

S *Semi-Annual Report*

July - December

2002



NATURAL RESOURCES
RESEARCH INSTITUTE

Our research goes to work.

Table of Contents NRRI Semi Annual Report July - December 2009

PROJECT HIGHLIGHTS	1-6
CENTER FOR APPLIED RESEARCH AND TECHNOLOGY DEVELOPMENT	7-77
Forest Products	
Agglomerated Corn Stover Oil Absorbent Beads	8
Creation of Energy Efficient Inorganic-Bonded Structural Insulated Panels	9
Epicurean Cutting Surfaces	10
Evaluation and Demonstration of Nondestructive Assessment Technologies for Sorting Eastern Hardwoods	11
Field Logic - NRRI Product Development Fund.....	12
Flue Gas Desulfurization (FGD) Gypsum Residual.....	13
Goodwill Industries, Inc. - NRRI Product Development Fund	14
Heat Treatment of Firewood - Meeting the Phytosanitary Requirements	15
House3: FEMA-Housing Assessment Tool Demonstration.....	16
Iron Phosphate Bonded OSB.....	17
Mat Inc. - NRRI Product Development Fund	18
Nondestructive Assessment of Advanced Composite Material.....	19
Phosphate Bonded Fiber and Waste Residual Composites for Applied Commercialization.....	20
Thermally-Modified Eastern Hardwoods as High-Tech Fenestration and Exterior Shuttering	21
Total Productive Maintenance for the Wood Products Industry	22
Use of Laser Scanning Technology to Obtain As-Built Records of Historic Covered Bridges	23
Wood Utilization Options for Urban Trees Infested by Invasive Species.....	24
Wood Utilization Research	25
Wood Utilization Research 2009	26
Forestry	
Assessment of Biomass Sources for Energy in Northern Minnesota for the Laurentian Energy Project.....	27
Indirect Liquefaction of Wood Waste for Remote Power Generation Fuel	28
Minnesota Forest Productivity Research Cooperative	29-30
Regional Biomass Feedstock Partnership-Poplar.....	31
Energy	
Regional Biomass Feedstock Partnership-Poplar.....	32
Polymetallic Gas to Liquid Catalysts	33
Environmental Chemical	
Distribution of Mercury During the Processing of Copper-Nickel Ores.....	34
Full Scale Mercury Sorbent Testing at Boswell.....	35
Investigation of Mercury Vaporization During Induration and Removal of Mercury from Scrubber Solids.....	36
Mercury Reduction Tests - Bench/Pilot Scale - Western Lake Superior Sanitary District	37
Slip Stream Pilot Plant for Testing Mercury Removal Methods for Taconite Flue Gases	38

Minerals, Ferrous

2009 USS Research Contract	39
Closing the Loop on Filter Cake Moisture Analysis and Control	40
Development of Engineered Tiles with Radiation Absorbing Properties from Taconite Raw Materials.....	41
Environmental Taconite Particulate Project-Mesothelioma.....	42
Evaluation of Tailings	43
Grant Writing and Grant Search for Minnesota Taconite Operations, State and Federal Department of Energy	44
Hydroseparator Modeling	45
Magnetic Separator Model Development.....	46
Mechanical Sampling Device for Hard to Sample Streams	47
Pellet Fines Removal System.....	48
Performance of Taconite Aggregates in Thin Lift HMA	49
Preclassification of the Final Stage of Magnetic Separation Feed	50
Research, Development and Marketing of Minnesota`s Iron Range Aggregate Materials for Midwest and National Transportation Applications	51
Shallow vs. Deep Bed Sinter Quality Comparison.....	52
Sinter Pot Equipment, Activation of the Coleraine Minerals Research Laboratory.....	53
Taconite Industry Products and By-products: An Investigation of Alternative Uses and Their Economic Potential	54
The Effect of Fluorine and Chlorine on Fired Pellet Metallurgical Properties.....	55
The Effect of Preheat Burners on a Straight Grate Induration Furnace.....	56
The Utility of Taconite Materials as Road Patch for Highway Construction.....	57
Up-Grade Computational Fluid Dynamic Cooler Models and Evaluate Bed Depth vs. Energy Recovery.....	58

Minerals, Industrial

Geologic and Stratigraphic Controls of the Aggregate Potential of the Mesabi Iron Range.....	59
--	----

Minerals, Non-Ferrous

Compile and Make Digital the Lithologic Data for all NRRI Drill Logs, Emphasis on Duluth Complex Drill Holes	60
Copper-Nickel-PGE Mineralization Potential of the Cloquet Lake Intrusion, NE MN	61
Further Evaluation of Diamond Base Metal, and Precious Mineral Potential of Minnesota.....	62
Heavy Stream Discharge from the Falcon Concentrator.....	63
History and Compilation of All Gold Exploration Data in Minnesota.....	64
Investigation of Various Flotation Reagent Schemes for the Flotation of Sulfides from Minnesota`s Copper-Nickel Deposits.....	65
Origin and Distribution of Chromium Mineralization in the Duluth Complex	66
Precambrian Research Center	67
Volcanogenic Massive Sulfide (VMS) Potential in Lake of the Woods, Koochiching & Beltrami Counties.....	68

Peat, Horticultural

Peat Expansion Premier Horticulture, Inc.....	69
Wetland Banking Fens Research Facility.....	70
Wetland Mitigation in Abandoned Gravel Pits	71

CARTD Program Notes.....	72-77
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CENTER FOR WATER AND THE ENVIRONMENT	78-111
ECOSYSTEM STUDIES - Land Resources	
Acceleration of Inorganic Nutrient Release and Mineral Organic Matter Association by Biophysical Soil Mixing along an Earthworm Invasion Chronosequence.....	79
Avian Migration within the Lake Superior Coastal Region.....	80
Bats and Wind Along the North Shore of Lake Superior.....	81
Biomass Harvest Effect on Wildlife (Minnesota).....	82
Canada Lynx and Snowshoe Hare Habitat Use Interactions.....	83
Exotic Earthworm Invasions: Integrated Research and Education to Achieve Natural Resource Protection.....	84
Grand Portage National Monument-Baseline Earthworm Survey.....	85
Lake Superior Carnivore Monitoring.....	86
Long-term Soil Productivity: Vegetation Sampling - Chippewa National Forest.....	87
Minnesota Breeding Bird Atlas.....	88
Monitoring Birds in Great Lakes National Forests.....	89
Prevention and Early Detection of Invasive Earthworms.....	90
Statewide Ecological Ranking of CRP Lands.....	91
Survey of Beaver Ecology in Grand Portage National Monument.....	92
Synoptic Mapping of Native Plant Communities of the Laurentian Mixed Forest.....	93
The North Shore Data Consortium: Acquiring and Distributing High-Resolution Geospatial Information.....	94
Vegetation Characterization and Conifer Regeneration Strategies for the Grand Portage National Monument.....	95
ECOSYSTEM STUDIES - Water Resources	
Assessing the Condition of Great Rivers using Benthic and Planktonic Algal Indicators.....	96
Data for Discovery and Decision-making: Lake Superior Streams.....	97
Duluth Residential Stormwater Reduction Demonstration.....	98
Ecosystems Study Area Working Group: Investigating the Effects of Changes in LakeLevel on Coastal Ecosystems ..	99
Great Lakes Biological Monitoring: Phytoplankton.....	100
Illustrating the Use of Conservation Easements to Mitigate Effects of Forest Parcelization.....	101
Landscape Metrics for Coastal Wetland Integrity Indices.....	102
International Upper Great Lakes Study Literature review.....	103
Low Impact Development on the North Shore: Lessons Learned.....	104
Minnesota`s Water Resources: Impacts of Climate Change - Phase II.....	105
Research Development Testing and Evaluation Facility for Ballast Treatment in the Great Lakes Region.....	106
Restoring Impaired Lake Superior Tributaries: Stormwater BMP Evaluation, Education, and Outreach.....	107
St. Louis River Watershed Streams and Lakes: Water Quality Biological Monitoring.....	108
Volunteer-Assisted Water Quality/Bio Monitor North Shore Superior Streams.....	109
CWE Program Notes.....	110-111
NRRI BUSINESS DEVELOPMENT	112-117
NRRI PUBLIC RELATIONS	118-119

Project Highlights

CENTER FOR APPLIED RESEARCH & TECHNOLOGY DEVELOPMENT

Wood Products and Forestry

New Hybrid Poplar Clones Being Propagated for Commercial Production

Work being done by the Minnesota Forest Productivity Cooperative has resulted in the development of new hybrid poplar clones that are being propagated for commercial production by Verso Paper, a paper mill in central Minnesota. Research done by the Natural Resources Research Institute has included breeding and field testing of new hybrids leading to the eventual recommendation for commercial production. This plantation program supplies roughly half of the raw material required by Verso's paper mill at Sartell, Minnesota.

Awarded \$325,000 to Expand the Genetic Resource of Hybrid Poplar

The Natural Resources Research Institute (NRRI) was awarded a grant of \$150,000 for the first year of a five year cooperative program between the NRRI, the Department of Energy, and the North Central SunGrant Initiative, located at South Dakota State University. The purpose of this project is to expand the genetic resource of hybrid poplar through breeding and field testing across a wide geographic range of the United States in cooperation with similar research institutions nationally. Funding in the amounts of \$150,000 in the first year and \$175,000 in the second year has been allocated to the Natural Resources Research Institute for this effort with additional funds anticipated in years three through five. The Natural Resources Research Institute is taking a central role in the coordination of research nationally.

Heat Treating Firewood to Eradicate Emerald Ash Borer Webinar

A webinar, hosted by the Natural Resources Research Institute in December, provided key information on the use of heat treatment to kill emerald ash borer in firewood to over 70 federal, state, and regional specialists. This webinar included presentations by Scott Myers, USDA Animal and Plant Health Inspection Service (APHIS); Rick Berglund, USDA Forest Products Laboratory; and former NRRI senior research associate Xiping Wang. The webinar provided critical information on the firewood heat treatment process for killing emerald ash borer, the parameters of the APHIS inspection program, and results from a NRRI research effort demonstrating the use of in-place temperature monitoring equipment and the time requirements for various species to reach the critical killing temperature for emerald ash borer.

Congress asks USDA to Incorporate Wood Utilization Research (WUR) into the FY 2012 Budget

With leadership from Congressman Oberstar and Senator Klobuchar, a group of 31 members of the U.S. House of Representatives and 19 members of the U.S. Senate sent letters to USDA Secretary, Tom Vilsack, asking him to include the successful Wood Utilization Research (WUR) program into the core USDA budget starting in 2012. The University of Minnesota Duluth NRRI began receiving funds from this special research grant in 1993 thanks to Congressman Oberstar's efforts. The program focused on helping enhance the competitiveness of Minnesota's wood product industry, has made a positive impact on small and medium-sized companies in Minnesota, helping to create and retain jobs. There are 11 WUR Centers throughout the U.S. working on national priorities with a regional emphasis.

NRRI Forest Products staff help lead 16th International Symposium on Nondestructive Testing and Evaluation of Wood

Brian Brashaw and Robert Vatalaro attended and made presentations at the 16th International Symposium on Nondestructive Testing and Evaluation of Wood, held October 10-13, 2010 in Beijing, China. Mr. Brashaw also served on the Organizing Committee for this Symposium, helping to coordinate over 70 technical presentations and posters provided by representatives from over 22 countries. Following the Symposium, Robert Ross and Xiping Wang of the USDA Forest Products Laboratory, along with Mr. Brashaw, gave an invited presentation on nondestructive inspection of historic structures to the City of Beijing's Cultural Heritage Administration.

Completion of the Construction of the FEMA Disaster Relief House – Unit One

Patrick Donahue and Scott Johnson completed the construction of the House3 – FEMA disaster relief demonstration house Unit One at the Coleraine Mineral Research Laboratory. This was a major milestone for the development of this breakthrough ready to assemble housing technology. The FEMA review and inspection will be scheduled in the 1st quarter of 2010.

The Market-Oriented Wood Technology Program has had Success Utilizing Energy-Efficient Inorganic Binders

In the Market-Oriented Wood Technology Programs EPA-funded project, “Research Into Phosphate-Bonded Fiber and Waste Residual Composites for Applied Commercialization,” we successfully created large-scale prototype panels for fire-rated door core, door stile and rail material, and niche fire door applications. We are currently working with our project partners to develop a possible research and collaboration agreement to tailor the properties of our panels to fit industry’s exact needs. In our University of Minnesota IREE-funded project, “Creation of energy-efficient inorganic-bonded structural insulated panels,” we have prototyped mineral-bonded strandboard panel skins and have scaled up to produce larger panels. Both of these projects utilize energy-efficient inorganic binders that have the potential to displace the petroleum-based resins traditionally used to manufacture wood-based panels. These binders require much less energy to produce than petroleum-based resins, plus they are less polluting as their manufacture releases fewer VOCs and they may be cured with less heat or no heat at all.

Energy

Biomass to Fine Chemicals and Energy

Igor Kolomitsyn and Andriy Khotkevych explored the differences in behavior of hardwood and softwood during thermochemical decomposition (torrefaction). It was found that torrefaction of softwood begins by the decomposition of the arabinoglucoronoxylan in the hemicelluloses. Naturally occurring monomolecular compounds are stable at these conditions. These findings may further help in fine-tuning the torrefaction process of woody biomass, as well as lead to development of a new technological pathway for manufacturing of bio-based chemicals. Scientific data were presented at the TCBiomass2009 conference in Chicago, September 2009.

Environmental Chemical

Environmental Study of Airborne Particulates on the Mesabi Iron Range

Air sampling has continued at Mesabi Range community sampling sites (Virginia, Silver Bay, Babbitt, Hibbing, Keewatin) and sites away from the Mesabi Iron Range (Duluth, Ely). In-plant sampling has also taken place at several locations (crusher, magnetic separator, agglomerator / ball drums, and kiln pellet discharge area) at the Northshore, Hibtac, Keetac, and ArcelorMittal mines. Laboratory analyses utilizing scanning electron microscopy / energy dispersive spectrometry, transmission electron microscopy, proton induced x-ray emission, and elutriator methodologies continues. Publishing and reporting protocols are being established with the University of Minnesota, School of Public Health.

Minerals

NuIron Nodular Reduced Iron Project

Several furnace runs were completed to evaluate current operating conditions for further process and equipment optimization. Process gas composition was measured and will be done in subsequent testwork for further verification of the furnace models and completion of the mass and energy balances. The influence of quality feed was determined in a series of tests to guide material handling systems design and fines removal from feed streams. In addition, both bench and pilot scale laboratory testwork were conducted to direct subsequent furnace operations using techniques for furnace control.

American Iron and Steel Institute (AISI) Project: Agglomeration and Green Ball Handling Study for the Paired Straight Hearth (PSH) Furnace

The objective of this study was to determine the green ball quality and material handling characteristics of both wet and dry coal-containing agglomerates that will be fed to a PSH furnace, to produce direct reduced iron (DRI). A device was fabricated to simulate the moving hearth of the PSH furnace, and green ball performance was evaluated for stacking a tall bed in an effective, stable, and economical manner. A conventional binder system using cooked starches or commercially available CMC (Carboxy Methyl Cellulose) binders added in slight excess was used to produce green balls capable of withstanding the material handling described for the Paired Straight Hearth furnace. Material handling characteristics for green balls prepared with iron ore concentrate and BOF sludge resulted in 99% or better retained integrity, or generation of less than 1% fines.

Plasma Arc Furnace Project

Research work is advancing using iron ore materials to produce architectural quality tiles with unique engineering attributes. Iron ore has successfully been melted at 2,800 degrees F in a plasma arc melting system installed at CMRL, and tests are being conducted to optimize processing conditions necessary to produce the unique UV and microwave radiation absorption properties of the tiles.

Direct Reduced Iron Project

A project is advancing to improve the physical quality of direct reduced iron pellets prior to ocean shipment to the electric arc furnace industry.

Minerals, Non-Ferrous

DOE Grant Submission for Carbon Dioxide (CO₂) Sequestration Project

A DOE grant proposal was submitted describing the use of Minnesota olivine resources to sequester CO₂. Olivine minerals (magnesium, iron silicates) are associated with many of our copper/nickel mineral deposits in Minnesota, and they provide a large resource of low-cost by-product material for use in permanent sequestration of CO₂ as magnesium carbonate, modeling the natural weathering process.

Peat, Industrial Products

Natural Product to Treat Environmental Problems

The Natural Resources Research Institute finalized the partnership agreement with American Peat Technology, a Minnesota company, to develop a technology for producing peat-based materials that will be used for waste water treatment. The outcome of this project has potential to create a significant industrial development opportunity for the region. Research is focusing on enhancing the natural ability of peat to attract and store toxic heavy metals such as lead, cadmium, mercury, etc. With chemical modifications, peat can also be used to attract anions such as phosphate, arsenate, etc. New peat products could potentially be used by various industries to treat waste water on site before discharging to surface waters.

CENTER FOR WATER AND THE ENVIRONMENT

Land Resources

Acceleration of Inorganic Nutrient Release and Mineral Organic Matter Association by Biophysical Soil Mixing Along an Earthworm Invasion Chronosequence

Our goal is to understand how and to what degree soil perturbation by earthworms affects the rates of chemical weathering and organic matter-mineral association in soils. Although earthworms are widely perceived to have beneficial influences on soil structure and nutrient dynamics, recent research has shown them to have negative impacts on soil structure, nutrient availability and water dynamics in cold-temperate hardwood forests.

Exotic Earthworm Invasions: Integrated Research and Education to Achieve Natural Resource Protection

We will conduct surveys for earthworms in each of eight state parks in the coastal zone (Jay Cooke, Gooseberry Falls, Split Rock, Tettegouche, George Crosby Manitou, Temperance River, Cascade River and Judge Magney). Walk through surveys of each park will provide distributional data on earthworm presence and absence across each park. A minimum of 12 stands in each park will be surveyed to assess the relative abundance and diversity of earthworm populations and the level of impact earthworm invasions are having on forest soils in a range of forest habitat and soil types in relation to human centers of activity in the parks.

Public education and involvement in this project is also a key component. We will present public programs at each park on the issues of exotic earthworms. Citizen volunteers and Minnesota Conservation Corp crews will be trained and assist in the detailed surveys at each park. Educational displays will be created for each state park highlighting the research and its results. All aspects of the research and education activities will be incorporated into the Great Lakes Worm Watch citizen science program (www.greatlakeswormwatch.org/).

Water Resources

Algae and Paleoecology

Members of NRRI-Ely's research team are gearing up for their seventh sampling cruise of the Great Lakes for the USEPA Great Lakes National Program Office's monitoring program. Phytoplankton collections from the research vessel Lake Guardian are being used to track long-term shifts in open-water conditions in the lakes. Data so far indicate that dramatic changes have occurred in the food web due to species invasions and several as-yet unexplained factors.

The Great Ships Initiative ballast water research facility is gearing up for a very busy summer evaluating three candidate treatment systems. Candidate treatments for ballast water are tested to determine if they are sufficiently effective to meet criteria for ship-board applications. NRRI personnel are ensuring that candidate treatments meet International Maritime Organization criteria for mortality of microorganisms, such as potentially invasive algae and protists being transported in the ballast water of ships. New and innovative methods to evaluate treatment effectiveness have been developed by NRRI personnel, and these methods are currently in review for publication.

A new project to collect sediment cores from Lake Superior has been initiated. This Sea Grant funded work will evaluate the long-term changes in the great lake to determine human impacts from various stressors such as pollution, climate change and changes to food web dynamics. Sediment cores will be collected from the research vessel Blue Heron this spring, and sediments will be analyzed for biological and chemical remains.

Upper Great Lakes Water Level Regulation Study

NRRI scientists are leading a group of Great Lakes coastal researchers working with the U.S. Army Corps of Engineers investigating the implications of changing the plan used to regulate water flow out of Lake Superior through the St. Marys River. The Water Level Study Board (with U.S. and Canadian interests represented) is exploring how to tweak water level regulation of Lake Superior to balance all interests in the Upper Great Lakes (shipping, tourism, coastal home owners, coastal ecology, etc.). NRRI put together a group of leading coastal Great Lakes researchers to help inform the study board of the potential effects on coastal ecosystems for various water level regulation scenarios. This project just started; researchers will be providing input to the study board over the next nine months.

Land/Water Interaction

Stream Restoration, Runoff Reduction

During the summer of 2009 the Lakeside Stormwater Runoff Reduction Project (led by NRRI personnel in conjunction with city of Duluth utilities staff) worked with homeowners in a two-block area of the Lakeside neighborhood in Duluth, Minnesota to reduce stormwater runoff, which runs from their neighborhood into Amity Creek. With help from Minnesota Conservation Corps youth work teams; we installed five rain gardens and twenty rain barrels. The Minnesota Conservation Corps crews dug eight storage sumps (3 x 3 x 3 ft holes filled with rock) and re-dug and restructured a stormwater ditch, including installing five ditch checks to slow stormwater and make it drop any dirt and trash it is carrying. Finally, Green Duluth youth helped us plant and seed wildflowers around the trees and shrubs planted last spring to help homeowners mow less lawn and let the stormwater better soak into the ground through the longer roots of the trees, shrubs, and wildflowers. Reducing the amount of stormwater runoff from city neighborhoods and streets is important to help protect Duluth streams from high, damaging flows and pollution picked up from city streets. During the summer of 2010 NRRI and Duluth utilities personnel will monitor the amount of runoff in the storm sewers to see how much it has been reduced.

The Weber Stream Restoration Initiative began in 2005 with a private endowment to create a partnership of University scientists and extension educators along with local, state, and federal agency staff to restore and protect Lake Superior basin trout streams (www.lakesuperiorstreams.org/weber/index.html). The initiative features a demonstration project targeting the sediment-impaired Amity Creek watershed for multiple restoration activities that include long-term monitoring and assessment using novel, interactive, web-based data visualizations of intensive real-time water quality where the stream discharges into western Lake Superior. The construction phase of three major projects was completed in the summer and fall of 2009: (1) bank stabilization and channel restoration of an intermittent tributary (Graves Rd Creek by Duluth, NRRI) to Amity fed largely by residential

stormwater; (2) two bank stabilizations, riparian zone re-vegetation, and in-stream flow diversion (J-vanes used for the first time on North Shore streams) on an upper watershed reach (South St. Louis County SWCD, NRRI); and (3) a neighborhood stormwater best management practices retrofit project (NRRI, Duluth, South St. Louis County SWCD, MN Conservation Corps, Barr Engineering).

Public Outreach/Information Dissemination

The Lakesuperiorstreams.org Website

The www.lakesuperiorstreams.org website (LSS) was developed by NRRI, MN Sea Grant, and the city of Duluth, Minnesota, as part of a regional effort to provide relevant water quality, landuse, and water quality impact data and interpretive materials, as well as prevention and remediation guidance to contractors, developers, realtors, agency staff, decision makers, and homeowners. The website has a strong emphasis on stormwater. It integrates animated, intensive data streams with climate and GIS landuse data, interpretive information, curricula, case studies, and a conservation design toolkit. There are five cross-linked, data-rich, educational/public access websites at NRRI that receive more than two million requests per month; LSS represents about 20-25% of those requests. The other four websites are: waterontheweb.org, mnbeaches.org, lakeaccess.org, and www.nrri.umn.edu/coastalGIS.

The LSS website continues to grow and peak in May and October every year, presumably in part due to student/teacher usage cycles. Overall website activity in 2009 totaled 5.27 million requests (similar to 'hits') and 1.01 million page requests; as of January 31, 2010, LSS had received 22,017,561 successful server requests and 4,689,730 successful page requests. The websites have received numerous awards at the regional, state, Great Lakes, and national scale (<http://www.lakesuperiorstreams.org/general/aboutus.html>)

Center for Research and Applied Technology Development

Corn Stover Agglomerates for Oil Sorbency Applications

Objective

This project seeks to identify a reactive two-part binding and agglomeration system capable of transforming delicate corn stover fibers into highly absorptive, free-flowing, porous granulates uniquely capable of absorbing a wide variety of hydrocarbon and water based fluids.

Background

Oil and coolant drips, leaks and spills from vehicles, machines, oil transfer units, and a myriad of business and personal activities account for nearly 36% of petroleum waste that is polluting the Nations surface water, ground water, surface soil and sub soil (US Dept. of the Interior Minerals Management Service). The usual cleanup method of these drips and spills on a hard surface is the use of clay or diatomaceous earth granules which are inefficient and pose expensive and potentially harmful disposal challenges, or polypropylene sorbents which are more efficient but are made from petroleum and present their own disposal problems. While no hard data exists, antidotal evidence indicates that as much as 60-70 percent of the clay based sorbents sold are disposed of improperly. Research performed by the University of Minnesota Duluth, Natural Resources Research Institute (NRRI) in cooperation with Clean Plus Inc. has demonstrated that the use of corn stover fiber shows promise as a highly absorbent medium for oils and other harmful fluids. Tests at NRRI have shown corn stover absorbs over five times more oil, on a pound for pound basis, than clay based sorbents.

Previous Activity

Five, two-part binder systems were evaluated to agglomerate corn stover particles. These include: lime/molasses, calcium sulfate/sodium silicate, boric acid/polyvinyl alcohol, boric acid/polyvinyl acetate, and guar gum/bentonite. The boric acid with polyvinyl alcohol (PVA) or polyvinyl acetate (PVAc) was found to provide the best performance value as evidenced by superior green strength, low dosage, and sorbency values of 5x or greater. A feed grind specification of minus 3/32 offered the most efficient means by which to form the agglomerates. PVAc/Boric acid system offered the best agglomeration potential, had superior green strength, had significant flame retardant properties, and met the lowest cost objectives. The optimal positioning of the feed of corn stover to the disc was in the upper left quarter section with binder addition just above that point. CPI staff was trained on the operation and optimal set-up parameters for the agglomeration system. Select distributors within CPI's network have shown remarkable interest in the product. An SBIR Phase I grant in the amount of \$79,812 was successfully obtained. Momentum continues to build around the potential of this technology and product.

Current Activity

An SBIR Phase II application was submitted in December 2009 to scale-up and prove the viability and use of corn stover agglomerates as a general purpose oil absorbent. Total requested funds were for \$398,739 and spans two years of development.

Principal Investigator(s)

Brian Brashaw
Timothy Hagen

Project Sponsor(s)

Clean Plus, Inc. (USDA prime)

Amount	Account	Active
25,231	3000-10414-00005616	05/01/2009 12/31/2009
Total	\$25,231	

Start Date: 05/01/2009

End Date: 12/31/2009

Project ID: 1549

Creation of Energy Efficient Inorganic-Bonded Structural Insulated Panels

Objective

Phase 1 objectives are to select suitable raw materials for the production of the inorganic binders that are compatible with low-value and underutilized wood fibers, fabricate bench-scale structural insulated panel samples, and optimize binder composition and content. Phase 2 objectives are to further define material compatibility and processing requirements, document environmental and economic benefits of the new structural insulated panels, and conduct energy and cost audits for the new structural insulated panels.

Background

This project combines the unique properties of chemically-bonded inorganic binders with those of regionally-sourced, low-value, and recycled wood fibers to develop moisture-, decay-, fire-, and mildew-resistant value-added structural insulated panels (SIPs). Specifically, this project will assess the technical and economic opportunity for developing new SIPs that contain not traditional oriented strandboard (OSB) skins, but chemically- and inorganic-bonded wood fiber skins. The environmentally-friendly and energy-efficient inorganic cements do not contain formaldehyde and are not petroleum-based, are manufactured from natural minerals, and set at room temperature in the presence of moisture. These binders – if used in place of petroleum-based PF and MDI resins – will significantly reduce the amount of energy required to make SIPs, reduce the negative environmental effects of petroleum-based resins, and offer products with greater durability and fungal resistance.

The new SIPs will be directly compared to conventional SIPs on the basis of strength-to-weight ratio, environmental integrity, cost competitiveness, recyclability, and ease of product use.

Previous Activity

This is a new project. No previous activity to report.

Current Activity

After many formulation trials, we have determined that the addition of fly ash to the binder mix may not be beneficial as it reduces the effectiveness of the MgO component of the binder. The most promising SIP skins are manufactured by briefly soaking the wood strands in a strong magnesium chloride solution (up to 133 percent concentration) and then sprinkling light-burned MgO powder onto the damp strands. This mixture is then consolidated under pressure, without heat, to form the panel. We have produced low-density skins of approximately one-inch thickness and higher density skins of approximately 0.75 inches. It appears that a wood to MgO ratio of approximately 0.65 produces a strong and stiff panel. We also believe that these skins may have applicability as a high-performing laminating platform for engineered wood flooring.

Principal Investigator(s)

Matthew Aro
Patrick Donahue

Project Sponsor(s)

MN Dept of Commerce

Amount Account

52,650 3005-10414-00011018

Active

06/01/2009 05/31/2010

Total \$52,650

Start Date: 07/01/2009

End Date: 05/31/2011

Project ID: 1551

Epicurean Cutting Surfaces

Objective

The goal is to assist Epicurean to complete the business and technical assessment required to successfully enter the field of resin saturated paper board production.

Background

Epicurean's specialty products have found success in the cooking accessories niche as food prep. and cutting board surface for both residential and commercial kitchens. Epicurean has seen continued growth and desires to develop other products both related to kitchen accessories and beyond. Vertically integrating composite board production as a core manufacturing capacity and taking full advantage of a regional base material supplier will lower Epicurean's cost of resin saturated boards for increased profitability and a stronger competitive advantage. This added capacity would improve Epicurean's long-term added-value business development potential.

Previous Activity

Several pilot plant trials were completed with difficulty in the performance of the paper feedstock. In the first trial, the paper supplied was not manufactured with National Food Safety-grade resin. This was not discovered until after the trial was complete. The second trial was only partially successful. The black composite panels work very well, however the tan paper failed because of decorative appearance. A third trial is being planned. Machine tool assessment was completed. The team traveled to Danville, Virginia, to inspect used equipment being considered for relocation to northern Minnesota. The assessment was very positive. The machine tools sourced seem to be ideal for the project. The cost to modify the machine tools, plant relocation, and plant set-up have been estimated and the purchase of the equipment is still pending.

Current Activity

Due to manufacturing and technical challenges our project partner has chosen not to pursue primary manufacturing of resin boards and instead will focus on remanufacturing opportunities assessing (1) flooring products manufactured from resin-saturated paper, and (2) acrylic-saturated natural wood cutting surfaces.

Principal Investigator(s)

Brian Brashaw

Patrick Donahue

Project Sponsor(s)

John S & James L. Knight Foundation

Amount Account

32,500 3001-10412-00009804

Active

11/01/2008 11/30/2010

Total

\$32,500

Start Date: 11/01/2008

End Date: 11/30/2010

Project ID: 1554

Evaluation and Demonstration of Nondestructive Assessment Technologies for Sorting Eastern Hardwoods

Objective

To evaluate several technologies including vibration, acoustic, tomography, thermography, and laser technologies for identifying critical material defects and for assessing potential product performance from hardwood materials prior to manufacturing into guitars and baseball bats, to assess the potential for these technologies to be used for other high value end products, and to identify commercial vendors that are capable of adapting equipment or developing new equipment.

Background

Recent advances in nondestructive assessment technologies offer opportunities to evaluate hardwood raw materials, particularly the potential quality of material that is used in the manufacture of high value specialty products. This proposed effort will focus on evaluation of several technologies for assessing the quality of material to be used in high value specialty products, with an emphasis on raw materials for use in manufacturing guitars and baseball bats. The outputs from this project would include an evaluation of these technologies and equipments, demonstration on these products, and the suitability for use in other high-value products.

Previous Activity

This is a new project.

Current Activity

A tour of both C.F. Martin Guitar (Nazareth, Pennsylvania) and Rawlings Adirondack (Dolgeville, New York) was completed to understand the types of defects and opportunities for including nondestructive evaluation technologies in their operations. The specific defects identified at C.F. Martin was identified as compression micro cracking that occurred from wind breaks during forest growth or harvest. Samples were obtained for conducting in-depth trials using nondestructive evaluation technologies such as thermography or laser shearography. A research plan was developed for Rawlings for implementation in 2010.

