Environment and Natural Resources Trust Fund

2023 Request for Proposal

General Information

Proposal ID: 2023-005

Proposal Title: Wildfire Resilience and Carbon Reductions Through Forest Management

Project Manager Information

Name: Matthew Aro

Organization: U of MN - Duluth - NRRI

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Project Basic Information

Project Summary: This work supports greenhouse gas emission (GHG) reductions by promoting healthy and wildfire-resilient forests in Minnesota through improved management and removal of low-value and small-diameter balsam fir ladder fuels.

Funds Requested: $120,000

Proposed Project Completion: June 30, 2025

LCCMR Funding Category: Small Projects (H)

Secondary Category: Air Quality, Climate Change, and Renewable Energy (E)

Project Location

What is the best scale for describing where your work will take place?

Region(s): NE, NW,

What is the best scale to describe the area impacted by your work?

Region(s): NE, NW,

When will the work impact occur?

During the Project and In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Small-diameter balsam fir found in the understory of Northern Minnesota boreal forests has minimal value and is often not removed, creating a hazardous ladder fuel situation where fires in low-growing vegetation rapidly spread to the forest canopy, exacerbating the intensity and spread of wildfires, such as the catastrophic 2021 Greenwood Fire in Minnesota. Further, balsam fir decays rapidly and is susceptible to the spruce budworm (374,000 acres of budworm damage occurred in the U.S. Forest Service Eastern Region in 2020, primarily in Minnesota's Superior National Forest); this has led to an increased amount of dead, dying, and diseased trees that degrade forest health and further contribute to the frequency and severity of wildfires. Further, there are 4.2 million cords of small-diameter (<9 inch) balsam fir in Minnesota; if wildfire were to spread through this timber, greenhouse gases (GHG), such as carbon dioxide (CO2), would be rapidly emitted to the atmosphere, exacerbating the climate crisis. There is a critical need to quantify the carbon in this understory timber to determine GHG emission reduction potentials that would be realized if these forests did not burn and the timber was, instead, converted into value-added forest products that store carbon long-term.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

The goal is to improve forest health and climate resiliency by reducing the risk of catastrophic wildfires and large-scale GHG emission events in Minnesota. Forests in Minnesota are currently a net carbon sink and possess the ability to store carbon and can, therefore, play a significant role in mitigating climate change. However, small-diameter balsam fir trees found in the understory of Minnesota forests often pose severe wildfire threats; once these trees are ignited, large-scale GHG emission events can occur from release of the carbon stored in the trees' tissues, turning a carbon sink into a source. Our solution is to: (1) determine the volumes and locations of balsam fir forest stands in Minnesota at significant risk of wildfire, (2) quantify the GHG emissions that would be avoided by creating value-added markets for this small-diameter balsam fir, (3) engage forest products industry stakeholders in the identification of economic and environmental benefits and barriers of utilizing this small-diameter balsam fir, and (4) develop a preliminary strategy to grow market development opportunities to increase utilization of small-diameter balsam fir.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

This project enhances the state's natural resources by increasing utilization of wood as a renewable resource and reducing risks from large-scale GHG emissions due to forest fires in fire-prone forested areas of the state. This work identifies forested areas at risk of wildfire, quantifies the benefits of GHG emission reductions, develops a strategy to grow new forest product markets, and grows the state's natural resource economy by providing economic opportunity to rural communities where the wood is harvested and processed.

Activities and Milestones

Activity 1: Determine volumes and locations of small-diameter balsam fir understory stands in Minnesota at significant risk of wildfire

Activity Budget: $43,230

Activity Description:
Estimation of forestland acres in Minnesota with small-diameter balsam fir will be conducted using U.S. Forest Service Forest Inventory and Analysis (FIA) data. Following estimation of total acres containing small-diameter balsam fir, datasets from a myriad of public land management agencies (state, county and federal) will be leveraged to identify and quantify site-specific areas with small-diameter balsam fir understories on public lands, as well as possibly extrapolating to private lands. Further, U.S. Forest Service aerial surveys and MN DNR Forest Insect and Disease reports will be used in conjunction with other public agency data to assist in determining areas that not only have a significant small-diameter balsam fir component, but are also co-located within acres containing dead or diseased trees, typically from spruce budworm damage. Available data sets can directly quantify estimates of totals, and through spatial imputation, mapping products will be produced showing sites (stands or areas) with risk factors for catastrophic disturbance in need of greater forest management.

