

Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-466

Proposal Title: Urban Nature: Mapping and Monitoring Minnesota's Green Spaces

Project Manager Information

Name: Adriana Uscanga Castillo Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences Office Telephone: (541) 606-9249 Email: auscanga@umn.edu

Project Basic Information

Project Summary: Sustainable urban development requires detailed geographic information of urban vegetation. We provide detailed maps of past and current urban vegetation, and a reproducible workflow for updating future urban vegetation maps.

ENRTF Funds Requested: \$505,000

Proposed Project Completion: June 30, 2029

LCCMR Funding Category: Land (F)

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

Narrative

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

Cities across Minnesota are actively expanding and enhancing urban green spaces. For example, in the Minneapolis-St. Paul metropolitan area, millions of dollars are being invested in increasing tree canopy on both public and private lands through initiatives like the Twin Cities Climate Resiliency Initiative, City Trees, and the Climate Legacy Initiative. Minneapolis alone aims to plant 200,000 trees by 2040. However, city planners and managers often face challenges due to outdated or incomplete maps of urban green spaces and gaps in historical vegetation data—critical for ecological restoration efforts. While significant progress has been made in collecting public vegetation data through tree inventories, drones, airborne surveys, and satellite imagery, processing and synthesizing this data into accessible, meaningful geographic information remains complex. Creating user-friendly maps requires technical expertise, advanced computational tools, and substantial time and resources. This project seeks to bridge these gaps by leveraging the vast amount of available data and computing power. Our goal is to provide detailed historical and current geographic information on urban vegetation while developing a reproducible workflow that streamlines map-making for future urban vegetation monitoring, enabling more effective management of greening initiatives and tracking their progress and impact over time.

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.

Leveraging our expertise in geospatial analysis and publicly available data from the State of Minnesota, the Department of Natural Resources, and the University of Minnesota, we will synthesize historical and current urban vegetation data to create accessible, detailed maps of urban ecosystems. The project consists of three stages: (1) mapping urban vegetation from the pre-GIS and Remote Sensing era by digitizing historical maps, (2) synthesizing spatial data to map current urban ecosystems using remote sensing and geospatial tools, and (3) developing the infrastructure to efficiently map future urban vegetation. Our key objectives are to (1) track historical vegetation changes through digitized maps, (2) create a detailed map of current urban green spaces, including relevant ecological descriptors such as location, quantity, composition, structure, and quality of vegetation, and (3) develop a reproducible workflow to streamline future vegetation mapping. This user-friendly workflow will be tested in the Twin Cities and will enable the expansion of the mapping process to other cities in Minnesota and beyond. The results of this project will be stored in publicly available digital libraries directly benefiting city planners and managers, providing them with essential data to enhance and restore urban ecosystems effectively.

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?

1. A publicly available series of historic digitized maps that will enable users to assess and compare urban green spaces change over time, particularly benefiting ecological restoration projects.

2. A publicly available detailed map of the present ecological state of public and private urban green spaces with information about fundamental ecological descriptors such as canopy height, and species assemblages, that is currently lacking and will improve resource management and conservation.

3. An open and public user-friendly reproducible workflow to update future urban vegetation maps with the ability to choose variables of interest to facilitate tracking the progress of greening initiatives.

Activities and Milestones

Activity 1: Processing historical city maps to analyze urban green spaces for ecological management and restoration

Activity Budget: \$150,000

Activity Description:

Historical city maps of Minnesota possess valuable information on the distribution and extent of green spaces and how they have evolved over time. However, this information is not readily available in a geographic information system (GIS) environment, where it would be more useful. The main objective of this activity is to extract historical urban green spaces data by digitizing maps made before 1996, when maps were made on paper without GIS and remote sensing tools, and archived in the John R. Borchert Map Library at the University of Minnesota. To achieve this, we will develop an AI algorithm capable of detecting urban green spaces in scanned maps, similar to Dr. Chiang's work on road network digital map processing. This approach will significantly reduce the need for manual digitization and ensure a scalable, repeatable process for mapping green spaces in different cities. After implementing the algorithm, we will carry out data validation and correction. Finally, the processed maps will be uploaded to a public digital repository, such as the Big Ten Academic Alliance Geoportal or MnGEO. Maintaining this data in a GIS environment will be crucial for ensuring public access to urban green space information.

