Environment and Natural Resources Trust Fund

2025 Request for Proposal

General Information

Proposal ID: 2025-112

Proposal Title: Transfer and Toxicity of Microplastics in Urban Ecosystems

Project Manager Information

Name: Lea Pollack

Organization: U of MN - College of Biological Sciences

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Project Basic Information

Project Summary: Researching how land use drives differences in the suites of microplastics and associated contaminants of concern found in ponds and the subsequent transfer of those pollutants into wildlife.

ENRTF Funds Requested: $300,000

Proposed Project Completion: June 30, 2027

LCCMR Funding Category: Water Resources (B)

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

Narrative

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

Millions of tons of plastic accumulate in the environment every year. Extensive research has documented the ingestion of plastic by hundreds of species and its associated negative health impacts. This is an especially important issue because plastics adsorb other toxicants (e.g., heavy metals, organic contaminants), making them up to six times more contaminated than the surrounding environment. Contaminants adsorbed to plastics are then consumed by wildlife, where they can bioaccumulate within food webs and create health risks for local ecosystems.

Stormwater systems are a key part of the freshwater ecosystems across Minnesota. Stormwater ponds retain storm runoff and ease downstream flooding during storm events. Importantly, these ponds reduce the negative impacts of runoff by allowing polluted sediment to settle to the bottom, where it can later be collected and properly disposed. This makes stormwater ponds a hotspot for plastic accumulation and potential wildlife transfer. However, how local land use impacts plastic accumulation and how this varies with contaminants of concern is wholly unknown. Moreover, how these factors affect consumption by local wildlife is poorly understood. Understanding of these key questions would guide efforts to reduce plastic mediated transfer of pollutants toward identification of effective control.

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.

In collaboration with established monitoring programs, we propose to survey stormwater ponds to measure microplastic concentrations and associated contaminants of concern. Stormwater ponds allow us to measure the impact of landscape features on a detailed scale, making it possible to pinpoint sources of plastic pollution and where plastics serve as vectors for other contaminants.

To identify avenues by which plastics move within food webs, we will also survey local snail populations for microplastic accumulation. We will pair field-based surveys with lab experiments that directly test how variation in the levels of contaminants associated with microplastics alters consumption rates. Freshwater snails are an ideal model for this study because they are ecologically important (i.e., in the diet of many species critical to Minnesota, including many ducks) and can bioaccumulate many types of microplastics. These snails are found across a broad range of stormwater ponds and, given their limited ability to move between ponds, provide a snapshot of a single pond's water quality.

We will share our data directly with stormwater managers (e.g., cities of Bloomington and Roseville) and the Minnesota Pollution Control Agency, with whom we have ongoing collaborations (via Co-PI Finlay). We will also publish two scientific papers.

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?

Identifying habitats where plastics are accumulating is important for targeted remediation efforts throughout the state (e.g., by updating source control and pond management practices). Moreover, this study will help fill the large gap in freshwater ecotoxicology research, since so little is currently known about how terrestrial and aquatic plastic cycles are connected. Therefore, the proposed study has the chance to impact both stormwater management practices and basic knowledge of the movements of plastic pollution within local freshwater ecosystems.

Activities and Milestones

Activity 1: Determine the accumulation of plastics and associated contaminants of concern in stormwater ponds

Activity Budget: $120,000

Activity Description:
The goals of activity 1 is to document how urban landscape features drives differences in plastic accumulation within stormwater ponds and the associated chemicals of concern. Forty stormwater ponds across the greater Metro Area with known differences in landscape features (i.e., traffic volume, green space, population density, commercial area use) will be surveyed for microplastics and contaminants of concern. Microplastic levels in the water column and pond sediment will be measured using previously established methods. After filtering and processing, microplastic particles will be identified and quantified using FTIR imaging (Fourier-transform infrared spectroscopy). Geographic Information Systems (GIS) will be used to derive land use cover and traffic volume surrounding ponds.