Principal Investigator(s)

Brian Brashaw

Project Sponsor(s)

USDA Forest Service

Amount Account

50,000 3002-10414-00008448

Active

07/01/2009 06/30/2010

Total

\$50,000

Start Date: 07/01/2009

End Date: 06/30/2010

Project ID: 1552

Field Logic - NRRRI Product Development Fund

Objective

To develop an engineered archery target from recycled foam and textile materials.

Background

Field Logic approached the Natural Resources Research Institute in regards to the formation and construction of an engineered archery target made from either waste textiles or polyurethane foam scraps. Their specific intent was to supplement their layered polyethylene targets with a low cost bag style target.

Previous Activity

Textile fibers were opened and blended with bi-component fibers to produce a lightweight bonded matrix capable of absorbing the kinetic energy from field tip arrows. The following types of fibers were investigated: cotton fibers, wood fibers, shoddy fibers, ceramic fibers, polyester fibers, polyester crimped, high loft fibers, kenaf fibers, and flax fibers. Several blends of fibers were produced using 6 x 12 in square molds to preliminarily evaluate mold ability and arrow stopping power. The blending and molding process encompassed opening the fibers on an opener, blending the fibers with a hot melt fiber, and compressing the fibers to a specified density into a mold. The molded mass was then heat activated at 315°F in a convection oven. Although several formulations appeared to have the required density of 6-8 pcf, mold ability and desirable arrow stopping capability, durability was significantly lacking as evidenced by “tunneling” throughout the fiberized matrix. This forced the project team to consider using polyurethane foam in the formulation. Efforts are now being directed at using steam cured polyisocyanates to bond foam scrap into engineered target structures. The scale-up and advancement of the densification and bonding procedure continues to be optimized in the pilot plant.

Current Activity

Although the arrow stopping capability of the bonded foam targets was initially impressive, durability was significantly lacking. The re-bonded foam particles were found to tear and deteriorate after only taking a marginal amount of arrow shootings. Deterioration and ultimate blow through happened as soon as 55 shootings. This led the development team to consider the addition of upholstery textiles intermixed with the foam in the targets. However, the inclusion of polyester upholstery scrap into the bond formulary only marginally improved the shooting durability. This ultimately led to the demise of this re-bonded foam formulation technique and forced the development team to again consider other alternatives. The team found ultimate success by using compressed un-bonded foam upholstery scraps. Field Logic sourced a viable supply of foam upholstery trimmings and designed a new manufacturing line to accommodate this material. They hired a production manager to oversee the implementation and production of this new target. Market introduction is planned for this year.

Principal Investigator(s)

Brian Brashaw
Timothy Hagen

Project Sponsor(s)	Amount	Account	Active
John S and James L Knight Foundation	29,241	3001-10412-00011032	12/01/2008 11/30/2010
Total	\$29,241		

Start Date: 02/01/2009 **End Date:** 12/31/2009 **Project ID:** 1546

Flue Gas Desulfurization (FGD) Gypsum Residual

Objective

To develop alternative uses for flue gas desulfurization gypsum.

Background

As Minnesota Power continues to improve flue gas emission reduction, the volume of waste flue gas desulfurization (FGD) gypsum increases. This study will review patent literature and current applications as they relate to FGD gypsum's wet use as an agricultural soil amendment. This project parallels a second project that focuses on process residual gypsum that could potentially be generated by any of the three proposed precious metal mining operations in Northern Minnesota. The volume of process residual gypsum that might be produced is significant.

Previous Activity

The key advantages of using FGD gypsum as a soil amendment (vs mined gypsum) are: better quality and consistency, ability to be used in conventional agricultural equipment, no need for mining, grinding, and transporting rock gypsum, extra "points" for using a recycled material, and great abundance east of the Mississippi River. Also, there is a reduction in energy use, greenhouse gas emissions, and ecological damage. Typical uses for FGD gypsum are as a nutrient source (calcium and sulfur) for crops, a conditioner to improve soil chemical properties, physical properties, and water infiltration and storage, and to reduce the transport of nutrients, sediment, pesticides, and other contaminants to surface waters/runoff. Agricultural experts were consulted, and some of the key findings pertinent to our region include: (1) Possible benefit to applying FGD gypsum to forage crops (including alfalfa) in the Twin Ports region of MN and WI; (2) Ability to increase yield of tomatoes and corn crops; (3) Possible improvement of potato growth on sandy soils in northern MN/WI; (4) Improvement of soil structure in red clay soils of northwest WI and northeast MN near Lake Superior; (5) Ability to add needed sulfur to central sand plains area of MN (in and around St. Cloud); and (6) The possibility to mix FGD gypsum with nitrogen fertilizer to create nitrogen sulfate fertilizer, which is used in the Red River Valley due to high soil pH. We have also clearly identified the steps required to receive legal permission to land apply FGD gypsum. Finally, if the FGD gypsum is to be land spread as is, there appears to be no patent infringement issues. However, if the FGD gypsum is mixed with other minerals and/or additives, or is granulated/pelletized prior to land spreading, a thorough patent review should be completed.

Current Activity

This project is complete. With our partners Minnesota Power and Iron Range Resources (with funding from Iron Range Resources and the University of Minnesota PUTF), we are using the results and knowledge gained in this project to further pursue and detail gypsum beneficial reuse options, not only for Minnesota Power, but also for PolyMet Mining Co.

Principal Investigator(s)

Matthew Aro

Patrick Donahue

Project Sponsor(s)

Minnesota Power

Amount Account

10,000 3000-10414-00007283

Active

12/15/2008 12/31/2009

Total

\$10,000

Start Date: 12/15/2008

End Date: 12/31/2009

Project ID: 1533

Goodwill Industries, Inc. - NRRI Product Development Fund

Objective

To develop and exploit a local market outlet for compacted mattress innersprings recovered from mattresses.

Background

Goodwill Industries, Inc. (GWI) operates a mattress recycling operation in Duluth, Minnesota. They have been operational since June 2004 processing over 46,000 units for deconstruction and recycling through 14 collection sites spanning ten counties in northeast Minnesota and Wisconsin. The operation has generated over \$282,699 in tipping fees, processed over 913 tons of steel, wood, cotton, foam toppers, and shoddy generating \$37,486 in sales for GWI and saved over 5,448 cubic yards of landfill space valued at \$169,962. These activities create steady work for five GWI individuals, contributing over \$294,000 in the form of wages and overhead to the local economy. GWI has been significantly challenged by deteriorating market outlets for the steel spring units recovered in their recycling operation. Previously, a local steel recycler would take the spring units and process them through an automobile shredding operation. However, the high tensile strength of the spring units have caused significant problems in the shredding operation and the processor recently banned any mattress or box spring unit from being accepted at the facility. This has caused an immediate backlog and buildup of stripped mattress and spring units at GWI. There is a critical need to find a sustainable and efficient means by which the steel mattress innersprings can be handled, properly processed, and prepared for sale into the local steel recycling market.

Previous Activity

A local engineer and designer, who after reading an article about mattress recycling in the NRRI Now, proposed a viable solution for the compaction and densification of stripped mattress innersprings. An initial working model of mattress compactor was completed and tested using actual mattress springs recovered from GWI. Tests revealed size and density matched the specifications of a local foundry. GWI continues to pave the way for cutting edge mattress recycling. Acquisition and full implementation of the mattress spring compactor at Goodwill's facilities is scheduled for third quarter of 2009. In a true cooperative effort, ME ElecMetal took a hard look at the chemistry and density of the steel springs and determined they could use it at their facility. A local start-up, Olaf Industries, Inc. provided the design, engineering, and fabrication of the mattress spring compactor. The NRRI, through its Coleraine Minerals Research Lab, provided the chemical analysis of the steel.

Current Activity

The acquisition, installation, and full implementation of the mattress spring compactor was delayed because of potential weight restrictions on the concrete floorings at Goodwill Industries, Inc. As a result, an engineering firm was hired to assess the potential floor loadings and recommend the best location for the spring compactor. Projected delivery and set up of the compactor is scheduled for mid January 2010.

Principal Investigator(s)

Brian Brashaw
Timothy Hagen

Project Sponsor(s)

Blandin Foundation

Amount	Account	Active
17,925	3001-10412-00009803	10/17/2008 04/01/2010
Total	\$17,925	

Start Date: 10/17/2008 **End Date:** 04/01/2010 **Project ID:** 1547

Heat Treatment of Firewood - Meeting the Phytosanitary Requirements

Objective

The purpose of this project is to transfer the knowledge and most advanced heat treating technology to field application through demonstration projects and via on-site and web-based training workshops.

Background

Due to the potential risk associated with moving emerald ash borer (EAB) infested firewood, the interstate movement of all hardwood firewood is currently restricted under the federal quarantine. Heat treatment is an approved treatment to kill the emerald ash borer in firewood and prevent their transfer between regions and states. However, states and firewood producers are faced with challenges on implementing a heat treating process and safely treating their firewood for interstate commerce. Federal Plant Protection and Quarantine officers and regulatory field staff have had little training and few internal resources to bring their knowledge of heat treatment operations to the level desired for program integrity.

Previous Activity

A cost-effective temperature monitoring system has been installed at Green Thumb Farm, Inc. We conducted the first training workshop on heat treatment of firewood in February 2009, covering the following topics: WI federal and state regulations on EAB infested firewood, current heat treatment standard for firewood and treating facility certification process, fundamentals of the heat treating process, and heat treating options, temperature monitoring, and thermal verification. The second temperature monitoring system was built and installed at John's Welding in Tomah, Wisconsin, in May 2009, incorporating a new thermocouple data logger. This data logger is powered directly by the USB port of a PC, allowing real-time monitoring of the heat treatment process.

Current Activity

Additional heat treatment demonstrations were conducted at three firewood treating facilities during this reporting period in Beardstown and Brazil, Illinois, and Tomah, Wisconsin. The purpose of these trials is to assess different types and configurations of temperature monitoring probes and data acquisition technology. The secondary purpose is to assess the performance of various types of heat treatment technologies and their capability for meeting the requirements for killing EAB. A web-based training seminar targeted at APHIS and state regulatory staff was conducted in December for over 50 people. The webinar featured Scott Myers, USDA APHIS, who provided an overview of new EAB developments and firewood regulations, with a focus on kiln certification process and monitoring requirements. Rick Bergman (USDA Forest Products Laboratory) presented the fundamentals of heat treatment facilities, energy sources, and kiln operations. Xiping Wang, formerly of the NRRI and currently with the Forest Products Laboratory, discussed key issues in heat treating firewood for EAB, with a focus on heat treating options, temperature monitoring, and thermal verification.

Principal Investigator(s)

Brian Brashaw

Project Sponsor(s)

USDA Forest Service

Amount	Account	Active
89,500	3002-10414-00005000	07/01/2008 06/30/2010
Total	\$89,500	

Start Date: 07/01/2008

End Date: 06/30/2010

Project ID: 1531

House3: FEMA-Housing Assessment Tool Demonstration

Objective

To build two demonstration buildings that serve Coleraine Minerals Research Laboratory's expanding office needs and also demonstrate ready to assemble housing technology for FEMA.

Background

The Natural Resources Research Institute has been creating an economic development initiative focused on wood based systems for transitional housing. The chief aim is maximizing the industrial development potential of added-value regional forest resources; resulting in new manufacturing and technology employment opportunities. The current work is based on a request by FEMA and will fulfill a need for additional temporary office space at the Coleraine Minerals Research Laboratory.

Previous Activity

Public private partnerships created with this project continue to flourish. The architectural and engineering in-kind has exceeded \$100,000. The donated materials and discounts on materials have been substantial; 18 private companies have provided materials free or at cost. The cooperation within the University of Minnesota has been outstanding. UMD Facilities Management and the Twin Cities Building Inspection Department has been proactively assisting the project with code compliance. The fabrication of the demonstration units has proceeded at a steady pace. The building materials have been from local or regional sources whenever possible. Noteworthy cooperation has occurred with WTW Construction Services, Inc. who has provided equipment, labor, and advice on a daily basis. WTW Construction Services, Inc. provided a Journeyman Union Carpenter to assist in the fabrication.

Current Activity

From July to October activities ranged from installing mechanicals in floor system prior to insulating, framing and siding, as well as dry runs of assembly, culminating with packing up and shipping to Coleraine for onsite assembly. From October to December activities included final finishing onsite of interior trim assemblies and work on exterior components for front and rear decks. Construction of Unit #2 began and is scheduled to be completed in April 2010. The FEMA Joint Housing Solutions Group – Housing Assessment inspection is scheduled for the week of April 12, 2010. A presentation was made to the Deputy Director of Public Safety of the State of Texas in early December resulting in a potential business development opportunity of 1,500 units. A three panel of sitting and retired judges from Texas are scheduled to inspect the CMRL demonstration units. There was a well received visit/tour by staff of the UMN Office of Technology Commercialization and General Counsel's Office. A project collaborator hosted an open house to build interest/support of community business leaders. Our technology partner from Austria visited in October.

Principal Investigator(s)

Patrick Donahue

Project Sponsor(s)

	Amount	Account	Active
Blandin Foundation	15,000	3001-10414-00006709	01/01/2009 01/01/2010
PUF Mineral Endowment	140,000	1750-10414-20090-	11/20/2008 06/30/2010
Total	\$155,000		

Start Date: 11/20/2008

End Date: 10/30/2009

Project ID: 1536

Iron Phosphate Bonded OSB

Objective

The overall objective is to demonstrate technology to produce iron phosphate-bonded oriented strandboard (OSB) building construction panels and thermally-conductive refractory board, both of which have the potential to outperform current products and reduce overall production energy requirements.

Background

This project proposes to develop novel oriented strandboard building construction panels and thermally-conductive refractory board using innovative inorganic iron-phosphate ceramic binders. These iron-phosphate binders may be useful for the treatment of a distinct and locally-available iron-rich feedstock – magnetite (Fe₃O₄) concentrate produced from the beneficiation of magnetic taconite. Fe₃O₄ generated from iron ore mining operations in northern Minnesota's Iron Range will be combined with an activator comprised of phosphoric acid (H₃PO₄) and/or other acids, phosphate salts, supplemental additives, and wood fibers with specific geometries to produce bench-scale iron phosphate-bonded OSB panels and thermally-conductive refractory board.

Previous Activity

Several prototypes were made to assess binder viscosity, heat evolution, activator concentration, and effects of various fillers. Preliminary results show that sodium phosphate (NaH₂PO₄) works well as the salt component of the activator. At this point, the ideal H₃PO₄: NaH₂PO₄ ratio appears to be 1.0:0.4. Extra H₂O (in addition to the water present in the activator mix) can be added at an approximate ratio of 1:1 (NaH₂PO₄: H₂O) without hindering the setting properties of the mix. There appears to be shrinkage cracks in the binder when it is applied as a sprayed-on thin coating to OSB substrate. Reasons for the shrinkage cracks could include excess H₂O or the binder setting too rapidly due to the pH differences between the binder components. Our next step will be to overcome the shrinkage issues. We will experiment with different salts (such as monopotassium phosphate which has a lower dissociation constant than NaH₂PO₄), various latex additives, and fiber reinforcement via short and thin fiberglass fibers (such as those used to reinforce concrete and reduce cracking). Also, we will experiment with using other phosphates (such as triple super phosphate) to replace the more expensive H₃PO₄.

Current Activity

Co-PI Tamara Diedrich left the NRRI approximately midway through the project. The main technical challenges with coating OSB with an iron-phosphate coating is that significant shrinkage of the coating occurs, thus causing wide scale cracking. We will refocus our efforts to look at new opportunities for iron phosphate-based products. We have learned that triple super-phosphate, magnetite, MgO, and NaH₂PO₄ (without the addition of H₃PO₄) can produce a rapid setting binder with good strength. Therefore, we will assess opportunities in the construction products field for using these new formulations.

Principal Investigator(s)

Matthew Aro
Patrick Donahue

Project Sponsor(s)

PUF Mineral Endowment

Amount Account

47,000

Active

08/27/2008 06/30/2010

Total

\$47,000

Start Date: 11/03/2008

End Date: 10/31/2009

Project ID: 1553

Mat Inc. - NRRI Product Development Fund

Objective

To develop sustainable market outlets for reclaimed mattress cotton.

Background

Mattress recycling is a viable and sustainable path way towards saving valuable air space in landfills. Partnerships with Goodwill Industries, Inc., the NRRI, and a local non-woven manufacturer, have shown cotton materials recovered from mattresses being used in filtering oil in diesel and locomotive engines. With the average mattress containing over 8 lbs of cotton and recent cotton prices hovering around \$0.42/lb, there are market forces contributing to the need and justification for finding ways to re-use mattress cotton. Until recently, market outlets for this material were few and far between. However, if the cotton batting is re-formed and processed with specially prepared wood fibers, it becomes a viable substrate to use in oil filtering applications. In addition, if these fibers are blended with lofted fibers, high-flow storm water filtration textiles become possible. Mat Inc. operates a 60 inch non-woven line which it uses to air lay synthetic and natural fibers such as wood, kenaf, jute, and flax into filtering and landscape fabrics. The NRRI has partnered Mat Inc. to develop product applications for mattress cotton spanning from storm water filtration and absorbent wipes to oil filtration mats

Previous Activity

Several product scenarios have shown potential. Working prototypes of a light weight, bonded composite fiber was recently provided to a storm water treatment firm for initial hydro-dynamic analysis and TSS reduction. A procedure for bonding the fibers together into a radial filter configuration was developed and refined. Initial integrity, durability, subsidence and TSS removal at lab scale level met performance objectives. Several formularies for a general purpose oil absorbent wipe were also recently evaluated and compared to conventional alternatives such as polypropylene. Results have shown sorbency ratios as high as 20x at basis weights of 28 to 35 gm per sq. ft. Several samples of the wipes were provided to Clean Plus , Inc for an internal sales and marketing evaluation.

Current Activity

Residual metal contaminants and staple fragments found in some of the re-processed filtration battings continue to prevent the further potential of using recovered mattress cotton for filtering applications. Many of the cotton battings recovered from individual mattresses have hundreds of staples that are difficult to remove manually. Several staples ended up in the re-laid battings produced at Mat Inc. This effectively put this application on hold until a reliable and fool proof method of removing the staples from the cotton is gained. The NRRI proposed a solution of opening the cotton, magnetically pulling off the staples, and capturing and rebaling the cotton battings into smaller bales. Goodwill Industries is considering this approach. A full size storm water filter met the objectives of 75% TSS removal at 15 gpm. Subsidence was found to be an issue for the full size filter.

Principal Investigator(s)

Brian Brashaw
Timothy Hagen

Project Sponsor(s)

	Amount	Account	Active
NRRI Prod Dev Fund/J&J Knight	25,000	3001-10412-00012499	11/15/2008 11/30/2010
Total	\$25,000		

Start Date: 07/17/2009 **End Date:** 12/31/2009 **Project ID:** 1548

Nondestructive Assessment of Advanced Composite Material

Objective

The purpose of this research is to investigate the potential of using several emerging nondestructive evaluation technologies to assess the performance of wood/nonwood based composite materials.

Background

As new wood/nonwood based composite materials are being developed and used in structural and nonstructural applications, their performance and product quality need to be tested as part of product development and production quality assurance. There is an urgent need from the manufacturers' perspective to develop effective nondestructive assessment procedures to evaluate the performance of these new composite materials and detect internal defects that could cause failure in-service.

Previous Activity

We have identified and reviewed several emerging nondestructive testing technologies by attending the 2008 American Society of Nondestructive Testing Conference and a subsequent literature search. The techniques with potential to meet the project's objectives include: (1) Portable laser shearography - a vibration resistant imaging laser interferometer, designed for the nondestructive inspection of aerospace composite repairs, structures, and components; (2) Infrared thermography - a widely used imaging technique for nondestructive inspection of different materials and structures; (3) Ultrasonic phased array system - incorporates an array of sensors to detect defects in different depths, provide B-, C-, and D-scans of the materials; (4) Resonant acoustic inspection system.

Current Activity

A meeting and tour was held with staff of Duluth's Cirrus Design to understand the NDE technologies used in inspection of airplane components. Several new companies were identified for assessing the use of thermography, noncontact acoustics, and laser shearography. Samples were obtained for assessment using advanced NDE techniques. These samples will be screened in future reporting periods to understand the potential of these advanced NDE techniques for application with wood products and materials.

Principal Investigator(s)

Brian Brashaw

Project Sponsor(s)

USDA Forest Products Lab

Amount Account

20,000

Total \$20,000

Active

07/14/2008 06/30/2010

Start Date: 07/14/2008

End Date: 06/30/2010

Project ID: 1532

Phosphate Bonded Fiber and Waste Residual Composites for Applied Commercialization

Objective

To develop durable building materials from paper mill waste using novel phosphate ceramic binders.

Background

This project has been funded by the Wisconsin Business Innovation Corporation with resources they received from the U.S. Environmental Protection Agency. There is over 3,000 tons of primary paper mill waste in Wisconsin daily. This waste consists of 50 percent fiber and 50 percent clay. The goal is to use novel mineral based binder technology to create a series of durable building materials using this waste stream as the primary manufacturing feedstock.

Previous Activity

Candidate magnesium oxychloride binders were researched and chosen. Prototype panels manufactured from paper mill residue and the candidate magnesium oxychloride binders were produced and analyzed. The prototypes were then shared with our industrial partner, Marshfield Door Systems. Marshfield Door Systems showed substantial interest in the prototypes; further, they asked for specific density and screw holding data. These parameters were tested and the preliminary data met Marshfield Door Systems technical requirements. Marshfield Door Systems has now asked for us to manufacture 3' x 3' x 1.75" panel prototypes to be subjected to pilot-scale burn testing in their burn laboratory. Flame spread and burn-through tests will be conducted on the pilot-scale prototypes. The data will then allow us to further refine the pilot-scale prototypes, if necessary, to enhance flame spread and burn-through properties. The next steps are to complete the pilot-scale burn tests at Marshfield Door Systems, refine the pilot-scale prototypes if necessary, retest, and then work with Marshfield Door Systems to identify options to incorporate our new technology into their product lines. We will also continue pursuing other door manufacturers who have shown interest in our technology.

Current Activity

We manufactured 3'x 3'x 1.75" prototype panels for burn testing at Marshfield Door Systems. In February, Matt Aro traveled to the company to witness the tests first-hand; the results were very impressive. After a 90-minute burn and water-spray test, the panels did not combust and they retained a substantial amount of their original strength and integrity. One concern is the panels tend to warp toward the heat source - we believe we can overcome this technical challenge. Marshfield Door Systems personnel appeared pleased with the results. They continue to see an opportunity for the panel to be used as door core, stile and rail material, or even niche products. We are currently working with the Wisconsin Business Innovation Corporation and Marshfield Door Systems to determine terms for a possible sponsored research project with Marshfield Door Systems. The goal of this project would be to conduct the technical tasks to bring our prototype concepts to commercialization, specifically for Marshfield Door Systems.

Principal Investigator(s)

Matthew Aro

Patrick Donahue

Project Sponsor(s)

	Amount	Account	Active
Wisconsin Bus Innov Corp-Prime EPA	136,407	1653-187-6609-00	11/01/2007 09/30/2010
Total	\$136,407		

Start Date: 11/01/2007 **End Date:** 09/30/2010 **Project ID:** 1501

Thermally-Modified Eastern Hardwoods as High-Tech Fenestration and Exterior Shuttering

Objective

To assess thermally modified wood as a feed stock for the regional wood window and door industry.

Background

The project goal is to analyze ThermoWood®-modified basswood and yellow poplar hardwood lumber with advanced screening methods developed by the Window and Door Manufacturers Association to provide a direct comparison of their performance properties with those of traditional softwood lumber used by the fenestration and exterior shuttering industry. The outcome will provide an opportunity for these advanced materials to be thoroughly vetted by manufacturers, engineers, and designers in the fenestration and exterior shuttering industries with a detailed technical baseline for new Eastern hardwood applications.

Previous Activity

Basswood and yellow poplar lumber was thermally modified at our partner's facilities. The lumber is currently undergoing a variety of mechanical and physical performance tests in the NRRI Mechanical Testing Laboratory. Even though the lumber has slightly reduced strength properties than traditional lumber, we believe the properties are sufficient for industrial use.

Current Activity

NRRI Scientists prepared samples from basswood lumber, yellow poplar lumber, red pine lumber, Southern yellow pine lumber, aspen-based hardboard, and aspen-based oriented strand board. The samples consisted of a set of thermally-modified wood fiber and a set of non-modified controls. Work was begun on the primary project objective of performance testing based on Window and Door Manufacturing Association (WDMA) Industrial Standard IS-10. WDMA IS-10 consists of 21 ASTM/WDMA performance testing protocols to understand the properties of modified and composite cellulosic fiber. 10 or 21 test protocols have been completed. The initial results indicate significant improvement in dimensional stability. The research focus has yielded an additional industrial development award. The new associated project is in collaboration with Lakehead University of Thunder Bay, Ontario, Canada. The focus is a planning grant to create a North American performance standard for thermally-modified lumber and composites. Three other grant proposals directly related to specific product and process development have been submitted and are pending.

Principal Investigator(s)

Patrick Donahue

Project Sponsor(s)

USDA Forest Service

Amount Account

47,514 3002-10414-00008459

Active

07/01/2009 06/30/2010

Total

\$47,514

Start Date: 07/01/2009

End Date: 06/30/2010

Project ID: 1550

Total Productive Maintenance for the Wood Products Industry

Objective

Develop customized total productive maintenance programs for wood products manufacturers through development of short courses and in-plant demonstration projects. A secondary objective is to use web-based video conferencing to conduct total productive maintenance training for regional groups of manufacturers as a means of reducing travel costs for employees and instructors.

Background

The project cooperators at Virginia Tech, Iowa State University, and the University of Minnesota Duluth have worked to help wood products manufacturers understand and implement lean manufacturing as a preferred continuous improvement program to support their economic stability and growth. Through these efforts, these cooperators have identified the need for wood products companies to strengthen their equipment reliability, minimize downtime, and improve productivity. Total productive maintenance programs are widely accepted as a key strategy by world class manufacturers as a means to satisfy these needs. The total productive maintenance concept grew from the broader lean manufacturing philosophy, which is based on continuous improvement.

Previous Activity

During the first six months of the project, our team of cooperators attended training from Fuss & O'Neil and the Marshall Institute and participated in total productive maintenance events at Andersen Windows (Bayport, MN), Merrilat (Akins, VA), and Anchor Packaging (Paragould, AK). A one day hands-on training course was developed and conducted for our wood products cooperators including Crystal Cabinet Works, Epicurean Cutting Surfaces, Shell Lake Furniture, Birchwood's Best, and Ferche Millwork. A relationship was established with ColdJet LLC, a manufacturer of dry ice blasting equipment used to clean equipment and other work surfaces. Using matching funds, we purchased a unit from ColdJet LLC for use in conducting demonstration projects. A comprehensive total product maintenance project was completed with Shell Lake Furniture in their stain and varnish spray booth, resulting in reduced time looking for materials and equipment, reduced downtime for their equipment, and improvements in finish quality.

Current Activity

An extension was approved by the project sponsor, extending the end date to December 31, 2010. This was due to challenges associated with the ongoing industry recession, as most cooperators have requested that we not conduct projects since they have reduced staff availability and cannot conduct activities that do not have an immediate payback.

Principal Investigator(s)

Brian Brashaw

Project Sponsor(s)

USDA Forest Service

Amount Account

95,479 1637-187-6601-00
\$95,479

Active

07/01/2007 12/31/2010

Total

Start Date: 07/01/2007

End Date: 12/31/2010

Project ID: 1467

Use of Laser Scanning Technology to Obtain As-Built Records of Historic Covered Bridges

Objective

To examine the technical feasibility of using laser scanning technologies for obtaining as-built records for historic, covered timber bridges.

Background

Covered bridges have been the fabric of American life. Today there are several hundred historic covered bridges remaining. Although there is much effort to preserve these structures, often times high cost of restoration, neglect, and vandalism takes its toll, and many are lost forever. One of the more famous bridges from "Bridges of Madison County movie" fame was burned down last year. The National Park Service's Historic American Engineering Record (HAER) has efforts underway to document historic structures and consists of measured and interpretive drawings, large-format photographs, and written historical reports. In order to assist in this effort newer technologies need to be explored which can provide as built records at a faster rate and with more accuracy. This research will explore the use of laser scanning technology to scan existing bridges for purposes of obtaining as-built records.

Previous Activity

This is a new project.

Current Activity

During this period, we have continued working with Faro, Inc., a laser equipment manufacturer to develop a strategy for using their equipment in this project. A previous Faro demonstration was held in July 2009 as a historic steel bridge was scanned on the grounds of Minnesota's St. Louis County Richard H. Hansen Public Works and Transportation Complex. At this point, we are still trying to arrange a demonstration and initial scan of a covered bridge in southern Wisconsin with Faro, Inc.

Principal Investigator(s)

Brian Brashaw

Project Sponsor(s)

USDA Forest Products Lab

Amount Account

50,000 3002-10414-00012627

Active

07/28/2009 06/30/2010

Total \$50,000

Start Date: 07/28/2009

End Date: 06/30/2010

Project ID: 1570

Wood Utilization Options for Urban Trees Infested by Invasive Species

Objective

To develop web-based information archives and user-friendly guidelines for assessing wood utilization options for woody materials obtained from trees infested by various invasive species.

Background

Invasive species have been identified as one of the four significant threats to our Nation's forest and rangeland ecosystems, characterized as a "catastrophic wildfire in slow motion." Emerald ash borer (EAB), for example, was discovered in southeastern Michigan in 2002 and has spread to many other states in the northeastern region of U.S. including Illinois, Wisconsin, and most recently Minnesota. As a result of infestation from invasive species, particularly EAB, tremendous numbers of infested trees are being removed each year for control and ultimate eradication of the pests. Proper utilization and safe disposal of woody biomass from these trees constitute challenges to many local communities and land owners. Urban forestry professionals are faced with the task of selecting appropriate utilization options for the materials and locating necessary technical information for making such decisions. Although many studies and wood utilization projects have been done for wood species attacked by invasive species, much of the basic information on wood materials, products options, and corresponding manufacturing requirements is scattered in technical reports prepared by universities and other research organizations. There is no central location (publications or websites) that fully addresses this need. As invasive species control efforts increase, a comprehensive wood utilization guideline is needed by urban communities and forestry professionals to quickly assess utilization options for wood obtained from infested trees.

Previous Activity

This is a new project.

Current Activity

A project planning meeting was held and used to develop the template for the chapters on wood utilization that needed to be developed. Specific sections will include: (1) Quarantine zones and their affect on wood supply movement; (2) Material properties of species affected by invasives; (3) wood utilization options; and (4) a special section on finishing wood. These sections will be developed during the winter, spring, and early summer of 2010.

Principal Investigator(s)

Brian Brashaw

Project Sponsor(s)

USDA Forest Service

Amount Account

46,845 3002-10414-00008444

Active

07/01/2009 06/30/2010

Total \$46,845

Start Date: 07/01/2009

End Date: 06/30/2010

Project ID: 1573

Wood Utilization Research

Objective

To help the forest products sector develop new products, new technologies, and new business systems to position Minnesota as a continued leader in wood products manufacturing and renewable energy.

Background

The Wood Utilization Research is a special research grant from the USDA Cooperative State Research Education and Extension Service. This program has been funded by Congress to provide needed research, education and outreach to the wood products industry to help enhance the competitiveness of the industry. These funds are leveraged with University state special funds to conduct applied research in the areas of wood materials and manufacturing, market oriented wood technology, applied forestry, and chemical derivatives, to facilitate economic growth and stability of Minnesota and other Lake States wood product manufacturers.

Previous Activity

Subprojects focused on total productive maintenance and thermal modification of wood were initiated. In the total productive maintenance effort, a band saw rebuild was initiated. A 1960 Northfield (Minneapolis, Minnesota) band saw is being used to return the equipment to original equipment condition. Dry ice blasting was successfully utilized to clean the equipment. Damaged or defective parts were ordered from the manufacturer. A case study is being prepared to document the potential for rebuilding equipment instead of purchasing new equipment. In the thermal modification project, opportunities for using basswood for window applications are being assessed. A relationship is being developed with Stellac, a European equipment manufacturer, for completing test runs for these materials so that samples can be developed.

