Environment and Natural Resources Trust Fund
2010 Request for Proposals (RFP)

LCCMR ID: 142-E2

Project Title:

Strategic Planning for Minnesota's Natural and Artificial Watersheds

LCCMR 2010 Funding Priority:

E. Natural Resource Conservation Planning and Implementation

Total Project Budget: $ $327,000

Proposed Project Time Period for the Funding Requested: 2 years, 2010 - 2012

Other Non-State Funds: $ $0

Summary:

Apply modern imaging technology to create a long-term strategic plan aimed at preventing pollutants from drain tiles and ditches from reaching the natural watersheds of the state.

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Sponsoring Organization: U of MN

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Location:

Region: Statewide

County Name: Statewide

City / Township:

_____ Knowledge Base _____ Broad App. _____ Innovation

_____ Leverage _____ Outcomes

_____ Partnerships _____ Urgency _____ TOTAL

MAIN PROPOSAL

PROJECT TITLE: Strategic Planning for Minnesota's Natural and Artificial Watersheds.

I. PROJECT STATEMENT

WHY THIS PROJECT IS IMPORTANT. Minnesota's vast natural watershed of lakes, ponds, rivers, and streams is one of our state's most precious resources. Interwoven with this vast natural watershed is a large artificial watershed of agricultural drain tiles and ditches, which dump excess water from the artificial watershed into the natural one. Nitrates, phosphorus, estrogenic compounds, pharmaceuticals, and other synthetic chemicals accompany the water and reach the natural watershed through a complex array of drain tiles that underlie agricultural fields, designed to lower the water table and enhance soil productivity. Once in the natural watershed, these chemicals create widespread potential for health problems in animals, humans, and the environment. The technology to address these problems is now available and this project will identify how and where that technology can be applied without delay.

GOALS OF THE PROJECT. The ultimate goal of the project is to restore and maintain the integrity, purity, and health of the state's natural waters by identifying optimal couplings between the artificial watershed of drain tiles and ditches and the natural watershed of lakes, ponds, rivers, and streams. This means disentangling the two watersheds by locating buffers and basins of native perennial vegetation matched to the natural topography or constructed with artificial landscaping to achieve several important sub-goals: (1) to filter drain waters before they reach our natural watersheds, (2) to expand wildlife habitat across the state and expand natural corridors along our fields and streams, (3) to increase our available supply of renewable energy and help the local economy by harvesting biofuel from the buffers and basins, and (4) to reduce Minnesota's greenhouse gas emissions and increase its carbon sequestration through the associated biofuel operations.

HOW THE GOALS WILL BE ACHIEVED. The natural watershed of the state is largely fixed, but the artificial watershed is continually being upgraded and replaced as it ages. That continual upgrading provides the opportunity to progressively reduce discharges by planning the upgrades so that waters proceed across buffers and into basins. Progress can begin immediately upon completion of this project and will continue into the indefinite future, with the entire watershed of the state being upgraded incrementally with time at feasible costs.

We will use the most accurate elevation models from LIDAR images presently available for portions of the state (see map) and will combine that with other available data including USGS 30m digital elevation models of the surface, standard aerial photography, and other relevant elevation data. We will apply existing geographic software together with new custom computer software to "fly over" the spatial data, analyzing the lowlands, uplands, and connecting waterways to determine where buffers and basins can be placed naturally, and where modifications such as stream-bed restoration or ditch-bank modifications would be useful.

The results of this project will be available for immediate consideration and implementation where LIDAR is ready. The methods and software developed in the project will be thoroughly documented and available to other regions of the state as LIDAR coverage expands (e.g., as a result of S.F. No. 2106, pending legislation). Naturally and over time the waters of our state can be restored to be as they were when we first encountered them.

II. DESCRIPTION OF PROJECT RESULTS

Result 1. Geographic Spatial Database **Budget:** $ 59,000

Background data will be gathered and organized into a common geographic database. These data include topography, elevation, soils, land cover, and slopes combined with locations of tiles, ditches, streams, rivers and other surface water bodies.

