

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

LCCMR ID: C18

Project Title: Comprehensive Contaminant Assessment in Minnesota Watersheds

Total Project Budget: \$ \$190,000

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

Other Non-State Funds: \$

First Name: Bryce

Last Name: Hoppie

Sponsoring Organization: MN State University Mankato

Address: 236 Wigley Administration Building
Mankato MN 56001

Telephone Number: 507-389-2315

Email: bryce.hoppie@mnsu.edu

Fax: 507-389-5625

Web Address: www.mnsu.edu

Region:	County Name:	City / Township:
Southwest, Southeast	Blue Earth, Cottonwood, Faribault, Freeborn, Jacks	12 incorporated communities

Summary: Building on recent success assessing contaminated loads in the Blue Earth River, we will expand our research to the rivers smaller tributaries where the majority of the contaminants originate.

Main Proposal: 0808-1-032-proposal-LCCMR_MainProposal.pdf

Project Budget: 0808-1-032-budget-RFP_Project_Budget.xls

Qualifications: 0808-1-032-qualifications-LCCMR_ProjMan_Org.pdf

Map: 0808-1-032-maps-BER_LocationMap.jpg

PROJECT TITLE: Comprehensive Contaminant Assessment in Minnesota Watersheds

I. PROJECT STATEMENT

Large contaminant loads in the Blue Earth River continue to negatively impact water quality and contribute to the impairment of the Minnesota and Mississippi rivers. To more fully describe how the Blue Earth River becomes contaminated, the LCCMR sponsored our research, *Improved River Quality Monitoring Using Airborne Remote Sensing*, for the 2007-09 fiscal cycle. As of August 2008, our results have confirmed the known complexity of contaminant transport in the river. We also discovered that the suspended solids in the river possess unique light spectra that are mappable using on-site and airborne remote sensing methods. Our initial analyses indicate that the suspended solids (containing contaminants) originate in mainstem reaches with tall, steep banks and in the wide, flat watersheds of the river's major tributaries. Whereas our current LCCMR research will describe loads coming from the mainstem riparian corridor, we seek additional funds to extend our research to the Blue Earth's two major tributaries: East Branch Blue Earth River and Elm Creek (See Figure 1).

Finding the sources of contaminants in the Blue Earth's tributaries will require us to develop a novel investigative method. Like many small streams in Minnesota, these tributaries are long, narrow, overgrown by thick vegetation, and experience highly variable water discharges. Using visual or simple in-stream monitoring methods to locate sources of contamination in these streams is often impractical. To circumvent these challenges, we will develop an alternative monitoring method that builds on the results of our current LCCMR-sponsored research. Briefly, our new study will include the following steps:

- We will gather samples of the six soil associations that lie along each tributary at sites of active erosion and use hand-held spectrometers to measure their visible to near infrared spectra in dilutions equivalent to the concentration of suspended solids in the tributaries and mainstem.
- For two consecutive and complete years, we will monitor the tributaries and mainstem; we will assess water quality and measure light spectra in approximately 280 samples.
- Using mathematical methods, we will match the soil association spectra to the stream water spectra and estimate the quantities of solids contributed to the streams by each soil association.
- We will use hydrologic, remote sensing, and GIS analyses to determine the total amount and distribution of contaminants throughout the river and identify most-likely source areas.

Effectively limiting contaminant loads in rivers requires knowledge of what solids contribute to the river's suspended load and where they originate. Our project will provide this information directly to all Blue Earth River SWCD managers. With proven methods, combined continuous monitoring records from consecutive years, and thorough analyses, we will be able to assess the effectiveness of existing load-reducing efforts in the watershed and provide guidelines to further reduce the contaminant loads in the Blue Earth, Minnesota, and Mississippi rivers.

II. DESCRIPTION OF PROJECT RESULTS

Result 1: Spectral Analyses of Soils Entering the Blue Earth River

Budget: \$24,000

We will create a library of visible to near infrared spectra of the six major soil associations in both tributaries using dilutions between 10 and 200 ppm. Five-kilogram composite samples of each association will be constructed from six or more sites of active erosion lying within one mile of each tributary. Each sample will be analyzed for physical and chemical properties. Filtered surface water will be used as the stock solution to create multiple dilutions of each soil association. Average spectra for each association will be constructed and used in subsequent studies.

