



# 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:** Improving Brook Trout Stream Habitat Through Beaver Management

**Project Manager:** Andrew Hafs

**Organization:** Bemidji State University

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**Location:** NE Minnesota (Cook, Lake, and St. Louis counties)

**Total ENRTF Project Budget:**

**ENRTF Appropriation:** \$225,000

**Amount Spent:** \$0

**Balance:** \$225,000

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

**Appropriation Language:**

\$225,000 the second year is from the trust fund to the Board of Trustees of the Minnesota State Colleges and Universities system for Bemidji State University to quantify how beaver activity influences habitat quality in streams for brook trout in northeastern Minnesota in order to improve current and future management practices. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

**I. PROJECT TITLE:** Improving Native Brook Trout Stream Habitat through Beaver Management

**II. PROJECT STATEMENT:**

Northeast Minnesota (NE MN) contains more than 1,500 miles of Designated Trout Streams (Fig. 1) and trout fishing is an important recreational and economic activity in the state. Beaver control is part of the DNR’s management of several trout streams in NE MN (Fig. 2). There is a need to REFINED this tool to ensure that beaver management is only applied where it HELPS trout and does not HURT trout. In cases where beaver removal hurts brook trout populations, this is a LOSE-LOSE situation for Minnesotans, because we also lose wildlife habitat creation, water filtration, recreational trapping opportunities, climate change mitigation, and other positive benefits of beavers.

**Goal 1: Quantify how beaver activity influences habitat quality for stream dwelling brook trout in NE MN.**

Often removing beaver from trout streams is related to the assumption that beaver activities degrade habitats by warming water temperatures beyond suitable ranges for trout. In addition to temperature, beaver dams also alter other important habitat characteristics for stream trout such as water flow and depth, sediment transport, erosion and connectivity of important seasonal habitat reaches. This project will quantify how beaver activity influences the amount of suitable brook trout habitat available in NE MN streams.

**Goal 2: Quantify importance of beaver in streams to ecosystems and to trout management.**

Beaver populations fluctuate over time and space and the need to manage beaver in individual trout streams will differ for different parts of the state or at different periods of time. Beaver activities, such as creation of ponds and dams along with tree cutting, are easily visible on aerial photos. Aerial photos from different time periods can show changes in the distribution and abundance of beavers. Understanding historical and current beaver population levels will provide insight into landscape-level effects and ecosystem services provided by beaver, which will be critical for wildlife diversity conservation in the face of projected climate change. In particular, beaver activities create critical habitat for waterfowl, moose, frogs, and other wetland wildlife.

Removing beaver from trout streams can lead to increased brook trout populations. Yet maintaining beaver as a component of streams can provide benefits to stream and riparian habitat. Optimizing brook trout management and ecological health is the outcome of this proposed research.

Brook trout streams in northeastern Minnesota are mostly fed by surface waters and are sensitive to increasing summer temperatures projected in Minnesota. The effects of beaver dams on streams could magnify temperature-related changes expected over the next 50-100 years. However, increased pool habitat resulting from beaver dams could store water and maintain flows if precipitation decreases or becomes more variable. A comprehensive analysis of the ecological cost-benefit dynamics of beaver management for improvement of brook trout habitat would benefit fisheries managers and natural resource agencies.

Results for this project will provide new information allowing for improved ability to meet management objectives for brook trout while retaining the broader ecological benefits of beaver.

**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: Effects of beaver ponds on brook trout habitat characteristics**

**Description:** In comparison to other stream systems where brook trout-beaver research has been conducted in the past, Northeastern Minnesota trout streams are unique in that base flow is limited because of the shallow depth to bedrock. Empirical evidence describing how trout habitat changes as result of beaver activity in this region is currently lacking. Agencies in charge of managing either brook trout or beaver in Northeastern Minnesota would benefit greatly from this type of data if it were available. Therefore, the main objective of this activity is to develop a relationship between the amount of suitable brook trout habitat per unit area and the amount of beaver activity in the stream.

