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

LCCMR ID: 017-A2

Project Title:

Sustainability Through Waste Streams: Cleaning Water with Bioenergy

LCCMR 2010 Funding Priority:

A. Water Resources

Total Project Budget: $ $444,000

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

Other Non-State Funds: $ $0

Summary:

Measure threats to groundwater quality from estrogenic compounds, pharmaceuticals, and nutrients in land-applied waste streams and identify management techniques that both intercept those contaminants and increase bioenergy yields.

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Sponsoring Organization: U of MN

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Location:

Region: Regional

County Name: Anoka

City / Township: Bethel

_____ Knowledge Base _____ Broad App. _____ Innovation

_____ Leverage _____ Outcomes

_____ Partnerships _____ Urgency _____ TOTAL

MAIN PROPOSAL

PROJECT TITLE: Sustainability Through Waste Streams: Cleaning Water with Bioenergy

I. PROJECT STATEMENT

Why this project is important. Waterborne pollutants continually escape from our cities and farms and enter the natural watershed, passing from the surface of the land through the soils to the groundwater below, or running from drainage systems directly into rivers and streams. Nitrates, estrogenic compounds, pharmaceuticals, and other pollutants in the watershed engender health problems in humans and animals alike—health problems so severe in some cases as to destroy the reproductive capacity of male fish and decimate whole fish populations. Yet little is known of exactly how these compounds reach the natural watershed on their waterborne journey from the surface through the soil to the groundwater, or how to arrest them on that journey. This project is poised to answer those crucial questions that are of imminent importance in protecting the waterways of our state and the health of its inhabitants.

Goals of the project. Our overall goal is to identify the benefits of utilizing waste streams, such as reclaimed waste water and/or biosolids, to increase the productivity of perennial crops grown for biofuel while cleaning the water. Knowing this will initiate the design of natural structures to purify water before it reaches streams and aquifers. The project has three specific sub-goals:

- *To demonstrate the influence of different land management practices on the risk of groundwater contamination from pharmaceuticals, estrogenic compounds, and nutrients present in land-applied wastes.*
- *To demonstrate the increased bioenergy potential of perennial crops receiving waste streams.*
- *To disseminate information to key stakeholders including educators, students, policy makers, and the general public.*

How the goals will be achieved. This project will impose additional waste stream treatments onto an already established "ecological observatory", a well replicated experiment, at the University's Cedar Creek field site. Instruments already installed at the site will be used to track estrogenic and pharmaceutical compounds applied at land surface. New methods for tracing these compounds will be used to learn what portions (1) reach the groundwater, (2) are retained in the soil, (3) are removed by the root systems, and (4) are translocated to leaves and stems where they may be burned for bioenergy and thus eliminated from the environment. We will use USGS facilities and methods, which are among the best in the world, for analysis of the compounds. Biofuel productivity will be assessed annually.

II. DESCRIPTION OF PROJECT RESULTS

Result 1: *Pharmaceutical, estrogenic compound, and nutrient tracking.* **Budget:** $422,000

Deliverable	**Completion Date**
1. Soil hydrology model for assessing transport and groundwater recharge.	*6/30/2011*
2. New chemical processing methods developed and documented.	*6/30/2012*
3. Final analysis communicated through presentations and reports.	*6/30/2012*

Result 2: *Biofuel production assessment.* **Budget:** $14,000

Deliverable	**Completion Date**
1. Final productivity analysis communicated through presentations and	*6/30/2012*

reports.

Result 3: *Educational media and program development.* **Budget:** $8,000

Deliverable	**Completion Date**
1. Project web page, established already but will continually be updated	*6/30/2012*
2. Tours led by researchers and professional educators, ongoing throughout the project	*6/30/2012*
3. *Public educational materials including handouts, brochures, etc.*	*6/30/2012*

III. PROJECT STRATEGY

A. Project Team/Partners

This project is a continuing partnership between the University of Minnesota (UMN) and the United States Geological Survey (USGS). Team members from the USGS include Mindy Erickson, Jared Trost, and Richard Kiesling. Team members from the UMN include Clarence Lehman (Project Manager), David Tilman, John Nieber, and Donald Wyse. Bioenergy, ecological, and soil processes are aspects managed by the UMN; contaminant analysis, surface and groundwater hydrology and chemical processes are aspects managed by the USGS. The UMN will receive $162,000 and the USGS will receive $282,000 in this proposal.

