Environment and Natural Resources Trust Fund
2018 Request for Proposals (RFP)

Project Title: **ENRTF ID: 079-B**

Determining the Impact of Microfibers on Septic System Performance

Category: B. Water Resources

Total Project Budget: $ 367,000

Proposed Project Time Period for the Funding Requested: 3 years, July 2018 to June 2021

Summary:

Project will determine the impact of microfibers on septic systems and evaluate options to reduce the microfibers in graywater from laundering clothing currently passing through various septic system and WWTPs

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Sponsoring Organization: U of MN

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Figure indicates the increasing amount of microfibers from laundering impacting septic systems and the environment.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%

PROJECT TITLE: Determining the Impact of Microfibers on Septic System Performance

I. PROJECT STATEMENT

WHY –This project will determine the impact of microfibers on subsurface sewage treatment system (SSTS) performance and develop options to inexpensively reduce the amount of microfibers in graywater from laundering both organic (i.e. cotton, wool) and synthetic (i.e. polyester, spandex) clothing passing through various septic system and wastewater treatment plant (WWTP) components across Minnesota.

- 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.
- When fabrics are laundered, **100,000+** microfibers can come off a single fleece jacket per wash cycle; these microfibers are then carried down the drain where they end up in the SSTS.
- Microfibers reduce the size of soil pores until the eventual plugging of the soil beneath the SSTS. This plugging process is exacerbated by the simultaneous organic growth in septic known as the biomat.
- When the SSTS soil treatment area becomes plugged, it causes effluent to pond and eventually surface in the yard or back-up in the home. This untreated wastewater contains pathogens, organic material and nutrients, which are very harmful to Minnesota's public health and the environment.
- Synthetic microfibers have been found in water and fish samples from the Great Lakes.

GOALS – The goals of this project are to:

- Determine the amount and type of fibers in laundry effluent with and without a lint filter on the laundry discharge line.
- Evaluate how these fibers move through septic tanks with different configurations, effluent screens and tank pumping intervals.
- Determine efficiency of the soil to capture these microfibers and the amount of physical plugging within the soil treatment systems.
- Develop inexpensive best management practices (BMPs) for laundering, septic tank design and maintenance.

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

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Collect and analyze laundry and septic tank effluent for microfiber content **Budget: $189,587**

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 to three times. 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 lint filters. 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 SSTS and WWTP.

Outcome	Completion Date
1. 20 homes modified to meet design parameters	August 31, 2018
2. Collection of samples completed, two at each site for a total of 80 samples	June 30, 2019
3. Microfiber content report for laundry wastewater	October 30, 2019
4. Microfiber content report for septic tank effluent	December 31, 2019

Activity 2: Evaluation of influence of microfibers on plugging of soil columns **Budget: $152,084**

Based on the data obtained from Activity 2, two microfiber concentrations will be test loaded into 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. Saturated hydraulic conductivity tests will be completed on each soil column before and after loading to compare the plugging effects. We will test the same 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 biomat formation to determine if and how microfiber factors into biomat formation and plugging. Results will aid septic system professionals to predict premature failures and provide design recommendations to limit soil plugging in the soil treatment area.

Outcome	Completion Date
1. Plugging determined with two microfiber concentrations	December 31, 2020
2. Plugging determined with two microfiber concentrations and septic tank effluent	March 31, 2021
3. Summary report documenting impacts of microfibers on SSTS	June 30, 2021

Activity 3: Develop BMPS for system design, maintenance and homeowner use **Budget: $25,329**

Based 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. The recommended BMPs could result in SSTS rule changes.

Outcome	Completion Date
1. Best management practices factsheets created for 1) septic system design, 2)septic system management and 3)homeowner use	June 30, 2021

III. PROJECT STRATEGY

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
- Dan Wheeler, UMN-TC Research Fellow, oversight on soil column work
- Graduate student at UMN-TC will collect field samples and assist with soil column evaluation
- Research assistant at UMN-TC will assist with field collection and soil column work
- Dr. Elizabeth Minor, Co-PI, Professor, Chemistry and Biochemistry and Large Lakes Observatory, UMN-Duluth, oversight on microfiber identification
- 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. Several students will be trained in a new and exciting area facing the wastewater industry.