Deliverable Completion Date Dec 2010

1. Assembled spatial data
2. Data maps and reports

Result 2. Computer Topographic Software **Budget:** $ 84,000

Existing geographic software will be supplemented with custom software that can "fly over" the land-cover data, analyzing watersheds to determine where buffers and basins can be placed naturally and where landscape modifications would be desirable and feasible.

Deliverable Completion Date Dec 2011

1. Procedures and documentation on methods of analysis
2. Geographic software and documentation

Result 3. Analyses of Artificial Watershed Improvements **Budget:** $ 184,000

Analyzing the assembled data with GIS and custom computer algorithms and validating the results with field observations, public input, and expert opinion. Resulting maps and reports will be made available for public use.

Deliverable Completion Date June 2012

1. GIS-based maps and reports analyzing and documenting the artificial watershed of the state. These maps and reports will be made freely available for public use.
2. GIS-based maps and reports identifying the locations within artificial watersheds which are optimal for treating tile drain effluents based on considerations of topography, soils, and environmental benefits.

III. PROJECT STRATEGY

A. Project Team/Partners

David Mulla (UMN Soil, Water, and Climate) is the project manager. In addition, ***Clarence Lehman*** (UMN, Ecology) will provide his long-time software expertise to design algorithms, carry out the computer computations, data processing, and geographic mapping, and work with research associates and graduate assistants. ***Donald Wyse*** (UMN, Agronomy) will contribute his expertise on agricultural systems, including parameters related to their drainage and sustainability. He will provide essential connections with government and industry, including those who must supply information and those who can use the results. His 2008 symposium on biofuel buffer strips and the workshop that followed gave rise to some of the ideas in this proposal. Project team partners will coordinate their efforts with several other ongoing related research efforts including the LCCMR Ecological Ranking of CRP project led by Julie Klocker at BWSR, the MDA Targeting BMP project led by David Mulla, and the LCCMR water/biofuel project led by Clarence Lehman.

B. Timeline Requirements

This is proposed as a two-year project. Its first year will involve data assembly, algorithm validation and development, analysis, and preparation of preliminary maps and tables. A series of workshops in the first year will make the project known and gather information from stakeholders. The second year will apply the methods developed in the first year to the designated areas of the state, culminating in final reports and presentation workshops.

C. Long-Term Strategy

High-resolution radar data are presently available for a fraction of the state (see map), but large-scale efforts are proposed to cover the entire state in the near future (e.g., S.F. No. 2106, pending legislation). That will be completed within five years and the methods developed in this project will be immediately available to utilize it as it emerges. The state-wide results will be available as drainage systems are gradually rebuilt and improved as they age. The beneficial consequences of this project will therefore ripple through the century.

Project Budget

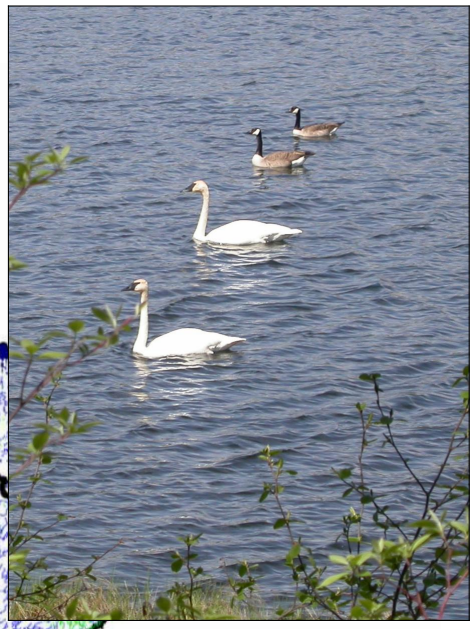
IV. TOTAL PROJECT REQUEST BUDGET (Two years)

