron Moen, Cord Reno, William Chen.

Front left to right: Tessa Tjepkes, Marc Sizer, Sierra Koethe, Kara Werner, Richie Vang, Rachel Ward.

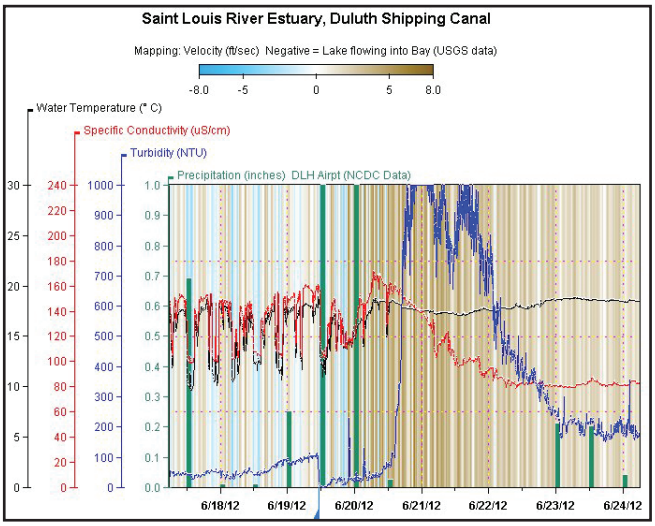
Not pictured: Lee Austin, Tim Cyr, Samuel Giebner, Yvette Ibrahim, Michael Joyce, Brian Kot , Amanda McGraw, Elizabeth Raedeke, Anna Sjodin, Becca Teigen, Juliann Terry, Kim Vanderwaal, Meagan Wojtysiak.

SEEING BELOW THE SURFACE

Data for discovery and decision-making

For the most part, when folks enjoy a walk along the shore of Lake Superior or a swim in Duluth's Lester River, they can't see the myriad harmful impacts these water bodies sustain.

But communities around the Great Lakes are facing increasingly challenging "tipping points" and the list is long – heat and oxygen stress on cold water brook trout, unswimmable beaches, and expensive fixes because of poorly planned developments. Lake Superior is particularly sensitive to pressure from urban and rural development and the stormwater management problems that go with more homes, roads and parking lots. And then there are the "legacy" pollutants and habitat destruction in the St. Louis River Estuary's industrial harbor where clean-up has already cost about $400 million and will cost at least that much over the next 12 years or so to finish the restoration effort.



Changes in the estuary after a rain event.

And there's another challenge – helping people, business owners and local governments protect these resources before more damage is done. To help with that, NRRI has developed online resources to help people "see below the surface" of water quality issues.

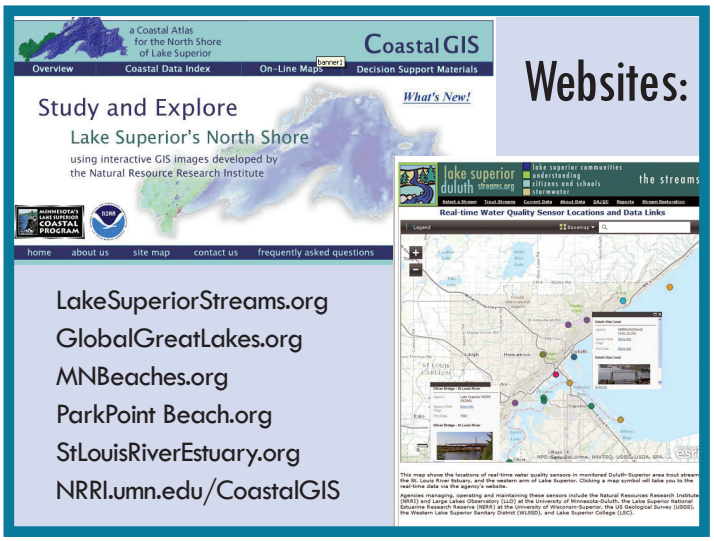
The website tools show how water quality varies with the weather and in response to society's activities on land and along the coastline. The hope is that when people understand what degrades water – a life force for humans and animals – they can collectively protect it. The tools are being developed by NRRI Scientists Norm Will, Terry Brown, George Host, and Rich Axler.

"We want people to see how a big rain can muddy-up a stream pretty quickly, and how this differs in paved urban versus wooded areas, or how the weather and seasons affect the St. Louis River, small trout streams and Lake Superior," said Axler. "We want people to be able to easily and virtually explore real world data to help them understand how streams and lakes 'work' and how changing their own behavior can help reduce water pollution."