Current Activity

Several new activities were completed during the reporting period. A total productive maintenance project was completed in cooperation with Loll Designs and Epicurean Cutting Services. This project focused on developing a daily operator inspection sheet, a critical spare parts list, and a schedule for planned maintenance for one of their CNC routers. As for the thermowood project, basswood and yellow poplar materials have been thermally treated and are being assessed to evaluate their structural performance. This testing is ongoing.

Principal Investigator(s)

Brian Brashaw

Project Sponsor(s)

	Amount	Account	Active
USDA Coop ST Res ED&Ext Srvc(CSREES)	163,130	3002-10414-00000-00002756	09/01/2008 08/31/2010
Total	\$163,130		

Start Date: 09/01/2008

End Date: 08/31/2010

Project ID: 1538

Wood Utilization Research 2009

Objective

To help the forest products sector develop new products, new technologies, and new business systems to position Minnesota as a continued leader in wood products manufacturing and renewable energy.

Background

The overall objective of the project is to complement a program of the University of Minnesota Duluth Natural Resources Research Institute. Major goals include: (1) helping existing small and mid-size wood products companies remain or become competitive through research and development; (2) conducting forest productivity work in hybrid poplar, red pine, and other Minnesota species to ensure the sustainability of the forest products industry and to help Minnesota meet their 2025 renewable energy mandate; and (3) formation of new regional industries based on forest products materials and technologies. Specific sub-projects include the following topics: (1) development of assessment models for woody biomass utilization; (2) fenestration development using thermally modified wood; and (3) development of new silicone/cellulose sealant/rubber materials.

Previous Activity

This is a new project.

Current Activity

This is a new project and activities are just being initiated during this reporting period.

Principal Investigator(s)

Brian Brashaw

Project Sponsor(s)	Amount	Account	Active
USDA Coop ST Res ED & Ext Srvc(CSREES)	147,372	3002-10414-00000-00011599	09/01/2009 08/31/2011
Total	\$147,372		

Start Date: 09/01/2009 **End Date:** 08/31/2011 **Project ID:** 1572

Assessment of Biomass Sources for Energy in Northern Minnesota for the Laurentian Energy Project

Objective

To assess resources and economic feasibility of procuring woody biomass from poplar plantations, brushlands, and forest harvest residues for energy for the Laurentian Energy Authority project.

Background

This project is funded through the US Department of Energy with the purpose to assess the feasibility of producing woody biomass for energy for delivery to the Laurentian Energy Authority facilities in Virginia and Hibbing, located in northern Minnesota. The project will evaluate the economic and practical feasibility of the various biomass options and conduct research on plantation forestry and harvesting of brushlands. The following tasks are part of this project: (1) Assessment of Best Management Practices for Harvesting of Brushlands and Forest Harvest Residues, (2) Development and Analysis of Best Available Technology for Harvesting Brushlands, (3) Biomass Availability and Collection Technology for Forest Harvest Residues, (4) Biomass Availability from Rights-of-Way and, (5) Evaluation of Available Soils and Variation in Productivity of Hybrid Poplar Plantations.

Previous Activity

A part of the project involves assessment of poplar clone performance on various study sites in northern Minnesota. Data have been collected on both clone tests and yield blocks in the 2007 planting during the quarter. Survival on new clone tests planted in 2008 at the Thief River Falls site is greater than 90 percent. Height growth of two year old yield blocks varies significantly by clone with the new set of 9,732-family clones performing well. Average heights of these clones range from 2.5 to 3.0 meters after two years which is very typical of the best-performing hybrids in similar tests in other regions of the state.

Current Activity

This project is currently being extended and amended to include analysis of Red Pine and Aspen biomass production for energy in addition to the current research topics. Work done during the reporting period include analysis of biomass distribution in Red Pine. Our results to date show that top and limb biomass as a proportion of round wood biomass is higher than expected ranging from 40 to 50 percent. This has implications to resources for energy, particularly as stands are being thinned. Work continues on establishment of the research network to evaluate growth of Red Pine stand following first-thinning. At this time, 12 sites have either been thinned or readied for installation of thinning treatments in large replicated blocks. Research on soils resources done during the reporting period include procurement of the SSURGO dataset, a detailed database of soils information published by the USDA and loading of these data into a GIS system at the NRRI. Analysis of poplar yield data show that relatively high biomass yields are possible with DN5, a *P. deltoides* X *P. nigra* in northwestern Minnesota. Average annual increment of stands of DN5 are 4.4 oven dry tons per acre per year, near the high end of the range of expected yield in Minnesota.

Principal Investigator(s)

William Berguson

Project Sponsor(s)

Laurentian Energy Authority LLC (USDOE)

Amount Account

455,265 1906-187-6616-00

Active

01/01/2007 09/30/2009

Total

\$455,265

Start Date: 01/01/2007

End Date: 09/30/2009

Project ID: 1513

Indirect Liquefaction of Wood Waste for Remote Power Generation Fuel

Objective

To evaluate the potential to produce methanol through thermochemical processes using wood resources native to Minnesota.

Background

The purpose of this project is to assist the University of North Dakota, Energy and Environmental Research Center (EERC) in the development and on-site testing of a portable gasification-to-methanol process unit. The participation of the UM-NRRI includes two tasks: (1) assistance in the location of an adequate site for testing of the mobile fuel production system; and (2) assessment of wood resources for conversion to liquid fuels in Minnesota. The UM-NRRI will assist the EERC in locating a test site that meets the requirements of the project. Also, we will assist the EERC in identifying and locating sources of wood species that may be particularly suitable for conversion to liquid fuels. We will recommend species-specific tests based on volume availability and price and assist in arranging for shipment of biomass materials to the test site as needed by EERC staff.

Previous Activity

This is a new project.

Current Activity

Contacts have been made with an owner of a facility that may be suitable for the eventual testing of the mobile, truck-mounted liquid fuels production system. We are evaluating electrical, waste disposal, and network connection capabilities of the facility. The fuels production unit is expected to be available for on-site testing in the fall of 2010 and the preferred site will be in the forested zone. Also, we have been in contact with the EERC to begin the process of developing a plan to bring the required raw material to the site for testing. At this time, the project is in the early stages and work is expected to begin to identify a suitable site and contact loggers to supply wood for gasification and conversion tests in the summer of 2010.

Principal Investigator(s)

William Berguson

Project Sponsor(s)

	Amount	Account	Active
Univ of North Dakota (Prime: USDOE)	24,693	3014-10414-00011388	01/01/2009 12/31/2010
Total	\$24,693		

Start Date: 01/01/2009 **End Date:** 12/31/2010 **Project ID:** 1574

Minnesota Forest Productivity Research Cooperative

Objective

To improve the productivity and value of natural stands and plantations in Minnesota, develop economically and environmentally sound silvicultural practices, and transfer this knowledge to Minnesota Forest Productivity Research Cooperative (MFPRC) members and the public.

Background

This MFPRC is a consortium of University of Minnesota personnel, industry members, and the USDA Forest Service with the purpose to enhance the productivity of Minnesota's forests. Research done as part of the MFPRC includes Norway Pine management, aspen productivity research, and hybrid poplar genetics and yield improvement. The goal of Norway Pine research proposed is to better understand productivity of Norway Pine plantations and optimize management of these stands both in terms of productivity and value. Aspen research is concentrating on assessment of productivity of regenerating aspen stands, an important issue as it relates to future wood resources. Hybrid poplar breeding and yield improvement is ongoing and replaces the previous activity done as part of the MFPRC.

Previous Activity

Work was ongoing to establish the set of experiments to evaluate biological impacts of thinning on productivity of Aspen and Red Pine. Progress continued toward establishing a large network of multi-treatment thinning studies in young Red Pine stands. We have nine Red Pine thinning sites that have been established with a total of 13 study sites slated for establishment. Also, we continued to establish thinning studies in Aspen in cooperation with the Minnesota Department of Natural Resources. We collected data from all of these sites. Poplar breeding has been successful this year with 84 crosses made in the NRRI greenhouse facility.

Current Activity

Red pine thinning research continues with a total of nine research sites established to date. An additional four sites have been identified for establishment of new studies in the spring of 2010. All trials consist of a variety of thinning treatments including above, below, and average-diameter thinning with varying levels of residual stand basal area. Results of our oldest trial at age four shows that incremental stand growth after thinning is most sensitive to trees per acre and not residual basal area. The treatment leaving the lowest number of trees is the thin-from-below to 60 square feet total stand basal area. This treatment resulted in a depression in near-term stand growth following thinning with most other treatments being equal to the unthinned control. Research on the effect of mechanical strip thinning of aspen continues with nine trials actively being measured. Results show that 19 years after thinning (average stand age 29), the merchantable volume in thinned treatments is 18% greater than in unthinned controls. We continue to establish new thinning trials in older stands to determine the effects of thinning at mid-rotation (age 25) on subsequent production.

Principal Investigator(s)

William Berguson

Project Sponsor(s)	Amount	Account	Active
MN Power	20,000	1664-187-6594-00	07/01/2006 12/31/2006
MN Dept of Natural Resources (DNR)	400,000	1663-187-6581-00	07/01/2005 06/30/2007
Blandin Paper Company	20,000	1664-187-6534-00	11/01/2004 06/30/2005
Boise White Paper LLC	20,000	1664-187-6535-00	07/09/2004 06/30/2005
International Paper Company	20,000	1664-187-6536-00	09/01/2004 06/30/2005
Minnesota Power	20,000	1664-187-6537-00	07/14/2004 06/30/2005
Potlatch Corporation	20,000	1664-187-6538-00	10/28/2004 06/30/2005
Forest Capital Partners LLC	20,000	1664-187-6558-00	07/01/2005 06/30/2006
International Paper Company	20,000	1664-187-6559-00	07/01/2005 06/30/2006
MN Power	20,000	1664-187-6560-00	07/01/2005 06/30/2006
Plum Creek	20,000	1664-187-6561-00	07/01/2005 06/30/2006
Potlatch Corporation	20,000	1664-187-6562-00	07/01/2005 06/30/2006
MN Dep of Natural Resources(DNR)	40,000	1663-187-6542-00	11/30/2004 06/30/2007
Forest Capital Partners LLC	20,000	1664-187-6593-00	01/01/2007 06/30/2008
MN DNR	200,000	3005-10414-00005642	06/26/2008 06/30/2009

Plum Creek	20,000	1664-187-6595-00	01/01/2007	06/30/2008
Blandin Paper Company	20,000	1664-187-6597-00	01/01/2007	06/30/2008
Verso Paper	20,000	1664-187-6598-00	01/01/2007	06/30/2008
St Louis County Land Department	20,000	1676-187-6585-00	11/15/2005	06/30/2007
Minnesota Power	20,000	3000-10414-00006971	12/17/2008	12/31/2009
Blandin Paper Company	20,000	3000-10414-00006973	12/01/2008	12/31/2009
Forest Capital Partners, LLC	20,000	3000-10414-00006974	12/05/2008	12/31/2010
Potlatch Corporation	20,000	3000-10414-00006975	12/01/2008	12/31/2009
Verso Paper	20,000	3000-10414-00006976	12/01/2008	12/31/2009
Plum Creek Timber Company, Inc	20,000	3000-10414-00007251	12/01/2008	12/31/2009
St Louis County	20,000	3003-10414-00011548	07/01/2009	06/30/2010
State of Minnesota	20,000	3005-10414-00005615	07/01/2007	06/30/2009
Blandin Paper Company	20,000	1664-187-6563-00	07/01/2005	06/30/2006
Total		\$1,140,000		

Start Date: 10/28/2004 **End Date:** 06/30/2010 **Project ID:** 1363

Regional Biomass Feedstock Partnership-Poplar

Objective

To conduct research to determine biomass yields of short rotation woody crops using poplar and develop new high-yielding, disease-resistant poplar clones for biomass production nationally.

Background

This project is part of the DOE-funded SunGrant Initiative's Biomass Feedstock Partnership national effort to develop dedicated biomass crops for production of renewable energy. The purpose of this research is to improve yields of woody crops for energy production focusing on poplar species. The research team is national in scope and consists of personnel from the University of Minnesota-NRRI, GreenWood Resources (Portland, OR), Mississippi State University and ArborGen LLC (Summerville, SC) which has a history of research in the genetic improvement and production of poplars as well as commercial application of poplar plantations for fiber and energy production. The project is viewed as a first step in a process to develop a longer term plan leading to improvement of biomass yield through genetic improvement and plantation management research. Proposed research involves analysis of the state of current poplar research, evaluation of the potential land resource suitable for poplar production and establishment of new genetic material at various locations across the U.S. to evaluate genotype performance over a range of conditions.

Previous Activity

This is a new project.

Current Activity

One of the tasks of the SunGrant poplar team is to describe the history of past and current poplar research and commercial development in the various regions of the U.S. We anticipate a draft of sections of the report being done by April of 2010. Tasks identified include work to explore opportunities to expand the dataset of plantation yield in the Southeast U.S. and begin to contact researchers that are known to have conducted poplar research in the past. We are in the process of determining availability of archived yield data produced by the Mead/Westvaco program in Kentucky as well as programs in the South, Midwest and the Pacific Northwest. These data are to be used in analyses of national biomass production potential such as the Billion Ton Study undertaken by the DOE. In addition to description of past research, this group is in the process of establishing new trials of poplar clones nationally. Several field study sites have been planted in Minnesota, Oregon, and Georgia in the spring of 2009 with more slated for establishment in 2010 in Minnesota, Oregon, Georgia, Mississippi, and Missouri.

Principal Investigator(s)

William Berguson

Project Sponsor(s)

	Amount	Account	Active
South Dakota State Univ-(USDOE-prime)	149,791	3014-10414-00012404	01/01/2009 09/30/2010
Total	\$149,791		

Start Date: 01/01/2009 **End Date:** 09/30/2010 **Project ID:** 1571

Minnesota's Geothermal Energy Production

Objective

To: (1) Collect downhole temperatures from over 100 water wells and exploration drill holes; (2) Collect, analyze, and describe 100 granite samples; and (3) Issue a final report with the new heat flow and temperature vs. depth maps.

Background

Enhanced Geothermal Systems (EGS) for future energy recovery are one of the primary technologies needed for future electrical power and/or thermal heat production systems. The U.S. Dept of Energy (DOE) in their 2007 study conducted by Massachusetts Institute of Technology (MIT) concludes that EGS extraction is one of the most promising clean energy technologies that can be used nationwide. EGS could provide 100 GWe (gigawatt electricity) or more of cost-competitive generating capacity in the next 50 years at sites throughout the U.S.A. where geothermal heat transfer conditions, rock stability, and appropriate hydrothermal environments are present at depths greater than 5 km. However, the heat flow and temperature versus depth maps in the DOE-MIT report indicate that temperatures at depth in Minnesota are very cold based on four data points within Minnesota and about 90 data points under Lake Superior. All but one of these data points were collected 2.5 meters under lakes. Temperatures at these shallow depths are affected by climate, and recent research has shown that temperatures begin to stabilize at about 300 ft. or 100 meters, which eliminates all but one of the previous data points.

Previous Activity

This is a new project.

Current Activity

The downhole temperature probe and related equipment and operational training occurred November 17-19, 2009, by Dr. William Gosnold (Consultant) at the University of North Dakota-Grand Forks. Temperature collection began in December at Rio Tinto/Kennecott's Tamarack Nickel-Copper deposit near Tamarack in Carlton County, MN, over two days. Downhole temperature data were collected from three of the four drill holes that we were allowed to access. The fourth drill hole was plugged at ~12 ft. Temperature data collection then moved to Duluth Metals Corporation's (DMC) Nokomis Cu-Ni-PGE deposit southeast of Ely, MN, in Lake County. Due to cold temperatures, data collection was slower, but good data from six drill holes (with one reprobated) were obtained over the 3+ mile width of the deposit. Temperature data collected in each instance were entered into an Excel database in a format specified by Dr. Gosnold. Drill hole location data, depth of hole, probed depth of hole, and temperature readings were entered and related to an ArcGIS file that illustrated the topography with the location of the probed drill holes. Also, three granite samples and one mineralized gabbro sample were collected at DMC for follow-up thermal conductivity and radionuclide study by Dr. Gosnold. Drill hole rock samples were requested and promised from Rio Tinto/Kennecott, but were not received by the end of the quarter due to the start of their winter drilling program.

Principal Investigator(s)

Steven Hauck

Project Sponsor(s)

	Amount	Account	Active
PUF Mineral Endowment	40,000	1750-10416-20090-	08/25/2009 06/30/2010
NMN Dept of Commerce	300,000	3005-10416-00013310	11/02/2009 09/30/2011
Total	\$340,000		

Start Date: 11/22/2009 **End Date:** 09/30/2011 **Project ID:** 1580

Polymetallic Gas to Liquid Catalysts

Objective

To conduct research and development to produce novel catalysts for thermochemical processing of biofuels based on local mineral sources.

Background

Recent publications show the significant potential of polymetallic catalysts in Fischer-Tropsch Reaction and related processes. Compared to the traditional pure iron or cobalt formulations, modification of iron catalysts with copper, chromium, titanium, manganese and/or others gives better conversion, improves the lifetime of the catalyst, positively influences the "C5+" selectivity and other parameters. Preparation of polymetallic catalysts requires multistep procedures to obtain the proper composition. On the other side, a number of minerals available for mining in Minnesota, such as ilmenite and magnetite, already contain the necessary metals in good proportion alongside the proper carrier compounds. These minerals may show the catalytic activity, and may be valuable for gas to liquid technology.

Previous Activity

Experiments on Syngas conversion have been conducted in order to explore the commercial potential of ilmenite-based polymetallic catalysts. Studies included tests on comparative activity, lifetime tests, and study of side processes – water gas shifting and isomerization. Separate tests have been conducted for optimization of the first stage of processing the catalysts - the alkaline fusion of ilmenite. A number of complex iron titanate catalysts have been synthesized using this approach and have been tested in the Fischer-Tropsch process.

Current Activity

Study of ilmenite-based catalysts has continued in the direction of conversion of low-hydrogen (below 50% hydrogen) Syngas. This composition is typical for Syngas obtained via biomass gasification. It was found that ilmenite-based catalysts, modified with additional amounts of iron or cobalt, are working well for this purpose. Physically, these catalysts activate the water gas shift reaction, which is a source of extra hydrogen needed to complete the Fischer-Tropsch process with a proper yield. Systematic study of a combined Fischer-Tropsch/water gas shift process was conducted using a variety of catalysts at variable process conditions (temperature, gas composition, pressure, flow rate). From April through September 2009, the Coleraine Minerals Research Lab conducted tests on thermal pretreatment of commercial wood samples. This was a joint study with D. Fosnacht and I. Kolomitsyn of the University of Minnesota Duluth's Natural Resources Research Institute (NRRI) Center for Applied Research & Technology Development (CARTD). As a result, we found the optimal range of parameters for devolatilization of wood biomass. Certain differences in the behavior of hardwood and softwood during the devolatilization process were also discovered. Results of this research were presented as a poster at the TCBiomass09 International Conference (Chicago, Sept. 16-18, 2009). The poster is available at the conference website: http://media.godashboard.com//gti/TCBiomass2009_Poster_IKolomitsyn.pdf

Principal Investigator(s)

Andriy Khotkevych
David Hendrickson
Richard Kiesel

Project Sponsor(s)

PUF Mineral Endowment

Amount Account

115,000 1896-783-1239-00
Total \$115,000

Active

02/29/2008 06/30/2010

Start Date: 02/29/2008

End Date: 06/30/2010

Project ID: 1500

Distribution of Mercury During the Processing of Copper-Nickel Ores

Objective

To determine the distribution of mercury during flotation and subsequent pressure leaching of the bulk flotation concentrate.

Background

The development of a copper-nickel mine and processing plant would be a large economic boost to the area. The proposed development area is within the Lake Superior Basin, which is an environmentally sensitive area. Therefore, mercury in the ore and resultant concentrates and tailings will be of great concern. Preliminary analyses of pulp samples from previous copper-nickel studies indicated a mercury concentration in the head sample of 65 nanograms per gram (ng/g) (or parts per billion - ppb) and 108 ng/g in a flotation concentrate sample. It should be noted that the samples had been previously pulverized (with no effort to prevent mercury contamination) and had been stored in paper envelopes for as long as nine years prior to analyses. While the absolute values of the above analyses may be suspect, they do indicate the presence of mercury in the ore and in the concentrate.

Previous Activity

An autoclave was being purchased to be able to accomplish the leaching test work.

Current Activity

It was decided to collect fresh concentrate for the autoclave tests from the "Investigation of Various Flotation Reagent Schemes for the Flotation of Sulfides from Minnesota's Copper-Nickel Deposits," previously reported under #1556 in this NRRRI semi-annual report Project Tracking system. New flotation concentrate will thus be prepared for the autoclave pressure leaching work. Mercury distribution will be evaluated during the concentration and leaching process.

Principal Investigator(s)

Blair Benner

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account
18,750	1896-783-1203-00
Total	\$18,750

Active
02/09/2005 06/30/2010

Start Date: 02/09/2005

End Date: 06/30/2010

Project ID: 1381

Full Scale Mercury Sorbent Testing at Boswell

Objective

To run a full scale sorbent addition test on Unit 1 at Minnesota Power's Boswell Energy Station in Cohasset, Minnesota. One or more mercury removal sorbents developed at the Coleraine Minerals Research Laboratory will be injected as dry sorbents into the 75 MW unit's 250,000 cfm stack gas stream prior to the unit's baghouse. Stack gas mercury measurements will be conducted before and after the sorbent addition to evaluate the efficiency of mercury removal.

Background

Three years of mercury removal research test work, utilizing funding from an EDA grant and the Permanent University Trust Fund (PUTF), has shown that chemically modified iron ore concentrate is an effective sorbent for the removal of oxidized and elemental forms of mercury in a 250 cfm flue gas slip stream from Unit 4 at Minnesota Power's Boswell Generating Station in Cohasset, Minnesota. NRRI-developed sorbents were shown to remove greater than 90% of total mercury at pilot scale in the stack gas stream. Previous test work has shown that it is possible to efficiently separate the sorbent from the fly ash. The mercury sorbent is capable of being reused and reinjected back into the gas stream for additional mercury removal. Sorbent regeneration work has shown that it is possible to remove greater than 90% of the total mercury from the "loaded" sorbent by heating in an inert atmosphere on a batch basis. Volatilized mercury can then be condensed and totally removed from the environment. Attempts to remove the mercury on a continuous basis, using an indirectly fired calciner, have shown that temperature control is critical to efficient removal. In addition to plant test work, computational fluid dynamics analysis of duct work in Unit 1 was also conducted at the Coleraine Minerals Research Laboratory to design an efficient dry sorbent injection system, ensuring good gas-sorbent contact.

Previous Activity

Full-scale dry sorbent injection equipment was obtained for sorbent injection into Unit 1 or 2 at Minnesota Power's Boswell Generating Facility in Cohasset, Minnesota. Full-scale test work has been postponed pending successful pilot scale test work being conducted on Unit 4 using a 250 cfm flue gas slip stream test system. Two pulse jet baghouses are being installed in the pilot system to enhance the quality of mercury removal research. The flue gas sampling point has been changed to provide a consistent 250°F flue gas temperature for sorbent testing in the flue gas stream. New dry sorbent materials were tested in the pilot scale stack gas mercury removal system at Boswell to investigate potential full scale mercury removal testing on Units 1 or 2.

Current Activity

Based on the results of new mercury reduction chemistry planned for use at pilot scale on Boswell Unit 4 stack gas, a full scale trial test on Unit 4 will be planned for the summer of 2010.

Principal Investigator(s)

Blair Benner
David Hendrickson

Project Sponsor(s)

	Amount	Account	Active
PUF Mineral Endowment	350,000	1896-783-1227-00	04/10/2007 06/30/2010
Total	\$350,000		

Start Date: 04/10/2007 **End Date:** 06/30/2010 **Project ID:** 1476

Investigation of Mercury Vaporization During Induration and Removal of Mercury from Scrubber Solids

Objective

To determine how mercury is volatilized during induration and to investigate methods of removing mercury from the scrubber solids.

Background

The taconite industry is under pressure to reduce the emissions of mercury from their induration process. Previous studies have shown that greater than 90 percent of the mercury in the green balls is vaporized during induration. What is not known is whether the mercury is vaporized quickly, early in the process, or is slowly evolved over the entire process. Once the temperature-time relationship for mercury volatilization is established, then it may be possible to treat a smaller portion of the gas stream to remove mercury. Previous studies have shown that the fine solids removed by the scrubbers contain mercury, which is recycled back to the indurating furnace. The solids cannot be simply discarded without a significant loss in iron units. However, if the solids could be treated to remove the mercury, then they could be recycled to recover the iron and still reject mercury.

Previous Activity

Modifications of the minipot exhaust were prepared to allow attachment of the Ohio Lumex on-line probe. Installation at Minnesota taconite operations will follow modification of the sampling probe as stated.

Current Activity

Modification of the mini-pot system is continuing. A sample of sodium bromide has been obtained for addition to the green balls.

Principal Investigator(s)

Blair Benner

Project Sponsor(s)

PUF Mineral Endowment

Amount Account

45,500 1896-783-1200-00

Active

02/09/2005 06/30/2010

Total

\$45,500

Start Date: 02/09/2005

End Date: 06/30/2010

Project ID: 1378

Mercury Reduction Tests - Bench/Pilot Scale - Western Lake Superior Sanitary District

Objective

To reduce the level of total mercury in the Western Lake Superior Sanitary District's discharge water from two parts per trillion to one part per trillion for Duluth's 40 million gallon per day wastewater treatment plant.

Background

As the new discharge limits for mercury in waters being discharged into Lake Superior have been reduced by the Minnesota Pollution Control Agency, the Western Lake Superior Sanitary District (WLSSD) needs to reduce to one part per trillion the mercury in their discharge water which flows into Lake Superior. WLSSD is Duluth's 40 million gallon per day wastewater treatment plant located in west Duluth along the Lake Superior waterfront.

Previous Activity

Bench scale work was scheduled to continue during the spring of 2009 to support the continuing effort requested by WLSSD to reduce its water discharge mercury levels to below 1.30 parts per trillion (ppt) total mercury. NRRI is part of a mercury reduction team assembled by WLSSD to continue bench and in-plant mercury reduction work at their 40 million gallons/day municipal waste water treatment plant in west Duluth. Previous in-plant test work showed relatively low mercury removal, therefore, WLSSD is seeking a more effective mercury reduction in-plant process. It was planned that new chemical design research would be tested in early 2009 to evaluate its mercury removal efficiency. It was also planned that the mercury reduction team formed by WLSSD would meet in the summer of 2009 to initiate new test work described by the team, and that NRRI would test new mercury sorbents to remove oxidized and elemental mercury forms in WLSSD's discharge waters in the early Fall of 2009.

Current Activity

A new mercury sorbent will be tested in the Spring of 2010 to measure its ability to remove 2ppt total mercury as it is placed in the sand section of the plant's final carbon/sand filter, which filters the plant's discharge water.

Principal Investigator(s)

David Hendrickson

Project Sponsor(s)

	Amount	Account	Active
Western Lake Superior Sanitary District	44,048	1933-187-6583-00	06/02/2006 12/31/2007
Total	\$44,048		

Start Date: 06/02/2006 **End Date:** 06/30/2010 **Project ID:** 1428

Slip Stream Pilot Plant for Testing Mercury Removal Methods for Taconite Flue Gases

Objective

To design and install a slip stream pilot plant at one of the taconite plants so that various mercury removal methods can be evaluated using real plant gases.

Background

The taconite plants are currently considered to be the second largest mercury emitters in the state. While millions of dollars have been spent on research and plant trials regarding mercury removal from power plant flue gases, relatively little has been done on taconite gases. With the large differences between the power plants and taconite plants, it is not clear that methods effective in power plants will be as effective in taconite plants. A slip stream is a more economical way to evaluate a relatively large number of alternatives without having the balance of the plant issues.

Previous Activity

The Ohio Lumex mercury continuous emission monitor was taken to Minntac for comparison testing with the Energy and Environmental Research Center at the University of North Dakota (UND). About a week was spent installing the unit and ancillary equipment and trying to get the unit to work. We were unable to get the unit to work, so it was brought back to Coleraine, where it was discovered that a gasket had been installed backwards, so that we were not drawing in gas from the stack. Subsequent testing at Boswell Unit 4 indicated that the unit was working properly. The work at Minntac pointed out a need for a longer heated sample line from the stack to the detector and a better environment for the instruments. It was planned that a longer heated sample line and a portable shed would be purchased during summer 2009, so that testing could begin when weather permitted. On-line speciated mercury testing was slated to commence at Minntac using the new Ohio-Lumex portable on-line continuous speciated mercury analyzer unit.

Current Activity

A longer heated sample line was purchased for our Ohio Lumex mercury continuous emission monitor so that this on-line analyzer can now be used at all of our Minnesota taconite operations in the sampling locations required on the stacks of the various pellet plant operations. Mercury sampling work at Minntac was completed and a final report is being prepared. A new mercury reduction team was assembled by the taconite operations, the MN DNR, the MPCA, and NRRI, and meetings were initiated in late 2009.

Principal Investigator(s)

Blair Benner
David Hendrickson

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account	Active
350,000	1896-783-1228-00	04/10/2007 06/30/2010
Total	\$350,000	

Start Date: 04/10/2007

End Date: 06/30/2010

Project ID: 1477

2009 USS Research Contract

Objective

NRRI's Coleraine Minerals Research Laboratory (CMRL) will conduct research and development work for U.S. Steel's Minntac and Keewatin Taconite plants in the areas of size reduction, classification, flotation, magnetic separation, filtering, balling, indurating, and pellet quality improvement. Research and development work will be conducted using bench and pilot scale equipment at CMRL in addition to in-plant test work at the mining operations plant sites.

Background

The Coleraine Minerals Research Laboratory has provided research support to the Minntac operation for many years. This research has helped Minntac reduce costs, improve their product, and better understand processes.

Previous Activity

A balling circuit audit was conducted to examine factors that influence green-ball sizing and to identify opportunities for improving target green-ball sizing. Measurements and data were collected on green ball size distribution by individual balling drum, operating parameters, recycle loads, roll screen performance, and green ball quality. Data analysis and a final report were prepared. Filter tests and bench balling studies were conducted to determine benefits associated with the use of soft water vs. typical plant water. Batch balling tests were subsequently fired using the mini-pot furnace to evaluate any effect on fired pellet physical quality properties. Plant water was used as a baseline and dried flot con was then prepared for each of the tests by re-pulping in softened water and pressure filtering to produce target moisture concentrate. Three levels of water hardness were evaluated as follows: 100% plant water, 50:50 plant water/DI water and 100% DI water. Concentrator improvements gained as a result of using softened water at each step in the concentrator flowsheet at Minntac were also evaluated and reported.

Current Activity

Alternative binder testing was completed to evaluate partial or full replacements for bentonite. The flotation audit report was completed. Stack gas testing was completed and a report is being generated. Additional research projects were put on hold as plants were shut down or cut back in production.

Principal Investigator(s)

Andriy Khotkevych
Blair Benner
Dave Englund
David Hendrickson
Iwao Iwasaki
Kyle Bartholomew
Richard Kiesel
Salih Ersayin

Project Sponsor(s)	Amount	Account	Active
US Steel Corp, MN Ore Operations	190,000	3000-10417-00008245	01/01/2009 12/31/2009
Total	\$190,000		

Start Date: 01/01/2009 **End Date:** 12/31/2009 **Project ID:** 1543

Closing the Loop on Filter Cake Moisture Analysis and Control

Objective

To determine what the best and least expensive on-line moisture analyzer and associated sampling system is and then how best to structure the actual moisture control loop program to achieve constant filter cake and green ball moisture.

Background

Previous test programs conducted by taconite plants and R&D laboratories have evaluated various on-line filter cake moisture analyzers, yet have not identified any analyzer that gives accurate and reproducible moisture data.

Previous Activity

Programming was ongoing for the NRRI moisture analysis system using Allen Bradley DeviceNet communications and an Allen Bradley Programmable Logic Controller (PLC). Design components were built into the system to make it capable of future automation in a taconite plant so as to create an automated on-line filter cake moisture analysis system.