B. Project Impact and Long-Term Strategy

This project will help to prevent 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 stress on 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.

C. Timeline Requirements

Three years are needed to complete the project due to the statewide analysis and the complexity of the range of issues to be evaluated.

2018 Detailed Project Budget

Project Title: Determining the Impact of Microfibers on Septic System Performance

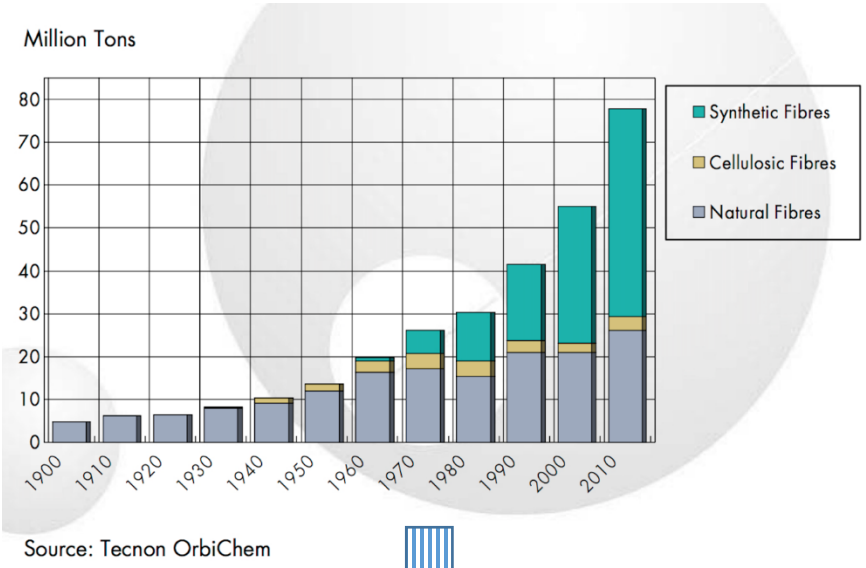
IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel: Principal Investigator, Adjunct Professor, S. Heger, Supervisory and analysis, 25% per year, 75% salary, 25% benefits, 3 years.	$ 84,518
Personnel: Professor, E. Minor. Supervisory, 4% per year, 75% salary, 25% fringe, 3 years.	$ 15,935
Personnel: Research Fellow, D. Wheeler, Supervisory and analysis related to soil columns, 10% per year, 75% salary, 25% benefits, 3 years.	$ 32,489
Personnel: Research Assistant, Assist with field sample collection, laboratory experiments and analysis, 25% per year, 74% salary, 26% benefits, 3 years.	$ 39,100
Personnel: Graduate Student - TC, Collecting samples, performing lab work, 50% appointment, 53% salary, 47% benefits, 3 years.	$ 126,806
Personnel: Technician - Duluth, Assist with microfiber analysis, 8% time, 74% salary, 26% benefits, 3 years.	$ 20,635
Personnel: Graduate Student - Duluth, Perform microfiber analysis, summer salary, 53% salary, 47% benefits, 3 years.	$ 20,400
Personnel: Editor, C. Hansen, Proof and edit documents, 2.5% time, 74% salary, 26% benefits, 3 years.	$ 3,834
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 =	$ 367,000

