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

LCCMR ID: A04

Project Title: Innovative Trout Stream Springshed Mapping in Southeast Minnesota-Continuation

Total Project Budget: $ $1,118,837

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

Other Non-State Funds: $ none

First Name: E. Calvin **Last Name:** Alexander, Jr.

Sponsoring Organization: U of M

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Region:	County Name:	City / Township:
Metro, Southeast	Dakota, Dodge, Fillmore, Goodhue, Hennepin, Houston, Mower, Olmsted, Ramsey, Scott, Wabasha, Washington, Winona	

Summary: Innovative identification and deliniation of supply areas (springsheds) for springs serving as coldwater sources for modern and historic trout sreams and assessing impacts on them from land and water development.

Main Proposal: 0808-1-056-proposal-2009-2012 LCCMR Springsheds 2. Main Proposal 2.doc

Project Budget: 0808-1-056-budget-2009-2012 LCCMR Springsheds 3. Project Budget 2.xls

Qualifications: 0808-1-056-qualifications-2009-2012 LCCMR Springsheds 5. PM Qualifications & Organ. D

Map: 0808-1-056-maps-2009-2012 LCCMR Springsheds 4. Map compressed.doc

MAIN PROPOSAL

PROJECT TITLE: Innovative Trout Stream Springshed Mapping in Southeast Minnesota-Continuation

I. PROJECT STATEMENT

Trout streams depend on a steady supply of clean, cold water to exist. Each of southeastern Minnesota's trout streams is sourced from springs. These trout springs are under increasing pressure from changing land use, climate change, and groundwater withdrawals for energy production and other uses. Delineation of the recharge areas or springsheds of these trout springs is a necessary first step in the protection of the trout fisheries and the restoration of those that have been degraded. Dye tracing is the proven method for accurately delineating springsheds in karst but is not always feasible. Development of supplemental springshed mapping tools is a critical component of evaluating the vulnerablity of trout stream springs and developing Best Management Practices to protect and improve the water quality in these springs.

Significant progress has been made during the first year of this project. The existing Galena karst springshed coverage in Fillmore County and Olmsted County has been expanded. Successful dye traces in the Prairie du Chien and St. Lawrence Formations have been an innovative use of tracers in geologic environments where they have not been widely used. A spring temperature-monitoring network has been established to determine if temperature fluctuations and changes can be used as an indicator of a spring's hydrogeologic vulnerability. High-resolution structural contour geologic maps are yielding information that correlates with water flow directions. Measurement of natural dissolved organic compounds spectra is starting to yield data that may also provide a simple fast way to evaluate a spring's vulnerability. New, faster methods to assess spring vulnerability are a critical component for future land and water management decisions. Figure 1, part 4, shows the new dye trace and spring monitoring locations.

This is a joint UM and DNR proposal and is the continuation of a 2007-2009 LCCMR funded project of the same name. Based on our experience during the first year of the existing project, a three year continuation and additional staff are needed to accomplish the project's goals. One additional staff person at the DNR, one additional graduate student at the UM, and three new partners will accelerate spring vulnerability assessments, karst landscape unit mapping, and springshed mapping. Map production will also be emphasized with the goal of making up-to-date springshed maps and karst features information available via user friendly web sites on the internet.

II. DESCRIPTION OF PROJECT RESULTS

Result 1 Innovative Trout Springshed Maps and Reports. Budget: $ 627,933.

Springsheds that feed source springs of trout streams will be delineated in the Galena, Prairie du Chien, and St. Lawrence karst lands. The emphasis will be on dye tracing in the St. Peter/Prairie du Chien/Jordan karst while still expanding the Galena karst coverage. Dye tracing will be done in the St. Lawrence as karst features are located in this newly recognized karst unit. Maps of the springsheds will be made available via a GIS-based website allowing regular updates.

Deliverable	Completion Date
1. 1:100,000 or smaller scale maps of all delineated springsheds	30 June 2012
2. Maps and reports of completed dye traces	30 June 2012

Result 2 Trout Springshed Assessment Protocols. Budget: $ 448,301.