A variety of cross-linked websites, each with their own focus and audience, offer water, watershed, fish and wildlife data with on-line graphing tools to make it easier to see trends and relationships between the data. The goal is to help local managers – developers, contractors and agencies, for instance – make proactive, environmentally informed land use decisions. It's a goal that is at the heart of NRRI's mission for sustainable resource use.

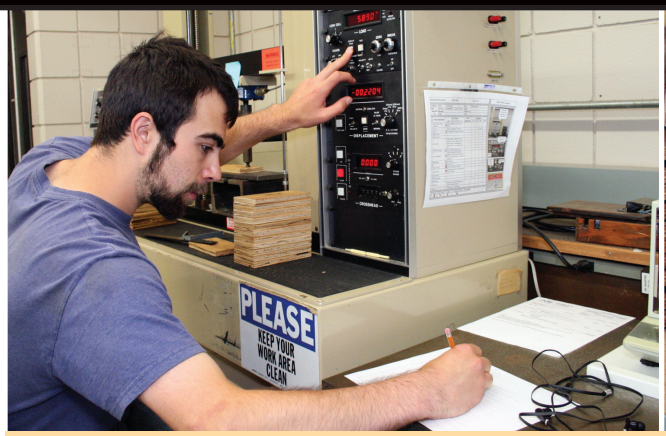
"The tools help inform agencies about the condition of the water and are critical to protection and restoration efforts," said Host. "Cities, townships and counties, in particular, need this type of cause-effect information to develop ordinances and long-term comprehensive plans."

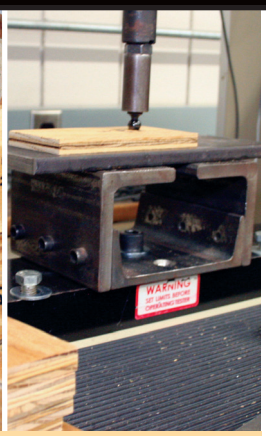
Much of the real-world data comes from automated underwater sensors and weather stations at lake, harbor and North Shore stream sites. NRRI works with extension educators at Minnesota Sea Grant to interpret the information for non-scientists and teachers. The sensors are placed and monitored by NRRI, UMD's Large Lakes Observatory, the Lake Superior National Estuarine Research Reserve (University of Wisconsin), the U. S. Geological Survey, the Minnesota Pollution Control Agency, and the Minnesota Department of Natural Resources.



NRRI's Center for Water and the Environment has established, as one of four focus areas, the goal to transfer knowledge by incorporating innovative methods to inform citizens, educators, businesses, agencies and policy makers.

Making Minnesota wood products even better





NRRI gets grant to expand uses for engineered wood products

What's up with Minnesota's forest-related industries? Just that. Things are looking up thanks to a projected upswing in the U.S. housing market which is recovering from the 2008 recession. In particular, NRRI Research Scientist Matt Aro is watching the trends for engineered wood products – plywood, oriented strandboard and the like. And his specific focus is to make these regional products even better.

Aro and his NRRI colleagues received a $600,000 grant from the National Science Foundation to advance the science and understanding of thermal modification techniques and test how it might improve engineered wood products. Thermal modification is a familiar process in Europe, mostly in the solid wood markets. Using a special kiln to cook the wood at specific temperatures, pressures, and lengths of time can make a basswood two-by-four behave like cedar – the wood becomes much more moisture resistant, dimensionally stable and durable. And it does this without chemicals, so it reduces environmental impacts while being a renewable, sustainable and carbon-sequestering material.

"We're testing and producing value-added plywood that could outperform what people are using now," said Aro. "Theoretically, a manufacturer would then get a premium price because thermally-modified plywood would offer greater durability and, thus, have a longer service life." Manufacturers could sell modified plywood as a subfloor product, for example, with less edge swell, and less overall movement.

Aro's research in the Market-Oriented Wood Technology Program at NRRI focuses on forest products because they are a cornerstone of Minnesota's economy. A 2011 University of Minnesota Duluth report shows that the state's forest-related businesses annually contribute $17.1 billion to the state's economy and provide almost 87,000 jobs. This kiln technology, once fully vetted, could help create new companies to produce the product, creating new regional and national jobs and increased opportunities for exports.

