



Environment and Natural Resources Trust Fund

M.L. 2025 Approved Work Plan

General Information

ID Number: 2025-107

Staff Lead: Tiffany Schaufler

Date this document submitted to LCCMR: June 11, 2025

Project Title: Soil Health Management for Water Storage

Project Budget: \$454,000

Project Manager Information

Name: Marcelle Lewandowski

Organization: U of MN - Water Resources Center

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Project Reporting

Date Work Plan Approved by LCCMR: June 24, 2025

Reporting Schedule: March 1 / September 1 of each year.

Project Completion: June 30, 2028

Final Report Due Date: August 14, 2028

Legal Information

Legal Citation: M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 04h

Appropriation Language: \$454,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota for the Water Resources Center to conduct on-farm and model-based research and develop guidance for watershed planners and land managers to effectively use soil health management to achieve water storage and water quality goals.

Appropriation End Date: June 30, 2028

Narrative

Project Summary: We will create guidance for watershed managers using in-field and near-riparian soil health practices to reduce streamflow. We will complete essential research and modeling connecting soil management to watershed impacts.

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

Two of the state's most challenging water quality issues – excess sediment and nitrogen loads – are largely driven by the increasing rates of streamflow and increasing amounts and intensity of precipitation. While driven by climate, streamflow rates and volume can be mitigated by increasing water storage across the watershed to reduce or delay the precipitation that reaches the stream channel. One approach to increasing water storage is to replace surface storage that was removed from the land when wetlands and closed depressions were drained to allow for agriculture. A complementary approach is to increase the amount of water stored in the soil by improving soil structure and increasing soil organic matter. While soil water storage is theoretically important, only soil organic matter has been considered in previous estimates of storage potential. We do not know the magnitude of impacts of changes to soil structure, and we do not know where in a watershed to site soil water storage improvements to maximize impacts. This research will connect state investments in water storage to in-field practices.

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.

We will conduct the on-farm and model-based research needed to understand practical issues of soil water storage. Then we will create guidance to help watershed planners and land managers effectively use soil health management to help mitigate streamflow.

On-farm studies will measure soil health, soil aggregation, and soil water storage potential to determine the potential for realistic soil management practices to alter soil hydrology. While many studies have measured changes in soil carbon and biology in response to soil management, few have examined the changes in soil structure and hydrology.

The field results will be used to adjust parameters in an existing model such as SWAT to ensure that the model accounts for changes to in-field soil hydrology. Then, the model will be run to quantify the potential impacts of land management on streamflow.

Practical guidance will be written based on the field and modeling work. The guide will be targeted at watershed planners and land managers to help them effectively prioritize land use change incentives and to improve the probability that land management practices will achieve desired outcomes

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?

By quantifying the potential to change water storage capacity in agricultural lands, planners will be able to evaluate the impact on watershed goals of in-field practices in combination with structural storage practices. They will be able to effectively prioritize specific soil health practices and programs to achieve their water storage and water quality goals. Soil health approaches enhance agricultural production, so they keep land in production while protecting water.

Project Location

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

Region(s): Central, SE, SW,

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: On-farm measurements of soil hydrology

Activity Budget: \$128,000

Activity Description:

Selecting fields that span a gradient of diversity, disturbance, and perennality on two landscape positions, we will characterize soil physical properties to understand how water is moving through and being retained in fields with different management. Specifically, we will compare 1) conventional annual crop fields with full-width tillage, low diversity; 2) soil health management systems (SHMS's) of annual cropping systems; and 3) perennial systems including pasture, hay, or undisturbed grassland. To understand how water is moving through and being retained in fields with different management, we will assess soil physical properties, soil pore architecture, and the quantity of water stored in the soil as impacted by preferential flow. Measures of soil structure will include the VESS (see Activity 3) and tracer dye to identify hydraulically active pores.

The first fall will be devoted to identifying cooperating landowners and doing field visits to confirm soil type matches. In the second year, we will take samples shortly after planting, and midsummer, to capture some seasonal variability in soil processes (avoiding spring and fall to accommodate field work in annual cropping systems).

