

**Environment and Natural Resources Trust Fund
2009 Phase 1 Request for Proposals (RFP)**

LCCMR ID: C16

Project Title: Removal of Endocrine Disruptors: Treatment and Education / Communication

Total Project Budget: \$ \$312,647

Proposed Project Time Period for the Funding Requested: July 2009 - June 2012 (3 yrs)

Other Non-State Funds: \$ 21920 (in kind)

First Name: Paige

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Sponsoring Organization: U of M

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Region:

County Name:

City / Township:

Statewide

Statewide

Summary: The goal of our research is to remove endocrine disruptors from Minnesota's waters. We will pursue strategies of enhancing treatment at wastewater treatment plants and decreasing use of these compounds.

Main Proposal: 0808-1-005-proposal-Novak 2009 main proposal.doc

Project Budget: 0808-1-005-budget-RFP_2009_Project Budget.xls

Qualifications: 0808-1-005-qualifications-Project Manager Qualifications and Organization D

I. PROJECT STATEMENT

Endocrine disrupting compounds include natural and synthetic hormones, pharmaceuticals/personal care products, and a range of industrial products and byproducts. Given the high potency of some EDCs at extremely low levels (1 ng/L or one part per trillion), these compounds may be the most dangerous pollutants that humans produce. Their developmental and reproductive effects are complex and widespread, causing fish feminization and potential developmental effects in humans that may result in a new, insidious kind of natural selection. In contrast to many historical pollution crises, the presence of EDCs in our water is often a direct result of the choices that people make with respect to the use of various products. Further complicating any solution to this problem are the real or perceived benefits of many of these compounds. Thus, the solution to the developing crisis that these powerful compounds pose will require changes in treatment technology *and* personal decision-making.

The ultimate goal of our research is to remove endocrine disruptors from Minnesota's waters.

There are two strategies for accomplishing this goal: enhancing treatment at wastewater treatment plants and decreasing use of these compounds. Some compounds have important benefits (e.g., birth control pills or anti-depression/anti-anxiety medications), and enhanced wastewater treatment will be required for their removal. The benefits of other compounds (e.g., the antimicrobials found in soaps-triclosan and triclocarban) are less clear. Education/communication could be a powerful way to decrease the load of such compounds to wastewater treatment plants, *also reducing the need for expensive treatment processes.*

We have just finished a 3-year LCCMR-funded project focused on developing mass balances for environmental estrogens over two wastewater treatment plants (the Western Lake Superior Sanitary District (WLSSD) plant in Duluth and the Metropolitan (Metro) plant in St. Paul). We found that removal of estrogenic compounds from the influent was variable (56-96%, with an increase in estrogenicity of 159% in one case), and the final effluent was still estrogenic. The dominant estrogens in the effluent were estrone, nonylphenol, and bisphenol A. Significant concentrations of the antimicrobial triclosan were present as well. Although triclosan is only weakly estrogenic, concentrations in effluents can be high, making it problematic. Triclosan concentrations also tend to track with triclocarban concentrations. Triclocarban is an endocrine-disrupting compound that significantly enhances the effect of testosterone in rats, potentially leading to reproductive and developmental problems. We need to understand how to best remove these compounds from wastewater. Removal can be accomplished through better treatment; it can also be accomplished (and economic benefits can be realized) by better understanding human decision-making and using this information to stop the use of these potent pollutants.

II. DESCRIPTION OF PROJECT RESULTS

Result 1: *Continued characterization of sources of environmental estrogens* Budget: \$ 94,215

Continued monitoring of treatment plant effluents (to determine what is released and in what quantity) is critical so that we can observe whether changes occur over time (see Result 3 below). Because of financial and time constraints, we will focus our research on the dominant environmental estrogens found in our previous project (estrone, nonylphenol, bisphenol A, and triclosan), as these will likely be relevant for the state in general. We will also begin monitoring the EDC triclocarban. In addition, we plan to discontinue monitoring of the WLSSD plant and focus our sampling on the Metro Plant and the Eagle's Point (EP) Plant (in Woodbury, MN). This is primarily because the personnel at Metropolitan Council Environmental Services have expressed interest in continuing to work with us, and the EP Plant serves a small-enough population to allow testing of our education/communication strategy (see below).

