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

LCCMR ID: 038-A3

Project Title:

Fecal Bacteria in Soil and Subsurface Drainage Water

LCCMR 2010 Funding Priority:

A. Water Resources

Total Project Budget: $ $381,604

Proposed Project Time Period for the Funding Requested: 3 years, 2010 - 2013

Other Non-State Funds: $ $0

Summary:

This project will quantify movement and persistence of fecal bacteria in agricultural soils and subsurface drainage water and provide guidance to resource managers on manure application to drained agricultural lands.

Name: Jeffrey Strock

Sponsoring Organization: U of MN

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Web Address:

Location:

Region: SW

County Name: Redwood

City / Township:

_____ Knowledge Base _____ Broad App. _____ Innovation

_____ Leverage _____ Outcomes

_____ Partnerships _____ Urgency _____ TOTAL

MAIN PROPOSAL

PROJECT TITLE: Fecal Bacteria in Soil and Subsurface Drainage Water

I. PROJECT STATEMENT

Pathogenic bacteria, such as Salmonella and enterohemorragic *E. coli* can cause potentially life threatening illnesses in humans and livestock. Although pathogenic bacteria are commonly found in both agricultural and non-agricultural watersheds, it is often difficult to ascertain the sources of these contaminants in surface water due to the presence of multiple input sources. Wildlife, such as white-tailed deer and Canada geese, can also be a significant nonpoint source of fecal bacteria and pathogens in many areas. However, animal manure application to agricultural land is often cited as a major nonpoint source of bacteria to surface water systems. This can lead to surface water impairment and restrictions on their use for recreational activities or animal waterings. The fate and transport of pathogens in soils receiving livestock manure is a complex issue. Surface runoff represents the greatest contamination risk for surface waters. However, under current manure application practices, leachate from manure-amended fields reaching subsurface tile drains also often exceeds water quality standards. The availability of fecal pathogens for transport in runoff or leachate is largely influenced by the survival rate of these bacteria in soil. Moreover the effect of soil freeze/thaw cycles on bacteria survival is not well understood. Tile drained land represents a large portion of the agricultural landscape in the Northern Corn Belt, including much of the highly productive agricultural areas of Minnesota. Despite the benefits of drainage systems, they are increasingly being recognized as potential contaminant sources for surface waters.

The quantity of manure nutrients and pathogens transported to tile drains is a function of the properties of the soil, field practices (tillage, drainage, and application method), antecedent soil moisture conditions, and weather. Not all of these factors can be controlled or managed to minimize access of manure to tile drains. This project will use a multi-scale approach to evaluate fecal bacterial survival in soil systems and the impact of drainage water management on manure nutrients and fecal bacterial loading in subsurface drainage water. Two field scale sites, 36 and 55 acres, and one plot scale site with no manure history will be established and monitored for nutrients and bacteria related to current water quality impairments in Minnesota. Soil and manure samples will be collected and analyzed for the presence and survivability of fecal bacteria and pathogens (*Salmonella* and *E. coli*). In addition, DNA fingerprinting techniques will be used to identify sources of bacteria in soil, water, and manure samples.

II. DESCRIPTION OF PROJECT RESULTS

Result 1: *Drainage water management and pathogen source and transport characterization.*
Budget: $181,052

Water sampling from the outlets of field and plot scale drainage systems. Discrete samples will be collected from storm events and base flow to characterize drain flow, nutrient and pathogen loads.

Deliverable	Completion Date
1. *Water quantity and quality comparison of drainage water management systems.*	*07/2013*
2. *Identification of fecal bacteria source.*	*07/2013*
3. *Development of management guidelines for manure applied to tile drained lands to minimize water quality impairments while maintaining*	*07/2013*

agricultural productivity.

Result 2: *Persistence and source of fecal bacteria in manured agricultural soil.*
Budget: $ 193,052

Soil samples will be collected before and after land application of animal manure to characterize present fecal bacteria and identify bacteria sources. Soil sampling will occur after application of animal manure to characterize fecal bacteria survival and growth.

Deliverable	Completion Date
1. Quantification of background levels of soil fecal bacteria.	*07/2013*
2. Identification of fecal bacteria source.	*07/2013*
3. Quantification of soil fecal bacteria survival and growth rates.	*07/2013*

Result 3: *Educational programming*
Budget: $7500

A field day and workshop will be held to convene agricultural producers, drainage contractors, researchers, and other stakeholders to interact on issues related to manure and drainage water management for productivity and environmental enhancement.

Deliverable	Completion Date
1. Field day and workshop	*07/2013*
2. Field day proceedings and bulletin on manure management under drained agricultural land	*07/2013*

III. PROJECT STRATEGY

A. Project Team/Partners

Brian Hicks, farmer/ cooperator from Redwood County is providing the field scale site.

Researchers from the University of Minnesota will provide data collection and analysis. Dr. Jeff Strock will be responsible for project management and administration as well as soil, water, and manure sample collection and nutrient analysis. Dr. Sagar Goyal, will be responsible for soil, water, and manure analysis for fecal bacteria and pathogens and Dr. Michael Sadowsky will be responsible for DNA fingerprint analysis to identifying sources of bacteria in soil, water, and manure.

