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

Project Title: **ENRTF ID: 081-B**

Variable Winter Thermal Regimes and Managing Trout Streams

Category: B. Water Resources

Total Project Budget: $ 641,907

Proposed Project Time Period for the Funding Requested: 3 years, July 2016 to June 2019

Summary:

We will develop predictive models relating to thermal regimes in trout streams during winter, will refine new molecular techniques to identify trout winter diets, and develop outreach and communication programs.

Name: Leonard Ferrington

Sponsoring Organization: U of MN

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Web Address

Location

Region: SE

County Name: Faribault, Fillmore, Goodhue, Houston, Olmsted, Rice, Steele, Wabasha, Winona

City / Township:

Alternate Text for Visual:

Text is included within the file that includes the map.

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

PROJECT TITLE: Variable Winter Thermal Regimes and Managing Trout Streams

I. PROJECT STATEMENT: This project builds on previous work by Ferrington (et al.) performed in 40 SE Minnesota streams (ML 2010 Chap. 362, Sec. 2, Subd. 5i) showing that groundwater inputs to trout streams:

- buffers stream water from summer high temperatures and winter cold/freezing temperatures,
- groundwater inputs can be highly variable along a very short stretch of stream, producing very different conditions for trout survival, for reproductive success, and patterns of growth, especially during winter,
- supports year-round abundance of invertebrates (the trout food base) that varies substantially in relation to groundwater inputs and thermal regimes, which is especially important during winter,
- buffering of thermal regime facilitates winter-adapted invertebrate species to develop dense populations that integrally promotes faster trout growth and greater population abundance,
- and several winter-adapted invertebrate species are new to science or relatively unknown in basic biology.

II. PROJECT ACTIVITIES AND OUTCOMES: We will intensively map and sample eight streams/year at each of five locations that span a wide range of groundwater input intensities, to generate results leading to improved habitat management guidance. Our specific objectives are to:

- identify how groundwater, air temperature, geology and streambed conditions interact to determine optimal winter habitat for invertebrates that trout feed on and are critical for trout in winter;
- understand how changes in geology, groundwater input, and vegetation affect stream temperatures and therefore influence food availability during winter, and ultimately trout productivity;
- create quantitative models relating winter thermal regimes to food availability to optimize habitats;
- recommend ways that the quantitative models can guide efforts to enhance trout productivity via changes that protect or improve stream temperature, with a special focus in the winter period.
- Trout in Minnesota's nearly 700 designated streams have great economic, sport and aesthetic importance. Trout depend on cold, clean stream water, a resource that is threatened by gradual warming. Minnesota's managers and landowners need ways to understand what actions can reduce the impacts of warming and by how much. Consequently, we will also **develop an outreach program that educates and utilizes citizen volunteers** to assist in monitoring the dynamics of invertebrate populations in a large number of trout streams in SE Minnesota.

Activity 1: Thermal Modeling---*We will build on Calvin Alexander's spring mapping work and leverage the MN DNR's Long Term Monitoring program to understand how groundwater inputs interact with geology and streambed conditions to buffer trout streams from winter cold and freezing temperatures.* ***Budget: $ 204,115***

This activity allows us to predict the ranges of thermal suitability for trout, and how they vary longitudinally within streams, which will enable managers to position restoration efforts to have the greatest impact in extending the moderating influence of groundwater on stream temperature. We will use air and water temperatures (5 sites/stream, 5 sampling events/stream/year) to map groundwater inputs at fine spatial scales. We will relate these conditions in a statistical model for identifying highest-priority management actions.

Outcomes for Activity 1	Completion Date
1. *Specific, measureable outcome:* Develop thermal models (TM) 8 streams, 5 sites/str, year 1	*June 2017*
2. *Specific, measureable outcome:* Develop TM for 8 more streams, 5 sites/str, year 2	*June 2018*
3. *Specific, measureable outcome:* Develop TM for 8 more streams, 5 sites/str, year 3	*June 2019*

Activity 2: Relate changes in macroinvertebrate abundances and genetics at the same 5 sites in the same 8 streams/year used for thermal models developed in Activity 1. ***Budget: $ 211,353***

This activity links stream conditions to trout through food availability and quality. Given that many winter species look the same (especially undescribed species), we will use a type of DNA (MtDNA) to efficiently

and accurately identify those insects that provide the most reliable energy to trout in winter. We will determine how genetic patterns of numerically dominant insects differ among the most abundance insects, and if genetic variability aligns with abundances and life cycles as a function of water temperatures across streams.