Current Activity

CMRL's new electrical engineer is working to complete the system with the new Allen Bradley Programmable Logic Controller (PLC) installed.

Principal Investigator(s)

David Hendrickson
Kyle Bartholomew
Richard Kiesel

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account	Active
88,800	1896-783-1060-00	02/01/2002 06/30/2010
Total	\$88,800	

Start Date: 02/01/2002

End Date: 06/30/2010

Project ID: 1181

Development of Engineered Tiles with Radiation Absorbing Properties from Taconite Raw Materials

Objective

To determine the feasibility of producing architectural quality tiles with unique engineering attributes from taconite iron ore raw materials. The tiles will be produced through high temperature melting in a plasma melting system provided by MetalRecovry sited at the Coleraine Minerals Research Laboratory (CMRL) and tile formation and annealing in other equipment at the same site provided by MetalRecovry.

Background

Based on previous test work already conducted at NRRI, it has been shown that taconite rock and magnetite concentrate have radiation absorbing properties, especially for UV and microwave radiation. It is thought that the creation of high density tiles and other consolidated products will result in material having unique engineering properties. This program will determine the conditions required for making high quality materials and will determine the processing conditions that will allow enhanced radiation absorption properties to be developed.

Previous Activity

Equipment from Phoenix Solutions Co. (aka: MetalRecovry) was received at CMRL. Coleraine personnel prepared a dry pilot plant work area and placed the plasma furnace, tile press, and annealing oven in position. Refractory lining of the plasma furnace was completed. A fluid cooler, air compressor, and air dryer were ordered to accommodate the specified plasma torch air and cooling water needs. Electrical service upgrade work was completed so as to power the plasma torch and annealing oven. The new air compressor and fluid cooler were received and installed. Compressed air lines, cooling water loop, and torch water loop were plumbed and leak tested. Furnace exhaust fabrication was completed. An access platform for the furnace was fabricated and installed. Taconite crude ore and tailings samples were identified and set aside for startup testing. The plasma torch has been installed and tested. The first run ramped the furnace through the refractory curing schedule, reaching a maximum temperature of 1200°F. The second run was an attempt to melt tailings. The furnace was heated to 1100°F when a torch cooling water leak was discovered, so the run was aborted. The cause of the leak was identified and corrective action has been taken. A second attempt at melting tailings will be performed shortly.

Current Activity

Taconite tailings have successfully been melted in the plasma furnace. The molten tailings have been successfully cast into tiles. Testing of additives and heat treatments is in progress to produce a variety of tiles with varying physical properties.

Principal Investigator(s)

David Hendrickson
Donald Fosnacht
Kyle Bartholomew
Lawrence Zanko
Richard Kiesel

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account
279,396	1896-783-1241-00
Total	\$279,396

Active

04/28/2008 06/30/2010

Start Date: 04/28/2008

End Date: 06/30/2010

Project ID: 1517

Environmental Taconite Particulate Project-Mesothelioma

Objective

To characterize particulates associated by taconite mining in northeast Minnesota, both on the mining properties and in the population centers surrounding the taconite operations. The work being done on the mining properties will support an exposure assessment of taconite workers being performed by University of Minnesota School of Public Health researchers. The community environmental study is an inventory of particulates across the Mesabi Iron Range that can be compared with the particulate characteristics in other locations in Minnesota.

Background

A recent update by the Minnesota Dept. of Health on a cohort of former iron miners from northeast Minnesota reported that in this group there have now been a total of 58 cases of mesothelioma. The report renewed longstanding concerns over the safety of exposure to dust derived from crushing taconite. The State requested the U of MN take a lead in studying whether the mesothelioma (and possibly other lung diseases) were caused by exposure to taconite dust, as opposed to workplace exposure to commercial asbestos. NRRI will conduct in-plant area sampling and detailed analysis of particulate characteristics. NRRI will inventory particulate characteristics in population centers around taconite operations. The results of the inventory can be used to compare the particulate populations in communities on the Mesabi Iron Range with other towns in Minnesota.

Previous Activity

We have continued to collect air samples as mining activity has slowed and, in some cases, ceased, along the Mesabi Iron Range due to the present economic downturn. These samples represent a "baseline" for the community without the contribution from the iron ore mines. We have also begun sampling within the taconite operations themselves, wherever the nature of the dust produced would be expected to change, either in its physical or chemical characteristics; for example, at the primary crusher, magnetic separators, agglomerator, and kiln.

Current Activity

Air sampling has continued at Mesabi Range community sampling sites (Virginia, Silver Bay, Babbitt, Hibbing, Keewatin) and sites away from the Mesabi Iron Range (Duluth, Ely). In-plant sampling has also taken place at several locations (crusher, magnetic separator, agglomerator / ball drums, and kiln pellet discharge area) at the Northshore, Hibtac, Keetac, and ArcelorMittal mines. Laboratory analyses utilizing scanning electron microscopy / energy dispersive spectrometry, transmission electron microscopy, proton induced x-ray emission, and elutriator methodologies continues. We will be establishing publishing protocols with the School of Public Health, and subsequently complete several Reports of Investigation, Technical Summary Reports, and conference presentations during the first 6-months of 2010.

Principal Investigator(s)

George Hudak
Steven Hauck
Tamara Diedrich

Project Sponsor(s)	Amount	Account	Active
PUF Mineral Endowment	200,000	1896-783-1237-00	07/23/2007 06/30/2010
U of M School of Public Health	350,349		07/01/2008 06/30/2011
Total	\$550,349		

Start Date: 07/01/2008 **End Date:** 06/30/2011 **Project ID:** 1539

Evaluation of Tailings

Objective

To provide baseline data by characterizing Duluth Complex Cu-Ni ore tailings and assessing their potential for additional mineral recovery and/or value-added beneficial uses on or beyond the mine-site.

Background

Cu-Ni ores from the Duluth Complex will generate more than 30 tons of tailings for every ton of bulk sulfide concentrate produced. This project will provide baseline data by characterizing Duluth Complex Cu-Ni ore tailings and assessing their potential for additional mineral recovery and/or value-added beneficial uses on or beyond the mine-site. Following a battery of physical, chemical, and mineralogical tests, potential end-use options will be identified and prioritized for further bench- and/or pilot scale testing and evaluation. The short-term goals are to thoroughly characterize the tailings, determine the viability of extracting additional value from them, e.g., oxide fraction, and identifying realistic end uses. The long-term goals are to provide the emerging non-ferrous mining industry and/or entrepreneurs with practical alternatives that are environmentally sound to pursue, technologically simple to implement, and economically beneficial to practice. The short-term and long-term benefits to the State of Minnesota include reducing tailings disposal impacts, maximizing resource use, and generating additional revenue streams.

Previous Activity

None to report; new project.

Current Activity

This is a new project. Work on this project will likely start in the second quarter of 2010.

Principal Investigator(s)

Blair Benner

Lawrence Zanko

Steven Hauck

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account	Active
15,000	1750-10416-20090	09/25/2009 06/30/2010
Total	\$15,000	

Start Date: 09/25/2009

End Date: 06/30/2010

Project ID: 1577

Grant Writing and Grant Search for Minnesota Taconite Operations, State and Federal Department of Energy (DOE)

Objective

To provide funding to NRRI/CMRL Director and staff engineers to evaluate State and Federal DOE grant opportunities, and to work with Minnesota taconite operations to write and submit grants for energy projects in taconite.

Background

More and more State and Federal Department of Energy grants are appearing that apply directly to the taconite industry. For example, the Federal DOE "Industries of the Future" program requests specific grant projects for the mining industry that apply to taconite mining. On a State level, NRRI/CMRL can now work directly with the Minnesota State Energy Office to submit grants for potential energy reduction projects in various fields of research and development.

Previous Activity

On a Federal basis, three DOE grant requests were submitted to pursue transformational energy technology projects including: (1) A project on the use of microwave energy for producing iron nuggets and using microwave energy to convert plastics into an energy fuel source; (2) A project on the use of coal-oxy burner technology to produce nodular reduced iron and; (3) A project on the use of plasma gasification technology to gasify biomass followed by conversion of the syngas into liquid fuels via Fisher Tropsch technology.

On a State basis, six grant proposals were submitted to the DNR's Iron Ore Co-Op group for advancing taconite research projects from CMRL.

Current Activity

A Federal DOE Grant was applied for identifying a novel use of olivine minerals, found in the State of Minnesota, to chemically sequester carbon dioxide from our State coal-fired power plants. On a State basis, four DNR Iron Ore Co-op grants were received for advancing taconite research. NRRI participated in the submission of two additional grant requests to the State Department of Energy for advancing wind turbine design and efficiency.

Principal Investigator(s)

Blair Benner
Dave Englund
David Hendrickson
Iwao Iwasaki
Kyle Bartholomew
Richard Kiesel
Salih Ersayin

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account
156,315	1896-783-1214-00
Total	\$156,315

Active
02/09/2005 06/30/2010

Start Date: 02/09/2005 **End Date:** 06/30/2010 **Project ID:** 1390

Hydroseparator Modeling

Objective

To develop a mathematical model of hydroseparators, which could be used for simulation, optimization, and control of hydroseparator operating conditions.

Background

The existing hydroseparator model does not take into account the effect of any operating variables. Available plant data indicate that there are large differences between hydroseparator performances from one plant to another. They are not operated at their optimum due to a lack of quantitative information defining their performance. Analysis of plant data led to the development of the current model, which could simulate the effect of variations in feed grade. Although there appears to be a good correlation between upward velocity and separation efficiency, systematic test work is required to establish such a relationship. Recently, the Coleraine Minerals Research Laboratory (CMRL) received Iron Ore Co-Op funding to carry out pilot scale hydroseparator tests in plants to demonstrate the benefits of magnetic field application. These tests will produce samples that could generate data needed for hydroseparator modeling. Funding will be used for additional analysis of these samples and model development.

Previous Activity

A final report will be drafted after liberation analytical results have been received from the Julius Kruttschnitt Mineral Research Centre in Australia.

Current Activity

We are still awaiting results from the JK Minerals Research Center.

Principal Investigator(s)

Blair Benner
Salih Ersayin

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account
36,000	1896-783-1201-00
Total	\$36,000

Active
02/09/2005 06/30/2009

Start Date: 02/09/2005 **End Date:** 06/30/2010 **Project ID:** 1379

Magnetic Separator Model Development

Objective

To develop a magnetic separator model for simulating the effects of significant operating variables, which model can then be used as a tool in circuit design and optimization.

Background

There exists no magnetic separator model capable of simulating the effects of the variables involved in taconite processing. The Concentrator Modeling Center at the Coleraine Minerals Research Laboratory has evaluated a number of plant data and developed a mathematical structure for magnetic separators. Further analysis of plant data showed that this structure could successfully be used to include the effects of operating and design variables. A model defining the effects of significant variables under various operating conditions is yet to be developed. This proposal will generate systematic pilot scale data for constructing mathematical relationships defining the effects of these variables. The model will provide answers to a large number of "what if" questions commonly asked by plant engineers and operators for improving their plant performance. Funding for this proposal will also constitute matching funds for a larger budget Department of Energy project.

Previous Activity

Data generated from Keetac plant sampling were added into the database. Davis tube tests were conducted on semi-autogenous grinding (SAG) mill feed and cobber magnetic separator feed samples to define liberation characteristics. Product samples were sent to the Julius Kruttschnitt Mineral Research Center (JKMRC) for liberation analysis. The Principal Investigator for this project left the University but was expected to complete reporting on this research by the end of summer 2009.

Current Activity

After the Principal Investigator left the University, it was necessary to close this project. Nearly all budgeted funds were still available and unspent, and therefore reverted to the general fund. It is planned that a new project will be proposed and that a magnetic separator model will be developed by a new Principal Investigator.

Principal Investigator(s)

Salih Ersayin

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account	Active
45,000	1896-783-1204-00	02/09/2005 06/30/2009
Total	\$45,000	

Start Date: 12/09/2005

End Date: 12/31/2009

Project ID: 1382

Mechanical Sampling Device for Hard to Sample Streams

Objective

To develop a mechanical device capable of taking accurate samples from hard to sample plant streams.

Background

Analysis of data generated by plant audit sampling shows that it is very difficult to obtain a representative sample from some of the streams in any given plant. This can be caused by large volumes of slurry and/or limited access to sampling points, requiring unconventional methods for sampling. Current methods of sampling involve cutting a small fraction of a stream under the influence of gravity. These methods provide representative samples in most cases. However, mass balancing of plant data indicate that one or more streams around some devices in a plant are not properly sampled. In such cases, the operator judgment is used to decide which sample is more reliable. This adds subjectivity into the process. Development of a device capable of accurately sampling these problematic streams will eliminate subjectivity and improve assessment of actual performance. This will eventually lead to improved plant performance.

Previous Activity

During a sampling survey in the Keetac plant, notes were taken in terms of sampling difficulty and expected sample accuracy. These notes were then reevaluated when mass balance of the circuit was carried out. It was found that the streams with difficult to sample locations produced higher error in mass balancing. The Principal Investigator for this project left the University but it was expected that he would complete this report by end of summer 2009.

Current Activity

After the Principal Investigator left the University, it was necessary to close this project. All budgeted funds were still available and unspent, and therefore reverted to the general fund. It is planned that a new project will be proposed and that a new mechanical sampling device will be developed by a new Principal Investigator.

Principal Investigator(s)

Salih Ersayin

Project Sponsor(s)	Amount	Account	Active
PUF Mineral Endowment	15,000	1896-783-1217-00	02/09/2005 06/30/2009
Total	\$15,000		

Start Date: 02/09/2005 **End Date:** 12/31/2009 **Project ID:** 1393

Pellet Fines Removal System

Objective

To construct and test a larger scale of a prototype fines removal system in a pellet plant operation on 150-250 LTPH fired pellets. A prototype fines removal system was developed at the Coleraine Minerals Research Laboratory as an alternative method for the sizing of pellets, ores, agglomerates, or coarse materials. Conventional screening methods typically use vibrating or roll screens, however, the high capital and maintenance costs associated with this equipment make the separation of fines uneconomical. The potential of this unit operation is to conduct a clean fines separation at a low cost and by more efficient means, replacing screening operations that are both costly and maintenance intensive.

Background

The fines removal system is proposed as a low cost, more efficient means of separating fines from coarser materials. Preliminary results show that 80-90 percent of the fines can be effectively removed while retaining 97-98 percent of the fired pellets in the product.

Previous Activity

Meetings were held with a Minnesota taconite operation who agreed to test the newly modified fines removal system on their stockpiled pellets during the summer and fall seasons of 2009.

Current Activity

CMRL's patented pellet fines removal system is being further modified to better fix the specialized AR400 chevron lifters affixed to the surface of the belt. It is planned that the newly modified system will then be tested in the spring of 2010 at one of the Minnesota taconite operations.

Principal Investigator(s)

David Hendrickson
Richard Kiesel

Project Sponsor(s)

	Amount	Account	Active
MN Department of Natural Resources	115,000	1663-187-6506-00	09/18/2003 06/30/2005
PUF Mineral Endowment	136,664	1896-783-1073-00	02/01/2003 06/30/2007
Total	\$251,664		

Start Date: 02/01/2003 **End Date:** 06/30/2010 **Project ID:** 1309

Performance of Taconite Aggregates in Thin Lift HMA

Objective

To develop and evaluate the performance of hot mix asphalt (HMA) mix designs made with taconite fine aggregate (coarse taconite tailings) and recycled materials like asphalt shingles and recycled asphalt pavement (RAP), to compare the physical properties of these mix designs with conventional HMA mixes, and to conduct chemical leachate (metal) testing of both aggregates and final HMA mixes.

Background

This project is funded by the U.S. Department of Transportation (U.S. DOT), Federal Highway Administration (FHWA). Its goal is to develop and evaluate the performance of hot mix asphalt (HMA) mix designs made with taconite fine aggregate (coarse taconite tailings) and recycled materials like asphalt shingles and recycled asphalt pavement (RAP). NRRI will be the lead organization for this project, and will work closely with research partners at the Minnesota Department of Transportation Office of Materials (Mn/DOT), and with the University of Minnesota's Department of Civil Engineering (U of M CE). The project will focus on leachate testing of aggregates, mix designs, and low temperature bending and/or fracture tests on both taconite-based and control HMA mix designs.

Proposed research activities will help advance and encourage the beneficial use of recycled/byproduct materials like durable and wear- and skid-resistant taconite aggregates, recycled asphalt pavement (RAP), and asphalt shingles. In combination, the use of each is highly desirable because it promotes resource conservation, safety, and energy-savings.

Previous Activity

This is a new project.

Current Activity

The project was awarded in late 2009. An initial project team conference call, between NRRI, FHWA, Mn/DOT and the U of M Department of Civil Engineering, took place in early December, 2009, to discuss the project's tasks and scheduling. A follow-up meeting was held the same week between NRRI and Mn/DOT in Maplewood, MN. Mn/DOT provided NRRI with conventional aggregate samples for the leachate portion of the project. Background data compilation work began in December.

Principal Investigator(s)

Lawrence Zanko
Steven Hauck

Project Sponsor(s)

	Amount	Account	Active
PUF Mineral Endowment	20,000	1750-10416-20090-	10/22/2009 06/30/2010
USDOT (Prime)	17,402	3002-10416-00014216	09/25/2009 11/24/2010
US DOT Federal Hwy Admin	82,598	3002-10416-00013020	09/25/2009 11/24/2010
Total	\$120,000		

Start Date: 09/25/2009 **End Date:** 11/24/2010 **Project ID:** 1579

Preclassification of the Final Stage of Magnetic Separation Feed

Objective

To investigate the utility of pretreating the feed material to the final stage of magnetic separation via size classification.

Background

Conventional magnetic separation units are relatively efficient at separating liberated non-magnetic material from magnetite. However, middling particles, high in non-magnetic material, are passed into the concentrate and are difficult to separate via further magnetic separation without additional grinding and liberation. Adjustment of operating conditions such as field strength and pulp density can facilitate higher rejection rates of non-magnetic material, but at a cost of usually unacceptable iron losses. This leaves the obvious alternative of regrinding the tailing material to reclaim iron units, but this process is prohibitively expensive. However, preclassifying the feed to magnetic separation, particularly the final stage of separation, may provide an alternative approach to this problem. Preclassification would provide two independent streams of material to magnetic separation: (1) the fine stream, which is low in non-magnetic material/silica and, (2) the coarse stream, which is high in non-magnetic material. Therefore, the fine stream can be treated in a magnetic separator to maximize iron recovery, and the coarse stream can be treated to maximize silica rejection. To gain benefits, the magnetic reject from the coarse stream will require regrinding. However, the volume of material requiring regrinding will be significantly lower than without preclassification at equivalent upgrading. This should facilitate an improvement in the grind/grade relationship in taconite facilities.

Previous Activity

Results indicate that Davis tube concentrate grade increases with decreasing magnetic strength, but as the size distribution becomes finer, the degree of upgrading seems to approach a limiting value. Bulk magnetic separator feed samples were obtained from an operating plant; a series of tests of unclassified feed was conducted with varying magnetic field strengths, percent solids, and feed rates. Two bulk cyclone underflow samples with unique size distributions were prepared for continuous magnetic separator testing. Test work has been completed. Final chemical analyses were completed and sent to the principal investigator. This test work was completed by an engineer who left the University. Test results will be reported by a newly assigned process engineer at the Coleraine Minerals Research Laboratory, with an expected completion date of June 1, 2009. Kyle Bartholomew was assigned this project and plans to draft a final report.

Current Activity

The newly assigned Principal Investigator is reviewing data to complete the final report.

Principal Investigator(s)

Jeremy Pletka

Kyle Bartholomew

Project Sponsor(s)

PUF Mineral Endowment

Amount Account

26,200 1896-783-1076-00

Active

06/01/2003 06/30/2005

Total \$26,200

Start Date: 06/01/2003

End Date: 06/30/2010

Project ID: 1318

Research, Development and Marketing of Minnesota's Iron Range Aggregate Materials for Midwest and National Transportation Applications

Objective

To develop various applications for taconite aggregates in highway and construction applications and identify the logistical and transportation requirements for bringing these materials to market.

Background

The economics of mining taconite ore relative to other worldwide iron mining resources show our mining resources are more costly to extract than many competitors. In order to secure a stable future for our mining operations, new revenue sources from current mining activities are required. One avenue for this purpose is to find uses for taconite mining by-products in highway and construction applications and to develop a logistical and transportation system that will economically bring these products to marketing areas. This project is being undertaken to fully explore how taconite by-products can be utilized as highway and construction aggregates and in other value-added opportunities related to these markets.

Previous Activity

Highlights: (1) Presented "Gray is Green: The Aggregate Potential of Mn Tac. Industry Byproducts," at 88th Transportation Research Board (TRB) meeting in Washington, DC, Jan. '09. (2) Completed geological work for correlating stratigraphy of Biwabik Iron Formation, and its relationship to potential aggregate horizons. (3) Compiled water chemistry and water quality data related to taconite tailings. (4) Filed patent application and continued work on taconite-based patching and paving formulations. (5) Over 3,300 tons of ArcelorMittal coarse taconite tailings were prepared by Ulland Brothers on 4/23/2009. (6) Presented to Center for Transportation Studies (CTS) 20th Annual Transportation Research Conference, on 5/19/09. (7) Shipped 5,000 tons of taconite aggregates from Duluth to Chicago on 5/28/09. L. Zanko and D. Fosnacht traveled to Chicago, IL, Cleveland, OH, and Pittsburgh, PA, to document delivery & hold meetings with taconite parent companies and potential end users. (8) Began compilation of project findings.

Current Activity

Most project activities neared completion during the second half of 2009. Highlights include: (1) Completion of geological work, including draft report in final editing stage; (2) Highway 53 bridge deck demonstration project in Virginia, MN, (August) in collaboration with Mn/DOT and POLY-CARB of Ohio, using washed, screened and dried coarse taconite tailings supplied by United Taconite; (3) Acquisition of 3,000 tons of coarse taconite tailings from U.S. Steel Minntac and ArcelorMittal Minorca, for processing by Ulland Brothers, Inc., into friction products in October. These friction products are stored at the Coleraine Minerals Research Laboratory for anticipated use in 2010 projects; (4) Completion of Mn/DOT sub-award work; final report to be edited in 2010; (5) Accepted invitation to make a presentation to the Mineral Aggregates Committee of the TRB at the January 2010 TRB meeting in Washington, DC; (6) Efforts to secure follow-up funding continued.

The project ends on June 30, 2010, when a final report will be submitted.

Principal Investigator(s)

Donald Fosnacht
Lawrence Zanko
Steven Hauck

Project Sponsor(s)

	Amount	Account	Active
Blandin Foundation	10,000	1670-187-6516-00	02/01/2004 12/31/2006
Minnesota Power	10,000	1831-187-2680-00	02/08/2005 06/30/2010
USDOC EDA	1,250,000	1661-187-6565-00	01/01/2006 06/30/2010
Total	\$1,270,000		

Start Date: 01/01/2006 **End Date:** 12/31/2009 **Project ID:** 1411

Shallow vs. Deep Bed Sinter Quality Comparison

Objective

To demonstrate shallow bed vs. deep bed sintering characteristics using the newly constructed sinter pot test facility at the Coleraine Minerals Research Laboratory (CMRL). This test program will permit establishing important statistics on test variances and sintering optimization studies.

Background

The sinter test facility has recently been completely renovated, giving it the capability to fire deep sinter beds (up to 26 inches depth). Prior to renovation, the maximum depth was limited to 16 inches. Additionally, the suction blower capacity was increased to achieve wind box pressures in excess of -65 inches water at the pot. This proposed test program will allow CMRL to refine sinter procedures for deep beds and ultimately to generate data in report form that can be used for discussion purposes with prospective clients. A former client has donated the sinter mix components that will be used in this study.

Previous Activity

Planning commenced for approximately 30 shallow bed (15 inches) sinter tests to be fired, with the goal of optimizing return fines rate, coke rate, and moisture addition. Another set of 11 deep sinter bed tests was scheduled to be run under the optimized conditions, and then a comparison was to be made between sinter quality and production rate when converting from shallow to deep bed conditions. The sinter mix was generic, not representing an operating plant blend, and, as a result, several tests were required to verify that the proposed mix would yield reasonable quality sinter. Technicians were trained in the use of the equipment and sinter quality testing. Sufficient tests were planned to establish test variances with respect to duplication of results.

Current Activity

Thirty tests have been completed, including six deep bed tests. The equipment is working well as designed. One problem with air flow measurement was identified, and we are in the process of modifying the installation. This requires changing from a six-inch diameter to a three-inch diameter exhaust pipe and purchasing a new pitot tube for the three-inch pipe. This modification is planned to take place during February 2010.

Principal Investigator(s)

Dave Englund

Project Sponsor(s)

PUF Mineral Endowment

Amount Account

62,930 1750-10417-20090-

Active

10/20/2009 06/30/2010

Total

\$62,930

Start Date: 10/20/2009

End Date: 06/30/2010

Project ID: 1557

Sinter Pot Equipment, Activation of the Coleraine Minerals Research Laboratory

Objective

To reactivate the sinter pot test equipment at the Coleraine Minerals Research Laboratory.

Background

The sinter pot was last used in 1996. In 2007, several inquiries regarding conducting sintering tests at the Coleraine Minerals Research Laboratory (CMRL) were received. It was decided to reactivate the sinter pot, including the incorporation of Programmable Logic Controller (PLC) based data logging and process automation. The test equipment suffered severe corrosion damage, necessitating extensive cleaning and rebuilding. It was also necessary to have the sinter fan inspected and balanced. Additionally, a new burner and burner train were required to bring the equipment into compliance with University and industry safety standards. NORAMCO was contracted to redesign the exhaust gas handling and cleaning equipment, providing a capital cost estimate for replacing the existing system with a new fan and gas cleaning system, to facilitate gas flow measurement and gas sampling for volatile organic compounds (VOCs).

Previous Activity

All major pieces of equipment arrived on site and were put in place. A new sinter pot was fabricated. Wiring and programming of the PLC (Programmable Logic Controller) were completed. Commissioning tests began in late summer 2009.

Current Activity

This project was completed in November 2009. A commissioning program was designed and approved to test the equipment, and is being reported under new Project ID #1557, Shallow vs. Deep Bed Sinter Quality Comparison. The equipment is performing very well, except that one problem with airflow measurement has been identified and will be corrected during February 2010. Final report #CMRL/TR-09-08 (NRRI/TR-2009-32) entitled "Demolition of a Shallow Bed and Reconstruction of a Deep Bed Sintering Pot Facility at the Coleraine Minerals Research Laboratory, January 2008 through October 2009," was issued on October 15, 2009, which brought this project reporting to completion.

Principal Investigator(s)

Dave England

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account	Active
394,007	1896-783-1238-00	01/31/2008 06/30/2010
Total	\$394,007	

Start Date: 01/31/2008 **End Date:** 06/30/2010 **Project ID:** 1493

Taconite Industry Products and By-products: An Investigation of Alternative Uses and Their Economic Potential

Objective

To investigate and identify alternative uses for taconite mining products and by-products from each Mesabi Range taconite operation, which have the best potential for providing the greatest short- and long-term economic benefit to the industry. These products and by-products can include gross physical features such as pits, stockpiles, and tailings basins; mined materials such as crude taconite, waste rock, and overburden; and processed materials including crushed taconite, tailings, taconite concentrate, and pellets. The project will attempt to quantify the potential economic impact of the various alternative uses and assign real dollar and cents values to each. The challenge will be to find opportunities that could have meaningful positive economic impacts, given the scale at which the industry operates. Therefore, the project's focus will be on finding alternatives that have the best income-generating potential, such as those that: (1) demand large volumes/tonnages of lower value materials, (2) have a significant value-added component, or (3) command a steady stream of revenue via property or equipment rental or lease arrangements.

Background

Minnesota's taconite industry is experiencing difficulties that are negatively impacting the region and the entire state. While everyone's main focus should be on helping the industry remain competitive in its primary role, i.e., making iron units from Minnesota ore, it is very important that we try to expand the industry's revenue-generating options by investigating alternative uses and markets for the products and by-products of taconite mining. Even if only one new alternative use or market were identified, it could benefit the entire taconite industry.

Previous Activity

Because this project is closely related to NRRI's ongoing taconite aggregate research efforts, it has provided additional resources that were used for pursuing alternative value-added use options such as various size fractions of taconite tailings; potential as a raw material source for cement making; and communicating related research findings to others.

Current Activity

None to report. A summary report will be filed in 2010.

Principal Investigator(s)

Julie Oreskovich
Lawrence Zanko
Steven Hauck

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account
65,000	1896-783-1065-00
Total	\$65,000

Active
05/01/2002 06/30/2010

Start Date: 02/01/2002

End Date: 06/30/2010

Project ID: 1186

The Effect of Fluorine and Chlorine on Fired Pellet Metallurgical Properties

Objective

To evaluate the effect of fluorine and chlorine on fired pellet metallurgical properties, specifically Reducibility (R40) and Low Temperature Disintegration (LTD). This will include the influence of halogenated process water for agglomeration and when applied to the surface of fired pellets for the purpose of pellet cooling, conveyor belt protection, and dust control.

Background

Reducibility (R40) and Low Temperature Disintegration (LTD) are established metallurgical tests used to distinguish the quality of iron ore pellets for their performance in the blast furnace. Fired pellet quality has been historically influenced by chlorinated water when applied as dust control or cooling water. Process water containing high levels of chlorine has been shown to be detrimental to metallurgical properties when applied to the surface of cooled pellets. Quenching hot fired pellets for cooling or with conveyor belt protection water is known to degrade metallurgical properties due to the stresses created within the microstructure of the pellet. However, the impact of the chlorine levels in this water must be evaluated. The concentration of these halogens in process water used for agglomeration should also be included in this investigation for its effect on R40 and LTD.

Previous Activity

Several 5-gallon pails of fired acid pellets were collected from Minntac to be used in this project. Appropriate halogen-bearing reagents were also identified and located at the Coleraine Minerals Research Laboratory. The experimental plan, a 2³ factorial with 2x replication and two center point trials, was also designed. Control factors include: chloride concentration of process water, chloride concentration of quench water, fluoride concentration of process water, fluoride concentration of quench water, and pellet temperature at time of quench. An infrared thermometer was purchased to be used to measure pellet temperature at quench. Testwork is planned to be completed by August 2009, to evaluate the potential effect fluorine and chlorine have on fired pellet metallurgical properties.

Current Activity

Quench tests for 20 sets of fired pellets are complete. Initial analytical data indicate a strong effect of temperature on Low Temperature Degradation (LTD) and compression. The scale of the effect of chloride, fluoride, and temperature appears to be about equal on R40. Porosity is affected by chloride and fluoride, but not by quench temperature. Full quantitative analysis of the fired pellet quench data is underway. Testing of the effect of chloride and fluoride on agglomeration will continue as technician time permits.

Principal Investigator(s)

Kyle Bartholomew
Richard Kiesel

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account	Active
30,000	1896-783-1075-00	06/01/2003 06/30/2010
Total	\$30,000	

Start Date: 06/01/2003

End Date: 06/30/2010

Project ID: 1317

The Effect of Preheat Burners on a Straight Grate Induration Furnace

Objective

To utilize pot-grate testing to evaluate the effect of adding preheat burners to supplement the thermal energy required when adding low levels of fluxstone.

Background

The addition of low level limestone can have a positive effect on fired pellet quality and can be advantageous to blast furnace iron reduction. The addition of limestone (calcite) to magnetite concentrates requires a significant amount of energy to calcine the fluxstone. This energy "sink" will partially prevent the pellets from reaching an effective induration temperature under normal operating conditions. This is because the calcination reaction takes place at relatively the same temperature as the oxidation of the magnetite begins to accelerate (600-800°C). The CO₂ released from the fluxstone fills the pellet pores, inhibiting the diffusion of oxygen into the pellet and slowing the oxidation kinetics. Although the same thermal energy is eventually available, the temperature rise as a result of the oxidation will be slower. Supplemental burners in the preheat section of the furnace may be required to add additional heat during critical stages of induration to maintain production levels and pellet quality.