To accomplish this objective we will measure habitat characteristics (e.g., water temperature, flow, depth, dissolved oxygen) in stream reaches with matched watershed size that have varying levels of beaver activity. It is assumed that habitat characteristics such as depth, flow, and temperature will be most limiting in the summer and early fall, therefore, habitat measurements will be taken at that critical time. All stream habitat measurements will be accompanied with GPS coordinates which will allow us to plot the locations in GIS. Once the habitat measurements have been loaded into GIS, interpolation techniques will be used to create detailed maps that predict habitat conditions at all locations within each selected stream reach. This technique will allow us to estimate the total amount of usable habitat for brook trout within each stream reach during the time that mapping occurred.

The estimated amounts of usable habitat can then be related to measures of beaver activity such as beaver dam density and average size of beaver dams within and upstream of the mapped sections. MNDNR currently conducts beaver dam removal in selected streams within this region which will help provide varying levels of beaver activity for study site selection.

Once the objective described above is completed the relationships established will allow us to make detailed recommendations for the immediate future of beaver and brook trout management in Northeastern Minnesota.

**Summary Budget Information for Activity 1:**

**ENRTF Budget: \$ 128,500**  
**Amount Spent: \$ 0**  
**Balance: \$ 128,500**

<b>Outcome</b>	<b>Completion Date</b>
<i>1. Habitat characteristics (flow, depth, temperature, etc.) measured and mapped in approximately 30, 300 m sections within approximately 9 NE MN brook trout streams in each summer of the three year study</i>	8/31/2018
<i>2. Provide management recommendations related beaver removal in brook trout streams based on the results from outcome 1</i>	6/30/2019

**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 2: Determine ecological effect of distribution and abundance of beaver in NE MN Trout Streams at the landscape scale**

**Description:** We will compile existing data on beaver abundance and activity for northeastern Minnesota from approximately 1900-present. These data will be gleaned from trapping records, historical accounts, and survey data from MN DNR and other agencies. We envision generating both qualitative and quantitative histories of beaver activity/abundance at the study area, watershed, and individual trout stream scales.

We will map beaver activity in selected areas in St. Louis, Lake, and Cook counties using aerial photos from 1930s to the present to characterize changes in beaver populations over time in areas surrounding Designated Trout Streams in NE MN. We will employ established remote-sensing and GIS techniques to identify beaver activity such as beaver dams and associated ponds that appear between consecutive sets of photos. Landscape features such as dams, lodges, and pond outlines are digitized and then can be tracked through time on subsequent aerial imagery. Changes in beaver activity can then be tracked through time for individual trout streams, watersheds, or across the study area. Imagery in hard copy and digital forms exists for most areas in the project area dating to at least the 1940s, with some areas also having earlier imagery from the 1920s or 1930s. Most of the digital imagery is available for free through online repositories (e.g., MNDNR Data Deli or GoogleEarth). Hard copies of older imagery will be obtained from land management agencies or other sources as necessary.

**Summary Budget Information for Activity 2:**

**ENRTF Budget: \$ 96,500**  
**Amount Spent: \$ 0**  
**Balance: \$ 96,500**

<b>Outcome</b>	<b>Completion Date</b>
<i>1. Report summarizing current and historical patterns of beaver activity in approximately 9 watersheds (or subwatersheds) containing brook trout streams measured in Activity 1.</i>	8/31/2018
<i>2. Management recommendations from landscape analysis of beaver populations in NE MN from Outcome 1.</i>	6/30/2019

**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:** We will generate outreach through Bemidji State University and University of Minnesota-Duluth. We will engage print and radio media when possible and appropriate. Fisheries managers within the

Department of Natural Resources should find this research extremely valuable as brook trout and beaver are both important recreationally, commercially, and environmentally. This research will result in two completed master's theses which will be permanently housed in the libraries at the campuses in which they are completed (Bemidji State University and the University of Minnesota Duluth). Additionally, a pdf copy of the thesis completed at Bemidji State University, as result of Activity 1, will be permanently available electronically through a Bemidji State University website maintained by Dr. Andrew Hafs <http://www.bemidjistate.edu/directory/facstaff/ahafs/>. We will prepare and disseminate information on the project through scientific papers submitted to peer-reviewed journals. We will also present our results at regional and national meetings (using funds other than those allocated through this grant). Finally, completed theses will be distributed to all Northeastern MN DNR regional offices so they can adjust future management strategies as needed.

