Environment and Natural Resources Trust Fund
2011-2012 Request for Proposals (RFP)

LCCMR ID: 145-F3+4

Project Title: Energy Conservation at Municipal Wastewater Treatment Facilities

Category: F3+4. Renewable Energy

Total Project Budget: $ $163,376

Proposed Project Time Period for the Funding Requested: 2 yrs, July 2011 - June 2013

Other Non-State Funds: $ 0

Summary:

Municipal wastewater treatment is a major faction of the energy needs for municipalities. We propose to analyze existing treatment operations to identify opportunities for energy conservation and cost reduction.

Name: Timothy LaPara

Sponsoring Organization: U of MN

Address: 500 Pillsbury Dr SE

Minneapolis MN 55455

Telephone Number: 612-624-6028

Email lapar001@umn.edu

Web Address

Location

Region: Statewide

Ecological Section: Statewide

County Name: Statewide

City / Township:

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ Employment	_____ TOTAL _____%

2011-2012 MAIN PROPOSAL

I. PROJECT STATEMENT

Municipal wastewater treatment is an essential, though often overlooked, component of modern society. Untreated municipal wastewater contains substantial quantities of biodegradable organic material, microbial pathogens, and nutrients. In the absence of effective wastewater treatment, the organic material leads to septic conditions; the pathogens pose a threat to public health; and the nutrients (nitrogen and phosphorus) lead to the eutrophication of surface waters. Unfortunately, current municipal wastewater treatment practices are also highly energy-intensive. Indeed, current estimates suggest that 3-5% of the total electricity consumption in the United States is for municipal wastewater treatment; this accounts for about 35% of the energy consumption used by municipalities.

The design and operation of municipal wastewater treatment has evolved over the past century. Facilities are intentionally designed to be functional for 15-30 years, after which they can easily be modified and/or upgraded. An emerging issue within the field of municipal wastewater treatment, therefore, is to reduce energy use during treatment and/or to design municipal wastewater treatment plants to be a source of energy (i.e., anaerobic digestion generates methane that can be used as a fuel source). The drivers of this implementation strategy are recent increases in energy costs and the need to reduce greenhouse gas emissions to help mitigate global climate change.

The goals of this project are two-fold. First, we propose to evaluate the energy use and energy conservation practices of four municipal wastewater treatment facilities in the State of Minnesota. This will allow us to generate a baseline of energy needs at municipal wastewater treatment facilities in Minnesota. Second, we propose to analyze an additional four treatment facilities whereby we would make recommendations for energy use and energy conservation. Finally, we will actively disseminate our results through numerous avenues, such as presentations several annual meetings (e.g., the Conference on the Environment, the Minnesota Water Conference, and the Central States Water Environment Association) so that other municipal wastewater treatment facilities can also benefit from our project. The proposed project should have a substantial impact on Minnesota, as it would reduce the cost of municipal wastewater treatment throughout the State without compromising treatment quality.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Analyze four municipal wastewater treatment facilities in Minnesota for their current energy use and the recent/future energy conservation plans. **Budget:** $81,688

We will initially visit and analyze the process designs of four municipal wastewater treatment facilities in Minnesota to assess both their energy use and their energy conservation practices. We tentatively plan to work with facilities in Faribault, Duluth, Rochester, and Mankato; we have selected these facilities because of our knowledge of their process designs (i.e., these facilities represent a relatively diverse set of treatment operations) and personal contacts that we have with these facilities. We also know that at least one of these facilities (Rochester) has been aggressively pursuing energy conservation opportunities for the past few years. Our approach will be holistic in that we will consider the entirety of the process design; initially, we will specifically focus on the aeration tanks (which are the major energy user) and the solids treatment processes (which can potentially be a source of energy).

Outcome	Completion Date
1. Visit four different treatment facilities to elucidate their process designs	September 2011
2. Interview facility operators to determine their recent and current energy conservation initiatives	December 2011
3. Elucidate detailed energy uses (as well as the associated costs) and energy conservation practices (and cost savings) at four treatment facilities.	June 2012

Activity 2: Analyze the energy use practices of four additional wastewater treatment facilities, making recommendations for energy conservation. **Budget:** $81,688

Based on the knowledge obtained from Activity 1 and our pre-existing expertise in wastewater treatment engineering and energy conservation, we will analyze an additional four wastewater treatment facilities within the State of Minnesota to identify specific opportunities for energy conservation and cost reduction (potentially facilities in Lakefield, Willmar, St. Paul, and Shakopee). We will identify these four additional treatment facilities during our work on Activity 1. Although it is difficult to predict the opportunities for energy conservation, our knowledge of existing wastewater treatment practices suggests the following opportunities for energy conservation. First, we will examine the operation of the aeration tanks, which are the primary cost of municipal wastewater treatment. Energy usage can be reduced by eliminating excess aeration, using more efficient aeration devices, and/or reducing the organic loading to the aeration tanks. Reductions in organic loading can be achieved by improved primary treatment (which removes readily biodegradable organic particles) and by re-routing high-strength industrial waste directly to anaerobic digestion systems (this practice is known as "co-digestion"). Second, we will examine the operation of anaerobic digestors. These digestors are used to treat residual wastewater solids, generating biogas rich in methane as a by-product. This methane can then potentially used a renewable fuel source for heating on-site buildings or for on-site electricity production. We will also investigate the use of heat exchangers to recover energy from the treated effluent.

