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

LCCMR ID: 034-A3

Project Title:

Transport and Creation of Contaminants from Ethanol Spills

LCCMR 2010 Funding Priority:

A. Water Resources

Total Project Budget: $ $250,000

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

Other Non-State Funds: $ $0

Summary:

This project proposes to study and model the increased transport of petroleum contaminants with the addition of ethanol to fuels and to the production of contaminants by indigenous microbes.

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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: Transport and Creation of Contaminants from Ethanol Spills

I. PROJECT STATEMENT

The past few years have experienced a dramatic increase in ethanol production for use in biofuels. The state of Minnesota is one of the largest producers of ethanol (550 million gallons in 2006), and the largest distributor of E85. By the year 2010 20% of Minnesota's fuel for transportation must be ethanol, through E85 and E10, but if this is insufficient then E20 must be made and sold by 2013. This is the most aggressive ethanol mandate in the U.S. and will require a waiver from the EPA. Before such a waiver is sought, it is important to understand the potential risks associated with increased ethanol production and consumption.

While much research has been performed on the economics, pollution and drain on natural resources during the production of ethanol, relatively little is known about the environmental impacts of accidental spills. The dangers associated with ethanol spills are two-fold. One is the ability of ethanol to transport associated petroleum chemicals through the subsurface to contaminate groundwater around Minnesota. The other is the creation of harmful by-products from microbial degradation of ethanol.

Ethanol is a strong organic solvent. As such, it can act to increase transport of petroleum based contaminants associated with biofuels such as E10, E20 and E85 to groundwater. This is called the co-solvency effect, and has been well studied in many situations, but not with ethanol and petroleum in natural systems. The contaminants present in gasoline include a mixture of benzene, toluene, ethyl benzene and xylene (BTEX). When there is a gasoline spill/leak in Minnesota, these are the chemicals of concern from a human and ecosystem health perspective. The degree to which BTEX transport is increased by the addition of ethanol is currently unkown.

Ethanol is also a good source of food for subsurface microbes. Bacteria utilize the ethanol to produce acetic acid and eventually methane gas. At two sites in Minnesota where 95% ethanol have been accidentally spilled, methane concentrations exceeded 20% by volume in air. The kinetics of degradation to acetic acid and eventually methane is currently unkown.

We propose to answer the questions of increased subsurface transport of petroleum based chemicals, and the kinetics of biodegradation to acetic acid and methane using column studies at the University of Minnesota, using soils sampled from two sites in Minnesota where ethanol has been spilled (Balaton and Cambria, MN).

II. DESCRIPTION OF PROJECT RESULTS

Result 1 Co-solvency effects on transport of petroleum based chemicals by ethanol
Budget: $ 125,000
Soil from Balaton and/or Cambria Minnesota will be packed into columns in the laboratory, water will flow through the column at typical groundwater flow rates, and ethanol/gasoline mixtures injected and tracked through the columns. Four columns will be set up with varying amounts of ethanol in gasoline including 0, 10, 20, 85 percent ethanol.

Deliverable	**Completion Date**
1. A model of subsurface transport of BTEX compounds given varying mixtures of ethanol in gasoline	*June 2012*

Result 2: Kinetics of acetic acid and methane production from ethanol/gasoline spills
Budget: $ 125,000
The same columns from Result 1 will be utilized to study the microbiology and production of acetic acid and methane from indigenous microbes and varying ethanol/gasoline mixtures.

Deliverable	**Completion Date**
1. A model of subsurface production of acetic acid and methane given varying mixtures of ethanol in gasoline	*June 2012*

III. PROJECT STRATEGY

A. Project Team/Partners

Matt F. Simcik, Ph.D., Division of Environmental Health Sciences, School of Public Health, University of Minnesota
Paige Novak, Ph.D., Civil Engineering Department, University of Minnesota
Tom Higgins, M.S., Minnesota Pollution Control Agency

B. Timeline Requirements

The timeline for this project is July 1, 2010 to June 30, 2012 with the following tasks and timelines:

	2010		**2011**				**2012**	
Task	**JAS**	**OND**	**JFM**	**AMJ**	**JAS**	**OND**	**JFM**	**AMJ**
Soil Sampling	***							
Column Setup		***						
BTEX transport			***	***	***	***		
Contaminant production			***	***	***	***		
Model Development					***	***	***	***
Presentation of Results								*

C. Long-Term Strategy

This project is expected to generate novel research questions regarding viability and genetic structure of microbial populations during an ethanol/gasoline spill and further investigation into the effect of soil typ on transport of contaminants. The U of M is interested in applying for funding from Federal agencies that require a non-federal match of funds. This project would qualify for this type of match so that further studies can be completed, in essence magnifying the impact of this study.

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:	$ -
Matt F. Simcik, Ph.D. (10% time)	$ 25,000
Paige D. Novak, Ph.D. (10% time)	$ 25,000
Research Assistants (2 at 50% time)	$ 144,000
Contracts: none	$ -
Equipment/Tools/Supplies: *GC/MS for the analysis of BTEX, methane and acetic acid ($5,500), laboratory supplies ($25,000 per year for two years)*	$ 55,500
Acquisition (Fee Title or Permanent Easements): *none*	$ -
Travel: *travel to Cambria and Balaton to collect soil samples*	$ 500
Additional Budget Items: *In this column, list any additional budget items that do not fit above categories. List by item(s) or item type(s) and explain how number was reached.*	$ -
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ 250,000

V. OTHER FUNDS

SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ Being Applied to Project During Project Period: *none*	$ -	*Indicate: Secured or Pending*
Other State $ Being Applied to Project During Project Period: *none*	$ -	*Indicate: Secured or Pending*
In-kind Services During Project Period: *none*	$ -	
Remaining $ from Current Trust Fund Appropriation (if applicable): *none*		*Indicate: Unspent? Not Legally Obligated? Other?*
Funding History: *none*	$ -	

Curriculum Vitae

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Education

Doctor of Philosophy, Environmental Science, Rutgers University, January 1998
Master of Science, Civil Engineering, University of Minnesota, December 1994
Bachelor of Science, Chemistry, Michigan State University, June 1992

Professional Experience

July 2006 – Present	Associate Professor, Division of Environmental and Occupational Health, School of Public Health, University of Minnesota
August 1999 – June 2006	Assistant Professor, Division of Environmental and Occupational Health, School of Public Health, University of Minnesota
August 1999 – Present	Full Member of the Graduate Faculty of the Water Resources Sciences Program, University of Minnesota
January 2005 – Present	Affiliate Member of the Graduate Faculty, Civil Engineering, University of Minnesota
October 1997 – August 1999	Post-Doctoral Fellow, School of Public and Environmental Affairs and Department of Chemistry, Indiana University
September 1996 – October 1997	Research Assistant, Environmental Science Department, Rutgers University
January 1996 – September 1996	Teaching Assistant, Environmental Science Department, Rutgers University
September 1995 – December 1995	Research Assistant, Environmental Science Department, Rutgers University
July 1992 – August 1995	Research Assistant, University of Minnesota