

**Environment and Natural Resources Trust Fund
2014 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 055-B

Does Water Contaminated with Oil Affect Your Hormones?

Category: B. Water Resources

Total Project Budget: \$ 233,089

Proposed Project Time Period for the Funding Requested: 3 Years, July 2014 - June 2017

Summary:

We will test Minnesota waters contaminated with oil for potential estrogenic and androgenic activity to evaluate the risk of these chemicals in drinking water to aid in water remediation strategies

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Location

Region: Statewide

County Name: Statewide

City / Township:

<input type="checkbox"/> Funding Priorities	<input type="checkbox"/> Multiple Benefits	<input type="checkbox"/> Outcomes	<input type="checkbox"/> Knowledge Base
<input type="checkbox"/> Extent of Impact	<input type="checkbox"/> Innovation	<input type="checkbox"/> Scientific/Tech Basis	<input type="checkbox"/> Urgency
<input type="checkbox"/> Capacity Readiness	<input type="checkbox"/> Leverage	<input type="checkbox"/> Employment	<input type="checkbox"/> TOTAL <input type="checkbox"/> %



PROJECT TITLE: Does water contaminated with oil affect your hormones?

I. PROJECT STATEMENT

Minnesota is known for its quality water resources but those environments are threatened by spills of petroleum from leaking underground storage tanks, oil refineries, and spills from the transnational pipeline that crosses our state. Though much work has been done to understand the risks of cancer from drinking water contaminated with oil, far less is known about the possible hormone-like activity of these waters. The work proposed here would expand our understanding of the lasting effects of oil spills on drinking water and allow regulators to better prioritize clean-up efforts to mitigate risk to human health given limited funds.

The MN Pollution Control Agency-Petroleum Remediation Program (MPCA-PRP) is monitoring more than 19,000 leaking tank sites and petroleum spills are prevalent throughout the state (see attached MPCA-PRP map). We are also located between the vast oil reserves of Alberta and oil refining facilities. The result is billions of gallons of crude oil moving across the state through hundreds of miles of pipelines with requests to increase that volume in place. When large volumes of any substance are transported and stored, there will inevitably be releases to the environment and small releases occur often (ex. 600 gallons was spilled from the pipeline in Viking, MN 4/25/13). And though we should work to minimize these events, realistically our goal cannot be to attempt to prevent all releases but rather to have strong scientific data to enable us to select effective remediation strategies that prioritize risks to human and ecosystem health so that our limited funds can be best spent to protect the people and resources of Minnesota. The long-term research **goals** of our group are to better understand the fate and transport of petroleum in the environment and the resulting toxicology of the resulting waster as fuel oil as mixes and reacts in natural systems.

We will test waters from the National Crude Oil Spill Research Site, located just west of Bemidji, MN, where a dramatic pipeline rupture released 10,000 barrels of crude oil into a wetland-aquifer-lake system in 1979. This is an ideal site as our work will build on the vast work that has already been done to understand how the oil will move and break down in various environments as well as allow us to evaluate lasting environmental effects. Current petroleum risk assessment considers mainly cancer but several studies have demonstrated that some chemicals found in petroleum may exhibit hormone-like activities (estrogenic or androgenic). *Our work is significant in that we will expand this understanding by testing the estrogenic and androgenic activity of the oil-water solutions that result in various real-life and simulated environments as oil moves and breaks down.*

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Characterize contaminated water chemistry and the resulting estrogenic and androgenic activity of water samples from the site

Budget: \$ 76,407

Water and sediment samples will be collected from distinctly different environments at the National Crude Oil Spill Research site near Bemidji, MN. Environments include a nearby wetland, lake, and several regions within the aquifer oil plume including samples from the area with the most contamination, an area near the fringe of the plume, and an area outside the known plume to act as a “control”. We will analyze the contaminant chemistry of the these samples as well as other chemical indicators that impact how oil breaks down using well established methods within the PIs expertise. These samples will also be analyzed for hormone-like activity (estrogenic and androgenic) using cutting-edge cell assay techniques on human breast cancer cells.

