Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)

Project Title: **ENRTF ID: 081-B**

Testing Filter Removal of Microfibers for Water Quality

Category: B. Water Resources

Sub-Category:

Total Project Budget: $ 320,936

Proposed Project Time Period for the Funding Requested: June 30, 2022 (3 yrs)

Summary:

This project will determine the effectiveness of low-cost filters to reduce microfibers from laundry discharge to increase longevity of septic systems and enhance performance of WWTPs for improved water quality.

Name: Sara Heger

Sponsoring Organization: U of MN

Title: Assistant Professor

Department: Water Resource Center

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Synthetic fiber use has increased to nearly 80 million tons annually in the US resulting in an increase in laundry microfibers that impacts Minnesota's waters and causes septic system failure.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%
____ If under $200,000, waive presentation?			

PROJECT TITLE: Testing Filter Removal of Microfibers for Water Quality

I. PROJECT STATEMENT

WHY – The last thing the 25% of Minnesotans served by septic systems want is sewage in their basement, but little is done to prevent their everyday activity of doing laundry from clogging their drainfield resulting in premature septic system failure. This untreated wastewater contains pathogens, organic material and nutrients, which are very harmful to Minnesota's public health, ground and surface water and the environment. This project will determine the effectiveness of installation of low-cost filters in reducing microfibers and thus increasing longevity of septic systems. Due to all the synthetic fibers we are wearing, more microfibers are being discharged to septic systems reducing the life of septic systems due to soil clogging and adding microplastics to lakes and rivers from wastewater treatment plants (WWTP). According the MPCA, there are over **544,000** septic systems in Minnesota serving over 25% of households; 2/3 of these systems are 15 years or older with approximately **20%** in some form of failure. A septic system should last 25+ years but this lifespan is reduced if the soil is overloaded with fibers that the soil cannot break down causing the eventual plugging of the soil beneath the septic system.

- When fabrics are laundered, **100,000+** microfibers can come off a single fleece jacket per wash cycle.
- When the septic system becomes plugged, it causes effluent to pond and eventually surface in the yard, cause freezing of septic system components and/or back-up in the home.
- There are inexpensive filters that can be put on the laundry discharge or added into a septic tank to reduce these fibers.

GOALS – The goals of this project are to:

- **Determine microfiber content -** amount and type of fibers in laundry effluent with and without a lint filter on the laundry discharge line.
- **Test tanks and screens -** Evaluate how these fibers move through septic tanks with different configurations, different effluent screens and tank pumping intervals.
- **Develop inexpensive best management practices (BMPs)** for laundering, septic tank design and maintenance that will increase septic system longevity and reduce microfibers reaching WWTP to improve water quality in Minnesota.

OUTCOMES – Microfibers are an ***emerging water contaminant.*** This project will assist wastewater treatment professionals and homeowners in reducing their impact in the environment and understanding how microfibers affect system performance. These outcomes will be achieved through the three main activities described below.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Collect and analyze laundry and septic tank effluent for microfiber content Budget: $171,697

Microfibers are less than a millimeter in length and come from laundering of clothing in washing machines. Since 1950, production of microfibers has increased, particularly in synthetic apparel like fleece, moisture wicking fabrics and swimwear. Twenty residential dwellings will be sampled two times pre and post screening. Both laundry wastewater discharge and septic tank effluent will be sampled during warm and cold periods to see if types of clothing affect fibers in laundry effluent. Single and multiple compartment tanks with effluent screens will be evaluated, as well as usefulness of a lint filter. Site selection criteria, a questionnaire and monitoring will identify levels of occupancy, water use and tank maintenance. Results will be useful to both properties connected to septic systems and treatment plants.

Outcomes	Completion Date
1. 20 homes modified to meet design parameters	August 31, 2019
2. Collection of samples completed	June 30, 2020
3. Microfiber content report for laundry wastewater	October 30, 2020
4. Microfiber content report for septic tank effluent	December 31, 2020

Activity 2: Evaluation of influence of microfibers on plugging of soil columns **Budget: $135,971**

Based on the data obtained from Activity 1, two different microfiber concentrations will be test loaded onto soil columns to determine the amount of microfiber retention. Recovery of effluent from the bottom of each column will be analyzed for breakthrough of microfibers. Hydraulic conductivity tests will be completed on each soil column before and after loading to compare the plugging effects. We will test similar quantities of microfibers combined with septic tank effluent to develop a typical soil treatment environment favoring biomat formation. This information will be compared to predicted rates of clogging mat formation to determine how microfiber factors affect clogging. Results will aid septic system professionals to predict premature failures and provide design and management recommendations to limit soil plugging in the soil treatment area.

