NRRI Scientist Victor Krause provides product testing for Minnesota’s secondary wood product manufacturers.

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NRRI Scientist Victor Krause provides product testing for Minnesota’s secondary wood product manufacturers.
Tim Doyle couldn’t have picked a worse time to start a new business venture with a unique new product—October, 2007. According to the National Bureau of Economic Research, the U.S. recession officially started just two months later.

“So 2008 was an R & D year, but when we were ready with products in 2009 nobody wanted to buy anything or try anything new,” Doyle said. “Luckily our investors continued to believe in us and invest and we stayed alive with a skeleton crew.”

But as Northern Sheer Veneer in Spooner, Wisc., heads into 2010 everything’s taking off again—new orders every day and one especially promising European customer with a new product that NRRI is helping to develop.

“The key to this has been Pat [Donahue],” said Doyle. “He put us with suppliers, sourced adhesives and carrier paper for the veneer, and found us the connections with logs. Without the assistance of NRRI, we would not be where we’re at today.”

Donahue is director of NRRI’s Market Oriented Wood Technology group. He calls Sheer Veneer’s unique ability to produce paper thin, real wood veneers “the last gold nugget in the wood products industry.”

NRRI scientist Matt Aro is kept busy testing adhesives, pressing temperature, and other manufacturing variables for the company to produce a sustainable, “green” key card for a Swedish company that is selling them to upscale European hotels. The idea was very popular at the recent Copenhagen Climate Change Convention, Doyle said.

“We also focused on some specific markets that are generating new sales and new customers.”

Like the new “flat-pack cabinet.” Northern Contours developed cabinet components in custom sizes that can be assembled by the purchaser, and faced to match their existing cabinets. In addition to regular product testing, NRRI did the full battery of performance testing required by the Kitchen Cabinet Manufacturing Association.

“We work hand-in-glove with NRRI and that’s just really great for us,” said Skow. “It saves us from having to think about it every time we need testing done. We just go right to NRRI. They know us and know our products and we trust them.”

Over the years, NRRI technician Victor Krause has done countless tests for Northern Contours: scratch and mar, impact testing, ultra-violet light and chemical resistance testing. And this winter he developed a device to determine the critical temperature and press time to bond finicky high gloss laminates to the cabinet doors.

“If we can shave some time off on the press cycle, they can press...
more cabinet doors a day and make more money each day,” explained Krause.

During the recession Northern Contours experienced some loss in sales with some large accounts and trimmed their workforce a bit, but also used the slowdown to focus on new projects that were in the pipeline.

“It’s early yet, but we’re very optimistic for 2010,” said Skow. “Even with a reduction in sales, we have enough diversification and our selling price is such that we remain a very profitable company.”

Hill Wood Products in Cook, Minn., a third generation wood products company, credits their engineered flooring product with carrying them through the recession. And according to sales manager Randy Rosandich the key to the success of the flooring product was NRRI’s expertise and technology for the baseline work on the floors.

NRRI lab technician Scott Johnson made the prototypes and did product testing. He helped Hill Wood understand the technicalities of adhesive performance, dimensional stability and the effects of moisture on the product.

“We didn’t have the technology here to make the floor boards, so we made them at NRRI and learned from their expertise to help us have a product ready for market,” Rosandich said. “When we were ready to make the jump into flooring, we were really ready.”

Duluth-based Epicurean Cutting Surfaces started in 2003 when business owner Tony Ciardelli looked for new uses for waste material from manufacturing skate board ramps. The new cutting board product took off. Through the recession, they focused on developing new products using NRRI’s testing facilities. Ciardelli says consumers are attracted to their “green” products and appreciate that they are made completely in the USA. He anticipates 2010 to be promising.

“NRRI’s lean manufacturing training has really helped us with manufacturing efficiency as a first thought, not an afterthought,” said Ciardelli. “We’re committed to being ‘made in the USA’ and that means we have to be as efficient as possible to compete with China. With our new products, NRRI helps us figure out the best way to move from raw materials coming in to products going out the door.”

The company makes durable outdoor furniture with recycled plastics. Company president Greg Benson relied on Brian Brashaw, director of NRRI’s Wood Materials and Manufacturing group, to help them set up an efficient manufacturing flow and used NRRI for product performance testing which led to improved designs.

