Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)

Project Title: **ENRTF ID: 045-B**

Assessing Wetland Restorations for Improved Water Quality

Category: B. Water Resources

Total Project Budget: $ 420,000

Proposed Project Time Period for the Funding Requested: 3 years, July 2016 to June 2019

Summary:

We will quantify the environmental benefits of sediment removal and native plant communities in wetland restorations by measuring reductions in nitrogen and phosphorus delivery to groundwater and surface water.

Name: Jacques Finlay

Sponsoring Organization: U of MN

Address: 100 Ecology Building, 1987 Upper Buford Circle
St. Paul MN 55108

Telephone Number: (612) 624-4672

Email jfinlay@umn.edu

Web Address http://www.cbs.umn.edu/lab/finlay

Location

Region: Central, NW, SW

County Name: Becker, Douglas, Grant, Jackson, Lac qui Parle, Mahnomen, Otter Tail, Pope, Swift, Todd

City / Township:

Alternate Text for Visual:

Wetland restoration is the best way to improve water quality, but we still need to identify restoration practices that optimize nitrogen and phosphorus removal from groundwater and surface water. We will examine the effects of two restoration practices - sediment removal and native plant community management - on nutrient removal from groundwater and surface water in restored wetlands.

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

PROJECT TITLE: Assessing wetland restorations for improved water quality

I. PROJECT STATEMENT

Wetland restoration is a priority for improving environmental services in Minnesota, but the methods to achieve the widest benefit for the least cost are unclear. A key unanswered question is whether wetland restoration practices designed to improve waterfowl habitat by restoring native plant communities also provide benefits to water quality. This question is of considerable concern, since restoration and management practices are costly and may limit the ability of managers to accept additional wetland restoration projects. **We will assess the benefits of two specific restoration and management activities - sediment removal and native plant management - by quantifying and comparing the amount of nitrogen (N) and phosphorus (P) that are removed from surface waters as they percolate through wetlands into the ground water supply.**

Between 1850 and 1980, about 80% of Minnesota's prairie pothole wetlands were drained for agriculture (Dahl 2014). Temporary and Seasonal wetlands were particularly vulnerable because they are local depressions that do not remain wet throughout the entire growing season, but fill and drain into the groundwater supply following rainfall events. Over time, these wetland basins fill with topsoil from the surrounding fields, burying native plant seeds in the wetland soils. In addition, eroded topsoil changes the hydrology and contributes to N and P loading in the basin. One strategy used to restore agricultural wetlands is to excavate the accumulated sediment – exposing buried wetland soils – prior to restoring the supply of water. After sediment excavation native wetland plants quickly re-establish, but occasionally invasive hybrid cattail and reed canary grass establish instead. These invasive plants form dense monocultures that provide very little food and cover for waterfowl.

Through the Partners for Fish and Wildlife Program, the United States Fish and Wildlife Service (USFWS) is engaged in an adaptive management project characterized by a series of wetland restorations with and without accumulated sediment removal. The goal of sediment excavation is to restore the original hydrologic regime of the basin, increase water storage potential, and expose wetland soils and the associated native plant community, thereby increasing the probability of restoring high quality waterfowl habitat and increasing nutrient removal from surface and groundwater. We will survey approximately 50 wetlands between 0.1 and 3 acres in size that were restored by the USFWS in the last 5 years in western Minnesota. Accumulated sediment was excavated and removed in half of the wetlands. We will measure how much N and P is stored in the wetland basin and removed from surface water as it percolates into the groundwater supply. **We will calculate differences in nutrient removal in wetlands with and without sediment excavation**. In addition, **we will examine whether native wetland plants increase the rate of nitrogen removal compared to invasive plants**. This project will provide valuable quantitative information that will directly influence wetland restoration and management decisions in Minnesota.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Quantifying rates of nitrogen removal from groundwater in restored wetlands **Budget: $358,000**

We will measure the quantity of nitrogen in wetland soils, plant matter, surface water, and shallow groundwater at 25 pairs of sites with and without sediment excavation and native plant species. This information will be paired with measurements of N removal via denitrification (conversion of nitrate to atmospheric nitrogen gas) to calculate N capture and removal efficiency for each restoration strategy.

