Environment and Natural Resources Trust Fund

M.L. 2023 Draft Work Plan

General Information

ID Number: 2023-222

Staff Lead: Mike Campana

Date this document submitted to LCCMR: February 22, 2023

Project Title: Integrating Remotely Sensed Data with Traditional Forest Inventory

Project Budget: $191,000

Project Manager Information

Name: John Du Plissis

Organization: U of MN - Duluth - NRRI

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Project Reporting

Reporting Schedule: April 1 / October 1 of each year.

Project Completion: June 30, 2025

Final Report Due Date: August 14, 2025

Legal Information

Legal Citation:

Appropriation Language:

Appropriation End Date: June 30, 2025

Narrative

Project Summary: We will evaluate state-of-the-art lidar technology's ability to provide stand-level summary statistics of forest resource measurements and how these data can be used to estimate ecosystem services

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., USFS 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 important attributes for evaluating ecosystem service. 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? 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 Natural Resources Research Institute (NRRI) has developed stand distribution and 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 forest resource measurements including but not limited to 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 level 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. This is one-time funding to support the development of site quality measures, growth and yield models and model validation.

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 us to test models for field level accuracy and demonstrate the ability of remotely sensed data to improve forest stand volume estimates. 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.

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

Activities and Milestones

Activity 1: Field data collection to calibrate LiDAR metrics

Activity Budget: $132,000

Activity Description:

We will collect high-resolution forest inventory metrics at the tree level so that tree and plot level estimations can be accurately tied to remotely sensed 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 calibrate remotely sensed data with field data collections in year one and then evaluate the modeled stand level estimates in year two. Plots will be located in the northeastern portion of the state where Lidar data has been collected by MNDNR_DOF_RA and we will install 150 1/10 acre field plots in year one to develop relationships between field data collection and LIDAR derived metrics. Staff will then compile field plot data and produce plot summaries that will be used in Activities Two and Three. Based on the calibration of the LIDAR Data described in activity two, we will estimate stand level summary statistics described in Activity three and then install 150 1/10th acre field plots in year two to test how well the model estimates stand level summary data.

Activity Milestones:

Description	Approximate Completion Date
Locate field plots for calibration of LIDAR measurements and validation of Model Estimates	September 30, 2023
Collect tree level metrics from 150 field plots for LIDAR Calibration	September 30, 2023
enter data into relational and spatial databases for summary and analysis	December 31, 2023
Collect stand level metrics from 150 field plots for model evaluation	September 30, 2024
Enter data into relational and spatial databases for summary and analysis	December 31, 2024

Activity 2: Calibrate Lidar Data

Activity Budget: $32,000

Activity Description:

We will perform an assessment of the Division of Forestry's lidar data and the forest inventory plot data collected in Activity 1 and establish model relationships between on-the-ground field data collection and lidar estimates of stand level metrics and summary data.

Activity Milestones:

Description	Approximate Completion Date
Model relationships between field inventory plots and lidar metrics	March 31, 2024
Develop model correlations between field and remotely sensed data collections for each forest cover type	March 31, 2024
Finalize forest type models and spatial predictions	March 31, 2025

Activity 3: Develop a geospatial map with stand level summary statistics for major forest cover types in Northeastern Minnesota

Activity Budget: $27,000

Activity Description:

We will build a geospatial database of forest stands on public and private lands in Minnesota. Based on the models

developed in Activity #2 and the evaluation of modeled landscapes in Activity #1 we will create a map forested parcels with stand summary data including but not limited to forest cover type, site quality, mean height, mean diameter, trees per acres, basal area, percent stocking, standing biomass, merchantable volume, and above and below ground carbon in northeastern Minnesota. The resulting inventory will be treated as a "starting inventory" and will be combined with NRRI's proprietary growth and yield models to estimate standing stocks of merchantable timber, identify stands that are in a "break-up and reinitiation" phase, stands overdue for harvest and estimates of when stands will be ready for their next harvest. The final output from the project will be a geospatial database of forest stands, estimated stand summary metrics and potential harvest dates and harvest volumes that will be available to the public. 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	Approximate Completion Date
Create Geospatial maps identifying forest stands and stand summary metrics	December 31, 2024
Estimate stand summary statisitcs based on relationships established in Activity #2	January 31, 2025
Create starting forest inventory and model utilization and ecological conservation scenarios	March 31, 2025
Conduct meetings with local stakeholders to communicate possibilities as well as feedback	May 31, 2025
Finalize publications and LCCMR Reporting	June 30, 2025

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.
The competed work product will be map layer created by a geographical Information system that will provide stand level summary data at the parcel level with current volumes (merchantable volumes, biomass and carbon) as well as harvest volumes and the next recommended harvest date. This information will be presented to the leadership teams of the Chippewa and Superior National Forests, MN DNR Forestry, Office of School Trust Lands, the Minnesota Association of County Land Commissioners and the 1854 Treaty Authority. We will seek to present these findings at the annual Minnesota Society of American Foresters Conference, Annual UMN Silviculture and Wildlife Research Conference and via webinar through UMN Sustatinable Forestry Education Center. We will seek other appropriate regional and national venues to disseminate our research and findings. We will also publish our findings as appropriate in peer reviewed and informational journals or other publications. Our goal is to reach the broadest possible audience with the results of this research, inform them of the outputs and outcomes, help them to understand how to best use the information we will provide and seek to continue to develop partnerships to improve the models and utilization of model outputs. We will follow the ENTRF Acknowledgement Guidelines in all education and out reach programs and material including but not limited to appropriate use of preferred text and logo on all materials, publications, and websites to ensure that appropriate credit is given to the ENTRF for funding this project.