“We started growing really fast, and were running our machines 24/7,” said Benson. “Our commercial sales took off and we got some really big orders. It was great to be able to pick up the phone and call Brian to figure out how to handle it and get the products out the door.”

For all four companies, diversified and new products that they developed with the help of NRRI was key to getting through the recession and keeping people employed.

“The development of these products not only increased our revenues but also allowed us to retain jobs and to add some new jobs as well,” added Hill Wood’s Rosandich.
Improvements provide fish habitat, keep clay out of creek

Washed out Graves Road finally gets fixed

It took about two years of planning, but once the shovels hit the ground a 400-foot stretch of Amity Creek was restored in just two weeks. Two exposed clay banks on the East Branch of Amity Creek were being severely eroded during big rain storms and spring runoff.

Now, as the water clears after the construction, the dace minnows and tiny brook trout have started coming back – which could mean good fishing this spring. At least, that’s the hope of Ron Weber who provided the seed money that started this, and other, stream restoration projects in Duluth.

His initial donation of $150,000 to NRRI started an initiative that has generated over $800,000 of research focused on restoring and protecting Lake Superior’s streams and nearshore zone.

Stabilizing the bank on Amity Creek was the kind of hands-on, direct-result project that Weber wanted to see.

For Keith Anderson, lead manager of the project, understanding the technical complexities of the stream system to design the right solution was an interesting challenge, and the first of its kind for a North Shore stream. Anderson is a conservation engineer with the South St. Louis County Soil and Water Conservation District.

“I had to look at how the stream physics were interacting with the surrounding geography and geology,” said Anderson. “It all gets down to how the stream is moving the sediments through the system.”

How did this erosion happen? Anderson thinks it’s possible that the soil and bank structure was weakened many decades ago when the forest was removed near the stream for a cattle pasture. Over time, the stream cut into the bank, getting worse and worse each year.

Smoothing out the slope and using rocks to redirect the stream flow has already diverted the stream power away from the clay bank allowing vegetation to grow back along the bank. Large root masses and constructed pools are providing trout cool hiding places, but the long-term goal is improving habitat by reducing sediment inputs and providing deeper pools.

“It’s natural for streams to intersect valley walls and change shape over time, but in this case it likely was increased by human activity,” said Anderson. “People don’t always understand their relationship with the land and how it impacts streams.”

NRRI scientists are monitoring the performance of the reconstruction by measuring water quality and surveying the communities of bugs and fish living there before and after, as well as upstream and downstream from the restoration site.

“When we evaluate the changes in the stream community following construction, we hope we’ll see continued native trout reproduction, plus better spawning habitat,” said NRRI scientist Dan Breneman. “There are hundreds of eroding bluffs along other North Shore streams so it’s important to evaluate this design as a tool that can be used in many other places.”

Washed out in a huge deluge in the 1940’s, Graves Road, connecting Lakeside in eastern Duluth to Seven Bridges Road, became an overgrown, eroding mess. Its red clay banks have been cut by storm sewer runoff from Lakeside and never stabilized. In 2004, a team from NRRI and the City of Duluth identified the area as a potential restoration project.

They secured the $200,000 needed and in late 2008, with support from the Weber Initiative and Duluth Stormwater Utility funding, the project was budgeted, designed and permitted. Federal and state grants were also received to evaluate its effect on water quality, habitat, aquatic insects and fish.

Stabilizing the steep clay banks and stopping the erosion was the goal. The City and its consultant SEH, Inc. designed a 3-phase restoration including new culverts, flow rerouting, bank slope reductions and stabilization. Design engineers were given a narrow easement to work with so they decided that piping the tributary through the steepest sections offered the best long term solution to the head cutting of the banks. Two 48-inch storm sewers were installed in the first 185 feet of the tributary, and then a rip rap rock channel was built to carry the water the last 210 feet to the stream.