Deliverable

Completion Date

- 1. Map and description of soil samples' physical-chemical properties**
- 2. Library of individual and composite spectra for each soil sample**

06/30/10
06/30/10

Result 2: Water Monitoring and Spectra of Surface Water

Budget: \$85,000

We will analyze surface water samples drawn from seven sampling stations throughout two complete monitoring seasons; approximately 280 individual samples are expected. Sampling stations will be distributed among the tributaries and mainstem to assess loads from all runoff sources, including ditches, gullies, tributaries, and the mainstem’s riparian corridor. Suspended solids and nutrient concentrations and the visible through near infrared spectrum of each sample will be measured. Laboratory results will be combined with field assessments of discharge to calculate total sediment and nutrient loads at all monitoring sites.

Deliverable

Completion Date

- | | |
|--|-----------------|
| 1. Database of surface water monitoring results | 06/30/12 |
| 2. Correlation matrix of water properties and spectral signatures | 06/30/12 |
| 3. Calculated total contaminant loads in tributaries and mainstem | 06/30/12 |

Result 3: Spectral Deconvolution, Analysis, and Dissemination of Results

Budget: \$81,000

The load contributions of each soil association will be determined using a mathematical technique known as *spectral deconvolution*. We will use the results to create maps showing load source areas as well as sediment and nutrient yields. GIS analyses will compare our results to previous estimates. We will re-process the airborne images obtained through our current LCCMR grant and acquire up to six additional images that will create a multi-year history of surface water quality in the river. Our results will be peer reviewed, shared with SWCD, MPCA, MDA, and BWSR personnel, and permanently posted on the Minnesota River Basin Data Center website.

Deliverable

Completion Date

- | | |
|---|-----------------|
| 1. GIS maps of sediment and nutrient source areas and estimated yields | 06/30/12 |
| 2. Up to 6 new airborne hyperspectral images of the Blue Earth River | 06/30/12 |
| 3. Complete water quality assessment using all remote sensing data | 06/30/12 |
| 4. GIS maps of prioritized areas of sediment/nutrient management | 06/30/12 |

III. PROJECT STRATEGY AND TIMELINE

A. Project Partners: Faculty and students at MSU Mankato will complete all soil/stream sampling and analyses related to this project. We will again call on the Civil Air Patrol to facilitate gathering hyperspectral images and share stream data with the MPCA and Met Council. Watershed managers from Faribault, Martin, and Blue Earth SWCDs as well as local staff from the Mankato MPCA and MDA offices will again participate as advisors and field guides.

B. Project Impact: Our study of specific, mappable contaminant source areas will help local and state agencies focus their resources where they have the highest likelihood of improving the river’s water quality. Because of the strong similarities of the Blue Earth River to many streams in southern and western Minnesota, this project will directly impact citizens and businesses in a large area. Finally, the new monitoring method described in this request will likely apply to anywhere in the state where small streams cross potentially erodible soils.

C. Time: July 2009 - June 2010: Budget: \$97,000
July 2010 – June 2011: Budget: \$73,000
July 2011 – June 2012: Budget: \$20,000

D. Long-Term Strategy: Applications we develop in this study can be continued long into the future for a minimal cost. When this project concludes, we will pursue linking our results to ongoing easement programs as part of our regular community-service responsibilities at MSU Mankato. This long-term work should further refine our results and help SWCD, MDA, MPCA, and BWSR personnel effectively promote soil conservation and improve river water quality.

Project Budget

IV. TOTAL PROJECT REQUEST BUDGET

<u>BUDGET ITEM</u>	<u>AMOUNT</u>	<u>% FTE</u>
Personnel: (Amounts are totals for 3 full years of project participation)		
Bryce Hoppie: Hydrology & Water Chemistry	\$ 30,000	14%
Fei Yuan: Remote Sensing	\$ 31,000	14%
Donald Friend: River / Riparian Corridor Physical Geography	\$ 10,000	3%
Graduate Assistants (2 @ 50% appointments)	\$ 42,000	
Undergraduate Interns (2 @ 10 hrs/week/season)	\$ 15,000	
Contracts: Civil Air Patrol-- acquisition of 6 airborne hyperspectral images	\$ 18,000	
Minnesota Valley Testing Laboratories-- 50 water analyses for QA/QC	\$ 3,000	
Equipment/Tools: River gauging (\$5000), stage logging (\$4000), weather (\$6000), water sampling and testing (\$8000); solids and nutrients testing (\$5000); spectral light sensor (\$3000); modeling (\$2000) and mathematical (\$2000) software; misc. field and lab supplies (\$2000)	\$ 37,000	
Other: Travel-- In-state mileage to field sites, laboratories, and meetings using university fleet vehicles	\$ 4,000	
TOTAL PROJECT BUDGET REQUEST TO LCCMR	\$ 190,000	