Outcomes	Completion Date
1. Plugging determined with two microfiber concentrations	December 31, 2021
2. Plugging determined with two microfiber concentrations and septic tank effluent	March 31, 2022
3. Summary report documenting impacts of microfibers on SSTS	June 30, 2022

Activity 3: Develop BMPS for system design, maintenance and homeowner use **Budget: $13,268**

Based upon Activity 1 and 2, inexpensive BMPs will be developed to assist wastewater professionals with design and management of systems and help homeowners improve the performance of SSTS, reducing the amount of microfibers discharged to WWTPs and lakes and rivers. Homeowner education materials will be developed and training provided to wastewater professionals.

Outcome	Completion Date
1. Best management practices factsheets created for 1) septic system design, 2) septic system management and 3) homeowner use	June 30, 2022

III. PROJECT PARTNERS

A. Project Team/Partners receiving ENTRF funding

- Dr. Sara Heger, PI, Research Engineer at the University of Minnesota Twin Cities (UMN-TC) in Water Resources Center and Adjunct Assistant Professor in Bioproducts and Biosystems, project management overseeing all sample collection, coordination of staff, data analysis, summary and dissemination
- Dr. Elizabeth Minor, Professor, Chemistry and Biochemistry and Large Lakes Observatory, UMN-Duluth, oversight on microfiber identification
- Dan Wheeler, UMN-TC Research Soils Fellow, oversight on soil column work
- Technician at UMN-TC will collect field samples and assist with soil column evaluation
- Graduate student at UMN-Duluth will perform microfiber quantification and identification
- Technician at UMN-Duluth will train and assist graduate student on microfiber identification
- Editor will assist with creating and editing documents for project dissemination

This *collaborative partnership* has a wealth of knowledge in septic systems, microfiber analysis, laboratory scale research and outreach.

IV. LONG-TERM IMPLEMENTATION AND FUNDING

This project will improve water quality by preventing avoidable septic system failures, with their attendant environmental degradations and risks to human health. The best management practices for removing fibers from laundry waste will also reduce the amount of fibers reaching WWTPs. In addition, this study will also lead to a reduction in microfiber pollution within Minnesota's lakes, rivers, and streams, and within the fish that live in these systems. The results of this project will be communicated to wastewater professionals across Minnesota through the over forty annual training events (https://septic.umn.edu/workshop-enrollment).

V. Timeline Requirements

This project is planned for three years beginning on July 1, 2019 and ending on June 30, 2022.

