



Environment and Natural Resources Trust Fund (ENRTF)

M.L. 2018 ENRTF Work Plan (Main Document)

Today's Date: 2/21/18

Date of Next Status Update Report: 01/31/2019

Date of Work Plan Approval:

Project Completion Date: June 30, 2021

Does this submission include an amendment request? NO

PROJECT TITLE: Protect Water Quality with Efficient Removal of Contaminants in Treatment Ponds for Stormwater

Project Manager: Heiko Schoenfuss

Organization: St. Cloud State University

College/Department/Division: Aquatic Toxicology Laboratory

Mailing Address: 720 Fourth Avenue South, WSB-273

City/State/Zip Code: St. Cloud, MN 56301

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Web Address: web.stcloudstate.edu/aquatictox

Location: State-wide

Total Project Budget: \$325,000

Amount Spent: \$0

Balance: \$325,000

Legal Citation: M.L. 2018, Chp. xx, Sec. xx, Subd. xx

Appropriation Language:

I. PROJECT STATEMENT:

Recent stormwater monitoring studies in Minnesota have determined that **urban stormwater is a significant source of contaminants of emerging concern** containing a broad suite of pharmaceuticals (including prescription drugs), current-use pesticides, personal care products, and other organic wastewater chemicals. These pollutants are currently discharged into major streams, rivers, and lakes at concentrations that may exceed those of treated wastewater effluent and are harmful to organisms in receiving waters. Understanding how existing stormwater treatment systems process these contaminants of emerging concern and how aquatic biota respond to stormwater discharges is central to safe-guarding Minnesota's aquatic environment.

The level of exposure of aquatic organisms to stormwater contaminants of emerging concern discharge will depend upon the ability of best management practices (BMPs) to abate pollutant loading to surface waters. A recent pilot study by the MN Pollution Control Agency, St. Cloud State University, and US Geological Survey monitored three different stormwater BMP systems and found evidence of reductions in the number and concentrations of contaminants of emerging concern in some BMP outflow samples. One third of the 48 most frequently detected contaminants of emerging concern showed significant reductions between BMP inlets and outlets suggesting that properly designed BMP treatment systems can reduce some pollutant concentrations depending upon season and stormwater composition. However, biological activity was not always reduced at the same rate as pollutant reduction suggesting differential efficiency in contaminant removal by BMP systems with room for improvement.

An assessment of stormwater composition and treatment in urban centers in Minnesota is needed to inform natural resource managers to the best options for reducing urban stormwater related pollution to Minnesota waters.

Stormwater outfalls and stormwater BMPs provide important wetland habitats for many aquatic species, especially in urban environments. Given the complexity of stormwater and the diversity of species utilizing stormwater impacted habitats, a whole animal study is inappropriate and premature given the many unknowns of stormwater. Instead, we will focus on key species at multiple taxonomic levels (invertebrate, fish, amphibian, reptilian) using a common cell-based assay to identify the most vulnerable species in impacted wetlands and to identifying the most effective stormwater treatment technologies to remove harmful biological effects.

II. OVERALL PROJECT STATUS UPDATES:

First Update January 31, 2019

Second Update June 30, 2019

Third Update January 31, 2020

Final Update June 30, 2020

III. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Measure BMP effectiveness of Contaminants of Emerging Concern Removal

Description:

The research goal for this project is to add to our understanding of how aquatic biota responds to CEC discharges into Minnesota’s aquatic environment. The primary objective for Activity 1 in this study is to document the role that urban stormwater plays in contributing CEC constituents to high-priority surface water in the large Minneapolis and St. Paul metropolitan area and in the moderate sized St. Cloud metropolitan area. This objective will be accomplished by collecting stormwater runoff at BMPs in St. Cloud and St. Paul during four precipitation events per year for two years (40 samples plus QA/QC samples). The secondary objective is to assess efficacy of emerging stormwater management techniques (BMPs) at reducing emerging contaminant concentrations in stormwater discharge. This objective will be accomplished by collecting pairing inlet and outlet samples from the above objective. All samples will be analyzed for a broad suite of CECs by the USGS National Water Quality Laboratory.

ENRTF BUDGET: \$190,000

Outcome	Completion Date
1. Collect 40 stormwater samples (and QA/QC samples)	June 30, 2020
2. Analyze stormwater and QA/QC samples	June 30, 2021
3. Estimate of urban storm water contribution to CEC loads in high priority surface waters	June 30, 2021
4. Report on the seasonal efficacy of two iron-enhanced sand filtration BMPs at reducing CECs in storm water discharge	June 30, 2021

First Update January 31, 2019

Second Update June 30, 2019

Third Update January 31, 2020

Final Update June 30, 2020

ACTIVITY 2: Measure the reduction in biological activity of stormwater before and after iron-enhanced sand-filtration in BMPs

The research goal for this activity is to determine how urban stormwater runoff affects gene expression across several aquatic species likely exposed to urban stormwater runoff in their natural habitats. To accomplish this research goal, cell-based assays for Leopard frog, and a turtle species will be developed to augment existing cell-based assays for bivalves and fishes. Biological effects of 40 urban stormwater samples (activity 1) will then be assessed using the cell-based assay to evaluate the removal efficiency of iron-enhanced sand filtration.