V. OTHER FUNDS

<u>SOURCE OF FUNDS</u>	<u>AMOUNT</u>	<u>Status</u>
Remaining \$ From Previous Trust Fund Appropriation (if applicable)	\$ -	
Other Non-State \$ Being Leveraged During Project Period:	\$ -	
Other State \$ Being Spent During Project Period:	\$ -	
In-kind Services During Project Period: All equipment, supplies, software, and assistantships provided by MSU Mankato. Services include: Hand-held spectrometers (\$20000); GIS hardware (\$10000); GIS (\$20000), remote sensing (\$14000), and hydrologic modeling (\$2000) software; water quality sensors (\$9000); sediment analysis lab (\$2000); cold storage (\$1000); ultra-pure dionized water (\$2000); misc. field gear and lab equipment (\$2000)	\$ 82,000	
Past Spending: \$107,000 from MR2007, Chap 30, Sec. 2, 5E for personnel salaries, images, bench-top spectrometer, computer workstation, chlorophyll fluorimeter, stage dataloggers, water samplers, and misc. lab supplies. \$82,000 from MSU Mankato for hand-held spectrometers, GIS and image processing computers, GIS and remote sensing software and misc. field and lab supplies used on this project.	\$ 189,000	

Project Manager Qualifications

Bryce Hoppie

Education

Ph. D., Earth Sciences, University of California, Santa Cruz; August 1996.

B.S., Geological Engineering, South Dakota School of Mines and Technology; December 1986.

Employment

1996 - Present Assistant/Associate Professor of Geology, Minnesota State University, Mankato
2003 - 2004 Lecturer and Research Associate, University of California, Santa Cruz
1991 - 1996 Teaching and Graduate Research Assistant, University of California, Santa Cruz
1986 - 1991 Geological Engineer, Shell Western E&P Inc., Bakersfield, California

Recent Teaching and Research Support History

2008: Surface Water Assessment of Lake Titlow, Sibley County, Minnesota. Clean Water Legacy, Minnesota Pollution Control Agency. (With Vorlicek, T.) \$81,700.
2007: Improved River Quality Monitoring Using Airborne Remote Sensing. Legislative-Citizen Commission on Minnesota Resources. (With Yuan, F., and others.) \$159,000.
2007: Making Minnesota Rivers Great Again. Great River Energy, Inc. Public Grants Program. \$1,500.
2007: GIDDe: GeoWall Initiative for Development and Deployment. Minnesota State University, Technology Fee Grant. (With Swart, D., and others.) \$35,200.
2005: Pre-Historical Environmental Changes in the Minnesota Prairie – Forest Ecotone Deduced From The Paleolimnology of High Island Lake, Sibley County, Minnesota: MSU Mankato Faculty Research Grant program. \$3,600.
2004: Rock Preparation and Imaging Laboratory Phases I & II: Institutional Development Fund, Minnesota State University. \$27,000.
2001: Improved Regional Water Quality Assessment Using Thematic Mapper: Minnesota State University Faculty Research Grant program. \$2,400.

Recent Publications, Abstracts, and Presentations

Brosch, K., and Hoppie, B., (2008), *Downstream Effects of Draining a Silted Reservoir: Rapidan Reservoir, Blue Earth County, Minnesota*. Annual Meeting of the Amer. Assoc. Geographers, Boston, Ma., URL: http://communicate.aag.org/eseries/aag_org/program/AbstractDetail.cfm?AbstractID=19001.
Merlini, M., and Hoppie, B., (2008). *Rapid Recharge of a Prairie Pothole Region Water Table Aquifer Following Severe Drought Conditions*. Annual Meeting of the Amer. Assoc. Geographers, Boston, Ma., URL: http://communicate.aag.org/eseries/aag_org/program/AbstractDetail.cfm?AbstractID=18723.
Elliot, M., and others (2008), *River Quality Monitoring Using Airborne Remote Sensing on the Blue Earth River, MN*. Annual Meeting of the Amer. Assoc. Geographers, Boston, Ma., URL: http://communicate.aag.org/eseries/aag_org/program/AbstractDetail.cfm?AbstractID=18696.
Vorlicek, T., Swart, D., and Hoppie, B. (2006) Abnormal hydrogeochemistry within the Prairie du Chien confined bedrock aquifer, southeastern Minnesota, USA: 231st ACS National Meeting, Atlanta, GA, vol. 46, no. 1, p. 189-192.
Hoppie, B., Vorlicek, T., and Swart, D. (2005) Rapid recharge of a deeply buried carbonate aquifer, Rice County, Minnesota. GSA Abstracts with Programs, vol. 37, no. 7, pp. 32.
Schimek, M., and Hoppie, B. (2005) Seasonal dynamics of a high arctic lake, Lake Linne, Spitsbergen Island, Svalbard. Abstracts with Programs, GSA (NE Section), March, 2005.
Hoppie, B. W., and Roost, B. (2004) Enhanced Thematic Mapper Plus analyses of chlorophyll-*a* concentration and distribution in small kettle lakes, southern Minnesota. Eos, Transactions of the American Geophysical Union, 85(47) H11F-0365.

