Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)

Project Title: **ENRTF ID: 075-B**

Understanding and Managing Persistent Chloride Pollution in Freshwaters

Category: B. Water Resources

Sub-Category:

Total Project Budget: $ 299,000

Proposed Project Time Period for the Funding Requested: June 30, 2023 (3 yrs)

Summary:

Stormwater systems can retain road salt, releasing it during summer and maximizing chloride impacts on freshwaters. We will collaboratively collect information needed to design stormwater ponds/wetland systems to minimize impacts.

Name: Jacques Finlay

Sponsoring Organization: U of MN

Job Title: Dr.

Department: College of Biological Sciences

Address: 140 Gortner Laboratory 1479 Gortner Avenue, University of Minnesota

St. Paul MN 55108

Telephone Number: (612) 624-4672

Email jfinlay@umn.edu

Web Address: https://cbs.umn.edu/finlay-lab/home

Location:

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Project devlops low costs sensors to collect data with students and agencies, leading to improved design and management of stormwater ponds and wetlands

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

PROJECT TITLE: **Understanding and managing persistent chloride pollution in freshwaters**

I. PROJECT STATEMENT

Ponds and wetlands near roads are most impacted by road salt contamination but least well understood due to lack of information. This project will *1)* **provide understanding of chloride persistence in road side waterbodies**, leveraging collaboration among local water management agencies and participating high schools, and use that information to *2)* **design new storm water BMP systems and retrofit old ones in ways that will minimize chloride impacts** on downstream lakes and rivers, and *3)* **provide opportunities for science education and public outreach** through sharing of low cost monitoring tools and workshops to raise awareness of road salt impacts on water quality.

Minnesota's lakes and rivers are experiencing rising levels of chloride contamination primarily due to winter road salt applications. Storm water ponds and wetlands provide essential services by controlling flooding and removing pollutants from storm water before it flows downstream to lakes and rivers. Although more than 40,000 road affected ponds and wetlands have been identified by the state, very little is known about how chloride affects these shallow waters. Our preliminary studies show that chloride levels are far greater in these waterbodies than nearby lakes and streams. In fact, springtime chloride levels are often similar to seawater, and extremely high levels can persist well into the summer at levels 10 to 100 times above the state's chloride standard – suggesting that current pond designs maximize impacts of road salt on freshwater ecosystems during summer, instead of protecting them from pollution. Currently, we do not know how widespread these contamination patterns are, nor how to design and manage these water systems to minimize chloride levels during the summer when they have the strongest biological impacts on native species.

Understanding of the persistence and impacts of chloride on storm water systems represents a high priority in Minnesota since many thousands of ponds and wetlands are in need of maintenance (such as removal of accumulated sediment or repair of inlet/outlet structures). Ponds could be redesigned to minimize chloride impacts - if sufficient knowledge existed to do so. This collaborative project will support a major expansion of data collection and enable interdisciplinary education of students and the public, towards building an understanding of how chloride accumulates and persists into summer in ponds and wetlands. These efforts will aid the development of ways to implement ponds into the landscape to achieve the best water quality outcomes for the limited funds available to concurrently address the dual problem of overdue maintenance of storm water systems and chloride contamination management. Partnerships with local schools and agencies will create environmental educational opportunities and enhance collaboration among scientists.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1 Title: *Collaboration, technology, and outreach to understand chloride persistence in surface waters*
Description: We currently lack information to determine how chloride moves through the 40,000+ storm water ponds and wetlands statewide that are affected by road runoff. We will develop a low cost sensor system and make the design widely available, cost effective, adaptable and easy to use for students, educators, and watershed management agencies. We will use the system in collaborative research with several schools and agencies to understand chloride persistence in shallow waters (at least 40 sites). These collaborations will expand the scale of data collection, promote education and outreach through workshops, and establish a model for future information sharing between researchers, practitioners, educators, and the public. Data collected will provide understanding of the conditions under which chloride persists in surface

water bodies in order to identify waters most likely to be impacted by chloride during the summer biologically active period, and to inform development of pond designs to minimize impacts, described below in Activity 2.
ENRTF BUDGET: $182,468