Activity Milestones:

Description	Completion Date
Complete estimation of forestland area containing small-diameter balsam fir	December 31, 2023
Complete spatial imputation of areas likely containing higher concentrations of small-diameter balsam fir	July 31, 2024

Activity 2: Quantify avoided greenhouse gas (GHG) emissions realized through development of markets for identified small-diameter balsam fir

Activity Budget: $37,369

Activity Description:
We will use the U.S. Forest Service's Forest Vegetation Simulator (FVS) and its Fire and Fuels Extension to quantify GHG emissions associated with fire in forest stands containing significant amounts of balsam fir in the understory. Similarly, we will use the FVS to quantify the carbon footprint of balsam fir harvest and utilization of small-diameter balsam fir in long-lived forest products. Combining these two analyses will then allow us to quantify avoided GHG emissions attributable to the reduction of balsam fir ladder fuels at the stand level. Results from Activity 1, on the extent and volume of balsam fir in Northern Minnesota, will then be used to extrapolate from stand-level estimates to landscape-level estimates of avoided GHG emissions attributable to the development of new markets for balsam fir.

Activity Milestones:

Description	Completion Date
Model GHG emissions of balsam fir fire at the stand level	March 31, 2024
Quantify carbon footprint and avoided GHG emissions of balsam fir harvest at the stand level	December 31, 2024
Merge results from Activity 1 to quantify avoided GHG emissions at the landscape level	June 30, 2025

Activity 3: Implement a strategy to identify market opportunities and document the barriers to increased utilization of small-diameter balsam fir

Activity Budget: $17,003

Activity Description:
We will identify existing forest products markets and manufacturers within 100 miles of landscapes identified in Activity 1 as having significant small-diameter balsam fir understory and conduct phone and/or e-mail surveys with them to identify economic and environmental benefits and barriers (e.g., supply chain or operational barriers) limiting new and/or increased utilization of small-diameter balsam fir. This has potential to develop future market development opportunities by documenting the financial and/or operational barriers limiting utilization of small-diameter balsam fir, while potentially establishing a social and climate carbon cost to make financial comparisons of forest management choices. The above analyses will then be summarized to determine potential optimal utilization strategies for the small-diameter balsam fir.

Activity Milestones:

Description	Completion Date
Identify existing forest products markets and manufacturers within 100 miles of targeted landscapes	December 31, 2024
Complete phone and/or email surveys	March 31, 2025
Generate summary report with potential optimal small-diameter balsam fir utilization strategies	June 30, 2025

Activity 4: Maximize project impact by disseminating results and benefits to public and private stakeholders

Activity Budget: $22,398

Activity Description:
To maximize project impact; promote climate resilience; reduce wildfire risks; improve forest health; and catalyze potential future balsam fir-based forest products industry markets, innovations, and investments in Minnesota, the NRRI and MN DNR will leverage their networks to ensure findings are shared with targeted public and private stakeholder groups. Specifically, project activities, results, and benefits will be shared with public/private stakeholders via: (1) webinars presented to National Forest Supervisors, the Minnesota Forest Industries (MFI), public and private land managers, and state foresters across Minnesota; (2) web/electronic media and technical reports delivered through the NRRI and MN DNR websites, newsletters, and social media; (3) news releases (potential outlets include Duluth/Minneapolis and National media); (4) an educational video; (5) a conference presentation; and (6) and one peer-reviewed journal article.

Activity Milestones:

Description	Completion Date
Deliver webinars and develop educational video	June 30, 2025
Distribute final report through NRRI and MN DNR media channels	June 30, 2025
Submit one peer-reviewed journal article to a high-level, impactful journal	June 30, 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
John DuPlissis	University of Minnesota Duluth Natural Resources Research Institute	As Co-PI, John will lead the efforts to determine volumes and locations of small-diameter understory balsam fir forest stands in Minnesota that are at significant risk of wildfire. This information will be gathered from U.S. Forest Service databases and from other sources, such as Forest Inventory and Analysis (FIA).	Yes
Chris Wright	University of Minnesota Duluth Natural Resources Research Institute	Chris will lead the efforts on quantifying avoided greenhouse gas (GHG) emissions that would be realized through creation of value-added markets for the identified small-diameter balsam fir understory stands in Minnesota.	Yes
Scott Hillard	Minnesota Department of Natural Resources	Scott will assist in the efforts to determine volumes and locations of small-diameter understory balsam fir forest stands in Minnesota that are at significant risk of wildfire. This information will be gathered from U.S. Forest Service databases and from other sources, such as Forest Inventory and Analysis (FIA).	Yes
Kristen Bergstrand	Minnesota Department of Natural Resources	Kristen will assist in identifying potential value-added markets for small-diameter balsam fir, engaging forest products industry stakeholders in the identification of environmental benefits and barriers of utilizing this material, and developing a strategy to grow market development opportunities to increase utilization of small-diameter balsam fir.	No

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?

