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

Project Title: ENRTF ID: 101-B
Maintaining Clean Water Supply from Working Forests
Category: B. Water Resources
Sub-Category:
Total Project Budget: \$ _275.785
Proposed Project Time Period for the Funding Requested: <u>June 30, 2023 (3 vrs)</u>
Summary:
We will identify watersheds at risk of degradation due to forest disturbance (e.g. fire, storms, pests, harvests) develop proactive strategies to maintain clean water focusing in Northeastern Minnesota.
Name: Diana Karwan
Sponsoring Organization: U of MN
Job Title: Assistant Professor
Department:
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Web Address:
Location:
Region: Metro, Northeast
County Name: Cook, Itasca, Koochiching, Lake, Ramsey, St. Louis

City / Township:

Alternate Text for Visual:

We will combine water and spatial information across different area footprints to identify areas at risk to water resource degradation.

Funding Priorities Multiple Benefits	OutcomesKnowledge Base
Extent of Impact Innovation	Scientific/Tech Basis Urgency
Capacity ReadinessLeverage	TOTAL%



PROJECT TITLE: Maintaining clean water supply from working forests

I. PROJECT STATEMENT

One of the most important benefits provided from forests is the production and supply of clean water. Land use and forest disturbance (arising from forest harvesting, extreme events such as fire and windstorms, and invasive species) are key factors placing water resources at risk in forested watersheds because they control the amount and timing of water and sediments delivered to streams and lakes. We will combine newly available time-series forest disturbance data with historical streamflow data in order to determine relationships between landuse/disturbance and streamflow. Our objectives are to 1) identify patterns of forest disturbance where impacts to water occur, 2) determine the watershed size where impacts are greatest, and 3) conduct a risk assessment to determine watersheds at greatest risk of impact. This fits well across the LCCMR's priorities on Water Resources (e.g. preventing reducing contaminants) and Foundational Natural Resource Data and Information (e.g. analysis of data, innovative combination of newly-available remote sensing, GIS, and non-geospatial water resource data).

There is great need for information related to forest disturbance/ land use patterns and water to identify at-risk watersheds and develop proactive strategies, such as best management practices, to maintain water supplies. The iconic North Woods of northeastern and north central Minnesota have great influence on three important watersheds: the Mississippi River, the Great Lakes/St. Lawrence, and Lake Winnipeg. Forests and clean water are closely linked, with about two-thirds of drinking water in the United States coming from forest lands in addition to other benefits, such as recreation. Maintenance of water resources in tandem with forest managment is essential to the sustainability of freshwater resources, forest-based economies, and public health. Change in the relative distribution of land use and disturbance threatens the continued supply of clean water from forested landscapes. Although there is recognition of the potential influence of disturbance patterns on streamflow and water quality, **actual patterns where significant impacts occur, are unclear and poorly understood.** Historically, foundational data on forests and water are collected over very different areas. Because of this, there is broad support among state agencies and the forestry community to identify water and landscape patterns in space and time that *prevent degradation* of clean water as well as timber supply.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Update forest disturbance maps and metrics

ENRTF BUDGET: \$ 21,277

We will utilize Landsat imagery to update a spatial dataset that characterizes forest disturbance in Minnesota to now encompass 1972-2019. Development of the original dataset (1972-2015) was funded by the Environment and Natural Resources Trust Fund, which allows us to capitalize on previous investments and create additional value for the state. Additional years of data (2015 – 2019) added under this project are incredibly important to maximize the overlap in time with streamflow measurements and recent disturbances, such as Emerald Ash Borer outbreaks, windstorms, and recovery from the Pagami Creek Fire. As shown in the next 2 activities, the majority of this project will add substantial value to the disturbance data to quantify where and when forest disturbance has been shown to affect water resources. Imagery (2015-2019) will be acquired and processed to remove geometric errors and account for atmospheric effects (e.g., clouds). Images will be incorporated into the existing time series analysis using the Landtrendr change detection algorithm and disturbance metrics recalculated (e.g., time since disturbance, total amount of disturbed area).

