# Environment and Natural Resources Trust Fund
# 2020 Request for Proposals (RFP)

**Project Title:**                                    **ENRTF ID:**  **221-F**

Enhanced Forest Inventory Implementation for Multiple Values Management

**Category:**    F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

**Sub-Category:**

**Total Project Budget: $**   1,470,000

**Proposed Project Time Period for the Funding Requested:**    June 30, 2023 (3 yrs)

**Summary:**

Forest Inventory is the foundational data set for all stakeholders. This project will implement a new remote sensing forest inventory methodology across the state, allowing management for multiple values.

**Name:**    Scott          Hillard

**Sponsoring Organization:**  MN DNR

**Job Title:**  Dr.

**Department:**   Forestry

**Address:**   500 Lafayette Dr.

St.Paul                  MN    55155

**Telephone Number:**   (651) 259-5253

**Email**  scott.hillard@state.mn.us

**Web Address:**  https://www.dnr.state.mn.us/forestry/resource-assessment.html

**Location:**

**Region:**  Statewide

**County Name:**  Statewide

**City / Township:**

**Alternate Text for Visual:**

The visual describes the workflow of combining on the ground inventory with auxiliary remote sensing data, and what attributes will be predicted in an all lands approach.

| _____ Funding Priorities | _____ Multiple Benefits | _____ Outcomes | _____ Knowledge Base |
|---|---|---|---|
| _____ Extent of Impact | _____ Innovation | _____ Scientific/Tech Basis | _____ Urgency |
| _____ Capacity Readiness | _____ Leverage | _____ TOTAL | _____ % |

**PROJECT TITLE:** Enhanced Forest Inventory Implementation for Multiple Values Management

## I. PROJECT STATEMENT

Forest inventory is the foundational dataset for all stakeholders, representing the full spectrum of forest management and values, to assess and plan their activities. This effort will move the knowledge gained from pilot projects into action, transitioning Minnesota to a new statewide forest inventory method that considers all interests and values. This new remote sensing-based inventory will provide common data and collection protocols that will be shared with, and used and improved upon by state, county, federal, tribal, and private forest management partners. The common, wall-to-wall forest inventory information generated in this effort will be a significant advancement to help identify and increase collaboration and shared stewardship opportunities across ownerships and disciplines. This concept is a significant leap forward in tax-payer investment value and gathers more information with less manual effort. This project will provide a greater understanding on multiple ecological values including but not limited to: habitat assessment and improvement, carbon inventories, canopy change detection, water resource protection, invasive species and forest health monitoring, and other emerging issues that impact different stakeholders across the state. Improved long-term resource management and forecasts will result from an up-to-date and more comprehensive inventory created by this project.

This project will:
- Standardize and apply field data collection protocols that improve measurement accuracy and modeling precision for Minnesota Department of Natural Resources' forest inventory;
- Provide common data across all lands and promote common field data collection methods;
- Improve efficiency by integrating current inventory and field work with remote sensing;
- Reduce DNR's forest inventory cycle from 23 years to 15 years;
- Redirect time spent collecting inventory data so DNR and partner staff time can support improving the health and vigor of our forests for multiple values;
- Improve monitoring of dynamic forest conditions; and
- Integrate multiple forest resource evaluation into harvest scheduling; increasing stakeholder/partner confidence in harvest scheduling.

## II. ACTIVITIES AND OUTCOMES

**Activity 1: Develop new sensing (RS) inventory methodology and coordinate a statewide RS acquisition plan.**

**Description:** DNR will develop, test, and then scale-up an inventory method that works in tandem with RS information from light detection and ranging (LiDAR) and will develop a strategic approach to collecting detailed on-the-ground plot information. This new methodology will significantly increase the total number of acres inventoried each year, shorten the inventory cycle, and provide an "all lands" approach to forest inventory. Along with partner organizations, the Divisions of Fish and Wildlife, Ecological and Water Resources, and Forestry will ensure multiple values are considered in inventory and modeling approaches. Overall coordination with forest management partners and the Minnesota Geospatial Advisory Council's 3DGeomatics Committee is a key aspect to develop a statewide LiDAR acquisition plan and garner support needed to make this project as successful as possible. This project will significantly advance Minnesota's forest resource monitoring and assessment.

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**ENRTF BUDGET: $670,000**

| Outcome | Completion Date |
|---|---|
| *1. Develop, test and scale a targeted and precise RS inventory method* | *April 2021* |
| *2. Integrate QAQC and error assessment into DNR business practices* | *June 2022* |
| *3. Develop a statewide RS acquisition plan involving multiple stakeholders and partners* | *June 2023* |

**Activity 2: Acquire LiDAR data and implement inventory methodology into DNR's statewide forest inventory protocol.**

**Description:** DNR will work with our resource management partners to begin a phased implementation of the RS inventory method and acquire LiDAR and field data. DNR Forestry will facilitate the acquisition of LiDAR and inventory across at least 200,000 acres of state forest land annually for each of two years totaling over 400,000 acres of State Forest land and potentially millions of acres on other ownerships. Areas with a significant number of contributing partners will be targeted initially to ensure the best economies of scale during LiDAR acquisition. This project will be leveraged to support federal, county, and other funding for RS acquisition, such as the U.S. Geological Survey 3D Elevation Program (3DEP).