First, this activity will allow us to identify how landscape features can drive differences in the amount of microplastics within a pond and the chemicals that come together in association with these microplastic particles. Second, this will allow us to identify how pond features (i.e., size, oxygen availability, salt levels) drive differences in plastic particles in the water column compared to particles collected within the sediment.

Activity Milestones:

Description	Approximate Completion Date
Identify 40 MN ponds with variation in important landscape features using GIS	August 31, 2025
Conduct field collections of water and sediment from 40 ponds	November 30, 2025
Identify and quantify microplastic particles within water and sediment using FTIR	May 31, 2026
Measure associated contaminants of concern with water and sediment	July 31, 2026
Share data with city partners and MPCA via first Whitepaper	December 31, 2026

Activity 2: Document how plastic moves into local food webs

Activity Budget: $100,000

Activity Description:
The goal of activity 2 is to document how variation in landscape features drives the movement of microplastics into food webs using aquatic snails as a model system. Fifteen snails per pond will be collected from the same forty ponds as activity 1 (n = 600). Using previously established methods, snail bodies will be analyzed for accumulated plastics and contaminants of concern. To quantify plastic load, snails will be digested in a strong acid, which dissolves organic material but leaves plastic remaining for identification and quantification using FTIR imaging. By comparing rinsed and unrinsed snails, we will be able to estimate both adhered plastic (i.e., that which clings to the sticky mucus on the outside of the snail) as well as ingested plastic. Both are important avenues for plastic uptake into local food webs.

This activity will allow us to compare how concentrations of plastics and associated contaminants in the sediment and water column correlate with snail uptake. In particular, we will be able to examine at what levels of background concentration snail accumulation of microplastics might increase or plateau.

Activity Milestones:

Description	Approximate Completion Date

Conduct field collections of snails from 40 MN ponds with variation in important landscape features	November 30, 2026
Process snails for chemical analysis using strong acid digestion	December 31, 2026
Identify and quantify microplastic particles within snail bodies using FTIR	March 31, 2027
Measure associated contaminants of concern within snail bodies	May 31, 2027
Share data with city partners and MPCA via second Whitepaper	June 30, 2027

Activity 3: Lab-based experiments to test animal consumption and toxicity of plastics and associated contaminants of concern

Activity Budget: $80,000

Activity Description:
The goal of activity 3 is to test how differences in the level of associated contaminants of concern with microplastics influences animal consumption and toxicity. Snails will be fed diets with 15% polystyrene particles (i.e., a common microplastic that sinks in water) with increasing ecologically relevant concentrations of PFAS (i.e., a common and contaminant of concern that sorbs to plastic). Using previously established UV light methods, levels of microplastics and PFAS bioaccumulation will be quantified across different ecologically relevant treatments. Fluorescent polystyrene fragments <200 um will be treated with varying amounts of PFAS within an aqueous solution and then mixed with food substrate. First, we will determine how variation in PFAS within solution translates to its sorption on plastic particles. Second, we will assess the relationship between plastic consumption and snail health (i.e., body condition and stress).

This activity will allow us to determine how variation in the suite of associated contaminants of concern influences animal consumption of microplastics. In particular, we will be able to examine whether snails modulate their intake of potentially harmful particles based on the level of toxicity and whether that translates into direct physical effects.

Activity Milestones:

Description	Approximate Completion Date
Experiments that test how much plastics sorb PFAS within an aqueous solution with different concentrations	September 30, 2026
Experiments that test how variation in PFAS associated with microplastics influence snail consumption and health	December 31, 2026
Experiments that test how variation in prior experience with pollution influences snail consumption and tolerance	March 31, 2027
For both experiments above, assess snail body condition and oxidative stress markers	May 31, 2027

