

**Environment and Natural Resources Trust Fund**

# 2021 Request for Proposal

## **General Information**

**Proposal ID:** 2021-048

**Proposal Title:** Precision Forest Inventory For Aspen And Red Pine

## **Project Manager Information**

**Name:** John Duplissis

**Organization:** U of MN - Duluth - NRRI

**Office Telephone:** (218) 788-2719

**Email:** jdupliss@d.umn.edu

## **Project Basic Information**

**Project Summary:** We will estimate sequestered carbon and standing volumes of red pine and aspen using state-of-the-art lidar technology to provide stand-level measures as an alternative to wide-spread data collection

**Funds Requested:** $199,000

**Proposed Project Completion:** 2023-06-30

**LCCMR Funding Category:** Small Projects (H) **Secondary Category:** Foundational Natural Resource Data and Information (A)

## **Project Location**

**What is the best scale for describing where your work will take place?** Region(s): NE

**What is the best scale to describe the area impacted by your work?** Region(s): NE

**When will the work impact occur?** During the Project

## **Narrative**

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

The current area based inventory system is insufficient to reliably estimate the standing volume and above ground biomass at a stand level. This is primarily due to the sparse network of forest inventory plots for all land ownerships (e.g., US Forest Service FIA Program has established one plot for every 3,000 acres of land). Lidar-derived data have been widely used to supplement forest inventories, as this active remote sensing system can accurately characterize 3-dimensional forest structure. Because lidar can provide spatially explicit coverage of metrics that are highly correlated with tree measurements on the ground, lidar data can be leveraged with limited forest sampling inventory data to formulate models for wall-to-wall mapping of stocking, biomass, merchantable volumes, and other attributes.  
In Minnesota, there is a dearth of information on the current state of the forest at a small-scale such as stand or township. The expense and often inability to conduct highly local forest measurements results in inconsistent forest inventories which hampers the ability of managers and policy makers to accurately manage the resources. Likewise forest projections through time (growth and yield) are increasingly inaccurate when the vintage of the last measurement is more than 10 years old.

**What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.**

The Natural Resources Research Institute (NRRI) has measured more than 9,000 cut and harvested red pine and aspen trees from over 450 locations across the Great Lakes region. This unique data set has allowed them to develop highly accurate stem volume models to improve prediction estimates of above ground biomass, sequestered carbon and merchantable timber volume in these economically and ecologically important forest-types.  
These models can be leveraged with the inventory data currently being collected by the MNDNR Forestry Resource Assessment Program and additional sampling data (planned in the project) for prediction of important inventory stocking, height and diameter of the target species at the sample plot locations. The high density lidar data being collected as part of the MN State Lidar Plan provides us with the unique opportunity to calibrate models relating the plot estimates of forest metrics with co-located lidar-derived predictors. Such models can then be applied to accurately map standing volume in forest stands across the landscape. We are proposing to map aboveground biomass, trees per acre, stocking levels, carbon sequestration and forest-types across the entire lidar acquisition areas in Minnesota. This remote sensing based information will establish baseline inventories with much greater accuracy.

**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?**

Ensuring Minnesota maintains economic and ecological services from its forests requires timely and accurate information. This project will allow for a never before achieved stand level baseline of two ecologically and economically significant forest-types (red pine and aspen). It is this baseline inventory combined with stem volume equations developed by NRRI that will allow us to develop growth and yield models for management outcome assessment on a scale relevant to administrators and land owners across the state. This precision view of these forest resources will allow stakeholders to continue work towards the enhancement of Minnesota’s forests.

## **Activities and Milestones**

### **Activity 1: Calibrate Lidar data**

**Activity Budget:** $95,000

**Activity Description:**Data collected from the lidar state plan, and the forest inventory plots collected in Activity 1, will be used to establish the model relationships between plots and the lidar data. These models will include aboveground biomass (i.e. carbon stocking/CO2 equivalent), standing volume, quadratic mean diameter, max height, average height, trees per acre, site index, and age. At the same time, aspen and red pine stands will be mapped using remotely sensed data ((lidar, satellite, aerial photography).

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Map aspen and red pine stands | 2021-07-31 |
| Compile and begin producing lidar metrics | 2021-07-31 |
| Compile Data from year two measurements | 2022-12-31 |
| Model relationships between field inventory plots and lidar metrics | 2022-12-31 |
| Finalize forest type models and spatial predictions | 2023-02-28 |

### **Activity 2: Develop spatial analysis of aspen and red pine forest inventory in Northeastern Minnesota**

**Activity Budget:** $38,800

**Activity Description:**Models and species maps developed from Activity one will be combined to map aspen and red pine specific inventory metrics across the landscape and create a current inventory. The resulting inventory will be treated as a “starting inventory” and will be combined with NRRI's proprietary aspen and red pine models to model growth and create utilization scenarios that can inform decision making on how to balance production and carbon storage in the state of Minnesota. Outcomes will be communicated through area meetings with stakeholders, as published papers, and spatial data will be made available on the Minnesota Natural Resource Atlas.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Finalize publications and LCCMR reporting | 2023-06-30 |
| Conduct meetings with local stakeholders to communicate possibilities as well as feedback | 2023-06-30 |
| Create starting forest inventory and model utilization and ecological conservation scenarios | 2023-06-30 |