Activity Milestones:

Description	Approximate Completion Date
Select research sites	December 31, 2025
Take soil cores and make in-field measurements including VESS and tracer dye evaluations	August 31, 2026
Analyze field data	May 31, 2027

Activity 2: Model watershed-scale hydrologic changes in response to soil health practices

Activity Budget: \$233,000

Activity Description:

We will examine several hydrologic models (e.g. SWAT, GSSHA, HSPF), and determine which best accounts for the impact of field-scale changes in soil health on watershed water balance. We will consider the model's theoretical framework and availability of already-calibrated projects for agricultural watersheds in the Minnesota River basin. Additional calibration will be conducted on the selected model to obtain accurate model predictions of watershed hydrology given current management and land-use. A sensitivity analysis may then be conducted to quantify how the model's predictions of soil-water storage and streamflow change consider changes in input parameters related to soil health. A review of literature will be used to help identify input parameters to include in the sensitivity analysis. Once the appropriate model is selected and calibrated for baseline conditions, we will calibrate the model's soil parameters to account for changes in the effective water holding capacity of the soil based on data from Activity 1. Then, we will apply a "soil health management practice" scenario to the model, running the model at its full watershed scale, and investigate impacts of SHMS on watershed hydrology.

Activity Milestones:

Description	Approximate Completion Date
Select a model that will best represent impacts of soil management changes	October 31, 2025
Complete sensitivity analysis to identify key soil parameters	December 31, 2025
Re-run model and simulations using field-validated parameters	October 31, 2027

Activity 3: Evaluate the "Visual Evaluation of Soil Structure"

Activity Budget: \$70,000

Activity Description:

The Visual Evaluation of Soil Structure (VESS) is a rigorous, qualitative soil assessment. While it requires training to use, it can be implemented by local agronomists and conservationists. The VESS will be conducted at the same field sites as in Activity 1, but at more positions across each field. We will analyze whether the VESS results adequately reflect results from the other soil physical metrics. If successful, it will be promoted as a practical tool for tracking whether changes to soil management systems are having the desired impact on soil hydrology. Currently, the soil physical metrics available for local advisors include ring infiltrometers, aggregate stability, or rainfall simulators. These are useful demonstrations, but inadequate for field assessments.

Activity Milestones:

Description	Approximate Completion Date
Conduct in-field VESS assessments	August 31, 2026
Analyze results	May 31, 2027
Write guidance for non-researchers to use VESS	September 30, 2027

Activity 4: Write guidance for enhancing soil water storage.

Activity Budget: \$23,000

Activity Description:

Analyze and integrate results from the modeling and the VESS assessment to write guidance for conservationists aiming to use SHMSs to meet watershed flow goals. The guidance will include results from the scenarios above, plus a comparison of the impacts of various soil health management practices (or combination of practices). Begin outreach activities to share the guidance with users.

Activity Milestones:

Description	Approximate Completion Date
Complete a plan for outreach and dissemination of results	September 30, 2027
Write guidance on using soil health management to meet streamflow goals	February 28, 2028
Begin dissemination of guidance	June 30, 2028

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Grace Wilson	U of M Dept of Bioproducts and Biosystems Engineering	Design and implement Activities 1&4	Yes
Dr. Anna Cates	U of M Dept of Soil Water and Climate	Design and implement Activity 2	Yes
Dr. Joe Magner	U of M Dept of Bioproducts and Biosystems Engineering	Design and implement Activities 3	Yes

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.

The mission of MN Office for Soil Health (MOSH) is to expand understanding and implementation of soil health management systems. The MOSH audience is local government conservation professionals, private sector agronomists, other ag advisors, and conservation and watershed planners in state agencies. Dissemination of lessons from this project will fit well into MOSH activities. We will also work with soil health and watershed specialists at the Board of Water and Soil Resources and Pollution Control Agency to ensure lessons are reflected in their programs and guidance, especially soil health incentive programs, Comprehensive Watershed Management Plan development and implementation, and the state Nutrient Reduction Strategy.

Through its research connections, MOSH will also ensure the information is updated and linked to future studies. Field data will be added to the G.E.M.S Soil Health Database – a privacy-protected system maintained by MOSH for sharing soil health measurements with other researchers for future analyses.

