

Trust Fund 2009 Work Program

Date of Report: 1 Jun 2009

Date of Next Progress Report: 31 December 2009

Date of Work Program Approval:

Project Completion Date: 30 June 2011

I. PROJECT TITLE: Innovative Springshed Mapping for Trout Stream Management-Continuation

Project Manager: E. Calvin Alexander, Jr.

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Location: Dakota, Dodge, Goodhue, Houston, Fillmore, Mower, Olmsted, Winona, Wabasha, and Washington Counties.

Total Trust Fund Project Budget:	U of Mn	Mn DNR	Total
Trust Fund Appropriation	\$ 250,000	\$ 250,000	\$ 500,000
Minus Amount Spent:	<u>\$ 000</u>	<u>\$ 000</u>	<u>\$ 000</u>
Equal Balance:	\$ 250,000	\$ 250,000	\$ 500,000

Legal Citation: M.L. 2009, Chp. 143, Sec. 2, Subd. 3d.

Appropriation Language: Springshed Mapping for Trout Stream Management.

\$500,000 is from the trust fund to continue to identify and delineate supply areas and springsheds for springs serving as coldwater sources for modern and historic trout streams and to assess the impacts from development and water appropriations. Of this appropriation, \$250,000 is to the Board of Regents of the University of Minnesota and \$250,000 is to the commissioner of natural resources.

II. PROJECT SUMMARY AND RESULTS: Trout streams depend on a steady supply of clean, cold water to exist. Minnesota's karst lands contain 173 designated trout streams each of which is sourced from springs. Those trout springs are under increasing pressure from changing land use. Additional large groundwater withdrawals for energy production and other development loom in the future. Delineation of the recharge areas or springsheds of the trout springs is a crucial first step in the protection of the trout fisheries and the restoration of those that have been degraded. This project is a continuation of a 2007-2009 LCCMR grant to develop innovative identification and delineation tools to determine the supply areas

(springsheds) for springs serving as coldwater sources for modern and historic trout streams and assessing impacts on them from land and water development.

Significant progress has been made during the first project. The existing Galena karst springshed coverage in Fillmore County and Olmsted County has been expanded. These traces tend to take a few weeks to months. Successful dye traces in the Prairie du Chien and St. Lawrence Formations have been an innovative extension of tracers into geologic environments where they have not been widely used. The St. Lawrence Formation has been considered an aquitard in previous hydrologic work, but significant springs that head trout streams flow from the St. Lawrence Formation. New dye trace results show that portions of the St. Lawrence Formation act as highly transmissive aquifers. Previously, springs flowing from the St. Lawrence and overlying Jordan Sandstone have been assumed to be fed by stable, well-protected diffuse groundwater recharge. The new results show that trout stream source springs in the Jordan and St. Lawrence are much more vulnerable than previously recognized. The St. Lawrence traces have proven to last for months to a year or more. We will continue to conduct dye traces in both the Galena, Prairie du Chien and St. Lawrence springsheds feeding trout streams.

Spring temperature-monitoring monitoring points have been established and show a wide and interesting range of temperature responses to seasonal and recharge forcing. Those temperature responses and changes can be used as indicators of spring hydrogeologic vulnerability.

New high-resolution structural contour geologic maps are yielding information that correlates with water flow directions. Measurements of natural dissolved organic compounds spectra are starting to yield data that may also provide a simple fast way to evaluate spring vulnerability. We will add stable isotope analyses of the spring waters to the array of tools used to define trout stream springsheds.

This is a joint UM and DNR proposal and is the continuation of a 2007-2009 LCCMR funded project of the same name. A two-year continuation is needed to accomplish the project's goals. Three new partners will accelerate spring 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.

III. PROGRESS SUMMARY AS OF (1 July 2009)

IV. OUTLINE OF PROJECT RESULTS:

Result 1: Innovative Trout Springshed Maps and Reports

Description: Springsheds that feed source springs of trout streams will be delineated in the Galena, Prairie du Chien, and St. Lawrence karst lands. Dye tracing will be expanded in the Prairie du Chien and Galena karsts. We will also conduct dye traces in the St. Lawrence Formation 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. The temperature monitoring network will be maintained and expanded as equipment and sites become available. High resolution structural contour maps, fluorescence data on the dissolved organic

compounds in the springs and stable isotope results will be included in the springshed maps and reports as they become available and useful.