**ENRTF BUDGET: $ 800,000**

| Outcome | Completion Date |
|---|---|
| 1. LiDAR and inventory data collection on more than a million acres of Minnesota forest lands (acquiring at least 200,000 acres of state managed land each year) | *June 2022* |
| 2. New RS inventory method is fully integrated | *June 2023* |

**III. PROJECT PARTNERS AND COLLABORATORS:**
A. Partners receiving ENRTF funding: NA
B. Partners NOT receiving ENRTF funding: The USFS Superior and Chippewa National Forest, Minnesota Association of County Land Commissioners, University of Minnesota, Minnesota Geospatial Advisory Council's 3DGeomatics Committee, Geological Survey 3D Elevation Program (3DEP).

**IV LONG-TERM IMPLEMENTATION AND FUNDING:**
Accurate and current forest inventory data is vital to accomplishing goals one and three of the DNR's Conservation Agenda:
- Minnesota's waters, natural lands, and diverse fish and wildlife habitats are conserved and enhanced.
- Minnesota's natural resources contribute to strong and sustainable job markets, economies and communities.

This effort will also provide an important jumpstart to the broader goals of a statewide LiDAR acquisition plan through the Minnesota Geospatial Advisory Council's 3DGeomatics Committee, of which the MNDNR plays a significant role, alongside multiple vested partners throughout the state. Acquisition will be coordinated with contributing partners. For example, St. Louis County has been identified as a starting point, as the USFS Superior National Forest, USGS 3DEP, neighboring counties, and private industry in the area have already expressed interest. They have offered additional funds if this project is approved, making this investment stretch significantly further. Overtime we expect the state dollars currently spent on forest inventory to be used implementing the new methods developed under this proposal.

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**Attachment A: Project Budget Spreadsheet**
**Environment and Natural Resources Trust Fund**
**M.L. 2020 Budget Spreadsheet**
**Legal Citation:**
**Project Manager: Scott Hillard**
**Project Title:  Enhanced Forest Inventory Implementation for Multiple Values Management**
**Organization: Minnesota Department of Natural Resources**
**Project Budget: $1,470,000**
**Project Length and Completion Date:  Three years, June 30, 2023**
**Today's Date:  April 15, 2019**

| ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET | Budget | Amount Spent | Balance |
|---|---|---|---|
| **BUDGET ITEM** | | | |
| **Personnel (Wages and Benefits)** | $ - | $ - | $ - |
| | | | |
| **Professional/Technical/Service Contracts** | | | |
| Service level agreement with DNR Resource Assessment Program - consultation on procedure development, scale methodology, data analysis/modeling, inventory management. | $ 570,000 | $ - | $ 570,000 |
| Service level agreement with DNR Resource Assessment Program - consultation on coordination with 3D Geo Committee and other forest management partners. | $ 100,000 | $ - | $ 100,000 |
| Service level agreement with DNR Resource Assessment Program - to facilitate the contracting of inventory field data collection and LiDAR data acquisition on a total of 400,000 acres of State forest land. | $ 800,000 | $ - | $ 800,000 |
| **Equipment/Tools/Supplies** | | | |
| | $ - | $ - | $ - |
| **Other** | | | |
| | $ - | $ - | $ - |
| **COLUMN TOTAL** | $ 1,470,000 | $ - | $ 1,470,000 |

| SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT | Status (secured or pending) | Budget | Spent | Balance |
|---|---|---|---|---|
| **Non-State:** | | $ - | $ - | $ - |
|    **Superior National Forest** | Pending | $ 300,000 | $ - | $ 300,000 |
|    **Koochiching County** | Pending | $ 30,000 | $ - | $ 30,000 |
| **State:** | | $ - | $ - | $ - |
| **In kind:** | | $ - | $ - | $ - |
| | | | | |

| Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS | Amount legally obligated but not yet spent | Budget | Spent | Balance |
|---|---|---|---|---|
| **Development of Innovative Cost-Saving Methodology for Forest Inventory** | | $ 800,000 | $ 782,855 | $ 17,145 |

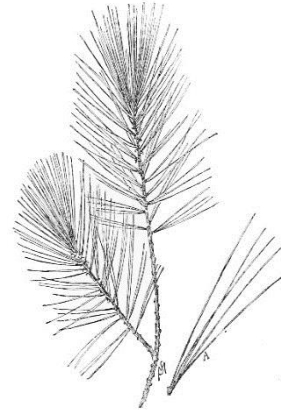# Enhanced Forest Inventory Implementation for Multiple Values Management

*Capturing Forest Values in an All Lands Approach, for Total Natural Resource Assessment*