Outcome	Completion Date
1. Visit four additional treatment facilities to elucidate their process designs	September 2012
2. Identify opportunities for energy conservation at the original four treatment facilities plus the four additional facilities	December 2012
3. Perform simple economic analysis of energy conservation opportunities (i.e., estimations of the costs of implementation, the cost savings, and simple paybacks)	May 2013
4. Disseminate our results to other wastewater treatment facilities through direct communication and through various conferences and workshops.	June 2013 (and beyond)

III. PROJECT STRATEGY

A. Project Team/Partners

Dr. Timothy M. LaPara (Department of Civil Engineering, University of Minnesota) will be responsible for coordinating the entire project and co-mentoring of a graduate student (yet to be hired). Dr. LaPara has considerable expertise in municipal wastewater treatment, having published more than 40 manuscripts that have been published in the peer-reviewed literature. Dr. Julian D. Marshall (Department of Civil Engineering, University of Minnesota) will also help co-mentor the graduate student, specifically offering his expertise in energy and the environment.

B. Timeline Requirements

As described in the activity outcomes, our plan is to analyze four treatment facilities during the first year of the project and four additional facilities during the second year of the project. The dissemination of our results (which is a critical component of the proposed project) will continue beyond June 2012 at no additional cost.

C. Long-Term Strategy and Future Funding Needs

The proposed project will be completed within the two-year project period. Additional work could be carried out (at additional treatment facilities) in the future, with the cost borne by the individual utilities.