A plunge pool at the downstream end of the storm sewers will dissipate energy during high flow events to reduce downstream erosion. The construction was performed in fall 2009 when flows are usually low, and trout are not spawning. There will be extensive re-vegetation and tree planting work done this spring.
When it rains, it pours (into Amity Creek)

Before streets, rooftops and driveways came to Duluth, much of the precipitation falling on the forests soaked slowly into the ground. Water soaked into the earth following the deep roots of the trees and shrubs, and tree leaves reduced the amount of water reaching the ground by as much as 40 percent.

But today, forests are replaced by plentiful impervious surfaces that move water quickly away from homes, into storm sewers, and then directly into nearby streams. In the case of Amity Creek, big rain falls can add more water than the stream can handle. The banks erode, the water muddies and the critters in the stream struggle.

The problem of excessive stormwater is especially troublesome for certain hilly areas of Duluth, including Ivanhoe, Idlewild and Kingston Streets in the Lakeside neighborhood. Plagued by wet basements and icy roads, residents on these streets welcomed taking part in a scientific study to get control of their stormwater runoff.

“We are at the base of this hill, so the water goes from neighbor to neighbor and finally ends up right in our yard,” said Betty Base last summer. “We also have a problem with a spring on one side of our house.”

The collaborative team, headed by NRRI Scientist Valerie Brady, addressed individual water problems experienced by residents on Idlewild and worked to reduce runoff along the street. This meant re-digging a ditch system that runs between Kingston and Idlewild to the Base home and into a culvert. The springs were transformed into beautiful rain gardens and about 20 trees and shrubs were planted around Betty Base’s yard to help with water infiltration. Stormwater runoff problems were addressed as necessary at 21 homes on the street with rain barrels, swales, rain gardens and plants. Minnesota Conservation Corps students did most of the manual labor while also learning about the issue.

“We won’t know for sure until next spring when we have the big runoff whether the projects worked,” said Base after the work was completed, “but with the heavy rains we’ve had this fall, we’ve had no water problems and no standing water. We’re just thrilled.”

Retro-fitting an older neighborhood with innovative stormwater solutions is a progressive experiment to see if stormwater problems can be reduced, and by how much.

“Fixing this isn’t easy because the clay and bedrock on steep hillsides don’t give us a break,” said Brady.

The scientists have been measuring how much water flows from each street since spring. Ivanhoe and Kingston streets did not get stormwater reduction “fixes” so that they can be compared to Idlewild. Measurements taken again this spring will show how well their efforts work to keep excessive stormwater out of Amity Creek.

**COLLABORATIVE PROJECT TEAM**

City of Duluth  
University of Minnesota Duluth  
- Minnesota Sea Grant  
- Natural Resources Research Institute  
- Facilities Management  
- Office of Sustainability  
- University of Minnesota  
- Water Resources Center  
South St. Louis Soil and Water Conservation District  
Barr Engineering  
Minnesota Conservation Corps
See expanded page 6 timeline
"NRRI's 25 Years of Groundwork on Minnesota's Non-Ferrous Potential"
on separate PDF file (Winter 2010 timeline).
As one might guess, it’s not easy to take the temperature of the earth’s core.

Temperature readings down through 100 meters (about 330 feet) reflect the earth’s climate going backwards into the past century. Getting past that to the earth’s core temperature is important to accurately understand geothermal energy potential.

NRRI’s economic geologists are familiar with probing deep into the earth. They’ve been charged with collecting temperature data as deep as 500 meters (roughly 1,600 feet) into the earth from at least 100 water wells and mineral exploration holes across Minnesota.

“The biggest challenge is finding enough places to put the probe down a hole,” explained Steve Hauck, NRRI deputy director of Economic Geology. “In most cases, geology exploration holes are sealed when they’re done. That’s why we’re also seeking out Department of Natural Resources, Division of Waters, observation wells.”

This two-year project will provide data for an accurate map of Minnesota’s geothermal energy potential—something sorely missing as new energy sources are explored. NRRI is working with Will Gosnold, professor of geophysics at the University of North Dakota, Grand Forks. Gosnold will interpret the data collected by NRRI and build the new map.

“The temperature probe equipment was made especially for Dr. Gosnold 20 years ago for his research on the effect of climate on down-hole temperatures and heat flow from the core,” said Hauck. “It seems those probes aren’t made anymore, so we’re borrowing some very unique equipment to do this study.”

