

**Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 023-A

Protecting Native Brook Trout: Temperature, Streamflow and Hydrogeology

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: \$ 119,858

Proposed Project Time Period for the Funding Requested: 2 years, July 2016 to June 2018

Summary:

Advances in temperature measurements using fiber optic cables (distributed temperature sensing) are used to evaluate links between southeastern Minnesota stream temperature, trout habitat and bedrock hydrogeology.

Name: Bob Tipping

Sponsoring Organization: Minnesota Geological Survey

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Location

Region: SE

County Name: Dakota, Fillmore, Goodhue, Houston, Mower, Olmsted, Wabasha, Washington, Winona

City / Township:

Alternate Text for Visual:

Brook trout, streams and temperature, southeastern Minnesota. A. Brook trout require cold, clean water to thrive. B. Photo of brook trout from MnDNR news release, April 16, 2015. C. Distributed Temperature Sensing (DTS) installation to look at soil moisture profiles, southwestern Wisconsin. D. Photo of trout stream from MnDNR news release, April 16, 2015.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____ %



PROJECT TITLE: Protecting native brook trout: temperature, streamflow and hydrogeology

I. PROJECT STATEMENT The recent discovery of resurgent brook trout populations – brook trout present in 68% of southeastern Minnesota streams compared to only 3% in the early 1970s - has led to an increased interest in documenting and improving critical habitat for this native species - the most temperature-sensitive of southeastern Minnesota's trout population. Many of the brook trout analyzed were not associated with known hatchery sources, leading investigators at the Minnesota DNR and University of Minnesota to focus on potentially remnant lineages that have proven their ability to sustain themselves in this region (Hoxmeier, Dieterman and Miller, 2015). Brook trout often display distinct distributions along stream reaches, thought to be caused by stream temperature, discharge, competition with brown trout, or a combination of all three. Previous groundwater and geologic investigations, funded in part by the LCCMR, have shown that specific layers within the bedrock provide greater groundwater flow. Stream reaches that cross these layers are subject to greater groundwater inputs, increased base flow and lower temperature along and downstream from these reaches thus providing habitat conditions supportive to brook trout.

The goal of this project is develop a workable temperature sensing methodology and apply the methodology to candidate trout stream reaches to quantify the changes in temperature, flow, and trout distributions that occur along them. Advances in temperature measurements using fiber optic cables (distributed temperature sensing, DTS) allow temperature to be recorded through time at regularly spaced intervals, over distances of 1 to 2 kilometers. Stream reaches to be measured will be chosen based on geologic mapping by the Minnesota Geological Survey, focusing in areas where different geologic conditions exist and information on trout distribution and abundance are available.

The proposed work will deliver maps showing where significant reductions in temperature and increases in stream flow are expected to occur. Because these intervals are in large part controlled by subsurface geologic conditions and detailed geologic maps exist for the region, results can be readily extended to unmeasured reaches in southeastern Minnesota. Once developed, the DTS methodology may be applicable to trout streams in other regions of Minnesota and to other aquatic resources that are sensitive to stream temperature distribution such as state and federally listed rare and endangered species.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Stream reach suitability assessment

Budget: \$ 17,912

To identify sites suitable for streamflow temperature measurement, we will use County Geologic Atlas maps from the Minnesota Geological Survey and previous trout distribution investigations to target potential reaches. Because the cable must remain submerged during measurement phases, factors such as stream depth, morphology, and bed characteristics will be considered. Ideally, we will identify reaches in several different geologic settings where contributions to streamflow will be primarily from groundwater (baseflow).

Outcome	Completion Date
1. Identification of potential stream reaches for measurement based on hydrogeologic setting and historic trout distribution data.	Fall 2016

Activity 2: Acquire Distributed Temperature Sensing (DTS) equipment

Budget: \$ 30,712

Distributed temperature sensing is an emerging technology that would be expensive to purchase on its own, and difficult to master without training. This project proposes to acquire equipment and training from the Center for Transformative Environmental Monitoring Programs (CTEMPS; <http://ctemps.org/>). CTEMPS works to promote use of this technology by providing equipment and training at minimal cost



Environment and Natural Resources Trust Fund (ENRTF)

2016 Main Proposal

Project: Protecting native brook trout: temperature, stream flow and hydrogeology

Outcome	Completion Date
1. Application for DTS equipment from CTEMPs	Fall 2016
1. Equipment acquired and training completed	Spring 2017

Activity 3: Methodology development and seasonal measurements of temperature, flow, and trout distribution **Budget: \$ 53,323**

Temperature data will be collected seasonally from Spring 2017 until Spring 2018. Fish population assessments and streamflow measurements will be conducted seasonally during the same time period.