ENRTF BUDGET: \$135,000

Outcome	Completion Date
1. Establish cell-based assay for six aquatic species	December 31, 2018
2. Analyze all stormwater samples (activity 1) for biological activity	December 31, 2020
3. Estimate estrogenicity of stormwater before and after iron-enhanced sand-filtration	June 30, 2021
4. Identify the most effective storm water treatment technology to reduce biological effects associated with CEC exposure.	June 30, 2021

First Update January 31, 2019

Second Update June 30, 2019

Third Update January 31, 2020

Final Update June 30, 2020

IV. DISSEMINATION:

Description:

The target audience for results from this research will be professionals in the areas of stormwater treatment and natural resource management. Specific targets will be environmental engineers and scientists in academia, industry, state agencies such as the DNR and MPCA, and environmental consultants. The regular meetings of the *Contaminant Roundtable* of MN State and federal agencies will provide another ready outlet for results from the current study. Results will be disseminated through scholarly publications in peer-reviewed journals such as *Environmental Science and Technology*. Results from the research project will also be presented at regional conferences such as the annual meeting of the *Midwest Chapter of the Society for Environmental Toxicology & Chemistry (SETAC)* and the *Minnesota Water* conference and if possible, at targeted seminars at the DNR and MPCA. Results will be used to determine whether iron-enhanced sand filtration in stormwater pond systems provide additional ecological protection.

First Update January 31, 2019

Second Update June 30, 2019

Third Update January 31, 2020

Final Update June 30, 2020

V. PROJECT BUDGET SUMMARY:

A. Preliminary ENRTF Budget Overview: See attached spreadsheet

Explanation of Use of Classified Staff: N/A

Total Number of Full-time Equivalent (FTE) Directly Funded with this ENRTF Appropriation: 1.5

Enter Total Estimated Personnel Hours: 3,120	Divide by 2,080 = TOTAL FTE: 1.5
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Total Number of Full-time Equivalent (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 0.5 (USGS subcontract)

Enter Total Estimated Personnel Hours: 1040	Divide by 2,080 = TOTAL FTE: 0.5
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B. Other Funds:

SOURCE OF AND USE OF OTHER FUNDS	Amount Proposed	Amount Spent	Status and Timeframe
Other Non-State \$ To Be Applied To Project During Project Period:			
USGS Cooperative water fund support	\$ 11,933	\$0	Secured
USGS Cooperative water fund support	\$23,866	\$0	pending
Other State \$ To Be Applied To Project During Project Period: N/A			
	\$	\$	
Past and Current ENRTF Appropriation:			
Funding History: ML 2009, Chap.142, Sec. 2, Subd. 5b "Vulnerability of Lakes to Endocrine Disruption"	\$297,000	\$ 297,00	<i>completed</i>
Funding History: M.L. 2010, Chp. 362, Sec. 2, Subd. 5c "Ecological Impacts of Effluent in Surface Waters and Fish"	\$340,000	340,00	<i>completed</i>
Funding History: M.L. 2010, Chp. 362, Sec. 2, Subd. 5e "Assessing Septic System Discharge to Lakes"	\$594,500	594,500	<i>completed</i>
Funding History: M.L. 2014, Chp. 226, Sec 2, Subd. 03d "Evaluation of Wastewater Nitrogen and Estrogen Treatment Options" (Novak, PI - Activity 2: Schoenfuss \$186,600)	\$186,600	164,410	<i>In progress</i>
Funding History: M.L. 2015, Chp. 76, Sec 2, Subd. 04c " Biological Consequences of Septic Pollution in Minnesota Lakes" (Schoenfuss, PI, Kiesling Co-PI)	\$364,000	189,454	<i>in progress</i>

Other Funding History:			
MN Pollution Control Agency (Pilot Study)	\$ 60,689	\$ 60,689	<i>Completed (09/30/2017)</i>

VI. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Name	Title	Affiliation	Role
Heiko L. Schoenfuss	Professor	St. Cloud State University	Principal Investigator
Satomi Kohno	Assistant Professor	St. Cloud State University	Oversight Activity 2
Richard W. Kiesling	Hydrologist	US Geological Survey	Co-PI, Oversight Activity 1

