



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2019 ENRTF Work Plan (Main Document)

Today's Date: August 27, 2018

Date of Next Status Update Report: March 1, 2020

Date of Work Plan Approval:

Project Completion Date: June 30, 2022

Does this submission include an amendment request? ___

PROJECT TITLE: Reducing Municipal Wastewater Mercury Pollution to Lake Superior

Project Manager: Scott Kyser

Organization: Minnesota Pollution Control Agency

College/Department/Division: Wastewater Effluent Limits

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Location: Statewide, Northeast

Total Project Budget: \$250,000

Amount Spent: \$0

Balance: \$250,000

Legal Citation: M.L. 2019, Chp. xx, Sec. xx, Subd. xx

Appropriation Language: TBD

I. PROJECT STATEMENT:

This technology transfer project helps the municipal wastewater plants in the Lake Superior basin reduce mercury pollution and save money.

Many Minnesota cities need guidance on the wastewater treatment technologies available to cost-effectively reduce mercury pollution. This project will produce a document that summarizes and evaluates mercury treatment technologies, allowing municipalities to select a mercury treatment strategy that appropriately meets their community's needs while also minimizing mercury pollution.

Every surface water of the state requires protection from mercury pollution, primarily because of human fish consumption but also because of risks to aquatic life. In the Lake Superior basin the protective water quality standard is 1.3 ng/L. In order to protect human health and aquatic life, all 16 municipal WWTPs in the Lake Superior basin will eventually (dependent on affordability) need to comply with mercury effluent limits protective of the 1.3 ng/L.

Some treatment systems in the Lake Superior basin successfully operate technologies that cost-effectively comply with mercury limits. (See partial list of technologies at right). Currently, each facility that is not meeting effluent limits needs to individually implement a costly compliance study when a permit is renewed. This project will compile technology transfer information into a single publically-accessible document, allowing wastewater facilities in the Lake Superior Basin to learn which technologies effectively reduce mercury pollution and save over \$70,000 in engineering fees for individual compliance studies. Since treatment effectiveness depends on water characteristics, this study will visit and sample individual treatment plants to identify important differences in wastewater characteristics that impact mercury treatment. The results of this study will provide the MPCA with consistent information it could not otherwise obtain to help develop a more robust and systematic mercury permitting strategy for municipal WWTPs. Eventually, the results of this project will lead to lower mercury inputs to Lake Superior and other Minnesota waters by systematically identifying cost-effective means to remove mercury from wastewater.

Technologies
✓ Dual Media Filters (<i>Aurora, Duluth</i>)
✓ Solid Contact Clarifiers (<i>Silver Bay</i>)
✓ Cloth Media Filters (<i>Central Iron Range</i>)
✓ Cerium Precipitation (<i>Virginia</i>)
✓ Ferric Precipitation (<i>Hibbing</i>)
✓ Alum Precipitation (<i>Hoyt Lakes, Babbitt</i>)
✓ Membrane Bio-Reactors (<i>Gilbert</i>)
✓ Stabilization Ponds (<i>Biwabik</i>)

II. OVERALL PROJECT STATUS UPDATES:

First Update March 1, 2020

Second Update September 1, 2021

Third Update March 1, 2021

Fourth Update September 1, 2022

Fifth Update March 1, 2022

Final Report between project end (June 30) and August 15, 2022

III. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1 Title: *Evaluate 13 of the 16 wastewater plants and seven different treatment technologies in the Lake Superior Basin*

Description: We will inventory previously collected mercury measurements from Minnesota WWTPs and existing treatment technologies. MPCA and UMD engineers will visit WWTPs for basic site assessments of treatment processes targeting mercury removal and contact site and/or design engineers. Drawing on literature descriptions of solids-removal technologies and mercury adsorption, we will articulate a framework for evaluating the mechanisms of mercury removal and the associated technology costs. We will compile and evaluate this existing information to understand, at a basic level, which technologies are effectively removing mercury from MN wastewater. A site-specific evaluation of each WWTP in the table below will place their effectiveness in the context of known Hg removal mechanisms. The 13 selected wastewater plants encompass the common types of wastewater treatment and will allow for a translation of the results of this study to a broad array of municipal wastewater plants in Minnesota and nationally. A statistical evaluation of data across all the evaluated WWTPs will provide a basis for evaluating Hg removal more broadly. *Key outcomes of this activity will be* 1) systematic documentation of effective mercury removal processes in MN; and 2) cost estimates associated with treatment technologies for mercury removal. These cost estimates will be useful for both facility capital expense planning as well as MPCA permit evaluations.