The NSF grant funding allows Aro and his team to test varied parameters on a variety of engineered wood products: bending strength and stiffness, water absorption, thickness swell, screw-holding capability, hardness, internal bond strength, and other properties.

"We've got a lot of data coming in now," Aro said. "It takes a lot of time because we have to do so many replications."

One of the project partners is Aspen Research Corporation which is skilled in understanding the impacts that thermal modification has on the integrity of the wood fiber and on the wood fiber/resin bond in the plywood. Every product and every tree species requires a different kiln "recipe" which ultimately is what NRRI will be able to publish for all manufacturers and production companies to use.

BORDER CROSSING

NRRI also received an additional $120,000 from the National Science Foundation to foster an international connection centered on thermal wood modification. The Wood Science and Forest Products department at Lakehead University in Thunder Bay, Ontario, is keenly interested in testing Eastern larch wood and upgrading this undervalued species. Working with NRRI, the specific goal of this grant will be to make this wood marketable.

"The Eastern larch grows coast to coast in Canada and into Minnesota. But it's not used commercially," explained Mathew Leitch, director of Lakehead's wood program. "It's a very good softwood tree but it's been misclassified which makes it difficult for producers to use because they have to retest it to meet codes."

Using NRRI's pilot scale thermal kiln, Matt Aro and Leitch will analyze the mechanical and physical performance of thermally-modified Eastern larch engineered wood products. With documented improvements in dimensional stability, resistance to biodeterioration and weathering, this underutilized and abundant wood resource can become a significant commercial species.

"As always at NRRI, we're developing this technology to help create new companies, new jobs and increased opportunities for exports with carbon-sequestering wood that is renewable, sustainable and durable," added Aro.

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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.

Lucinda Johnson, interim director

Center for Water & the Environment
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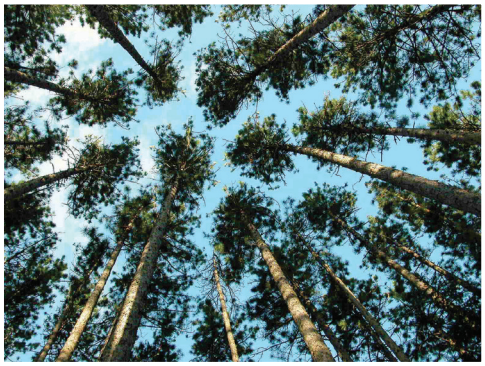
Growing trees – Growing jobs

NRRI works to grow markets for regional wood

Invigorating Minnesota's regional wood industry is at the heart of NRRI's wood products research mission. And sometimes it feels like a David and Goliath fight – local loggers against the plastics and fossil fuel industries. But two NRRI program directors are leading efforts to help.

NRRI's Pat Donahue organized the first ever North American Wood Window and Door Symposium in Roseville, Minn., this past spring to reinvigorate discussions about the practicality of wood for this regional industry.



"Vinyl has taken over about 60 percent of the window and door industry, but there have been tremendous advancements in wood durability and coating," said Donahue. "We have the people, the infrastructure and the wood resources right here. Why are we importing plastics and sending our money out of the state?" Donahue has also been actively researching emerging technologies in wood modification that shows promise for increasing wood durability and moisture resistance.

The inaugural symposium, sponsored by NRRI, the Forest Products Society and the USDA Forest Products Lab, attracted over 100 people. Marvin Windows and Doors and the Wood Window and Door Manufacturers Association (WDMA) were key supporters, along with the many companies that participated with informational trade booths. The organizations hope to host another symposium, potentially incorporating it into future WDMA technical conferences. Information on future events can be found at www.ForestProd.org.

NRRI's Brian Brashaw is helping to instigate a similar discussion around increasing the use of biomass for wood heating opportunities. Working with other Midwest companies and organizations, a grassroots effort coalesced into "Heating the Midwest with Renewable Biomass." A conference and expo was held in 2012 followed by a second conference in 2013. This year's event in Cloquet brought together leaders of the woody and agricultural biomass industry to present a goal of having 15 percent of homes and businesses heated with renewable energy by 2025.

"By increasing the amount of efficient thermal energy from biomass, we can save over a billion gallons of non-renewable propane, 275 million gallons of heating oil, invest in the Midwest economy and create jobs," said Brashaw. "We can create rural economic opportunities that also help save heating costs by using the biomass resources we have available."

The 2014 Heating the Midwest conference will be held in Green Bay, Wisc., April 29 – May 1. More information can be found at www.heatingthemidwest.org.