



Natural Resources Research Institute

NRRI Now

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NRRI Executive Director Rolf Weberg gestures as he talks to Rep. Roger Skraba (right) about new opportunities for Minnesota to take a lead in industrial decarbonization.

Reaching Out

What's the best way to broaden the impact of great research? Share and collaborate. Get it out of the laboratories and into the world. That's part of our research DNA.

From our Executive Director Rolf Weberg (pictured above) talking to legislators about new opportunities for Minnesota to our student technicians delivering poster presentations... It's no accident that two of NRRI's Core Values are Partnership and Collaboration.

As 19th Century Poet Margaret Fuller said, "If you have knowledge, let others light their candles in it."

Shine on!

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Mining, metallurgy experts share knowledge



NRRI researchers Jestos Taguta, Matt Mlinar and Brett Spigarelli stand ready to mingle at SME 2023.

June Breneman
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NRRI researchers to present industry innovations at SME 2024.

Each spring, movers and shakers in the world of mining, minerals processing and metallurgy descend on northern Minnesota. And, as they have for decades past, NRRI researchers will move and shake with the best of them.

The annual Society for Mining, Metallurgy and Exploration – known widely as the SME – will be held at the Duluth Entertainment Convention Center April 15 - 17. Four NRRI research efforts will be presented focused on increasing industry efficiencies and improving processes.

SME Minnesota is a popular Midwest event aimed at helping this traditional industry embrace new technologies and modernize operations while considering new mineral possibilities for a long and sustainable future.

Taconite Tradition

Minnesota's Iron Range has been producing traditional taconite pellets since the 1950s. It involves a high energy, high heat and heavy water-use process that makes 65 percent iron ore pellets, suitable for traditional blast furnace steelmaking.

But adapting to the electric arc furnace process of the steelmaking market means Minnesota must also produce a higher iron content, metallic product. Enter Direct Reduced Iron, or DRI as it is known. NRRI is helping industry with this adaptation with a new pilot-scale DRI Simulator and Engineer Brett Spigarelli is going to share new details about this equipment at the conference.



Photo left: Brett Spigarelli

“I’m going to explain how the DRI Simulator will be used to enhance the properties of the feed materials and lead to products with more than 90 percent iron,” Spigarelli explained. “This will help the Iron Range produce the necessary virgin metallic iron to meet electric arc requirements and improve steelmaking efficiencies.”

Water Everywhere

To address the water use challenge, a team of NRRI engineers will present a technology review of a novel dry mineral separation process. Typically, the process that separates valuable metallic and nonmetallic minerals from unusable minerals uses large amounts of recycled water.

Photo right: Sunil Tripathy

However, some new advances in developing dry-based separators and classifiers based on sensor-based sorting, gravity, magnetic, and electrostatic techniques offer options to separate without water.

“There are also many new options for coarse-sized ore sorting,” said NRRI Engineer Sunil Tripathy, who will present the technology review. “These technologies will be especially important to understand the applicability to Minnesota iron ores.”



Optimizing Ores

Making the most of Minnesota’s ore bodies requires knowing exactly how to process the various ore types – from high grade taconite to lower quality oxidized ore– into a product of value to steel makers. Siderite-rich iron along with partially- and fully-oxidized iron samples were investigated to develop customized flowsheets to upgrade these currently non-ore types of iron formation.



Photo left: Rodney Johnson

“We anticipate that this study will provide insight into the design of customized flowsheets that may allow the iron ore industry to be more sustainable and diversify the iron ore-based product portfolio,” said Rodney Johnson, principal investigator on the project and NRRI’s Endowed Taconite Chair.

The overall goal is to provide avenues for keeping more of the profits and jobs generated from Minnesota iron resources in the state. The knowledge gained from this research will also be applied to identifying a path for producing carbon neutral and carbon negative iron and steel in Minnesota.

