



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2016 Work Plan

Date of Report: May 29, 2016

Date of Next Status Update Report: January 1, 2017

Date of Work Plan Approval: June 7, 2016

Project Completion Date: June 30, 2019

Does this submission include an amendment request? No

PROJECT TITLE: Evaluate Temperature, Streamflow, and Hydrogeology Impact on Brook Trout Habitat

Project Manager: Bob Tipping

Organization: Minnesota Geological Survey

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Location: Dakota, Goodhue, Wabasha, Olmsted, Winona, Houston, Fillmore, Mower

Total ENRTF Project Budget:

ENRTF Appropriation: \$115,000

Amount Spent: \$0

Balance: \$115,000

Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 03k

Appropriation Language:

\$115,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota for the Minnesota Geological Survey to evaluate links between southeastern Minnesota stream temperatures, trout habitat, and bedrock hydrogeology to improve trout stream management. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: Protecting Native Brook Trout: Temperature, Streamflow and Hydrogeology

II. 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

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of January 1, 2017:

Project Status as of July 1, 2017:

Project Status as of January 1, 2018:

Project Status as of July 1, 2018:

Project Status as of January 1, 2019:

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Stream reach suitability assessment

Description: 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).

Summary Budget Information for Activity 1:

ENRTF Budget: \$ 26,500
Amount Spent: \$ 0
Balance: \$ 26,500

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

Activity Status as of January 1, 2017:

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Activity Status as of July 1, 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

ACTIVITY 2: Seasonal measurements of temperature, flow and trout distribution

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

Summary Budget Information for Activity 2:

ENRTF Budget: \$ 62,000
Amount Spent: \$ 0
Balance: \$ 62,000

| Outcome | Completion Date |
|---|------------------------|
| 1. Application for DTS equipment from Center for Transformative Environmental Monitoring Programs (CTEMPS) | December 31, 2016 |
| 2. Equipment acquired and training completed | May 1, 2017 |
| 3. Practical aspects and pitfalls of using DTS equipment to measure stream temperatures identified. Seasonal measurements of stream temperature, flow and trout distribution taken. | June 1, 2018 |
| 4. links between stream temperature, streamflow and bedrock geology analyzed | January 1, 2019 |
| 5. links between brook trout populations and bedrock geology analyzed | January 1, 2019 |

Activity Status as of January 1, 2017:

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Activity Status as of July 1, 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

ACTIVITY 3: Critical reach mapping and report

Description: Report with interpretation of collected data will provide, for the first time, maps showing the extent of both measured and projected cold water reaches, their correlation with trout habitat, and their position relative to specific bedrock hydrogeologic conditions.

Summary Budget Information for Activity 4:

ENRTF Budget: \$ 26,500
Amount Spent: \$ 0
Balance: \$ 26,500

| Outcome | Completion Date |
|--|-----------------|
| 1. Map capturing key reaches where significant reductions in temperature and increases in stream flow to occur. Map will also show areas where significant reductions in temperature and increases in flow are expected to occur based on investigation results. | June 1, 2019 |
| 2. Map identifying distribution of brook trout associated with colder reaches | June 1, 2019 |

Activity Status as of January 1, 2017:

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Activity Status as of July 1, 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

V. DISSEMINATION:

Description: Report and maps will be disseminated as Minnesota Geological Survey Open File Report, stored at the University of Minnesota’s Digital Conservancy (<http://conservancy.umn.edu/>) and accessible via the Minnesota Geological Survey’s web site (<http://www.mngs.umn.edu/>). Results will be presented in talks at Minnesota Ground Water Association and MN Water conferences. Publication in peer-reviewed journals will also be pursued.