Outcome	Completion Date
1. Characterize the chemistry of contaminated water samples from the site	June 2015
2. Characterize the estrogenic and androgenic toxicity of samples from the site	June 2015
3. Linking the outcomes of 1&2 identify areas of greatest risk and communicate those findings to interested parties, such as current and new contacts at the MPCA-PRP and the MN Dept. of Health who monitor these compounds in drinking water.	October 2015



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Activity 2: Determine the chemistry and toxicity of waters generated by mixing at interfaces including groundwater and surface water interactions. **Budget: \$ 159,682**

In-field tests (ex. push-pull) and laboratory studies will be conducted in which waters from the site are mixed in the presence of natural sediments to initiate reactions and generate a new water chemistry representative of that which would likely occur at the interfaces between groundwater and a wetland and groundwater and a lake. Our prior research has shown that these mixing interfaces are the most dynamic parts of the system and warrant further investigation. Resulting samples would be analyzed for chemistry and toxicity as described in Activity 1 and findings communicated.

Outcome	Completion Date
1. Conduct field and lab experiments to simulate groundwater-wetland and groundwater-lake interfaces	June 2016
2. Characterize the resulting water chemistry for detailed chemistry and estrogenic and androgenic toxicity	December 2016
3. Linking the outcomes of 1&2 identify areas of greatest risk and communicate those findings to interested parties, such as current and new contacts at the MPCA-PRP and the MN Dept. of Health who monitor these compounds in drinking water.	June 2017

Activity 3: Educational Dissemination and Outreach

Budget: \$ 0 new, included above

We will use project data to enhance Environmental Science curriculum through a) the direct training of students involved in the project, b) classroom activities developed for undergraduate courses taught by the PIs, and c) dissemination of educational materials through online academic routes such as SEAK. The SEAK (“Scientists Eagerly Acquiring Knowledge”) program is a partnership between Wolf Ridge Environmental Learning Center, the Boys & Girls Clubs, and several schools. The program gives urban students from socio-economically diverse backgrounds an opportunity to explore careers in science and natural history.

Outcome	Completion Date
1. Incorporation of new activities in UST BIOL209 course	September 2016
2. Dissemination of knowledge via SEAK program	June 2017

III. PROJECT STRATEGY

A. Project Team/Partners

This project will be carried out under the supervision of Drs. McGuire and Martinovic (University of St. Thomas), with collaborator Dr. Cozzarelli (United States Geological Survey). Information transfer and study design will be conducted with existing and new contacts at the MN Department of Health and Minnesota Pollution Control Agency Petroleum Remediation Program Staff.

B. Timeline Requirements

Sampling will occur 2014-2017. Final reports will be issued August 2017 and PIs will disseminate results as they are obtained at National Meetings, through peer-reviewed publications, and information transfer meetings with above identified collaborators. An addition no-cost outcome will be curriculum development from project data.

C. Long-Term Strategy and Future Funding Needs

This project will provide critical data of the longer term effects of oil spills on human health for use by regulatory agencies, such as the MN pollution control agency and MN Dept. of Health, to best manage contaminated sites in a cost effective and safe manner.