Outcome	Completion Date
1. Low cost design and manual for chloride sensing in surface waters for research and education	*Dec 2020*
2. Collaborative network for monitoring chloride in 40 shallow water bodies	*Mar 2021*
3. Workshops for teachers, students and professionals on low cost monitoring systems	*Dec 2022*
4. Data to predict chloride persistence in waterbodies near roads	*Dec 2022*

Activity 2 Title: *Pond design to minimize summertime impacts of chloride on freshwater ecosystems*
Description: If winter applied road salt is retained in ponds and wetlands and released downstream in the summer, as our preliminary data show, its negative impacts on aquatic life will be maximized, both within the ponds and in downstream lakes and rivers. We will use data collected in Activity 1 with water quality modeling to determine best pond and wetland designs, as well as maintenance or retrofit methods that minimize chloride impacts on aquatic life and water quality in watersheds. Results will be made available via a final report, and methods and tools developed will be built to integrate with existing water quality models used by practitioners; these products will be made publicly available.
ENRTF BUDGET: $116,532

Outcome	Completion Date
1. Model of chloride persistence in shallow water bodies	*July 2022*
2. Optimal designs to minimize chloride levels in ponds and wetlands during summer	*Jan 2023*
3. Dissemination of results via web tool, and publications	*June 2023*

III. PROJECT PARTNERS AND COLLABORATORS:

Partners receiving ENRTF funding
- Dr. Jacques Finlay, PI, Professor, Department of Ecology, Evolution, and Behavior, UMN-Twin Cities
- Dr. Ben Janke, co PI, Saint Anthony Falls Lab, UMN-Twin Cities
- Dr. Bill Herb, co Pi, Saint Anthony Falls Lab, UMN-Twin Cities
- Dr. Pete Marchetto, co PI, Assistant Professor, Bioproducts and Biosystems Engineering, UMN-Twin Cities

Collaborators not receiving ENRTF funding
- Dr. John Gulliver, Professor, Department of Civil, Environmental and Geo-Engineering, UMN-Twin Cities
- Mike Trojan and Brooke Asleson, Minnesota Pollution Control Agency

IV. LONG-TERM IMPLEMENTATION AND FUNDING:
Road salt accumulating in surface waters has direct and indirect harmful effects on aquatic life, and may be detrimental to the function of many ponds and wetlands being used for storm water management. Development of alternate deicers will help reduce chloride impacts but use of chloride will undoubtedly continue for driving safety. Current storm water systems are unknowingly constructed in ways that maximize effects of winter road salt during the summer. Knowledge gained in this project can be used to design new storm water BMP systems and retrofit old ones over the next decades in ways that will minimize chloride impacts. The tools and approaches developed in this project will provide the basis for expansion of collaborative monitoring, and engagement of students in multiple areas: engineering, technology, physics, environment science, data collection and analysis. The project will commence July 1, 2020 and conclude June 30, 2023.

Attachment A: Project Budget Spreadsheet
Environment and Natural Resources Trust Fund
M.L. 2020 Budget Spreadsheet
Legal Citation:
Project Manager: Jacques Finlay
Project Title: Understanding and Managing Persistent Chloride Pollution in Freshwaters
Organization: University of Minnesota
Project Budget: $299,000
Project Length and Completion Date: 3 Years (June 30, 2023)
Today's Date: April 10, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 253,000	$ -	$ 253,000
Jacques Finlay, PI, $28,000 (74% salary, 26% benefits), 4% FTE Years 1-3			
Ben Janke, Co-PI, $92,000 (74% salary, 26% benefits), 100% FTE Year 2			
Bill Herb, Co-PI, $29,000 (74% salary, 26% benefits), 25% FTE Year 2			
Pete Marchetto, Co-PI, $22,000 (74% salary, 26% benefits), 4% FTE Years 1-3			
Graduate Student, $48,000 (52% salary, 48% benefits during the academic year and 61% salary, 39% benefits during the summer), 50% FTE Year 1			
Undergraduate Student, $17,000 (100% salary, 0% benefits), 33% FTE Years 1 & 2			
Lab Technician, $17,000 (77% salary, 23% benefits), 25% FTE Year 1			
Professional/Technical/Service Contracts			
	$ -	$ -	$ -
Equipment/Tools/Supplies			
Lab/Field Supplies - $38000	$ 38,000	$ -	$ 38,000
Capital Expenditures Over $5,000			
	$ -	$ -	$ -
Fee Title Acquisition			
	$ -	$ -	$ -
Easement Acquisition			
	$ -	$ -	$ -
Professional Services for Acquisition			
	$ -	$ -	$ -
Printing			
	$ -	$ -	$ -
Travel expenses in Minnesota			
Travel - $3,000	$ 3,000	$ -	$ 3,000
Other	$ 5,000	$ -	$ 5,000
Lab Services - $5000			
COLUMN TOTAL	$ 299,000	$ -	$ 299,000

