Environment and Natural Resources Trust Fund
2018 Request for Proposals (RFP)

Project Title: **ENRTF ID: 184-F**

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

Category: F. Methods to Protect or Restore Land, Water, and Habitat

Total Project Budget: $ 319,063

Proposed Project Time Period for the Funding Requested: 3 years, July 2018 to June 2021

Summary:

Conduct the first statewide quantitative analysis estimating the extent of unprofitable croplands, and quantify the water-quality and habitat benefits of converting these lands to perennial vegetation.

Name: Jason Ulrich

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

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Web Address

Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Illustration of approach to converting unprofitable cropland to perennial vegetation

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

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 it be the silver bullet for achieving Minnesota's water-quality and wildlife habitat goals?

- **Achieving Minnesota's water-quality goals using standard conservation practices is too expensive.**
  It has been estimated that meeting our water-quality goals using standard conservation practices could cost over a billion dollars per year. Expansion of perennial vegetation (perennial crops or permanent vegetation) is an effective, but thus far economically impractical, way to make meaningful progress towards water-quality goals and also increase the amount of quality grassland habitat. Simply put, we need to find more cost effective ways of getting perennial vegetation on the landscape.
- **It is estimated that a million or more acres of unprofitable cropland may exist in Minnesota.**
  Based on Midwestern studies, it is likely that 1 million acres or more of cropland in Minnesota are unprofitable (i.e., lose farmers money) in some or all years. The concept of targeting this unprofitable land for conversion to perennial vegetation is not new, and in fact, organizations such as Pheasants Forever are currently implementing this concept on a number of demonstration farms in Minnesota.
- **However, we do not know the extent of unprofitable cropland in Minnesota nor the water-quality and habitat benefits of converting it to perennial vegetation.**
  Presently, there is no information on the potential statewide extent and locations of unprofitable cropland, and the cumulative water-quality and habitat benefits from converting some or all of these unprofitable croplands to perennial vegetation. If the water-quality and habitat benefits from such conversions are predicted to be significant, focusing conservation on unprofitable croplands needs to become a focus of water and wildlife management efforts.
- **We propose conducting the first statewide quantitative analysis estimating the extent of unprofitable croplands, and quantifying the water-quality and habitat benefits of converting these lands to perennial vegetation.**
  The project will first estimate locations of unprofitable croplands across Minnesota over the last ten years. Next, we will quantify the water-quality and habitat benefits of implementing perennial vegetation on these lands. The final deliverables of this project will be a statewide map and dataset of cost-effective opportunities based on the intersections between cropland profitability, water-quality benefit, and habitat benefit. These opportunities will be presented at a sub-field scale, enabling policymakers and water managers from local to state levels to evaluate the potential of this approach and develop implementation scenarios.

In order to direct future policy, Minnesota needs to know if repurposing unprofitable croplands is the silver bullet for cleaning up water and restoring habitat.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Estimate statewide extent of unprofitable croplands, i.e., where are the opportunities. **Budget: $106,354**

We propose building upon previous work of researchers at Iowa State to estimate at a sub-field scale the profitability of row-crop agriculture across Minnesota during the last 10 years of large fluctuations in commodity prices and swings in rainfall and temperatures. The statewide extent of potential unprofitable croplands will be estimated using a GIS (geographic information systems) approach that utilizes soils, topography, cropping history, crop prices, input costs, and crop yield data over the last 10 years. 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 and cost data necessary for profitability analyses	January 31, 20[r21][JU2]19
2. Generate and validate GIS dataset of the statewide extent of unprofitable croplands.	June 30, 2019

Activity 2: Quantify water-quality and habitat benefits of converting unprofitable cropland to perennial vegetation. **Budget: $212,709**

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 crop and permanent vegetation scenarios using a GIS based field-scale model. Our approach entails choosing 7-10 regionally representative subwatersheds distributed across Minnesota 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, WRAPS and One Water, One Plan projects whenever possible. The results from modeling these representative watersheds will be scaled up to their respective regions providing aggregated water-quality benefits at scales consistent with established water-quality goals. Habitat benefits will be determined with a scoring system developed based on habitat size, geometry, vegetation type and hydrologic regime.

The resulting water-quality and habitat benefits will be intersected with the extent of unprofitable land from Activity 1 to create statewide maps and spatial datasets of row-cropped lands that present the most cost-effective opportunity for conversion to perennial vegetation. Results will be also 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.	June 30, 2020
2. Develop habitat scoring system and estimate habitat benefits.	June 30, 2020
3. Create maps and dataset with areas of greatest cost-effective 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 benefits of converting row-cropped 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 projects such as BWSR One Watershed, One Plan and MPCA Watershed Restoration and Protection Strategies, and can serve as a model for all of the Midwest's agricultural regions.

C. Timeline Requirements[r24]

The tasks and activities outlined in this proposal will be completed over 3 years.

2018 Detailed Project Budget

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

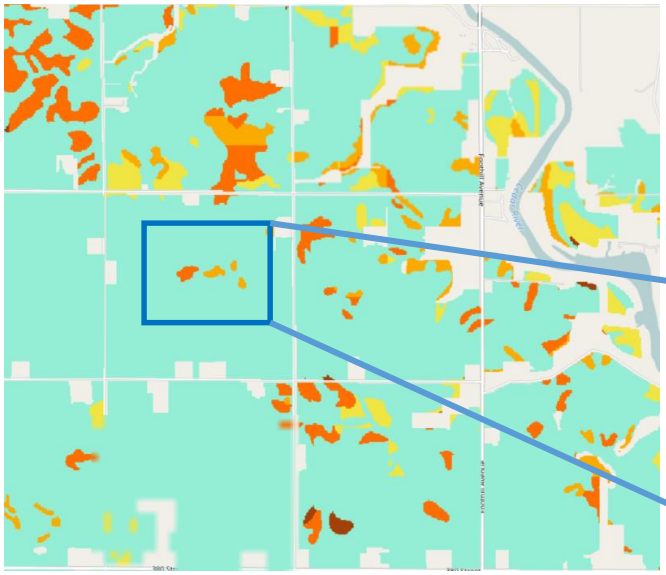
IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel: - Ulrich, Assistant Scientist. Science Museum of MN, Project coordination, estimating extent of unproitable cropland, quantifying water quality benefits, watershed modeling: 75% FTE for 3 years; Salary =70%, Benefits=30% ($172,012) - Schottler, Senior Scientist. Science Museum of MN, Cost benefit analysis, calculate habitat scores: 33% FTE for 3 years; Salary =70%, Benefits=30% ($94,951) - Almendinger, Senior Scientist. Science Musem of MN, Assist with watershed modeling, 15% FTE for 3 years; Salary =70%, Benefits=30% ($50,040)	$ 317,003
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 =	$ 319,063

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	$ 130,274	
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
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

Project Manager Qualifications: Jason S. Ulrich

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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.