Hydrogen Tech

Johnson will also present a new microwave hydrogen plasma technology applied to iron ore reduction. This technique was developed at the High Temperature and Plasma Laboratory at the University of Minnesota and is a collaboration between NRRI and University faculty. It is a fully electric technology that

could eliminate two steps – carbon-intensive reduction and energy-intensive “cooking” – that hardens the marble-sized pellets.

“As a virtually instant on-off technology, hydrogen plasma is exceptionally compatible with intermittent renewable electricity,” Johnson added. Both of Johnson’s projects are funded by the Legislative Citizen Commission on Minnesota Resources, Environment and Natural Resources Trust Fund.

With more than 13,000 members representing minerals industry professionals in more than 100 countries, the Society for Mining, Metallurgy and Exploration provides a wide range of educational and networking opportunities. Its ongoing events and conferences offer connections to learn from industry thought leaders.

Sharing, connecting at the St. Louis River Summit



NRRI graduate student researcher Abigail Latanich talks about her research on non-native, ballast-borne protists at the 2024 Summit on March 6. (Photo credit: E. Reavie)

June Breneman
Mar 7, 2024

NRRI scientists present findings on projects with broader water community.

Critical habitat for wildlife, cultural value to local indigenous communities and outdoor enthusiast attraction, the St. Louis River Estuary has a lot going for it.

But it also faces a lot of human-caused challenges, requiring some human support.

And the [St. Louis River Summit](#) brings it all together. Hosted by the Lake Superior National Estuarine Research Reserve on March 6 - 8, the Summit is a clearinghouse for scientists and community groups showcasing estuary research, sharing stories, even celebrating with artwork.

As they have since the Summit began in 2010, NRRI scientists will present research that addresses some of the challenges in, on and around the estuary. Here are some of the presentations showcased at this year's event.

Back in Time

The industrial history of the river is captured in sedimentary layers that build over hundreds of years. Analyzing cores pulled from the bottom of the estuary, NRRI Aquatic Scientist Malachi Granmo uncovered the history of metals pollution in the estuary associated with natural factors and human-caused stressors. They were able to identify cadmium, lead, zinc, tin and other metals that reached a peak in the 1970s.

“Together with mercury, this group represents metals that are airborne and linked to fossil fuels and other industrial sources,” Granmo explained. “Our preliminary data indicate a complex combination of natural and human-caused variables to explain the changing metallic compositions in the estuary’s sedimentary record.”

Attracting People

As the estuary moves closer to being removed from the official “Area of Concern” list it’s sure to attract more recreational tourists. And that’s a good thing. But this active waterway has currents that are not as well understood as its adjacent Lake Superior rip currents. NRRI Limnologist Chris Filstrup will give a presentation about a forecasting model being developed to help people understand these dangerous currents to increase safety.



Photo right: Chris Filstrup

“Highly dynamic inflows from the St. Louis River and smaller tributaries combined with seiche effects from Lake Superior create complex circulation patterns in the estuary,” said Filstrup. “And yet, we have limited knowledge of the diverse types of drowning hazards in this area.”

This project will collect historical drowning data to identify high risk locations and scenarios, then develop a forecasting model to increase the lead time for community hazards in a free, online tool.

Toxic Algae

Despite water quality improvements beginning in the late 1970’s to the estuary, a recent increase in cyanobacteria blooms points to emerging environmental stressors. Graduate student researcher, Peter Birschbach will share research aimed at illuminating the extent and causes of several novel water quality concerns in the estuary, including algal community shifts, toxic cyanobacteria harmful algal blooms and hypoxia.

“In September and October last year, there were unprecedented blooms in the estuary, so this project investigates locations, timing and dominant bloom species to better understand what’s happening there and develop a long-term monitoring program,” said Birschbach.

The scientists are documenting the environmental conditions prior to, during and after blooms, along with evidence of cyanotoxin production.