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?
This project is being developed in concert with the MN DNR Division of Forestry Resource Assessment. The process developed will be utilized to improve estimates of or stand level metrics for all forest cover types on private, county, state (Forestry and School Trust Lands) and federal lands in northeastern Minnesota. These same data can be used by the industry, agencies, tribal governments, conservation and habitat organizations to improve shared stewardship at the local and landscape level. Expansion of this project to other species and to other regions of the state will depend on additional lidar data and financial support

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
John DuPlissis, Project Manager		Project management			25.1%	0.16		$27,599
Kristi Nixon		Cover type mapping and producing/finalizing maps			22.3%	0.04		$3,301
2 Summer Interns (year 1)		Field data collection			0%	1		$24,960
2 Summer Interns (year 2)		Field data colelction			0%	1		$24,960
TBD Researcher 6		Forest Cover Type Mapping and Site Quality Evaluations			25.1%	0.3		$31,049
TBD Researcher 4		Field Crew SUpervision and QA/QC			22.3%	0.5		$33,258
							Sub Total	**$145,127**
Contracts and Services								
							Sub Total	-
Equipment, Tools, and Supplies								
	Tools and Supplies	Fieldwork Supplies	2 complete sets of equipment to support two teams (1) Suunto PM5/360PC Clinometer: hand-held tool used to measure tree height: $130.50 (2)Silva Ranger 2.0 Compass: Hand-held tool used with map to locate field plots to locate field plots: (x2 - $44.50 = $89) (3)Spencer Logger's Tape: hand-held tool used to measure tree diameter measure tree diameter for modeling: (x2 - $51.25 = $102.50) (4) Haglöf Monopod: portable tool used in					$1,046

			conjunction with the laser rangefinder mount for laser rangefinder: $124.95 (5) Aluminum 360° Adapter: mounts on monopod laser rangefinder receiving unit: $75.95 $522.90 total per team x two teams for a total of						
	Tools and Supplies	Additional Fieldwork Supplies	2 complete sets of equipment to support two teams (1) Haglöf Vertex Laser Geo 360° Package: laser range finder used to accurately measure heights and distances: $2,537.00 (2) Trimble R2 GPS: global positioning unit to geolocate plots and trees with submeter accuracy: $4,700.00 $7,237per team. Total of $14,474						$14,474
	Tools and Supplies	Mesa 3 Rugged Tablet	These are all-weather, hand-held field data recorders designed for the collection of natural resource data and more specifically to handle field conditions forestry technicains will encounter as a normal part of thier job. "Mesa 3 rugged tablet: robust handheld device for data acquisition and processing in the field under all weather conditions" $3,125.00 each or $6,250 total to supply each team	X					$6,250
								Sub Total	$21,770
Capital Expenditures									
								Sub Total	-
Acquisitions and Stewardship									
								Sub Total	-
Travel In Minnesota									
	Miles/ Meals/ Lodging	Forest Resource Field Data Collection. There will be two field crews plus a forest technician to check cruise the summer field team work.	(1) 2023 collect forest inventory data: two-person crew to collect stand level forest inventory data. 48 trips.						$24,103

		Mileage+hotel+meals = $4140 * 2 crews = $8,280 (2) 2023 Training / Quality assurance. Provide training and support for remote located field staff and provide quality control checks on data collected. 9 trips. Mileage+hotel+meals . $3,771 (3) 2024 collect forest inventory data: two-person crew to collect stand level forest inventory data. 48 trips. Mileage+hotel+meals = $4140 * 2crews - $8,280 (4) 2024 Training / Quality assurance. Provide training and support for remote located field staff and provide quality control checks on data collected. 9 trips. Mileage+hotel+meals . $3,772					
						Sub Total	$24,103
Travel Outside Minnesota							
						Sub Total	-
Printing and Publication							
-						Sub Total	-
Other Expenses							
-						Sub Total	-
						Grand Total	**$191,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Equipment, Tools, and Supplies		Mesa 3 Rugged Tablet	Although these are referred to as tablets these are in actuality hand-held field data recorders designed specifically for all-weather field data collection of natural resource that are specific to and will only be used as a part of this research project.

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	$105,050
			Non State Sub Total	**$105,050**
			Funds Total	**$105,050**

Attachments

Required Attachments
Visual Component
File: 293c36c8-632.pdf

Alternate Text for Visual Component
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 estimate stand summary metrics...

Optional Attachments
Support Letter or Other

Title	File
UMD Sponsored Projects Transmittal Letter	52dc0a69-7c2.pdf
Background Check for john duplissis	cb9a128b-444.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage
additional text added to narrative section in response to reviewer request "This is one-time funding to support the development of site quality measures, growth and yield models and model validation."

11-22-2022
Cleaned up and added context and depth to the descriptions of Activities #1 and #3. Added a new milestone to activity #3 to better define the steps in the process of creating a geospatial map of forest stands with stand summary data. Created a separate line-item for the hand-held field data recorders and provided a justification that documents them as directly related to and necessary for the project and that they will be used solely for project-related work.

Combined the year 1 field interns and year 2 field interns into single line items in the budget.

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?
 N/A

Do you agree travel expenses must follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?
 Yes, I agree to the UMN Policy.

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