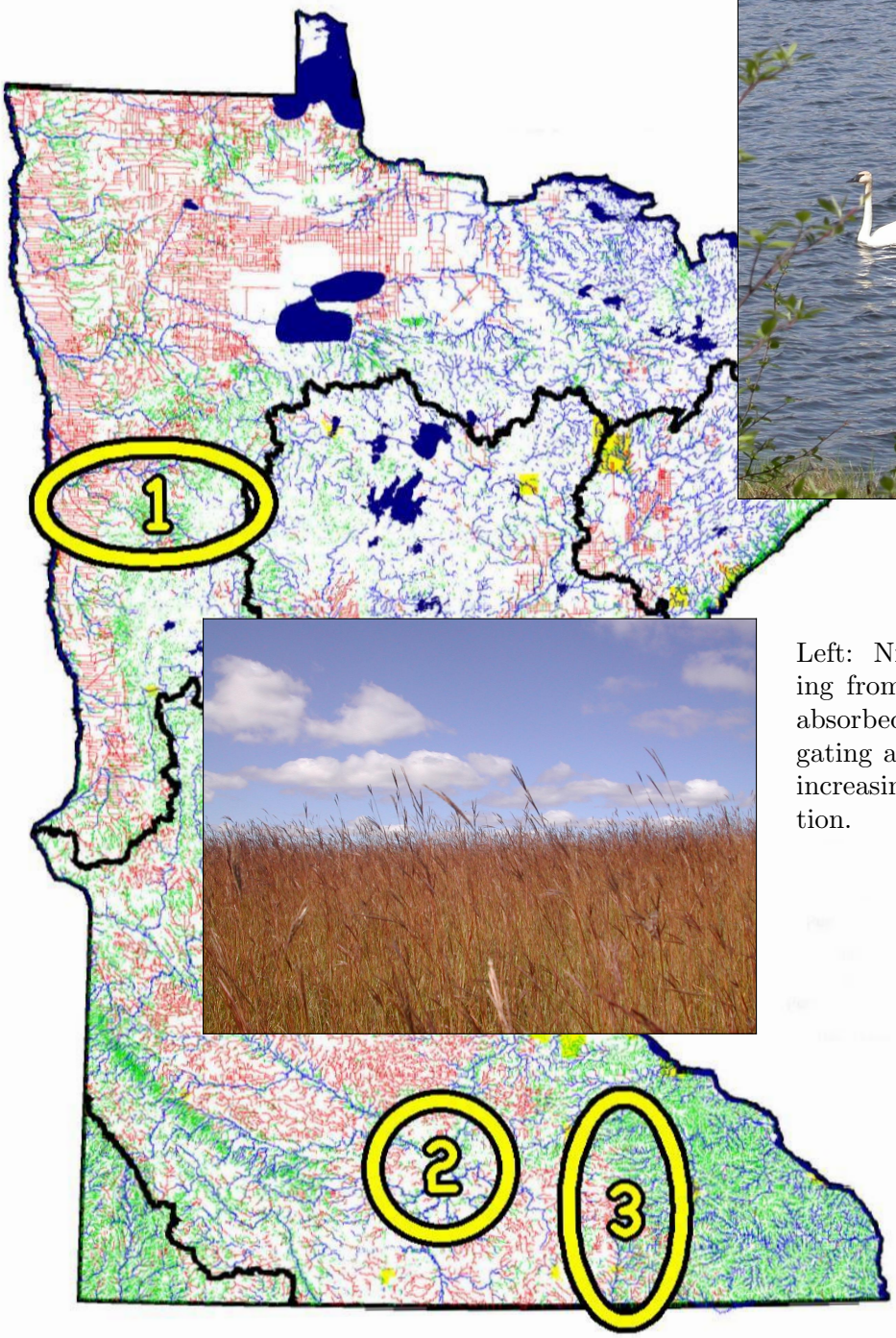
BUDGET ITEM (See list of Eligible & Non-Eligible Costs, p. 13)	AMOUNT	
Personnel: One Research Associate 43% time to work on application of existing software and development of custom software for spatial data analysis. Salary $63,840 fringe @ 32.3% $20,620	$	84,460
One Post-doctoral associate @ 100% time to work on creation of GIS-based maps and reports documenting artificial versus natural watersheds in MN. Salary $83,116 and fringe @ 19.75% $16,416.	$	99,532
One graduate Research Assistant @ 50% time to help post-doc work on creation of GIS-basd maps and reports documenting artificial versus natural watersheds in MN. Salary $39,49 and fringe @ 77% $30684	$	70,533
One civil service GIS technologist @ 12% time to develop or modify needed spatial data processing necessary for custom software development. Salary $13,897 and fringe @ 37% $5142	$ 19,039	
Contracts: contract for aircraft flights to acquire current images of areas with drain tiles for input to the geographic information system and subsequent use in custom software analysis.	$	20,000
Equipment/Tools/Supplies: LIDAR software be purchased and used for input to the custom software analyses used to locate strategic positions for vegetated buffers and basins.	$	20,000
GIS lab and licensing fee to be used for GIS processing of digital elevation	$ 4,000	
Travel: travel in-state for site visits to Rochester, Lamberton, and Crookston, MN and local workshops by project participants. Includes meals	$	6,650
Additional Budget Items: Local workshops to disseminate results of project findings. Include box lunches or the equivalent ($650), printing and duplicating of pamphlets that present research results ($2130)	$	2,786
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$	327,000