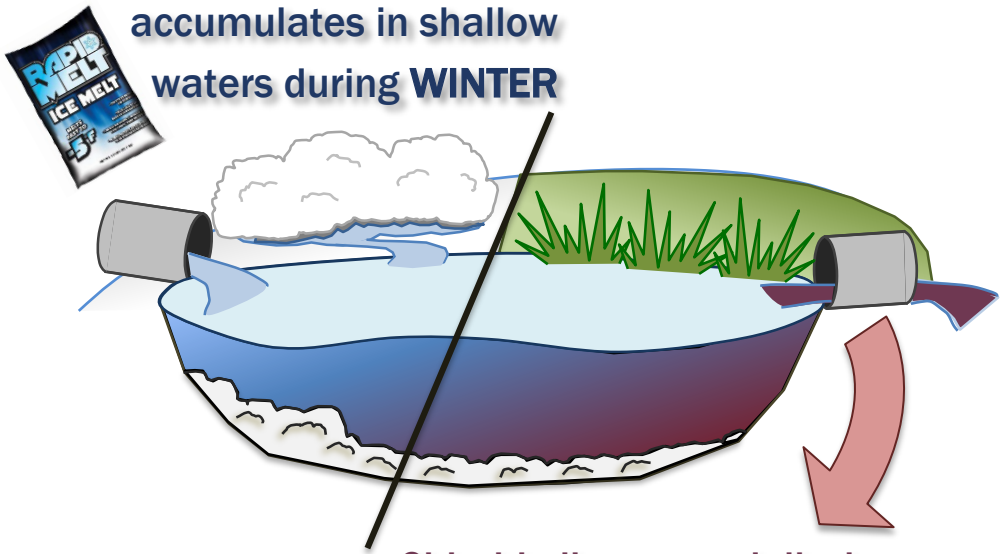
SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		$ -	$ -	$ -
State:		$ -	$ -	$ -
In kind: Indirect Costs associated with this proposal @ 54% MTDC	secured	$ 150,000	$ -	$ 150,000

Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
		$ -	$ -	$ -

Understanding and Managing Persistent Chloride Pollution in Freshwaters

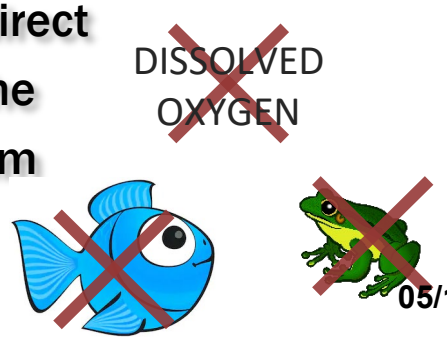
- 40,000 roadside ponds & wetlands in Minnesota
- Many need maintenance, repair, or re-design
- Designs should minimize impacts of chloride discharging to sensitive downstream waters