Previous Activity

Development of a typical straight grate furnace firing cycle was established. Green balls were collected from a commercial balling drum to eliminate any variance associated with balling, and these were then fired as a baseline. Pot grate tests will be used for comparing the standard firing cycle to one adding additional heat in the pre-heat zone. Pelletizing feed mixtures were prepared containing bentonite binders with 0.3% and 1.2% fluxstone. Mini-pot furnace tests were conducted to observe the effect of additional temperature in the pre-heat section of a straight grate furnace. Pre-heat tests were also conducted with the mini-pot furnace using the same cycles. A pre-heat test is quenched in nitrogen following the preheat stage of induration so as to stop the oxidation. This was done for the purpose of comparing physical quality at this intermittent point in the process.

Current Activity

Additional full pot grate firings will be used to confirm the results using the temperatures for pre-heat established by the mini-pot tests and compared to the previously established baseline. These tests are currently pending the completion of the pot grate upgrade to the control system, airflow, plumbing and combustion system. A final report for the results is in progress.

Principal Investigator(s)

Richard Kiesel

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account	Active
25,000	1896-783-1215-00	02/09/2005 06/30/2010
Total	\$25,000	

Start Date: 02/09/2005

End Date: 06/30/2010

Project ID: 1391

The Utility of Taconite Materials as Road Patch for Highway Construction

Objective

To confirm the utility of using inorganically bound taconite aggregate and concentrate as highway road patching and construction materials.

Background

Preliminary test work using a proprietary binder formulation has demonstrated the utility of using taconite mining products as a highway patching material. Actual field demonstrations show that the material, if properly formulated, can act as a semi-permanent patch.

Previous Activity

Based on the research findings, a patent application has been filed. Next steps in the project include making adjustments to the binder formulation.

Current Activity

Testing of modified patch blends began. New taconite materials were acquired, and adjustments were made to the binder formulation. Testing will continue in 2010, with the goal to conduct a field demonstration in the spring.

Principal Investigator(s)

Donald Fosnacht
Lawrence Zanko
Steven Hauck
Tamara Diedrich

Project Sponsor(s)

PUF Mineral Endowment

	Amount	Account	Active
	50,000	1896-783-1216-00	02/09/2005 06/30/2010
Total	\$50,000		

Start Date: 02/09/2005

End Date: 06/30/2010

Project ID: 1392

Up-Grade Computational Fluid Dynamic Cooler Models and Evaluate Bed Depth vs. Energy Recovery

Objective

The objective of this project is two-fold as follows: (1) To up-grade cooler model grids to Solid Works 3D model versions, because original grids exist in an electronic format that can no longer be modified if future studies require evaluation of physical changes to cooler, and (2) To perform an evaluation of cooler speed and bed depth effects on process stream temperatures and energy recovery.

Background

Computational Fluid Dynamics (CFD) cooler models were developed for five operating taconite lines in Minnesota between 1997 and 2002. However, as the result of a change in CFD software, and advances to mesh generation software, the grids for these models have become obsolete. They cannot be modified to reflect proposed physical changes, and they are not compatible with existing CFD software. This project will develop new cooler grids using Solid Works 3D modeling software, which will leave them in a forwardly compatible format so that future changes can be made as needed. Revised models will be completed for the seven existing grate-kiln taconite lines.

Previous Activity

It was planned that one model would be selected to perform a fundamental study of cooler performance where bed depth is varied over a pellet production range. This study will lead to a better understanding of energy recovery as a function of bed depth and production rate, and may ultimately lead to new control strategies for the cooler. A collaborative initiative was proposed, using Itasca Community College (ICC) students to begin the model development. The proposal was approved and work was scheduled to begin effective March 2009. Two first-year engineering students were used to begin developing 3D SolidWorks models for this project. The goal was to complete as many coolers as possible. Only one model was completed (United Taconite Line 2) by the project deadline of June 30, 2009, which prevented starting the CFD modeling phase. However, the project was successful in starting a collaborative effort between the NRRI Coleraine Minerals Research Lab (CMRL) and Itasca Community College Engineering Program. One of the students was hired as a summer intern at CMRL and continued building remaining models during July/August. The Iron Ore Co-Op portion of this project ended on June 30, 2009. A continuation of the project received high ranking and was awaiting budget approval.

Current Activity

We are waiting for signed contracts between the University and the Minnesota Department of Natural Resources Lands and Minerals Division. Once these are in place we can begin the work.

Principal Investigator(s)

Dave Englund

Project Sponsor(s)

Project Sponsor(s)	Amount	Account	Active
MN DNR	55,200	1663-187-6607-00	11/07/2007 06/30/2009
Total	\$55,200		

Start Date: 11/07/2007 **End Date:** 06/30/2010 **Project ID:** 1497

Geologic and Stratigraphic Controls of the Aggregate Potential of the Mesabi Iron Range

Objective

To continue to compile and generate baseline geological, technical, and economic information on the quality of potential higher-value aggregate products (e.g., Class A-type aggregate, concrete aggregate, railroad ballast) derived from the major stratigraphic units within the Biwabik Iron Formation. This research will build upon our current investigation of the Virginia Horn area (Mittal Steel-Minorca through United Taconite), by continuing westward in the iron formation through U.S. Steel Minntac in 2006 and through Hibbing Taconite in 2007.

Background

Minnesota's taconite industry generates potentially huge amounts of aggregate in the form of taconite mining and processing byproducts. However, geology and stratigraphy control the ultimate quality of the taconite rock used for aggregate, just as geology and stratigraphy control the quality of the ore used for pellet production. A more systematic and larger-scale research program of geologic mapping, sampling, and testing is geared toward identifying "optimal" (both technically and economically) geologic units.

Previous Activity

A final report is in progress. The report illustrates the correlation of stratigraphic units across the Mesabi Iron Range, which was previously difficult to do. Each mine had its own stratigraphic nomenclature to describe different rock packages. This report corrects this problem, by correlating the rocks based upon their bedding characteristics and composition.

Current Activity

The report is very near completion, and the second draft has been edited. Corrections are pending. The final report will be issued before summer of 2010.

Principal Investigator(s)

Mark Severson

Steven Hauck

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account
176,000	1896-783-1225-00
Total	\$176,000

Active
07/16/2006 06/30/2010

Start Date: 07/16/2006

End Date: 06/30/2010

Project ID: 1437

Compile and Make Digital the Lithologic Data for All NRRI Drill Logs, with Emphasis on the Duluth Complex Drill Holes (an Update)

Objective

To update a 2003 NRRI report that provided a database that listed the lithologic/geologic picks in over 600 drill holes that the NRRI had logged in the Duluth Complex.

Background

The above-referenced report presented virtually all of the publicly available drill hole location data and Cu-Ni assay data for 2,145 drill holes in and near the Duluth Complex. These databases are also available online and have been extensively used by at least four exploration companies (PolyMet, Teck Cominco, Duluth Metals, and Encampment Exploration) in order to more fully understand and model the mineralization trends at their respective properties. Since 2003, all of the remaining publicly available holes (approximately an additional 200 holes) along the western margin of the Duluth Complex will have been logged by NRRI personnel. The lithologic information from these holes needs to be added to the 2003 database. Locations for holes drilled in the Duluth Complex since 2003 will also be added to the database.

Previous Activity

Five databases have been generated for the project. They include: (1) a header file listing locations of all holes drilled in the Duluth Complex since 2003; (2) a header file listing locations of all Biwabik Iron Formation holes that have been logged by NRRI personnel; (3) a listing of rock types and units in 106 drill holes (9,933 lines of data) for the Mesaba Cu-Ni deposit; (4) a listing of rock types and units in 46 drill holes (1,332 lines of data) for the Dunka Pit Cu-Ni deposit; and (5) a listing of the members and submembers in 86 holes (4,600 lines of data) in the Biwabik Iron Formation for holes logged by NRRI personnel. Data that are still pending and need to be added to various databases are: Teck American's holes (64) from the Mesaba deposit; Duluth Metals holes (seven) from the Nokomis deposit; drill holes from the Deer Lake Complex (Itasca County); drill holes from the Animikie Basin (most were logged by Severson for a previous SEDEX project).

Current Activity

A first draft report has been produced, edited, and corrected. While there is no longer any available funding for this project, further input of data has been conducted on an intermittent basis (during personal hours) and is very near to completion. The final report will be published before summer.

Principal Investigator(s)

Mark Severson
Steven Hauck

Project Sponsor(s)

	Amount	Account	Active
MN DNR	40,000	1663-187-6613-00	03/07/2008 06/30/2009
PUF Mineral Endowment	40,000	1896-783-1240-00	04/01/2008 06/30/2010
Total	\$80,000		

Start Date: 03/07/2008 **End Date:** 06/30/2010 **Project ID:** 1505

Copper-Nickel-PGE Mineralization Potential of the Cloquet Lake Intrusion, NE MN

Objective

To conduct a first pass reconnaissance sampling campaign to evaluate the potential of the Cloquet Lake Intrusion to host basal Cu-Ni-PGE deposits and/or stratiform PGE reef deposits related to a sulfide saturation event.

Background

The Cloquet Lake Intrusion, comprising part of the Beaver Bay Complex, represents one of the largest Keweenawan-age intrusions in NE Minnesota. The intrusion is 2-3 times larger than either the Partridge River or South Kawishiwi intrusions, which contain several Cu-Ni-PGE deposits. However, exploration for base and precious metals in the Cloquet Lake Intrusion has been limited to three drill holes. All three holes intersected massive sulfide at the basal contact, but PGE, Cu, and Ni values were generally low, and further exploration efforts were discontinued. Despite this lack of encouraging results, the Cloquet Lake Intrusion should still be explored for the following reasons: (1) the intrusion is situated near a buried crustal ridge of older country rock that may have served as a local sulfur source for basal disseminated Cu-Ni-PGE sulfide deposits; (2) the massive sulfide in the 3 holes may be related to proximity to a vent, wherein, additional massive sulfide with higher Cu-Ni-PGE values (related to fractional crystallization) may be present and could be located more distally to the vent; and (3) the layered nature of this intrusion suggests that it may be possible that one or more stratiform PGE reefs (associated with low sulfide contents) lies hidden in the upper portions of the intrusion. This project would be aimed at collecting more samples of weak to moderately-mineralized rock in order to gain a better appreciation of the mineralized potential of the Cloquet Lake Intrusion.

Previous Activity

Field reconnaissance mapping continued throughout July and August 2009.

Current Activity

A considerable portion of the summer of 2009 was spent conducting searches for rock outcroppings of this poorly exposed intrusion that covers a 274 square mile area. All public roads (72 linear miles), almost all logging roads (18 linear miles), and several back country traverses (38 linear miles) were driven or walked in attempts to further refine the known geology. In the end, several new outcrops were found in the northeast corner of the intrusion and additional outcrops were found in the southeast corner of the intrusion. The majority of the intrusion is not exposed except for one outcrop that is present along the side of Lake County Road #15. All of the new outcrop information has been added to a preliminary map, and a final geologic map will be produced pending review of the mineralogy in thin sections from collected rock samples. No obvious zones of Cu-Ni mineralization were located; however, a unique alteration pattern was discovered in the northeast corner of the intrusion that may be related to potential mineralization.

Principal Investigator(s)

Mark Severson
Steven Hauck

Project Sponsor(s)

PUF Mineral Endowment

Amount Account

15,000 1896-783-1082-00
Total \$15,000

Active

09/01/2004 06/30/2010

Start Date: 09/01/2004

End Date: 06/30/2010

Project ID: 1358

Further Evaluation of Diamond Base Metal and Precious Mineral Potential of Minnesota Using Various Glacial Till Sampling and Analytical Methods

Objective

To: (1) compile all pertinent Minnesota geological and geophysical information that are relevant to the formation of diamond pipes; (2) conduct additional processing and mineral analyses on some of the 120 previously collected glacial till samples from the Vermilion District for mineral potential; and (3) conduct a down-ice glacial till demonstration study in the International Falls area using the methods of Larson and other recognized glacial till sampling methodologies for identifying kimberlite and base and precious mineral indicator minerals.

Background

In Canada, sampling glacial till has been successfully used to locate diamond pipes and base metal mineralization. Very limited similar surveys have been conducted in Minnesota, but there has not been a systematic glacial till sampling survey conducted in northern Minnesota.

Previous Activity

Two poster presentations of the glacial indicator data were conducted, i.e., Heine, J., Hauck, S., and Thorleifson, H., 2009, Selected Indicator Mineral and Till Chemistry Results from Multiple Till Surveys in Minnesota: University of Minnesota, Duluth, MN, Natural Resources Research Institute, Economic Geology Group Poster Series, NRRI-POSTER-2009/01, presented at the Prospectors and Developers Association of Canada (PDAC), in Toronto in March, and the second poster by Hauck, S.A., Heine, J.J., and Thorleifson, L.H., 2009, A Follow-up Glacial Till Indicator Mineral Survey in Minnesota: What Does it Indicate About Exploration for Diamonds and Other Mineral Deposits?: University of Minnesota, Duluth, MN, Natural Resources Research Institute, Economic Geology Group, Poster Series NRRI-POSTER-2009/04, presented at the 55th Annual Meeting of the Institute on Lake Superior Geology (ILSG), in Ely, MN, in May 2009. Work is continues on the final report.

Current Activity

Gold data from a new DNR Lands & Minerals survey has been added to the database and gold map and will be incorporated into the final report.

Principal Investigator(s)

John Heine
Steven Hauck

Project Sponsor(s)

	Amount	Account	Active
MN Department of Natural Resources	74,700	1663-187-6586-00	08/10/2006 06/30/2008
PUF Mineral Endowment	95,000	1896-783-1223-00	07/16/2006 06/30/2010
Total	\$169,700		

Start Date: 08/10/2006 **End Date:** 06/30/2010 **Project ID:** 1438

Heavy Stream Discharge from the Falcon Concentrator

Objective

To test various modifications designed to enable a free flow of the heavy mineral stream out of the standard Falcon concentrator bowl. If successful, a performance evaluation will measure the device's ability to separate low silica magnetite out of a mixed stream that contains middlings and gangue.

Background

Previously, the Coleraine Minerals Research Laboratory completed evaluation of the Falcon concentrator, which is a device that separates minerals based on specific gravity. While performance was promising, the previous researcher was concerned regarding clogging of the heavy mineral discharge hardware. On the other hand, investigators from the gold industry state that the Falcon is the device of choice for "fine" particle size distributions, such as those used in the taconite industry. In addition, they report: "The ability to recover a mineral of density equal to 5.2 from a gangue of density 2.7, especially below 50 um (270 Mesh), is clearly demonstrated," (La Plante, Andre, "A Comparative Study of Two Centrifugal Concentrators," CMP Mineral Processing Proceedings, 1993). Existing magnetic separators are designed to remove magnetite out of the tailings stream, while sending both liberated magnetite and middlings on to further processing. These machines are not designed to separate pure magnetite away from the middlings. However, if that can be done with a Falcon, then the combination of the two devices could produce a returning mill feed stream consisting of only middlings. As the net mill feed tonnage is reduced, so the line productivity increases. In addition, if the heavy concentrate is sufficiently low in silica, then flotation recovery will increase. Solving the heavy particle discharge problem with the Falcon concentrator could result in large improvements for taconite plants.

Previous Activity

A new principal investigator has been assigned to prepare the final report for the completed study using the Falcon concentrator to separate a low silica magnetite concentrate from middlings and gangue. In addition, the centrifuge-type device was recommended for use in a tungsten processing circuit in the Yukon and is being run successfully at that location. The unit is also being evaluated for possible copper-nickel upgrading for Minnesota copper-nickel ore. Tom Larson was contacted by the new principal investigator, and data from the project have been located. Testwork is complete and final report writing is under way. The primary conclusion from the project is that the concentrator shows technical promise for upgrading taconite ore, but the physical configuration of the Falcon concentrator likely makes it too capital intensive for the proposed application.

Current Activity

The final report will be completed in the spring of 2010. New uses of the Falcon concentrator will also be evaluated in 2010.

Principal Investigator(s)

Kyle Bartholomew
Thomas Larson

Project Sponsor(s)

PUF Mineral Endowment

Amount	Account
40,000	1896-783-1208-00
Total	\$40,000

Active
02/09/2005 06/30/2006

Start Date: 02/09/2005

End Date: 06/30/2010

Project ID: 1386

History and Compilation of All Gold Exploration Data in Minnesota

Objective

To compile all available information (maps, assays, reports, etc.) from historical records to produce a Guidebook that describes “who did what, where, and how, and what did they find?” regarding the gold exploration history of northeastern Minnesota.

Background

Overall, the history of gold exploration in Minnesota may be summarized as very brief periods of activity: Vermilion Gold Rush of 1865-1867, Rainy Lake Gold Rush of 1893-1895, Raspberry Prospect (west of Ely) circa 1900, and more recently, a brief intense campaign in the 1980s following the discovery of the Hemlo gold deposit in Ontario. The latter includes such areas as the Virginia Horn, Lost Lake area in Itasca County, and the Mud Creek Shear Zone/Vermilion Fault area.

Previous Activity

No work reported.

Current Activity

No work reported. Waiting for Minerals Coordinating Committee (MCC) proposal with a similar name to be funded.

Principal Investigator(s)

Mark Severson
Steven Hauck

Project Sponsor(s)

PUF Mineral Endowment

Amount Account

31,000 1750-10416-20090-

Active

09/25/2009 06/30/2010

Total \$31,000

Start Date: 09/25/2009

End Date: 06/30/2010

Project ID: 1576

Investigation of Various Flotation Reagent Schemes for the Flotation of Sulfides from Minnesota's Copper-Nickel Deposits

Objective

To determine the best reagent schemes for recovering copper and nickel sulfides from the various Minnesota deposits, to train Coleraine Minerals Research Laboratory (CMRL) technicians in the "art" of sulfide flotation, and to develop analytical expertise in copper and nickel.

Background

Much of the sulfide flotation work on Minnesota copper-nickel deposits has been conducted by Lakefield Lab in Canada. Once they have established the "best practice" for one deposit, they appear to apply that practice to all deposits. There are some mineralogical differences between the various deposits, and it may be beneficial to develop different reagent schemes for the different mineralogies. There is a lack of experience at CMRL regarding the flotation of sulfide ores. Running a series of bench-scale flotation tests would be a training opportunity. Likewise, the CMRL analysts have little experience in conducting determinations on sulfide samples.

Previous Activity

As this project begins, CMRL currently has ore from three Minnesota deposits. It is proposed that a series of laboratory flotation tests be run on each ore to investigate the effect of reagents, grind, pH, eH, and mineralogy. Only rougher flotation tests would be run. Chemical analyses for the primary metals would be run at CMRL on all samples, with Platinum Group Minerals (PGM) analysis on selected tests being run by ALS Chemex Laboratories. Polished sections would be made of selected rougher concentrates and tails. Chemical analyses by size fractions will be run on selected tests to determine recovery by size. Ore samples will be generically identified, i.e., deposits A, B and C. At the completion of the test work, it is expected that a better understanding of the interaction of reagents and flotation conditions will be obtained and that CMRL, with trained staff, will be better positioned to provide technical support to the various copper-nickel mining companies.

Current Activity

Tests were run using sodium isopropyl xanthate as the collector to determine the effect of grind on copper recovery by size fractions. Grind times were 25, 35 and 45 minutes. Overall copper recovery in the rougher concentrate increased with grind time, resulting in 89.11% at 25 minutes, 90.15% at 35 minutes, and 91.92% at 45 minutes. The resultant rougher tails were screened through 10 microns, and the fractions were analyzed. The highest copper concentrations were in the minus 10 micron fractions and ranged from 0.125% at 25 minutes to 0.118% at 35 minutes and 0.097% at 45 minutes. Although the copper content of the minus 10 micron fractions decreased with grind time, because of the increase in the amount of minus 10 micron material, the actual percentage of total copper in the minus 10 micron fraction increased from 37.1 to 39.5 to 44.2 percent with the finer grinds. Test work is continuing with other ores and reagents.

Principal Investigator(s)

Blair Benner

Project Sponsor(s)

PUF Mineral Endowment

Amount Account

43,500 1750-10417-20090-

Active

08/25/2009 06/30/2010

Total \$43,500

Start Date: 08/25/2009

End Date: 06/30/2010

Project ID: 1556

Origin and Distribution of Chromium Mineralization in the Duluth Complex and Related Keweenawan Intrusives in Minnesota, and Its Relationship to PGE Mineralization

Objective

To expand our knowledge of Cr-mineralization and its potential relationship to PGE mineralization by: (1) using existing geochemistry data and collecting Cr-bearing samples for polished thin section analysis; (2) identifying other unassayed drill core that may contain chromium mineralization, analyzing the drill core, and collecting samples for polished thin sections; (3) supporting one Ph.D. thesis on the Birch Lake area that will investigate the PGE-Cr mineralization and relationships to oxide mineralization; (4) conducting quantitative microprobe analyses to determine the various chromium-related minerals; and (5) evaluating and further analysis of one chromium occurrence identified in a drill hole outside of the Duluth Complex.

Background

Chromium (Cr) mineralization associated with PGEs in the Duluth Complex was first recognized by Sabelin and Iwasaki (1985, 1986) in Du-15 in the Birch Lake area. The presence of chromium spinels was noted earlier by Weiblen and Morey (1976) at the Spruce Road deposit. Severson (1995) identified chromium and platinum mineralization in drill hole SL-19 northeast of the Water Hen deposit. Severson (1991) identified Cr-rich spinels in the Local Boy ore zone of the Babbitt deposit. Hauck et al. (in prep.) have identified a variety of Cr-rich spinel in the Birch Lake area, not all of which are directly associated with PGE mineralization. In addition, Heine et al. (1998) reported 1.64% Cr₂O₃ in saprolite in a drill hole drilled into a Keweenawan ultramafic body in Stearns County.

Previous Activity

The microprobe identification of materials continues, but is still in preliminary stages due to more immediate commitments.

Current Activity

The microprobe identification of materials continues, but is still in preliminary stages due to more immediate commitments. A new chromite deposit has been discovered in the James Bay Lowlands. Steve Hauck is trying to get a sample for comparison with the Duluth Complex chromites.

Principal Investigator(s)

Mark Severson
Steven Hauck

Project Sponsor(s)

PUF Mineral Endowment

Amount Account

76,000 1896-783-1071-00
\$76,000

Active

05/01/2002 06/30/2010

Total

Start Date: 02/01/2002

End Date: 06/30/2010

Project ID: 1192

Precambrian Research Center

Objective

To provide training and support to the next generation of geoscientists in modern methods of geological mapping and mapmaking. This training will focus on the unique attributes of mapping the ancient Precambrian rocks of the southern Canadian Shield. The Canadian Shield and similar terranes on every continent are host to many of the world's premier ore deposits.

Background

The Precambrian Research Center (PRC) was created at the University of Minnesota Duluth (UMD) in 2006 to satisfy an urgent, long-term demand for and critically low supply of geoscientists skilled in field mapping. The PRC seeks to reverse the two decades-long decline in the teaching of geologic mapping skills in U.S. colleges and to provide advanced training to professional geologists.

Previous Activity

Jan 1-June 30, 2009 Activities:

Field Camp: Promoted 2009 camp by distributing 250 posters and making several school visits; 2009 camp enrollment = 19.

Workshops: Promoted and planned a professional workshop on Mafic Layered Intrusions to be held at UMD in October 2009.

Student Awards: UMD student Tom Johnson was supported during the 2009 spring semester with a PRC Graduate Research Assistantship (GRA). Research grants were awarded to five students this spring (3 UMD, 1 U of TN-Knoxville, 1 U of MN-Twin Cities).

Fundraising: Solicitations were made by email correspondence, distribution of the annual report, and contacts made at industry conferences - Prospectors & Developers Assoc. of Canada (PDAC) and SME. Contributions for 2009 currently total \$31,000 due largely to continued memberships by our main corporate sponsors: Anglo American, Newmont, and Cliffs NR.

Other Activities: PRC hosted the 55th Annual Institute on Lake Superior Geology in Ely, MN, May 5-10. The meeting was attended by 235 participants, the third largest in ILSG history.

Current Activity

Field Camp: 2009 camp enrollment was full with 20 students from 18 different schools.

Workshops: Promoted and planned a professional workshop on Mafic Layered Intrusions to be held at UMD in Oct. 09

Student Awards: 08-09 PRC GRA recipient Tom Johnson successfully defended his MS thesis in September. No GRAs were awarded for the 09-10 academic year.

Workshop: The 3rd PRC professional workshop was held Oct. 5-10 on the pic of Mafic Layered Intrusions. The workshop was fully attended by 21 participants and involved nine instructors.

Fundraising: Contributions for 2009 totaled \$41,500.

Conference Presentations: Geological Society of America (GSA) - Portland, OR - Jim Miller gave talk on PRC field camp.

Board of Advisors: Updated and expanded PRC board to 14 members from industry, government, and academia. Plan to hold Advisory meeting in March, 2010 at PDAC.

Principal Investigator(s)

Dean Peterson

George Hudak

Jim Miller

Steven Hauck

Project Sponsor(s)

PUF Mineral Endowment

Amount Account

150,000 1896-783-1226-00

Total \$150,000

Active

07/18/2006 06/30/2010

Start Date: 07/18/2006

End Date: 06/30/2010

Project ID: 1432

Volcanogenic Massive Sulfide (VMS) Potential in Lake of the Woods, Koochiching & Beltrami Counties, Reconnaissance Evaluation of the

Objective

To determine the volcanogenic massive sulfide potential of an area drilled between the late 1960s and middle 1980s using new ideas about the generation and occurrence of base-metal sulfides.

Background

The main objective of this proposal is to make a first pass evaluation of the volcanogenic massive sulfide potential, through logging of selected drill holes, within a portion of a greenstone belt (80 mile strike-length) that was drilled by several exploration companies from the late 1960s through the middle 1980s. Many of the holes drilled by the companies intersected massive sulfide horizons associated with a variety of volcanic, chemical, and sedimentary rock packages. However, the massive sulfides in the holes were mainly pyrite and pyrrhotite with limited amounts of base metal sulfides, a fact that discouraged further exploration in the area. At the time, detailed alteration and volcanic facies studies were not routinely conducted by the companies, nor was it recognized that volcanogenic massive sulfide districts typically contain some amounts of base metal-deficient massive sulfides that are distally-located relative to volcanogenic massive sulfide vent areas. In essence, the exploration companies never tried to put together a big picture in an attempt to further refine the mineral potential of the area. The goal of this project is to begin to relog the holes, with emphasis on conducting alteration studies and detailed volcanogenic facies mapping (as has been recently done in the Vermilion District by the NRRI and UW-Oshkosh) in order to fully assess and document the mineralization potential of this greenstone belt.

Previous Activity

Mark Severson has updated a map of drill hole locations and drill hole lithologies. The drill holes will be described and logged after January 1, 2009.

Current Activity

All of the drill hole data and exploration data have been reviewed and summarized in preliminary maps, tables, and various databases. This review indicates that out of the 210 drill holes that were drilled in the area, 44 drill holes intersected massive sulfides, but most of these are base metal-poor. The abundance of massive sulfides in this terrain suggests that base metal-rich massive sulfides may be present and could potentially be discovered with more intense exploration efforts. Drill logs for all but a few of the holes have been summarized, the remaining logs apparently do not exist, and these holes will be logged in the near future in order to complete the database and write a final report.

Principal Investigator(s)

Dean Peterson
Mark Severson
Steven Hauck

Project Sponsor(s)

PUF Mineral Endowment

Amount Account

10,000 1896-783-1087-00

Active

09/01/2004 06/30/2010

Total \$10,000

Start Date: 09/01/2004

End Date: 06/30/2010

Project ID: 1356

Peat Expansion Premier Horticulture, Inc.

Objective

To locate, assess, and secure a suitable horticultural peat resource for Premier Horticulture, Inc., to allow expansion of their Peatrex operation, and to initiate the environmental review and permitting process.

Background

Premier Horticulture, Inc. contacted NRRI for assistance in expanding their Peatrex operation located west of Cromwell, Minnesota. It is estimated that their current peat resource (approximately 240 acres) will be depleted in the next 5 to 10 years. Also, their packaging facilities are presently operating under capacity and could readily handle additional peat from another resource, making the operation more cost-effective and profitable. An expansion would not only maintain present employment at Peatrex, but would also result in 15 additional jobs at the processing plant and harvesting site. Supplementary employment would also occur in spin-off industries such as trucking. NRRI will assist Premier Horticulture, Inc. by: (1) conducting a detailed assessment of potential peat resources in proximity to the Peatrex operation, (2) identifying financial assistance and other incentives available for peatland development from State, County, and local agencies, and (3) assisting in the purchase or lease of the property, and beginning the environmental review and permitting process required by Federal and State regulatory agencies prior to peat development.

Previous Activity

NRRI personnel completed a National Pollutant Discharge Elimination System (NPDES) permit renewal for Premier's Black Lake Bog (formerly Peatrex) in March.

Current Activity

NRRI's involvement in the Wright Bog horticultural peat development continues to remain on hold while Premier negotiates an easement with a local landowner to allow construction of a drainage ditch from the site.

Principal Investigator(s)

Kurt Johnson
Steven Hauck

Project Sponsor(s)

Minnesota Technology, Inc

Amount	Account	Active
99,982	1673-187-6441-00	07/01/1999 06/30/2004
	1196-187-2428-00	10/25/2001 06/30/2010
Total	\$99,982	

Start Date: 07/01/2000 **End Date:** 06/30/2010 **Project ID:** 1074

Wetland Banking Fens Research Facility

Objective

To restore most of the effectively drained Fens Research Facility (Fens) to a variety of wetland types so new wetland credits can be deposited into a state wetland bank for future withdrawal as wetland mitigation credits.

Background

For about 100 years, the Fens has been used for agriculture, horticulture, fuel peat production, and peatland research. The peat soils have been intensively drained. With recent demand for wetland mitigation credits, the Fens became a candidate for peatland restoration. The Minnesota Board of Water and Soil Resources (BWSR) and the Minnesota Department of Transportation (Mn/DOT) approached NRRI about establishing numerous wetland banks at the Fens. After lengthy review, five banks are in the process of being established. A variety of wetland types are being established. New wetland credits (NWC) are being deposited into BWSR wetland banks. NWC are used for wetland replacement mitigation following loss of wetlands as a result of road construction in Northeast Minnesota.

Previous Activity

In 2002 and 2005, the University of Minnesota (UM) entered into agreements with BWSR and Mn/DOT to restore 333.2 acres of drained peatlands for NWC at the Fens. Under the 2002 and 2005 agreements, the land was cleared, vegetation killed, and the soil rototilled. Subsequently, the ditches were filled, the land leveled and donor material (plant fragments) from nearby bogs was gathered and spread at the Fens. Water wells and vegetation plots were monitored and herbicide was sprayed on invasive species in August and September of each year since bank establishment. In 2008, UM entered into another agreement with BWSR to restore 145.4 acres of drained peatlands for NWC at the Fens. The construction and establishment of monitoring sites followed the same process as that for the 2002 and 2005 agreements.

Current Activity

Vegetation and well monitoring of the 2002, 2005 and 2008 BWSR and Mn/DOT banks were carried out in the summer and early fall of 2009. A mosaic of wetland types has been established at the banks. Control of invasive species, primarily reed canary grass, involved spot spraying with glyphosate. The entire bank site was sprayed. Annual reports were written for the wetland banks. Seventy-five percent of NWC have been deposited for the 2002 and 2005 agreements and 25 percent of NWC have been deposited for the 2008 agreement. It is expected that the 2002 agreement will end in 2010 with full acceptance of peatland restoration for NWC.

Principal Investigator(s)

Steven Hauck
Thomas Malterer

Project Sponsor(s)

Amount	Account	Active
	1196-187-2426-00	05/01/2001 06/30/2010
Total	\$	

Start Date: 07/01/2002

End Date: 09/30/2013

Project ID: 1367

Wetland Mitigation in Abandoned Gravel Pits

Objective

To determine if viable mitigation wetlands can be created on abandoned gravel pit sites to compensate for wetland impacts due to road construction in northeastern Minnesota.