Assessment of spring vulnerability is the second step, which requires the development of new protocols. These protocols are vital to the assessment of the impacts of water and land use changes and large water withdrawals in springsheds. Discharge and water quality information is critical to evaluate spring vulnerability. These physical parameters will be measured at springs and used with springshed maps to develop a more complete understanding of the hydrology of the springs of southeast Minnesota and to develop a methodology to assess spring vulnerability. The springshed maps and spring vulnerability protocols will be integrated into the Karst Landscape Unit (KLU) mapping process. Karst Landscape Units are discrete three-dimensional bodies in which solution of the bedrock has resulted in the integration of surface water and groundwater. They are delineated

using geologic, geomorphologic, and hydrologic parameters. KLU mapping provides a comprehensive view of karst flow systems and their springs and springsheds.

Deliverable	Completion Date
1. Spring vulnerability assessment methodology development	30 June 2012
2. KLU mapping hierarchy developed for the Galena karst	30 June 2011
3. KLU mapping hierarchy developed for the Prairie du Chien karst	30 June 2012

Result 3 Web Accessible Trout Springshed Maps and KFDB **Budget: $ 42,603**

The springshed maps as they are produced and updated will be useful to resource managers. They need to be accessible in a user-friendly web site. The MN Karst Features Data Base (KFDB) exists and is and will continue to be an integral part of the springshed mapping project. The KFDB needs to be updated, made more web accessible and user friendly.

Deliverable	Completion Date
1. Web site for user friendly posting of GIS based springshed maps	30 June 2011
2. Updated access to KFDB for on-line data entry and management	30 June 2012

III. PROJECT STRATEGY AND TIMELINE

A. Project Partners

Jeffrey A. Green P.G. will be co-PI and will manage the DNR's portion of this project. Jeff is the Southeast Minnesota Groundwater Specialist for the Minnesota Department of Natural Resources. He will be the lead on the KLU section (Result 2) of this project and will be involved in all aspect of this project. He has extensive experience managing LCCMR projects.

Dr. Yongli Gao will be a contractor who is responsible for developing the GIS based web site for public access to the springshed maps and updating the KFDB to make it more user friendly and accessible (Result 3). Gao designed and implemented the current Mn KFDB and is currently working with the USGS on a National Karst Features Data System. He is an Assistant Professor at East Tennessee State University in Johnson City, TN.

Dr. Anthony C. Runkel will be contributing stratigraphic information to Results 1, 2, and 3 of this project. Tony is the Minnesota State Geologist with the Minnesota Geological Survey. He has done extensive work on the karst hydrostratigraphy of southeastern Minnesota.

Robert G. Tipping is a Senior Scientist with the Minnesota Geological Survey. Bob currently maintains the MN KFDB. He has also done pioneering work on the karst hydrostratigraphy of southeastern Minnesota and will also contribute his expertise to all three Results.

B. Project Impact

By delineating springsheds and developing tools to assess spring vulnerability, this project will provide critical information for the protection and management of the springs that form the coldwater streams of southeast Minnesota. This information is critical for Total Maximum Daily Load (TMDL) implementation strategies, impaired waters remediation, ground water protection and allocation issues, and local land and water management decisions.

C. Time

The goal is to accelerate springshed mapping and KLU mapping. Three years with additional staff will allow for a significant increase in mapping activities. This work will need to continue after the three-year period due to the large area being investigated, the complexity of karst systems, and the changing demands on the resources.

D. Long-Term Strategy (if applicable)

Karst ground water flow is the most complex hydrogeologic environment in Minnesota. Springshed mapping, spring vulnerability assessments, and KLU mapping are critical components of karst aquifer characterization. Long-term resources are needed to continue these efforts with the available trained staff.

The availability of high-resolution LiDAR maps, scheduled for July 2009, will produce a flood of new information showing the locations of karst features. We anticipate that new information will have a major impact on the springshed mapping project.

