# Environment and Natural Resources Trust Fund
# 2017 Request for Proposals (RFP)

**Project Title:** **ENRTF ID: 164-F**

Identifying Optimal Soil Conditions for Sustainable Forest Management

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

**Total Project Budget: $** 415,000

**Proposed Project Time Period for the Funding Requested:** 4 Years, July 2017 - June 2021

**Summary:**

Quantify factors that control soil operability with historic data and experimental manipulations. Develop strategies and tools to identify conditions that minimize impacts to soil and promote regeneration of diverse forests.

**Name:** Robert Slesak

**Sponsoring Organization:** U of MN

**Address:** 1530 Cleveland Ave N

St. Paul MN 55108

**Telephone Number:** (651) 603-6756

**Email** raslesak@umn.edu; awards@umn.edu

**Web Address**

**Location**

**Region:** Statewide

**County Name:** Statewide

**City / Township:**

**Alternate Text for Visual:**

Impacts to soil such as rutting (upper left picture) and reduced regeneration of desirable tree species such as white pine (upper right picture) can occur if soil conditions are not optimal during forest harvesting. We will quantify how key factors (shown in the lower pictures) related to soil properties, air temperature, and surface dynamics influence optimal soil conditions and develop practical tools for assessment.

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

**PROJECT TITLE:** Identifying optimal soil conditions for sustainable forest management

**I. PROJECT STATEMENT**

The overarching goal of this project is to quantify the factors that influence soil degradation during forest harvesting and develop practical tools to avoid impacts under a variable and changing climate. Soil is a fundamental resource from which many others arise**,** and minimizing impacts to soil during forest harvesting is a primary objective**.** Soil operability, or the ability to operate on soil with minimal detriment, is a key management issue in sustainable forestry. Logging during winter when soil is frozen is one of the most common methods prescribed to protect soil when harvesting timber, but impacts to forest resources can still occur if there is insufficient frost penetration in the ground and regeneration of certain species (e.g., white pine) can be inhibited by a lack of surface scarification. Summer harvesting can cause similar impacts for certain soils at or near water saturation, but can also be beneficial to regeneration and native plant communities if conducted under favorable soil-water conditions. **Although many of the factors that influence soil operability are known, our current ability to predict when soil conditions are optimal to minimize impacts and promote ecological functions is surprisingly limited.** An improved understanding of the mechanisms that control soil operability will allow us to forecast when operating conditions are ideal to maintain ecological benefits, develop practices to promote favorable operating conditions (e.g., remove or compact snow), and help the DNR, county land departments, federal, industry and private landowners develop strategic plans for harvesting under a variable and changing climate. We also expect that the findings will have economic benefits for loggers, wood-using businesses, and the state by increasing site access and reducing uncertainty related to fiber supply.

The goal of this project is to quantify the mechanisms that contribute to soil operability in summer and winter across a range of soil types and weather conditions to improve our ability to predict optimal harvesting conditions and develop practices that minimize impacts to forest resources. We will achieve this goal using long-term soil and climate datasets and a network of experimental treatments that manipulate key factors which influence soil operability.

**II. PROJECT ACTIVITIES AND OUTCOMES**

**Activity 1**: **Empirically model the influence of climate on soil operability** **Budget: $ 150,000**

We will utilize a 50+ year dataset from the Marcell Experimental Forest (located in the Chippewa National Forest) that includes data on climate, soil moisture, frost, and snow depth across representative forest cover types and soils of northern Minnesota. We will use this dataset and other available data (e.g., weather records, soil temperature records, soil survey database) to empirically model soil operability as a function of soil properties, climate, and other pertinent variables. Model results will be used to classify each soil type into an operability class and develop diagnostic criteria for changes in operability throughout the year.

| Outcome | Completion Date |
|---|---|
| 1. Datasets acquired and pre-processing completed | July 2018 |
| 2. Climate-operability models developed | Dec. 2018 |
| 3. Models checked and validated with real-time weather data | Apr. 2020 |
| 4. Effects of weather variation incorporated into final report and management strategies | June 2021 |

**Activity 2: Assess the influence of soil properties and weather on operability across a range of site conditions for 3 years** **Budget: $ 210,000**