Outcome	Completion Date
1. Practical aspects and pitfalls of using DTS equipment to measure stream temperatures identified.	Spring 2018
2. links between stream temperature, streamflow and bedrock geology established	Spring 2018
3. links between brook trout populations and bedrock geology established	Spring 2018

Activity 4: Critical reach mapping

Budget: \$ 17,912

Interpretation of collected data will provide, for the first time, maps showing the extent of both measured and projected cold water reaches, their impact on trout habitat, and their position relative to specific bedrock hydrogeologic conditions.

Outcome	Completion Date
1. Map capturing key reaches where significant reductions in temperature and increases in stream flow are expected to occur	Spring 2018
2. Map identifying type and extent of biota associated with colder reaches	Spring 2018

III. PROJECT STRATEGY

A. Project Team/Partners The project will be conducted by Bob Tipping, Tony Runkel, Julia Steenberg and Andrew Retzler from the Minnesota Geological Survey (MGS). MGS will work in collaboration with southeast Minnesota research scientist John Hoxmeier from Minnesota Department of Natural Resources (MNDNR) Fisheries division, and staff from Minnesota Pollution Control Agency's Rochester office. Oregon State University's Center for Transformative Environmental Monitoring Programs (CTEMPS) leases Distributed Temperature Sensing (DTS) equipment supported by staff scientists at minimal cost in order to promote research with this new technology.

B. Project Impact and Long-Term Strategy The proposed work will deliver maps showing where significant reductions in temperature and increases in stream flow are expected to occur. Because these intervals are in large part controlled by subsurface geologic conditions and detailed geologic maps exist for the region, results can be readily extended to unmeasured reaches in southeastern Minnesota. Once developed, the DTS methodology may be applicable to trout streams in other regions of Minnesota and to other aquatic resources that are sensitive to stream temperature distribution such as state and federally listed rare and endangered species.

The proposed project will apply DTS technology to Minnesota streams to assess its potential applicability and efficacy for evaluating trout stream habitat conditions. Depending on the project findings, the MGS and MNDNR may return to LCCMR in future years for additional funds to apply DTS to other types of streams or to evaluate habitat conditions for other temperature sensitive aquatic resources of concern.

C. Timeline Requirements The project will start July 2016 and continue for 24 months, to allow time for seasonal data collection and analysis.

2016 Detailed Project Budget

Project Title: Protecting native brook trout: temperature, streamflow and hydrogeology

IV. TOTAL ENRTF REQUEST BUDGET 2 years

BUDGET ITEM	AMOUNT
Personnel: Two and one-half month salary equivalent, in each of the two project years, for Bob Tipping (MGS) to assist with hydrostratigraphic investigations, assist with DTS equipment installation and monitoring, lead on DTS equipment acquisition and training. Tipping will also serve as project manager, coordinate project activities and data dissemination. One month salary is \$5,648 plus \$1,486 for fringe benefits (26.3%)	\$ 35,669
Personnel: Two-month salary equivalent for Tony Runkel (MGS), in each of the two project years, to lead hydrostratigraphic investigations and assist with DTS equipment installation and monitoring. One month salary is \$6,138 plus \$1,614 for fringe benefits (26.3%)	\$ 31,009
Personnel: One month salary equivalent for Julia Steenberg (MGS), in each of the two project years, to assist hydrostratigraphic investigations and assist with DTS equipment installation and monitoring. One month salary is \$4,535 plus \$1,193 for fringe benefits (26.3%)	\$ 11,456
Personnel: One month salary equivalent for Andrew Retzler (MGS), in each of the two project years, to assist hydrostratigraphic investigations and assist with DTS equipment installation and monitoring. One month salary is \$3,731 plus \$981 for fringe benefits (26.3%)	\$ 9,424
Professional/Technical/Service Contracts: MN DNR staff to conduct stream stream discharge measurements at the beginning and end of the fiber optic cable for each measurement location and period	\$ 8,300
Professional/Technical/Service Contracts: Center for Transformative Environmental Monitoring Programs (CTEMPs) - Oregon State University. Leases distributed temperature sensing equipment and provides training support. DTS equipment lease rates: Field Deployable DTS \$50/day; fusion splicer for cable repair, \$50/day; 240 Solar power system for field DTS, \$200/month. total listed is for 4 months leasing.	\$ 12,800
Equipment/Tools/Supplies: supplies to submerge and protect fiber optic cable in the stream bed; estimated shipping for DTS equipment, 4 shipping events; 2000 meters of armored fiber optic cable used as part of the DTS installation; cable connectors used as part of the DTS installation (20 at \$50 each); water tight splice boxes (20 at \$65 each)	\$ 9,600
Travel: Travel for site evaluations; trips to and from installation sites	\$ 1,600
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 119,858

