



Environment and Natural Resources Trust Fund

M.L. 2026 Final Work Plan

General Information

ID Number: 2026-124

Staff Lead: Lisa Bigaouette

Date this document submitted to LCCMR: May 18, 2026

Project Title: Protecting Minnesota's Waters from Plastic- and Rubber-Derived Chemicals

Project Budget: \$418,000

Project Manager Information

Name: William Arnold

Organization: U of MN - College of Science and Engineering

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Project Reporting

Reporting Schedule: April 1 / October 1 of each year.

Project Completion: June 30, 2029

Final Report Due Date: August 14, 2029

Legal Information

Legal Citation: M.L. 2026, Chp. 104, Sec. 2, Subd. 04f

Appropriation Language: \$418,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to develop stormwater treatment strategies and recommendations to protect surface water and groundwater from pollutants leached from polymers, coatings, plastics, and tire rubbers by assessing pollutant sources, presence, and reactivity.

Appropriation End Date: June 30, 2029

Narrative

Project Summary: Strategies to protect surface and groundwater from pollutants leached from polymers, coatings, plastics, and tire rubbers using stormwater treatment will be developed by assessing pollutant sources, presence, and reactivity.

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

Polymers, coatings, plastics, and tire rubbers are critical components of our infrastructure, yet as these materials age and wear, the chemical additives they contain are released. These toxic chemicals present a risk to Minnesota's surface and groundwater systems. The composition of these materials is complicated. They contain chemicals used in producing the materials to achieve desired performance and to protect them from wear or weathering by sunlight. Over time, these chemical additives are introduced into stormwater runoff as exterior building materials age, tires wear on our roads, and litter is left uncollected. These chemical additives include diphenylguanidines, benzotriazoles, benzothiazoles, melamines, and phenyl-p-phenylenediamine (PPDs). These pollutants are similar to pesticides with known toxicity. Thus, we need to know 1) the levels of these chemicals present in stormwater runoff and different stormwater collection ponds that drain into Minnesota's lakes, rivers, and groundwater; 2) whether natural processes can degrade these chemicals; 3) whether stormwater pond sediments can accumulate these chemicals; and 4) how to use this information to optimize removal in existing or new stormwater infrastructure so we can minimize negative impacts on surface and groundwater.

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.

Because chemical additives are continually released into Minnesota's water resources from polymers, coatings, plastics, and rubbers, information about their presence and persistence in the environment is critical. We propose the collection of field samples to determine the levels of selected chemicals leached from polymers/coatings/plastic/rubber in stormwater runoff and stormwater ponds, from which we will assess the scope of pollutant levels and distribution in Minnesota's stormwaters. Laboratory experiments will be used to quantify degradation rates by natural chemical and biological processes that occur in stormwater ponds. The collected information will be used to develop a model to estimate the inputs and degradation of these pollutants so that we can provide recommendations on how to minimize impacts of these chemicals on Minnesota's surface water systems that receive or are recharged via stormwater.

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?

Understanding the loadings, sources, and fate of polymer/coating/plastic/rubber-derived chemicals to Minnesota's surface water and groundwater systems will allow 1) assessment of risks to aquatic species and impacts on waters used as drinking water sources; 2) evaluation of stormwater treatment infrastructure to remove these chemicals and protect downstream lakes, rivers, and groundwater; 3) assessment of whether stormwater ponds (and their sediments) are a reservoir of these harmful chemicals or if they are a place where degradation occurs; and 4) recommendations on improvements to stormwater infrastructure and management to minimize impacts of these chemicals on surface water and groundwater.

Project Location

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

Region(s): Metro

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: Quantify polymer/coating/plastic/rubber-derived chemicals in stormwater, stormwater ponds, and identify potential sources of these pollutants into the environment.