For all products resulting from this project, the Environment and Natural Resources Trust Fund will be acknowledged through the use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENRTF Acknowledgment Guidelines.

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 MN Office for Soil Health (MOSH) is equipped to share results from this project through its outreach activities and its network of local conservation and agricultural professionals. MOSH will also ensure the information is updated and linked to future research projects. Field data will be added to the G.E.M.S Soil Health Database – a privacy-protected system maintained by MOSH for sharing soil health measurements with other researchers for future analyses.

The soil health guidance will be shared with BWSR and PCA managers who support Comprehensive Watershed Management Plan development and implementation.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Quantifying New Urban Precipitation and Water Reality	M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 04e	\$500,000

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Principle investigator		Project coordination and reporting. Lead writing of final guidance document.			27%	0.15		\$21,285
Co-PI		supervise modeling work (Activity 2), contribute to sensitivity analysis, writing of reports			27%	0.42		\$56,360
Co-PI		Design and implement Activity 1			27%	0.09		\$14,938
Co-PI		Design and implement Activity 3			27%	0.42		\$56,360
Post-doctoral researcher		Conduct modeling, analyze field data, write grant report and papers			21%	2		\$157,372
Field and lab manager		Assist post doc and faculty with Activities 1 & 3 data collection and analysis			25%	0.54		\$40,088
field staff (multiple undergraduates)		Assist post doc and faculty with field data collection and data management.			0%	1.35		\$48,760
Extension support		Assist in field work, data analysis, and outreach for Activities 1 & 3			25%	0.36		\$29,957
							Sub Total	\$425,120
Contracts and Services								
Farmer cooperators	Service Contract	Access to farmland for soil sampling, and management data.				0		\$9,000
							Sub Total	\$9,000
Equipment, Tools, and Supplies								
	Tools and Supplies	Field supplies including water containers, water sample containers, soil bags	Field data collection for Activity 1 & 3					\$3,105
							Sub Total	\$3,105
Capital Expenditures								
							Sub Total	-

Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	3 destinations (with 3 sites each) X 335 miles/trip X 6 trips/yr, including 10 hotel rooms/yr for 3 years	Site visits for Activity 1 & 3 field data collection					\$15,975
	Miles/ Meals/ Lodging	Travel for PIs and advisors to visit field sites and evaluate results (4 trips X 300 mi X \$0.67/mi)	Planning and interpretation of field data (Activities 1 & 3)					\$800
							Sub Total	\$16,775
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
							Sub Total	-
							Grand Total	\$454,000

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: \$454,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [f1d2100d-491.pdf](#)

Alternate Text for Visual Component

The graphic illustrates the causal link from land management, to changes in soil properties, to changes in the amount and quality of water reaching the field edge, to changes in streamflow and water quality....

Supplemental Attachments

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

Title	File
UofM SPA Letter of Support-Lewandowski	3811bacd-c19.pdf
2025-107 Research Addendum revised_final	710eb9dd-5e2.docx

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

REVISIONS TO WORKPLAN - MAY 2025

Added milestones to Activities 3 and 4

Added language to dissemination plan about acknowledging ENRTF in project products

CHANGES AFTER RESEARCH ADDENDUM WAS REVISED

Combined Activities 1 and 4 to become Activity 2 (modeling).

Activity 2 (field work) became Activity 1.

Activity 3 was replaced with a new activity to develop VESS.

CHANGES FROM PROPOSAL TO WORKPLAN

Activity 2 has been reduced from three on-farm sites down to two sites, reducing personnel and travel costs. This change will reduce our confidence in the modeling, but should still be informative. This is the most significant change in deliverables. Other deliverables remain unchanged.

Personnel costs were reduced (a) by cutting salary allocated to PIs and (b) by replacing two-and-a-half years of funding for a graduate student with two years of funding for a post-doctoral research assistant.

Activity 3 sites will be close enough together to slightly reduce travel costs for data collection. Labor costs were increased because they were mis-calculated in the proposal. Costs were eliminated for some monitoring equipment, as it will be available from another source.

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 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 project:

Jodi Rahn, U of M Water Resources Center, Finance Professional

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

Yes, I understand