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Emilie Snell-Rood	University of Minnesota (Ecology, Evolution & Behavior)	Professor collaborating on project with strong expertise on ecotoxicology, microplastic pollution, and animal behavior. Will provide guidance on experimental design, field protocols, and snail behavior experiments.	No
Jacques Finlay	University of Minnesota (Ecology, Evolution & Behavior)	Professor collaborating on project with strong expertise on stormwater pond pollution and ecology. Will provide guidance on experimental design, field protocols, and chemical analysis.	Yes
Cara Santelli	University of Minnesota (Earth and Environmental Sciences)	Professor collaborating on project with strong expertise on water and sediment chemistry. Will provide guidance on experimental design and chemical analysis.	Yes
Matt Simcik	University of Minnesota (Public Health)	Professor collaborating on project with strong expertise on PFAS pollution and microplastic chemistry. Will provide guidance on experimental design and chemical analysis.	Yes
Ben Janke	University of Minnesota (St. Anthony Falls Laboratory)	Researcher collaborating on project with strong expertise on stormwater hydrology, stormwater pond structural components, and ecology. Will provide guidance on experimental design, field work protocols, and statistical analysis.	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?

This data has the potential to update stormwater management practices, which is disseminated by the MPCA via the Minnesota Stormwater Manual. Co-PI Finlay currently collaborates with the MPCA on updating the manual. Moreover, the PIs on this project are part of a broader collaboration across universities, state and federal agencies, and non-profits within Minnesota through the NSF Long Term Ecological Research Program. This work will add to the larger data collection efforts to document pollution across the urban metro region, where researchers can continue to access this information for future work, including via two white papers and two scientific publications.

Project Manager and Organization Qualifications

Project Manager Name: Lea Pollack

Job Title: Postdoctoral Researcher

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

Dr. Lea Pollack is a Postdoctoral Researcher in the Ecology, Evolution, and Behavior Department at the University of Minnesota. Dr. Pollack is an expert on the ingestion of plastics by wildlife. She received her PhD in 2021, where her dissertation research focused on fish consumption of microplastics. She then completed a National Science Foundation Postdoctoral Fellowship in Biology at Rice University. Currently, she is leading a research program studying heavy metal pollution across the stormwater network of the Twin Cities Metro. This makes her uniquely familiar with the potential challenges of stormwater fieldwork that could arise while managing the proposed project. Furthermore, she has already established relationships with various stormwater management agencies and local governments across the Metro area because of this research program.

Organization: U of MN - College of Biological Sciences

Organization Description:
Within the University of Minnesota College of Biological Sciences, this research will be part of the Minneapolis-St. Paul Metropolitan Area (MSP) Long-Term Ecological Research Program (mspurbanlter.umn.edu). Funded by a National Science Foundation program to support research infrastructure for decades, the MSP program focuses on the impacts of urban stressors on wildlife, freshwater, forests, and people. Through this program, all senior personnel involved in the proposal are part of a larger collaborative effort between the University of Minnesota, University of Saint Thomas, USDA Forest Service, The Nature Conservancy, and The Water Bar. ENRTF funding would support new research within this long-term research program. This structure and organization, along with regular communication with relevant agencies, ensures the implementation and sustainability of this work.