B. Timeline Requirements

This is a two-year proposal. Its first year will monitor the applied estrogenic, pharmaceutical, and nitrogen compounds as they are taken up by plants, retained in the soil, or move through the soils toward the groundwater. It will use new measurement techniques developed in the prior project to determine exactly how the compounds are partitioned in plant tissues, waters, and soils. Its second year will validate the first year's findings and be used for evaluation, analysis, and reporting.

The existing LCCMR/USGS project that established the observatory site has already uncovered important facts guiding the design of the proposed project:

- Contaminants can move surprisingly slowly even through porous soil and therefore can produce their effects for extended periods of time (up to 2 years or more after application).
- Nitrate contaminants escaping from agricultural fields as runoff (up to 7 $g/m^2/yr$ or more) can be used as fertilizer to increase yields in associated prairie biofuel buffers and to simultaneously prevent the contaminants from reaching streams and aquifers.
- Pharmaceutical compounds are present in the aboveground portion of biofuel plant material and therefore capable of being removed by prairie plants grown under field conditions for biofuel.

These results indicate a significant potential for both cleaning water and increasing energy yields by intersecting waste streams with biofuel production.

C. Long-Term Strategy

This project is part of a long-term strategy to use perennial buffers and basins to accomplish water purification, energy production, and other services to society. The present project is designed to provide that necessary parameters for to guide those long-term strategies. Perennial landscapes can purify tile drainage, sub-surface flow, and surface runoff from agricultural and urban areas before the waters reach our streams, lakes, and aquifers. That will not only help our waters but will also irrigate and partially fertilize biofuel areas, increasing yields for farmers and in the process improving the state's carbon footprint.

Project Budget

INSTRUCTIONS AND TEMPLATE (1 PAGE LIMIT)

Attach budget, in MS-EXCEL format, to your "2010 LCCMR Proposal Submit Form".

(1-page limit, single-sided, 11 pt. font minimum. Retain bold text and delete all instructions typed in italics. ***Add or delete rows as necessary.*** *If a category is not applicable you may write "N/A" , leave it blank, or delete the row.)*