Deliverables

1. EDC monitoring at the Metro Plant in St. Paul, MN
2. EDC monitoring at the Eagle's Point Plant in Woodbury, MN

Completion Date

1/31/12
1/31/12

Result 2: *Testing and cost estimation of treatment technologies for removal of EDCs* Budget: \$ 134,245

In general, little research has been focused on the removal of the *mixtures* of common environmental estrogens and EDCs present in wastewaters at *environmentally-relevant concentrations*. Based on our prior LCCMR-funded work, it is clear that better treatment occurs in the absence of high concentrations of

competing organic compounds; what is unknown is how best to overcome this competition problem. Our goal is therefore to quantify the processes that influence persistence under realistic conditions (low concentrations, complex matrix) so that they can be modeled and scaled up into more efficient and effective treatment processes. Initial cost estimation of these processes will be performed so that, if desired, informed decisions regarding treatment plant upgrades can be made.

Deliverables	Completion Date
1. Determine transformation kinetics for EDC removal techniques at low concentrations in the presence of competing/fouling compounds	6/30/11
2. Assess the activity of byproducts in treated waters	1/30/12
3. Cost estimates for processes tested	6/30/12

Result 3: *Determine the current use patterns of EDCs among the Minnesota public and examine whether use reductions can be encouraged through specific targeted communication and education efforts*

Budget: \$ 84,187

Reducing the human use of certain EDCs represents an efficient strategy for decreasing their levels in wastewater. Nevertheless, developing effective education and communication strategies requires research to understand specific attributes of target audiences (e.g., motivations, beliefs, etc.). We will collect information (surveys) from a random sample (n = 400) of households in each of the communities served by the Metro and the EP treatment plants to identify the level of household use of triclosan and triclocarban (high use compounds that are not medically necessary), and motivations, beliefs, attitudes and perceptions of risks and benefits related to these products. We will use this base information to develop a specific, targeted information and education pilot program consisting of community workshops and informational packets, for the households served by the EP plant. We will implement this program and monitor the self-reported use of products containing these compounds along with commensurate changes in beliefs and attitudes (n = 400). D. Fulton has a great deal of experience with these types of efforts. Monitoring the wastewater influent and effluent (Result 1) will continue through this period to determine if changes can be detected in the discharge of triclosan and triclocarban from the EP plant. Results will be combined to assess the success of the program.

Deliverables	Completion Date
1. Complete study identifying household use and attributes of communities served by the Metropolitan and Eagle's Point treatment plants	6/30/10
2. Design, implement, and evaluate the effectiveness of a pilot education/communication strategy for altering household use patterns	6/30/12

III. PROJECT STRATEGY AND TIMELINE

A. Project Partners

Metropolitan Council Environmental Services (contact: Larry Rogacki, Process Engineering Manager) will provide access to the plants and in-kind services related to sample collection and data gathering.

B. Project Impact

The outcome of this research, with potential impact for *any* community with centralized treatment, will be a two-pronged strategy for the state of Minnesota focused on reducing EDCs in our surface water. Potential improvements to wastewater treatment will be outlined, along with initial cost estimations. In addition, we will test an education and communication strategy designed to decrease consumer use of two widely-used EDCs (triclosan and triclocarban) and provide an evaluation of its effectiveness with respect to altering the use of these products. This combination of science-based and social science-based research is particularly exciting, novel, and likely to succeed.

C. Time

The proposed project will be completed in the allotted three-year period.

