Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)

Project Title: **ENRTF ID: 100-BH**

Repurposing Unprofitable Cropland: Water and Wildlife's Silver Bullet?

Category: H. Proposals seeking $200,000 or less in funding

Sub-Category: B. Water Resources

Total Project Budget: $ 199,618

Proposed Project Time Period for the Funding Requested: June 30, 2021 (2 yrs)

Summary:

We propose conducting the first statewide analysis mapping the extent of Minnesota's unprofitable cropland and estimating both the water-quality and habitat benefits of converting these lands to perennial crops/vegetation.

Name: Jason Ulrich

Sponsoring Organization: Science Museum of Minnesota, St. Croix Watershed Research Station

Title: Project Manager

Department:

Address: 16910 152nd St N

Marine on St. Croix MN 55047

Telephone Number: (651) 261-1272

Email julrich@smm.org

Web Address

Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Figure illustrating the concept of converting unprofitable cropland to perennial vegetation at the scale of the proposed project area.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%
____ If under $200,000, waive presentation?			

PROJECT TITLE: Repurposing Unprofitable Cropland: Water and Wildlife's Silver Bullet?

I. PROJECT STATEMENT

What is the statewide potential of converting unprofitable cropland to perennial vegetation?

Could this approach be the silver bullet for improving Minnesota's water-quality and habitats?

- **Our current conservation approaches have not met Minnesota's water-quality or habitat goals.**
  Despite investing millions of dollars in best management practices, water-quality has not improved demonstrably. At the same time, increases in corn and soybean acres, and changes in agricultural practices, have resulted in dramatic declines in grassland habitat critical for migratory birds and pollinators.
- **Perennial vegetation is a very effective way to improve water-quality and habitat but is too expensive.**
  It has been estimated that meeting our water-quality goals using existing best management practices will cost over a billion dollars per year. However, despite this investment, habitat will be not be significantly improved. Alternatively, perennial vegetation -- defined here as either perennial cash-crops (such as kernza or alfalfa), or permanent vegetation (such as pasture or restored prairie) -- is a very effective means of improving both water-quality and habitat but thus far has been economically impractical because it requires taking profitable cropland out of production.
- **It is estimated that at least 1 million acres of Minnesota's cropland is unprofitable.**
  Based on Midwestern studies, it is likely that 1 million acres or more of cropland in Minnesota has been unprofitable (i.e., lost farmers money) in some or all of the last 5 years. Moreover, in 2017, Minnesota's cropland was unprofitable on approximately of 2/3 of its 8 million total corn acres.
- **Targeting unprofitable cropland is the cheapest way to increase perennial vegetation in Minnesota.**
  Prioritizing unprofitable cropland for perennial vegetation makes sense because this land costs the least to take out of production and can even increase whole farm profits. These unprofitable areas are generally very wet or very dry portions of otherwise profitable fields. This concept of targeting unprofitable land is not new, and in fact, organizations such as Pheasants Forever are currently implementing it on a number of demonstration farms in Minnesota.
- **However, we do not know the statewide extent of unprofitable cropland in Minnesota, nor the water-quality and habitat benefits of converting some or all of it to perennial vegetation.**
  Presently, there is no information on the probable statewide locations and extent of unprofitable cropland, and the cumulative water-quality and habitat benefits from converting some or all of these areas to perennial vegetation. If the extent of unprofitable cropland as well as the water-quality and habitat benefits from converting these areas are significant, targeting unprofitable cropland needs to become a major focus of water and wildlife management and policy efforts.
- **We propose conducting the first statewide analysis to map the probable extent of unprofitable croplands, and quantify both the water-quality and habitat benefits of converting these areas to perennial crops or permanent vegetation.**

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Estimate the probable extent of unprofitable croplands in Minnesota. **Budget: $66,532**

We propose building upon previous work of researchers at Iowa State to estimate at a field scale the profitability of row-crop agriculture across Minnesota during the last 10 years that will reflect fluctuations in commodity prices, input costs, and swings in rainfall and temperatures. The probable statewide extent of unprofitable croplands will be determined using a GIS (geographic information systems) approach that utilizes soils, topography, cropping history, crop prices, input costs, and crop yield data. An important and unique component of

our approach will be to evaluate the size, position and shape of the estimated unprofitable areas to ensure that conversion of these areas is practical given current farming practices, equipment sizing, etc. These profitability estimates will be validated using precision-based farm profit data from the ongoing LCCMR Pheasants Forever *Growing Green Together* project.

Outcome	Completion Date
1. Compile GIS, input cost, pricing and yield data necessary for profitability analyses.	October 31, 2019
2. Generate and validate GIS maps of the probable extent of unprofitable croplands.	March 31, 2020

Activity 2: Quantify water-quality and habitat benefits of converting unprofitable cropland to perennial vegetation. **Budget: $133,086**

We propose quantifying the water-quality benefits of repurposing unprofitable croplands by predicting and comparing nutrient and sediment loads under row-crops and several perennial vegetation scenarios (e.g., kernza, alfalfa, pasture, prairie) using a GIS based field-scale hydrologic and agronomic model. Our approach entails choosing 7-10 regionally representative subwatersheds distributed across Minnesota's predominant agricultural areas in which to model scenarios. Model results will be validated using existing field scale monitoring sites and current literature. In addition, we will utilize existing models, data and analyses from efforts such as TMDL and One Water, One Plan projects whenever possible. The results from modeling these representative watersheds will be scaled up to their respective regions providing water-quality benefits from the field-scale up to the watershed-scales consistent with established water-quality goals. Habitat benefits will be determined by applying an existing scoring system based on habitat size, geometry, vegetation type and hydrologic regime.