Status as of January 1, 2017:

Status as of July 1, 2017:

Status as of January 1, 2018:

Status as of July 1, 2018:

Status as of January 1, 2019:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

| Budget Category | \$ Amount | Overview Explanation |
|---|-------------------|--|
| Personnel: | \$ 77,100 | 1 project manager and hydrogeologist at 9.5% FTE each year for 3 years (\$27,000); 1 lead geologist at 8.5% FTE each year for 3 years (\$25,800); 1 geologist at 6.0% FTE each year for 3 years (\$13,300); 1 geologist at 6.0% FTE each year for 3 years (\$11,000) |
| Professional/Technical/Service Contracts: | \$ 14,872 | 1 contract with Center for Transformative Environmental Monitoring Programs (CTEMPS), administered jointly by Oregon State University, University of Nevada-Reno, and National Science Foundation – leasing Distributed Temperature Sensing (DTS) equipment during the project (\$12,800); 1 contract with CTEMPS technical field support (\$2, 072) |
| Equipment/Tools/Supplies: | \$ 19,028 | Portable Velocity Meter with 20' Cable for stream gauging (\$4,903); Supplies to submerge and protect data collection equipment (\$1,055); Estimated shipping costs for DTS equipment – 4 shipping events at \$1,500 per event (\$6,000); 2000 meters of armored fiber optic cable (\$2,000); DTS cable collectors (\$900); DTS water-tight splice boxes (\$1,170) |
| Travel Expenses in MN: | \$ 4000 | Travel between potential and established field sites – 2000 miles - 0.17/mile- and vehicle rental - \$239/week for 4 weeks – (\$1,300); lodging – 10 days at \$118/day (\$1,180); meals – 30 days at \$48/day (\$1440) |
| TOTAL ENRTF BUDGET: | \$ 115,000 | |

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than \$5,000:

A Portable Velocity Meter with 20 feet of cable for stream gauging is expected to cost \$4,903. This purchase will cost less than contracting out for professional services, provide more scheduling flexibility, and allow us to conduct flow surveys at more than one site. After the project has ended, the equipment will continue to be

used by the Minnesota Geological Survey and Earth Sciences Department at the University of Minnesota for research and educational purposes.

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 0.85

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 0.06

B. Other Funds:

| Source of Funds | \$ Amount Proposed | \$ Amount Spent | Use of Other Funds |
|---|--------------------|-----------------|--|
| Non-state | | | |
| | \$ | \$ | |
| State | | | |
| DNR Fisheries (In-kind Support) | \$ 15,200 | \$ | One month salary equivalent, in each of two project years for John Hoxmeier, MNDNR Fisheries to lead the fish population assessment and assist with DTS equipment installation and monitoring |
| MPCA (In-kind Support) | \$ 16,000 | | One month salary equivalent in each of two project years for MPCA staff person to assist with siting, DTS equipment installation and monitoring |
| University of Minnesota (In-kind Support) | \$ 46,362 | | 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 |
| TOTAL OTHER FUNDS: | \$ 77,562 | \$ | |

VII. PROJECT STRATEGY:

A. Project Partners:

Project Partners Not Receiving Funds:

- Minnesota Department of Natural Resources – Fisheries Division: John Hoxmeier providing in-kind support to lead fish population assessment and to assist with Distributed Temperature Sensing (DTS) equipment installation and monitoring.
- Minnesota Pollution control Agency: Staff providing in-kind assistance with DTS equipment installation and monitoring.
- University of Minnesota Department of Earth Sciences: Technical support for equipment field testing.

Project Partners Receiving Funds:

- Center for Transformative Environmental Monitoring Systems (CTEMPS), jointly operated by Oregon State University, Corvallis and the University of Nevada, Reno, and funded by the National Science Foundation: \$12,800 to lease DTS equipment used during the investigation.

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 study will benefit the MN DNR in developing better management strategies for conserving recently discovered remnant brook trout populations in Minnesota. Given that brook trout rely heavily on cold groundwater inputs, information on these inputs is crucial toward understanding limits to their distribution. With a predicted increase in air temperatures over the next half century, identifying coldwater springs and stream reaches will become even more valuable in terms of providing coldwater fish refuge.