We will develop a network of 10 research sites along a temperature gradient from southern to northern Minnesota across a range of soil textures. Soil texture is a key property that influences soil operability because it

controls soil moisture dynamics – a primary factor influencing operability. Experimental treatments that manipulate soil moisture during the summer and snow depth during the winter will be replicated at each site. Treatments will be applied throughout the project period to assess the influence of inter-annual variability in weather on soil operability. We will measure and analyze the effect of these treatments on soil temperature and moisture, frost occurrence and depth (during winter), soil strength, and variation in response over time.

| Outcome | Completion Date |
|---|---|
| 1. 10 sites identified that span the range of climate and soils in MN | Oct. 2017 |
| 2. Measurement of treatment effects on soil properties completed | Oct. 2020 |
| 3. Effect of soil moisture, snow depth, and texture on soil strength determined. | June 2021 |

**Activity 3: Develop soil operability guidelines and a field measurement tool** **Budget: $ 55,000**

Results from Activities 1 and 2 will be used to identify key factors and conditions influencing soil operability, and develop guidelines on when operations may occur under current and future climate conditions. We will also develop strategies and recommendations to enhance operability under subpar conditions including post-storm events and early season snowfall. Practical tools, including a GIS-based operability framework and a measurement device that can be used in the field to assess soil operability, will be developed for use by foresters. We will communicate our findings to agencies, policy organizations, and land managers.

| Outcome | Completion Date |
|---|---|
| 1. Findings from Activities 1 and 2 synthesized and key factors identified | Mar. 2021 |
| 2. Guidelines for operability across a range of soil and climate conditions developed | Apr. 2021 |
| 3. Best practices to enhance operability and measurement tool developed | June 2021 |
| 4. Final report and communication of findings completed | June 2021 |

## III. PROJECT STRATEGY

### A. Project Team/Partners

Team members who will contribute time and effort to the project are Dr. Robert Slesak (MN Forest Resources Council; who receives funds from the request), Dr. Charlie Blinn (University of Minnesota; who receives funds from the request), Dan Hanson (DNR Forestry), Dr. Randy Kolka (US Forest Service) and Dr. Stephen Sebestyen (US Forest Service). The Forest Service will also contribute additional in-kind funds to the project in the form of Drs. Kolka's and Sebestyen's salary, equipment use, and data sets. The Minnesota Department of Natural Resources is also cooperating by providing their lands for study treatments, and will work closely with the project team on Activity 3 to incorporate findings directly into DNR operations and policies.

### B. Project Impact and Long-Term Strategy

**The impact of this work will be large because there is strong support from the entire forestry stakeholder community including MN DNR, county land departments, the USFS, forest industry, environmental organizations, and many others.** The findings will be widely used by private and public land managers to reduce impacts to soil during harvesting and increase site access by clearly identifying when conditions are suitable to maintain and promote ecological benefits. Furthermore, the results will be used by governmental agencies for long-term planning efforts and development of related policies for addressing variability in climate and summer wood supply. Findings will be disseminated in a variety of mediums, and incorporated into Minnesota's Forest Management Guidelines.

### C. Timeline Requirements

The proposed project duration of four years is necessary to assess manipulative treatment effects for 3 growing seaons (May-Sept) to account for variability in climate conditions among years.

# 2017 Detailed Project Budget

**Project Title: Identifying optimal soil conditions for sustainable forest management**

**PIs:** R.A. Slesak (UMN), C. Blinn (UMN), D. Hanson (DNR), R. Kolka (USFS), S. Sebestyen (USFS)

**IV. TOTAL ENRTF REQUEST BUDGET 4 years**

| BUDGET ITEM | AMOUNT |
|---|---|
| **Personnel:** Salary (0.5 FTE each) and fringe (0.82) for 2 MSc students for 2 years | $ 169,577 |
| **Personnel:** Salary and fringe (0.307) for 1 Research Associate (1.0 FTE) for 3 years who will coordinate treatment application and data collection at the project sites | $ 149,473 |
| **Personnel:** Salary and fringe (0.0743) for 1 summer work study student for 3 years | $ 25,783 |
| **Equipment/Tools/Supplies:** Soil temperature and moisture sensors (100 totaling $15,000), dataloggers (25 totaling $10,000), mobile soil pressure apparatus ($25,000), snow tube and scale ($500), shovels, water pump, and misc. supplies for treatment application ($1,667) | $ 52,167 |
| **Travel:** Travel for mileage (75%) and lodging (25%) within Minnesota for researchers, the Research Associate, and Graduate Student to the project sites. A large amount of travel will be requiried because sites will be located from southern to northern Minnesota and require periodic visits following snow events. | $ 18,000 |
| **TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =** | $ 415,000 |