Activity Budget: \$169,000

Activity Description:

Various toxic chemicals are used as crosslinking agents, vulcanization accelerators, and anticorrosion and UV-light stabilizers in the production of plastics, rubbers, and coatings used in cars, roads, and buildings. Stormwater runoff is the major carrier of the chemicals entering the environment as these materials wear and degrade. While the oxidation product of the tire chemical 6-PPD, known as 6-PPDQ, has received attention due to its potential toxicity to fish, our preliminary results indicate that other compounds, specifically 1,3-diphenylguanidine (used in rubber manufacture), hexamethoxymethylmelamine (a crosslinking agent), and 1H-benzotriazole (a corrosion inhibitor) are present at 50 to 500-fold greater concentrations in urban stormwater ponds than 6-PPDQ. We will measure the concentrations of the chemicals in four stormwater ponds, with one pond selected for more intense spatial and temporal sampling. Pond sediments will also be tested to evaluate their role in pollutant capture during storms or release during dry periods.

Activity Milestones:

Description	Approximate Completion Date
Update and finalize contaminant list and verify analytical methods	October 31, 2026
Measure chemicals in collected runoff and stormwater pond water samples	December 31, 2027
Evaluate pond sediments as sources of chemicals via leaching experiments	June 30, 2028
Manuscript publication	December 31, 2028

Activity 2: Evaluate degradation processes of rubber, coating, and plastic derived chemicals by chemical and biological processes in stormwater ponds

Activity Budget: \$189,000

Activity Description:

Stormwater ponds are the location where the rubber, coating, and plastic derived chemicals are most likely to end up via transport by runoff. Thus, it is important to understand if and how these chemicals are degraded in ponds. This will help determine if ponds are useful in protecting downstream surface water bodies and groundwater from these chemicals, or if they are merely serving as repositories that hold and then transfer the pollutants to water resources with economic and environmental value. Because the surfaces of ponds are exposed to sunlight, the process of photolysis (reaction driven by light) is one possible degradation process that will be explored. We will also test if highly reactive radicals produced when light shines on water degrade the chemicals. The bacteria naturally present in the pond waters may also have the capability to degrade some of the target chemicals.

Activity Milestones:

Description	Approximate Completion Date
Direct and indirect photolysis experiments	December 31, 2027
Aqueous biodegradation experiments	December 31, 2028
In situ field experiments	March 31, 2029
Manuscript publication	June 30, 2029

Activity 3: Develop models for inputs and fate of chemicals and recommendations to protect surface and groundwater

Activity Budget: \$60,000

Activity Description:

Using information on sources, loadings, and degradation rates of the target chemicals obtained from Activities 1 and 2, we will build a general mass balance model for stormwater ponds that accounts for pollutant transport and processing in dry versus wet periods. The model will allow assessment of potential capture, degradation, and accumulation of the target compounds in the stormwater pond system. Using this information, we will propose modifications that would lead to increased capture or removal of the pollutants. Input from stakeholders and watershed managers will be sought to maximize the potential impact of the recommendations and extent of water resource protection.

Activity Milestones:

Description	Approximate Completion Date
Model contaminant processing in dry periods	June 30, 2028
Dynamic model development for storm events	December 31, 2028
Recommendations and communication with stakeholders	March 31, 2029
Manuscript/report publication	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Boya Xiong	University of Minnesota, Civil, Environmental, and Geo-Engineering	Co-Investigator. Quantification of polymer/plastic/rubber particles present in stormwater, ponds, and sediment. Identification of particle sources. Experiments to determine materials that leach chemicals to stormwater. Graduate student supervision.	Yes
Poornima Natarajan	UMN Saint Anthony Falls Laboratory	Co-Investigator. Stormwater, stormwater pond water, and sediment collection. Development of models for inputs and fate of chemicals and recommendations to protect surface and groundwater. Supervision of undergraduate students/field crews.	Yes
Kristine Wammer	University of St. Thomas, Department of Chemistry	Co-Investigator. Chemical and biological degradation of stormwater chemicals in stormwater pond waters and sediments. Supervision of undergraduate students.	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 findings of this effort will be published in the peer reviewed literature. Additionally, results will be disseminated via communication with watershed managers, MPCA scientists, and other stakeholders. We will connect with the stakeholders through the Minnesota Stormwater Seminar Series, the Minnesota Water Conference, and the Minnesota Conference on the Environment. The collected data and model will be made available in the Data Repository of the University of Minnesota to maximize availability. The Environment and Natural Resources Trust Fund will be acknowledged through 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?