### **Activity 3: Field data collection to calibrate LiDAR metrics**

**Activity Budget:** $65,200

**Activity Description:**The purpose of field plots is to collect high-resolution forest inventory metrics at the tree level so that tree and plot level estimations can be accurately tied to remote sensing data (i.e. lidar). Lidar by itself does not allow for prediction of forest inventory making field plots a vital component of this analysis. Building upon work by the MN DNR Division of Forestry’s Resource Assessment unit (MNDNR\_DOF\_RA) we will collect 1/10 acre field plots. Staff will install 140 field plots over two summers in aspen and red pine stands following the MNDNR-DOF-RA field plot protocol. Staff will then compile field plot data and produce plot summaries that will be used in Activities two and three.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Locate 140 1/10th acre plots | 2021-07-31 |
| Collect forest resource metrics from the established plots | 2021-09-30 |
| enter data into relational and spatial databases for summary and analysis | 2021-12-31 |
| Measure remaining field plots | 2022-09-30 |
| Enter data into relational and spatial databases for summary and analysis | 2022-12-31 |

## **Project Partners and Collaborators**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Organization** | **Role** | **Receiving Funds** |
| Division of Forestry - Resource Assessment | MN Department of Natural Resources | MN DNR, Division of Forestry - Resources Assessment staff will be coordinating plot locations with MN State lidar plan data collections, assisting with the analysis of field data, analyzing lidar data, building relationships between datasets, developing models, modeling aspen and red pine volumes and mapping across the arrowhead region | Yes |

## **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 be funded?**This project is being developed in concert with the MN DNR Division of Forestry. The process developed will be utilized by the MN DNR to improve estimates of standing volumes of aspen and red pine on private, county, and state lands (Forestry and School Trust Lands) in northeastern Minnesota. These same data can be used by the forest products industry to better assess supply chains improve shared stewardship at the landscape level. Expansion of this project to other species and to other regions of the state will depend on state budget and grant funding to characterize additional species.

## **Project Manager and Organization Qualifications**

**Project Manager Name:** John Duplissis

**Job Title:** Silviculture Research Program Manager

**Provide description of the project manager’s qualifications to manage the proposed project.**DuPlissis' provides direction and leadership for the NRRI’s silviculture research group focused on developing cutting-edge, applied forest management research leading to stabilization and expansion of forest-based industry in Minnesota. This includes development of a full range of silvicultural strategies from intensive forest management and multiple-use forestry to conservation forestry. Existing programs include research on intermediate stand treatments for aspen and red pine ecosystems, growth, yield and harvest volume modeling, regional resource analyses to assess timber quantity and availability and assessment of remote sensing data to accurately quantify stand forest volumes.  
  
DuPlissis has extensive experience in the development, implementation and management of resource management and applied research projects funded by grants from private foundations and state and federal agencies. DuPlissis has served as the project manager on over a dozen grants, from nine different agencies or organizations, totaling nearly $5,500,000, to fund cost-share assistance to implement forest restoration project or applied research to guide land management decisions.

**Organization:** U of MN - Duluth - NRRI

**Organization Description:**The Natural Resources Research Institute (NRRI) is a part of the University of Minnesota Duluth and employs over 130 scientists, engineers and technicians. Its mission is to deliver research solutions to balance our economy, resources and environment for resilient communities. 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. Major objectives include 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 an established mechanism for sharing outcomes through press releases, publication in peer-reviewed journals, annual reports (https://www.nrri.umn.edu/resources-publications/annual-reports), periodicals, and through social media channels.