Summary Budget Information for Result 1:

Trust Fund Budget:	U of Mn	Mn DNR	Total
Trust Fund Appropriation	\$ 190,211	\$ 250,000	\$ 440,211
Minus Amount Spent:	\$ 000	\$ 000	\$ 000
Equal Balance:	\$ 190,211	\$ 250,000	\$ 440,211

Deliverable	Completion Date	Budget
1. Innovative Trout Springshed Maps and Reports U of Mn. These reports and maps will present the results of the dye traces and other data that help to define the trout spring springsheds.	30 June 2011	\$ 190,211

Result Status as of 31 December 2009:

Result Status as of 30 June 2010:

Result Status as of 31 December 2010:

Final Report Summary 30 June 2011:

Result 2 Web Accessible Trout Springshed Maps and KFDB

Description: 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 will be updated, made more web accessible and user friendly. Web sites will be designed to facilitate user access to the springshed maps and the data in the KFDB. The most appropriate location for the long term web host for the Springshed Maps and web accessible KFDB is being investigated. Whatever host is most appropriate, the site will be linked to the Mn DNR, MGS and U of Mn and any other relevant web pages.

Summary Budget Information for Result 2:

Trust Fund Budget:	U of Mn	Mn DNR	Total
Trust Fund Appropriation	\$ 59,789	\$ 000	\$ 59,789
Minus Amount Spent:	\$ 000	\$ 000	\$ 000
Equal Balance:	\$ 59,789	\$ 000	\$ 59,789

Deliverable	Completion Date	Budget
1. Web site for user friendly posting of GIS based springshed maps & updated access to KFDB for on-line data entry & management.	30 June 2011	\$ 59,789

Result Status as of 31 December 2009:

Result Status as of 30 June 2010:

Result Status as of 31 December 2010:

Final Report Summary 30 June 2011:

V. TOTAL TRUST FUND PROJECT BUDGET:

	U of Mn	Mn DNR	Total
Personnel:	\$ 171,291	\$ 202,500	\$ 373,791
Contracts:	\$ 28,000	\$ 000	\$ 28,000
Equipment/Tools/Supplies:	\$ 30,000	\$ 16,000	\$ 46,000
Travel:	\$ 20,709	\$ 29,000	\$ 49,709
Other:	\$ 000	\$ 2,500	\$ 2,500

(See explanation of the capitol equipment, equipment/tools/supplies and the in- and out of state travel below.)

TOTAL TRUST FUND PROJECT BUDGET: \$ 500,000

Explanation of Capital Expenditures Greater Than \$3,500:

The \$20,000 Capital Equipment item in the U of Mn portion of this project is to purchase a new, fast, high capacity Laser Cavity Liquid Water Isotope Analyzer to measure the stable isotope composition of oxygen and hydrogen in water. The \$20,000 from the LCCMR will be matched by funds from other sources to purchase an Analysis System that will cost about \$40,000. The current high cost of mass spectrometric water isotope measurements limits the application of isotope measurements to Trout Springshed mapping. This new technology decreases the cost by a factor of 10.

Of the remaining \$10,000 of the U of Mn Equipment/Tool/Supplies budget, \$2,000 will be spent purchasing non-capital equipment and tools such as field meters, electrodes for field meters, sensors, and replacement parts for existing equipment. \$8,000 will be spent on expendable supplies such as fluorescent dye, charcoal, labels, bottles, lab supplies, etc.

Explanation of Travel Costs:

The U of Mn's \$17,709 item for instate travel is to cover the cost of the extensive field work involved in this project. Most of that will cover the mileage costs of the field vehicles. A few overnight trips will include lodging and food charges for the project partners.

The \$3,000 item for travel outside of Minnesota is to partially defray the costs of the Project Manager, Scientist and Graduate Research Assistant to attend to learn from colleagues in other states who are working on karst hydrogeology. Possible meetings include the 12th Sinkhole Conference in 2010 or the Annual Geological Society of America Meetings.