Outcomes: The following outcomes will be accomplished at 5 sites in each of the 8 streams/year	Completion Date
1. Assessment of density & genetic variability of the most abundant invertebrate species	*June 2017*
2. Assessment of density & genetic variability of the most abundant invertebrate species	*June 2018*
3. Assessment of density & genetic variability of the most abundant invertebrate species	*June 2019*

Activity 3: Develop a communication and educational outreach program Budget: $ 226,439

Landowners in SE Minnesota, agricultural stakeholders, and conservation organizations are a critical audience for this project, as researchers must gain access to privately owned land to collect data. We will conduct focus group and survey research with these groups to better understand their knowledge of trout stream research, attitudes towards the importance of this research, and barriers to granting access to researchers or serving as citizen volunteers that aid in data collection. This survey and focus group research will help us identify the best communication strategies, channels and content to reach SE Minnesota landowners and best ways to partner with conservation and agricultural stakeholder groups.

We will develop a communications plan and other material that will help us share the goals, results, and impact of this research with these key audiences. The communication plan will leverage social media channels, media organizations in SE Minnesota, and the publications, communication channels and events held by opinion leader organizations (e.g. Minnesota Farm Bureau, FFA, Minnesota Farmers' Union, and Trout Unlimited).

Outcomes: Development of a communication and educational outreach program	Completion Date
Complete formative communication research with key audiences and develop communication campaign plan	*June 2017*
Develop communication and outreach materials and begin implementing campaign plan	*June 2018*
Finish implementing communication campaign and evaluate the impact of education and outreach messages. Complete final revisions to all on-line products	*June 2019*

III. PROJECT STRATEGY

A. Project Team/Partners: Our **project team** consists of Principal Investigator (PI) Leonard Ferrington, Co-PI Rebecca Swenson, three graduate students (=1 per activity), and undergraduate field assistants. As previously, we will integrate non-funded team members as volunteers and advisors (Jim Perry and Bruce Vondracek) as appropriate. We will consult with and seek guidance from Minnesota DNR Division of Fish & Wildlife (e.g., Doug Dieterman, Research Biologist), and Trout Unlimited. In our previous grant-work related to trout streams the assistance of the partners has been critical to our success and we will continue to nurture these collaborations.

B. Project Impact and Long-Term Strategy: This project will optimize decisions & activities that affect trout streams in SE Minnesota. We will disseminate findings to the public through Trout Unlimited, the National Trout Center (Preston, MN), and the Minnesota Master Naturalist program, and to technical audiences (researchers, managers, policymakers) through state conferences and meetings with the MN DNR. This project is part of a larger, long-term effort by the UMN, the MN DNR, and Trout Unlimited to understand, preserve, and enhance trout streams and trout fishing in SE Minnesota. This project builds on our previous effort (ML 2010 Chap. 362, Sec. 2, Subd. 5i), that established the importance of groundwater to healthy trout populations in SE Minnesota.

C. Timeline Requirements: years: This project requires three field seasons so that we can intensively survey and sample all 24 streams and develop the statistical tools for translating management and restoration efforts into trout productivity and availability. The communication and educational outreach deliverables will be developed and refined each of the three to fine tune our communication, outreach and educational effectiveness