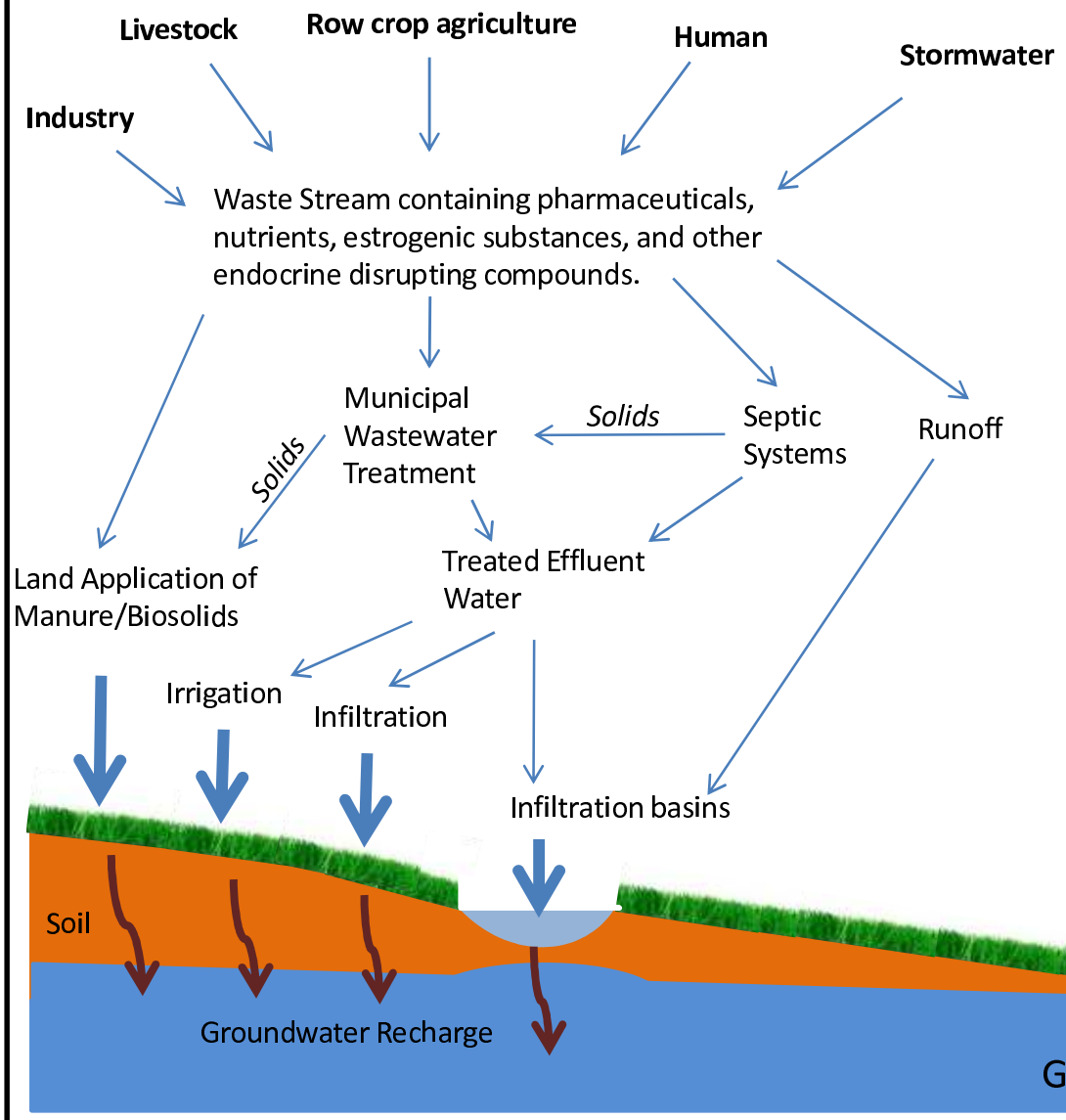
IV. TOTAL PROJECT REQUEST BUDGET (*[Insert # of years for project]* years)

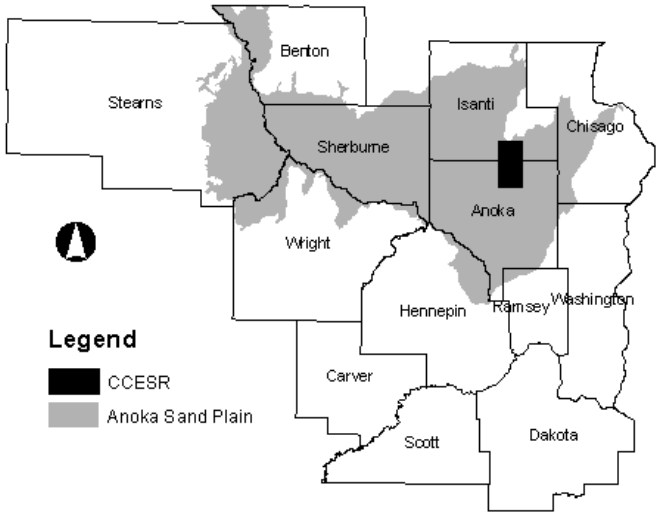
BUDGET ITEM *(See list of Eligible & Non-Eligible Costs, p. 13)*	**AMOUNT**
Personnel: Academic Salaries for data analysis, project presentation, disseminating results (1 person 15% FTE over 2 years, 32.3% toward benefits)	$ 33,000
Civil Service Salaries for managerial positions associated with field data collection and data management (2 people, 20% FTE over 2 years, 37% toward benefits)	$ 49,000
Civil Service Salaries for education coordinator (1 people, 4% FTE over 2 years, 37% toward benefits)	3,000
Civil Service Salaries for seasonal positions to apply experimental treatments and for field data collection (2 people, 35% FTE over 2 years, 37% toward benefits)	42,000
Civil Service Salaries for educational media development (1 person, 14% FTE, 9.3% toward benefits)	5,000
Contracts: USGS contract for equipment, personnel, and analytical cost associated with chemical analysis, data collection, methods development, database management	$ 282,000
Equipment/Tools/Supplies: Irrigation Supplies including garden hoses, sprinkler heads, PVC, PVC cement, valves, plumbing supplies, and related items.	6000
Treatment application supplies and sampling supplies (no item over $3500) including fertilizer, chemicals, sprayers, safety equipment, soil cores, hardware, hand tools, sample bottles, filters, tubing, clippers, bags, labels, storage vials, pumps, and related items.	17000
Travel: For presenting project results to stakeholders across the state	$ 1,000
Additional Budget Items: Laboratory services for analysis of water, soil, and plant samples	4000
Repair of field equipment	1000
Shipping of samples and field equipment	1000
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ 444,000