VI. PROJECT STRATEGY:

A. Project Partners:

Dr. E. Calvin Alexander, Jr. will be the project manager of the overall Trout Springshed Mapping Project and the manager of the U of MN portion of the project. He is a tenured Professor in the Geology & Geophysics Department at the University of Minnesota

Jeff Green will be project manager of the DNR portion of this project and will be responsible for carrying out the DNR share of project activities. He is a classified state employee. His current position of Ground Water Specialist will be backfilled.

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. 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 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.

B. Project Impact and Long-term Strategy: By delineating springsheds and making web-based maps available, 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.

Karst ground water flow is the most complex hydrogeologic environment in Minnesota. Springs are the natural features that return groundwater to surface waters. Karst springs respond much faster to surface recharge than is expected from conventional hydrology theory. Karst springs exhibit a wide range of rapid responses to recharge events. Springs integrate all of the natural and anthropogenic processes that occur in their recharge areas – in their individual springsheds. Springshed mapping is critical component of karst aquifer characterization. Long-term resources are needed to gather and maintain the parameters necessary to realistically, effectively manage karst springs in Minnesota and to train staff and resource managers in the use of the available karst data.

LCCMR and LCCMR have played a leading role in the effort to understand and manage Minnesota's karst springs

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.

C. Other Funds Proposed to be Spent during the Project Period:

D. Spending History: \$ 250,000 from the trust fund to a joint project between the U of MN and the DNR, 1 July 2007 to 30 June 2009.

VII. DISSEMINATION: GIS based maps and written reports of the springsheds will be prepared and disseminated to the LCCMR and interested residents and to local, regional and state resource managers and regulators interested in specific targeted areas. Interim dye trace results will be available as GIS shape files and derived products on a dye trace by dye trace basis. Data tables of discharge and chemistry will be available as developed.

VIII. REPORTING REQUIREMENTS: Periodic work program progress reports will be submitted not later than 31 December 2009, 30 June 2010, 31 December 2010. A final work program report and associated products will be submitted between June 30 and August 1, 2011 as requested by the LCCMR.

IX. RESEARCH PROJECTS:

Attachment A: Budget Detail for 2009 Projects - Summary and a Budget page for each partner (if applicable)								
Project Title: Innovative Springshed Mapping for Trout Stream Management-Continuation								
Project Manager Name: E. Calvin Alexander, Jr.								
Trust Fund Appropriation: \$ 250,000								
2009 Trust Fund Budget	Result 1 Budget:	Amount Spent (date)	Balance (date)	Result 2 Budget:	Amount Spent (date)	Balance (date)	TOTAL BUDGET	TOTAL BALANCE
	Innovative Trout Springshed Maps and Reports			Web Accessable Trout Springsheds and KFDB				
BUDGET ITEM								
PERSONNEL: wages and benefits (Total)	139,502	0	139,502	31,789	0	31,789	171,291	171,291
UM Prof. E. Calvin Alexander, Jr. (1 month/yr - 8% FTE - \$23,884)								
UM Scientist Scott Alexander (50% FTE - \$59,540)								
UM Graduate Research Assistant (50% FTE - \$53,300)								
MGS Scientist Anthony Runkel (1 month/yr - 8% FTE - \$14,444)								
MGS Scientist Robert Tipping (1 month/yr - 8% FTE - \$13,787)								
UM Undergrad Res. Assist. (8 hr/wk, 9 m/yr - 15% FTE - \$6,336)								
Contracts								
Professional/technical								
Yongli Gao (Web page & Data Base design)	0	0	0	28,000	0	28,000	28,000	28,000
Non-capital Equipment / Tools								
meters, electrodes, sensors, etc.	2,000	0	2,000	0	0	0	2,000	2,000
Capital equipment over \$3,500								
Equipment such as Los Gatos Research Liquid Water Isotope Analyzer	20,000	0	20,000	0	0	0	20,000	20,000
Supplies								
Fluorescent dye, charcoal, labels, bottles, etc.	8,000	0	8,000	0	0	0	8,000	8,000
Travel expenses in Minnesota								
(see explanation in section V of work plan)	17,709		17,709				17,709	17,709
Travel outside Minnesota								
(see explanation in section V or work plan)	3,000	0	3,000	0	0	0	3,000	3,000
COLUMN TOTAL	\$190,211	\$0	\$190,211	\$59,789		\$59,789	\$250,000	\$250,000