2014 Detailed Project Budget

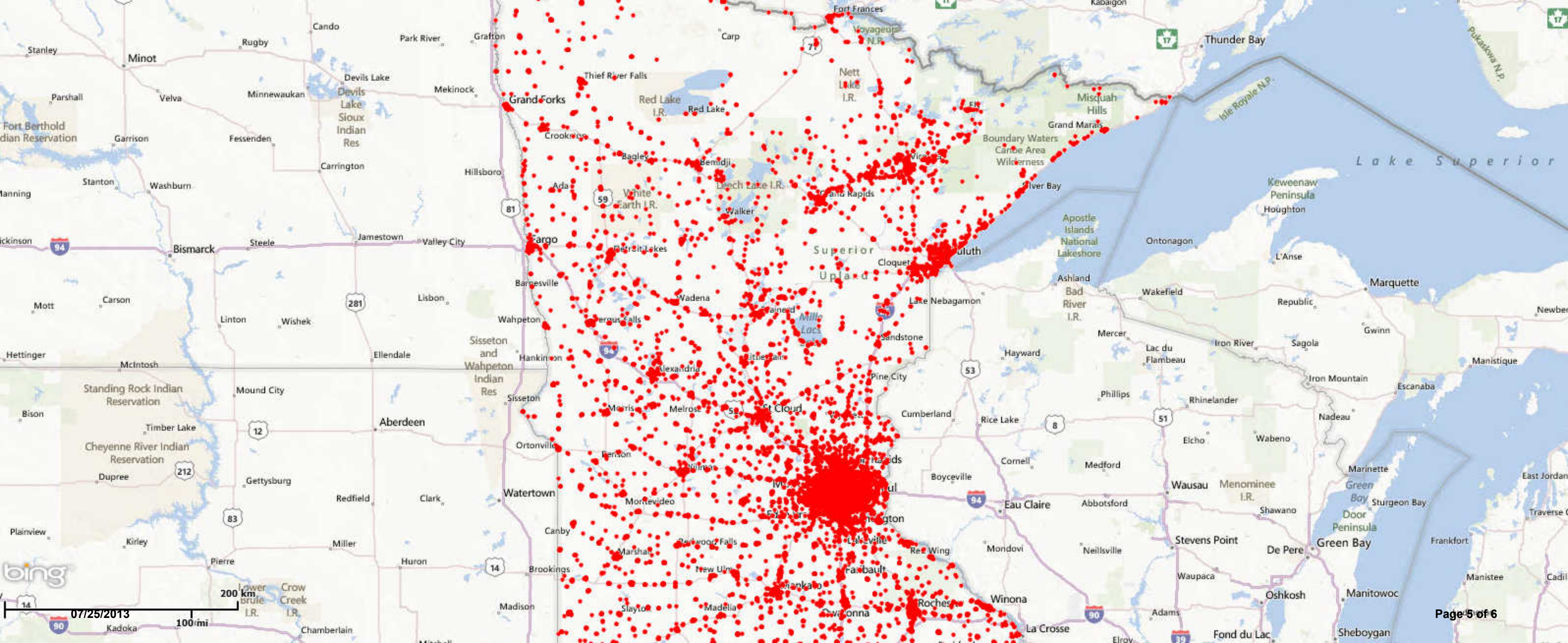
Project Title: *Does water contaminated with oil affect your hormones?*

IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM (See "Guidance on Allowable Expenses", p. 13)	AMOUNT
University of Saint Thomas Personnel: Jennifer McGuire, Principal Investigator (PI) , 2 months salary (16.6% effort) per year (totaling \$52,147 for 3 yrs) plus 7.65% fringe (\$ 3,989) for 3 years). Duties: Responsible for coordinating project, conducting field experiments & chemistry analyses, and compiling reports and disseminating results. Dalma Martinovic, Co-Principal Investigator (Co-PI) , 1 month salary (8.33% effort) per year (totaling \$22,650 for yrs) plus 7.65% fringe (\$1733 for 3 years). Duties: Responsible generating and compiling chemical and neuroendocrine assay measurements, compiling reports and disseminating results. Undergraduate students , Assist with field sampling and lab analyses. One student during the academic year, 10 hrs for 32 weeks each year @ \$10/hr, totaling \$9,600 for three years, no fringe (0%). 2 students during each summer, 40 hrs/week for 10 weeks @ \$10/hour totaling \$24,000 plus 7.65% fringe (\$1,836).	\$116,689
Contracts: Some of the water and sediment sampling and analytical chemistry (ex. organic chemistry characterization) work will be conducted by USGS laboratories supervised by Dr. Cozzarelli. The subcontract amount will include supplies for chemical analyses and travel to field sites in Minnesota to collect samples for these analyses.	\$ 54,000
Equipment/Tools/Supplies: \$3,600 Estrogen and Androgen cell lines; \$18,900 Cell Assay supplies (disposable plastic sampling containers, cells, chemicals, CO2 gas, media etc.); \$6,900 Field sampling supplies (bottles, tubing, filters, reagents); \$13,400 Miscellaneous lab supplies (capillaries, reagents, filters, buffer solutions) \$4,900 Lab microcosm setups and microbiology supplies	\$ 47,700
Acquisition (Fee Title or Permanent Easements): <i>In this column, indicate proposed number of acres and name of organization or entity who will hold title.</i>	\$ -
Travel: Travel to conduct field sampling and field experiments, 1 week field campaign - team of 4 x 5 days x 100 (lodging and food)x 3 yrs = \$6,000; Mileage for travel to field sites in MN @ \$0.50/mile = \$5,100; Present findings of the study at the annual conference of Society of Env Toxicology and Chemistry (McGuire), \$3,000.	\$ 14,100
Additional Budget Items: Computer Software for TOXcalcs (\$600)	\$ 600
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 233,089