C. Funding History:

| Funding Source and Use of Funds | Funding Timeframe | \$ Amount |
|--|--------------------------|------------------|
| Proposed project builds on County Geologic Atlas mapping program, with the first southeastern Minnesota Geologic Atlas map completed in 1982. Since 2007, Statewide ENRTF 2007-2014 \$3,952,199; CWF 2010-2014 \$674,000; DNR 2007- 2014 \$2,155,694; Fed cost-sharing 2008-2013 \$663,791. ENRTF 2015-2018 \$2,040,000 | 2007 - 2018 | \$9,485,684 |
| Clean Water Fund - County Geologic Atlases for Houston and Winona Counties | 7/1/2010 – 12/31/2014 | \$305,000 |
| ENTRF funded a 2010 project “Investigation of the hydrologic properties of the St. Lawrence Formation” (M.L. 2010, Chp. 362, Sec. 2, Subd. 3a). The results of that investigation have led to findings that we will apply to this proposed project | 7/1/2010 – 6/30/2013 | \$307,000 |
| Investigation of bedrock controls on nitrate distribution in southeastern Minnesota streams, funded by the Minnesota Pollution Control Agency - 319/Clean Water Partnership/TMDL project | 1/3/2011 – 6/30/2013 | \$73,563 |

VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS:

A. Parcel List: N/A

B. Acquisition/Restoration Information: N/A

IX. VISUAL COMPONENT or MAP(S):

A.

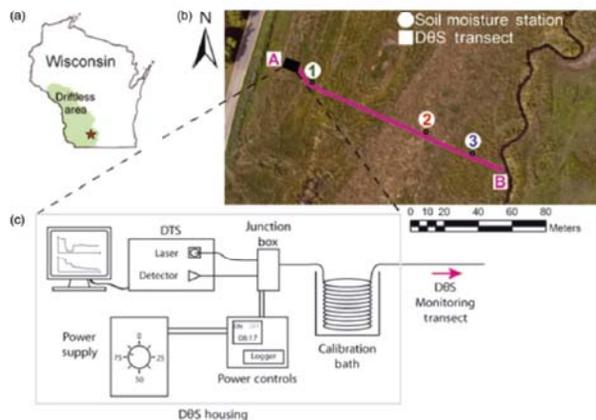


B.

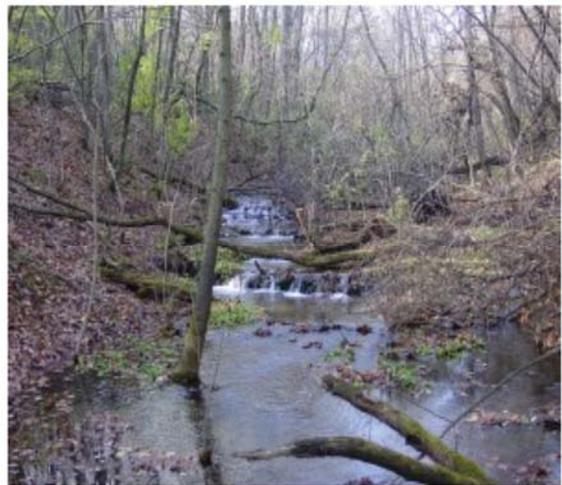


Southeastern Minnesota brook trout average less than 10 inches, although brook trout up to 17 inches are occasionally caught. Because brookies can tolerate only the cleanest and clearest water, fishing for this species invariably takes anglers to the most pristine and scenic areas of the southeast.

C.



D.



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

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.

- A. http://www.dnr.state.mn.us/fishing/trout_streams/trout_species.html
- B. <http://news.dnr.state.mn.us/2015/04/16/for-trout-fishing-in-southeastern-minnesota-these-are-the-good-old-days/>
- C. Streigl, A. and Loheide, S., 2012, Heated distributed temperature sensing for field scale moisture monitoring, Groundwater, v. 50 no. 3, p. 340-347.
<http://news.dnr.state.mn.us/2015/04/16/for-trout-fishing-in-southeastern-minnesota-these-are-the-good-old-days/>

X. RESEARCH ADDENDUM: N/A

XI. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted not later than January 1, 2017; July 1, 2017; January 1, 2018; July 1, 2018, and January 1, 2019. A final report and associated products will be submitted between June 30 and August 15, 2019.