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period:	**$ -**	
Other State $ Being Applied to Project During Project Period:	**$ -**	
In-kind Services During Project Period:	**$ -**	
Remaining $ from Current Trust Fund Appropriation (if applicable):		
Funding History:	**$ -**	

Right: Swans and geese on a prairie pothole basin. Buffers and basins will purify water and serve wildlife and recreation as well.





Left: Nitrate pollutants draining from agricultural fields are absorbed in biofuel buffers, irrigating and fertilizing them and increasing their biofuel production.

Map of the surface hydrology and drainage of Minnesota. Strategic planning for Minnesota's natural and artificial watersheds will begin in three representative areas that have broad data coverage, amenable topography, and good local knowledge: (1) Mahnomen or Norman Counties in the Red River Watershed, (2) Blue Earth County in the Minnesota River Watershed, and (3) Dodge or Mower Counties in the Mississippi River Watershed. Starting here and extending to the state, the project will identify locations for basins and buffers that can absorb pollutants before they reach the natural watershed.

Project Manager Qualifications and Organization Description

Project Manager: David Mulla

Current Position: Professor and Larson Chair for Soil and Water Resources; Dept. Soil, Water & Climate; University of Minnesota. This department is ranked nationally in the top 5 for research productivity and quality on soil, water and environmental quality issues.

Education:

- Ph.D (1983) Purdue Univ.; W. Lafayette, IN
  - Agronomy with emphasis on Soil Physics
- MS: (1981) Purdue Univ.; W. Lafayette, IN
  - Agronomy with emphasis on Soil Chemistry

Experience:

Twenty six years experience in research on soil and water resources at two Land Grant Universities (Washington State Univ. 1983-1995; Univ. Minnesota 1995-present). Appointed Founding Fellow to Univ. MN Institute on Environment in 2007. Elected Fellow Soil Science Society of America (1997) and Fellow American Society of Agronomy (1999). World Pioneer in research on Precision Agriculture and Precision Conservation. Co-leader of Energy Production and Use Team for LCCMR Statewide Conservation Plan (2008). Member, Scientific Advisory Panel for Lake Pepin TMDL Process, St. Paul, MN. (2005-present). Member, Gulf of Mexico Hypoxia Task Force for White House Committee on Environment and Natural Resources, (1998). Team Leader Environ. Quality Board GEIS Animal Agriculture Water Quality Impacts (1999-2001). Published 110 refereed articles on Soil and Water Resources in scientific journals. Awarded over $12 million in scientific research grants. Invited to present research findings at conferences and workshops in 20 countries around the world.

--Major projects have included:

- Integrated modeling and management of the Minnesota River Basin. Funded by NSF/EPA for $813,000 from 1996-1999.
- Sustainable farming systems. Funded by LCCMR for $910,000 from 1997-2001.
- Generic Environmental Impacts Study of Animal Agriculture. Funded by Environ. Quality Board for $132,000 from 1999-2001.
- Paired watershed nutrient reduction strategies. Funded by USDA-CSREES for $539,000 from 2001-2005.
- Minnesota Statewide Conservation and Protection Plan. Funded by LCCMR for $496,000 from 2007-2008.
- Statewide ecological ranking of CRP and other critical lands. Funded by LCCMR and Emerging Issues Fund for $275,000 from 2009-2011.

Organization Description

The University of Minnesota is both the state land-grant university, with a strong tradition of education and public service, and the state's primary research university