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
N/A			

VII. LONG-TERM- IMPLEMENTATION AND FUNDING:

The proposed research fits into a larger research agenda centered at St. Cloud State University and the USGS focused on contaminants of emerging concern and protection of MN aquatic ecosystems. We have previously determined that fish exposed to estrogens (a known class of potent CECs) in small pond-like settings will delay spawning which may have detrimental effects on fish populations (ML 2009, Chp. 142, Sec. 2, Subd. 5b). These effects were found to be of environmental relevance when we assessed in the context of estrogen concentrations in point-source (municipal treatment plants and industrial discharge) (M.L. 2010, Chp. 362, Sec. 2, Subd. 5c and M.L. 2014, Chp. 226, Sec 2, Subd. 03d). Furthermore, in addition to point-source discharge, our recent studies also determined that estrogenic compounds are found in lake habitats near onsite septic systems (M.L. 2010, Chp. 362, Sec. 2, Subd. 5e). These findings, mostly related to the potent estrogens associated with human and animal excretions lead to a recently funded proposal to assess how already scheduled changes in wastewater treatment technology to reduce effluent nitrogen loads may further benefit the environment through reduction in estrogens (M.L. 2014, Chp. 226, Sec. 2, Subd. 03d). The current proposal builds on these findings and other information in the published literature to identify other sources of CECs and determine their impact on receiving aquatic ecosystems. The proposed research, therefore, builds upon and complements current and prior research in this area. When taken together, this research will provide a more complete picture of how to assess the environmental impact of stormwater discharge, improve treatment through best management practices, and safeguard our aquatic species.

VIII. REPORTING REQUIREMENTS:

- **The project is for 3 years, will begin on 07/01/2018, and end on 06/30/2021.**
- **Periodic project status update reports will be submitted 01/31 and 07/31 of each year.**
- **A final report and associated products will be submitted between June 30 and August 15, 2021.**

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

- A. Budget Spreadsheet**
- B. Visual Component or Map** (*embedded in Research Addendum*)
- E. Research Addendum**

Attachment A:
 Environment and Natural Resources Trust Fund
 M.L. 2018 Budget Spreadsheet

Project Title: Protect Water Quality with Efficient Removal of Contaminants in Stormwater Treatment Ponds

Legal Citation:

Project Manager: Heiko L. Schoenfuss

Organization: St. Cloud State University

College/Department/Division: Aquatic Toxicology Laboratory

M.L. 2018 ENRTF Appropriation: \$325,000

Project Length and Completion Date: 3 years, June 30, 2021

Date of Report: 2/21/18



ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	TOTAL BUDGET	TOTAL SPENT	TOTAL BALANCE
BUDGET ITEM	Measure BMP effectiveness of Contaminants of Emerging Concern Removal		
Personnel (Wages and Benefits)	\$112,505		\$112,505
Heiko L. Schoenfuss, Project Manager (74% salary, 26% benefits); 5% FTE per year for 3 years (total: \$13,923)			
Satomi Kohno - Activity 2 oversight (62% salary, 30% fringe); 25% FTE year 1, 50% FTE years 2 & 3 (total: \$98,582)			
Professional/Technical/Service Contracts			
Subcontract USGS (Mounds View, MN) Stormwater sampling and analysis coordinated by the US Geological Survey (Activity 1) including analytical services from the USGS National Water Quality Lab for the analysis of 40 samples (32 stormwater samples & 8 QA/QC samples) for three analytical schedules of approximately 400 chemicals (\$112,000), expendable supplies (\$2,300), shipping of samples to Nat'l Quality Lab (\$2,800), communication costs with remote equipment (\$520), and travel to collection sites (\$1,680). Subcontract includes salary and benefits for project staff: (Kiesling - 79% salary, 21% benefits = \$32,500; Sarah Elliott - 72% salary, 28% benefits = \$12,000); GS-6 Hydrologic Technician - 68% salary, 32% benefits = \$5800; Program Manager Mark Brigham- 79% salary, 21% benefits = \$13,000; and Administrative Assistance 69% salary, 31% benefits = \$7,400).	\$190,000	\$0	\$190,000
Equipment/Tools/Supplies			
Preparation of receptor constructs, sequencing and cloning into expression vector (\$2,400), cloning kit, 5'RACE kit and 3'RACE kit. Analysing biological activity of contaminants across six species for 40 stormwater samples (\$19,595): \$80/species x 6 species x 40 stormwaters.	\$21,995		\$21,995
Travel expenses in Minnesota			
For sampling, visiting two stormwater BMPs four times/ year for 2 years according to the Commissioner's Plan = \$500	\$500		\$500
COLUMN TOTAL	\$325,000	\$0	\$325,000