Background

It is becoming increasingly difficult to provide on-site mitigation for wetland impacts due to road construction in northeastern Minnesota counties which retain greater than 80 percent of their pre-settlement wetlands. Abandoned gravel pits are one of the few remaining areas that can serve as wetland mitigation sites within the impacted watersheds. The main goal of the project is to determine if viable mitigation wetlands can be created on abandoned gravel pit sites to compensate for wetland impacts due to road construction in northeastern Minnesota. To achieve this goal a wetland creation demonstration site will be established in an abandoned gravel pit within the U.S. Trunk Highway (TH) 53 reconstruction corridor. The site will allow research and evaluation of hydrologic controls, soil amendments, direct seeding, mulch, and other techniques for wetland establishment. Soil and plant materials displaced by the TH 53 reconstruction will also be evaluated for use in wetland creation. The completed demonstration site will consist of a complex of several wetland types most likely to be impacted in northeast Minnesota (Types 2, 6, 7, and 8). The research will result in preliminary recommendations for creating wetlands in abandoned gravel pits based on information acquired during the funding period.

Previous Activity

Bog donor material collected from NRRI's Fens Research Facility and Premier's Black Lake Bog was spread on selected areas of the Mitigation 4 site in March. A mulch study was also established on the site. A new study site was established on Mitigation 3 in late May to test the effects of mulch, new Minnesota Board of Water and Soil Resources (BWSR) seed mixes, and conifer seedlings on wetland success. Another plant survey of all the plots was conducted in late June. The presentation "Wetland Mitigation in Abandoned Gravel Pits" was given at the Society of Wetland Scientists 2009 Annual Meeting in Madison, Wisconsin, in June.

Current Activity

Continued to control invasive plant species by spraying with glyphosate herbicide on the Mitigation 4 and 5 sites in July 2009. Completed the fall 2009 plant surveys of the research plots in early September 2009. Presented the paper "Wetland Mitigation in Abandoned Gravel Pits - Creating Fresh Meadow and Shrub Swamp" at the International Conference on Ecology and Transportation held in Duluth, Minnesota, September 13-17, 2009. Submitted the proposal "Wetland Mitigation in Abandoned Gravel Pits (Phase II)" to the Center for Transportation Studies (CTS) in October 2009. The article "From Gravel Pit to Wonderful Wetland" was published in the Autumn issue of NRRI NOW. Plant survey data organization and analysis were ongoing in preparation for the draft final report.

Principal Investigator(s)

Kurt Johnson

Project Sponsor(s)

Project Sponsor(s)	Amount	Account	Active
MN Dept of Transportation(MNDOT)	109,562	1663-187-6591-00	10/09/2006 03/31/2010
Total	\$109,562		

Start Date: 10/09/2006 **End Date:** 03/31/2010 **Project ID:** 1445

Center for Applied Research and Technology Development – Program Notes

Forestry/Forest Products

Personnel

Sue French-Coda rejoined the Forest Products scientific staff as a part-time Scientist. Sue will focus on performance testing of thermally modified lumber and composite products.

Two University of Minnesota Duluth students have joined the Forest Products staff: **Eric Hagen**, an economics senior, will assist in market research and economic analysis, and **Nick Westing**, a computer science/electrical engineer double major junior, will assist in the applied housing system development.

Xiping Wang resigned his position as Senior Research Associate. Xiping was hired by the USDA Forest Products Laboratory, in Madison, Wisconsin. He will continue to serve as a research cooperater and be asked to serve as an Adjunct Senior Research Associate.

Scientific Meetings/Presentations

Matthew Aro presented a research poster entitled, “Energy-Efficient Structural Insulated Panels” at the E3 2009 Conference at the St. Paul River Centre in St. Paul, Minnesota on November 17, 2009.

Bill Berguson gave a presentation to Geneva Pellet regarding wood supplies and issues related to pellet markets. Bill gave this presentation in Duluth, Minnesota, in July 2009.

Bill Berguson gave a presentation entitled, “Factors Affecting Biomass Yield of Poplar Plantations in Minnesota: Past Experience and Research Needs” at the Annual Joint Meeting of the American Society of Agronomy, Crop Science Society of America, and the Soil Science Society of America, in Pittsburgh, Pennsylvania, in November 2009.

Brian Brashaw gave a presentation entitled, “Lean Thinking: Changing the Way you Think about Your Business” to the Forest Products Society members and guests during the Forest Products Society Upper Mississippi Valley Section Meeting held in Duluth, Minnesota, on July 15, 2009.

Brian Brashaw gave a presentation to the NE Minnesota Forest Action Team and Electronic Commons! at the Northeast Minnesota sustainable Development Partnership Annual Meeting on December 3, 2009.

R.J. Ross, **B.K. Brashaw** and **X. Wang** presented their research paper entitled, “Nondestructive Evaluation and Inspection of Historic Wood Structures in the USA” to the Beijing Cultural Heritage Administration, in Beijing, China, on October 14, 2009.

Brian Brashaw, R. Vatalaro, K. Sarvela, M. Verreux, X. Wang, J. Wacker and R.J. Ross were all co-authors of the paper entitled, “Development of Flexural Vibration Inspection Techniques to Rapidly Assess the Structural Health of Timber Bridge Systems: Phase II” which was presented at the 16th International Symposium on Nondestructive Testing of Wood, in Beijing, China on October 10-12, 2009.

Xiping Wang was invited to present a seminar entitled, “NDT Technologies for Wood – Current Research and Development” which he presented to the Chinese Academy of Forestry, Forest Machinery Research Institute, in Beijing, China on July 1, 2009.

Publications

B.K. Brashaw, R. Vatalaro, K. Sarvela, M. Verreux, X. Wang, J. Wacker and R.J. Ross. 2009. Development of Flexural Vibration Inspection Techniques to Rapidly Assess the Structural Health of Timber Bridge Systems: Phase II. In: Proceedings of the 16th International Symposium on Nondestructive Testing of Wood, October 10-12, 2009. Beijing, China.

B.K. Brashaw, R. Vatalaro, X. Wang, K. Sarvela, M. Verreux and J.P. Wacker. 2009. Development of Flexural Vibration Inspection Techniques to Rapidly Assess the Structural Health of Rural Bridge Systems - Phase II. CTS 09-xx, Intelligent Transportation Systems Institute, Center for Transportation Studies, University of Minnesota. (in-press)

X. Wang. 2009. Nondestructive Evaluation Technique to Assess Quality of Standing Timber. Natural Resources Research Institute Technical Report NRRI/TR-2009/02.

B.K. Brashaw, V. Krause and R. Vatalaro. 2009. Dimensional Stability of Various Lumber Groups. Natural Resources Research Institute Technical Report NRRI/TR-2009/08.

V. Krause. 2009. Engineered Hardwood Floor Testing 09-1233. Natural Resources Research Institute Technical Report NRRI/TR-2009/29.

V. Krause. 2009. Engineered Hardwood Floor Testing 09-1234. Natural Resources Research Institute Technical Report NRRI/TR-2009/30.

V. Krause. 2009. Evaluation of Powder Coated MDF for IB Strength and KCMA tests 9.1 and 9.2. Natural Resources Research Institute Technical Report NRRI/TR-2009/38.

V. Krause. 2009. Evaluation of Laminated Cabinet Doors for KCMA Finish Tests and Ultraviolet Light Exposure. Natural Resources Research Institute Technical Report NRRI/TR-2009/39.

Outreach

BTD Wood Powder Coatings, Brainerd, Minnesota: The Wood Materials and Manufacturing Program conducted KCMA humidity and KCMA hot/cold testing on powder coated MDF panels.

Cirrus Design, Duluth, Minnesota: The Wood Materials and Manufacturing Program conducted resin flow testing in support of the quality assurance program for incoming materials. We also performed shear testing of various products.

Crystal Cabinets, Princeton, Minnesota: The Wood Materials and Manufacturing Program conducted humidity exposure testing on cabinet doors.

Forest Capital Partners, International Falls, Minnesota: The Forestry Program provided technical assistance to the staff at Forest Capital Partners regarding assessment of productivity and thinning options in Red Pine stands in August.

Friul Intagli, Italy: The Wood Materials and Manufacturing Program Conducted KCMA finish tests and UV exposure on laminate doors.

Great Lakes Logcrafters Association, Two Harbors, Minnesota: The Wood Materials and Manufacturing Program provided information and ideas about the testing of handcrafted log homes to determine R-value and thermal mass properties.

KL Energy, Superior, Wisconsin: The Forestry Program provided technical assistance in October to KL Energy and Jeff Foster Trucking to discuss issues related to biomass procurement and costs for a potential pilot-scale liquid fuels project.

Minnesota Forest Productivity Research Cooperative (MFPRC): A tour of the MFPRC field research sites was given in September to all members of the MFPRC (Potlatch Corporation, Minnesota Power, Verso Paper, Forest Capital Partners, Minnesota DNR and the St. Louis County Land Department) by the Forestry Program Director. This tour included ongoing research in hybrid poplar production and breeding, Red Pine thinning, and Aspen production

Northern Contours, Fergus Falls, Minnesota: The Wood Materials and Manufacturing Program conducted KCMA kitchen cabinet assessment testing and laminate performance testing. We also provided technical assistance for a variety of products and manufacturing processes in support of their product families.

Steve Pultz, Redwood Falls, Minnesota: The Wood Materials and Manufacturing Program provided information on hydro mulch products and processing equipment.

Renewable Resource Solutions LLC, Crystal Falls, Minnesota: The Wood Materials and Manufacturing Program moderated a webinar on pine straw production for the Northeastern Woody Biomass Utilization program of the USDA Forest Service.

Minnesota Department of Natural Resources, St. Paul, Minnesota: The Wood Materials and Manufacturing Program provided information on moisture analyzers for use with woody biomass.

Rockland Flooring, Red Wing, Minnesota: The Wood Materials and Manufacturing Program conducted abrasion resistance, static bending, and shear strength testing on truck flooring samples.

Stephenson-Warner, Cloquet, Minnesota: The Wood Materials and Manufacturing Program conducted proof loading of their "Wide Receiver" skid steer attachment product.

D. Towley, Bemidji, Minnesota: The Wood Materials and Manufacturing Program provided information and referral to the USDA Forest Products Laboratory on the potential toxicity of catalpa wood for use in wood bowls.

USDA Animal and Plant Health Inspection Service, Madison, Wisconsin: The Wood Materials and Manufacturing Program provided technical assistance on training federal and state Plant Protection and Quarantine (PPQ) officers on heat treating ash firewood for EAB and certifying heat treating facilities in the state of Wisconsin.

Van Technologies, Duluth, Minnesota: The Wood Materials and Manufacturing Program conducted abrasion resistance and coefficient of friction testing for various products.

A.J. Vandeburghe, St. Paul, Minnesota: The Wood Materials and Manufacturing Program provided information to the Minnesota Technical Assistance Program on the energy footprint of OSB manufacturing.

Verso Paper Company, Alexandria, Minnesota: A meeting was held in December with Verso Paper company staff to discuss research results and breeding plans for hybrid poplar genetic improvement for the 2010 season.

WLSSD, Duluth, Minnesota: The Forestry Program provided technical assistance to WLSSD and US Steel-KeeTac at Keewatin, Minnesota during the quarter through a series of meeting related to application of WLSSD biosolids material on forested areas on the KeeTac tailings basin.

Facilities

The NRRI greenhouse and growth chamber are being used for the 2010 poplar breeding activities being done under the Minnesota Forest Productivity Research Cooperative program. Parent material for this breeding has been recently planted and pollinations will begin in the greenhouse in March. This facility has been updated to include upgraded louver control mechanisms and notification systems in the event of power failure.

Coleraine Minerals Research Lab & Economic Geology Group

Personnel

Dr. E. Caner Orhan has accepted the Program Director's position in Math Modeling and Process Simulation to advance our Concentrator Modeling Center at CMRL. Dr. Orhan was previously a Professor in the Mining Engineering Department at Hacettepe University, Ankara, Turkey.

Kurt Johnson was appointed as the head of the Peat Resources and Applied Wetland Rehabilitation Research program area within the Economic Geology Group.

Outreach

Morris Campus Biomass Project - We are advancing a joint biomass project with the University of Minnesota Morris campus, to gasify six different biomass feed stocks and send the biomass ash produced in the process to the Department of Agriculture for further testing.

Task Force on Mercury Removal in Taconite - We have secured a large grant with the Department of Natural Resources, Minerals Division, to evaluate different mercury reduction technologies in taconite plant stack gas. Bench scale research work is being initiated at CMRL prior to conducting full scale mercury removal test work on individual furnace lines at Minnesota taconite operations.

Fafard, Inc., Floodwood, Minnesota - Kurt Johnson provided assistance in completing the National Pollutant Discharge Elimination System (NPDES) permit renewal application for their horticultural peat operation.

Berger Horticultural Products, Ltd., Big Falls, Minnesota - Kurt Johnson met with Berger representatives and the Koochiching Development Authority (KDA) in Big Falls on October 12, 2009, to discuss plans for developing the Pine Island Bog as a horticultural peat operation. A tour of the bog followed the meeting.

Facilities

Pellet Pot Grate Upgrade - The taconite pellet pot grate system is being upgraded to advance the system. State of the art Programmable Logic Controller (PLC) controls, including a new burner and control system, pneumatic positioning controls, and new air handling equipment, are being added. The pot grate system simulates the pelletizing process in taconite and fires iron ore greenball samples, replicating firing cycles used in grate-kiln and straight pelletizing furnaces in our Minnesota taconite operations.

DOE Coal Fired Oxy Burner Installation in Our LHF - A Maxon coal oxy-burner was installed in our Linear Hearth Furnace (LHF) at CMRL as part of our Department of Energy (DOE) "Next Generation Metallic Iron Nodule Technology in Electric Furnace Steelmaking" project. The burner is being evaluated as a potential replacement for natural gas oxy-burners installed in our linear hearth furnace used to produce nodular reduced iron. Different coal types are being tested as fuel sources for the coal oxy-burners, including bituminous and sub-bituminous Powder River Basin (PRB) coal. LHF operating parameters are being optimized, with the coal oxy-burner providing heat in the melting zone of the furnace. This type of burner will also be tested using various biomass derived bio-coals in a new DOE program.

Scientific Meetings/Presentations/Papers

Johnson, K., 2009, Wetland Mitigation in Abandoned Gravel Pits – Creating Fresh Meadow and Shrub Swamp. Presentation at the International Conference on Ecology and Transportation held in Duluth, Minnesota, September 13-17, 2009.

Coleraine Technical Reports

CMRL/TR-09-06 – (aka: NRRI/TR-2009/21) – Confidential Report issued to American Iron & Steel Institute – R. F. Kiesel – July 23, 2009 – 26 pgs.

CMRL/TR-09-08 – (aka: NRRI/TR-2009/32) – Demolition of a Shallow Bed and Reconstruction of a Deep Bed Sintering Pot Facility at the Coleraine Minerals Research Laboratory, January 2008 through October 2009 – D. J. Englund – October 15, 2009 – 9 pgs.

CMRL/TR-09-09 – (aka: NRRI/TR-2009/34) – Confidential Report issued to Duluth Metals Corp. – B. R. Benner – October 29, 2009 – 17 pgs.

Economic Geology Group Technical Reports

Severson, M.J., Oreskovich, J.A., and Patelke, M.M., 2009, Compile and make digital the lithologies for all NRRI drill logs, with emphasis on the Duluth Complex drill holes (An addendum to an earlier NRRI database): University of Minnesota Duluth, Natural Resources Research Institute, Technical Report NRRI/TR-2009/33, 45p.

Economic Geology Group Technical Summary Reports

Zanko, L.M., and Patelke, M.M., 2009, Taconite Aggregate for I-290 Slurry Seal Project Processing and Testing of Screened Product: University of Minnesota Duluth, Natural Resources Research Institute, Technical Summary Report NRRI/TSR-2009/02, 6 p.

Zanko, L.M., and Patelke, M.M., 2009, Taconite Aggregate – Crushed Rock – Laurentian Aggregate Transportation of Material by Barge to Chicago, Illinois: University of Minnesota Duluth, Natural Resources Research Institute, Technical Summary Report NRRI/TSR-2009/03, 19 p.

Diedrich, T.R., Brecke, D.M., and Zanko, L.M., 2009, Glossary of Selected Terminology for the Environmental Exposure Characterization Study for Minnesota Taconite Workers Lung Health Partnership: University of Minnesota Duluth, Natural Resources Research Institute, Technical Summary Report NRRI/TSR-2009/04, 18 p.

Economic Geology Group Reports of Investigation

Brecke, D.M., 2009, Mesothelioma Air Particulate Project Review: Developing Procedures for Particle Collection and Gravimetric Analysis: Natural Resources Research Institute, University of Minnesota, Duluth, MN, Report of Investigation NRRI/RI-2009/02. 28 p.

Economic Geology Group Posters

NRRI/POSTER-2009/06

Work Completed by the Natural Resources Research Institute in the Duluth Complex and Related Mineral Deposits, M. Severson, 2009.

NRRI/POSTER-2009/07

Work Completed by the NRRI in Deciphering the Stratigraphy and Aggregate Potential of the Biwabik Iron Formation, Mesabi Range, Northeastern Minnesota, M. Severson, 2009.

NRRI/POSTER-2009/08

Copper-Nickel and Iron-Titanium Deposits in the Partridge River, South Kawishiwi, and Bathtub intrusions, Duluth Complex, NE Minnesota (and amount of work conducted at each by the Natural Resources Research Institute), M. Severson, 2009.

NRRI/POSTER-2009/09

Current MN DNR Lease Lands and Warren Family Properties, M. Schreiber, S. Hauck, J. Heine, 2009.

NRRI/POSTER-2009/10

Diamond Drill Holes and Warren Family Properties, M. Schreiber, S. Hauck, J. Heine, 2009.

NRRI/POSTER-2009/11

MN DNR Controlled Mineral Lands and Warren Families Properties, M. Schreiber, S. Hauck, J. Heine, 2009.

NRRI/POSTER-2009/12

Surface Rights from MN DNR Files and Warren Family Properties, M. Schreiber, S. Hauck, J. Heine, 2009.

NRRI/POSTER-2009/13

University Trust Lands and Warren Family Properties, M. Schreiber, S. Hauck, J. Heine, 2009.

NRRI/POSTER-2009/14

Geological and Geophysical Maps of Portions of Koochiching, Itasca, and St. Louis Counties, Minnesota, M. Schreiber, S. Hauck, J. Heine, 2009.

NRRI/POSTER-2009/15

Chemical and Physical Evolution of Aerosols during Taconite Mining and Beneficiation, Mesabi Iron Formation, T. Diedrich, D. Brecke, M. Schreiber, S. Monson Geerts, V. Marple, 2009.

Center for Water and the Environment

Acceleration of Inorganic Nutrient Release and Mineral Organic Matter Association by Biophysical Soil Mixing along an Earthworm Invasion Chronosequence

Objective

Two major life sustaining processes of the terrestrial earth surface are the release of inorganic nutrients through mineral weathering and carbon cycling, which are strongly influenced by soil organisms. We propose that vertical soil mixing by earthworms will have far reaching impacts on the rates of mineral weathering and carbon cycling when viewed against the steep vertical gradients in: 1) the concentrations, compositions and dynamics of minerals and organic matter, and 2) the geochemical environment affecting mineral weathering that define soil types. Our goal is to understand how and to what degree soil perturbation by earthworms affects the rates of chemical weathering and organic matter-mineral association in soils. Although earthworms are widely perceived to have beneficial influences on soil structure and nutrient dynamics, recent research has shown them to have negative impacts on soil structure, nutrient availability and water dynamics in cold-temperate hardwood forests.

Background

Dr. Hale's research characterized earthworm invasion chronosequences in the Chippewa National Forest that could be used to examine the effects non-native earthworms have on carbon and mineral weathering dynamics in cold-temperate hardwood forests.

Previous Activity

2009 activities: Earthworm sampling was conducted using the mustard extraction technique at 30 plots along three transects along an earthworm invasion chronosequence, midden counts were also conducted to estimate populations of deep dwelling species.

Soil sampling was conducted in 6 excavated soil pits with varying degrees of earthworm invasion. Detailed soil morphologic description was made and two sets of samples by horizons were collected for analysis of bulk density, elemental composition, C and N concentrations, stable isotope ratios, mineralogical compositions, and the activities of short-lived isotopes. Another set of samples were collected specifically for ¹⁴C analysis.

At each excavated soil pit, three zero tension lysimeters were installed below the A and E1 horizons and at the depth of 45 cm; five piezometers were installed. The lysimeters and piezometers will be allowed to equilibrate with the surrounding environments until the next snow melt when water sampling will begin.

Current Activity

Principal Investigator(s)

Cindy Hale

Project Sponsor(s)

University of Delaware, USDA(Prime)

Total

Amount Account

16,223 3014-10424-00002871

\$16,223

Active

09/01/2008 08/31/2011

Start Date: 09/01/2008

End Date: 08/31/2011

Project ID: 1565

Avian Migration within the Lake Superior Coastal Region

Objective

1) Assess the timing, distribution, and relative abundance of fall migrants along the North Shore of Lake Superior, 2) Examine fine-scale stopover habitat selection of migrants, 3) Improve understanding of landscapes of migratory stopover sites, and 4) Provide recommendations for conservation priorities to ensure protection of migratory bird populations along the North Shore of Lake Superior.

Background

Over the past 50 years there has been increasing urban, exurban, and recreational development along the North Shore of Lake Superior, while recently there has been strong interest and plans to develop wind energy along the North Shore ridges. During bird migration periods, the Great Lakes are a migration barrier resulting in vast congregations of birds on or near shorelines, especially on the North Shore of Lake Superior.

Previous Activity

Data have been gathered on the fall bird migration along the North Shore during the fall of 2008 and 2009 with other funding sources.

Current Activity

Compiling and analyzing data. Completing preparation for 2010 fall field season.

Principal Investigator(s)

Anna Peterson

Gerald Niemi

Project Sponsor(s)

USDI Fish and Wildlife

Amount Account

38,110 3002-10429-00010606

Active

10/01/2009 09/30/2011

Total \$38,110

Start Date: 10/01/2009

End Date: 12/31/2011

Project ID: 1564

Bats and Wind Along the North Shore of Lake Superior

Objective

Background

Previous Activity

Current Activity

Habitats important to bats were identified on the North Shore by two Landsat-based satellite imagery land cover classification types in GIS. Identification of sampling locations based on stream and transportation GIS coverages. We used Anabat II acoustic detectors to measure bat presence and relative abundance at 54 sites along the North Shore.

Detectors were placed at 23 corridor, 16 forest, and 15 riparian sites for three to four consecutive nights during the summer and fall of 2009. These detectors were in the coniferous, mixed deciduous and coniferous, and deciduous forest types. We also trapped nocturnal insects with black light traps at a comparable site an average of 120 meters from the bat detector to estimate prey availability.

Bat activity levels were greatest at riparian area sites with 45% of bat call files along rivers and streams, 39% of bat call files were recorded at corridor sites along trails and pipelines, and 9% in contiguous forest. Bat activity was greatest in mixed forest, with 41% of bat call files recorded, compared to 31% in deciduous forest, and 28% in coniferous forest. Sites with the highest bat activity had high insect abundance. However, there was also bat activity at sites with low insect abundance.

Principal Investigator(s)

Ronald Moen

Project Sponsor(s)

National Fish & Wildlife Foundation

Amount Account Active

10,637 3011-10430-00001053 01/15/2009 09/30/2010

Start Date: 09/24/2009 **End Date:** 12/31/2010 **Project ID:** 1559

Biomass Harvest Effect on Wildlife

Objective

Forest fuel reduction near houses and removing residual woody material for biomass energy plants (biomass harvest) seem to be complementary solutions that would help save property, conserve energy, and reduce the risk of large forest fires. A hidden cost to biomass harvest may be a negative effect on species that depend on down and decayed woody material for survival. Acquiring data on mammal and amphibian responses to biomass harvest that will enable planning for appropriate levels of biomass removal is the primary objective of this research.

Background

Previous Activity

We trapped beaver with Hancock live traps in the fall of 2008 following protocols and methods currently being used in an ongoing study in Voyageurs National Park.

Current Activity

No results to report at this time.

Principal Investigator(s)

Ronald Moen

Project Sponsor(s)

National Fish & Wildlife Foundation

Amount Account

10,637 3011-10430-00001053

Active

01/15/2009 09/30/2010

Total

\$10,637

Start Date: 01/15/2009

End Date: 09/30/2010

Project ID: 1541

Canada Lynx and Snowshoe Hare Habitat Use Interactions

Objective

The objective of this project is to understand the factors affecting the apparent reappearance, current distribution, and long-term persistence of the Canada lynx in Minnesota. This requires a much greater understanding of the biology and ecology of lynx in this geographic region than we currently have. Methods used will include telemetry, snow-tracking, documentation of habitat use, and geographic information system analysis of locations.

Background

This project will increase understanding of Canada lynx (*Lynx canadensis*) in Minnesota, ranging from demographic information to habitat use data that can be used to make management recommendations for Canada lynx, a species which is listed as threatened under the Endangered Species Act. The only previous study on Canada lynx in the region was conducted by L. David Mech in the 1970s.

Previous Activity

Thirty Canada lynx have now been live-trapped and radiocollared on the project. Almost 10,000 global positioning system locations of lynx have been collected with GPS radiocollars. Other lynx are wearing standard VHF telemetry collars. Several mortalities have been documented over the past year. The project website at www.nrri.umn.edu/lynx provides full details and a current update.

Current Activity

The project website at www.nrri.umn.edu/lynx provides full details and a current update.

Principal Investigator(s)

Ronald Moen

Project Sponsor(s)

	Amount	Account	Active
USDA Forest Srvs/Superior National Forest	30,000	1636-189-6186-00	09/03/1999 10/13/2000
USDA/Forest Service	117,000	1636-189-6202-00	08/29/2000 09/30/2005
USDI- US Geological Survey	56,242	1727-189-6251-00	06/09/2003 12/31/2006
USDI Geological Survey	285,482	1648-189-6255-00	04/21/2003 12/31/2006
MN DNR	180,165	1662-189-6287-00	06/01/2005 04/30/2008
USDA Forest Service	121,210	1636-189-6252-00	07/16/2003 07/16/2008
NCASI National Council for Air & Stream	49,750	1665-189-6288-00	04/01/2005 06/30/2010
Total	\$839,848		

Start Date: 09/03/1999 **End Date:** 06/30/2010 **Project ID:** 740

Exotic Earthworm Invasions: Integrated Research and Education to Achieve Natural Resource Protection

Objective

We will conduct surveys for earthworms in each of eight state parks in the coastal zone (Jay Cooke, Gooseberry Falls, Split Rock, Tettegouche, George Crosby Manitou, Temperance River, Cascade River and Judge Magney). Walk through surveys of each park will provide distributional data on earthworm presence and absence across each park. A minimum of 12 stands in each park will be surveyed to assess the relative abundance and diversity of earthworm populations and the level of impact earthworm invasions are having on forest soils in a range of forest habitat and soil types in relation to human centers of activity in the parks.

Public education and involvement in this project is also a key component. We will present public programs at each park on the issues of exotic earthworms. Citizen volunteers and MN Conservation Corp crews will be trained and assist in the detailed surveys at each park. Educational displays will be created for each state park highlighting the research and its results. All aspects of the research and education activities will be incorporated into the Great Lakes Worm Watch citizen science program.

Background

Non-native earthworms are altering the fundamental structure and function of previously earthworm-free hardwood forests in North America. These forests developed over thousands of years in the absence of earthworms and historically had thick layers of leaf litter that serve as rooting medium for herbaceous and woody species. Following invasion of a northern forest by earthworms, a cascade of ecological effects occurs. Identification and protection of earthworm-free areas in the coastal zone could substantially limit the impacts for generations to come.

Previous Activity

Current Activity

Summer walk-through surveys were completed in nine state parks and two waysides. A total of 1,328 samples points were surveyed for visual indicators of earthworm invasion, wedge prism measurements, canopy composition and upper soil horizon data. Fall quantitative surveys of earthworm populations were completed at 160 of the survey points.

Ryan Hueffmeier, an M.S. student, is taking lead on the analysis to create a "Rapid Assessment Visual Indicators Tool" for land managers. Zach Bennett began a study in Tettegouche State Park to examine how the March 2009 ice storm, which caused catastrophic canopy damage hardwood forests in the park, may interact with earthworm invasion status to alter the successional trajectories of the understory plant communities in these forests; laying the groundwork for his M.S. thesis.

Educational displays illustrating the research conducted and the results of the study are being developed for public programs at each park.

Nicole Vander Heiden conducted a study using a combination of bait shop surveys, bait disposal containers and bait container labels to assess the effectiveness of educational efforts on anglers earthworm bait disposal practices.

Principal Investigator(s)

Cindy Hale

Project Sponsor(s)

MN Lake Superior Coastal Program

Amount Account

46,935 3013-10424-00000337

Active

08/22/2008 12/31/2010

Total

\$46,935

Start Date: 08/22/2008

End Date: 12/31/2010

Project ID: 1525

Grand Portage National Monument-Baseline Earthworm Survey

Objective

A study was conducted to assess the presence, absence or relative abundance of invasive earthworms at up to 80 pre-approved sample points in the Grand Portage National Monument. This data will be integrated with data from the project "Exotic Earthworm Invasions: Integrated Research and Education to Achieve Natural Resource Protection" funded by the Minnesota Coastal Program.

Background

GIS data and metadata documenting the distribution of exotic earthworms, relative abundance and relative impacts in relation to forest type, soil and/or landforms and distance from human centers of activity in Grand Portage National Monument will be gathered through field surveys. In particular, we will identify areas that are earthworm-free or minimally impacted by earthworms.

Previous Activity

Current Activity

Summer walk-through surveys were conducted in August 2009, including regularly stratified sample points (~every 50 meters) along designated routes. At each point, visual indicators of earthworm presence/absence or relative abundance were collected (i.e. earthworms themselves, burrow entrances, cast material, middens, A horizon and forest floor thickness).

Fall quantitative sampling of earthworms in a randomly selected subset of the pre-approved sample points was conducted in September and October 2009, using Minnesota Conservation Corps crews, trained volunteers, and NRRI field staff. Crews will conduct earthworm sampling (liquid extraction) in a minimum of three randomly located plots within a minimum of 12 stands to provide species list and relative abundance of earthworms.

Principal Investigator(s)

Cindy Hale

Project Sponsor(s)

USDI National Park Service

Amount Account

2,875 3002-10424-00011181

Active

05/29/2009 03/30/2010

Total

\$2,875

Start Date: 05/29/2009

End Date: 03/30/2010

Project ID: 1566

Lake Superior Carnivore Monitoring

Objective

Summarize existing data on carnivore distribution in Lake Superior watershed.

Background

The Lake Superior Binational Program is a partnership of federal, state, provincial, and tribal/First Nation governments working with citizens to ensure the protection of the Lake Superior watershed. Among the needs to meet this goal is improved knowledge of plant and animal species within the watershed. An update on the status of reptiles and amphibians has been completed, also needed is an update on the status of mammalian carnivores in the watershed.

Previous Activity

This is a new project.

Current Activity

Principal Investigator(s)

Ronald Moen

Project Sponsor(s)

Great Lakes Indian Fish & Wildlife Comm

Amount Account

5,000 3006-10430-00013286

Active

08/01/2009 12/31/2009

Total

\$5,000

Start Date: 08/01/2009

End Date: 12/31/2009

Project ID: 1558

Long-term Soil Productivity: Vegetation Sampling - Chippewa National Forest

Objective

A long term experiment to assess long-term effects of soil compaction and organic matter removal on aspen forests of the Great Lakes.

Background

The Long Term Soil Productivity (LTSP) study is a national effort to document the effects of soil compaction and organic matter removal on forest productivity and biodiversity. As part of the Region 9 LTSP study, ground-flora has been sampled periodically since the installation of treatments in the early 1990s. Treatments are in place on the Chippewa National Forest in Minnesota, and the Ottawa and Huron-Manistee National Forests in Michigan.

Previous Activity

The Natural Resources Research Institute was responsible for sampling the Chippewa National Forest LTSP plots prior to harvest and compaction in 1992, and again in 1994, 1995, 1998, and 2004. This sampling will provide the cooperators data required to analyze and report on results from this study.

Current Activity

2009 represents a 15-year interval from the first treatment record, and an important milestone in the project. This sampling will provide the Forest Service information on how the floristic community has changed in response to soil compaction and organic matter removal.