Results will be immediately implemented into currently-funded NRRI research to: (1) develop thermally modified strand-based mass timber, and (2) convert small-diameter balsam fir into biochar for revegetation of closed landfills. These two research programs will readily apply the results to demonstrate how utilization of small-diameter balsam fir can reduce wildfires and large-scale GHG emission events in Minnesota to improve forest health and climate resiliency. Further, a potential continuation of the project is implementation of the optimal understory material utilization technologies to develop new forest products markets. This work could be funded by the U.S. Forest Service.

Project Manager and Organization Qualifications

Project Manager Name: Matthew Aro

Job Title: Research Program Manager, Forest Products

Provide description of the project manager's qualifications to manage the proposed project.

Matthew Aro is a Research Program Manager of Wood Products at the University of Minnesota Duluth Natural Resources Research Institute (NRRI). He has nearly 20 years of experience providing product, process, and business concept research and development services to entrepreneurs, organizations, and agencies associated with the wood products and natural resources sectors. His work fosters regional economic development for enterprises that impact the building material and industrial wood markets. He has worked on a broad spectrum of applied research projects, often conducted in cooperation with private industry, dealing with wood- and natural fiber-based materials. He also regularly interacts and collaborates with public and private sector professionals and academicians in the wood products field. Project collaborators have included state agencies, the U.S. Department of Agriculture, the National Science Foundation, and the private sector (both in the U.S. and abroad). Much of this work has focused on advancing industrial

development of thermally modified wood in the U.S. Other areas of interest include wood composites, wood materials manufacturing, and beneficial use of industrial waste materials. He also has experience conducting environmental life cycle and sustainability assessments of a range of new natural resource-based technologies. He has a B.S. degree in Broad Field Science from the University of Wisconsin-Superior, as well as M.S. degrees in Management of Technology and Natural Resources Science and Management, both from the University of Minnesota.

Organization: U of MN - Duluth - NRRI

Organization Description:
The Natural Resources Research Institute (NRRI) is a part of the University of Minnesota research enterprise and employs over 130 scientists, engineers and technicians in its mission is to deliver integrated research solutions that value our resources, environment and economy for a sustainable and resilient future.

NRRI collaborates broadly across the University system, the state and the region to address the challenges of a natural resource-based economy.

By partnering with industry, business leaders, agency decision-makers and many others, NRRI researchers frame and deliver on real-world solutions. NRRI scientists have extensive experience in managing large, interdisciplinary projects, including the development of tools for environmental assessment and resource management. NRRI's role is as an impartial, science-based resource that develops and translates knowledge by characterizing and defining value-resource opportunities, minimizing waste and environmental impact, maximizing value from natural resource utilization, and maintaining/restoring ecosystem function.

Major outcomes from NRRI projects include informing environmental management and policy and assisting industry and communities in defining and maintaining the social license to operate in natural systems. NRRI has established mechanisms for sharing outcomes through press releases, publication in peer-reviewed journals, technical reports, annual reports, periodicals, and through social media channels.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Matthew Aro		Project Manager responsible for preparing all LCCMR-required reports and leading project tasks to ensure they are completed on time and within budget			25.1%	0.4		$41,529
John DuPlissis		Determine volumes and locations of small-diameter understory balsam fir forest stands in Minnesota that are at significant risk of wildfire			25.1%	0.1		$17,249
Chris Wright		Quantify avoided greenhouse gas (GHG) emissions that would be realized through creation of value-added markets for the identified small-diameter balsam fir understory stands in Minnesota			25.1%	0.24		$27,182
							Sub Total	**$85,960**
Contracts and Services								
Minnesota Department of Natural Resources	Sub award	Will assist in the efforts to determine volumes and locations of small-diameter understory balsam fir forest stands in Minnesota that are at significant risk of wildfire, identify potential value-added markets for the small-diameter balsam fir, and disseminate projects results and benefits.				0.12		$25,000
							Sub Total	**$25,000**
Equipment, Tools, and Supplies								
							Sub Total	**-**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								