2019 Detailed Project Budget

Project Title: Testing Filter Removal of Microfibers for Water Quality

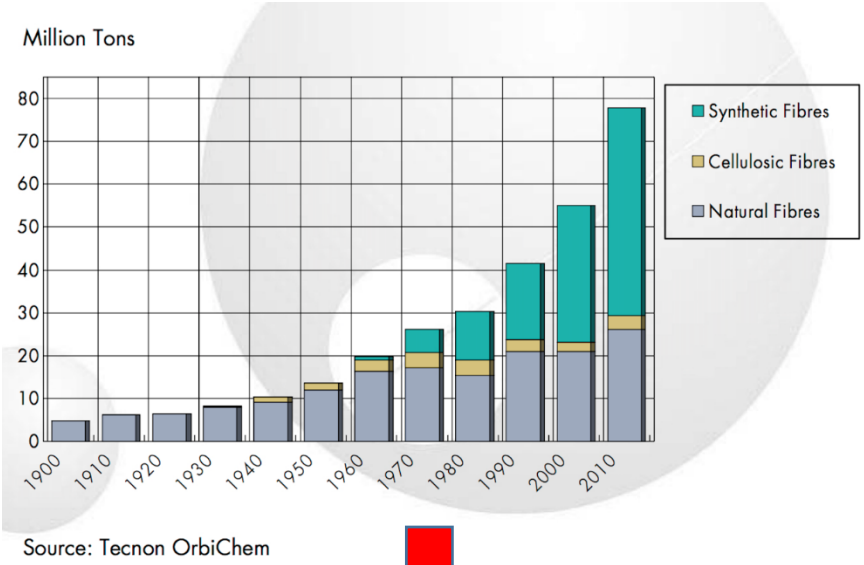
IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel: Principal Investigator, Adjunct Professor, S. Heger, Supervisory and analysis, 25% per year, 75% salary, 25% benefits, 3 years.	$ 83,699
Personnel: Professor, E. Minor. Supervisory, 4% per year, 75% salary, 25% fringe, 3 years.	$ 21,234
Personnel: Research Fellow, D. Wheeler, Supervisory and analysis related to soil columns, 10% per year, 75% salary, 25% benefits, 3 years.	$ 30,676
Personnel: Research Assistant, Assist with field sample collection, laboratory experiments and analysis, 75% per year, 79% salary, 21% benefits, 3 years.	$ 120,819
Personnel: Technician - Duluth, Assist with microfiber analysis, 8% time, 79% salary, 21% benefits, 3 years.	$ 17,340
Personnel : Graduate Student - Duluth, Perform microfiber analysis, summer salary, 53% salary, 47% benefits, 3 years.	$ 20,834
Personnel: Editor, C. Hansen, Proof and edit documents, 2.5% time, 79% salary, 21% benefits, 3 years.	$ 3,051
Laboratory Fees: Analytical laboratory charge for scanning electron microscope and wastewater analysis for 150 samples.	$ 6,151
Supplies: Misc. Supplies for experimental setup and analysis including soil columns, glassware, micrcoscope slides and bulb, filters, gloves, etc.	$ 5,682
Equipment: Modifications to 20 selected sites for design parameters including lint filters, water meters and effluent screens at $300 per site.	$ 6,000
Acquisition (Fee Title or Permanent Easements): *NA*	$ -
Travel: *To sites to collect samples and to Duluth to deliver samples. 5000 miles @ $0.545/mi*	$ 5,450
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST	$ 320,936

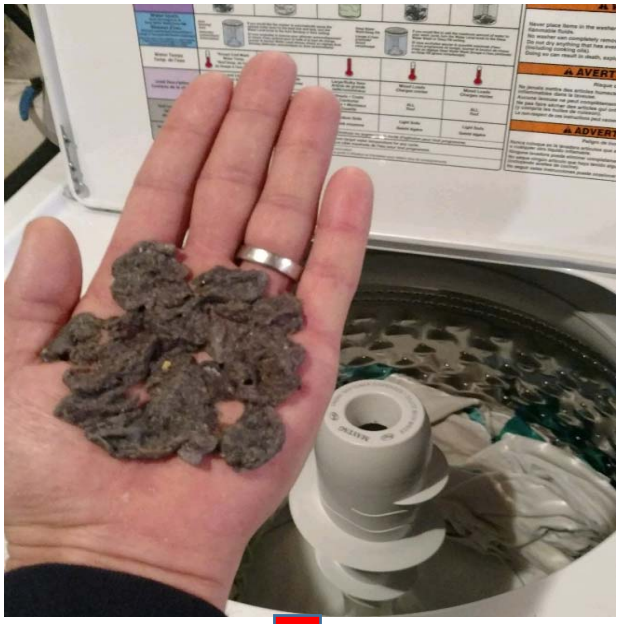
V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Unrecovered F&A at 54% MTDC	$ 173,305	Secured
Other State $	NA	
In-kind Services To Be Applied To Project During Project Period	NA	
Past and Current ENRTF Appropriation	NA	
Other Funding History	NA	