One of the three main replicates of the study was sampled in September 2009, and data entered. The remaining two replicates are scheduled for sampling in summer 2010.

Principal Investigator(s)

George Host

Project Sponsor(s)

	Amount	Account	Active
		1635-186-6057-00	
USDA Forest Service	15,631	3002-10424-00012648	07/28/2009 12/31/2010
Total	\$15,631		

Start Date: 09/12/1991 **End Date:** 12/31/2010 **Project ID:** 811

Minnesota Breeding Bird Atlas

Objective

To complete a systematic count of breeding birds in all townships in the state of Minnesota as part of the Minnesota Breeding Bird Atlas. The methodology will allow samples to be gathered in the future in a representative and repeatable fashion.

Background

Minnesota is one of only six states in the U.S. that does not have a breeding bird atlas. An atlas is important to define the distribution and abundance of breeding species throughout the state. It will be useful for conservation planning and environmental impact assessment.

Previous Activity

Breeding birds were counted in over 540 townships during the 2009 field season (May-July 2009). This exceeded the number of townships we anticipated sampling and will allow several townships to be re-sampled in 2010 to examine annual variability.

Current Activity

Data are being double-entered for quality control. Field crews and logistics for sampling in the 2010 field season are being completed.

Principal Investigator(s)

Gerald Niemi

Project Sponsor(s)

LCCMR

	Amount	Account	Active
	101,000	3015-10429-00000576	07/01/2008 06/30/2010
Total	\$101,000		

Start Date: 07/01/2008

End Date: 06/30/2010

Project ID: 1529

Monitoring Birds in Great Lakes National Forests

Objective

To develop strategies to monitor the abundance of forest bird populations.

Background

Forest bird populations are a key biological indicator of the health and stability of forest ecosystems. Recent evidence suggests that some North American species are declining in abundance, in particular, Neotropical migrants or species that breed in North America and winter in Central or South America. With the increased interest and awareness of the status of Neotropical migrant birds in the United States, several organizations have developed strategies to monitor abundance of these species. We have established monitoring programs in three Great Lakes national forests: Chippewa (1993), Superior (1991), and Chequamegon (1992). Long-term monitoring will give us information on species abundance patterns over time and data will be used to identify species that are significantly increasing or decreasing in abundance.

Previous Activity

The summer of 2009 marked the 18th year of sampling for the forest bird monitoring project. Over 70 species have been tested for their trends over this period. In general, more species have been increasing compared with those decreasing. Species that have been increasing include permanent residents and many species that nest in shrubs and trees. Species declining have generally been those that nest on the ground such as the Winter Wren, Veery, Hermit Thrush, Ovenbird, Mourning Warbler, and Song Sparrow.

Current Activity

Trend analysis through 2009 indicated that 16 species increased across all three national forests over the past 19 years, while nine species declined. Increases in populations are still detected in permanent resident species such as Blue Jay, Black-capped Chickadee, and Red-breasted Nuthatch. Ground nesting species continue to be the most prominent species that have declined in population; they represent six of the nine species that are declining. Field crews and preparations are being made for the 2010 field season (funding pending).

Principal Investigator(s)

Gerald Niemi

Project Sponsor(s)	Amount	Account	Active
US Dept of Agriculture	198,710	1635-186-6037-00	05/01/1991 12/31/1995
USDA/Nicolet National Forest	30,000	1637-189-6129-00	01/01/1996 12/31/1996
USDA/Nicolet National Forest	49,000	1637-189-6146-00	05/01/1997 04/30/1998
Chequamegon/National Forest	49,000	1637-189-6171-00	05/01/1998 10/31/1999
USDA/Chequamegon/Nicolet National Forest	98,000	1637-189-6187-00	05/01/1999 04/30/2001
USDA/Forest Service	290,554	1637-189-6219-00	05/01/2001 12/31/2005
USDA Forest Service	61,148	1637-189-6294-00	05/19/2006 12/31/2006
USDA Forest Service	66,156	1637-189-6327-00	04/15/2008 12/31/2008
USDA Forest Service	66,156	3002-10429-00011308	05/15/2009 12/31/2009
Total	\$908,725		

Start Date: 05/01/1999 **End Date:** 12/31/2010 **Project ID:** 420

Prevention and Early Detection of Invasive Earthworms

Objective

The goal of this three-year project is to use a multi-pronged approach to greatly reduce the introduction and spread of invasive earthworms through rigorous quantification of the relative importance of different vectors of introduction for earthworm species (result 1), development and testing the effectiveness of management recommendations for resource managers to limit the spread and introduction of earthworms (result 2), and through a comprehensive effort involving research and educational institutions, governmental agencies, non-governmental organizations and citizen science to inform and actively engage diverse stakeholders in efforts to accumulate distributional data on invasive earthworm and their relative impacts across the state/region and to identify earthworm-free and minimally impacted areas worthy of protection (result 4). Results 1, 2 & 4 will provide key information and evidence for the development of regulation recommendations/policies to respond to early detection of incipient invasions of new invasive earthworm species that have begun to appear in adjacent states but are not yet detected or established in the state (result 3). Anticipated results and outcomes include a publication summarizing the in-state and interstate risk assessment of the vectors of invasive earthworms spread; a publication of the results of the testing of the effectiveness of management recommendations; a plan for regulatory response by various governmental agencies for early detection of non-established invasive earthworms in the state; public education and conference presentations of our research and results; All distributional data will be summarized in a map (GIS layers) showing the know earthworm distributions and levels of impacts for the state.

Background

Previous Activity

This is a new project.

Current Activity

Result 1 –protocol-based internet searches and KAP studies (knowledge, attitudes & practices) of potential target audiences, and is expected to be finish in spring 2010. Result 2 - A KAP study has been developed and will be delivered at 5 conferences (Jan-June 2010). Result 3 – no activity on this, Results 1&2 need to be largely completed first. Result 4 - Earthworm species profiles are being developed for all 16 species in the “Earthworms of the Great Lakes” book; Development and implementation of protocols for handling earthworm survey data and voucher specimens has been finalized; We are now beginning to for 2010 workshops are now being scheduled; Several hundred new citizen-based data points have been added to our database across the Great lakes region.

Principal Investigator(s)

Cindy Hale

Project Sponsor(s)

Legislative Comm on MN Research

Amount Account

59,539 3015-10424-00007735

Active

07/01/2009 06/30/2010

Total

\$59,539

Start Date: 07/01/2009

End Date: 06/30/2012

Project ID: 1545

Statewide Ecological Ranking of CRP Lands

Objective

Identify Minnesota lands with high habitat quality that may be taken out of the Conservation Reserve Program

Background

This project will identify and rank the ecological value of CRP and other critical lands throughout Minnesota using soil productivity, landscape, water, wildlife, and other relevant natural resource factors.

Previous Activity

This is a new project.

Current Activity

We are acquiring and analyzing soil productivity data in light of the critical habitat information generated through Minnesota's Statewide Conservation and Preservation Plan. Our collaborators have generated a crop productivity index that will determine the probability of land being removed from the CRP program. By intersecting critical habitat with the above data sets, we can identify individual land parcels that can be targeted for acquisition, conservation easements, or other land preservation policies.

Principal Investigator(s)

George Host

Project Sponsor(s)

	Amount	Account	Active
MN Board of Water and Soil Resources	15,000	3005-10422-00009516	03/19/2009 06/30/2011
MN Board of Water and Soil Resources	14,000	3005-10422-00009514	03/19/2009 06/30/2011
Total	\$29,000		

Start Date: 03/19/2009

End Date: 06/30/2011

Project ID: 1569

Survey of Beaver Ecology in Grand Portage National Monument

Objective

Improve knowledge of beaver in Grand Portage National Monument

Background

Baseline characteristics of the beaver population in Grand Portage were established in a 1987 study, which was originally intended to be a comprehensive comparison of beaver populations in national parks in and near Lake Superior. We will trap beaver with Hancock live traps, deploy trail cameras on paths used by beaver to move from the pond to trees (which will be cut in fall 2008 and 2009). We will use 0.025 ha circular plots to determine tree species composition around beaver ponds, and interpret a historical series of aerial photos for pond occupancy.

Previous Activity

Begin analysis and acquisition of historical aerial photographs.

Current Activity

Data collected to date will result in a good review of beaver status on the Boardwalk pond in the Grand Portage National Monument.

Principal Investigator(s)

Ronald Moen

Project Sponsor(s)

USDI National Park Service

Amount Account

18,985 3002-10430-00000804

Active

06/05/2008 09/30/2010

Total

\$18,985

Start Date: 06/05/2008

End Date: 09/30/2010

Project ID: 1544

Synoptic Mapping of Native Plant Communities of the Laurentian Mixed Forest

Objective

Background

By analyzing similarities between land type associations in the northern forests of Minnesota we will identify a set of plant survey data from beyond the Aitken target area which can be used to augment mapping of native plant communities in the Aitken target area.

Previous Activity

Some preliminary data collection has been completed (land type association attributes for clustering). A framework for the rest of the project has been laid out.

Current Activity

Land Type Associations are landscape units commonly used in landscape analysis. They are aggregated into sub-sections, sections, and provinces. DNR forest plans are often generated at the sub-section level.

We have applied cluster analysis (data analysis techniques which group things by degree of similarity) to find sets of land type associations with similar attributes (elevation, soils, slope, percent wetland). These clusters should improve native plant community mapping by allowing expensive plant survey data to be pooled among similar land type associations.

Principal Investigator(s)

George Host
Terry Brown

Project Sponsor(s)

MN DNR

Amount	Account	Active
27,894	3005-10424-00006899	11/18/2008 12/30/2009
Total	\$27,894	

Start Date: 11/18/2008

End Date: 12/30/2009

Project ID: 1530

The North Shore Data Consortium: Acquiring and Distributing High-Resolution Geospatial Information

Objective

To create the North Shore Data Consortium - a group of local and regional government and industry officials with the goal of collaborating on the collection and use of high-resolution spatial data, including LiDAR.

Background

There are strong local and regional interests in the acquisition and distribution of high-resolution spatial data needed for land use planning, natural resource management, and environmental assessment. Included among these data are LiDAR imagery, which provides very high resolution (0.5 to 1 m) digital elevation models, high resolution digital aerial photography products and derivative products such as hierarchically structure watersheds, topographic moisture indices, and refined wetland classifications. In spite of the strong interests in these data sources, acquisition has been hampered by the fact that no single agency has the mandate for developing interagency strategies to coordinate funding and planning for large-scale data acquisition projects. We propose to create the North Shore Data Consortium, with the purpose of developing specific funding strategies and timelines for collecting LiDAR and contemporary high-resolution aerial photography for the region. The Consortium will develop memoranda of understanding among local, state and federal agencies and interested NGOs to provide for data sharing and leveraging of funds for contracting LiDAR acquisition. The NSDC will also identify data gaps and future data needs. To ensure compatibility with statewide data standards, we will work closely with the Digital Elevation Committee of the Governor's Council on Geographic Information

Previous Activity

This is a new project.

Current Activity

We gave a presentation on the North Shore Data Consortium at the 19th Annual MN GIS/LIS conference, held Oct 21-23, 2009. This conference provided an opportunity to introduce the project and connect with many potential members of the NSDC. We also had several internal project meetings and conversations with MN DNR and MN Sea Grant to discuss the project.

On November 12, 2009 G. Sjerven attended a meeting of the digital elevation committee of the Governor's Council on Geographic Information Systems to discuss the project. The discussions led to development of a grant proposal to USGS specifically targeting northeastern Minnesota for LiDAR acquisition. We then helped to coordinate a number of support letters from those potential partners from northeastern MN in support of this grant application, including one under the consortium itself. The application was submitted on December 1, 2009. We continue to be in direct contact with MnGeo, Minnesota DNR, and USGS concerning the goals of the project.

We attended the Northern Minnesota GIS User group meeting on December 16, 2009 in Duluth, MN, where we introduced the project and outlined the objectives and how they fit with the state efforts.

Principal Investigator(s)

George Host
Lucinda Johnson

Project Sponsor(s)

	Amount	Account	Active
MN's Lake Superior Coastal Program	39,137	3013-10424-00007525	09/04/2009 12/31/2010
Total	\$39,137		

Start Date: 09/04/2009 **End Date:** 12/31/2010 **Project ID:** 1568

Vegetation Characterization and Conifer Regeneration Strategies for the Grand Portage National Monument

Objective

Identify sites on the Grand Portage National Monument where white pine is most likely to succeed, work with park staff to develop and implement regeneration strategies

Background

The major natural resource management goal of the Grand Portage National Monument is to restore the trail corridor to conditions that existed during the fur trade era, or approximately 200 years ago. At this time, white pine (*Pinus strobus*) was a major species in the landscape, growing in concert with red pine or as supercanopy trees in mixed forest conditions. Due to turn of the century logging, the advent of white pine blister rust, and the reduction in the occurrence of natural wildfires, the numbers of white pine are now considerably reduced in the landscape.

This project will identify areas where restoration and enhancement actions are the most likely to succeed. These areas will then receive site specific recommendations for conifer restoration.

Previous Activity

We conducted an analysis of 20 vegetation plots placed along the Grand Portage National Monument by the National Park Service Great Lakes Network in 2006. Three major vegetation types were identified, two of which seem well suited to white pine. We also used digital elevation data to create a topographic moisture index for the trail, which relate well to potential species composition and site productivity.

Finally, we visited the Grand Portage trail with NPS cooperators to discuss potential sites and methods for restoring white pine. Collecting seeds from local sources and using field crews to scarify small plots are among the options being considered for white pine restoration.

Current Activity

We spent August 2009 sampling plots in the Grand Portage National Monument. In each plot we recorded overstory and ground flora information, along with coarse woody debris, soil profile information, and counts of white pine seedlings. We also used the rapid worm assessment protocol to check for presence of invasive worm species.

Data were entered in fall 2009, and data analysis is currently underway.

Principal Investigator(s)

George Host

Project Sponsor(s)

USDI National Park SRVC

Amount	Account
35,646	1648-189-6321-00
Total	\$35,646

Active
06/01/2007 09/30/2010

Start Date: 06/01/2007

End Date: 09/30/2010

Project ID: 1480

Assessing the Condition of Great Rivers using Benthic and Planktonic Algal Indicators

Objective

The U.S. Environmental Protection Agency Environmental Monitoring and Assessment Program has embarked on a comprehensive survey of Great Rivers in order to provide tools the states need to better manage and protect these important national resources. This survey will assess the health status of the Missouri, Mississippi, and Ohio Rivers using indicators of water quality, sediments, algae, plants, insects, and fish. The Natural Resources Research Institute's task in this project is to develop indicator tools from the algae, collected from hundreds of sites throughout the Great Rivers system. A variety of algal based tools will be developed for use by environmental managers and agencies.

Background

The Natural Resources Research Institute is developing indicator tools from algae, collected from hundreds of sites throughout the Great Rivers system. Indicators will be available to track ecological quality using periphytic and phytoplanktonic assemblages. These indicator approaches will support future monitoring and paleoecological programs, and be used to identify and verify reference locations in rivers.

Previous Activity

We have nearly completed four years of the Great Rivers-algae project.

Four articles from this project have been published or are in review:

- Reavie ED, Jicha TM, Angradi TR, Bolgrien DW, Hill BH. 2009. Algal assemblages for large river monitoring: comparison among biovolume, absolute and relative abundance metrics. *Ecological Indicators*.
- Sgro et al. Development of new rapid-assessment indicators using river algae, and comparing these indicators to approximately 20 indicators currently in use worldwide.
- Kireta et al. Development of a weighted-averaging model to infer environmental quality using periphytic and phytoplanktonic algae from the Great Rivers.
- Kireta et al. Determination of the appropriate data structure for Great Rivers algae indicators. For instance, should we be using relative abundance of species? Biovolumes? Relative biovolumes? Density? Other considerations include comparison of species- and genus-based indicators.

Current Activity

We have completed the Great Rivers-algae project.

Four articles from this project have been published or are in review:

- Reavie ED, Jicha TM, Angradi TR, Bolgrien DW, Hill BH. 2010. Algal assemblages for large river monitoring: comparison among biovolume, absolute and relative abundance metrics. *Ecological Indicators* 10:167-177/.
- Sgro GV, Reavie ED, Kireta AR, Angradi T, Jicha, TM, Bolgrien, DW, Hill BH. 2010. Comparison of diatom-based indices of water quality for mid-continent (USA) Great Rivers. *Environmental Bioindicators*. In press.
- Kireta et al. Development of a weighted-averaging model to infer environmental quality using periphytic and phytoplanktonic algae from the Great Rivers.
- Kireta et al. Determination of the appropriate data structure for Great Rivers diatom indicators. *Journal TBD*.

Principal Investigator(s)

Euan Reavie

Project Sponsor(s)

	Amount	Account	Active
Environmental Protection Agency	535,199	1628-189-6289-00	10/01/2005 09/30/2010
Total	\$535,199		

Start Date: 10/01/2005 **End Date:** 09/30/2010 **Project ID:** 1397

Data for Discovery and Decision-making: Lake Superior Streams

Objective

This project continues funding for the LakeSuperiorStreams.org project via the NOAA/Minnesota DNR funded Lake Superior Coastal Program. Its goal is to improve environmental literacy and decision-making in regard to regional water resource issues by providing online public access to real-time water quality data and other relevant data and interpretive information.

Background

LakeSuperiorStreams.org provides an easy access web portal for the public to understand the environmental, public health and regulatory issues related to North Shore stream condition and its relationship to the coastal waters of Lake Superior as affected by land use management.

Previous Activity

Stream gauging stations were operated through fall, winter, and spring 2008-2009. Data from the MPCA /South St. Louis SWCD Knife River TMDL study for three sites from 2006-2009 were acquired for the period 2004-06 and from the Western Lake Superior Sanitary District for historical water quality data from sites along the lower St. Louis River. Data from a new UMD Large Lakes Observatory nearshore buoy was imported and temperature profile and related meteorological data can be viewed in real-time at a 10-min frequency via our data animation tools. A prototype map-based data viewer was developed for citizen stream and lakes monitoring program data.

Current Activity

Remotely operated flow and water quality sensors generated on-line, animated data sets for stations on the trout streams: Tischer, Chester, Kingsbury, Miller, and Amity, the WLSSD discharge, and a nearshore Lake Superior buoy operated by the UMD Large Lakes Observatory for summer and fall 2009. A prototype web 'mashup' using Google Earth mapping utilities was developed for the lower St. Louis River and St. Louis River estuary and historical water quality data can now be accessed and visualized via our online, interactive data animation tool. Data from other recent (2008-09) North Shore stream projects is now accessible in user-friendly formats via the website. The website continued to display information serving the needs of regional communities and agency partners representing the Superior Regional Stormwater Protection Team and to provide water-related information via a bulletin board *What's New* section. Website activity has remained at a level of ~ 400-500,000 requests per month with peak activity in spring and fall when schools are in session.

Principal Investigator(s)

Cindy Hagley
George Host
Richard Axler

Project Sponsor(s)	Amount	Account	Active
MN's Lake Superior Coastal Program	89,862	3013-10423-00000651	08/14/2008 06/30/2010
Total	\$89,862		

Start Date: 08/14/2008 **End Date:** 06/30/2010 **Project ID:** 1526

Duluth Residential Stormwater Reduction Demonstration

Objective

Determine whether property-owner-based stormwater reduction practices are effective in reducing peak stormwater runoff in Duluth due to the cold climate, clay soils, and surficial bedrock.

Background

We propose to demonstrate the effectiveness of residential Best Management Practices (BMPs) at reducing stormwater runoff problems for Lake Superior tributaries. We will install residential BMPs in a subwatershed in an older residential neighborhood and compare the runoff to that of a similar control subwatershed without stormwater BMPs. The neighborhoods identified for the program are located in the Lester-Amity stream system that is on the Minnesota 303(d) list for turbidity. Tributaries receiving the runoff from the targeted neighborhoods/subwatersheds are being severely eroded by high peak flows and deliver highly turbid water to Amity Creek. Water flow, temperature, and turbidity measurements will be taken within storm sewers in both subwatersheds before and after BMP installation, requiring three full field seasons of work. Flow, temperature, and turbidity data from storm sewer flow will be posted and interpreted on the educational Lake Superior Streams website, as will final results. Resident knowledge of runoff issues, solutions, and responsibilities will be evaluated at the beginning and end of the project. Results from this demonstration project should be applicable throughout the Great Lakes.

Previous Activity

Monitoring equipment (flow, temperature, conductivity, and turbidity) was installed in the three neighborhood storm sewer systems for the ice-free seasons of 2008-2009. All residents in the street selected for treatment were visited by engineers and had appropriate stormwater runoff BMPs designed for their properties. All participants agreed to provide 10 hrs volunteer labor helping with the installation and upkeep of their stormwater runoff devices.

Current Activity

During summer 2009 stormwater BMPs were provided for about 22 properties in the area chosen for treatment. These included planting (and protecting from deer) more than 250 trees and shrubs with wildflowers between to reduce yard space for folks to mow; 5 rain gardens; 21 rain barrels; 6 rock-filled sumps; and aeration on 20 yards. Most of the work was done by the Minnesota Conservation Corps youth and young adult crews, supervised by Center for Water and the Environment scientists, Duluth utilities department, Barr Engineering, and South St. Louis Soil and Water Conservation District personnel. MCC personnel also dug several long trenches, re-dug a stormwater ditch, and installed 5 ditch checks to improve and clean up stormwater flow.

BMP results will be analyzed during summer 2010 by again monitoring stormwater flow in the storm sewers.

Principal Investigator(s)

Valerie Brady
Richard Axler
Jesse Schomberg

Project Sponsor(s)	Amount	Account	Active
City of Duluth-MPCA(Prime)	121,482	3003-10426-00004857	02/27/2008 06/01/2011
Total	\$121,482		

Start Date: 02/27/2008 **End Date:** 06/01/2011 **Project ID:** 1528

Ecosystems Study Area Working Group: Investigating the Effects of Changes in Lake Level on Coastal Ecosystems

Objective

To develop mathematical relationships between water levels and various coastal ecosystem indicators. These relationships will be used in various water level scenarios run over 100 years to determine potential ecosystem effects of various proposed regulation plans.

Background

The US Army Corps of Engineers is evaluating changing the way Lake Superior's water level is regulated at the St. Marys River locks and dams. While there are many things to consider (shipping, tourism, lake homes, etc), coastal ecosystem impacts are also possible. Our group of researchers has long-term datasets for many coastal areas on the Upper Great Lakes (Superior, Michigan, and Huron), which we will use to determine potential effects of the various water level regulation plans.

Previous Activity

This is a new project.

Current Activity

Working with modelers at LimnoTech, Great Lakes coastal ecosystem researchers are developing mathematical relationships between water level and various coastal habitats and species. These mathematical relationships will be used in models that predict water levels on the Upper Great Lakes over the next 100 years for various water regulation scenarios. Using these scenarios, we will be able to evaluate how each regulation scenario affects various coastal habitats and species. This project has just started, but researchers are already hard at work developing the mathematical relationships. They have met with LimnoTech modelers in Ann Arbor, MI, in January and February, 2010.

Principal Investigator(s)

Valerie Brady

Project Sponsor(s)

USDOD Army Corps. Engineers

Amount Account

300,004 3002-10426-00014506

Active

01/04/2010 09/30/2010

Total

\$300,004

Start Date: 11/13/2009

End Date: 09/30/2010

Project ID: 1560

Great Lakes Biological Monitoring: Phytoplankton

Objective

The primary objectives of the Great Lakes phytoplankton program are to: 1) collect phytoplankton from the Great Lakes; 2) identify and enumerate phytoplankton, maintaining quality assurance standards; 3) maintain a database of phytoplankton data; 4) interpret phytoplankton data, including evaluation of long-term trends in phytoplankton and food web dynamics; 5) dissemination of data and interpretations through reports, presentations, peer-reviewed journals and on the internet.

Background

Phytoplankton are known to respond to stressors such as nutrient loading and invasive species. We will take a comprehensive approach to GLNPO's Biological Monitoring program for the Great Lakes using proven sampling and evaluation techniques. New and long-term phytoplankton data will be used to track shifts in the offshore biological community related to natural and anthropogenic influences.

The research will characterize and evaluate phytoplankton communities throughout the Great Lakes. Analyses of these data in concord with long-term sampling data, and other project data (e.g., zooplankton, water quality) will provide interpretations of stressor influences on lake biology. A database of detailed, quality-assured phytoplankton data will be provided for contemporary and future evaluations of Great Lakes condition.

Previous Activity

All 2007 and 2008 samples have been analyzed, and analyses are ongoing. Significant efforts have been undertaken to create photographic plates and refine diatom taxonomy using virtual communications among team members and iterative revisions to these plates. Several taxonomic workshops and QA/QC sessions were held to ensure taxonomic accuracy for the project. Sample assessments show that significant changes have occurred in the Great Lakes food web over the last decade. These shifts are being examined for causes and trophic linkages.

Current Activity

All 2007 and 2008 samples have been analyzed and taxonomic databases have been submitted to EPA. Six month-long sampling cruises aboard the R/V Lake Guardian have been completed and we are currently planning for the seventh. Significant efforts have been undertaken to create photographic plates and refine diatom taxonomy using virtual communications among team members and iterative revisions to these plates. We have initiated development of a SOLEC indicator that will use algal monitoring data to track pelagic condition in the lakes. We have also initiated development of an algal flora for the open water assemblages.

Several taxonomic workshops and QA/QC sessions were held to ensure taxonomic accuracy for the project.

Sample assessments show that significant changes have occurred in the Great Lakes food web over the last decade. These shifts are being examined for causes and trophic linkages. The first publication from this study is in preparation by Reavie.

Principal Investigator(s)

Euan Reavie

Project Sponsor(s)

	Amount	Account	Active
Environmental Protection Agency (EPA)	590,295	1628-189-6315-00	03/01/2007 02/28/2010
Total	\$590,295		

Start Date: 03/01/2007 **End Date:** 02/28/2012 **Project ID:** 1487

Illustrating the Use of Conservation Easements to Mitigate Effects of Forest Parcelization

Objective

To identify lands in Itasca County that have both high parcelization risk and high ecological value.

Background

Land parcelization is one of several factors contributing to forest fragmentation, which in turn has been linked to degradation in water quality and habitat loss. Parcelization, the division of tracts of land into smaller holdings, is often accompanied by changes in ownership, changes in land use/land cover and public access, and often development. The increased trend toward divestiture of land holdings by forest products companies is well-documented in Minnesota and elsewhere. The Phase 1 report of the Minnesota Statewide Conservation and Preservation Plan identified habitat degradation, fragmentation, and consumptive use of land (conversion of land through and development and associated infrastructure) as three of the main drivers of change affecting Minnesota's land resources.

Previous Activity

This is a new project.

Current Activity

We created maps for select townships in Itasca County showing parcels most likely to be subdivided. The probably for subdivision is related to distance to water, public lands infrastructure, and several other factors.

This risk map was linked with a map of 'critical habitat' from the Statewide Conservation and Preservation Plan. The resulting map shows parcels with both high parcelization risk and high ecological value.

Principal Investigator(s)

George Host

Project Sponsor(s)

CR Planning, Inc (Minnesota DNR prime)

Total

Amount Account

10,000 3000-10424-00007753

\$10,000

Active

12/01/2009 03/31/2010

Start Date: 12/01/2009

End Date: 03/31/2010

Project ID: 1562

Landscape Metrics for Coastal Wetland Integrity Indices

Objective

We propose to test existing landscape indicators of coastal marsh integrity that can be incorporated into a coastal wetland monitoring program. Using the same set of coastal marshes selected for the USGS project we will: 1) Evaluate the ability of individual landscape indicators to discriminate between reference, disturbed, and managed sites. 2) Analyze redundancy among landscape indicators and between landscape and site specific indicators.

Background

The National Wildlife Refuge System includes 161 coastal refuges on 1,045,925 acres of coastal marsh. Unfortunately, there are few coastal marshes that remain in pristine condition. The majority of these marshes have experienced some form of anthropogenic alteration such as oil spills, chemical mosquito control, drainage for mosquito control, salt hay farming, introduction of invasive species, restricted tidal flow, road construction, or channelization. These alterations impact both the intrinsic value of coastal marshes as well as the quality of marsh habitat for the unique wildlife they support. Implementation of mandates to preserve and restore coastal marsh integrity requires scientifically-based methods for evaluating and monitoring wetland condition.

Despite the large scientific literature on coastal marsh ecosystem pattern and functioning, tools for the assessment of ecological condition remain underdeveloped for these ecosystems. Such tools are critically needed to guide decisions regarding protection, management, and restoration. The most meaningful and useful assessments of ecosystem condition are based on reliable indicators of ecosystem integrity that are integrative across several spatial scales and levels of biological and environmental organization.

Previous Activity

Examples of wetland characteristics that can be used as landscape indicators: landscape position, wetland size, wetland exposure, habitat heterogeneity, connectivity, surrounding land use, wetland morphology, human use.

Current Activity

Wetland monitoring is underway in 13 National Wildlife Refuges, with sampling in reference, disturbed and managed areas. Most National Wildlife Refuge Systems are in the Northeast and East U.S. (11/13); two from the Northwest U.S. were added in 2009. Landscape data and metrics are partially acquired across the regions. Derivation of additional landscape indicator metrics are underway.

Principal Investigator(s)

Jennifer Olker
Lucinda Johnson

Project Sponsor(s)

USDI US Geological Survey

Amount Account Active

39,330 3002-10426-00012660

08/01/2009 09/30/2010

Total \$39,330

Start Date: 08/01/2009

End Date: 09/30/2010

Project ID: 1561

International Upper Great Lakes Study Literature review

Objective

Do a literature review and write a summary on the topic of the effects of water level fluctuations on Great Lakes coastal ecosystems and biota.

Background

We were asked to create an annotated bibliography of literature relating to the effects of water level fluctuations on ecosystems and biota of the Laurentian Great Lakes. This report will support investigations into the potential ecosystem effects of altering the water level regulation of Lake Superior at the St. Marys River lock and dam system. Because such a change would most affect lakes Superior, Michigan, and Huron, we tried to concentrate on these lakes. However, we have included quite a bit of literature from lakes Erie and Ontario, where there has been more investigation of water level fluctuations (or lack thereof) and water level regulation. We have also included pertinent literature from around the world on effects of water level fluctuations in large lake and reservoir systems, primarily because of the paucity of pertinent literature for the upper Great Lakes.

Previous Activity

Of the approximately 220 references found, 134 deal directly with water level fluctuations while the rest provide general background information. Of the 134 water level references, 30 are on the upper Great Lakes (3 for Superior, 16 for Michigan, and 11 for Huron), while 49 are on the lower Great Lakes (17 for Erie, 25 for Ontario, and 7 for the St. Lawrence River). The remaining water level fluctuation papers are more general in nature, with 31 on the Great Lakes in general and 24 on general information from other areas, often Europe. For those papers that deal directly with water level fluctuations, the majority discuss effects on invertebrates (42 papers) or vegetation, particularly wetland vegetation (40 papers). Fish (10 papers) and birds (12 papers) are the next most-discussed biota, with algae (3 papers) and amphibians (2 papers) having received little attention in the water level fluctuation discussions. The other subjects include contaminants (5 papers), water quality (2 papers), and wetland hydrology or water quality (11 papers). There were a number of topics of interest for which we found no information. These include:

- Effects on long-lived, wetland-obligate species
- Effects on most lake-oriented species of fish of interest (e.g., lake sturgeon, coaster brook trout)
- Effects on turtles, snakes, and their habitat
- Effects on beaver
- Effects on meadow and heather voles and their habitat
- Effects on wild rice
- Effects on benthic metabolism

Current Activity

This project is complete and a full report has been submitted.

