



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

Date of Report: August 08, 2018

Date of Next Status Update Report: January 1, 2020

Date of Work Plan Approval:

Project Completion Date: June 30, 2022

Does this submission include an amendment request? No

PROJECT TITLE: Improving Drinking Water for Minnesotans through Pollution Prevention

Project Manager: Raymond M. Hozalski

Organization: University of Minnesota

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Location: Statewide

Total ENRTF Project Budget:

ENRTF Appropriation: \$345,000

Amount Spent: \$0

Balance: \$345,000

Legal Citation: M.L. 2019, Chp. xx, Sec. xx, Subd. 04l

Appropriation Language:

PROJECT TITLE: Improving Drinking Water for Minnesotans through Pollution Prevention

I. PROJECT STATEMENT:

The upper Mississippi River, the water supply for ~1 million Minnesota residents, is under constant assault by a variety of chemical and microbiological contaminants. A contaminant of emerging concern in Twin Cities drinking water supplies is the **highly toxic and potent cancer-causing chemical N-nitrosodimethylamine (NDMA)**. NDMA itself is not present in the river water but the chemical is formed by the reaction of so-called 'precursors' in the water with chloramines, a form of chlorine added to the water for disinfection. Although NDMA currently is not a regulated contaminant, many states are considering regulations and California has established a notification level of 10 ng/L (10 parts-per-trillion). Initial testing has shown high levels of precursors in Upper Mississippi River water, with the potential to form more than 50 ng/L of NDMA. A preliminary sampling campaign completed with the aid of St. Paul Regional Water Services personnel has identified the Crow River as a major contributor to NDMA precursor levels in the Upper Mississippi, but the sources of these precursors to the Crow River are not known. NDMA precursors are associated with municipal wastewater discharges and include some industrial chemicals and pharmaceutical compounds such as ranitidine, a medicine used to treat acid reflux. Another potential source in the Crow River watershed is animal waste from agricultural operations. To protect drinking water consumers from NDMA and other toxic nitrosamines, it is critical to first identify and then curb the main sources of precursors. **The main impact of the proposed project is to reduce exposure of Minnesotans to the toxic chemical NDMA by recommending pollution prevention strategies to the MN Pollution Control Agency (MPCA) and the MN Department of Health (MDH) and treatment options to water utilities.** This will be done by:

- Assessing seasonal variability in NDMA precursor levels in the Upper Mississippi and Crow Rivers;
- Identifying the major sources of NDMA precursors to the Crow by sampling along the length of the river from the confluence and working upstream along the North and South Forks as well as Buffalo Creek; and
- Investigating options to reduce NDMA formation during water treatment.

This research project will benefit Minnesotans by providing critically important information for policy makers regarding which waste streams to target to reduce inputs of NDMA precursors to surface waters and for water utilities regarding potential treatment strategies for reducing NDMA formation when precursors are present.

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

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Assess seasonal variability in the quantities of NDMA precursors in the Crow River and in the Mississippi River both upstream and downstream of the Crow.

Description: Known NDMA precursors include nitrogen-containing organic compounds with specific structures called secondary and tertiary amines. Such precursors are often associated with municipal wastewater discharges, but the main sources to the Crow River are not known and may include human waste, animal waste, or both. Additional work is needed to assess seasonal variability in precursor levels in the Crow River and the Upper Mississippi River. We will collect water from 3 sampling locations on at least 4 sampling dates from the summer of 2019 through summer of 2020. As duplicate samples will be collected from each location on every sampling date, this results in a total of at least 24 water samples. Water samples will be collected from the middle of the river just below the surface. All water samples will be lime softened using a jar test apparatus to mimic the treatment that occurs in the two Twin Cities treatment facilities. We have discovered through previous work that lime softening is critical for ‘activating’ the precursors. After lime softening, the samples will be analyzed for NDMA precursor levels (formation potential test) as well as for organic amine concentrations. Finally, the samples will be analyzed for selected known NDMA precursor chemicals in an attempt to identify the dominant precursors and possible sources (e.g., human waste, animal waste, industrial activities).

