



Environment and Natural Resources Trust Fund

2023 Request for Proposal

General Information

Proposal ID: 2023-030

Proposal Title: Identification and Analysis of Contaminants in Fire Wastewater

Project Manager Information

Name: Grace Wilson

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

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Project Basic Information

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

Funds Requested: \$345,000

Proposed Project Completion: July 31, 2025

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?

In the Future

Narrative

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

Water used to extinguish structural fires may transport chemicals into Minnesota's waters. These chemicals are potentially toxic to humans and aquatic life. During a structural fire, building and household materials undergo chemical transformations under the extreme fire temperatures. Some of these chemicals can become mobile in the water used in extinguishing the fire and are 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 chemicals found in some 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. Little is known about the chemical makeup of this "black sludge." A better understanding of this is needed in order to identify and address potential toxicity to first responders and effects on water 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 chemical makeup of the waste-water resulting from extinguishing structural fires by:

1. Identifying contaminants present in fire waste-water
2. Analyzing the timing of contaminant release into the water during a live fire
3. Modelling the fate and transport of these contaminants 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 chemicals in the wastewater that are known toxins to humans (carcinogens, endocrine disrupters, etc), as well as those that can also damage aquatic ecosystems (such as heavy metals). We will also make prediction on the amounts of these chemicals delivered to receiving waterbodies (including rivers, ponds, and other waters). Information from this project will enable the State of Minnesota to better address environmental contamination from, and first-responder exposure to, chemicals generated during structural fires.

Activities and Milestones

Activity 1: Identify contaminants present in fire waste-water

Activity Budget: \$198,153

Activity Description:

The waste-water resulting from fighting structural fires will be analyzed to determine the presence and concentrations of contaminants known to be toxic to humans and aquatic systems. We will specifically 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, and fire fighters on the scene will take grab samples of this water following actual structural fires. These samples will be delivered to a laboratory and analyzed to determine the presence and concentrations of those contaminants listed above. The total amount of the contaminant in the effluent will be calculated based on these concentrations and estimates of water used to extinguish the fire. Additionally, 1 to 2 contaminants from that full list will be selected to undergo further analysis to determine decomposition rates.

Activity Milestones:

Description	Completion Date
Identify contaminants present and their concentrations in fire-water effluent grab samples from fire scenes	July 31, 2025
Estimate total contaminant load in the effluent	July 31, 2025
Determine decomposition rates of select contaminants from effluent	July 31, 2025

Activity 2: Analyze the timing of contaminant release into waters during a live fire

Activity Budget: \$112,331

Activity Description:

Fire water effluent samples will be collected at different times during a fire-fighting exercise at a controlled burn at 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 scene, and take water samples and measurements of flow at set times during the fire scenario. This data will provide a detailed picture of how concentrations of contaminants in the fire water effluent 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 contaminant in the effluent can be calculated. These samples will be analyzed for the same contaminants identified in Activity 1.

Activity Milestones:

Description	Completion Date
Determine the time response of contaminant during fire-fighting efforts	July 31, 2025
Identify contaminants present and their concentrations in fire-water effluent from a controlled burn	July 31, 2025

Activity 3: Modeling the Fate and Transport of Contaminants from Structural Fires

Activity Budget: \$34,516

Activity Description:

Data from activities 1 and 2 will be used to model the fate and transport of a contaminants from the fire. Modeling will be limited to those contaminants selected for determining the rates of decomposition of 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 contaminant load to receiving surface water bodies. This spreadsheet tool will account for the initial mass of the contaminant entering the stormwater system (including the water volume from fire-fighting and the initial concentration of the contaminant expected in the effluent), as well as changes in its concentration due to decomposition and dilution from lateral flow in the storm drain. Given these variables, and an estimate of the length of the stormdrain and travel time, we will be able to estimate the total discharge of the contaminant into receiving surface water bodies.

Activity Milestones:

Description	Completion Date
Decomposition model for selected contaminants	July 31, 2025
Spreadsheet tool that calculates contaminant delivered at downstream location	July 31, 2025

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
John Gulliver	University of Minnesota	Co--investigator for the proposed research; will provide instrumentation support for sample collection	No
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
Byran 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
Michael Mondor	Maplewood Fire Department	The Maplewood Fire Department is a partner organization which will collect samples for the study. As fire chief, Michael Mondor will work with the researchers to facilitate sample collection by staff with the Maplewood Fire Department.	No

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 contaminants, their transport, and to consider mitigation strategies. Any additional work will be funded by separate grants after completion of the deliverables from this project.

Project Manager and Organization Qualifications

Project Manager Name: Grace Wilson

Job Title: Researcher and Lecturer

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

Dr. Wilson received a B.A degree from Macalester College in 2007, majoring in Biology with a minor in Chemistry. In 2012, she received her M.S. degree in Applied Plant Sciences, and her Ph.D. in Land and Atmospheric Sciences in 2018, both from the University of Minnesota. Her long-term research interests involve finding solutions to water quality and water resources problems using tools that combine chemical, biological, and physical sciences. Dr. Wilson's research and academic experiences have focused on utilizing statistical and hydrologic/water quality models to study pollution of surface and groundwater. During work on her M.S. and PhD degrees at the University of Minnesota, she developed in-depth knowledge of hydrologic processes and contaminant transport, including topics related to surface and groundwater hydrology, water quality field methods, and computer modeling of watershed processes. Dr. Wilson has worked on research projects focused on water quality in agricultural and urban watersheds. Her work in agricultural watersheds has included interdisciplinary projects which utilized models to examine the effect of different cropping systems, farm management practices, and livestock systems on water quality. In addition to her work in agricultural water quality, Dr. Wilson has worked on research projects related to urban storm water runoff, including work related to nutrient contributions to urban raingardens from organic solids. Her work has also included statistical evaluation of hydrologic model performance

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

Organization Description:

The College of Food, Agriculture, and Natural Resources Sciences (CFANS) at the University of Minnesota is dedicated to using science to find answers to the world's grand challenges and solve tomorrow's problems. The College includes twelve academic departments along with ten research and outreach centers, all representing a range of disciplines and research expertise. This breadth of expertise allows the College to tackle challenges in novel ways, including the Grand Challenge research and education investments program which specifically focuses on research geared towards water resources and uses.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Faculty		Manage project and consult on analysis of results; general grant management			33.5%	0.2		\$37,941
Researcher		Conduct analysis of results; manage sample collection; general grant management			33.5%	1		\$100,125
Graduate Student		Provide research support and data analysis support			23.6%	0.13		\$16,856
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
							Sub Total	\$176,522
Contracts and Services								
TBD	Professional or Technical Service Contract	Analyzing water samples for specified contaminants and reporting results to the researchers				2		\$162,580
							Sub Total	\$162,580
Equipment, Tools, and Supplies								
	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
							Sub Total	\$5,500
Capital Expenditures								
							Sub Total	-

Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	4 trips with a rented University fleet truck or large van @ \$70/day	Carry supplies to controlled burns					\$398
							Sub Total	\$398
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
							Sub Total	-
							Grand Total	\$345,000

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	-

Attachments

Required Attachments

Visual Component

File: [8ff70949-c81.docx](#)

Alternate Text for Visual Component

The graphic shows an active structural fire with firefighters putting out the blaze. A magnifying glass is shown zooming in on the water from the fire, and showing toxins within that water....

Optional Attachments

Support Letter or Other

Title	File
Letter of Support-Maplewood Fire Dept.	6f426abe-4c4.pdf
Letter of Support--St. Paul Fire	5b2025db-095.pdf
Letter of Support--Minneapolis Fire	3a5f5875-69c.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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

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