2016 Detailed Project Budget

Project Title: Variable Winter Thermal Regimes and Managing Trout Streams

IV. TOTAL ENRTF REQUEST BUDGET: 3 years (2016-2019)

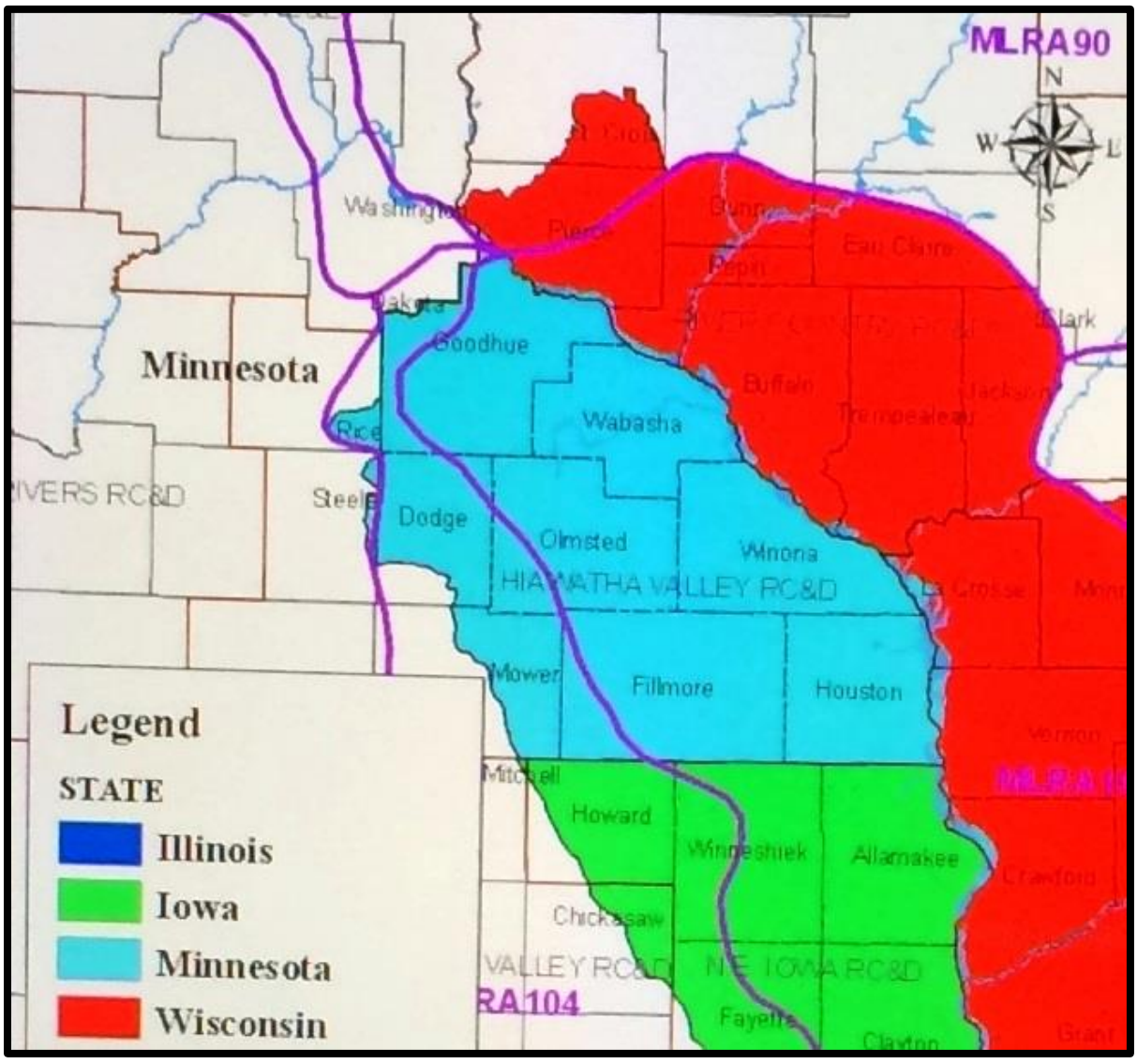
BUDGET ITEM	AMOUNT
Personnel: Ferrington---All costs include 3% adjustment/year for inflation. PI, project supervision/field work for activities 1 &2, one month salary per year = $ 30473; Ferrington fringe benefits [33.7% of salary](=$10239); **Swenson---** Co-PI, supervise Activity 3, 2 months salary per year = $ 55386; Swenson fringe benefits [33.7% of salary](=$ 18665); Graduate Student Research Assistants [PhD-level, 3 students/year and 3 years per student @ $ 22473/student/year](=$ 208385) Grad Student fringe benefits [17.6% of salary](=$ 36676) Undergraduate hourly assistants [2 students/year for 3 years @ 16 hour/week, @ 40 weeks/year @ $ 11.50/hour](=$ 45498)	$ 405,352
Professional/Technical/Service Contracts: N/A	$ -
Equipment/Tools/Supplies: EXPENSES FOR ACTIVITIES 1 & 2----- (1) Disposable lab & field supplies (=$14,275); (2) MtDNA Analyses (=$8655); (3) temperature recording devices (=$16691) **EXPENSES FOR ACTIVITY 3**----- (1) Participant incentive for Focus Groups (=$1200); Participant Incentive for Surveys (=$ 200); (3) Food, building and printing costs to conduct focus groups (=$ 500); (4)Communication Campaign materials development and printing costs ($ 5000).	$ 46,521
Acquisition: N/A	$ -
Travel: EXPENSES FOR ACTIVITIES 1 & 2----- (1) Vehicle Rental = $ 3709; (2) Vehicle mileage costs =$ 17266; (3) Room rentals =$ 12,463; (4) Per diem =$ 5564. **EXPENSES FOR ACTIVITY 3**----- Travel by private vehicle for interviews/focus groups with landowners and stakeholders [total of 1,755 miles reimbursed @ $ 0.57/mile](=$ 1000)	$ 40,002
Additional Budget Items: Licenses, permits, entrance fees to sample in state parks =$ 695. Publication costs for scientific journals = $ 6000. Graduate Student Tuition = $ 143337.	$ 150,032
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 641,907

