



# Environment and Natural Resources Trust Fund

M.L. 2024 Approved Work Plan

## General Information

**ID Number:** 2024-057

**Staff Lead:** Lisa Bigaouette

**Date this document submitted to LCCMR:** June 6, 2024

**Project Title:** Characterization of Chemicals in Structural Fire Wastewater

**Project Budget:** \$369,000

## Project Manager Information

**Name:** Grace Wilson

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

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## Project Reporting

**Date Work Plan Approved by LCCMR:** June 20, 2024

**Reporting Schedule:** June 1 / December 1 of each year.

**Project Completion:** July 31, 2026

**Final Report Due Date:** September 14, 2026

## Legal Information

**Legal Citation:** M.L. 2024, Chp. 83, Sec. 2, Subd. 04b

**Appropriation Language:** \$369,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to identify, analyze, and model the fate of chemicals present in wastewater from extinguished structural fires to better understand potential toxicity to humans and aquatic life.

**Appropriation End Date:** June 30, 2027

## Narrative

**Project Summary:** The wastewater from extinguishing structural fires will be analyzed to identify and characterize chemicals present and better understand potential toxicity to humans and water systems.

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

Water used to extinguish structural fires may be a significant source of toxic chemicals into Minnesota's waters. During a structural fire, building and household materials (especially vinyl materials) undergo chemical transformations under the extreme fire temperatures. Some of these chemicals can become mobile in the water used to extinguish the fire, and are then transported into storm drains and water systems. In addition to contaminant sources from the fire itself, the effluent (described by first responders as resembling "black sludge"), may also transport toxic PFAS chemicals found in fire-fighting foams. First-responders are also exposed to these chemicals while on the scene, and may transport them on their clothing, gear, personal protective equipment. Chemicals generated during burning and those used in fire-fighting foams are categorized as persistent organic pollutants (or POPs), and are known to be very slow to breakdown in the environment while also being extremely toxic to humans and aquatic ecosystems. However, there has been little research into the specific types and the amounts of these chemicals in the water effluent following fires. A better characterization of the chemicals found in fire wastewater is needed in order to identify and address potential toxicity to humans and aquatic systems.

**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 propose to characterize the chemicals found in the wastewater resulting from extinguishing structural fires by:

1. Identifying the presence and amounts of toxic chemicals in fire wastewater
2. Analyzing the timing of chemical release into the water during a live fire event
3. Modelling the fate and transport of these chemicals in storm water systems

**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?**

This work will identify and characterize contaminants that are present in firefighting wastewater. This includes identifying the presence and amount of those that are known to be toxic to humans (carcinogens, endocrine disruptors, etc), as well as those that can also damage aquatic ecosystems. We will also make predictions on the amounts of these chemicals delivered to receiving waterbodies (including rivers, ponds, and other waters) after considering potential degradation or transformation. Initial identification and characterization of these chemicals is necessary in order to better understand their effect on human and aquatic ecosystem health.

## Project Location

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

County(s): Hennepin, Ramsey,

**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: Identify chemicals present in fire wastewater

**Activity Budget:** \$209,744

**Activity Description:**

The wastewater resulting from fighting structural fires will be analyzed to determine the concentrations of chemicals known to be toxic to humans and aquatic systems, including heavy metals and persistent organic pollutants. We will test for toxic chemicals likely to be found in the fire-water effluent, including: per- and poly-fluoroalkyl substances (PFAS) used in fire-fighting foams, polychlorinated dioxins and furans (by-products formed when PVC plastics burn), heavy metals (used in structural components of buildings), and polyaromatic hydrocarbons (formed during combustion of materials used in household items). Sample kits will be provided to partnering firefighting agencies (including the Minneapolis and St. Paul Fire Departments), and fire fighters on the scene will take grab samples of this water following structural fires. These samples will be delivered to a laboratory and analyzed to determine the concentrations of the chemicals identified above. The total amount of the chemical in the wastewater will be calculated based on measured concentrations and estimates of water volumes used at the fire. Additionally, 2-3 chemicals from the full list will undergo further analysis to characterize decomposition. For this, the water sample will be subdivided, and some of the samples will be sent in for analysis on a time-lagged basis.