**V. OTHER FUNDS**

| SOURCE OF FUNDS | AMOUNT | Status |
|---|---|---|
| **Other Non-State $ To Be Applied To Project During Project Period:** | N/A | *N/A* |
| **Other State $ To Be Applied To Project During Project Period:** | N/A | *N/A* |
| **In-kind Services To Be Applied To Project During Project Period:** In-kind salary from R. Slesak (0.1 FTE) , R. Kolka (0.05 FTE) and S. Sebestyn (0.05 FTE) | $ 76,900 | *Secured* |
| **Funding History:** Funds used to support Marcell Experimental Forest data collection over past 50 years | $ 100,000 | |
| **Remaining $ From Current ENRTF Appropriation:** | N/A | *N/A* |

Severe rutting under suboptimal soil conditions


Establishment of native plant communities with optimal soil conditions

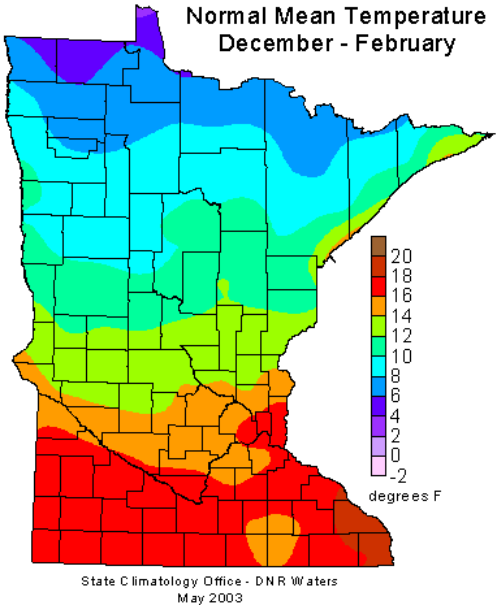
**We want to <u>avoid this</u> and <u>increase this</u> by quantifying how these factors influence soil operability**

## Soil properties

Soil water content is key factor controlling <u>soil strength</u>

Dependent on soil texture and density

## Air temperature




Air temperature influences soil water and frost dynamics

Dependent on soil type and snow conditions

## Surface conditions

Snow and forest floor influence frost development and soil water

Dependent on timing / intensity of rain and snow storms

**Identifying optimal soil operability conditions for forest management**

**Project manager qualifications**

**Robert A. Slesak**

**Qualifications**

Rob is Adjunct Assistant Professor in the Department of Forest Resources, University of Minnesota, and manager of the Site-level Program at the Minnesota Forest Resources Council. He is responsible for evaluation and development of Minnesota's Forest Management Guidelines, assessing their effectiveness with monitoring and research, and conducting research to address existing and emerging threats to sustainable forest management. Rob has extensive experience addressing complex forest resource issues including the identification of information needs for efficient and effective solutions to the challenges of sustainable forest management. He is a principal investigator and project manager on several ongoing projects related to invasive species, soil productivity, and forest sustainability, and has published a number of peer-reviewed journal papers related to these topics. Rob has a Ph.D in Forest Soils from Oregon State University, a M.S.in Forest Ecosystem Science from SUNY Environmental Science and Forestry (ESF), and a B.S. in Forest Resource Management from SUNY ESF. His research and professional interests are broadly focused on sustainable forest management, including identification of processes critical to ecosystem functions, evaluation of the potential for those processes and functions to be altered by management activities, and the application of management practices to restore degraded ecosystem functions.

**Organization description**

The Department of Forest Resources is part of the University of Minnesota.

The Minnesota Forest Resources Council was established by the Sustainable Forest Resources Act to promote long-term sustainable management of Minnesota's forests.