Environment and Natural Resources Trust Fund

M.L. 2023 Approved Work Plan

General Information

ID Number: 2023-092

Staff Lead: Mike Campana

Date this document submitted to LCCMR: June 2, 2023

Project Title: Statewide Forest Carbon Inventory and Change Mapping

Project Budget: $987,000

Project Manager Information

Name: David Wilson

Organization: MN DNR - Forestry Division

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Project Reporting

Date Work Plan Approved by LCCMR: June 22, 2023

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

Project Completion: June 30, 2026

Final Report Due Date: August 14, 2026

Legal Information

Legal Citation: M.L. 2023, Chp. 60, Art. 2, Sec. 2, Subd. 03f

Appropriation Language: $987,000 the first year is from the trust fund to the commissioner of natural resources to work with Minnesota Forest Resources Council, Minnesota Forestry Association, the Board of Water and Soil Resources, and the University of Minnesota to develop a programmatic approach and begin collecting plot-based inventories on private forestland for use with remote sensing data to better assess changing forest conditions and climate mitigation opportunities across all ownerships in the state.

Appropriation End Date: June 30, 2026

Narrative

Project Summary: Accurate inventories are needed to facilitate carbon market entry for forestland owners. An estimated 800 plot-based inventories will be collected from private forestland to expand all-lands lidar forest inventory

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

Minnesota's forests play a key role in providing natural climate solutions by absorbing carbon dioxide from the atmosphere and storing it in vegetation, soil, and harvested wood. Accurate estimation and mapping of attributes like standing volume, biomass, and carbon are needed to support operational and strategic forest management planning, and emerging opportunities for climate mitigation. Current forest inventories do not provide sufficient spatial and temporal resolutions to accurately assess carbon stocks over time. Recent high-density lidar data, acquired as part of the Minnesota Lidar Plan, have potential to provide foundational forest inventory information when paired with a network of on-the-ground forest sampling data through plot-based inventory (PBI). However, the availability of PBI data is currently limited to public forest lands and needs expansion over private lands to capture their forests' unique characteristics. Programmatic design, in coordination with partners, is needed to build on initial ENRTF investment for trial private, county, and Tribal PBI data collection. This project will provide critical information about forestlands statewide by combining privately held forestland PBI information with existing public forestland PBI and remotely sensed data (i.e., lidar and imagery). The results will help expand forest structure, carbon stock, and change mapping across all ownerships.

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.

This project creates connections, incentives, and assistance to private landowners to opt-in to the MNDNR Division of Forestry's PBI program, resulting in an all-lands forest inventory. By expanding on work beginning fiscal year (FY) 2023, our goal is to collect 800 additional plots on private lands. Collaboration with the DNR's Private Forest Management Program, Board of Soil and Water Resources, Soil and Watershed Conservation Districts, University of Minnesota Extension Services, Minnesota Forestry Association, and the Minnesota Forest Resources Council Landscape Committees will expand the PBI network. Collaborators will help to design sound programmatic approaches that incentivize participation, add value through measurable outcomes, and meet stakeholder needs. The proposed 800 private plots, when paired with existing public PBI, will improve accuracy of lidar-based forest inventory across all ownerships and enable error estimation for private forestlands. This expansion of PBI to private lands is needed for the creation of more precise information used by the broader forestry community in site-to-landscape level planning, analysis, and monitoring at the statewide scale. The ground plot network collected through PBI will be used in combination with existing lidar, satellite, and aerial imagery to enhance Minnesota's forest inventory and enable estimates and projections of change.

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?

The Resource Assessment Program (RAP) will oversee the collection of approximately 800 PBI plots on private lands critical to accurately mapping and monitoring changing forest conditions across ownerships. These private field plots will be used in combination with existing public PBI, and remotely sensed data to produce statewide models of forest inventory metrics. This project contributes to understanding the role our forests play in carbon storage and sequestration and provides key benchmark information for management planning and policy evaluation. The inclusion of private lands enables enhanced landscape and regional planning for many shared ownership natural resource priorities and values.

Project Location

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

Statewide

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

Statewide

When will the work impact occur?