The resulting maps of water and habitat benefits will be intersected with the mapped extent of unprofitable land from Activity 1 to create statewide maps of croplands that present the most cost-effective opportunities for conversion to perennial vegetation. These deliverables are intended for watershed and conservation managers and will also be summarized in fact sheets describing watershed scale and statewide benefits, and presented to watershed management organizations and state agencies.

Outcome	Completion Date
1. Construct and validate models predicting water-quality benefits.	January 31, 2021
2. Apply habitat scoring system and estimate habitat benefits.	January 31, 2021
3. Create maps and datasets with areas of highest cost-effective conversion opportunities.	June 30, 2021
4. Create and disseminate fact-sheets and presentations.	June 30, 2021

III. PROJECT STRATEGY

A. Project Team/Partners

This project will be led by St. Croix Watershed Research Station scientists: Jason Ulrich, Shawn Schottler and Jim Almendinger.

B. Project Impact and Long-Term Strategy

This project is the first of its kind in Minnesota to analyze the extent of unprofitable cropland and the potential water-quality and habitat benefits of converting this land to perennial vegetation at a statewide scale. Therefore, it has the potential to be an exceptionally effective and economically practical approach for significantly improving the quality of Minnesota's waters and grassland habitats. Results of this project are intended to be of immediate value to restoration projects such as BWSR One Watershed, One Plan, and can serve as a model for all of the Midwest's agricultural regions.

C. Timeline Requirements

The tasks and activities outlined in this proposal will be completed over 2 years.

2019 Detailed Project Budget

Project Title: Repurposing Unprofitable Cropland: Water and Wildlife's Silver Bullet?

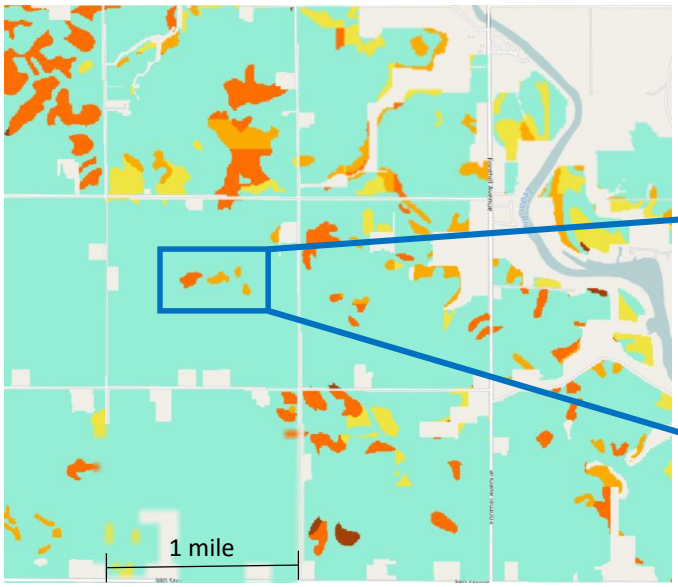
IV. TOTAL ENRTF REQUEST BUDGET 2 years

BUDGET ITEM	AMOUNT
Personnel: - Ulrich, Assistant Scientist. Science Museum of MN, Project coordination, estimating extent of unprofitable cropland, quantifying water quality benefits, watershed modeling: 75% FTE for 2 years; Salary =70%, Benefits=30% ($113,280): this is an entirely grant-funded position. - Schottler, Senior Scientist. Science Museum of MN, Cost benefit analysis, calculate habitat scores: 33% FTE for 2 years; Salary =70%, Benefits=30% ($50,438): this is an entirely grant-funded position. - Almendinger, Senior Scientist. Science Musem of MN, Assist with watershed modeling: 15% FTE for 2 years; Salary =70%, Benefits=30% ($33,840): this is a partially grant-funded position.	$ 197,558
Professional/Technical/Service Contracts:	
Equipment/Tools/Supplies: Printing Supplies, modeling software licenses	$ 1,000
Travel: -Travel to present and disseminate concept and ideas of market scenarios (2000 miles x $0.53/mile = $1060)	$ 1,060
Additional Budget Items:	
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 199,618

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period:	NA	
Other State $ To Be Applied To Project During Project Period:	NA	
In-kind Services To Be Applied To Project During Project Period: - Support services from Science Museum of Minnesota 40.83% of direct costs	$ 81,504	
Funding History:		
ENRTF M.L. 2016 Chp 76 Sec 3 Subd 08c. $179,000: Establishment of permanent habitat strips with row crops.	$ 179,000	Ends 06/2019
ENRTF M.L. 2015 Chp 76 Sec 3 Subd 03g. $900,000: Watershed-Scale Monitoring of Long-Term Best Management Practices	$ 900,000	Ends 06/2017
ENRTF M.L. 2018 Chp xx Sec xx Subd 08c. $150,000: Develop Market-Based Alternatives for Perennial Crops to Benefit Water Quality and Wildlife	$ 150,000	Ends 06/2021
Remaining $ From Current ENRTF Appropriation:	NA	

How big of an environmental opportunity does repurposing unprofitable croplands offer?