Bird Habitat

The estuary flows between Minnesota and Wisconsin, and in the middle sits a unique island made of channel dredge material that is home to a regionally threatened bird species, the Common Tern, and lots of Ring-billed Gulls.

Interstate Island underwent a major restoration to improve the habitat, so NRRI Avian Researchers Annie Bracey and Steve Kolbe will present a summary of how this purposefully built space is used by birds.



“The primary goal of the habitat restoration was to maintain and increase the population of Common Terns breeding there,” said Bracey. “But we also documented how shorebirds and other species were using the newly restored habitat.”

Photo left: Annie Bracey

The researchers documented 60 bird species using the island, including 10 species that are considered to be declining and six that are listed as common birds in steep decline.

This project highlights the value of providing critical habitat in the St. Louis River for breeding and migratory birds and describes the value of building partnerships in the estuary to conserve biodiversity.

“This is a great example of how managing for a single species can benefit many other non-target species and how active management provides the opportunity to continually improve conditions to maximize the benefits of restoration into the future,” Bracey added.

Cultural Experience

It's not hard to understand that a natural resource like the estuary benefits the lives of many people living in its proximity. But access is not necessarily equitable. A “Waterways Benefits Study” conducted by Molly Wick, a graduate student working at the Environmental Protection Agency and NRRI, identified a wide range of barriers to the cultural ecosystem services provided by the St. Louis River.

“Things like communication, governance and personal resources and privilege, don't always reach all communities equally,” explained Wick. “So understanding these barriers can inform ways to mitigate those barriers for more people.”

Photo right: Tiffany Sprague

Another project that reaches across cultural divides will be presented by NRRI researcher Tiffany Sprague and Minnesota Sea Grant's Madison Rodman. They will showcase a community-centric demonstration of educating specific communities about green infrastructure. The “One Block” collaboration installed 20 rain barrels to residents' homes in a marginalized St. Louis River community.



“By showing them where their rainwater flows and how rain barrels help water quality in their own neighborhoods, we can make a difference, one block at a time,” said Sprague. “Our goal is to broaden access to climate information, involve diverse groups in planning, and enhance environmental literacy on climate hazards and mitigation strategies.”

In addition, NRRI poster presentations include topics like protecting wild rice from rusty crayfish, improved analytical methods for measuring phosphorus concentrations and other projects to mitigate the impact of aquatic invasive species in the estuary.

Meet the Researcher - David Haugen



David Haugen wears research PPE in NRRI's Minerals Pilot Plant in Coleraine.

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Advanced degree moves technician into broad arena of project management.

He could have fit a career into any of NRRI's strategic initiatives.

David Haugen started at Itasca Community College considering a career in [forestry](#). During that time he also worked in [aquatic invasive species](#) management. But he landed at NRRI Coleraine where the world of [mining research](#) caught his attention.

"I was hired in 2014 as a technician, running a variety of pyrometallurgical tests. I also worked in our Batch Lab doing a lot of mineral processing tests," said Haugen. "The more I learned about the mining process and testing procedures the more I wanted to stay in this field."

And he did. Sort of. After achieving a bachelor's degree in business management from the College of St. Scholastica, Haugen expanded his skillset to project management – and, fittingly, he now works across NRRI's multidisciplinary research initiatives as part of NRRI's Technical Operations team. Though he's still on the learning curve.



Photo left: David Haugen

"My expertise is still pyrometallurgical and mineral processing procedures," he said. "But eventually I want to be an expert in project management using our new software, WorkOtter."

It became clear to NRRI's leadership team that simultaneously managing some 150 diverse projects underway required a system to track timelines, budgets and progress. It would have to be robust yet easy to use. WorkOtter, a top tier project and portfolio management software system, widely used by industry, was implemented in 2022. But it required full time attention to manage and get staff trained. Haugen was ready and took on the role of Research Project Specialist last year.

“What keeps my job interesting is supporting and managing so many interesting research, facility and equipment projects,” said Haugen. “There are always new challenges to work through and overcome and I enjoy working with our awesome teams to overcome these challenges every day.”