Road salt (chloride) accumulates in shallow waters during **WINTER**

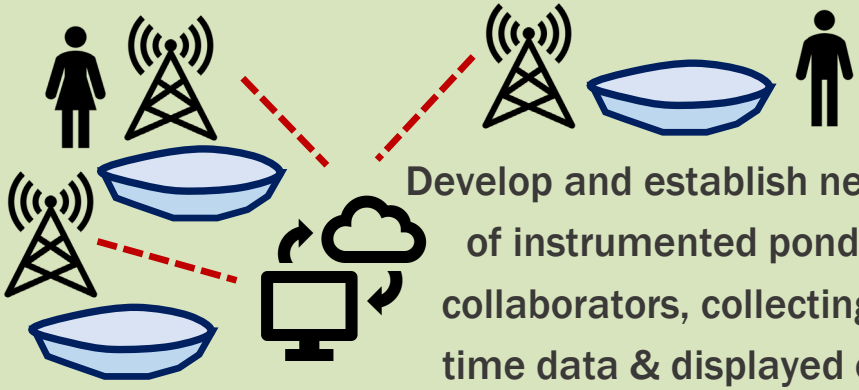


Chloride lingers and discharges from ponds during **SUMMER...**

...Causing direct and indirect harm to aquatic life in the ponds and in downstream lakes and streams



ACTIVITIES



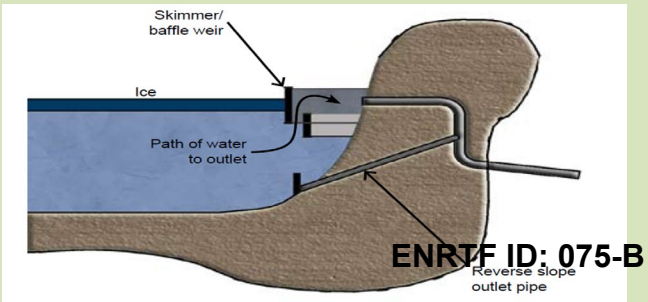
Develop and establish network of instrumented ponds with collaborators, collecting real-time data & displayed online

Pond sites at agencies and schools are opportunity for science education; workshops used for outreach and technology transfer

Analysis of collected data and water quality models used to create a **tool** to predict chloride transport through ponds

OUTCOMES

This project will inform *design* of new stormwater BMP systems and *retrofit* of old systems to **minimize chloride impacts on lakes and streams**



Jacques Finlay
Professor, Department of Ecology, Evolution and Behavior, University of Minnesota
B.S., Natural Resources, with honors, 1990. University of New Hampshire, Durham, New Hampshire
Ph.D., Integrative Biology, 2000. University of California, Berkeley, California

Jacques Finlay will be responsible for project coordination, mentoring the junior scientists associated with the project, and coordination of all activities with PI's, educators and watershed management organizations. Throughout his career, Dr. Finlay has studied how watershed management practices influence carbon, nitrogen, phosphorus, and mercury processing in aquatic ecosystems. His recent work is focused on water quality improvement via improved understanding and management of sources pollutants in urban and rural ecosystems. He has mentored 12 graduate students and 11 post docs in his career. In the proposed project, he and co investigators are committed to connecting research and technology to environmental education via unique partnership with students, educators, and watershed scientists.

Representative publications include

Hansen, A.T., C. Dolph, E.P. Foufoula-Georgiou, and J.C. Finlay. 2018. ***Contribution of wetlands to nitrate removal at the watershed scale.*** *Nature Geoscience 11(2): 127-132*

Janke, B., J.C. Finlay, and S.E. Hobbie. 2017. ***Trees and Streets as Drivers of Urban Stormwater Nutrient Pollution****. Environmental Science & Technology. 51(17): 9569-9579*

Hobbie, S.E., J.C. Finlay, D. Millet, B.D. Janke, L.A. Baker, and D. Nidzgorski. 2017. ***Contrasting nitrogen and phosphorus budgets in urban watersheds and implications for managing urban water pollution****. Proceedings of the National Academy of Sciences 114(16): 4177–4182*

Finlay, J.C., G.E. Small, and R.W. Sterner. 2013. ***Human influences on nitrogen removal in lakes****. Science.342 (6155),247-250. DOI:10.1126/science.1242575.*

Keeler, B.L., S. Polasky, K.A. Brauman, K.A. Johnson, J.C. Finlay, A. O'Neill, K. Kovacs, and B. Dalzell. 2012. ***Linking water quality and well-being for improved assessment and valuation of ecosystem services.*** *Proceedings of the National Academy of Sciences 109(45): 18619-18624*

Organization Description
The University of Minnesota is one of the largest, most comprehensive, and most prestigious public universities in the United States (http://www1.umn.edu/twincities/01_about.php). The labs and offices of the investigators are equipped with the necessary space and facilities needed for the proposed activities.