During the Project and In the Future

Activities and Milestones

Activity 1: Strategic Planning and Network Design for Programmatic Approach to Plot Based Inventory and Model Development Incorporating Private Lands.

Activity Budget: $97,000

Activity Description:

Strategic design and collaboration will begin with new investment from ENRTF in FY23 starting in a priority pilot region. This design work will continue throughout the first year of the proposed project, with heavy emphasis in the first six months to meet PBI data collection time constraints. Though coordinated by RAP, other state and non-state partners will be involved in development of this program, including: DNR's Private Forest Management Program, University of Minnesota Extension Service, Minnesota Forestry Association, and the Minnesota Forest Resources Council Landscape Committees. Strategic elements to be addressed include: identification and collaboration with organizations focused on private lands forestry, design of the needed PBI network for inventory metric estimation at desired levels of precision, development of private lands data management model and procedures, and project management planning for contracting with private forestry consultants for PBI data collection. Additional effort will be needed to identify all feasible logistical solutions for collecting PBI on private lands. Partner input will be essential in solidifying the organizational structure needed to accomplish project objectives. Final design of the private lands PBI network will depend on partner capacity and organizational priorities as well as desired levels of model precision and data privacy considerations.

Activity Milestones:

Description	Approximate Completion Date
Finalize landscape priorities for PBI collection; forest conditions and areas to be sampled.	September 30, 2023
Identify desired maps and levels of model precision for landscape and ownership strata	September 30, 2023
Finalize plan for engaging private vendors able to complete private lands PBI field work.	September 30, 2023
Design alternatives for private lands PBI network establishment (# and location of plots in priority landscapes).	October 31, 2023

Activity 2: Strategize and begin private landowner outreach, PBI network development, and use of alternatives expanding the forest inventory to all lands.

Activity Budget: $290,000

Activity Description:

RAP will work with internal and external stakeholders identified in Activity 1 to coordinate private landowner outreach associated with strategic priorities and needs defined by Activity 1. RAP's proposed Program Coordinator will work with private forestry consultants to conduct PBI field work on lands where permission to collect data is granted. Private PBI data will be managed by a non-state entity identified during Activity 1 to ensure privacy considerations. Procedures and standards used for PBI data collection will follow the public lands PBI effort currently nearing completion. Approximately 800 PBI plots will be collected on private forestland ownerships to enable extension of public lidar derived forest inventory models to all-lands, providing information needed for carbon market engagement. We'll investigate incorporating other field inventory efforts from public lands PBI and United States Department of Agriculture's Forest Inventory and Analyses Program (FIA) to improve precision of final products. Other stakeholders are also working on complementary pieces of this process via separate project proposals (Zobel - Removing Barriers to Carbon Market Entry, Duplissis – Integrating Remotely Sensed Data with Traditional Forest Inventory). We will work with these project partners to merge our methods and work products, producing the best available models and maps.

Activity Milestones:

Description	Approximate Completion Date
Finalize development of private PBI network (~800 plots for this project plus partner plots)	October 31, 2023
Assist contractors with landowner contacts (~2,500) and permissions (~800) for private lands PBI collection.	November 30, 2023
Coordination with partners on needed inventory metrics and best models for lidar forest inventory.	June 30, 2024
Design workflow for merging PBI and other data to produce best possible models.	June 30, 2024

Activity 3: PBI data collection, carbon model development, multi-temporal map production, and stakeholder training workshops

Activity Budget: $600,000

Activity Description:

PBI data will be collected on private lands using a combination of private forestry consultants and DNR Private Forest Management Program foresters. RAP Research Scientists will work in consultation with external partners to produce up to date carbon models and maps, also leveraging research from ENRTF investment beginning in FY23. RAP will also produce multi-temporal maps showing forest carbon change over time (ex. 2003, 2008, 2013, 2018, 2023), by leveraging 2010 statewide lidar, a time-series of Landsat imagery and other data. Multi-temporal maps will be designed to correspond with the 5-year cycle used by FIA to facilitate validation of statewide carbon estimates. Final carbon maps will be published to an online service and individual property reports will be developed for landowners participating in the private lands PBI network. Final maps and models will also be shared with stakeholders via one or more workshops focused on utilization of the project deliverables for resource evaluation and management planning. Project collaborators will participate in the design and execution of workshops.