Activity Milestones:

Description	Approximate		
	Completion Date		
Developing AI algorithm for detecting urban green spaces in scanned maps predating 1996	June 30, 2027		
Implementing AI algorithm to digitize scanned maps	December 31, 2027		
Validating and correcting digitized maps	June 30, 2028		
Create public digital map library with digitized maps available in a GIS environment	December 31, 2028		

Activity 2: Mapping ecological attributes of vegetation in urban green spaces across cities in Minnesota

Activity Budget: \$235,000

Activity Description:

Detailed, updated geographic information of the current ecological state of urban vegetation in Minnesota is currently not available. Current maps (like Google Maps or OpenStreetMap) show the location of urban green spaces but do not provide information on relevant ecological descriptors, such as canopy height, species composition, or presence of invasive species. Here, using high- and medium-resolution satellite and airborne imagery, inventories, and city plots that have already been collected by state and city efforts (such as the statewide Lidar data collection), we will classify urban green spaces with machine learning algorithms, and describe their main ecological characteristics, such as species composition and canopy height. We will also describe landscape metrics such as the size of different green spaces and their connectivity. Remote sensing data modeling will be validated in the Minneapolis-St Paul metropolitan area. Then we will identify good quality ecological descriptors of urban ecosystems, filtering out descriptors with high modeling errors. Communication with our collaborators at the DNR will be fundamental for ensuring the selection of meaningful ecological descriptors. Each ecological descriptor will represent a layer in a map. The final map will be publicly available as an online resource with capabilities of data selection, filtering, and downloading.

Activity Milestones:

Description	Approximate Completion Date
Classifying urban green spaces using state and city remote sensing and vegetation data	December 31, 2026

Interpolate ecological descriptors using machine learning models	June 30, 2027			
Validate machine learning models and select best ecological descriptors	December 31, 2027			
Publish peer-reviewed manuscript describing urban vegetation map of the Twin Cities with ecological Ser				
descriptors				
Present results at conference	December 31, 2028			
Create public online map of urban vegetation with best ecological descriptors as layers June				

Activity 3: Building a reproducible workflow for updating urban vegetation maps yearly and monitoring resource management in the future

Activity Budget: \$120,000

Activity Description:

The ecology of urban vegetation changes constantly and it is difficult to keep maps updated at the same speed. One example of this is the effects of the emerald ash borer outbreak on ash trees in recent years that have changed the urban canopy of the Twin Cities remarkably. The last assessment of tree canopy in the Twin Cities, however, dates back to 2015. This hinders the monitoring and quick management response needed to address environmental challenges and protect urban nature. Therefore, this last activity focuses on facilitating the process of making maps of urban nature with the most up-to-date information available in an automated, user-friendly reproducible workflow. This activity will be based on the main outcomes of Activity 2. Once high-quality ecological descriptors are selected, we will create a platform with an application programming interface (API) where users can select data and ecological descriptors to obtain customized ready-to-use maps.

Activity Milestones:

Description	Approximate Completion Date	
Create workflow scaffolding for automated update of maps based on Activity 2 results	December 31, 2028	
Implement a public facing online mapping tool where users can customized ready-to-use maps	June 30, 2029	

Project Partners and Collaborators

Name	Organization Role		Receiving
			Funds
Rui Cheng	University of Minnesota. College of Food, Agricultural, and Natural Resource Sciences	Co-Principal Investigator. Dr. Cheng is an expert in environmental sensing and modeling with 8 years of experience in monitoring forest health using multi- stream sensing. Dr. Cheng will advise one of the graduate research assistants and analyze remote sensing data to map the current ecological state of urban vegetation (Activity 2).	Yes
Yao-Yi Chiang	University of Minnesota. College of Science and Engineering	Co-Principal Investigator. Dr. Chiang is an expert in Artificial Intelligence and machine learning tools for mapping. Dr. Chiang will advise one of the graduate research assistants, contribute to developing algorithms for mapping historical urban spaces, and oversee the development of a workflow for updating maps effectively (Activities 1 and 3).	Yes

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?