ACTIVITY 1 ENRTF Budget: \$ 112,724

Outcome	Completion Date
1. Collect water samples from the Crow River and Mississippi River upstream and downstream of the Crow at least 4 times over a one-year period.	August 31, 2020
2. Analyze the river water samples for NDMA precursor levels using the uniform formation conditions (UFC) test.	September 31, 2020
3. Analyze the river water samples for total organic amine levels and specific known precursor compounds (e.g., ranitidine, selected antibiotics).	December 31, 2020

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

ACTIVITY 2: Identify NDMA precursor sources by sampling along the length of the Crow River during the season where precursor levels are highest as determined from Activity 1.

Description: Initially, a background investigation will be performed to identify likely NDMA precursor chemicals used in the Crow River watersheds. Internet searches will be performed to identify industrial, agricultural, and other pertinent activities in the Crow River region and the types of chemicals used in these activities. We will also contact representatives at the MPCA, MDH, and USGS who would have knowledge on chemical usage and occurrence in the Crow and Mississippi Rivers. We will collect samples at roughly ten-mile intervals working upstream along the Crow, North and South Forks of the Crow, and Buffalo Creek to identify where precursor levels increase significantly. Subsequent trips will involve sampling with increasing spatial resolution in river reaches with large precursor increases to hone in on specific sources. Sampling and testing of specific waste streams will be used to confirm precursor sources. We will take approximately 10 trips and collect 10 water samples per trip for a total of approximately 100 samples. Water samples will be collected from the middle of the river just below the surface. All water samples will be lime softened using a jar test apparatus to mimic the

treatment that occurs in the two Twin Cities treatment facilities. After lime softening, the samples will be analyzed for NDMA precursor levels (formation potential test) as well as for organic amine concentrations. Finally, the samples will be analyzed for selected known NDMA precursor chemicals in an attempt to identify the dominant precursors and possible sources (e.g., human waste, animal waste, industrial activities).

ACTIVITY 2 ENRTF Budget: \$ 96,541

Outcome	Completion Date
1. <i>Collect river water and wastewater samples along the Crow River, North and South Forks of the Crow, and Buffalo Creek during the season with highest precursor levels.</i>	August 31, 2021
2. <i>Analyze the river and wastewater samples for NDMA precursor levels using UFC test.</i>	September 31, 2021
3. <i>Analyze the samples for total organic amine levels and specific known precursors (e.g., ranitidine, selected antibiotics).</i>	December 31, 2021

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

ACTIVITY 3: Investigate the effects of chlorine and ozone concentration and exposure time on destruction of precursors.

Description: There is some evidence that pre-oxidation of the precursors with free chlorine or ozone prior to addition of chloramines reduces the subsequent formation of NDMA. We will investigate the effects of chlorine and ozone concentration and exposure time on destruction of precursors. Mississippi River water samples will be lime softened as describe above and then treated with either free chlorine or ozone over a range of typical concentrations and contact times and subjected to testing before and after treatment to determine NDMA precursor levels and treatment effectiveness.

ACTIVITY 3 ENRTF Budget: \$ 98,685

Outcome	Completion Date
1. <i>Collect Mississippi River water samples and pretreat using chlorine or ozone.</i>	April 30, 2022
2. <i>Analyze the river water samples before and after treatment for NDMA precursor levels using the UFC test.</i>	September 31, 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: Findings will be disseminated directly to the two participating utilities as a written report and an in-person presentation. Findings will also be disseminated and archived via reports to LCCMR, peer-reviewed journal publications (open access), and presentations at conferences. We will also, if and when appropriate, disseminate results via press releases to the media and via the MDH website.

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](#).