Unprofitable cropland

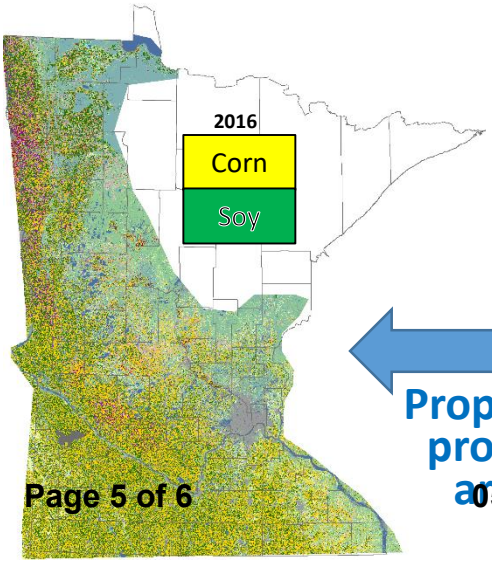
Profitable cropland

We will provide the first statewide quantitative estimate of the:

- Extent of unprofitable croplands
- Water-quality and habitat benefits of converting unprofitable croplands to perennial vegetation

Repurposed cropland

Proposed project area



Project Manager Qualifications: Jason S. Ulrich

St. Croix Watershed Research Station	Tel:	651-261-1272
Science Museum of Minnesota	Fax:	651-433-5924
Marine on St. Croix, MN 55047	E-mail:	julrich@smm.org

Research and Modeling Expertise

As a watershed modeler and hydrologist, my scientific studies focus on understanding and quantifying the effects of factors such as landuse, climate and agricultural practices on hydrology and water quality. My two principal areas of expertise are: a) modeling the behavior of agricultural watersheds using the state of the art models SWAT and HSPF, and b) geographic information systems (GIS) analysis for better understanding of field-scale hydrologic, nutrient and sediment processes using LiDAR elevation data. My work often combines modeling with GIS and statistical analyses to predict the effectiveness of proposed agricultural best-management-practices (BMP) strategies, and to understand the effects of climate change and agricultural drainage on trends in river hydrology and water quality.

Affiliations

2016-present: Assistant Scientist, St. Croix Watershed Research Station, Science Museum of Minnesota
2013-present: Ph.D. Student, Water Resources Science. University of Minnesota, Minneapolis, MN

Education

2006. M.S., Water Resources Science. University of Minnesota, Minneapolis, MN
2000. B.S., Natural Resources and Environmental Studies, University of Minnesota, Minneapolis, MN

Selected Publications

Almendinger, J.E. and **J.S. Ulrich**. 2017. Use of SWAT to Estimate Spatial Scaling of Phosphorus Export Coefficients and Load Reductions Due to Agricultural BMPs. Journal of the American Water Resources Association.

Ulrich, J.S. and P. Conrad. 2015. Cost-Effective Agricultural BMP Planning Using Precision Conservation Principles and Advanced GIS Tools: A Case Study in the Squaw Creek Watershed, Iowa. Presented at 2015 MN Water Resources Conference and 2015 Iowa Water Conference.

Schottler S. P., **Ulrich, J.S.**, Engstrom, D.E. 2016. Comment on climate and agricultural land use change impacts on streamflow in the upper Midwestern United States. Water Resources Research. DOI: 10.1002/2015WRO17323

Schottler S. P., **Ulrich, J.S.**, Belmont, P., Moore, R., Lauer, J.W., Engstrom, D.E., Almendinger, J.E. 2013. Twentieth century agricultural drainage creates more erosive rivers. Hydrological Processes. DOI: 10.1002/hyp.9738

Organization Description

The Science Museum of Minnesota (SMM) is a private, non-profit 501(c)3 institution dedicated to encouraging public understanding of science through research and education. The St. Croix Watershed Research Station the environmental research center of the SMM with the mission to foster, through research and outreach, "a better understanding of the ecological systems of the St. Croix River basin and watersheds worldwide." The SCWRS supports an active year-round program in environmental research and graduate-student training, guided by a dedicated in-house research staff with direct ties to area universities and colleges. It collaborates closely with federal, state, and local agencies with responsibility for managing the St. Croix and upper Mississippi rivers and is a full partner with the National Park Service for resource management in parks of the western Great Lakes region. Its research has played a central role in setting management policy for the St. Croix and Mississippi rivers, for establishing water-quality standards for Minnesota lakes and for developing long-term monitoring plans for the National Park Service.