**Activity Milestones:**

Description	Approximate Completion Date
Prepare sample collection kits, distribute to partnering fire agencies, and train fire personnel	October 31, 2024
Identify chemicals present and their concentrations from approximately 15 wastewater grab samples from fire scenes	December 31, 2025
Estimate total chemical load in this effluent	December 31, 2025
Determine decomposition and chemical transformation of select contaminants from effluent	December 31, 2025

### Activity 2: Analyze the chemicals present and timing of their release into stormwater systems during a live fire

**Activity Budget:** \$123,886

**Activity Description:**

Samples of wastewater from a structural fire will be collected at different times during a fire-fighting exercises. This data collection will occur during training exercises either at planned burns of houses (ideal), or the East Metro Public Safety Training Center (located in Maplewood, MN). In coordination with partnering fire-fighting agencies, researchers will set-up collection devices at the controlled burn, and take water samples and measurements of flow at set times during the fire scenario. These samples will be analyzed to determine chemical species present in the water and their concentrations (as in Activity 1). This data will provide a detailed picture of how concentrations of chemicals in the fire wastewater change over the course of fighting a fire. Estimates of the flow rate of the effluent will also be taken so that the total load of the chemicals can be calculated. These samples will be analyzed for the same constituents identified in Activity 1. Samples from at least 1 controlled burn will be taken; ideally we will be able to collect samples from 2-3 controlled burns.

**Activity Milestones:**

Description	Approximate Completion Date
Determine the time-response of chemical release into waters during fire-fighting efforts	May 31, 2026
Identify chemicals present and their concentrations in fire-water effluent from a controlled burn	May 31, 2026

Report distributed to Minnesota Department of Public Safety State Fire Marshal Division summarizing results	July 31, 2026
Presentations given and fact-sheets distributed to stormwater management agencies and fire departments	July 31, 2026

### Activity 3: Model the fate and transport of chemicals released into waters from structural fires

**Activity Budget:** \$35,370

**Activity Description:**

Data from activities 1 and 2 will be used to model the fate and transport of water-born chemicals resulting from firefighting activity. Modeling will be limited to those chemicals selected for determining the rates of decomposition in Activity 1. These rates will be modeled using a first-order process or other relatively simple relationships. The resulting equations will be used to develop a spreadsheet tool that estimates the chemical load to receiving surface water bodies. This spreadsheet tool will account for the initial mass of the chemical entering the stormwater system (including the water volume from fire-fighting and the initial concentration of the chemical expected in the effluent), as well as changes in its concentration due to decomposition or chemical transformation (including sorption and volatilization processes) and dilution in the storm drain from lateral flow or precipitation events. Given these variables, and an estimate of the length of the storm drain and travel time, we will be able to estimate the total discharge of the chemical into receiving surface water bodies.

**Activity Milestones:**

Description	Approximate Completion Date
Decomposition/transformation model for selected chemicals	July 31, 2026
Spreadsheet tool that calculates chemical delivered at downstream locations considering lateral flow and chemical transformations	July 31, 2026

## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Matt Simcik	University of Minnesota	Co-principal investigator for the proposed research; will work with sample collection design and analysis and general grant management	Yes
Barton Inks	St. Paul Fire Department	The St. Paul Fire Department is a partner organization which will collect water samples for the study. As fire chief, Barton Inks will work with the researchers to facilitate sample collection by staff at the St. Paul Fire Department.	No
Bryan Tyner	Minneapolis Fire Department	The Minneapolis Fire Department is a partner organization which will collect samples for the study. As fire chief, Bryan Tyner will work with the researchers to facilitate sample collection by staff at the Minneapolis Fire Department.	No

## 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 team will give open scientific presentations and publish scientific papers addressing the project objectives.

Additionally, the team will provide a summary of the key results in the form of fact-sheets and presentations to the partnering fire-fighting agencies as well as other interested government units (such as Minnesota Department of Public Safety State Fire Marshal Division)

## 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 team will give open scientific presentations and publish scientific papers addressing the project objectives. We expect to achieve the stated objectives of this project within the bounds of this grant timeline. However, there has been little previous research in this area, and results of this work may indicate additional research is necessary to fully characterize the chemicals, their transport, and to consider mitigation strategies. Any additional work will be funded by separate grants after completion of the deliverables from this project.