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ To Be Applied To Project During Project Period:	N/A	
Other State \$ To Be Applied To Project During Project Period: The proposed project is in part an outgrowth of knowledge about the importance of how groundwater flows through bedrock in southeastern Minnesota, attained through the ongoing Minnesota Geological Survey and DNR County Geologic Atlas program, funded through ENRTF.	N/A	Secured
In-kind Services To Be Applied To Project During Project Period: One month salary equivalent, in each of the two project years for John Hoxmeier, MNDNR Fisheries to lead the fish population assessment and assist with DTS equipment installation and monitoring (15,200); One month salary equivalent in each of the two project years for MPCA staff person to assist with siting, DTS equipment installation and monitoring (16,000)	\$ 31,200	
In-kind Services To Be Applied To Project During Project Period: The University of Minnesota's Facilities and Administrative rate is 52% of modified total direct costs (total direct less graduate student fringe, capital equipment, subawards over \$25,000 and on-site facilities rental). The amount, if F&A expenses would have been allowed on this project, would be \$46,362	\$ 46,362	
Funding History: Proposed project builds on County Geologic Atlas mapping in southeastern Minnesota, funded through the ENRTF going back to the early 1980s, with additional funding coming from the Clean Water Fund for Winona and Houston County mapping. The project also builds on a recently completed investigation of bedrock controls on nitrate distribution in southeastern Minnesota streams, funded by the Minnesota Pollution Control Agency.	\$ -	Completed
Remaining \$ From Current ENRTF Appropriation:	N/A	

A.

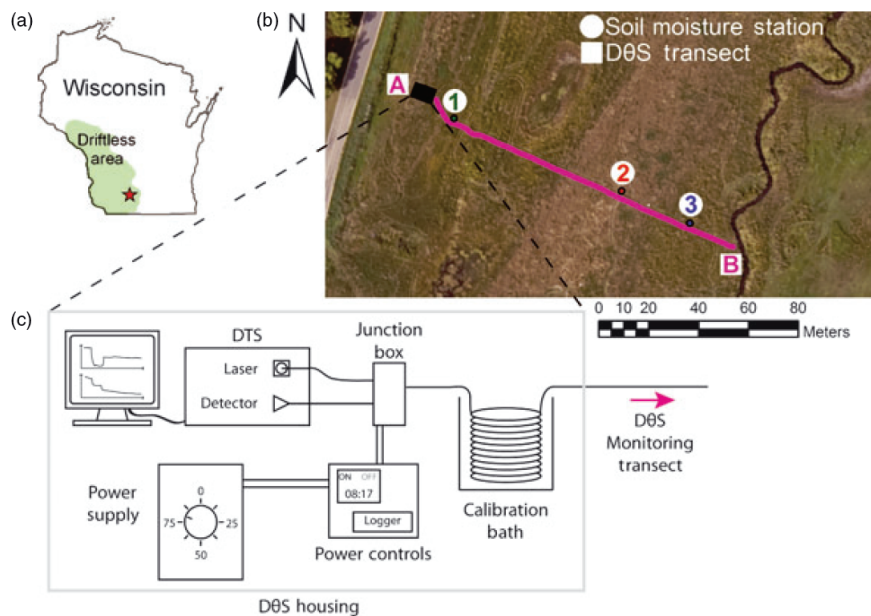


B.



Southeastern Minnesota brook trout average less than 10 inches, although brook trout up to 17 inches are occasionally caught. Because brookies can tolerate only the cleanest and clearest water, fishing for this species invariably takes anglers to the most pristine and scenic areas of the southeast.

C.



D.



Distributed Temperature Sensing installation in southwestern Wisconsin. (Striegl and Loheide, 2012)

Project Title: *Distributed temperature sensing in southeastern Minnesota trout-streams*

Project Manager Qualifications and Organizational Description:

Bob Tipping, Senior Scientist, Minnesota Geological Survey

Dr. Tipping has been with the Minnesota Geological Survey – University of Minnesota, full time since 1990. His work focuses on groundwater resources in Minnesota, with an emphasis on geologic controls on groundwater flow. He is involved in the County Geologic Atlas (CGA) program, providing assistance in using geologic maps and datasets to solve groundwater resource management problems. Research relevant to this project includes 20 years of work with colleague Dr. Tony Runkel of the MGS on the hydrogeology of southeastern Minnesota Paleozoic bedrock. Much of this work has been funded by the LCCMR through the CGA program; specific LCCMR hydrogeologic projects include aquifer characteristics of the Prairie du Chein Group, and the St. Lawrence confining unit. Tipping is an adjunct faculty member in both the Earth Sciences and Water Resources Science Departments at the University of Minnesota. He received is PhD in Water Resources Science from the University of Minnesota (2012), MS in Geology from the University of Minnesota (1992), and BA in History from Carleton College (1981).

Minnesota Geological Survey, University of Minnesota (Twin Cities)

The Minnesota Geological Survey is a unit of the Newton Horace Winchell School of Earth Sciences in the University of Minnesota. The Survey is the University outreach center for the science and technology of earth resources in Minnesota. The Survey conducts basic and applied earth science research, conveys that information to the public through publications and service activities, and promotes earth science education. Minnesota is its exclusive focus.