## **Budget Summary**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Category / Name** | **Subcategory or Type** | **Description** | **Purpose** | **Gen. Ineli gible** | **% Bene fits** | **# FTE** | **Class ified Staff?** | **$ Amount** |
| **Personnel** |  |  |  |  |  |  |  |  |
| John DuPlissis, Project Manager |  | Project management |  |  | 26.7% | 0.18 |  | $24,905 |
| Dan Buchman |  | Compiling and processing inventory data |  |  | 24.1% | 0.14 |  | $12,970 |
| Kristi Nixon |  | Cover type mapping and producing/finalizing maps |  |  | 24.1% | 0.08 |  | $6,665 |
| Temporary/Casual, Inventory Coordinator |  | Coordinating inventory |  |  | 7.3% | 0.14 |  | $10,319 |
| Summer Intern |  | Field data collection |  |  | 0% | 0.46 |  | $16,762 |
| Summer Intern |  | Field data collection |  |  | 0% | 0.46 |  | $16,762 |
|  |  |  |  |  |  |  | **Sub Total** | **$88,383** |
| **Contracts and Services** |  |  |  |  |  |  |  |  |
| Minnesota Department of Natural Resources | Sub award | MN DNR, Division of Forestry - Resources Assessment staff will be coordinating plot locations with MN State lidar plan data collections, assisting with the analysis of field data, analyzing lidar data, building relationships between datasets, developing models, modeling trembling aspen and red pine volumes and mapping across the arrowhead region |  |  |  | 0.42 |  | $84,297 |
|  |  |  |  |  |  |  | **Sub Total** | **$84,297** |
| **Equipment, Tools, and Supplies** |  |  |  |  |  |  |  |  |
|  | Tools and Supplies | Suunto PM5/360PC Clinometer: hand-held tool used to measure tree height (quantity 1) | To measure tree height |  |  |  |  | $131 |
|  | Tools and Supplies | Silva Ranger 2.0 Compass : hand-held tool used with map to locate field plots (quantity 2) | To locate field plots |  |  |  |  | $89 |
|  | Tools and Supplies | Spencer Logger’s Tape: hand-held tool used to measure tree diameterr (quantity 2) | To measure tree diameter for modeling |  |  |  |  | $102 |
|  | Tools and Supplies | Haglöf Monopod: portable tool used in conjunction with the laser rangefinder (quantity 1) | To mount for laser rangefinder |  |  |  |  | $125 |
|  | Tools and Supplies | Aluminum 360° Adapter: mounts on monopod (quantity 1) | Laser rangefinder receiving unit |  |  |  |  | $76 |
|  | Tools and Supplies | Haglöf Vertex Laser Geo 360° Package: laser range finder (quantity 1) | Used to accurately measure heights and distances |  |  |  |  | $2,537 |
|  | Tools and Supplies | Mesa 3 rugged tablet: field data recorder (quantity 1) | robust handheld device for data acquisition and processing in the field under all weather conditions |  |  |  |  | $3,125 |
|  | Tools and Supplies | Trimble R2 GPS: global positioning unit (quantity 1) | To geolocate plots and trees with submeter accuracy |  |  |  |  | $4,700 |
|  |  |  |  |  |  |  | **Sub Total** | **$10,885** |
| **Capital Expenditures** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Acquisitions and Stewardship** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Travel In Minnesota** |  |  |  |  |  |  |  |  |
|  | Miles/ Meals/ Lodging | Collection of forest inventory for Year 1 and 2: 48 day trips each year. 150 miles round trip. Costs include GSA approved rates for mileage | Two-person crew to collect stand level forest inventory data at the Rainy River site |  |  |  |  | $8,280 |
|  | Miles/ Meals/ Lodging | Training / Quality assurance for Year 1 and 2: 9 two-day trips each year. 400 miles round trip. Costs include GSA approved rates for per diem, lodging, and mileage | Provide training and support for remote located field staff and provide quality control checks on data collected |  |  |  |  | $7,155 |
|  |  |  |  |  |  |  | **Sub Total** | **$15,435** |
| **Travel Outside Minnesota** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Printing and Publication** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Other Expenses** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
|  |  |  |  |  |  |  | **Grand Total** | **$199,000** |

### **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** |  |  |  |  |
|  |  |  | **State Sub Total** | **-** |
| **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 | $76,837 |
|  |  |  | **Non State Sub Total** | **$76,837** |
|  |  |  | **Funds Total** | **$76,837** |

## **Attachments**

### **Required Attachments**

#### ***Visual Component***

File: [b06706aa-795.pdf](https://lccmrprojectmgmt.leg.mn/media/map/b06706aa-795.pdf)

#### ***Alternate Text for Visual Component***

The visual should help the reviewers understand that the current area-based inventory estimates forest metrics using a system that measures approximately one, one-sixth acre inventory plot for every 1,700 acres of forest land in northeast MN. Light Detection and Ranging, also known as lidar, is an active remote sensing system that can be used to measure vegetation height across wide areas. Using lidar we can accurately measure tree height data and even digitally describe the crown of individual trees. Our goal is to collect comprehensive forest stand data and compare on-the-ground measurements to lidar estimates to build models that will allows us to use lidar to accurately model aboveground biomass, sequestered carbon and merchantable timber with higher accuracy and lower cost than the current area-based inventory system

### **Optional Attachments**

#### ***Support Letter or Other***

|  |  |
| --- | --- |
| **Title** | **File** |
| Sponsored Projects Authorization Letter | [0524d318-f21.pdf](https://lccmrprojectmgmt.leg.mn/media/attachments/0524d318-f21.pdf) |

## **Administrative Use**

**Does your project include restoration or acquisition of land rights?**   
 No

**Does your project have patent, royalties, or revenue potential?**   
 No

**Does your project include research?**   
 Yes

**Does the organization have a fiscal agent for this project?**   
 Yes, Sponsored Projects Administration