The project also includes collecting data from granite core samples to understand the rocks’ thermal conductivity and their inherent radioactivity from uranium-, potassium- and thorium-bearing minerals that contribute to heat flow. With that information, Gosnold will be able to determine how much heat is generated in the earth’s core and how fast it moves through the rock.

Even with the special equipment, collecting temperature data is a slow process for NRRI geologists Mark Severson and John Heine. The thermometer probe is lowered into the drill hole or well very slowly, reading every meter down to 100 meters—past the climate signal—and then every 10 meters down to about 500 meters.

“At this rate, they’re doing about two to three holes a day,” said Hauck. “They’re collecting data in subzero temperatures, so we bought them a heated ice house. We’ll just keep plugging away at it.”

The geothermal project is funded by the Minnesota Legislature through the Department of Commerce’s Office of Energy Security.

**ABOUT DEEP GEOTHERMAL ENERGY**

Deep geothermal energy captures the energy produced by the ever-churning, super-hot core of the earth. Capturing the earth’s heat for production of electricity requires locating a “hot spot” in the earth’s crust, drilling two or more deep drill holes, fracturing the rock enough to allow water to flow between the drill holes while becoming heated, and pumping the hot water to the surface to a plant that removes the heat from the water to make steam to drive a turbine that produces electricity. Geothermal energy is very clean. The U.S. Department of Energy says the geothermal power plants now in operation keep 4.1 million tons of carbon dioxide and hundreds of thousands of tons of other forms of air pollution out of the atmosphere each year. It is believed that deep geothermal energy is renewable for the next 4 to 5 billion years. It is capable of meeting large energy needs worldwide, and is much less expensive than fossil fuels.

Research by NRRI Geologist Steve Hauck indicates that Minnesota may have more geothermal heat potential than is shown in this 2004 map by the American Association of Petroleum Geologists (D.D. Blackwell and M. Richards). Collaboration with Will Gosnold, University of North Dakota, resulted in this state-funded study to get more accurate data.
Lucinda Johnson was appointed Director of NRRI’s Center for Water and the Environment. Her 20-plus years of research and managerial experience at NRRI, as well as serving as assistant and interim center director, uniquely qualified Johnson for the position.

“Dr. Johnson has been integral to our research programs over the past two decades,” said NRRI Director Mike Lalich. “Her early work at NRRI to establish a world-class Geographic Information System lab has proven to be a vital investment for us. Most of NRRI’s environmental and resources management studies have a landscape component, and these studies rely heavily on GIS analysis.”

NRRI’s Center for Water and the Environment has built a reputation for their commitment to understanding and solving the problems that impede the environmentally sound development of the economy. It works with NRRI’s Center for Applied Research and Technology Development to forward the institute’s overall mission of fostering the economic development of Minnesota’s natural resources in an environmentally sound manner to promote private sector employment.

Johnson understands the challenges of maintaining programmatic strength for the research center as state and federal funding gets tighter.

“We are looking forward to the opportunities presented by the federal Great Lakes Restoration Initiative,” said Johnson. “We have a number of projects related to our successful Great Lakes Environmental Initiative and north shore streams that we hope will be funded so we can continue our work in those areas.”

Johnson will manage the center’s research programs which included Aquatic Ecosystems, Forest Ecosystems, Land/Water Interface, and Environmental Chemistry. It operates under a multi-million dollar annual budget with research staff ranging from undergraduate students to senior researchers. She was hired at NRRI as Geographical Information System Manager in 1987 with a Bachelor of Arts degree from Duke University and a Master of Science degree in Environmental Science and Forestry from the State University of New York. She received her Ph.D. in Zoology from Michigan State University in 1999.

Johnson’s recent research focus has included effects of climate change on aquatic systems; effects of multiple stressors on aquatic communities; testing indicators of coastal ecosystem integrity using fish and macroinvertebrates; and development of protocols for selecting classification systems and reference conditions. She serves as the president of the Association of Ecosystem Research Centers and is president-elect of the North American Benthological Society.
Effects of forest fragmentation

Fragmentation disrupts animal travel corridors and creates barriers that isolate populations from potential breeding opportunities.