							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Roundtrip automobile travel from NRRI (Duluth) to MN DNR (St. Paul) (2 trips each by 2 people in Y1 and Y2). Day trips only (no lodging/per diem required). Per trip: 300 miles * $0.585/mile = $351/trip	Travel to MN DNR (St. Paul) to discuss project activities, results, and strategies and mechanisms for sharing projects results and benefits with public/private stakeholders.					$1,425
	Conference Registration Miles/ Meals/ Lodging	Roundtrip automobile travel from NRRI (Duluth) to one conference in MN. Day trip only (no lodging/per diem required). Per trip: 900 miles (est) * $0.585/mile. Conference registration: $442.50/person.	Present project results and benefits at one conference in MN (location TBD) in Y2.					$1,427
							Sub Total	**$2,852**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	Publication charges	Publication charges for publishing projects results in one peer-reviewed journal (Y2).					$1,500
							Sub Total	**$1,500**
Other Expenses								
		Life cycle assessment software server hosting fee	Charge for hosting SimaPro life cycle assessment (LCA) software on a UMD virtual server. Includes hosting, maintenance, and security. $107/month * 12 months = $1,284 in Y1 and Y2. To be used for estimating GHG emission reduction potential.					$2,568
		Life cycle assessment software service contract renewal	The service contract ensures that our SimaPro life cycle assessment (LCA) software is up to date with the latest impact assessment methods and life cycle inventory databases.					$2,120

			$106/month * 20 months = $2,120 (Y1). This contract ensures we have the most up-to-date databases so our GHG emission calculations are as accurate as possible.					
							Sub Total	**$4,688**
							Grand Total	**$120,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
In-Kind	MN DNR, Utilization and Marketing Program	These funds will be used to assist in implementing a strategy to identify market opportunities and document the barriers to increased utilization of small-diameter balsam fir (Activity 3).	Secured	$4,400
			State Sub Total	**$4,400**
Non-State				
In-Kind	UMN unrecovered indirect costs are calculated at the UMN negotiated rate for research of 55% modified total direct costs.	Indirect costs are those costs incurred for common or joint objectives that cannot be readily identified with a specific sponsored program or institutional activity. Examples include utilities, building maintenance, clerical salaries, and general supplies. (https://research.umn.edu/units/oca/fa-costs/direct-indirect-costs)	Secured	$66,000
			Non State Sub Total	**$66,000**
			Funds Total	**$70,400**

Attachments

Required Attachments

Visual Component

File: 04828d20-733.pdf

Alternate Text for Visual Component

Small-diameter balsam fir trees are ladder fuels that support catastrophic forest fires, which rapidly release large volumes of greenhouse gas (GHG) emissions into the atmosphere. We will identify timber stands at most risk of wildfire, quantify the carbon in these stands, and identify market opportunities for utilization of this timber....

Optional Attachments

Support Letter or Other

Title	File
Superior National Forest, Letter of Support	c6a700f2-029.pdf
MN DNR Letter of Collaboration	1bd93fa7-e96.pdf
Sponsored Projects letter approving proposal submisssion	7055a130-fca.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have potential for royalties, copyrights, patents, or sale of products and assets?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

Natural Resources Research Institute
University of Minnesota Duluth
Driven to Discover

Wildfire Resilience and Carbon Reductions Through Forest Management

Summary: Reduce greenhouse gas (GHG) emissions and promote wildfire-resilient forests through improved forest management and removal of low-value, small-diameter balsam fir ladder fuels.

Problem: Small-diameter balsam fir trees are ladder fuels that support catastrophic forest fires.

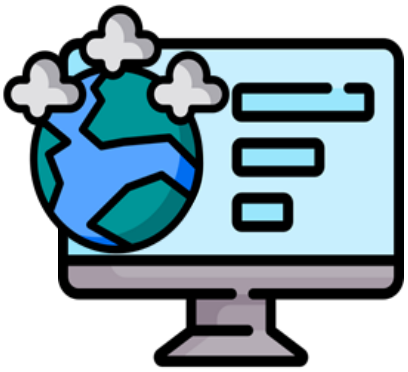
Balsam fir burning in 2021 Greenwood Fire

Forest Fires and the Climate Feedback Loop

As trees burn, stored carbon is released as carbon dioxide (CO_2) and other potent greenhouse gases (GHG), which exacerbate the climate crisis.

Outcome #1: Identify small-diameter balsam fir landscapes in MN forests with greatest risk of catastrophic wildfire.

Outcome #2: Quantify amount of climate change-causing greenhouse gases (GHG) that would be rapidly emitted into the atmosphere should wildfire occur on these landscapes.



Outcome #3: Identify market opportunities to utilize this small-diameter balsam fir, resulting in improved economic incentives to increase its harvest and lowered risk of large-scale GHG emission events.

Outcome #4: Educate public and private stakeholders on the benefits of this research.

Project Partner

DEPARTMENT OF NATURAL RESOURCES