Implementing Otter

Haugen’s focus these days is getting WorkOtter implemented across the entire Institute – Coleraine to Duluth. He holds regular training sessions with busy research staff to demonstrate how this new tool can help them manage their work flow even better. He’s also helping NRRI apply it to managing facilities upgrades and new equipment onboarding.

“This software has lot of capabilities to quickly help leaders and researchers understand project status and resource utilization,” Haugen explained. “It also creates a portfolio of all the projects within a research group or all of NRRI to help with planning, resource allocation, staffing, and a whole lot more.”

In this research support role and as a key member of the Management of Change committee, Haugen works with expertise from across the institute to help make the best decisions to achieve NRRI’s mission.

Collegial Collaborations

When project challenges surface, Haugen leans on the “awesome team” at NRRI Coleraine. He recalled a recent mineral processing pilot plant project where he was especially grateful for the work of colleagues Jeff Kinkel, Patrick Casey and Julie Mutcher.

“All three did a fantastic job supporting that project, working with the researchers to keep it on time and on budget,” said Haugen. “They made sure we had the necessary tools and resources to successfully complete the project with high quality and do so without any safety incidents.”

Off Hours

Haugen is a self-proclaimed “Skoldier” – a big Minnesota Vikings fan – so don’t try to reach him during a Vikings game. And when he’s not hanging out with his wife and kids, you might catch him fishing or deer hunting.

“And my wife and I are taking a delayed honeymoon trip to Punta Cana in the Dominican Republic in March,” he added. “We’re really looking forward to getting away and hanging at the beach.”



One Last Thing



Revisiting lynx research

In a February radio interview, NRRI Senior Wildlife Biologist Ron Moen talks about plans to expand research on Canada Lynx by studying its primary prey: snowshoe hare.

[Listen at QTIP>](#)

Photo left: NRRI Archive 2004

NRRI Organization Overview

NRRI was created by the MN Legislature in 1983 to deliver applied research informing environmental stewardship and economic development of the state's natural resources. It is a nationally unique model for integrated research focused on three strategic initiatives: Ecosystem Resilience, Future Forest Industries, and Iron and Minerals of the Future.

As part of the University of Minnesota system research enterprise, NRRI employs over 140 scientists, engineers, technicians, staff and students in two industrial research facilities. Through collaborative partnerships, we deliver the innovative tools and solutions needed to utilize and sustain Minnesota's valuable natural resources.

Find out more: [NRRI website](#) • [Facebook](#) • [X](#) • [Instagram](#) • [YouTube](#) • [LinkedIn](#)

NRRI Facilities Overview

NRRI has extensive laboratory capabilities to discover and deliver at the bench-to-pilot scales, reducing risk inherent in commercializing innovations.

NRRI Duluth has 19 labs that address the needs of land, wildlife, water and minerals research, as well as several technology development labs and the LP Innovation Center, developed in partnership with LP Building Solutions.

NRRI Coleraine, a former U.S. Steel R&D facility, is a 27-acre industrial-scale site that was acquired in 1986. The minerals processing and metallurgy labs provide bench to pilot-scale research to broaden the state's portfolio of ore resources while impacting process efficiencies and improved production of taconite. The engineered biocarbon product development lab tests processes for converting a variety of biomass into fuel and carbon materials up to commercial demonstration scale.

NRRI Fens is a 425-acre property near Zim, Minnesota, was acquired in 1986 to restore its function as a valuable peatland and fens bog after being drained in the 1950s for farmland. Decades of effort have restored the peatland - nature's most effective carbon sequestration solution - and the restoration credits were sold to state agencies. Ongoing research on the site will continue to inform successful peatland restorations across the nation.

NRRI Mission

Deliver integrated research solutions that value our resources, environment and economy for a sustainable and resilient future.

NRRI Vision

Discover the economy of the future.