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

Project Title: **ENRTF ID: 055-B**

Protecting Minnesota Waters by Removing Contaminants from Wastewater

Category: B. Water Resources

Sub-Category:

Total Project Budget: $ 345,877

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

Summary:

Wastewater contains many environmental contaminants including pharmaceuticals, personal-care products, PFAS and micro-plastics. They are not removed by treatment plants. We propose to remove them using commercially available drinking water coagulants.

Name: Matt Simcik

Sponsoring Organization: U of MN

Title: Associate Professor

Department: School of Public Health

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Web Address

Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Before wastewater treatment, we had fish dying of lack of oxygen. Since the advent of advanced wastewater treatment, we have solved this problem, but are unable to remove low level pollutants. Our method is expected to advance treament to the point that these contaminants are removed.

_____ 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: Protecting Minnesota Waters by Removing Contaminants from Wastewater

I. PROJECT STATEMENT

Everything we flush down the drain ends up in our waste stream. Most of this ends up going through one of our wastewater treatment plants (WWTPs). These plants have protected our environment from raw sewage for over 100 years. Without them we would have fish dying from lack of oxygen, as it takes oxygen to break down all that waste. Unfortunately, these plants are not equipped to handle contaminants at the part per million or part per billion level. Therefore, many contaminants make it through our WWTPs into our surface waters. They include pharmaceuticals, personal care products, per and polyfluoroalkyl substances (PFAS) like PFOS and PFOA, and microplastics. A study in 2002 found as many as 82 industrial, residential and agricultural chemicals downstream of WWTPs.

Recent research by the two Principal Investigators has developed a method for the sequestration of PFAS in groundwater. They have used a polymer commonly used as a drinking water coagulant to dramatically increase the sorption of PFAS to soil particles in a groundwater system. This same coagulant is expected to increase the sorption of PFAS to activated sludge in a wastewater treatment plant.

This method is effective because of the negative charge on the PFAS molecules and the positive charge on the coagulant. Therefore, it is expected that the coagulant addition will also improve the removal of other negatively charged compounds/materials like pharmaceuticals and personal care products (PPCPs) and microplastics. We also plan to investigate some negatively charged coagulants to remove positively charged contaminants.

PFAS enter our waste stream, mostly from consumer products, but some industrial sources may be present. PFAS were used as stain and water repellents in upholstery and clothing for many years. They were also used in food packaging like microwave popcorn bags. As surfaces containing these compounds are washed they enter our waste stream.

Pharmaceuticals that are taken by the general population are excreted into the waste stream or flushed into the waste stream when unused. When excreted, they are transformed chemically by our bodies so they can be eliminated. Once in the waste stream the activated sludge can actually reform the active compound taken by the individual. The 2002 study found antidepressants, pain killers, caffeine, nicotine and anti-inflammatories in surface waters.

Personal care products such as fragrances, lotions and insect repellents can be washed from the skin and enter our waste stream. One of the most commonly found compounds in the 2002 study was the insect repellent, DEET.

Recent interest has grown over microplastics. They can enter the environment from personal care products where they are an ingredient as micro-beads. They can also be formed be the degradation of other larger plastics, such as water bottles and food packaging. Once in the waste stream they are not readily removed by WWTPs.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: *Determine the optimum coagulant(s) and dosage to remove PFAS, PPCPs and microplastics in approximately 30 WWTP samples taken over an 18 month period*

We propose a series of experiments to determine the optimal coagulant to remove the most contaminants dose to the waste stream to achieve removal of the contaminants of interest. The concentration necessary to adequately remove the contaminants will also be determined. This will be an experiment where WWTP samples will be treated in the laboratory, and the concentrations determined in both Dr Simcik's and Dr. Arnold's laboratories. Samples will be collected using a pump and 4L glass bottles from a WWTP, and sterilized with sodium azide to insure safety from pathogens for personnel. Contaminant concentrations will be determined

from bottles where the sludge has been allowed to settle. Varying concentrations and type of coagulant will be added to each of the same bottles. They will then be shaken and allowed to settle again. The contaminant concentration will be determined on the treated bottles, and compared to the untreated values.

ENRTF BUDGET: $161,629

Outcome	Completion Date
1. Determine optimum coagulant(s) and dosage to remove contaminants of interest	*June 1, 2020*

Activity 2: *Dose coagulant(s) in an actual WWTP and monitor effluent over a period of 18 months.*

We propose to use the loading/concentration determined in Activity 1 to add coagulant(s) to an actual WWTP. The plant we propose to use is the Seneca WWTP in Eagan, MN. The reason for choosing this plant is that it is actually two parallel systems, where coagulant(s) could be added to one side, but not the other to determine the removal efficiency of the method. Approximately 36 samples will be taken over an 18 month period (one from each side each month). Contaminants will be determined in the same manner as Activity 1.

Outcome	Completion Date
1. Determine the removal efficiency of polydDADMAC for contaminants of interest in an actual WWTP	*January 1, 2022*

ENRTF BUDGET: $184,248

III. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Name	Title	Affiliation	Role
Dr. Larry Rogacki	Assistant General Manager, Support Services	Metropolitan Council Environmental Services	Liason between the UofM and the MetCouncil WWTPs

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:

The results of this project will be used to inform other WWTP's in Minnesota as to how best to improve the removal of these contaminants from their waste streams.

V. TIME LINE REQUIREMENTS:

This project will require three years to complete. During the first eighteen months the type and optimal dosage of the coagulant(s) will be determined, then during the next eighteen months the removal of contaminants from the WWTP effluent will be determined.