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ Being Applied to Project During Project Period: <i>Indicate any additional non-state cash dollars to 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.</i>	\$ -	<i>Indicate: Secured or Pending</i>
Other State \$ Being Applied to Project During Project Period: <i>Indicate any additional state cash dollars (e.g. bonding, other grants) to 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.</i>	\$ -	<i>Indicate: Secured or Pending</i>
In-kind Services During Project Period: <i>Dr. Cozzarelli will contribute 1 month per year of her salary for 3 years (\$16252 per year, \$48,756 total) and \$2000 per year in field travel funds (total \$6000)</i>	\$ 54,756	<i>Indicate: Secured or Pending</i>
Remaining \$ from Current ENRTF Appropriation (if applicable): <i>Specify dollar amount and year of appropriation from any current ENRTF appropriation for any directly related project of the project manager or organization that remains unspent or not yet legally obligated at the time of proposal submission. Be as specific as possible. Describe the status of funds in the right-most column.</i>	\$ -	<i>Indicate: Unspent? Not Legally Obligated? Other?</i>
Funding History: <i>Indicate funding secured prior to July 1, 2014, for activities directly relevant to this specific funding request, including past ENRTF funds. State specific source(s) of funds.</i>	\$ -	



Project Manager Qualifications and Organization Description

The University of St. Thomas (UST) - Dr. Jennifer McGuire, PhD , Principal Investigator – Dr. McGuire has served as an associate professor at UST, St. Paul, MN (2008-present). From 2002-2008 she served as an assistant professor at Texas A&M University where she was tenured. She completed Ph.D. in Environmental Geoscience-Environmental Toxicology, at Michigan State University, 2002. Dr. McGuire has co-authored circa 20 research manuscripts that address chemical fate and transport and environmental biogeochemistry. Her research focuses on understanding the controls on the spatial and temporal variability of microbial metabolism which is necessary to evaluate health and safety concerns such as: chemical routes of exposure (risk assessment), natural attenuation and bioremediation capabilities, and the management of redox sensitive environments such as wetlands and estuaries. Dr. McGuire has been awarded, and has managed several externally-funded projects at UST (ca \$1,550,000) including MN PCA's Field Studies of Chemical and Microbiological Controls on Biodegradation Rates of Crude Oil in Aquifer and Wetland Systems and NSF's Biocomplexity in the Environment: Quantifying the Role of Mixing Interfaces in Biogeochemical Cycling in a Contaminated Aquifer-Wetland System: Linking Hydrogeological, Microbiological, and Geochemical Processes Grants.

The University of St. Thomas (UST) - Dalma Martinovic, PhD - Dr. Martinovic has served as an assistant professor at UST, St. Paul, MN (2009-present). She completed Ph.D. in Fisheries Science and Water Resources at the U of MN (2005), and served as National Academies Research Associate at the U.S. Environmental Protection Agency (US EPA). Since 2009, Dr. Martinovic has co-authored two reports to MN Legislature and circa 30 research manuscripts that assess occurrence and the effects of chemicals of emerging concern and on fish and aquatic ecosystems. Dr. Martinovic is a recipient of three *US EPA's Scientific and Technological Achievement Awards*. She has served on *The Contaminant Screening Criteria and Prioritization Development Task Group for MN Dept. of Health*, and the *Editorial Board of the Environmental Toxicology and Chemistry Journal*. Dr. Martinovic has managed several externally-funded projects at UST (ca \$300,000).

UST was founded in 1885 and emphasizes values-based education and career preparation, it helps solve community problems through education and service-learning programs. 56% of UST students receive need-based *scholarship or grant* aid. The largest private university in Minnesota (11,000 students, 461 full-time faculty), it offers bachelor's degrees in 85 major fields of study and 45 graduate degree programs, and is ranked as a National University. UST's Biology Department views -faculty research as essential - over the past 10 years, the faculty in Biology Department have received research grants from the NSF, NIH, USDA, USEPA, USGS, and multiple MN agencies (DNR, MPCA). Currently, the UST's Science Division has ca \$5.7 million of capital equipment, nearly half of which is owned/ maintained by Biology.