Dissemination Budget: \$ 98,685

Status as of January 1, 2020:

Status as of July 1, 2020:

Status as of January 1, 2021:

Status as of July 1, 2021:

Status as of January 1, 2022:

Status as of July 1, 2022:

Final Report Summary:

V. ADDITIONAL BUDGET INFORMATION:

A. Personnel and Capital Expenditures

Explanation of Capital Expenditures Greater Than \$5,000: N/A

Explanation of Use of Classified Staff: N/A

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

Enter Total Estimated Personnel Hours for entire duration of project: 5460	Divide total personnel hours by 2,080 hours in 1 yr = TOTAL FTE: 2.63
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Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:

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

Name	Title	Affiliation	Role
William Arnold	Professor	University of Minnesota	Co-Investigator

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

Name	Title	Affiliation	Role
-None -			

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

Name	Title	Affiliation	Role
George Kraynick	Water Quality Manager	MWTDS	Sampling, sharing data
Jim Bode	Water Production Manager	SPRWS	Sampling in Crow River

VII. LONG-TERM- IMPLEMENTATION AND FUNDING:

The main goals of the proposed research are to identify significant sources of NDMA precursors to the Upper Mississippi River and to develop pollution prevention strategies for reducing precursor inputs. For example, if it is found that a certain class of antibiotics given to farm animals is an important precursor, then one possible **strategy** would be to suggest a ban on that class of antibiotics for animal use. The **project impact** will be improved drinking water quality and protection of the health and safety of Minnesotans, particularly those in the Twin Cities and surrounding suburbs served by the Minneapolis and St. Paul water utilities.

C. Funding History: N/A

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: N/A**
- D. Acquisition, Easements, and Restoration Requirements: N/A**
- E. Research Addendum**

Attachment A:
 Environment and Natural Resources Trust Fund
 M.L. 2019 Budget Spreadsheet



Legal Citation:
 Project Manager: Raymond M. Hozalski
 Project Title: Improving Drinking Water for Minnesotans through Pollution Prevention
 Organization: University of Minnesota
 Project Budget: \$345,000
 Project Length and Completion Date: 3 years, June 30, 2022
 Today's Date: March 20, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	\$ 272,000	\$ -	\$ 272,000
Raymond Hozalski, Project Manager (75% salary, 25% fringe benefits). 8% FTE for years 1 - 3. Overall project coordination, lead Task 1 and Task 3 studies, co-lead Task 4. \$57,644			
William Arnold, Co-Project Manager (75% salary, 25% fringe benefits). 6% FTE for years 1 - 3. Lead Task 2 studies, co-lead Task 4. \$50,979			
Graduate student Research assistant 1, Perform environment fate studies for Task 1, perform computations in Task 3 (55% salary, 45% fringe benefits) 50% FTE for years 1-3. \$143,580			
Undergraduate researchers. Assist with laboratory experiments. 16 hrs per week during the calendar year for years 1 and 2 only. (100% salary). \$19,797			
Equipment/Tools/Supplies			
Laboratory Supplies (chemical and isotopically labelled standards, chemical reagents, necessary glassware, solvents, consumable supplies, laboratory notebooks, software licenses, instrument	\$ 33,000	\$ -	\$ 33,000
Analytical time for quantification of NDMA in water samples.	\$ 10,000	\$ -	\$ 10,000
Analytical time for identification of precursor chemicals using mass spectrometry.	\$ 10,000	\$ -	\$ 10,000
Travel expenses in Minnesota			
University vehicle rental and hotel stays to collect water samples. Presentation of results at local conferences. Reimbursement will be according to University of Minnesota guidelines.	\$ 15,000	\$ -	\$ 15,000
Other (Open access fees for peer-reviewed journal papers)			
Publication charges to make to make published journal articles (2-3) immediately available via open access to maximize data availability and dissemination.	\$ 5,000	\$ -	\$ 5,000
COLUMN TOTAL	\$ 345,000	\$ -	\$ 345,000

OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		\$ -	\$ -	\$ -
State: U of MN (In-kind; Indirect costs not charged to project)	Secured	\$ 167,067	\$ -	\$ 167,067
In kind: Because the project is overhead free, laboratory space, electricity, and other facilities/adminstrative costs (54% of direct costs excluding permanent equipment and graduate student tuition benefits) are provided in-kind.		\$ -	\$ -	\$ -

PAST AND CURRENT ENRTF APPROPRIATIONS	Amount legally obligated but not yet spent	Budget	Spent	Balance
Current appropriation:		\$ -	\$ -	\$ -
Past appropriations:		\$ -	\$ -	\$ -