D. Long-Term Strategy (if applicable)

N/A

Project Budget

IV. TOTAL PROJECT REQUEST BUDGET

BUDGET ITEM	AMOUNT	% FTE
Personnel: (Novak, Swackhamer, and Arnold will provide at least 6% effort, 2% of which will be unpaid; 2 graduate students will work on the project, but will only be paid for 2 years each, averaging to 33% effort; David Fulton is a USGS employee and cannot be paid from the grant)		
Paige Novak, PI (\$20,232 salary, \$6,393 fringe, 31.6% fringe rate; total for 3 years)	\$ 26,625	4%
William Arnold, Co-PI (\$19,709 salary, \$6,253 fringe, 31.6% fringe rate; total for 3 years)	\$ 25,962	4%
Deborah Swackhamer, Co-PI (\$22,796 salary, \$7,204 fringe, 31.6% fringe rate; total for 3 years)	\$ 30,000	4%
Two Graduate Research Assistants (\$95,125 salary, \$61,435 fringe (includes healthcare and tuition); total for 3 years)	\$ 156,560	33%
Other:	\$ -	
Costs for conducting interviews of households, production, copying, and mailing of surveys and informational packets, and production of community workshops	\$ 30,000	
Laboratory supplies and analytical costs (for results 1 and 2)	\$ 37,500	
Travel to sites to pick up samples, implement education/communication strategies, and attend/present at conferences (in state)	\$ 2,000	
Travel to sites to attend/present at conferences such as those sponsored by the American Chemical Society and the Association of Environmental Engineering and Science Professors, to gather information to inform the project and communicate findings (out of state)	\$ 4,000	
TOTAL PROJECT BUDGET REQUEST TO LCCMR	\$ 312,647	

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Remaining \$ From Previous Trust Fund Appropriation (if applicable):	\$ -	
Other Non-State \$ Being Leveraged During Project Period: (salary and fringe for 6% of David Fulton's effort over 3 years)	\$ 21,920	
Other State \$ Being Spent During Project Period:	\$ -	
In-kind Services During Project Period: (unpaid effort from Novak, Arnold, and Swackhamer; roughly 2% FTE/year for 3 years)	\$ 31,864	
Past Spending: (Previous LCMR grant in 2005, "Unwanted Hormone Therapy: Protecting Water and Public Health")	\$ 300,000	complete

Project Manager Qualifications and Organization Description

Paige J. Novak

Associate Professor, Environmental Engineering, Department of Civil Engineering and Founding Fellow of the Institute on the Environment, University of Minnesota

B.S., Chemical Engineering, 1992, The University of Virginia, Charlottesville, VA.

M.S., Environmental Engineering, 1994, The University of Iowa, Iowa City, IA.

Ph.D., Environmental Engineering, 1997, The University of Iowa, Iowa City, IA.

Dr. Paige Novak will be responsible for overall project coordination. She has been studying the fate and biological transformation of micropollutants for over ten years. Recent work has focused on the presence and fate of estrogenic compounds in wastewater, including wastewater flows from industrial facilities. Phytoestrogens have received little attention, yet Dr. Novak has found that these compounds are present in high concentrations in industrial effluents and is currently studying their fate under a variety of conditions. Dr. Novak was the 2007 recipient of the Paul L. Busch Award (Water Environment Research Foundation) for her research on industrial phytoestrogens. She, Dr. Michael Semmens, and Dr. Deborah Swackhamer recently completed an LCCMR-funded project on the presence and fate of estrogenic compounds across two Minnesota wastewater treatment plants. Two manuscripts will be submitted for publication from this work.

Dr. David Fulton (US Geological Survey and University of Minnesota) has studied the influence of human values, attitudes, and norms on conservation and pro-environmental behaviors for more than 15 years. He has worked closely with state and Federal agencies including the Minnesota DNR, US Fish and Wildlife Service, and the National Park Service in developing theory-based research to effect changes in public understanding and behavior regarding environmental conservation and management. His recent work has focused on understanding support for pro-environmental policies and behaviors ranging from the use of non-toxic shot to the conservation of lake shore properties. **Dr. William Arnold** (University of Minnesota) is an expert on the chemical transformation of organic chemicals in aquatic systems. For the past seven years he has focused on the photolysis of a wide range of pharmaceuticals. His current efforts are focused on tracking wastewater-derived compounds and their reaction products in the environment. **Dr. Deborah Swackhamer** (University of Minnesota), the Interim Director of the newly-formed Institute on the Environment, has been studying the processes affecting the behavior and fate of persistent organic compounds including PCBs, dioxins, and pesticides in aquatic systems for 20 years. Currently, her research has expanded to include exposures and impacts of endocrine disruptors in aquatic systems. She also is developing and validating chemical indicators of ecological condition for coastal zones of the Great Lakes.

Organization Description

The University of Minnesota is one of the largest, most comprehensive, and most prestigious public universities in the United States (http://www1.umn.edu/twincities/01_about.php). The laboratories and offices of the PI and co-PIs contain all of the necessary fixed and moveable equipment and facilities needed for the proposed studies.