Beyond access to research organization, cutting-edge tools, and scientific expertise, the MSP Long-Term Ecological Research Program has infrastructure for education and outreach. This includes middle school and high school education events through the Bell Museum. This project will use this structure to offer teaching demonstrations with snails at the Bell Museum stormwater pond.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Academic Research Associate - Lea Pollack		Project manager responsible for leading the project full time for the 2 years proposed.			37.1%	2		$182,000
Academic Faculty - Matt Simcik		Collaborate on on microplastics and PFAS sampling, analysis, and interpretation (Activities 1-3). Dr. Simcik is an expert on microplastics and PFAS pollution.			37.1%	0.04		$10,000
Academic Faculty - Cara Santelli		Collaborate on field sampling and processing of water and sediment (Activity 1). Dr. Santelli is an expert on inorganic pollutants in water and sediment.			37.1%	0.04		$10,000
Academic Faculty - Jacques Finlay		Collaborate on field sampling and processing of water (Activities 1 & 2). Dr. Finlay is an expert on stormwater, freshwater ecology, and urban watershed pollution.			37.1%	0.04		$10,000
Academic Research Associate - Ben Janke		Collaborate on field sampling and analysis of water and sediment (Activity 1 & 2). Dr. Janke is an expert on stormwater ecology and hydrology.			37.1%	0.2		$11,000
Undergraduate Research Assistant - Academic Year		Student will assist in field work and lab processing of samples collected. Student will work 5 hours per week during the academic school year.			0%	0.38		$6,000
Undergraduate Research Assistant - 2 Students for Summer		Students will assist in field work and behavioral studies with snails. One student will work full time and one student will work part time.			0%	1.5		$24,000
							Sub Total	**$253,000**
Contracts and Services								
Simcik Laboratory	Internal services or	The Simcik Laboratory will measure PFAS pollution levels in water, sediment, and snail samples.				0.02		$15,000

	fees (uncommon)							
University of Minnesota Characterization Facility	Internal services or fees (uncommon)	Fourier-Transform Infrared Spectrometer (FTIR) analysis to analyze plastic particles from samples will be performed at the College of Science and Engineering Characterization Facility.				0.02		$13,000
							Sub Total	**$28,000**
Equipment, Tools, and Supplies								
	Tools and Supplies	Field Supplies - Inflatable Kayak	An inflatable kayak is needed to float on top of pond surfaces so that the bottom water and sediment are not disturbed before collection. An inflatable kayak allows the researchers to easily move between multiple ponds in a day.					$1,500
	Tools and Supplies	Laboratory Supplies - Chemical Reagents	Chemical reagents are needed to store and process samples appropriately.					$3,000
	Tools and Supplies	Field Supplies - Gravity Corers	Gravity corers for both sediment and water allow us to collect water and sediment from the bottom of the ponds from the floating kayak without mixing.					$3,500
	Tools and Supplies	Plasticware (1000 vials and 500 bottles)	Plastic vials and bottles will be used to collect samples in the field and transport them into the lab. Once in the lab, plastic vials will be used to process and store samples.					$1,000
	Tools and Supplies	Laboratory Supplies - Tanks (40)	Tanks, tubing, and bubblers to house snails collected for behavioral experiments					$1,000
							Sub Total	**$10,000**
Capital Expenditures								
							Sub Total	**-**

Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel between approximately 40 different ponds and laboratory. Approximately 3000 miles over the course of the 2 year project at a rate of $0.67/mile.	Driving is needed to collect and transport samples between stormwater ponds across the Metro Area and the University of Minnesota.					$2,000
							Sub Total	**$2,000**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	Open Access Fees	Fees paid to academic journals to make sure publications are available to the public free of charge.					$6,900
	Printing	Protocols, data sheets, reports (1000 pages).	Printing to share information between researchers and between researchers and community partners					$100
							Sub Total	**$7,000**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$300,000**

Classified Staff or Generally Ineligible Expenses

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

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	**-**
Non-State				
In-Kind	University of Minnesota	In-kind overhead for administrative and operational expenses that will support the proposed research	Potential	$164,000
			Non State Sub Total	**$164,000**
			Funds Total	**$164,000**

Total Project Cost: $464,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 703e18a5-9c6.pdf

Alternate Text for Visual Component

Microplastics can transport contaminants of concern in local freshwater food webs. Pollution into stormwater ponds includes microplastics and PFAS, which can attach to each other chemically. When local wildlife consumes plastic, they might also be ingesting high concentrations of PFAS, which then can bioaccumulate up the food chain....

Supplemental Attachments

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

Title	File
SPA Letter of Approval	effcd25a-090.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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:

Emilie Snell-Rood, Jacques Finlay, Cara Santelli, Matt Simcik, Ben Janke (University of Minnesota)