Activity Milestones:

Description	Approximate Completion Date
Plot based inventory data collection (~800) via forestry consultants	November 30, 2024
Lidar derived forest inventory model development (6-10 metrics related to above ground carbon)	June 30, 2025
Final point in time carbon models using all available data (2003, 2008, 2013, 2018, 2023)	October 31, 2025
Multi-temporal map development showing carbon change over time (2003-2023, 5-year intervals))	February 28, 2026
Publish final carbon maps to online GIS service, provide property reports to private landowners	June 30, 2026
Stakeholder workshops to showcase project results and demonstrate product application to natural resource management planning.	June 30, 2026

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Resource Assessment Program	Minnesota DNR - Forestry	Project Management, Remote Sensing Model Development, Partner Coordination, PBI Network Design, PBI Collection Procedure Oversight, Time Series Map Production	Yes
Minnesota Forest Resources Council	Minnesota DNR - Forestry	Partner Coordination, Landscape Prioritization for PBI Collection, Strategic Direction and Oversight of Project Objectives and Deliverables, Oversight of student workers involved with private landowner interactions.	No
Department of Forest Resources	University of Minnesota	Carbon Program Integration, Consultation on USDA-Forest Inventory and Analysis data Integration, Map Product Validation, Private Lands Data Management	Yes
Private Forest Management Program	Minnesota DNR - Forestry	Private Landowner Contact and PBI Permissions for Private Lands	Yes
Extension Services	University of Minnesota	Private Landowner Contact and Permissions	Yes
Minnesota Forestry Association	Minnesota Forestry Association	Private Landowner Contact and Participation	Yes
Natural Resources Research Institute	University of Minnesota - Duluth	Online GIS Map Hosting and Tools	Yes
Forest Stewardship Planning Coordination	Minnesota Board of Soil and Water Resources	Coordination with local Soil and Water Conservation Districts, Partner Coordination, Strategic Direction and Contribution to Project Objectives and Deliverables, Private Landowner Contact and Participation	No

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.
We will publish final forest inventory and carbon maps to an online GIS service. We are currently looking into including products of this project as a component of the Minnesota Natural Resources Atlas (https://mnatlas.org/), but will explore other alternatives as well. Depending on partner development capacity, this online service may provide the ability to derive site level reports for a variety of forest inventory metrics involved in development of the statewide forest carbon maps. Additionally, we will provide property reports to participating private landowners, incorporating plot observations from their land with the lidar forest inventory and carbon mapping results. We will also hold stakeholder workshops to showcase project results and demonstrate product application to natural resource management planning. The Environmental and Natural Resources Trust Fund will be acknowledged in all data products and reports disseminated as a result of 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?
Through this project, time-sensitive private lands PBI will be collected and merged with public data to produce statewide estimates of forest resources focused on carbon storage and sequestration over time. Project results will be shared with

all project participants in the form of statewide and / or landscape / property specific maps and reports. Private landowners participating in the PBI initiative will be provided with reports for their properties based on the project results and PBI data specific to their property. Carbon maps will be made available through one or more online GIS platforms managed by project participants.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Project Coordinator		Project Management and Coordination			25%	2		$249,000
							Sub Total	**$249,000**
Contracts and Services								
Resource Assessment Program	Internal services or fees (uncommon)	RAP (an enterprise unit within Division of Forestry) will provide overall project coordination, hiring, data analysis, model development, and contractor management services. All project deliverables will be produced directly by RAP (lidar inventory models, maps, property reports).				1.5		$225,000
Private Forestry Consultants	Professional or Technical Service Contract	Private Forestry Consultants will do most of the actual plot based inventory data collection. Private contractors will report to Resource Assessment. Private data will be managed by a third party.				5		$400,000
University of Minnesota	Sub award	University of Minnesota - Department of Forest Resources researchers will work to independently validate final maps and products of the project. U of M researchers will be consulted throughout the project for input on best model development, FIA data integration and carbon market requirements.				0.21		$30,000
Minnesota Forestry Association	Sub award	MFA will provide a point of contact with private forest stewards possibly interested in participation in the private lands PBI network. Landowner information and communications related to this effort will be maintained by MFA. Participating landowners will be provided with a private forestry consultant to collect PBI data.				0.5		$30,000
Natural Resources Research Institute	Sub award	Online GIS Map Hosting and Tools				0.15		$20,000
							Sub Total	**$705,000**