Principal Investigator(s)

Valerie Brady

Project Sponsor(s)

The Louis Berger Group, Inc

Amount Account

26,081 3010-10426-00006714

Active

10/10/2008 09/30/2009

Total

\$26,081

Start Date: 10/10/2008

End Date: 09/30/2009

Project ID: 1527

Low Impact Development on the North Shore: Lessons Learned

Objective

We propose to: 1) operate the LakeSuperiorStreams.org (LSS) sentinel stream network and its easy access web portal for disseminating water resource information, interpretive materials, and Regional Stormwater Protection Team information to the public to understand the environmental, public health and regulatory issues related to North Shore stream condition as affected by land use management; 2) develop an enhanced Low Impact Development Toolkit for LSS to document what LID techniques have been used, develop web- and print materials to explain local examples, hold a workshop with local/regional experts, and develop a 'virtual tour' of LID projects in the area, with photos and videos including discussions with project designers, builders, and owners about the practices.

Background

This project continues funding for the LakeSuperiorStreams.org project via the NOAA/Minnesota DNR funded Lake Superior Coastal Program. Its goal is to improve environmental literacy and decision-making in regard to regional water resource issues by providing online public access to real-time water quality data and other relevant data and interpretive information. It also will update its Site Design Toolkit which provides comprehensive information for homeowners, business owners, communities, contractors, and landscape/development associated businesses regarding low impact development associated best management practices for reducing stormwater runoff and erosion. Major partners include: the city of Duluth, MPCA-Duluth, WLSSD, the South St. Louis SWCD, and the Superior Regional Stormwater Protection Team.

Previous Activity

This is a new project.

Current Activity

Filming of the construction of residential rain gardens and other stormwater features by a film crew working with the St. Louis County planning department began in July in the conjunction with the Lakeside Stormwater Retrofit Reduction project (Project ID: 1528). We have also provided technical editing of a series of films developed by the county to educate shoreland property owners.

Principal Investigator(s)

Richard Axler

Project Sponsor(s)	Amount	Account	Active
MN's Lake Sup Coastal Program	89,987	3013-10423-00007522	09/04/2009 12/31/2010
Total	\$89,987		

Start Date: 09/04/2009 **End Date:** 12/31/2010 **Project ID:** 1567

Minnesota's Water Resources: Impacts of Climate Change - Phase II

Objective

To assess the consequences of past climate trends on aquatic resources we are analyzing hydrologic, water quality, and fish community responses. We propose to expand that study to develop prediction for future climate specific to Minnesota, and then quantify the potential economic impact of climate-induced changes in precipitation and hydrology on the water resource infrastructure, including storm sewers, bridges, water treatment facilities, and shoreline development. Projections of future biotic responses from hydrologic and water quality models will be developed. Lastly, to assist the state's natural resource managers and regulators, we will identify potential hydrologic and aquatic indicators and propose monitoring methods that can be implemented in Minnesota.

Background

Minnesota's climate has become increasingly warmer, wetter, and variable, resulting in unquantified economic and ecological impacts. More recent changes in precipitation patterns combined with urban expansion and wetland losses have resulted in an increase in the frequency and intensity of flooding in parts of Minnesota with extensive and costly damage to the state's infrastructure and ecosystems. We are examining historic climate records and developing a database of key climatic measures and their variability in a current LCCMR project Impacts on Minnesota's aquatic resources from climate change.

Previous Activity

Substantial progress has been made in the refinement of the climate retrieval tool, which has allowed for the identification of past climate episodes. These data are currently being used to develop down-scaled predictions of Minnesota's climate into the coming century. The tool is available to project scientists and cooperators

Current Activity

Historic responses to climate and covariates for these biological responses are being analyzed. In addition to the down-scaled climate predictions for Minnesota, we have acquired projected 2020 land use data for the seven county metropolitan area. Projected biological responses will be made by extrapolation of historic responses.

We have begun to identify data-sets and analytical methods to identify biotic indicators of climate change. We have identified a set of more than 90 data-dense lakes which we will use as our test set to develop indicators. These lakes have the greatest breadth (time-series) and depth (across data types) of records in our accumulated database. A larger subset (up to 500 lakes) will be used for validation, and then projections can be applied state-wide (greater than 4000 lakes).

Principal Investigator(s)

Jennifer Olker
Lucinda Johnson
Richard Axler

Project Sponsor(s)

	Amount	Account	Active
MN Legislative Commission on MN Rsrc	78,808	1527-189-6301-00	06/27/2006 06/30/2009
LCCMR	172,860	1527-189-6320-00	07/01/2007 06/30/2010
Total	\$251,668		

Start Date: 06/27/2006 **End Date:** 06/30/2010 **Project ID:** 1488

Research Development Testing and Evaluation Facility for Ballast Treatment in the Great Lakes Region

Objective

The Great Ships Initiative (GSI) is a innovative collaboration whose objective is to end the problem of ship-mediated invasive species in the Great Lakes-St. Lawrence Seaway System, including through independent research and demonstration of environmental technology, financial incentives and consistent basin-wide harbor monitoring.

Background

The near-term objective of the GSI is to significantly accelerate research, development and implementation of effective ballast treatment systems for ships that visit the Great Lakes from overseas. To that end, the GSI has established research capabilities at three scales—bench, land-based, and shipboard. Each scale is dedicated to addressing specific evaluation objectives, with protocols as consistent with the International Maritime Organization (IMO) and federal requirements as practicable.

NRRI's role in the GSI is to test candidate ballast water systems to ensure they are able to meet the IMO's criteria for mortality of the microorganisms carried in ballast water.

Previous Activity

Significant development and testing of the land-based testing facility has been completed over the last two years. This past summer we completed testing of the first candidate system, and several others are in the queue for testing in September 2009 and summer 2010.

Substantial efforts have been allocated to determining appropriate methods for assessing whether treatment systems are effectively killing organisms. One article establishing a new method for assessing phytoplankton mortality in ballast water is in review.

Current Activity

Significant development and testing of the land-based testing facility has been completed over the last three years. This past summer we completed testing of the first candidate system, and the final report from that testing has been submitted to the vendor and regulating agencies. Three additional treatment systems are in line for testing in summer 2010.

Substantial efforts have been allocated to determining appropriate methods for assessing whether treatment systems are effectively killing organisms. The first article establishing a new method for assessing phytoplankton mortality in ballast water has been submitted to the Journal of Great Lakes Research (Reavie et al.).

Principal Investigator(s)

Euan Reavie

Project Sponsor(s)

	Amount	Account	Active
University of Wisconsin Superior	30,000	1673-189-6311-00	01/22/2007 12/31/2007
University of Wisconsin Superior	17,497	1673-189-6323-00	12/01/2007 05/31/2008
Northeast Midwest Institute	249,932		06/01/2008 12/31/2010
Total	\$297,429		

Start Date: 01/22/2007 **End Date:** 12/31/2010 **Project ID:** 1469

Restoring Impaired Lake Superior Tributaries: Stormwater BMP Evaluation, Education, and Outreach

Objective

Our primary goal is to coordinate with local agency remediation/best management practice projects and the existing Chester, Kingsbury, Tischer, Amity and Poplar Creek/River automated water quality monitoring and public education effort carried out by the LakeSuperiorStreams.org project to demonstrate their effectiveness at reducing stormwater runoff problems as indicated by upstream-downstream and before-after water quality and biological monitoring.

Background

Urban Duluth streams are generally similar to the less developed watersheds of the North Shore with >70% forested, similar geology and hydrology, and in the case of Amity in particular, the potential for increased development pressure. Therefore, Duluth's streams can serve as pilot-watersheds for evaluating restoration, mitigation and planning strategies for use in protecting more pristine, but developing, North Shore streams.

Previous Activity

1) Graves Road Creek restoration -lower Amity Creek. We worked with the city of Duluth to develop a project including new culverts, flow rerouting, bank slope reductions, and sediment stabilization. Survey and design elements were outlined by city engineers, with construction and implementation targeted for 2009. This ~400 ft project will replace and extend old concrete culverts on the steepest, critical clay banks sections; to prevent further headcutting; stabilize the clay sloughing on the other creek sections, and engineered rip rap to prevent further scour; address side channel headcutting and erosion on a side creek just above present culvert location. The engineering design is in progress via funding from the Weber Stream Restoration Initiative and an extensive baseline data set of upstream-downstream water quality, habitat and invertebrates has been developed; 2) We are sampling upstream and downstream of a sediment trap installed in Miller Creek in 2004 behind Miller Hill Mall to evaluate its performance. Sediment depth has also been determined throughout the trap and it will be re-surveyed if we can locate original engineering drawings; 3) Upper Amity Creek bank stabilization. Engineering designs are being developed to stabilize two eroding bluffs with anticipated implementation in 2009. NRRI has sampled for water quality, and benthic invertebrates below the funding to generate a year of intensive baseline water quality, suspended sediment levels and turbidity, and biological monitoring data to assess project results and cost-effectiveness.

Current Activity

Principal Investigator(s)

Dan Breneman
Richard Axler

Project Sponsor(s)

MN Pollution Control Agency

Amount Account

103,553 1662-189-9023-00

Active

02/01/2007 06/30/2011

Total \$103,553

Start Date: 02/01/2007

End Date: 06/30/2011

Project ID: 1511

St. Louis River Watershed Streams and Lakes: Water Quality Biological Monitoring

Objective

The overall project goal is to develop complementary (same year) physical, biological and chemical data sets for a range of Minnesota Pollution Control Agency-prioritized streams and lakes in northeast Minnesota and to process and/or compile historical, but modern, water quality and biological data into the overall state database.

Background

Water quality, biological, and habitat data are critical for identifying status and trends that may reflect short and long-term water resource impairments in response to impacts at local, regional, and global scales such as urbanization, agriculture and forestry practices, invasive species introductions, atmospheric deposition, and climate change. Ideally, since field collections are costly, sampling designs and types of assessment data are best selected by considering multiple benefits and efficiencies. NRRI is assisting the MPCA in assessing the condition of St. Louis River watershed lakes (14) and streams (34) by collecting intensive water quality information and summer habitat, macroinvertebrate (bug) and fish data.

Previous Activity

This is a new project.

Current Activity

Fourteen lakes were sampled five times each during the ice-free growing season of May through October (2009) for a suite of core and advanced water quality parameters; 2) 22 Minnesota Pollution Control Agency-selected St. Louis River stream sites and 12 additional NRRI stressor gradient selected St. Louis River stream sites were sampled 10 times over the course of the 2009 ice-free season and a suite of field and lab samples were analyzed and submitted to the MPCA; 3) the 34 streams were surveyed once in summer 2009 for macroinvertebrates (bug), fish, and habitat assessment; 4) bug analysis are ongoing. The 12 stressor gradient selected sites were chosen from across a GIS-based anthropogenic stressor gradient delineated from major sub-basin within the St. Louis River watershed from a previous project. This will enable us to directly compare two different assessment processes and sampling protocols across a range of conditions in the watershed.

Principal Investigator(s)

Dan Breneman
Lucinda Johnson
Richard Axler
Valerie Brady

Project Sponsor(s)

	Amount	Account	Active
MN Pollution Control Agency	302,067	3005-10423-00009742	05/13/2009 06/30/2011
Total	\$302,067		

Start Date: 05/13/2009 **End Date:** 06/30/2011 **Project ID:** 1542

Volunteer-Assisted Water Quality/Biological Monitoring of North Shore Superior Streams

Objective

Collect intensive water quality, stream invertebrate (bug), and habitat data to help the Minnesota Pollution Control Agency assess the condition of more than 20 Lake Superior basin trout streams.

Background

The overall project goal is to develop complementary physical, biological and chemical data sets for a range of agency-prioritized streams to process and/or incorporate historical, but modern, biological data into the overall state database. Major objectives are: 1) Historical water quality and invertebrate data from ~ 30 North Shore stream sites sampled from the late 1990s through 2007 (NRRI, EPA, UMD) will be screened, further analyzed where necessary, and entered into STORET/EDA. These efforts also included substantial water quality, flow, and habitat data, and sampling of other biota (fish, diatoms). Some data was recently used for the Knife River total maximum daily load, but additional processing is needed for it to become truly useful. Water quality data is also available from the same studies using certified methods/labs and from the LakeSuperiorStreams project (3-4 urban streams at >20/yr), that would also be entered into STORET; 2) Sample 12 Superior basin streams intensively for flow, total suspended solids, turbidity, nutrients and other parameters and establish citizen lake monitoring program sites for 12 sites in eight priority streams; 3) sample benthic invertebrates at 13 Superior basin stream sites coordinated with 2008/2009 water quality sampling for North Shore and St. Louis River tributaries or performed independently by MPCA (Superior Loading and Milestone projects), the Flute Reed River Partnership, or the St Louis River citizen's action committee. This proposal is based on discussions with MPCA/Minnesota DNR staff regarding priority basin watersheds and the need for concurrent physical, chemical, biological, and geomorphic stream data over a gradient of stressor indicators.

Previous Activity

A Quality Assurance Project Plan was developed and can be loaded or viewed on the LakeSuperiorStreams.org website. Biological monitoring and stream habitat evaluation field observations were completed in 2008.

Current Activity

Midge larvae were processed from EPA archived samples and slide mounted in early 2009. Identification of midge larvae to the appropriate taxonomic levels is 100% completed. Remaining macroinvertebrate and stream reach habitat data have been compiled undergoing final QAQC for submission to MPCA. All water quality field and lab data for 2008 and 2009 were completed and submitted to STORET/EDA. These data are being re-formatted for user-friendly access via the LakeSuperiorStreams.org website. Historic data from previous University and EPA- Mid Continent Ecology Division (Duluth) have been compiled and will be submitted in early 2010. All North Shore water quality data are also being classified as to their hydrology at time of sampling by examining field notes, nearby flow gauging stations, and weather

Principal Investigator(s)

Dan Breneman
Richard Axler
Valerie Brady

Project Sponsor(s)

MN Pollution Control Agency

Amount Account

229,533 1663-189-6325-00

Active

04/07/2008 06/30/2010

Total \$229,533

Start Date: 04/07/2008

End Date: 06/30/2010

Project ID: 1519

Center for the Water and the Environment - Program Notes

Personnel

Lucinda Johnson was named director of the Center for Water and the Environment at the Natural Resources Research Institute, University of Minnesota Duluth. In this position Johnson will manage the Center's research programs, which include aquatic ecosystems, forest ecosystems, land/water interface and environmental chemistry.

Dr. Johnson was hired as geographical information system manager in 1987 and has served in various roles as the center's assistant, associate and interim director from 1990-2009.

She holds a bachelor's degree from Duke University and a master's degree in environmental science and forestry from the State University of New York. She received her doctorate in zoology from Michigan State University in 1999. Her 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 president of the Association of Ecosystem Research Centers and is president-elect of the North American Benthological Society.

Presentations/Posters/Muffin Meetings

NRRI staff gave the following presentations at the North American Diatom Symposium, held at the Iowa Lakeside Laboratory in September, 2009:

- 1) "Consequences of taxonomic discord in a Great Lakes monitoring program," **Euan Reavie**.
- 2) "Comparison of diatom-based indices of water quality for mid-continent (USA) Great Rivers," Gerald Sgro (John Carroll University), **Reavie, Amy Kireta**, and Ted Angradi, Terri Jicha, David Bolgrien, and Brian Hill (all four from the U.S. EPA).
- 3) "Diatom indicators of disturbance in US Great Rivers," **Kireta, Reavie**, Sgro, Angradi, Jicha, Bolgrien, and Hill.

NRRI researchers presented the following papers at the Minnesota GIS/LIS Consortium conference held in Duluth on Oct. 21-23: **George Host** and **Terry Brown**, "Quantifying Parcelization Potential for Minnesota Forest Lands;" **Gerry Sjerven** and **George Host**, "the North Shore Data Consortium: Acquiring and Distributing High-resolution Geospatial Information."

Valerie Brady, Jesse Schomberg (Minnesota Sea Grant) and **Gerry Sjervan**, gave a presentation at the Minnesota Water Resources Conference in St. Paul on Oct. 26 and 27. The talk was titled, "Using community growth scenarios to evaluate potential water quality impacts".

Euan Reavie, Mary Balcer (University of Wisconsin - Superior) and Allegra Cangelosi (Northeast Midwest Institute, Washington D.C.) held a seminar titled "Testing ballast water treatments at the Great Ships Initiative land-based facility: Zooplankton and phytoplankton viability assessments," at the Coastal Estuarine Research Foundation 20th Biennial Conference in Portland, Oregon on November 1-5, 2009.

Rich Axler, Chris Kleist (city of Duluth), **Dan Breneman**, **George Host**, **Norm Will**, Cindy Hagley (Minnesota Sea Grant), Jesse Schomberg (Minnesota Sea Grant), **Jerry Henneck**, Todd Carlson (City of Duluth), **Elaine Ruzycski**, **Gerry Sjerven** and **Valerie Brady** gave a presentation entitled "Weber Stream Restoration Initiative, Superior Regional Stormwater Protection Team and LakeSuperiorStreams.org" at the Great Lakes Restoration Conference, the annual meeting of the Healing Our Waters coalition, held September 10-12, 2009 in Duluth, Minn.

Rich Axler, George Host, Norm Will, Cindy Hagley and Jesse Schomberg (Minnesota Sea Grant), **Jerry Henneck, Gerry Sjerven, Elaine Ruzycski,** Todd Carlson and Chris Kleist (city of Duluth) gave a presentation entitled "Interactive web-based data visualization for discovery and decision-making: LakeSuperiorStreams.org" at the Land Conservation and Water Quality Summit on September 24-25, 2009 at the University of Minnesota Landscape Arboretum in Minneapolis.

Terry Brown presented two posters at the Minnesota GIS/LIS Consortium conference held in Duluth October 22-23, 2009: "Open Source, Open Access" and "Sampling Open Source and Minnesota's Birds."

Subhash Basak, Guillermo Restrepo (Universidad de Pamplona, Pamplona, Norte de Santander, Colombia) and José L. Villaveces (Universidad de los Andes, Bogota, Colombia), were co-chairpersons of the First Mathematical Chemistry Workshop of the Americas (With applications to drug design, environmental protection, genomics and proteomics), organized on the campus of Universidad de los Andes, August 21-22, 2009 in Bogota, Colombia. Basak gave the following invited lectures at the workshop: Mathematical chemodescriptors: Development and applications, Development and use of biodescriptors in predictive toxicology and drug discovery, Mathematical Chemistry: A futuristic view.

Basak chaired a scientific session at the workshop. He also discussed with colleagues in Colombia the possibility of collaboration in fundamental mathematical chemistry, applications of mathematical chemistry in hazard assessment of chemicals, and discovery of drugs against leishmaniasis, a disease spread through sandflies which affects 12 million people in 88 countries.

The idea of the Bogota event emerged out of interactions between Colombian scientists with the Indo-U.S. Workshop on Mathematical Chemistry Series organized in India and the U.S. by UMD/ NRRI.

NRRI Business Development

What's New - Research Collaborative/Commercialization Agreement Development

On September 2, 2009, a meeting was held with individuals from NRRI, the UMN Office of Technology Commercialization (OTC) and UMN Office of General Counsel (OGC) to discuss NRRI's intellectual property portfolio and its need to create research/service agreements that capture royalties on sales and/or fees in the event that collaboration results in commercialization. NRRI has know-how, which may or may not result in patentable technology whereas industry takes the risk associated with commercialization and has established niches in the marketplace with existing distribution paths. As a result of the meeting, the NRRI Business Group has been working with OTC, OGC, and the Sponsored Research Administration (SPA) offices to craft agreements which acknowledge the research and collaboration toward commercialization. NRRI has been successful in reaching agreement with three companies that address a sharing of revenue if commercialization of a joint development is achieved. It may be a couple of years before the results of such agreements will be realized.

It has now been a couple of years that NRRI's Business Group has been working with the new leadership and staff at the OTC to evolve and develop and/or adapt existing policies and procedures relating to intellectual property. NRRI's intellectual property portfolio is quite large with multiple inventors and stages of development for each disclosure that has been made. The new model of working through NRRI's Business Group as a liaison to NRRI inventors and management has helped to focus priorities as well as serve as a contact for OTC when it needs input for US Patent & Technology Office (USPTO) office actions. An informal procedure will be drafted and agreed upon in 2011 as a communication tool for NRRI staff in how to handle intellectual property disclosures.

Intellectual Property Portfolio

- Biodiesel Technology – A concentrated effort was spent working with the OTC on a potential license to an LLC and retaining a portion of ownership. The OTC has a CEO-in-Residence program, with one of the participants taking interest in the technology. The CEO-in-Residence created an LLC to evaluate and take this technology to commercialization. Further, various individuals of the UMN have been working together to validate the economics of the technology including the UMN Animals Sciences, Extension, Technology Commercialization and Venture Center. This technology has a non provisional patent application and received a first office action to which OTC responded. The PI is Pavel Krasutsky. The concept for this technology is that an ethanol plant can improve its economics by processing the Dry Distillers Grain and Solubles (DDGS) to extract additional oil and High Protein DDGS. Through this technology's process, the PI discovered additional byproducts that would improve the economics of the ethanol plant.

NRRI continues to support the research and development of this technology which has attracted additional industrial partners who are interested in various aspects of the technology. As a result, NRRI submitted another short proposal for the Large IREE Grant application and was one of fifteen applicants invited to submit a full proposal by February 2, 2010. The purpose of the IREE Large Grant is to take the bench scale operation to an industrial pilot scale, working with Crown Iron Technologies Inc. Further, two additional companies have come forward with interest in different aspects of the technology. The combined "in-kind" contributions from the industrial partners are just over \$1 million and exceeded the NRRI grant request. NRRI anticipates hearing whether it is successful in March 2010.

- Systemic Plant Conditioning Composition (SPCC) – The UMN has been in negotiations with an option holder to convert this technology to a license for browse deterrents. An Exclusive License Agreement was executed on November 23, 2009. The Licensee anticipates completing testing with enough data for an EPA filing in the spring of 2010 and going to market in August of 2010. This particular technology has a non provisional patent application filed and is awaiting office action. The technology addresses plant protection through a systemic level approach. Active ingredients are assimilated into tissue and dispersed through the plant. It may have applications for pesticides, insecticides, and fungicides for non-agricultural plants. The principle investigator is Tomas Levar, who has worked with collaborators from the private industry for several years.

- Road Patch –An additional Research Collaboration Agreement was needed with the licensee of this technology in order to optimize the recipe of this technology. This Agreement wasn't finalized until November, 2009, which has slowed down the commercialization aspect of the technology. The company has an existing distribution channel in an eleven state region. The primary principle investigator is Don Fosnacht, but there are several other inventors from NRRI that have contributed to the technology as well. NRRI continues to refine the formulation of the road patch to create the optimum composition for what is called a "cold patch". Research and demonstration projects are anticipated for spring 2010.
- Fines Removal System – NRRI has been working to resolve the wear issues on the chevrons for this technology, and had a meeting with an end-user and potential licensee. After much testing at NRRI's Coleraine Minerals Laboratory, a new chevron material and design has been agreed upon. The potential licensee that NRRI is working with will manufacture the new chevrons for the working prototype. A solution was then needed to handle the extra weight of the new chevrons. The goal of the project is to have all modifications made in spring of 2010, with pilot scale testing to be completed in April or May 2010 at the Northshore Mine. This technology had a patent issued on March 25, 2008. The inventors for this technology are David Hendrickson, Richard Kiesel, and Rodney Bleifuss.
- Chemical Derivatives Laboratory – NRRI continues to work with the OTC to sort through birch bark related technologies that it can continue to advance its research. Part of the Nature North intellectual property portfolio (LLC ownership included Minnesota Power, Potlatch Corporation and UMN) was sold to Myriad. NRRI participated in a meeting with OTC in Salt Lake City, Nevada at Myriad headquarters to dialog about NRRI's interest in certain technologies which were funded by NRRI and not Nature North. NRRI wants to make sure that its program grows in a direction which doesn't conflict with the intention of the UMN license to Myriad.

NRRI Product Development Fund

The Knight Foundation and Blandin Foundation granted NRRI a total of \$350,000 for product development initiatives. NRRI applied for the Blandin Foundation and Knight Foundation grant to be able to support the economic development efforts of entrepreneurs and/or small businesses in creating or retaining jobs with product development. NRRI has built an infrastructure over the last 25+ years which can support applied research efforts; however, NRRI is only able to provide a limited amount of technical support without payment for services. NRRI anticipated that entrepreneurs and/or small businesses would be willing to match any contributions from the Product Development Fund with cash and/or in-kind services and materials. A key outcome of the grant is to work with up to 30 businesses that will fully understand their proposed product's market which gives them the ability to evaluate and make a "go/no go" decision based on the on whether the economics of the product support a commercialization effort.

NRRI is on task with the major activities identified for the grant. At 32 months into the grant period, direct results include new products, job creation, and manufacturing efficiencies which have increased revenues and net profits for our clients. Further, a joint client of NRRI and the UMD CED business incubator was successful in attracting an angel investor who is assisting with licensing her technology.

The Product Development Fund has nine completed projects, one project closed prior to completion due to scheduling conflicts with client and three active projects in progress. In addition to the investment by Blandin and Knight, each project required a cash and in-kind match. For the \$241,116 awarded through the Product Development Fund, \$710,293 private sector investment has been committed, plus \$61,384.96 in-kind from UMD Natural Resources Research Institute.

For 2010, there is a balance of \$108,884 for additional projects. It is anticipated that two more projects will be under review in the first semester of 2010.

Small Business Innovation Research Program

The NRRI Business Group has initiated research into understanding the art and science involved with participating in the Small Business Innovation Research (SBIR) program. The SBIR program was created through the Small Business Innovation Development in 1982. The program was developed because the nation's small, high-tech, innovative businesses are recognized as being a significant part of the federal government's research and development efforts. Eleven federal agencies participate in the SBIR program by setting aside a portion of their research and development budgets for SBIR contracts with small businesses. In 2010, the estimated budget is \$2.4 billion. The SBIR program has four principal objectives:

1. To stimulate technological innovation by small business;
2. To increase small business participation in meeting federal Research and Development needs;
3. To increase the commercialization of technology developed through federal R&D;
4. To enhance outreach efforts to ensure that all qualified small businesses are aware the SBIR program and the many benefits it provides.

The SBIR program is a competitive process. Each year, the 11 agencies identify various research and development topics for pursuit by small businesses under the SBIR/STTR program. The topics are then released in a pre-solicitation, allowing small business to discuss topics with experts. The second release is the final solicitation. Contract winners are chosen on competitive merit by an agency's technical and scientific experts (www.sbir.gov). There are the three phases of the SBIR/STTR Program – each agency has slightly different parameters but in general, the following is true:

- Phase I is a feasibility study to evaluate the scientific and technical merit of an idea and up to \$150,000.
- Phase II is to expand on the results of and further pursue the development of Phase I. Phase II awards are for periods of up to two (2) years in amounts up to \$1 million.
- Phase III is for the commercialization of the results of Phase II and requires the use of private sector or non-SBIR federal funding. Receiving Phase II funding is now more dependent on demonstrating a commercialization plan which will result in Phase III or what's considered a "use-condition" of the technology.

Small businesses in Minnesota as a whole do not do as well in participating in the SBIR program as other states and ranks about 20th for proposals awarded. An example would be in comparing Maryland and Minnesota, which are similar in gross state product as well as population as follows:

(See Table on following page)

Table 1. Synopsis of Maryland and Minnesota SBIR-STTR Data

	Maryland	Minnesota
Total SBIR dollars since 2003	\$452,673,458	\$119,475,673
Percentage of Whole SBIR program \$ for same period	4.79%	1.27%
Total SBIR dollars, 1983-2008	\$1,295,917,061	\$372,719,767
Total SBIR Awards:		
Phase I	4,042	1,140
Phase II	1,149	425
Number of Awardees	905	265
Business Conditions Related to SBIR Awards:		
• Publicly Traded	27	15
• Merger & Acquisitions	57	19
• Venture Capital Funded	164	48
• Total Issues patents to Awardees	2,637	1,787

<http://www.inknovation.com/lobby/StateOffice.html>, retrieved 11/6/2009

Keep in mind that Maryland has direct access to the various federal agencies as well as 60 federal laboratories (Minnesota has one). NRRI would like to learn what Minnesota and the NE Minnesota Region can do differently to more actively to help small business attract program dollars to advance innovation and thus job creation. Minnesota does have one representative that serves as the liaison for the state for small business interested in learning more about the program and assisting with review of proposals. For the most part, all but a handful of the SBIR firms in Minnesota are located within a tight radius of the Twin Cities area.

NRRI has been successful in helping some of its small business clients write SBIR proposals who have received funding. As an applied research institute, NRRI is concentrating efforts of its business development manager to learn more about the SBIR program in order to help its clients understand how to navigate through the process.

Small Business Development Assistance

The NRRI supports the UMD Center for Economic Development (CED) for small business development assistance to those businesses focusing on the commercialization or conservation of natural resources. The assistance is related to business planning, financial planning, financing plans, marketing plans, ecommerce, etc, which complements the research and development activities at NRRI.

During 2009, 699 businesses were provided one-on-one consulting, with 259 during the last half of the year. Of those, 12% were manufacturing businesses, which successfully raised over \$2,000,000 of capital with the assistance of CED business consultants.

Between July and December 2009, CED continued to assist businesses that would be considered “green,” with the total for 2009 totaling 54. The industries included alternative energy using solar, wind or alternative fuels, energy saving initiatives, environmentally sustainable products and geo-thermal processes. Some of the current businesses involve the development of bio-fuels, financing and marketing assistance for a sprinkler system that has been successfully used in the preservation of buildings during wild-fires, a plasma gasification project, the bottling of natural, pure water in bottles made of corn, and a researcher who has a carbon sequestration process he is developing.

One of the NRRI Product Development Fund recipients is also participating in the CED Business Incubator Program and has been working on numerous business and financial projections with CED staff members in order to obtain additional financing which became reality during the last half of 2009. With the new investors and financing, this business will be continuing to explore market opportunities, including product licensing agreements in 2010.

Additionally, CED assisted several of the regional businesses that are part of the aviation sector with business planning, marketing and financial support, along with assistance and encouragement to participate in the Pohlads Foundation/MN Chamber Grow Minnesota grants and loans. Three of the businesses that CED assisted were recipients of the Pohlads Foundation/MN Chamber grants and loans.

During 2009, overall the CED had the following economic impact in our region:

Businesses assisted	669
New businesses created	67
Assisted in creating and retaining jobs	506
Accessed capital for business investment	\$18,100,000
Affected the generation of business revenues of	\$95,200,000
Assisted in generating tax revenues of	\$ 2,536,000

NRRI Public Relations

NRRI PUBLIC RELATIONS ACTIVITIES

Media Progress/Results

NRRI media coverage for the second half of 2009 (July – December) amounted to an official commercial advertising equivalent of \$101,952.24, down from the first half of 2009 by \$76,887.44 (although total number of stories published, both print and web, is up). During the second half, NRRI was represented in 39 newspaper stories, 10 web stories, 1 commercial television news stories and 2 public television feature stories. NRRI research was also featured in *BioScience* (November 2009) which has no associated advertising equivalent. Although they've experience severe staff reductions, we are fortunate that the *Duluth News Tribune* continues to show interest in NRRI projects and has printed 14 stories related to NRRI this half. Rural and small town newspapers ran a total of 39 NRRI stories. In the Twin Cities, NRRI was mentioned in one *St. Paul Pioneer Press* story, two stories in the *Daily Planet*, and two *Minnesota Daily (UMN)* stories.

New Media: NRRI staff developed an electronic version of the *NRRI Now* newsletter to be emailed to a growing list of recipients every two months. A NRRI LinkedIn professional networking group has also been developed and has a dozen followers. Research updates are sent every couple of weeks.

The NRRI website receives an average of 7,000 successful page requests per day (up from 6,000 reported in the first half of 2009). The top 10 search words that bring people to the NRRI website are: worm, ecosystem, University of Minnesota Duluth, cacing (related to worms, soil cultivation), soil horizons, soil layers, cacing tanah (worm-related), Canada lynx, soil, and cycle.

Visibility/Other PR Projects

Public Relations staff gave tours to a total of 40 people in the second half of 2009.

Other Public Relations efforts to promote NRRI research and programs included:

- Coordination and publicity of a tour for Senator Al Franken on August 13.
- Coordination with UMD Chancellor's staff to host a non-ferrous minerals meeting and NRRI tour with northern Minnesota landowners on September 17.
- Developed display and staff attendance at the University's E3 conference (Energy, Economic & Environmental).
- PR staff participated in the interview process to hire a new Communications Director for Minnesota Sea Grant.