V. OTHER FUNDS

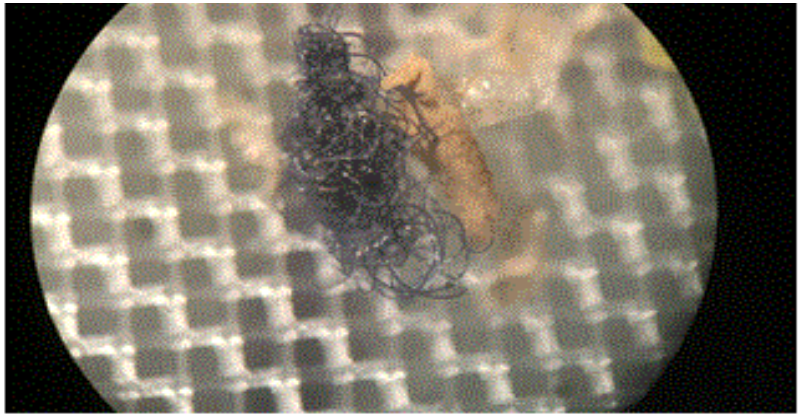
SOURCE OF FUNDS	AMOUNT	Status
Unrecovered F&A at 52% MTDC	$ 190,840	Secured
Other State $	NA	
In-kind Services To Be Applied To Project During Project Period	NA	
Past and Current ENRTF Appropriation	NA	
Other Funding History	NA	

Synthetic Fiber Use Increasing Dramatically



Lint from a washing machine

Microscopy analysis of microfiber content in Minnesota's waters



Project Manager Qualifications & Organization Description

Dr. Sara Heger

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

Education

2015, Ph.D. in Water Resource Science, University of Minnesota,
2001, M. S. in Water Resource Science, University of Minnesota
1998, B. S. in Biosystems and Agricultural Engineering

Key Related Work Activities

1999 – Present University of Minnesota. Research Engineer and Adjunct Assistant Professor. Water Resource Center and Bioproducts and Biosystems Engineering.

- Principle Investigator on MN Department of Transportation evaluating of wastewater reuse.
- Principle Investigator on LCCMR grant evaluating impacts of chloride from water conditioning and the recommended best management practices to reduce this impact.
- Principle Investigator on NIFA Community Septic System Owner's Guide project.
- Principle Investigator on MN Department of Transportation evaluation of 52 rest stop and truck garage septic systems.
- Extension Specialist on LCCMR grant on septic tanks for evaluation of nutrient recuperation, bioenergy generation and environmental protection by the implementation of a bio-electrochemical system.
- Developing septic system and milkhouse wastewater estimators for BWSR under a LCCMR grant.
- Publish/report on Alternative Wastewater Treatment for ISTS including sand and recirculating sand filters, peat filters and constructed wetlands for LCMR Project: On-Site Sewage Treatment Alternatives: Performance, Outreach & Demonstration
- Present at many local, state and national conferences regarding onsite sewage treatment.
- Serve as the chair the Minnesota State Advisory Committee on septic systems and on the NSF International Wastewater Committee.

Grants

- MnDOT Wastewater Reuse Grant, 2017-2019
- LCCMR Project - Understanding Impacts of Salt Usage on Minnesota Lakes, Rivers, and Groundwater, 2016 - 2019
- LCCMR Project - Septic Tank Evaluation: Greenhouse Gas Collection and Nutrient Removal, 2014 - 2017
- MnDOT Rest Stop Septic System Evaluation Grant, 2013-2019
- MPCA Online Training Evaluation and Advanced Inspector Educational Assistance Grant, 2014-2015
- USDA NIFA Community Septic System Owner's Guide Grant, 2013-2016
- Waterloo Phosphorus Removal Study, 2013-2015
- LCCMR BWSR Septic System and Milkhouse Wastewater Estimator Development, 2012-2014

Select Publications

1. Heger, S. F., D. Wheeler, D. Gustafson and M. Szmorlo. 2016. Septic System Evaluation at MnDOT Rest Stops, Truck Stations and Weigh Scales. Center for Transportation Studies. Report no. CTS 15-11B. Minneapolis, MN.
1. Heger, S.F., D.R. Schmidt and K.A. Janni. 2010. Aerobic and Media Filter Treatment Systems for Milk House Wastewater on Small Dairy Operations. Applied Engineering in Agr., 26(2): 319-327.
2. Heger, Sara. 2015. Community Septic Systems Owner's Guide. National Onsite Wastewater Recycling Association Annual Conference Proceedings, Virginia Beach, VA.

UMN WRC Capacity

The Univ. of Minn. 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 Univ. of Minn. 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, and working across disciplines and across institutions. The WRC maintains sufficient permanent staff to complete all grant reporting and data submittal requirements in the timeframe required.