Outcome	Completion Date
1. Evaluate the effect of sediment removal and native plant communities on the fate of nitrogen after it enters wetlands.	Summer 2019
2. Calculate the nitrogen capture and removal efficiency of wetlands with and without accumulated sediment and native plant communities.	Summer 2019
3. Calculate and report the reduction in groundwater nitrogen due to sediment removal and native plant communities.	Summer 2019

Activity 2: Quantify phosphorus capture and burial in wetland basins **Budget: $60,000**

We will measure the quantity of P in wetland soils, plant matter, surface water, and groundwater at sites with and without sediment excavation and native plant species. This information will be used to calculate P retention and export rates for each restoration strategy.

Outcome	Completion Date
1. Evaluate the effect of sediment removal and native plant communities on the fate of phosphorus after it enters wetlands.	Summer 2019
2. Calculate potential phosphorus storage in wetlands with and without sediment and native plant communities.	Summer 2019

Activity 3: Dissemination of results **Budget: $2,000**

We will report our results to the public through several avenues. We will participate in outreach events at the West Central Research and Outreach Center Summer Field Day located in Morris, MN. In addition we will create a fact sheet for distribution through the University of Minnesota Extension service. Finally, our results will be reported at professional society meetings frequented by state and federal natural resource management officials, and in notable peer reviewed journals.

Outcome	Completion Date
1. West Central Research and Outreach Center Summer Field Day presentations.	Summer 2019
2. At least two presentations of results at the annual meeting of the Minnesota Chapter of the Wildlife Society and presentations at the Minnesota Water Resources Conference.	Summer 2019
3. Two publications in notable peer reviewed journals, at least 1 informational flyer, and a final report of results.	Summer 2019

III. PROJECT STRATEGY

A. Project Team/Partners

Project Partners Receiving Funds:

- Dr. Jacques Finlay (Project Manager; University of Minnesota)
- Dr. James Cotner (Collaborator; University of Minnesota)

Project Partners Not Receiving Funds:

- Sheldon Myerchin (Collaborator; USFWS)
- Shawn Papon (Collaborator; USFWS)
- Dr. Chip Small (Collaborator; University of St. Thomas)

B. Project Impact and Long-Term Strategy

This research will inform land management decisions by providing valuable data about how wetland restoration practices and invasive plant species influence water quality in the state of Minnesota. Specifically, the USFWS will use the data to inform on-the-ground restoration and management decisions. In addition, we will take the initiative to share our results with Minnesota state agencies whenever possible, and public presentations of our results will be designed to reach as many of Minnesota's natural resource management professionals as possible.

C. Timeline Requirements

Collection of preliminary data and methods testing will occur this summer by a graduate student funded by U of MN. The full-scale project will begin in summer 2016 when we will take surface and buried wetland soil sediment samples to quantify nutrient storage across all basins, and we will begin annual measurements of surface water characteristics and nutrient removal rates. In 2017, we will install lysimeters in order to access and sample groundwater at regular intervals over the remainder of the study. Data and results will be analyzed and available for use by practitioners, natural resource managers, and citizens no later than summer 2019.