Results will be implemented via communication with watershed managers, MPCA scientists, polymer manufacturing industry contacts, and other stakeholders. We will connect with the stakeholders through the Minnesota Stormwater Seminar Series and other avenues. The collected data and model will be made available in the Data Repository of the University of Minnesota to maximize availability. If additional work is needed, other federal, state, and local funding will be pursued.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Removing CECs from Stormwater with Biofiltration	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 04j	\$641,000

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
William Arnold, Senior Investigator		Project Manager			27%	0.15		\$50,843
Boya Xiong		co-Investigator			27%	0.06		\$11,685
Poornima Natarajan, Research Associate		co-Investigaor			27%	0.12		\$13,484
Graduate student 1		Field studies, degradation experiments, and modeling			44%	1.5		\$176,054
Undergraduate 1		Assist with field sampling and sample processing			0%	0.6		\$13,382
Undergraduate 2		Assist with field sampling and sample processing			0%	0.6		\$13,382
							Sub Total	\$278,830
Contracts and Services								
University of St Thomas	Subaward	co-investigator Kristine Wammer will supervise 1.5 undergraduates who will work on the degradation experiments (personnel \$58,625, fringe 6%, laboratory supplies \$11,000)				1.2		\$69,625
Agilent	Service Contract	service and maintain the mass spectrometry system required for analysis of the targeted chemical pollutants				0.3		\$30,000
							Sub Total	\$99,625
Equipment, Tools, and Supplies								
	Tools and Supplies	Chemicals, glassware, solvents, extraction materials, safety equipment, isotopically labelled standards, and general laboratory supplies.	The supplies are needed to process field samples, quantify chemicals and particles, conduct laboratory experiments, and laboratory analyses.					\$27,551
							Sub Total	\$27,551

Capital Equipment								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Conference Registration	registration fees, mileage, and parking. One trip, 3 people. Registration (two students \$150 each, \$500 faculty), Parking \$60 total, mileage \$63 total, meals \$75 total.	present at MN based water conferences					\$2,994
	Miles/ Meals/ Lodging	vehicle rental and/or mileage. Estimate 15 day-long sampling trips per year. UMN vehicle rental is \$67 per day.	travel to stormwater ponds for sample collection.					\$3,000
							Sub Total	\$5,994
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Publication	publication fees	open access for journal publications					\$6,000
							Sub Total	\$6,000
Other Expenses								
							Sub Total	-
							Grand Total	\$418,000

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				
In-Kind	Indirect costs associated with University of Minnesota projects	facilities and administrative support	Secured	\$184,145
			Non State Sub Total	\$184,145
			Funds Total	\$184,145

Total Project Cost: \$602,145

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [f16eedf9-16e.pdf](#)

Alternate Text for Visual Component

Rainwater falls on buildings, roads, and tires leaching pollutants from the plastics, coatings, and rubbers. The water drains into a stormwater pond. In the pond, the pollutants are stored in the sediment and may be partially removed by sunlight and bacteria. Remaining pollutants are released to a river and groundwater....

Supplemental Attachments

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

Title	File
UMN Submission Approval	206a5307-bf4.pdf
2026 LCCMR Peer Review research addendum Arnold 2026-124	e51ef1b3-ff0.docx

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

Due to the lower recommended budget than requested, the plan was altered to focus on measuring environmental levels of the contaminants in water and sediment, assessing degradation processes, and optimization of infrastructure to maximize degradation/removal in ponds to prevent release to downstream waters. The means that testing the leaching of chemicals from various materials and identifying polymer debris sources in stormwater ponds that were part of Activity 1 will not be part of the project. Additionally, Activity 2 will focus on degradation in the water column, rather than in the sediment. The text was altered and these milestones were deleted.

Even with these changes, we believe the project is robust and will provide valuable information about plastic and rubber-derived chemical presence, transformation, and management in stormwater.

12-16-2025. We have updated the work plan to reflect changes in the peer review addendum. In Activity 1, the description was updated to reflect the number of ponds samples. Activity 2 has an added milestone for the in situ field experiments. The description for Activity 3 was modified to reflect the plan for two models, one for dry periods that includes degradation and/or leaching from the sediment and one for storms where transport dominates, and the milestones will updated accordingly.

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?

No

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:

Enoch Pan, Finance Professional, University of Minnesota

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