V. OTHER FUNDS *(This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)*

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period: N/A	$ -	*N/A*
Other State $ To Be Applied To Project During Project Period: N/A	$ -	*N/A*
In-kind Services To Be Applied To Project During Project Period: N/A	$ -	*N/A*
Funding History: This project builds on previous work by Ferrington (et al.) performed in 40 SE Minnesota streams (ML 2010 Chap. 362, Sec. 2, Subd. 5i)	$ -	
Remaining $ From Current ENRTF Appropriation: N/A.	$ -	*N/A*

PROJECT TITLE: Variable Winter Thermal Regimes and Managing Trout Streams
Principal Investigator: Len Ferrington

Map of area in which project activities will occur. The area shown in blue (below) roughly corresponds to the counties that are part of the Driftless Region in Minnesota. Streams to be used in the study all occur in the Driftless Region in Minnesota, and will be located in Goodhue, Dodge, Wabasha, Olmsted, Winona, Mower, Filmore and/or Houston counties. We have previously worked in 40 streams in these counties. Final selections of streams to be used for this project will be made after extensive consultations with our partner organizations and stakeholder groups (eg., MN DNR, USFWS, Trout Unlimited, FFA, Farm Bureau and local citizen monitoring and county extension groups).



(NOTE: This map has been modified from a larger map prepared by David C. Wilson, as a resource for the Driftless Area Initiative in Minnesota, Wisconsin, Iowa and Illinois, and credit for the product is acknowledged).

PROJECT MANAGER QUALIFICATIONS AND RESPONSIBILITIES

Dr. Len Ferrington (Principal Investigator) Education: Ph.D. University of Pittsburgh, 1980
Present Position: Professor, Department of Entomology, CFANS, University of Minnesota
Past Positions: Co-Coordinator, Environmental Sciences, Policy & Management Degree Program

Dr. Len Ferrington is an expert in stream invertebrate taxonomy and ecology with 35 years of professional research experience. His laboratory has shown that aquatic insects important to trout in SE Minnesota are adapted to colder temperatures and are exclusive to, or most abundant in, spring-fed streams. Ferrington has developed Rapid Bioassessment Protocols for use in Biological Monitoring and Impact Assessment, and worked with numerous local, state and federal agencies to define responses of aquatic invertebrates to various types of water pollution. He has worked collaboratively with many citizen monitoring groups and private stakeholders interested in water quality and conservation. Dr. Ferrington will be the Principal Investigator and project manager for this research effort. For more details see: http://midge.cfans.umn.edu/people/ferrington/

Dr. Rebecca Swenson will serve as Co-PI and be responsible for Activity 3. Dr. Swenson is an Assistant Professor of Agriculture, Food, and Natural Resource Communication tract of the Agricultural Education Program at the University of Minnesota. She teaches communication courses to provide foundational writing and speaking skills needed to share ideas with the public, their peers, and other important stakeholder groups. She has a Ph.D. in Mass Communication from the School of Journalism at the University of Minnesota. She also serves as the Major Coordinator of the Agricultural Education undergraduate degree program in CFANS. For more details see: http://ag-ed.cfans.umn.edu/People/Faculty_Staff_Highlight/RebeccaSwenson/index.htm

Dr. Jim Perry (UMN) will volunteer as a student resource mentor and policy advisor. Dr. Perry is a Morse-Alumni Distinguished University Professor who studies water quality management, aquatic ecology, environmental policy and management decision making. For 33 years he has collaborated with international, federal, and state agencies/organizations on projects related to water quality monitoring, assessment, and regulation at the level of landscapes, watersheds, lakes, and streams.

Dr. Bruce Vondracek (Recently retired, Minnesota Cooperative Fish and Wildlife Research Unit) will also volunteer as a student resource mentor and fisheries biology and fisheries policy advisor. Dr. Vondracek is an expert in stream ecology and restoration with over 42 years of research experience. His laboratory focused on the interactions among management, water quality, and fish and invertebrate communities to assess ecosystem health in relation to land use and restoration.

ORGANZATION DESCRIPTION: The University of Minnesota is one of the largest and most recognized public research universities in the United States. Its mission is to 1) "**conduct high-quality research**, scholarship, and artistic activity that benefit students, scholars, and communities **across the state**, the nation, and the world"; 2) "share that knowledge, understanding, and creativity by providing a broad range of educational programs … and **prepare graduate, professional, and undergraduate students**…for active roles in a multiracial and multicultural world"; and 3) extend, apply, and **exchange knowledge between the University and society** by applying scholarly expertise to community problems, by helping organizations and individuals respond to their changing environments, and by making the knowledge and resources created and preserved at the University accessible to the citizens of the state, the nation, and the world.