Equipment, Tools, and Supplies									
							Sub Total	-
Capital Expenditures									
-							**Sub Total**	-
Acquisitions and Stewardship									
							Sub Total	-
Travel In Minnesota									
							Sub Total	-
Travel Outside Minnesota									
							Sub Total	-
Printing and Publication									
	Printing	Printing for outreach materials (2,500 copies, no postage) associated with landowner contact and permissions.	A large number of landowners will need to be contacted to inform them about the project and request permissions for inclusion of their property in the PBI network.						$14,000
							Sub Total	$14,000
Other Expenses									
		Direct and Necessary Costs	People Support, Safety Support, Financial Support, Communication Support, IT Support, Planning Support						$19,000
							Sub Total	$19,000
							Grand Total	$987,000

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	General Fund (DNR, MNIT, DOT), DNR-FOR (FMIA, PFM, Fire)	High density lidar collection and processing (In progress: Statewide 2021 - 2024)	Secured	$2,145,000
In-Kind	DNR - DOF	Public lands PBI collection (Statewide)	Secured	$1,690,525
In-Kind	General Fund (DNR-DOF)	0.2 FTE x 3 years for Project Oversight and Consulting	Secured	$56,000
Cash	ENRTF FY2023 - HF 3765 (d) Forest Data Inventory	$500,000 the second year is from the trust fund to the commissioner of natural resources for an enhanced forest inventory on county and private lands.	Secured	$500,000
In-Kind	General Fund - Division of Forestry	Natural Resource Program Consultant - Project oversight and administrative consulting	Secured	$40,000
Cash	General Fund - Division of Forestry	Private Forest Management - Division of Forestry: PFM foresters working on private stewardship plans will provide a point of contact with landowners likely to agree to participate in the private lands PBI network. PFM foresters may collect PBI plots on lands where they have developed stewardship plans.	Secured	$50,000
			State Sub Total	**$4,481,525**
Non-State				
In-Kind	County, Federal, Tribal and local government	High-density lidar collection statewide (In progress: 2021-2024)	Secured	$16,544,874
In-Kind	County, Federal	Public lands plot based inventory (2021-2024)	Secured	$658,360
In-Kind	Federal, County, Tribal and local government	High Density lidar data collection statewide (Planned: 2022-2024)	Potential	$5,000,000
			Non State Sub Total	**$22,203,234**
			Funds Total	**$26,684,759**

Attachments

Required Attachments

Visual Component

File: [5ce4ff4d-80b.pdf](5ce4ff4d-80b.pdf)

Alternate Text for Visual Component

Timeline of overall lidar forest inventory process and and funding status with maps of total and private plot based inventory needs for each Minnesota county....

Optional Attachments

Support Letter, Photos, Media, Other

Title	File
Background Check Certification Form	[5387e863-ab1.pdf](5387e863-ab1.pdf)

Media Links

Title	Link
Statewide Forest Carbon Inventory Change Mapping	https://files.dnr.state.mn.us/forestry/statewide-for-carbon-inv-change-mapping.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

A variety of changes to activities and budget items were made to align project deliverables with recommended funding levels. Several budget lines were reduced significantly to cut the total budget by over $500,000. Some activity milestones associated with the early planning phase of the project were removed to reduce the overall budget and to reflect the ability to accomplish some of these milestones using FY23 ENRTF funding allocated to begin the needed private lands PBI work. Additional details related to dissemination of project deliverables were added.

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?
> N/A

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?
> No