**On the Ground- Plot Level Data**

↕
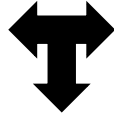
**All Ownership Airborne LiDAR**

*Relate Response to Predictors Using Regression Analysis & Machine Learning*

$$\hat{\gamma} = b_0 + b_1 X_1 + b_2 X_2 \dots b_n X_n$$

*Stand Level Estimates*

*Significant Reduction in Field Work*

*Major Reduction in Costs*

**Quadratic Mean Diameter(QMD)**
**Max Height**
**Mean Height**
**Volume**
**Basal Area**
**Above Ground Biomass**
**Site Index**
**Age**
**Cover-type**
**Trees per Acre**
**Stand Boundaries**
***Habitat Metrics**
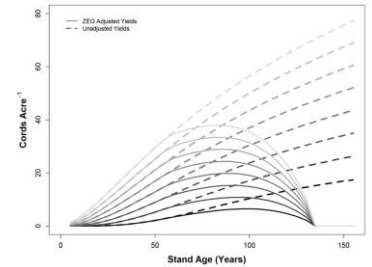***Invasive Species**
***Carbon Inventories**
***Change Detection**

***Possible future inventory additions**

*Habitat Assessment*

*Timber Harvest Coordination*

*Water Quality, BMP Monitoring*
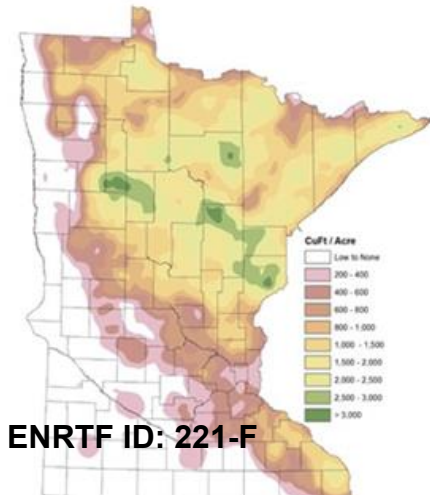
*Improve Growth and Yield; Estate Planning*

*All Lands Stand Level Assessments to Statewide Resource Management!*
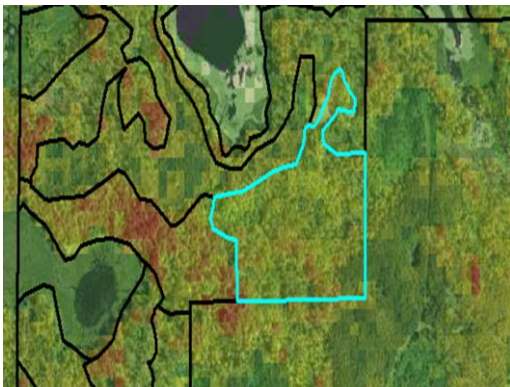
## Project Manager Qualifications & Organization Description

Scott Hillard; Ph.D
Research Scientist 3 (Forest Biometrics and Modeling)
MN DNR Forestry; Resource Assessment

Scott Hillard has a Ph.D in Forest Science and a Masters in Geographic Information Sciences from Michigan Technological University. As well, he was a Peace Corps Volunteer in Malawi from 2009-2012, working with their Department of Forestry, Parks and Wildlife. Dr. Hillard has worked with the Division of Forestry for three years, and has already participated in high profile projects such as the DNRs Sustainable Timber Harvest Analysis project, work that was awarded a project award by the Commissioner's office. Dr. Hillard played a critical role in developing and implementing the methodology for the ENRTF funded *Development of Innovative Cost-Saving Methodology for Forest Inventory*. Dr. Hillard's expertise and role in implementing ENRTF funded projects in the past, makes him uniquely positioned to manage this project. The current proposed project is highly technical, requiring expert knowledge in statistics, remote sensing, and design based sampling methods, knowledge that Dr. Hillard is specialized in.

MN DNR
The Minnesota Department of Natural Resources works to integrate and sustain the interdependent values of a healthy environment, a sustainable economy, and livable communities. DNR's integrated resource management strategy shares stewardship responsibility with citizens and partners to manage for multiple interests. DNR protects the state's natural heritage by conserving the diversity of natural lands, waters, and fish and wildlife that provide the foundation for Minnesota's recreational and natural resource-based economy (M.S. 84, M.S. 97A). DNR manages natural lands such as forests, wetlands, and native prairies; maintains healthy populations of fish and wildlife; and protects rare plant and animal communities throughout the state. DNR manages the state's water resources, sustaining healthy waterways and ground water resources. DNR provides access to enrich public outdoor recreational opportunities, such as hunting, fishing, wildlife-watching, camping, skiing, hiking, biking, motorized recreation, and conservation education through a state outdoor recreation system that includes parks, trails, wildlife management areas, scientific and natural areas, water trails, and other facilities (M.S. 86A). DNR supports natural resource-based economies, managing state forest lands for multiple forest values (M.S. 89), ensuring the maximum long-term economic return from school trust lands (M.S. 127A), and providing other economic opportunities in a manner consistent with sound natural resource conservation and management principles. The mission of the Minnesota Department of Natural Resources is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life.