2016 Detailed Project Budget

Project Title: Assessing wetland restorations for improved water quality

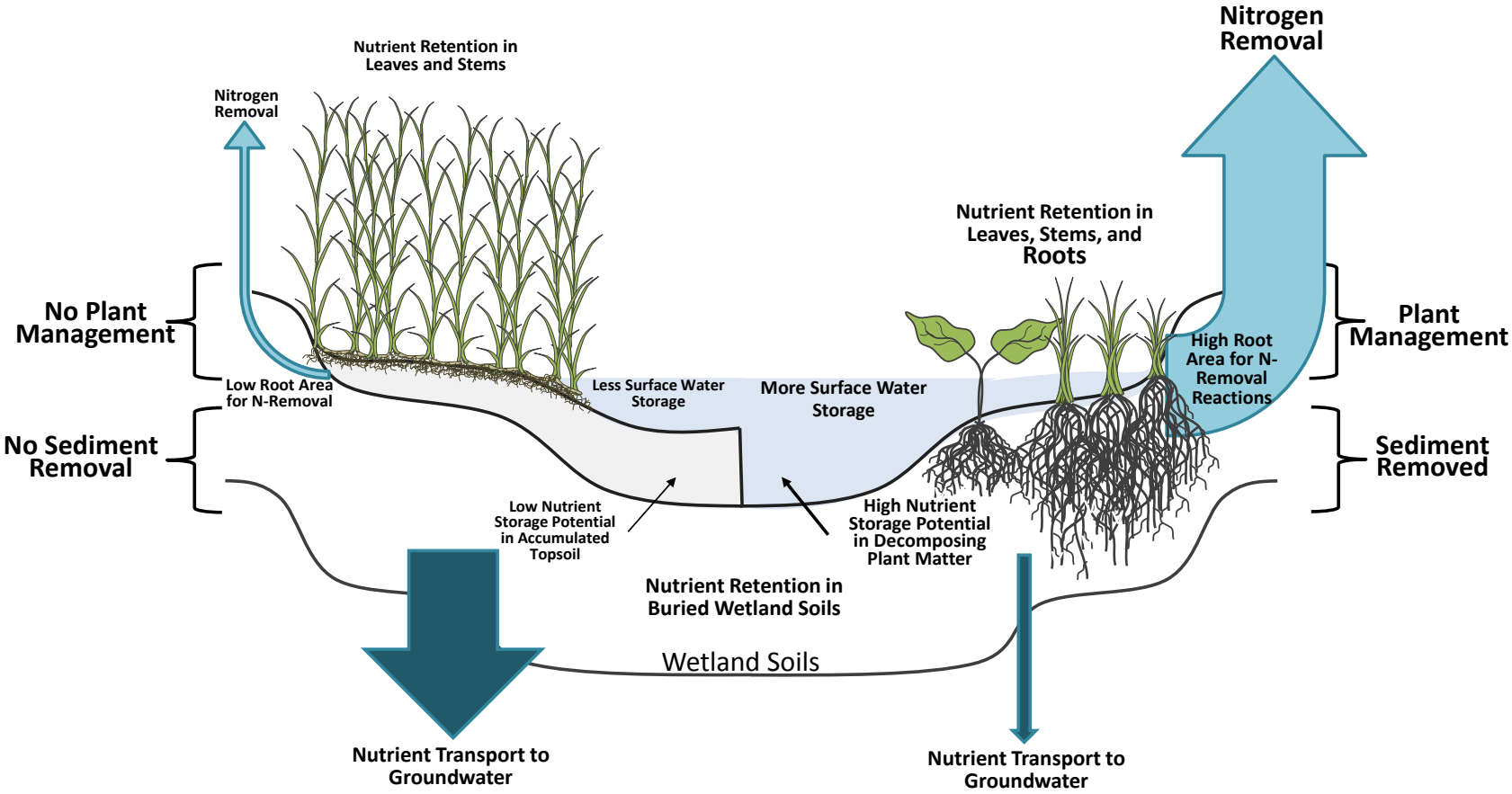
IV. TOTAL ENRTF REQUEST BUDGET - 3 years

BUDGET ITEM	AMOUNT
Personnel:	
Jacques Finlay, Project Manager (75% salary, 25% benefits); 0.5 month/year for 3 years; mentorship for graduate research assistant, and logistics and data analysis support	$ 21,000
James Cotner, Collaborator (75% salary, 25% benefits); 0.5 month/year for 3 years; logistical and technical support for P burial analyses	$ 23,000
Graduate Research Assistant (51% salary, 49% benefits during academic year; 85% salary, 15% benefits during summer); 50% FTE for 3 years; directly involved in all project activities	$ 142,000
3 undergraduate students (100% salary, 0% benefits); 44% FTE for 3 years; field and lab assistance	$ 73,000
Lab Tech (78% salary, 22% benefits); 23% FTE for 3 years; laboratory support for activity 1	$ 21,000
Jr. Scientist (78% salary, 22% benefits); 25% FTE for 3 years; lab management for all activities	$ 33,000
Equipment/Tools/Supplies:	
Glass Fiber Filters (1000/year for 3 years; $1/filter)	$ 3,000
Nalgene Sample Bottles (1000/year for 3 years; $1/bottle)	$ 3,000
Exetainers and Spare Caps for Denitrification Assays (3000 total; $1.33/exetainer)	$ 4,000
Centrifuge Tubes for Denitrification Assays and Nutrient Extractions (4000 total; $0.75/tube)	$ 3,000
Consumables including aluminum drying pans, whirl paks, 30 ml syringes, waterproof labels for sample identification, and chemicals for nutrient extractions and assays	$ 3,000
Soil Chemical Analysis: Total Nitrogen in accumulated and buried soils (600 @ $6/sample), Total Phosphorus (600 @ $12/sample)	$ 11,000
Groundwater Chemical Analysis: Total Dissolved Nitrogen (450 @ $3/sample), Inorganic Nitrogen (450 @ $14/sample), Particulate Phosphorus (450 @ $12/sample), Dissolved Phosphorus (450 @ $12/sample)	$ 18,000
Surface Water Chemical Analysis: Total Dissolved Nitrogen (450 @ $3/sample), Inorganic Nitrogen (450 @ $14/sample), Particulate Phosphorus (450 @ $12/sample), Dissolved Phosphorus (450 @ $12/sample)	$ 18,000
Denitrification Analysis (9000 @ $0.53/sample)	$ 5,000
Nitrogen Mineralization Analysis (450 @ $6.67/sample)	$ 3,000
Plant Tissue Chemical Analysis: Total Nitrogen (500 @ $6/sample), Total Phosphorus (500 @ $12/sample)	$ 9,000
Additional Field and Lab Supplies - pH, ORP, conductivity meter ($2150); 50 µL pipette ($400); shaker table ($1500); GeoPump ($1000), soil auger ($350), 50 porous cup lysimeters ($212 / lysimeter)	$ 16,000
Travel:	
Mileage cost per university reimbursement rates for graduate student travel to the Fergus Falls Field Station (364 miles; 1 trip/year); to annual meeting with USFWS partners in St. Cloud (145 miles)	$ 1,000
Car rental and mileage costs per university reimbursement rates for undergraduate student travel between the University and Fergus Falls Field Station (364 miles round trip; 1 trip/2 weeks)	$ 8,000
Additional Budget Items:	
Publication costs - 1 report; 2 papers in peer reviewed journals (20% estimated cost, $2500/publication)	$ 1,000
Printing costs - fact sheets distributed at outreach events; posters for professional meetings	$ 1,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 420,000