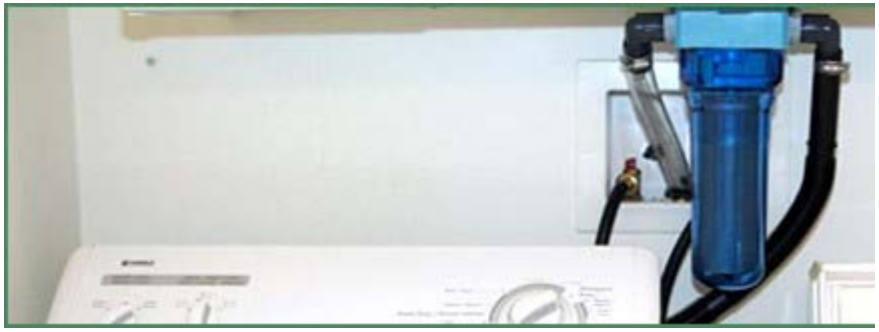
Synthetic fiber use increasing dramatically



Lint from a washing machine



Filters on washing machine **Can** reduce septic system failure and improve ***Water Quality***



Project Manager Qualifications & Organization Description

Dr. Sara Heger

University of Minnesota, Water Resources Center
Onsite Sewage Treatment Program, septic.umn.edu
sheger@umn.edu, O: 612-625-7243 C: 612-239-8198

Project PI: Dr. Sara Heger is an engineer, researcher and instructor in the Onsite Sewage Treatment Program in the Water Resources Center and is an Adjunct Assistant Professor in the Bioproducts and Biosystems Engineering Department. Since 1998, she has been providing education and technical assistance to homeowners, small communities, onsite professionals and local units of government regarding onsite wastewater treatment. Sara coordinates the research program at the UMN and is currently serving as the principle investigator on grants to evaluate chloride impacts from water softeners on water quality, MnDOT rest stops served by septic systems and develop materials and provide education related to chemicals of emerging concern. Sara serves on the NSF International Committee on Wastewater Treatment Systems. She is also the chair of the Minnesota State Advisory Committee on Decentralized Systems. She has BS in Biosystems & Agricultural Engineering and a MS and a PhD in Water Resources Science. Heger will oversee the entire project and provide expertise in water quality sampling, data analysis and septic systems performance.

Elizabeth Minor, Professor, Chemistry and Biochemistry and Large Lakes Observatory, University of Minnesota Duluth. Minor's lab will perform microfiber isolation via oxidation and density extraction. Her lab group will also perform microfiber analysis via PyGC-MS and SEM/EDS to determine if the fibers are plastic, natural organic fibers, or inorganic materials. The Minor lab group has published novel protocols for the isolation and analysis of microplastic particles and has applied these to obtain quantitative microplastics data from Lake Superior. The funds to support the microfiber work on septic system samples are included in this Environment and Natural Resources Trust Fund request.

Daniel Wheeler, Research Fellow, University of Minnesota. Wheeler is a Research Fellow/Instructor in the Department of Soil, Water and Climate and the Water Resources Center. His research interests focus on interpreting landscape-scale hydrology and soil morphology to assess environmental issues such as water quality, wetlands and soil erosion. He teaches several Soil Science courses on the UMN-TC campus as well as conducting soils training workshops for the Onsite Sewage Treatment Program and Wetland Delineation Certification Program. Dan has an MS degree in Soil Science with a Water Resources Science Minor and a BS in Environmental Science from the University of Minnesota. Wheeler will provide expertise on the impacts of synthetic fibers on the soil in septic systems.

The University of Minnesota Onsite Sewage Treatment Program (OSTP) has been providing education and performing research on septic systems since the mid-1970s. OSTP a multi-disciplinary program with four distinct yet interrelated activities and programs: 1) Professional Training, 2) Research and Demonstration, 3) Small Community Wastewater Education, and 4) Homeowner Operation and Maintenance. The integration of the four programs has continued to be a priority for the overall program, both within the University and state of Minnesota and on a broader scale to partnering Universities' research, education, and outreach functions across the nation.

UMN WRC Capacity, The University of Minnesota is a large, comprehensive, public land grant research university serving a state where both water resources and agriculture are hallmarks of the economy. The WRC is the primary coordination unit for University of Minnesota research, outreach and graduate education related to water resources. It manages 20-25 active grants, from federal, state, and private funders, totaling over $2 million at any one time, works across disciplines and across institutions. The WRC maintains sufficient permanent staff to complete all grant reporting and data submittal requirements in the timeframe required.