V. OTHER FUNDS

SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ Being Applied to Project During Project Period: *Indicate any additional non-state cash $ to be spent on the project during the funding period. For each individual sum, list out the source of the funds, the amount, and indicate whether the funds are secured or pending approval.*	$ 150,000	*Pending*
Remaining $ from Current Trust Fund Appropriation (if applicable): *Specify $ and year of appropriation from any current Trust fund appropriation for any directly related project of the project manager or organization that remains unspect or not yet legally obligated at the time of proposal submission. Be as specific as possible. Describe the status of $ in the right-most column.*	$ -	*All spent or legally obligated*
Funding History: *Indicate funding secured prior to July 1, 2010 for activities directly relevant to this specific funding request. State specific source(s) of funds.*	$ 1,069,000	

Managing the surface is the key to clean water





This project is being done on the Anoka Sand Plain, an area of Minnesota where highly permeable soils expose groundwater and connected surface waters to contamination.

As humans, we greatly impact the thin upper two feet of soil. Can we manage this buffer such that waste streams become beneficial rather than environmental problems?

Project Manager Qualifications

Clarence Lehman is an adjunct faculty member in the Department of Ecology, Evolution, and Behavior, College of Biological Sciences, at the University of Minnesota. For six years he served as Associate Director of Cedar Creek Natural History Area, the University's ecological research site, where this project is proposed to be situated. (Now named Cedar Creek Ecosystem Science Reserve.)

His academic degrees are all from the University of Minnesota, with Masters and PhD received studying under Prof. David Tilman, one of the participants in this proposed project. Clarence Lehman's research covers theoretical, experimental, and computational ecology, renewable biofuel energy and the planet's future temperature trajectory, biodiversity and its ecosystem properties, connections between ecology and economics, and restoration of natural habitats. He has restored several areas of native prairies, savannas, and wetlands in northwestern Minnesota and maintains them through specialized experiments for adaptive management (www.cedarcreek.umn.edu/lehman/2001-01-26/).

Clarence Lehman has experience designing a number of experiments related to the present proposed project, including the computerized aspects of the design and layout of Cedar Creek's two long-term biodiversity experiments and its long-term carbon dioxide enrichment experiment. He also has designed and managed three practical prairie experiments located in northwestern Minnesota to determine best establishment practices, seeding times, and burning frequencies for restored native prairies. He is the project manager on two LCCMR grants, one on bioenergy and water purification, another on bioenergy and wildlife conservation. He also designed and established a new prairie biofuel experiment located on the St. Paul Campus of the University of Minnesota, in partnership with David Tilman.

Scientific papers authored and coauthored cover topics such as biodiversity and the functioning of ecosystems, habitat destruction and extinction, competition among species, environmental change, long-term carbon cycling, and ecological economics. (www.cedarcreek.umn.edu/biblio/citation/iaLehman.html). He was a principle author of the prescribed burning plan for maintaining prairie areas at Cedar Creek and a co-author on the Science paper on carbon-negative biofuel (Tilman et al., Science 314:1598-1600, Dec. 8, 2006). He also has long-term experience in computer science and practical experience in the business world. Software development related to this project includes a computer system to select native prairie plants suited to a specified geographic location in Minnesota under specified soil, moisture, and sunlight conditions.

Organization Description

Cedar Creek Ecosystem Science Reserve is a research station, managed and funded through the College of Biological Sciences at the University of Minnesota. Cedar Creek's mission is to understand our planet's ecosystems and how they are changing under human pressures.