Organization Description

Minnesota State University, Mankato is a regional, comprehensive university that serves the state, region, and global community through effective teaching, basic and applied research, and outreach.

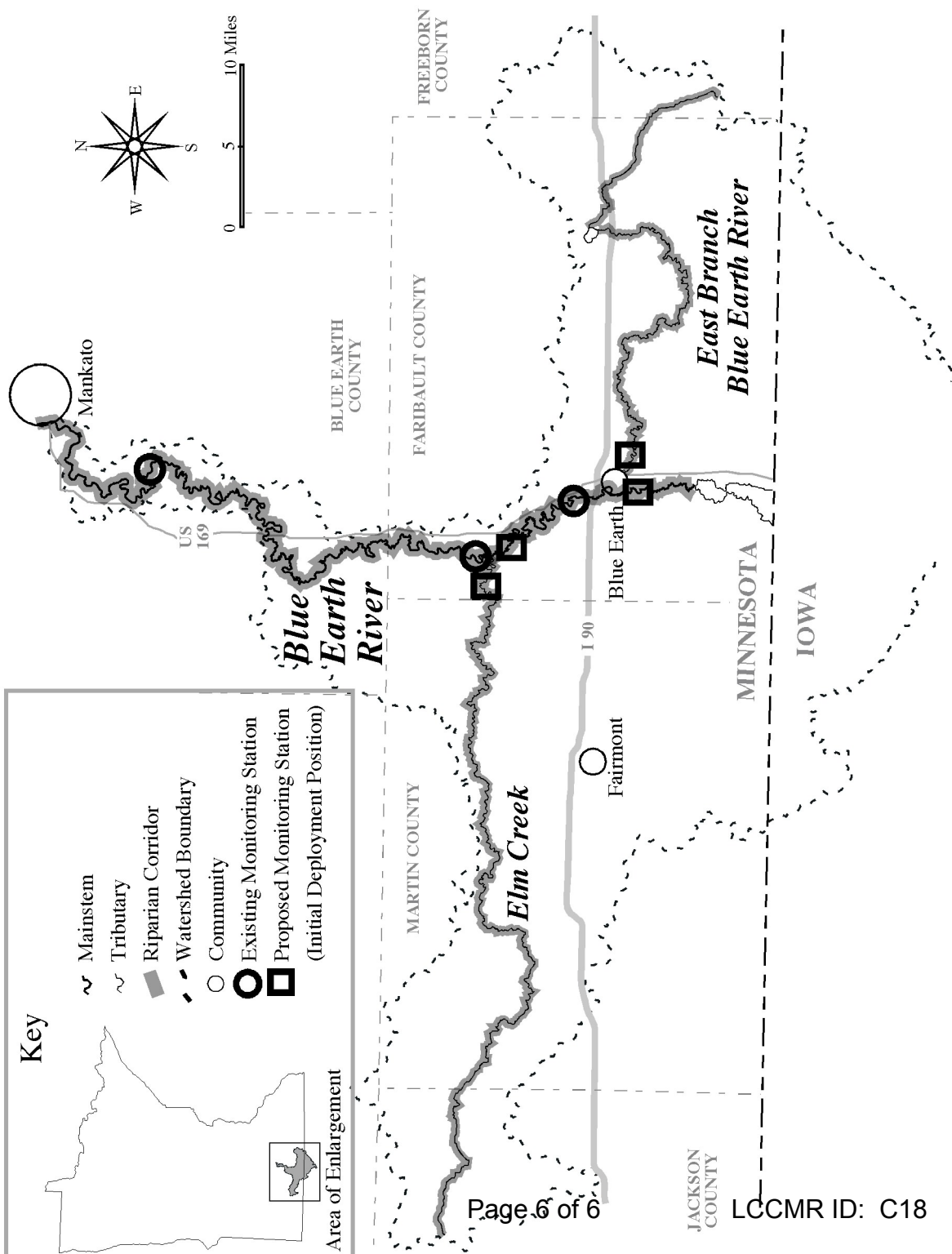


FIGURE 1: Blue Earth River Watershed, Streams and Sampling Sites