Project Budget

IV. TOTAL PROJECT REQUEST BUDGET

BUDGET ITEM	AMOUNT	% FTE
Personnel:		
E. Calvin Alexander, Jr. Project Manager	$ 29,235	8%
UM Scientist (Scott Alexander)	$ 72,827	50%
2 UM Graduate Research Assistants	$ 138,429	50%
MGS Staff Scientist (Anthony Runkel)	$ 33,074	15%
MGS Staff Scientist (Robert Tipping)	$ 31,795	15%
Fringe Benefits on UM and MGS staff	$ 95,304	---
UM Undergraduate Research Assistant	$ 24,570	38%
Result 2: DNR Waters Hydrogeologist 3	$ 246,000	100%
Result 1: DNR Waters Hydrogeologist 2	$ 217,000	100%
Contracts:	$ -	
Yongli Gao (Web page and Data Base design)	$ 42,603	
Equipment/Tools: *What? List general description of needs.*	$ -	
DNR Result 1	$ 15,000	
DNR Result 2	$ 10,000	
UM (2 submersable continuously recording fluorometers)	$ 22,000	
Acquisition (Including Easements): None	$ -	
Restoration: None	$ -	
Other:	$ -	
UM Expendable field and laboratory supplies (dye, sample bottles, chemicals, lab and field supplies, chemical analyses, etc.)	$ 25,000	
UM Milage and travel costs in Minnesota	$ 45,000	
UM Out of State Travel to National meetings to present results and to learn from colleagues in other states.	$ 6,000	
DNR Result 1: Vehicle milage costs in Minn.	$ 30,000	
DNR Result 1: Meals and lodging costs in Minn.	$ 1,000	
DNR Result 2: Vehicle milage costs in Minn.	$ 25,000	
DNR Result 2: Meals and lodging costs in Minn.	$ 1,000	
DNR Result 1: Out of State Travel to 12th Sinkhole Conference, Geological Society of America Conference to present findings, MGWA workshops.	$ 4,000	
DNR Result 2: Out of State Travel to 12th Sinkhole Conference, Geological Society of America Conference to present findings, MGWA workshops.	$ 4,000	
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ 1,118,837	

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Remaining $ From Previous Trust Fund Appropriation (if applicable): ML 2007 (5G) appropriation to the University of Minnesota. Unexpended balance as of 18 Aug 2008.	$143,288	unexpended, contract expires 30 Jun 2009
Other Non-State $ Being Leveraged During Project Period:	none	
Other State $ Being Spent During Project Period:	none	
In-kind Services During Project Period: DNR Waters staff project support 0.05 FTE (General Fund)	$12,000	
Past Spending:	$0	

5. Project Manager Qualifications & Organization Description

Project Manager Qualifications

1. **E. Calvin Alexander, Jr., Project Manager and Principle Investigator.** Calvin Alexander is a Morse-Alumni Professor in the Geology and Geophysics Department of the University of Minnesota's Minneapolis Campus. He has conducted thirty years of research on Minnesota's karst hydrogeology and karst elsewhere on Earth. He is the author or co-author of many publications on Minnesota's karst hydrogeology. Calvin is conducting ongoing, active research on many facets of the interactions between Minnesota's karst and the people who live and work on it. Calvin has taught numerous karst courses and short courses, presented many papers at local, state, national, and international meetings on karst hydrogeology, and presented hundreds of talks to local, regional, state, and national gatherings.

   Calvin is the Project Manager of this proposal. He has been involved in a variety of LCMR and LCCMR funded projects since the early 1970s and is familiar with the process. Calvin will manage the University of Minnesota's part of this effort and oversee the activities of Scott Alexander (not related), graduate Research Assistant Andrew Luhmann and another graduate student to be named, and other UM staff involved. Calvin and Jeff are jointly providing the scientific and logistical management to the current LCCMR Springsheds projects. They have jointly managed or co-managed several karst hydrogeology projects in the past decade.

2. **Jeffrey A. Green, Project Partner and Co-Project Manager**. Jeff Green is a Hydrologist 3 and is the Karst Groundwater Specialist for the Minnesota Department of Natural Resources Division of Waters in Rochester. His primary areas of emphasis are karst hydrology, karst mapping, and carbonate hydrogeology. These efforts are done to provide technical assistance to local units of government, DNR staff, and other state agencies. He has a B.S. with Distinction in Soil Science and a M.S. in Water Resources Management from the University of Wisconsin-Madison and is licensed as a Professional Geologist by the State of Minnesota. Current projects include ground water mapping in Fillmore County for the Root River Initiative (dye tracing karst ground water flow) and Decorah Edge hydrology studies in the Rochester area.

   Jeff is the principle Project Partner. He has been involved in a variety of LCMR funded project since 1993, he was the Project Manager on the LCMR Quarries project for 2001 to 2004, is co-managing the current LCCMR Springsheds project and is familiar with the process. Jeff will manage the DNR's part of this effort and oversee the activities of the Hydrologist 2 Andrew Peters and any other DNR staff involved. The DNR will be a contractor on this project. Jeff and Calvin will jointly provide the scientific and logistical management of this project. They have jointly managed or co-managed several karst hydrogeology projects in the past decade.

