Environment and Natural Resources Trust Fund
2009 Phase 2 Request for Proposals (RFP)

LCCMR ID: 069-B4

Project Title: Evaluating Nitrogen Pollution from Septic Systems

Total Project Budget: $ $200,000

Proposed Project Time Period for the Funding Requested: 3 year, July 2009 to June 30, 2012

Other Non-State Funds: $ $0.00

Priority: B4. Deep Water Lakes

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Sponsoring Organization: DNR

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Region:	County Name:	City / Township:
NW, NE, Central	Cass, Clearwater, Crow Wing, Hubbard, Itasca	

Summary: Nitrogen stable-isotopes will be used to assess human sewage based nutrient inputs into deepwater lakes. Findings of nitrogen pollution from septic systems may have broad applications in land use management.

Main Proposal: 0908-2-027-proposal-2009_main_proposal_N_POLLUTION_deepwaterlakes.doc

Project Budget: 0908-2-027-budget-RFP_2009_Project Budget_N_POLLUTION.xls

Qualifications: 0908-2-027-qualifications-Project_Manager_N_POLLUTION.doc

Map: 0908-2-027-maps-Map_N_pollution_deepwaterlakes.doc

Letter of Resolution:

MAIN PROPOSAL

PROJECT TITLE: *EVALUATING NITROGEN POLLUTION FROM SEPTIC SYSTEMS.*

I. PROJECT STATEMENT

Although, phosphorus (P) is usually the limiting nutrient in Minnesota lakes for algae production, low levels of available nitrogen (N) can also limit, or co-limit (with P) algal growth in many deepwater lakes. Excess loading of N can therefore lead to eutrophication and degraded water quality. In addition, increased loading of N also has important effects on aquatic plant communities (i.e. "weeds"). In deepwater lake embayments and nearshore areas of many lakes, this pollution can lead to declines in diversity and structure of aquatic plant communities, with consequences of increased algal growth, loss of important fish habitat and sediment de-stabilization. Decomposition of algae and plants, stimulated by high nutrient loading, consumes oxygen in deep water, which is critical for cool- and cold-water fishes.

An estimated half million households in Minnesota are not connected to public sewer systems and with the growing use and expansion of lakeshore homes, cabins and resorts, many have the potential to degrade surface and groundwater resources, as they depend primarily on individual sewage treatment systems for treatment and dispersal of domestic wastewater. These systems may contribute significant N to Minnesota lakes even when in compliance with the State's rules since they are rarely designed to remove nitrogen. Concentrations of N in septic tank effluent are generally 2-10 times higher than the drinking water standard for nitrate-N (10 mgN/L). In the form of nitrates, nitrogen dissolves easily in water and is stable over a wide range of environmental conditions so it is easily transported in groundwater. Unless leach fields are much larger than required by prescriptive codes, or an alternative treatment system designed for N-removal (e.g. constructed wetland or certain recirculating filters) is used, less than 25% will be immobilized in the soil. The remainder ends up in the lake via direct drainage from subsurface seepage and by intermittent flushing of surface seepage by rainstorms or snowmelt runoff. Since about 1995, considerable research has been conducted in Minnesota to confirm these findings, quantify the performance of most of the treatment systems used in lakeshore settings, improve State codes, and provide better tools and information to local government for better managing septic systems. However, the focus has been on pathogen risks and their direct threat to human health. Very little research has been done to determine the relative importance and magnitude of wastewater nitrogen loading to lakes, and the potential risks to water quality and fish and wildlife habitat.

Nitrogen stable-isotope analysis ($\delta^{15}N$ signatures) has become a powerful tool used to identify anthropogenic nutrient inputs into aquatic systems. Nitrogen has two stable isotopes, ^{14}N and ^{15}N, that occur with a natural abundance of 99.63% and 0.37%, respectively. Because they are so different in abundance, and because the many biological and chemical processes in ecosystems discriminate slightly differently between them, distinct isotopic signatures can be identified and used to trace sources of nitrogen. Within a food chain, top predators have the highest $\delta^{15}N$ values and human wastewater typically has elevated $\delta^{15}N$ values compared to unimpacted groundwater. By analyzing the ratio of these isotopes from aquatic animal and plant material collected from near-shore areas we can determine the source of the nitrogen they are utilizing in their growth.

II. DESCRIPTION OF PROJECT RESULTS

Result 1: *Collect specimens and samples* **Budget: $** 90,000

On 15-20 lakes, summer field surveys will be conducted in near-shore habitat to collect macroalgae, macrophytes, and invertebrates. A double-headed, weighted garden rake will be used

to sample macroalgae (*Chara sp*.) and other aquatic plants. The dominant snail species will be collected. Mini-piezometers will be installed at sampling sites to determine the locations of groundwater inflow and to collect groundwater samples for water quality analysis. At locations where hydraulic head in the mini-piezometer is higher than the lake surface, groundwater inflow will be noted and a water sample will be collected for analysis of nitrogen (total nitrogen, ammonium-N, nitrite/nitrate-N) and conductivity. Established protocol for sample collection will be used.

Deliverable	Completion Date
1. 7 to 10 lakes surveyed	**Sept 2009**
2. 8 to 10 lakes surveyed	**Sept 2010**

Result 2: *Nitrogen stable-isotope ($\delta^{15}N$ signatures) and water analysis* **Budget: $** 60,000

Biological samples will be submitted to a certified laboratory for nitrogen isotope ratio determination. Samples will be analyzed using continuous flow isotope ratio mass spectrometry and following established protocol. Quality control protocol will also be followed, such that there will be a 95% probability that the result returned would be within ±0.4 ‰. Water samples will be sent to a certified laboratory for nitrogen analysis.