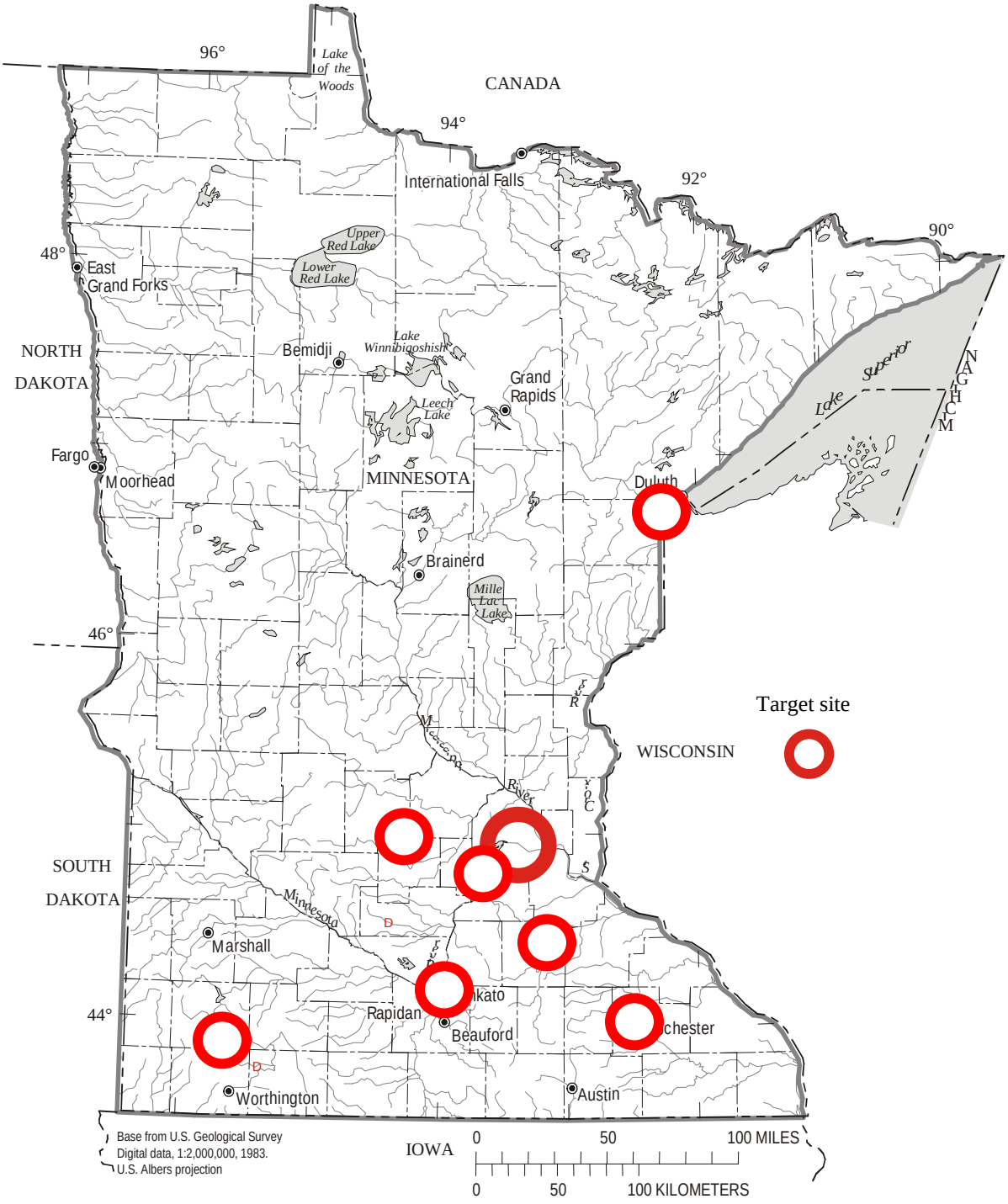
2011-2012 Detailed Project Budget

IV. TOTAL TRUST FUND REQUEST BUDGET *2* years

BUDGET ITEM	AMOUNT
Personnel:	
Timothy M. LaPara, Project Manager. 6 weeks of salary per year plus associated fringe benefits. Duties: Project management, graduate student supervision, results dissemination	$ 41,144
Julian D. Marshall, co-Project Manager. 6 weeks of salary per year plus associated fringe benefits. Duties: Project management, graduate student supervision, results dissemination	$ 34,315
Graduate Student, University of Minnesota. Funding for a graduate student for two years plus associated fringe benefits (including tuition)	$ 75,917
Contracts:	$ -
Equipment/Tools/Supplies: Education materials for disseminating results	$ 2,000
Acquisition (Fee Title or Permanent Easements):	$ -
Travel: *Travel to wastewater treatment plants within the State of Minnesota*	$ 10,000
Additional Budget Items:	$ -
TOTAL ENVIRONMENT & NATURAL RESOURCES TRUST FUND $ REQUEST	$ 163,376

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period:	$ -	*Indicate: Secured or Pending*
Other State $ Being Applied to Project During Project Period:	$ -	*Indicate: Secured or Pending*
In-kind Services During Project Period:	$ -	
Remaining $ from Current ENRTF Appropriation (if applicable):	$ -	*Indicate: Unspent? Not Legally Obligated? Other?*
Funding History:	$ -	


96°
Lake of the Woods
CANADA
94°
International Falls
92°
90°
48°
East Grand Forks
Upper Red Lake
Lower Red Lake
NORTH DAKOTA
Bemidji
Lake Winnibigoshish
Grand Rapids
Leech Lake
Fargo
Moorhead
MINNESOTA
Duluth
Lake Superior
Brainerd
Mille Lacs Lake
46°
Target site
WISCONSIN
SOUTH DAKOTA
Marshall
Rapidan
Beauford
Worthington
Austin
44°
IOWA
Base from U.S. Geological Survey
Digital data, 1:2,000,000, 1983.
U.S. Albers projection
0 50 100 MILES
0 50 100 KILOMETERS

Project Manager Qualifications

***Timothy M. LaPara,* Associate Professor, Department of Civil Engineering, University of Minnesota**

Education
B. S. C. E., 1995, Civil Engineering, University of Notre Dame
Ph.D., 1999, Environmental Engineering, Purdue University

Research and Teaching
Dr. LaPara's research is focused on the role of municipal and industrial wastewater treatment plants in preserving environmental quality and in protecting public health. Dr. LaPara teaches courses in the design of municipal water and wastewater treatment facilities and in environmental microbiology.

***Julian D. Marshall*, Assistant Professor, Department of Civil Engineering, University of Minnesota**

Education
B. S. E., 1996, Chemical Engineering, Princeton University
M. S., 2002, Energy and Resources, University of California Berkeley
Ph.D., 2005, Energy and Resources, University of California Berkeley

Research and Teaching
Dr. Marshall is interested in energy and environmental impacts of cities, especially urban transportation systems. His research group analyzes data and builds models to understand the air pollution, climate-change emissions, and health impacts of the built environment. The goal is to investigate approaches to improve the environmental and public health aspects of urban areas. Dr. Marshall teaches courses in Air Pollution Management and Sustainability.

Responsibilities
Dr. Timothy M. LaPara will be responsible for coordinating the entire project and co-mentoring of a graduate student (yet to be hired). Dr. LaPara has considerable expertise in municipal wastewater treatment, having published more than 40 manuscripts that have been published in the peer-reviewed literature. Dr. Julian D. Marshall will also help co-mentor the graduate student, specifically offering his expertise in energy and the environment.

Organization Description
The University of Minnesota-Twin Cities is the state of Minnesota's largest institution of higher education