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
Faculty		Manage project and consult on analysis of results; general grant management			36.8%	0.2		\$38,879
Researcher		Conduct analysis of results; manage sample collection; general grant management			36.8%	1		\$102,600
Graduate Student		Provide research support and data analysis support			24.1%	0.15		\$22,115
Undergraduate Researcher		research support; position would pay 1 undergraduate 25% time during academic year; 2 students 75% over the summer			0%	0.75		\$21,600
							<b>Sub Total</b>	<b>\$185,194</b>
<b>Contracts and Services</b>								
TBD, likely SGS AXYS Analytical Services	Professional or Technical Service Contract	Analyzing water samples for specified chemicals and reporting results to researchers. Includes persistent organic pollutants (PAHs, PBDEs, PCBs, PCDD/F, PFAS), and heavy metals. Contract will be awarded to lab facility used by US Dept of Defense which use EPA certified methods to test for the list of analytes.				2		\$177,908
							<b>Sub Total</b>	<b>\$177,908</b>
<b>Equipment, Tools, and Supplies</b>								
	Tools and Supplies	Sample Collection kits (coolers, water collection bottles, ice packs)	Collect water samples. Each kit costs \$100 x 40					\$4,000
	Tools and Supplies	Materials to sample water from controlled burn (sampling bottles, equipment to funnel water to sampling location)	Items will be used to collect water samples from a controlled burn					\$1,000
	Tools and Supplies	Extra sampling bottles and sampling supplies (quantity 20-40)	Additional sampling bottles to use in chemical degradation analysis					\$500
							<b>Sub Total</b>	<b>\$5,500</b>
<b>Capital Expenditures</b>								

							<b>Sub Total</b>	-
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	-
<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	4 trips with a rented University fleet truck or large van @ \$70/day	Carry supplies to controlled burns					\$398
							<b>Sub Total</b>	<b>\$398</b>
<b>Travel Outside Minnesota</b>								
							<b>Sub Total</b>	-
<b>Printing and Publication</b>								
							<b>Sub Total</b>	-
<b>Other Expenses</b>								
							<b>Sub Total</b>	-
							<b>Grand Total</b>	<b>\$369,000</b>

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	-

## Attachments

### Required Attachments

#### *Visual Component*

File: [12813f19-ee0.pdf](#)

#### *Alternate Text for Visual Component*

The graphic shows a structural fire with a firefighter putting out the blaze. Water is shown leaving the fire and entering a wetland. A magnifying glass is shown zooming in on the water from the fire, and showing toxins leaving the fire in that water entering the wetland....

### Supplemental Attachments

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

Title	File
Support Letter-Minneapolis Fire	<a href="#">7523fd31-289.pdf</a>
Support Letter-St Paul Fire	<a href="#">8114407f-b70.pdf</a>
UMN PRF	<a href="#">1f5ce179-b3d.doc</a>
Research Addendum revised 2024-057_final	<a href="#">d59c2edc-b28.pdf</a>

## Difference between Proposal and Work Plan

### *Describe changes from Proposal to Work Plan Stage*

Updated May 2024: Added information to milestone in Activity 1 specifying that approximately 15 samples will be analyzed; additional information also added to Activity 2 to specify that we will collect samples from at least 1 controlled burn, ideally 2-3 controlled burns. Added information to Activity 3 specifying that the project will examine the effects of volatilization/sorption processes on chemical concentrations in storm drains, as well as the impact of lateral flow and precipitation. Modified Milestone in Activity 3 to specify this information as well. Added a milestone to Activity 2 specifying that presentations and factsheets of study findings will also be given to stormwater management agencies

Updated October 2023: Added new information to budget and milestones to address comments. Added Milestone to Activity 2 to indicate a report summarizing the results will be distributed to State Fire Marshall and other local departments. Added Milestone to Activity 1 to indicate timing of preparation of sample kits and training of fire personnel. Included in the budget (professional/technical contracts) how contracts will be awarded and what chemicals will be tested

Updated August 2023: A key difference between the submitted and original workplan is that the deadline for Milestones in Activity 1 was changed from October 2025 to December 2025 to allow for more time for sample collection from structural fires (and ideally ensure that the we are able to collect the number of desired samples). Additional information was added to the Dissemination plan as well.

## 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 agree travel expenses must 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 agree to the UMN Policy.

**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