B. Timeline Requirements

This project will require three years of study to ensure adequate characterization of the survivability of pathogens in soil and to ensure that an adequate number of drainage events are sampled to characterize pathogen sources and transport under conventional and controlled drainage practices.

C. Long-Term Strategy

This project is one component of a long-term project initiated in 2005 at the Hicks family farm near Tracy, MN Redwood County. A paired analysis approach is being used to evaluate the effect of field-scale drainage water management (controlled vs conventional drainage) on crop performance, drain flow volume, and nutrient loss to surface water. The long-term goal of this project is to implement drainage water management practices that have both agronomic and environmental benefits.

Project Budget

IV. TOTAL PROJECT REQUEST BUDGET (Three year project)

BUDGET ITEM	AMOUNT
Personnel:	$ -
Two University of Minnesota Post-Doctoral Fellows at 50% time for bacterial analysis (salary $40,000/year plus 19.75% fringe) for 3 years	$ 287,400
University of Minnesota technician at 10% time for sample collection (starting salary $4,502/year plus 32.7% fringe, includes 3% annual increase) for 3 years	$ 18,280
Contracts:	$ -
Land owner for cooperation and access to field site for soil and water sampling ($2,500/year) for 3 years.	$ 7,500
Equipment/Tools/Supplies:	$ -
Supplies for microbiological analysis including Petri dishes, media, reagents, test tubes, etc. ($6,000/year)	$ 18,000
Supplies for DNA analysis including Petri dishes, media, reagents, test tubes, etc. ($10,000/year)	$ 30,000
Supplies for nutrient analysis including reagents, vials, replacement distillation cartridges, etc. ($2,000/year)	$ 6,000
University of Minnesota Plot fees ($500/year)	$ 1,500
Travel:	$ -
In-state	$ -
Round-trip travel to on-farm research site (14 trips/year at $0.55/mile: $308/year)	$ 924
Out-of-state	$ -
Travel to one professional meeting including airfare, lodging, meals, etc. ($1500/year)	$ 4,500
Additional Budget Items:	$ -
Educational field day, proceedings, and bulletin.	$ 6,000
Shipping (FEDEX) samples to laboratories in St. Paul ($500/year)	$ 1,500
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ 381,604

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period:	NA	*NA*
Other State $ Being Applied to Project During Project Period:	NA	*NA*
In-kind Services During Project Period:	$ -	
In-kind for PI and co-PI's ($5828/year)	$ 17,484	secured
Remaining $ from Current Trust Fund Appropriation (if applicable):	NA	*NA*
Funding History:	$ -	
University of Minnesota - Southwest Research & Outreach Center (SWROC)	$ 11,500	
Minnesota Agricultural Fertilizer Research and Education Council (2008-2010)	$ 87,388	
University of Minnesota - SWROC in-kind (2006-2008)	$ 9,000	

Project Manager Qualifications

Dr. Jeff Strock
Associate Professor, Soil Scientist
University of Minnesota
Southwest Research and Outreach Center
23669 130th St.
Lamberton, MN 56152

Education

Ph.D.. Soil Science. North Carolina State University, Raleigh, NC. (1999)
M.S. Soil Science. Oregon State University, Corvallis, OR (1995)
B.S.. Soil Science; Watershed Mgmt. University of Wisconsin-Stevens Point, Stevens Point, WI (1993)

Professional Experience

Associate Professor. Soil Scientist (May 2005 – present), Department of Soil, Water, and Climate, University of Minnesota, and Southwest Research and Outreach Center, Lamberton, Minnesota.

Assistant Professor. Soil Scientist (January 1999 – May 2005), Department of Soil, Water, and Climate, University of Minnesota, and Southwest Research and Outreach Center, Lamberton, Minnesota.

Skills

Soil and Water Management and Conservation: Project management; Research design; Data collection, analysis, interpretation, and presentation; Education and outreach programming for agricultural professionals, general public, K-12 and higher education communities. Specific expertise: Nutrient management; Water quality and water quantity monitoring, Biogeochemistry, and Soil physics.

Selected Publications

Pradhan, S., M.T. Hoover, G.H. Clark, M. Gumpertz, A.G. Wollum, C. Cobb, J. S. Strock. 2008. Septic tank additive impacts on microbial populations. J. Environ. Health. 70:22-27.

Needelman, B., P. Kleinman, and J.S. Strock. 2007. Improved management of agricultural drainage ditches for water quality protection: science, policy and management. J. Soil Water Conserv. 62:171-177.

Strock, J.S., J.P. Schmidt, and C. Dell. 2007. Managing natural processes in drainage ditches for non-point source nitrogen control. J. Soil Water Conserv. 62:188-196.

Oquist, KA., J.S. Strock, and D.J. Mulla. 2007. Influence of alternative and conventional farming practices on subsurface drainage and water quality. J. Environ. Qual. 36:1194-1204.

Feyereisen, G.W., G.R. Sands, J.S. Strock, B.N. Wilson, P.M. Porter. 2007. Hydrology and nitrogen components of a simple rye growth model. J. Irrg. Drainage Eng. 133:90-99.

University of Minnesota Southwest Research and Outreach Center Mission

The Southwest Research and Outreach Center is a resource that builds quality of life through individuals working together providing research and education for agriculture, communities, and family.