Following fragmentation, habitat for forest species that favor forest interiors (such as certain songbirds like orioles, tanagers, and wood thrushes) is lost and there is greater vulnerability to predators and nest robbers.

Species that cannot easily disperse, including reptiles and amphibians, are more likely to be harmed by forest fragmentation.

Smaller remaining forests are more susceptible to invasive species, often resulting in a loss of species diversity.

The loss of forested lands almost certainly means the loss of recreational lands.

With smaller forests, there is an increase in the frequency of conflicts between people and wildlife.

Scenic views are lost, making the places we choose to live and visit less beautiful.

By losing forests, we are losing the ability to clean the air and buffer our environment from pollution.

(Source: Minnesota Department of Natural Resources)

Definitions

Parcelization: The breaking up of larger forest parcels into smaller forest parcels.

Fragmentation: The conversion of forest parcels to non-forest parcels (development).
Just when we need it most, a young industry is ready to grow into maturity in the upper Midwest. It is capable of employing thousands in the wood products sector—from logging to manufacturing to sales.

The woody biofuel pellet industry is in place and poised to fuel residential stoves and wood pellet boilers for small businesses and schools. It’s a sustainable and renewable energy source that is also considered carbon neutral.

The need is there. But to grow and succeed, this young industry needs research, product development assistance and technical support. NRRI is uniquely qualified to provide that support and help the industry jump hurdles to be successful.

“We went out there and interviewed wood pellet manufacturers and industry suppliers in Minnesota, Wisconsin and Michigan. We toured their plants, we listened to their problems,” said NRRI scientist Tim Hagen. “Their industry is changing and for small- to mid-sized companies, they just don’t have the R&D capability.”

One big hurdle is that the industry started by pelletizing a wood industry by-product—sawdust. But as that source decreased and demand for pellets increased, pellet manufacturers turned to the forest to harvest wood, chip it, dry it and compress it into pellets. So what’s the problem?
“Now they’re seeing a whole range of different tree species coming into the plant, depending on what’s available,” said Hagen. “Each species reacts differently when pelletized and used for fuel.”

To further complicate matters, the pellet industry is also looking at alternative materials—agricultural wastes like corn stover and soybean hulls, for instance. The new feedstock will require a significant amount of analyses to understand the properties and BTU output.

Then there are uncertain fuel standards, on-going training, product development and improvement, chloride that causes pipe corrosion…and that’s just the beginning.

NRRI would like to establish a Great Lakes Woody Biofuel Pellet Research and Outreach Center—much like the agricultural industry has the Agricultural Utilization Research Institute (AURI) and the wood/plastics composite industry has Washington State University’s Wood Plastic Composite Information Center.

“We have a long history of working closely with the wood products industry to keep their businesses competitive—from OSB plants to lumber and many secondary wood products companies,” said NRRI Program Director Brian Brashaw. “This effort is based on industry pull and we’re responding. We have the good wood science and processing expertise and appropriate lab technology to get the center going. All we need is the funding to get this rolling.”

Brashaw is seeking funding to establish the center and begin research to match internal seed funding from NRRI and the USDA Wood Utilization Research Program. Their plan is to develop their pellet applications laboratory for a mid-summer start-up.

“‘To be successful, pellet fuels have to compete with fossil fuels. That means they have to be cost-efficient and consumers have to trust in the supply and the quality,” said Brashaw. “We can work in cooperation with the industry to support that, with non-biased, public research, industry short courses and technical assistance.”

Chris Wiberg, chief operating officer of Twin Ports Testing in Superior, Wisc., is also chairman of the pellet industry standards committee for the Pellet Fuels Institute. He said that pellet fuel trade associations would welcome this NRRI initiative.

“‘As incentives for using alternative fuels open up the markets over the next five years, this industry needs to be ready,’” said Wiberg. “‘We need to answer the questions, get the product ready for market, minimize the problems and turn out consistent quality from producer to producer. This is a real opportunity for our economy.’”

NRRI will tap Twin Ports Testing for their overall knowledge of the industry and for some testing and research development. AURI will also be a collaborative partner, building on their leadership and expertise in pelletizing agricultural by-products.
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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