Outcome	Completion Date
1. Suitable Landsat imagery identified, downloaded, and preprocessed	Aug. 2021
2. Forest disturbance and land use metrics updated statewide through year 2019.	Dec. 2021



Activity 2: Determine relationships between forest disturbance and surface water

ENRTF BUDGET: \$ 77,946

The updated disturbance dataset developed in Activity 1 will be combined with other spatial datasets related to land use, topography, and water features (e.g., National Wetland Inventory), among others. We will acquire all stream gauge data available in Minnesota since 1972 (the start year of the disturbance dataset), and compile it into a uniform format for analysis. We will use a suite of spatial and time-series statistical techniques to relate disturbance and land use patterns to changes in water quantity as a baseline to water quality. Where available, water quality data will also be used. Analyses will be conducted across the range of watershed sizes to determine how different-sized disturbances and their relationship with water resources vary with watershed size.

Outcome	Completion Date
1. All datasets acquired and compiled in uniform format	Aug 2021
2. Disturbance/land use configurations/watershed size with impacts to water identified	Aug 2021

Activity 3: Watershed risk assessment

ENRTF BUDGET: \$ 176,562

Products from Activities 1 and 2 will be combined with other data, such as landform, soils, and precipitation, to identify forested watersheds approaching disturbance levels where impacts to water resources may occur. We will combine forest and hydrologic / water resources data to produce risk assessment maps across multiple watershed sizes showing the spatial scale at which surface water resources could be at risk based upon forest landscape disturbance. We will examine watersheds of varying sizes with recent history of fire, timber harvest, and those susceptible to invasive species, such as the Emerald Ash Borer. We will conduct a geospatial analysis that incorporates other factors that govern water cycling (e.g. landscape, soils, precipitation regimes, forest types) in order to identify landscape patterns leading to water resource degradation from forest disturbance. Using the above information, we will determine the existing and future risk for watersheds across Minnesota.

Outcome	Completion Date
1. Disturbance patterns (amount and configuration) quantified for forested watersheds	Aug 2022
2. Geospatial analysis of modifying factors completed	Aug 2022
3. Risk assessment completed for all forested watersheds (>20% forest cover)	June 2023

III. PROJECT PARTNERS AND COLLABORATORS:

The project team includes Dr. Diana Karwan (lead) from the UMN Department of Forest Resources and Dr. Robert Slesak from the Minnesota Forest Resources Council. Cooperators include the Divisions of Forestry, Ecological and Water Resources, and Fisheries and Wildlife within the DNR; and the Watershed Division of the MN PCA.

IV. LONG-TERM IMPLEMENTATION AND FUNDING: We will work closely with federal, state, and county agencies to incorporate our findings into statewide watershed assessments (e.g., modeling associated with MNPCA WRAPS) and regional planning efforts (e.g., DNR and USDA Forest Service planning, MFRC Regional Landscape plans). We will also work with the broader forestry community (via R. Slesak's affiliation with the MN Forest Resources Council) to develop strategies that avoid threshold configurations while also maintaining the supply of fiber for forest industry and the economies dependent on it. We are working to identify a source of funds to support periodic updating of the disturbance dataset for future assessments related to water quality, wildlife management, and timber availability.

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Attachment A: Project Budget Spreadsheet
Environment and Natural Resources Trust Fund
M.L. 2020 Budget Spreadsheet
Legal Citation:
Project Manager: Dr. Diana Karwan
Project Title: Maintaining clean water supply from working forests
Organization: University of Minnesota
Project Budget: \$275,785
Project Length and Completion Date: 3 years, June 30, 2023
Today's Date: 4/8/2019



ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET			Budget	Amount Spent	Balance	
BUDGET ITEM						
Personnel (Wages and Benefits)		\$	269,785	\$-	\$	269,785
Dr. D. Karwan, (8% FTE / 4 weeks per year in each of 3 years; 36% fringe based on UMN FY 2019 rates with 2% increase per year) manage project, supervise researcher and graduate student, conduct all reporting, guide scenarios and written reports of scenarios ; present findings to relevant state stakeholders (\$44,776)						
Geospatial Research Associate (0.25 FTE in year 1; \$62,577 annual, 36% fringe) upda	ate imagery and					
Hydrology Research Associate (0.5 FTE in each year: \$53,549 annual, 36% fringe) co	nduct					
hydrology Research Associate (0.5 FTE in each year; \$53,549 annual, 36% fringe) conduct hydrological time series analysis; coordinate geospatial analysis and match with hydrologic data; develop scenarios case studies per activity 3. (\$113,668)						
Graduate Student (0.5 FTE for years 2 and 3; \$22.30 per hour acadmic year, \$24.66	per hour in					
summer, 16.1% fringe; \$15,990 per academic year for tuition; based on FY 2020 est	imates from UMN					
with a 2% increase per year); conduct hydrologic and GIS analysis necessary for case	e studies in					
Professional/Technical/Service Contracts						
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Fauipment/Tools/Supplies		Ļ	_	ې ب	Ļ	_
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Capital Expenditures Over \$5,000				,		
· · ·		\$	-	\$-	\$	-
Fee Title Acquisition						
		\$	-	\$-	\$	-
Easement Acquisition						
		\$	-	\$-	\$	-
Professional Services for Acquisition				+		
Dulatin -		Ş	-	Ş -	Ş	-
Printing				ć	ć	
Troval overance in Minnaseta			-	Ş -	Ş	-
Travel expenses in Minnesota Travel within MN by car from the Twin Cities to cast study sites, such as Bagami Creek Eire in Superior			6.000	Ś.	¢	6 000
National Forest associated ranger stations and forest management offices. This will facilitate case			0,000	Ŷ	Ŷ	0,000
study development and dissemination of case studies to forest managers. All conducted per UMN policy and using UMN Fleet Services vehicles and rates.						
Other						
		\$	-	\$-	\$	-
COLUMN TOTAL		\$	275,785	\$-	\$	275,785
SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	E	Budget	Spent	Ва	alance
Non-State:		\$	-	\$ -	\$	-
State:		\$	-	\$-	\$	-
In kind: University of Minnesota Unrecovered Facilities and Administrative costs		\$	129,264	\$-	\$	129,264
54%						
Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget		Spent	Balance	
M.L. 2015, Chp. 76, Sec. 2, Subd. 03r (PI: Karwan)		\$150,000		\$150,000	\$150,000 \$0	

M.L. 2015, Chp. 76, Sec. 2, Subd. 03q, (PI: Slesak)

200,000 \$

200,000 \$

\$

Maintaining clean water supply from working forests



⁽a, b, and c are conceptual thresholds where impacts begin to occur)

Project Manager Qualifications

Dr. Diana Karwan has over 15 years of experience conducting and managing hydrologic research focusing on the effects of land cover change on water quantity, quality, and instream processes. Dr. Karwan received a PhD in Environmental Science from the Yale University School of Forestry & Environmental Studies with a focus on forest and environmental hydrology. She has authored peer-reviewed journal articles and given presentations at scientific conferences and for community groups on these studies (listed at http://www.forestry.umn.edu/People/DianaLKarwan/index.htm) as well as led large teams collecting water quantity and quality data in forest, agricultural, and suburban landscapes in response to forest management, landscape disturbance, and large storms. She has completed one previous project for the LCCMR (M.L. 2015, Chp. 76, Sec. 2, Subd. 03r) which provides a single case study of water resource monitoring immediately before and after commercial timber harvest.

Organization Description

The University of Minnesota is a land-grant institution and research university with a strong tradition of education and service to the state. The Department of Forest Resources is the leading research and educational institution on forest related issues in Minnesota. For over 100 years the department has played a key role in discovering and fostering sustainable forest resource management activities in Minnesota.