VI. SEE ADDITIONAL PROPOSAL COMPONENTS:

A. Proposal Budget Spreadsheet
B. Visual Component or Map
C. Parcel List Spreadsheet
D. Acquisition, Easements, and Restoration Requirements
E. Research Addendum (not required at proposal stage)
F. Project Manager Qualifications and Organization Description
G. Letter or Resolution
H. Certified Audit or 990 Tax Information

2019 Proposal Budget Spreadsheet

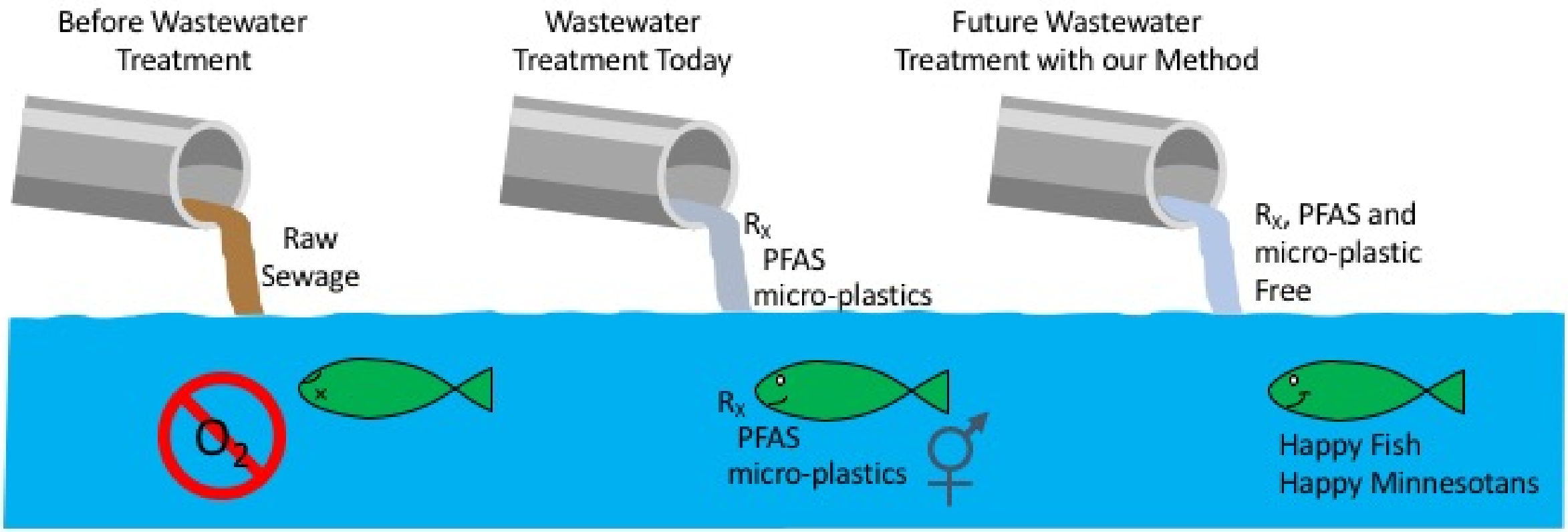
Project Title: Protecting Minnesota Waters by Removing Contaminants from Wastewater

IV. TOTAL ENRTF REQUEST BUDGET *3* **years**

BUDGET ITEM	AMOUNT
Personnel:	
Matt Simcik, Principal Investigator [20% + Fringe (33.5%)] 12month appointment with no state funding towards salary	$ 114,221
William Arnold, Co-Investigator [8% + Fringe (33.5%)] summer salary	$ 42,525
Grad RA (PhD) [50% Salary + Fringe (15.0%) + Tuition]	$ 129,131
Equipment/Tools/Supplies: consumables for contaminant analysis, polyDADMAC and other coagulants	$ 60,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 345,877

V. OTHER FUNDS *(This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)*

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period:	NA	
Other State $ To Be Applied To Project During Project Period:	NA	
In-kind Services To Be Applied To Project During Project Period: Indirect costs contributed in-kind by the University of Minnesota	$ 162,120	
Past and Current ENRTF Appropriation:	NA	
Other Funding History:	NA	


Before Wastewater Treatment
Raw Sewage
O_2
Wastewater Treatment Today
R_X
PFAS
micro-plastics
R_X
PFAS
micro-plastics
Future Wastewater Treatment with our Method
R_X, PFAS and micro-plastic Free
Happy Fish
Happy Minnesotans

Project Manager Qualifications:
Dr. Matt Simcik will be the project manager. He is an Associate Professor in the Division of Environmental Health Sciences in the School of Public Health at the University of Minnesota. He is also on the graduate faculty of the Civil, Environmental and Geoengineering Department and the Water Resource Sciences Program. He is an expert in the fate and transport of organic contaminants in the environment, and has been studying perfluoroalkyl substances for over 15 years, including Principal Investigator on the Department of Defense project that developed the groundwater remediation method employing drinking water coagulants to sequester PFAS. He will be responsible for project and data management.

Dr. William Arnold is a Distinguished McKnight University and the Joseph T. and Rose S. Ling Professor in the Department of Civil, Environmental, and Geo- Engineering and a Resident Fellow-Institute on the Environment at the University of Minnesota. He is also on the graduate faculty of the Water Resource Sciences Program.

Sponsoring Organization:
Regents of the University of Minnesota
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