Organizational Description

The University of Minnesota's mission is threefold: 1) Research and Discovery, 2) Teaching and Learning, and 3) Outreach and Public Service.

The Minnesota Department of Natural Resources- Division of Waters mission is: Helping people ensure the future of our water resources

Part 4. Map

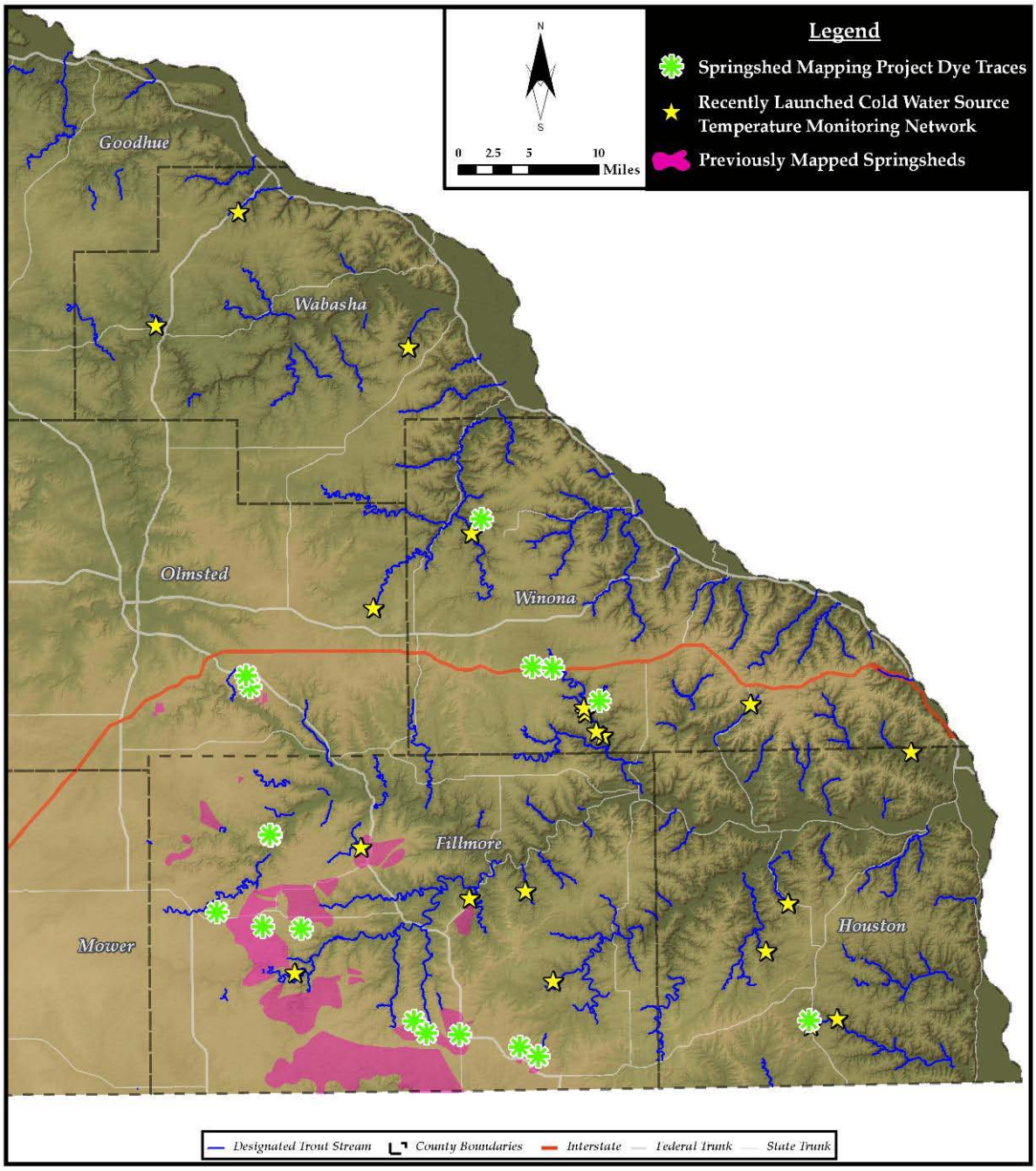

Figure 1. Map of the Trout Streams in Southeastern Minnesota showing mapped springsheds and the locations of current investigations of additional springsheds.