Wastewater Class	Facility
Dual Media Filters	Aurora, Duluth, Two Harbors
Alum Precipitation	Babbitt, Hoyt Lakes, Mountain Iron
Cerium Precipitation	Virginia
Ferric Precipitation	Hibbing
Cloth Disk Filter	Central Iron Range
Sand Filter	Eveleth
Solid Contact Clarifiers	Silver Bay
Membrane Bio Reactors	Gilbert
Stabilization Ponds	Biwabik

ACTIVITY 1 ENRTF BUDGET: \$122,000

Outcome	Completion Date
1. Review of existing mercury wastewater treatment performance: statistical analysis of existing Hg removal data from MN WWTP in relation to compliance with wastewater effluent limits.	August 2020
2. Evaluate and document costs for mercury treatment technologies: white-paper-style description of Hg removal mechanisms including cost and effectiveness	December 2020
3. Recommendations providing a basis for guidance document: site-specific evaluation of Hg removal at 13 WWTP	June 2021

ACTIVITY 2 Title: *Targeted sampling of mercury treatment technologies to develop a treatment design theory*
 Activity 2 will measure mercury and water characteristics in 13 of the 16 wastewater from WWTPs in the Lake Superior basin, encompassing a variety of representative treatment technologies. This in-depth sampling will complement existing compliance monitoring data in order to identify how mercury responds to different treatment technologies. Water samples from key locations in WWTPs treatment chain will be separated in the lab into 4 different “phases” to understand how water characteristics change the treatability of mercury. Additional laboratory investigations will elucidate which “phases” of mercury are conducive to enhanced removal with candidate treatment technologies. *A key outcome from this activity will be* the documentation of

critical water chemistry parameters that impact mercury removal for each evaluated technology. These tests will ensure that treatment technologies are transferrable across different water types.

ACTIVITY 2 ENRTF BUDGET: \$118,000

Outcome	Completion Date
1. Mercury chemistry samples from all MN treatment technology types: synoptic sampling of plants with different water chemistry	February 2021
2. Evaluate key water characteristics impacting mercury removal performance: identify how Hg “phases” depend upon water chemistry	February 2021
3. Document providing basis for evaluating transferability: synthesis of key Hg removal mechanisms and water chemistry parameters for effective removal technology	June 2022

ACTIVITY 3 Title: *Technology transfer communication and outreach*

We will disseminate the findings from the proposed study to Minnesota wastewater engineers, managers and operators through public presentations and publications in peer-reviewed journals. *The key outcome from this activity will be presentations at local and statewide wastewater conferences.*

ACTIVITY 3 ENRTF BUDGET: \$10,000

Outcome	Completion Date
1. Present results to MN conference for wastewater operators & engineers	June 2022
2. Preparation of manuscripts for peer-reviewed publication	June 2022

First Update March 1, 2020

Second Update September 1, 2021

Third Update March 1, 2021

Fourth Update September 1, 2022

Fifth Update March 1, 2022

Final Report between project end (June 30) and August 15, 2022

IV. DISSEMINATION:

Description:

We will disseminate the findings from the study to wastewater engineers, managers and operators through public presentations and publications in peer-reviewed journals. The key outcome from this activity will be presentations at two local and statewide wastewater conferences.

The final report will be available on the MPCA webpage and will be used to inform MPCA mercury wastewater treatment permitting policy.

The Minnesota Environment and Natural Resources Trust Fund (ENRTF) will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the [ENRTF Acknowledgement Guidelines](#).

First Update March 1, 2020

Second Update September 1, 2021

Third Update March 1, 2021

Fourth Update September 1, 2022

Fifth Update March 1, 2022

Final Report between project end (June 30) and August 15, 2022

V. ADDITIONAL BUDGET INFORMATION:

A. Personnel and Capital Expenditures

Explanation of Capital Expenditures Greater Than \$5,000: None expected

Explanation of Use of Classified Staff: None expected

Total Number of Full-time Equivalent (FTE) Directly Funded with this ENRTF Appropriation:

Enter Total Estimated Personnel Hours for entire duration of project: Zero	Divide total personnel hours by 2,080 hours in 1 yr = TOTAL FTE: Zero
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Total Number of Full-time Equivalent (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:

Enter Total Estimated Contract Personnel Hours for entire duration of project: ---	Divide total contract hours by 2,080 hours in 1 yr = TOTAL FTE: 2.6
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VI. PROJECT PARTNERS:

A. Partners outside of project manager’s organization receiving ENRTF funding

University of Minnesota Duluth

B. Partners outside of project manager’s organization NOT receiving ENRTF funding

None

VII. LONG-TERM- IMPLEMENTATION AND FUNDING:

Reducing mercury discharges to Minnesota waterbodies is part of the MPCA’s long term strategy to reduce pollution. The MPCA undertakes routine measurements for mercury in wastewater discharges, surface waters, and fish and these ongoing measurements will be ultimately be used to evaluate the effectiveness of the proposed work in reducing mercury pollution from wastewater plants. The results of this study will be incorporated into regular discussions with wastewater treatment facilities in the Lake Superior Basin and throughout the state. This study will not need long term funding past this funding cycle.

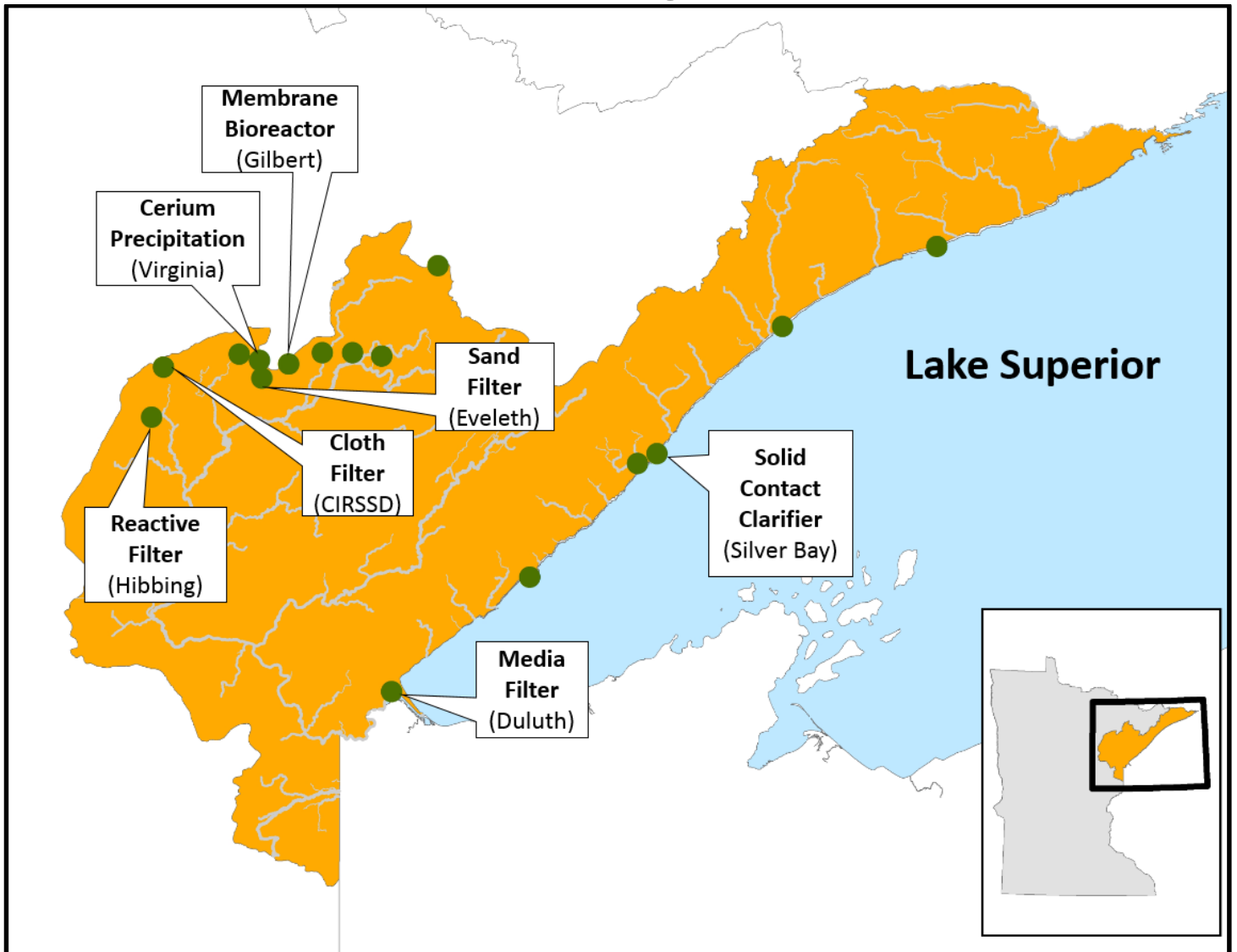
VIII. REPORTING REQUIREMENTS:

- Project status update reports will be submitted March 1 and September 1 each year of the project
- A final report and associated products will be submitted between June 30 and August 15, 2022

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

- A. Budget Spreadsheet**
- B. Visual Component or Map**
- C. Parcel List Spreadsheet**
- D. Acquisition, Easements, and Restoration Requirements**
- E. Research Addendum**

Municipal wastewater plants in the Lake Superior basin with low-level mercury limits and selected mercury treatment technologies



- Many types of mercury treatment technologies are used in the lake Superior Watershed
- Some are more affordable, some are less affordable
- Some remove mercury well, some do not, some have yet to be fully evaluated

Attachment A:

Environment and Natural Resources Trust Fund

M.L. 2019 Budget Spreadsheet

Legal Citation: TBD

Project Manager: Scott Kyser

Project Title: 58B Reducing Municipal Wastewater Mercury Pollution to Lake Superior

Organization: MPCA

Project Budget: \$250,000

Project Length and Completion Date: 3 years, June 30, 2022

Today's Date: February 8, 2019



ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET		Budget	Amount Spent	Balance	
BUDGET ITEM					
Personnel (Wages and Benefits)		\$ 179,127	\$ -	\$ 179,127	
Principal Investigator: UMD Professor: \$17,258 (74.5 % salary, + 25.4 % benefits) 3.5 % FTE each year for 3 years					
Co- Principal Investigator: UMD Professor \$14,159 (74.5 % salary, 25.4 % benefits) 2 % FTE each year for 3 years					
UMD Graduate Students: Research Assistant \$128,176 (54 % salary, 9.6 % benefits, 36.4 % tuition remission) 50 % FTE each year for 3 years					
Undergraduate Laboratory Assistant: Research Assistantship \$19,534 (96 % salary, 4 % benefits) 25 % FTE each year for 3 years					
Professional/Technical/Service Contracts		\$ 26,915	\$ -	\$ 26,915	
Contract with laboratory to perform mercury analysis. Laboratory with capability of specialized Hg					
Contract with lab to perform routine water chemistry (DOC & cations/anions). Lab TBD. \$7,665					
Equipment/Tools/Supplies (Supplies for UMD laboratory analysis)		\$ 38,219	\$ -	\$ 38,219	
Sampling bottles and sampling supplies (\$7,750)					
Water filtration tubing and pump (\$2,469)					
Consumable lab supplies for Hg and carbon analysis: (\$28,000)					
Capital Expenditures Over \$5,000		\$ -	\$ -	\$ -	
Fee Title Acquisition		\$ -	\$ -	\$ -	
Easement Acquisition		\$ -	\$ -	\$ -	
Professional Services for Acquisition		\$ -	\$ -	\$ -	
Printing		\$ -	\$ -	\$ -	
Travel expenses in Minnesota		\$ 5,739	\$ -	\$ 5,739	
- 10 regional WWTP * 75 miles/trip * 2 trips/year * 0.545/mile = \$2,515					
- Trips to two conferences to present - \$1,715					
- Trips to St Paul: 3/yr * 300/trip * 0.545/mile = \$1,509					
travel expenses and conference cost		\$ -	\$ -	\$ -	
Other		\$ -	\$ -	\$ -	
COLUMN TOTAL		\$ 250,000	\$ -	\$ 250,000	
OTHER FUNDS CONTRIBUTED TO THE PROJECT		Status (secured or pending)	Budget	Spent	Balance
Non-State:			\$ -	\$ -	\$ -
State:			\$ -	\$ -	\$ -
In kind:			\$ -	\$ -	\$ -
PAST AND CURRENT ENRTF APPROPRIATIONS		Amount legally obligated but not yet spent	Budget	Spent	Balance
Current appropriation:			\$ -	\$ -	\$ -
Past appropriations:			\$ -	\$ -	\$ -