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period: N/A	$ -	
Other State $ To Be Applied To Project During Project Period: N/A	$ -	
In-kind Services To Be Applied To Project During Project Period: Indirect Costs (52% MTDC) associated with this proposal.	$ 187,000	Secured
Funding History: University of Minnesota provided funds for preliminary research in summer 2015.	$ 8,100	Secured
Remaining $ From Current ENRTF Appropriation: N/A	$ -	

What is the best way to restore a wetland?



Wetland restoration is the best way to improve water quality, but we still need to identify restoration practices that optimize nitrogen and phosphorus removal from groundwater and surface water.

We will examine the effects of 1) sediment removal and 2) plant communities on nutrient removal.

Jacques Finlay
Associate Professor and Director of Graduate Studies, Department of Ecology, Evolution and Behavior, University of Minnesota.

B.S., Natural Resources, with honors, 1990. University of New Hampshire, Durham, NH.
Ph.D., Integrative Biology, 2000. University of California, Berkley, CA.

Jacques Finlay will be responsible for project coordination, mentoring the graduate research assistant, and providing logistical and analytical support. Throughout his career, Dr. Finlay has studied how watershed management practices influence carbon, nitrogen, phosphorus, and mercury processing in aquatic ecosystems. He has concentrated on linking terrestrial and aquatic ecosystems, with studies focusing on the environmental controls of mercury bioavailability. In addition, he has been involved in multiple projects tracing the sources and fates of nitrogen and phosphorus in urban and rural ecosystems. His most recent work has focused almost exclusively on finding ways to improve water quality in Minnesota by decreasing nutrient transport from terrestrial ecosystems into lakes and streams. Some of his most relevant publications include:

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.

Guentzel, K.S., M Hondzo, B.D. Badgley, **J.C. Finlay**, M.J. Sadowsky, and J.L. Kozarek. 2014 Measurement and modeling of denitrification in sand-bed streams of varying land use. Journal of Environmental Quality 43:1013–1023 10.2134/jeq2013.06.0249

Hobbie, S.E., L.A. Baker, C. Buyarski, D. Nidzgorski, and **J.C. Finlay**. 2014. Decomposition of tree leaf litter in a street: implications for urban water quality. Urban Ecosystems. DOI 10.1007/s11252-013-0329-9

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

Small, G.E, J.B. Cotner, **J.C. Finlay**, R.A. Stark, and R.W. Sterner. 2013. Carbon and nitrogen transformations at the sediment-water interface across redox gradients in the Laurentian Great Lakes. Hydrobiologia DOI 10.1007/s10750-013-1569-7

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 and collaborators are equipped with the necessary space and facilities needed for the proposed studies.