Environment and Natural Resources Trust Fund

M.L. 2016 Project Budget

Project Title: Evaluate Temperature, Streamflow, and Hydrogeology Impact on Brook Trout Habitat

Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 03k

Project Manager: Bob Tipping

Organization: Minnesota Geological Survey

M.L. 2016 ENRTF Appropriation: \$ 115,000

Project Length and Completion Date: 3 Years, June 30, 2019

Date of Report: May 29, 2016



| ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET | Activity 1 Budget | Amount Spent | Activity 1 Balance | Activity 2 Budget | Amount Spent | Activity 2 Balance | Activity 3 Budget | Amount Spent | Activity 3 Balance | TOTAL BUDGET | TOTAL BALANCE |
|---|-------------------------------------|--------------|--------------------|---|--------------|--------------------|---|--------------|--------------------|------------------|------------------|
| BUDGET ITEM | Stream reach suitability assessment | | | Seasonal measurements of temperature, flow and trout distribution | | | Critical reach mapping and report writing | | | | |
| Personnel (Wages and Benefits), overall budget | \$25,700 | | \$25,700 | \$25,700 | | \$25,700 | \$25,700 | | \$25,700 | \$77,100 | \$77,100 |
| Bob Tipping, Project Manager, Geologist: [73.6 % salary, 26.4 % benefits]; 9.5% FTE each year for 3 year: \$27,000] | | | | | | | | | | | |
| Tony Runkel, Geologist: [73.6 % salary, 26.4 % benefits];8.5% FTE each year for 3 years: \$25,800] | | | | | | | | | | | |
| Julia Steenberg, Geologist: [73.6 % salary, 26.4 % benefits]; 6.0% FTE each year for 3 years: \$13,300] | | | | | | | | | | | |
| Andrew Retzler, Geologist: [73.6 % salary, 26.4 % benefits]; 6.0% FTE each year for 3 years: \$11,000] | | | | | | | | | | | |
| Professional/Technical/Service Contracts | | | | | | | | | | | |
| Center for Transformative Environmental Monitoring Systems (CTEMPS), jointly operated by Oregon State University, Corvallis and the University of Nevada, Reno, and funded by the National Science Foundation. Leasing of Distributed Temperature Sensing (DTS) equipment used during the project | | | | \$12,800 | | \$12,800 | | | \$0 | \$12,800 | \$12,800 |
| CTEMPS Technical support in the field (2 people, 4 days). Airfare: \$1,200; lodging \$118/day; food: \$50/person per day | | | | \$2,072 | | \$2,072 | | | | \$2,072 | \$2,072 |
| Equipment/Tools/Supplies, overall budget | | | | \$19,028 | | \$19,028 | | | | \$19,028 | \$19,028 |
| Portable Velocity Meter with 20' Cable for stream gauging [\$4,903] | | | | | | | | | | | |
| Supplies to submerge and protect data collection equipment, and fiber optic cable in the stream bed [\$1,055] | | | | | | | | | | | |
| Estimated shipping for DTS equipment, [4 shipping events at \$1,500 per event: \$6,000] | | | | | | | | | | | |
| 2000 meters of armored fiber optic cable used as part of the DTS installation [\$2.50/meter: \$5000] | | | | | | | | | | | |
| Cable connectors used as part of the DTS installation [18 at \$50 each: \$900] | | | | | | | | | | | |
| Water tight splice boxes [18 at \$65 each: \$1170] | | | | | | | | | | | |
| Travel expenses in Minnesota | | | | | | | | | | | |
| Travel between potential and established field sites – 2000 miles - 0.17/mile- and vehicle rental - \$239/week for 4 weeks – (\$1,300); lodging – 10 days at \$118/day (\$1,180); meals – 30 days at \$48/day (\$1440) | \$800 | | \$800 | \$2,400 | | \$2,400 | \$800 | | \$800 | \$4,000 | \$4,000 |
| COLUMN TOTAL | \$26,500 | \$0 | \$26,500 | \$62,000 | \$0 | \$62,000 | \$26,500 | \$0 | \$26,500 | \$115,000 | \$115,000 |