The three main outcomes will be publicly available through the University of Minnesota library system at the end of the project. We will collaborate with the Resource Assessment and Community Forestry offices in the Department of Natural Resources to ensure successful implementation, including a potential transition of the mapping workflow to MnGEO or the Minnesota Natural Resources Atlas for long-term usability. Sustaining these products will require external funding, which we will seek through grants from USDA NIFA, NASA, and other opportunities identified with support from the University of Minnesota AI-CLIMATE Institute.

Project Manager and Organization Qualifications

Project Manager Name: Adriana Uscanga Castillo

Job Title: Assistant Professor

Provide description of the project manager's qualifications to manage the proposed project.

Dr. Uscanga is an expert in spatial analysis of social-ecological systems, with seven years of experience integrating remote sensing data and vegetation surveys to study forests and human-modified ecosystems. She currently teaches Geographic Information Systems for Natural Resource Management and has five years of experience mapping natural resources. She is an active member of the urban forest group within the recently established Long-Term Ecological Research Site in the Twin Cities, serving as a mapping and remote sensing expert. Additionally, she leads a Twin Cities-based project examining the relationship between urban nature and wildlife sightings, funded by the College of Food, Agricultural, and Natural Resource Sciences collaboration summit award at the University of Minnesota. Geographic data collection of urban green spaces will be supported by this complementary award, enabling having all data needed for this proposal by the start of this project. As principal investigator, Dr. Uscanga will oversee project progress, manage research activities, and advise one of the graduate research assistants.

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Organization Description:

The College of Food, Agricultural and Natural Resources Sciences (CFANS) at the University of Minnesota seeks to inspire minds, nourish people, and enhance the natural environment. CFANS vision is to advance Minnesota as a global leader

in food, agriculture, and natural resources through extraordinary education, science-based solutions, and dynamic public engagement that nourishes people and enhances the environment in which we live.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineli	% Bene	# FTE	Class ified	\$ Amount
				gible	fits		Staff?	
Personnel								
Adriana		Principal Investigator			36.6%	18		\$31,724
Uscanga								
Rui Cheng		Co-Investigator			36.6%	9		\$22,472
Yao-Yi		Co-Investigator			36.6%	9		\$33,714
Chiang								. ,
То Ве		Graduate Student			23.2%	150		\$112,433
Detirmined								
То Ве		Graduate Student			23.2%	150		\$132,592
Determined								
То Ве		Graduate Student			23.2%	9.4		\$13,577
Determined								
							Sub	\$346,512
							Total	
Contracts								
and Services								
							Sub	-
							Total	
Equipment,								
Tools, and								
Supplies								<u>.</u>
	Tools and	M&S	software subscriptions and computer					\$1,000
	Supplies		accessories					44.000
							Sub	\$1,000
Conital							Total	
Capital								
expenditures							Sub	
							Total	-
Acquisitions							Total	
and								
Stewardship								
P							Sub	-
							Total	
Travel In								
Minnesota								

	Miles/ Meals/	(0.7 usd/milage) \$350 12 days	Ground-truthing data			\$13,202
	Lodging					
	Conference	Registration, lodging, meals	Confernece travel (Registration,			\$9,000
	Registration		lodging, meals)			
	Miles/ Meals/					
	Lodging					
					Sub Total	\$22,202
Travel						
Outside						
Minnesota						
					Sub	-
					Total	
Printing and						
Publication						
					Sub	-
					Total	
Other						
Expenses						
-		Publication Costs	Publication Costs			\$8,176
		Graduate Student Tuition	Graduate Student Tuition			\$127,110
					Sub	\$135,286
					Total	
					Grand	\$505,000
					Total	

Classified Staff or Generally Ineligible Expenses

Category/Name Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
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Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub	-
			Total	
Non-State				
			Non State	-
			Sub Total	
			Funds	-
			Total	

Total Project Cost: \$505,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component File: 2221339c-a80.pdf

Alternate Text for Visual Component

Figure showing the problem we want to address with this project, our solution, and the three main outcomes we will deliver at the end of the project....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
UMN Board Resolution. Sponsored Projects Administration	<u>2356fc9f-4f9.pdf</u>

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they 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 understand the UMN Policy on travel applies.

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

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

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing \$10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care, treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal:

Rick Huismann

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

N/A