Deliverable	Completion Date
1. Analysis of samples from 7-10 lakes	**March 2010**
2. Analysis of samples from 8-10 lakes	**March 2011**

Result 3: *Model development and report preparation and dissemination* **Budget: $** 50,000

The analysis of $\delta^{15}N$ signatures will include the use of statistical models. The purpose of using statistical models is to make probability statements about the occurrence of septic system derived nitrogen pollution to near-shore aquatic communities that can be combined with existing lake PCA and DNR lake data to accurately assess the extent and significance of the problem and its potential implications for lake management.

Deliverable	Completion Date
1. Statistical model of nitrogen pollution	**Dec 2011**
2. Submitted manuscript to peer-review journal	**Jun 2012**

III. PROJECT STRATEGY AND TIMELINE

A. Project Partners
Michael E. Sierszen, U.S. EPA [technical advisor; in-kind value]
Richard Axler, Natural Resources Research Institute, Univ. of Minnesota-Duluth [for experimental design, data analysis and limnological consultation; $17,000 of budget plus additional in-kind effort]

B. Project Impact
The consequences of nitrate loading on near-shore communities to Minnesota lakes has not be evaluated. Findings of nitrogen pollution of near-shore areas of sensitive lakes or lakeshore may support either the advancement or requirement of the installation of new nitrogen-reducing septic systems. For example, PCA is concerned about nitrogen in groundwater. In the City of Baxter, a PCA study found nitrate levels down gradient of septic drainfields exceeded the drinking water criteria at all sites surveyed. Nitrate concentrations in domestic wells from three central Minnesota communities increased with increasing age of the septic systems in the area. Such findings supported the advancement of public sewers in high-density areas.

C. Time
This is a multi-year project ending on June 30, 2012.

Project Budget

EVALUATING NITROGEN POLLUTION FROM SEPTIC SYSTEMS

IV. TOTAL PROJECT REQUEST BUDGET

BUDGET ITEM *(See list of Eligible & Non-Eligible Costs, p. 17)*	**AMOUNT**	**% FTE**
Personnel: non-classified NR Specialist	$ 70,000	50%
student interns	$ 6,000	50%
two classified staff positions	$ 40,000	10%
Contracts: *Stable Isotope Lab for chemical analysis*	$ 30,000	
NRRI for experimental design, data analysis and limnological consultation	$ 17,000	
water samples (lab)	$ 17,000	
Equipment/Tools: *Fleet, lab supplies, 1 boat*	$ 20,000	
Acquisition (Including Easements): *List # of acres and who will hold title (e.g., DNR, Non-profit)*	$ -	
Restoration: *List # of acres.*	$ -	
Other: *List by item and explain.*	$ -	
	$ -	
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ 200,000	

V. OTHER FUNDS

SOURCE OF FUNDS	**AMOUNT**	**Status**
Remaining $ From Previous Trust Fund Appropriation (if applicable): *How much Trust Fund money remains not spent or legally obligated from any previous Trust Fund appropriation for any directly related project of the proposing project, project manager, or project organization? Specify the appropriation.*	$ -	*Unspent or Not Legally Obligated*
Other Non-State $ Being Leveraged During Project Period: *What additional non-state cash $ will 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.*	$ -	*Secured or Pending*
Other State $ Being Spent During Project Period: *What additional state cash $ (e.g. bonding, other grants) will 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.*	$ -	*Secured or Pending*
In-kind Services During Project Period: *What in-kind services will be provided during the funding period? List type of service(s) and estimated value. In-kind services listed should be specific to the project.*	$ -	
Past Spending: *List money spent or to be spent on this specific project, cash and/or in-kind, for 2-year timeframe prior to July 1, 2009*	$ -	

Project Manager Qualifications & Organization Description

Organization Description: State Agency, Minnesota Department of Natural Resources. DNR Mission Statement: Our mission is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life.

Project Manager: Paul Radomski

Paul Radomski is a research scientist with the Minnesota Department of Natural Resources. He has worked for the DNR for about 20 years, and he has extensive experience managing innovative projects. He currently serves as the science advisor to Minnesota's Shoreland Rules Update Project.

Education:
University of Wisconsin-Stevens Point, M.S., Aquatic Biology and Fisheries, 1983-1986
University of Wisconsin-Stevens Point, B.S., Limnology, 1979-1983

Recent Employment:
Project Consultant – Senior, Shoreland Rules Update Project 2008-present. Alternative Shoreland Management Standards Project, 2005-2006. Responsible for development of modernized state shoreland development standards. Provide scientific and technical expertise to Department staff, Advisory Committee members, and the public. Currently project manager for the LCCMR-funded project on intra-lake zoning to protect sensitive lakeshores.

Research Scientist 2, Minnesota Department of Natural Resources, Brainerd, 2000-2005. Responsible for performing independent research. Review research work, correlate complex technical findings, interpret theories and reports, disseminate advanced technical expertise on statistics, biology and research techniques, publish in peer reviewed journals, instruct and train employees in research procedures, and perform supervisory and administrative functions. Skills include: knowledge of fish ecology, invertebrate biology, chemistry, physics, aquatic plant management, applied and theoretical statistics, scientific research techniques, system analysis and simulation, and computer programming. Demonstrated oral and written communication abilities and leadership and public relation skills.

Map 1. Study Area for evaluating nitrogen pollution from septic systems to near-shore communities of deep water lakes.