**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:**

<b>Budget Category</b>	<b>\$ Amount</b>	<b>Overview Explanation</b>
Personnel:	\$ 167,640	<p>BEMIDJI STATE UNIVERSITY            1 project manager at 10% FTE each year for 3 years (\$10,540); 1 graduate research assistant at 100% FTE for 3 years plus tuition and fees (\$64,600); 1 undergraduate research assistant at 33% FTE for 3 years (\$15,000).</p> <p>UNIVERSITY OF MINNESOTA-DULUTH            1 graduate research assistant at 25% FTE for 2 years (\$48,000); 1 undergraduate research assistant at 35% FTE for 18 mo. and 75% FTE for 6 mo. (\$20,000); 1 GIS technician at 15% FTE for 2 years (\$9,500).</p> <p>Allocation of effort among personnel categories are estimates that may be adjusted to best meet project objectives.</p>
Equipment/Tools/Supplies:	\$26,360	72 Temperature loggers @ \$130 apiece (\$9,360); 24 depth/temperature loggers @ \$500 apiece (\$12,000); flow meter (\$5,000).
Travel Expenses in MN:	\$18,000	BEMIDJI STATE UNIVERSITY Mileage (\$6000), lodging (\$3000), meals (\$3000)

		UNIVERSITY OF MINNESOTA-DULUTH Mileage (\$3000), lodging (\$1500), meals (\$1500)
Other:	\$13,000	UNIVERSITY OF MINNESOTA-DULUTH Aerial imagery acquisition (\$11,000) GIS Lab fee (\$2,000)
<b>TOTAL ENRTF BUDGET:</b>	<b>\$225,000</b>	

**Explanation of Use of Classified Staff:** None

**Explanation of Capital Expenditures Greater Than \$5,000:** None

**Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation:** 5.6

**Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:** 0

**B. Other Funds:**

Source of Funds	\$ Amount Proposed	\$ Amount Spent	Use of Other Funds
<b>Non-state</b>			
Dr. Steve Windels (In-kind support)	\$30,000	\$0	Dr. Steve Windels will mentor a graduate student at the University of Minnesota Duluth on his personal time outside the scope, duties, and function of his current position with the National Park Service (valued at \$60/hr @ 500 hours).
<b>State</b>			
Dr. Andrew Hafs and Bemidji State University (In-kind support)	\$15,500	\$0	Provide access to backpack electrofishing equipment, additional YSI meters, temperature loggers, flow meters, and canoes already owned.
Bemidji State University (In-kind support)	\$69,075	\$0	Will provide indirect costs (30.7%)
Minnesota Department of Natural Resources (In-kind support)	\$33,000	\$0	MN DNR Fisheries spends approximately \$11,000 annually on beaver dam removal
Minnesota Department of Natural Resources (In-kind support)	\$5,000	\$0	MN DNR staff time (~\$50/hr salary/comp*100 hours) to provide access to data (temperature, flow, other habitat data) and input in project scope, development, and final projects as requested
<b>TOTAL OTHER FUNDS:</b>	<b>\$152,575</b>	<b>\$0</b>	

**VII. PROJECT STRATEGY:**

**A. Project Partners:**

Dr. Andrew Hafs, trout ecology expert with Bemidji State University (will mentor 1 graduate student).

Dr. Steve Windels, beaver ecology expert and adjunct faculty at University of Minnesota-Duluth (will mentor 1 graduate student). Dr. Windels' work on this project would be outside the scope, duties, and function of his current position with the National Park Service and would be completed on his own time.

Dr. Lucinda Johnson, cold water fish habitat and climate change expert with UMD.

MNDNR staff from Area Fisheries Offices (Deserae Hendrickson and Dean Paron), Fisheries Research (Peter Jacobsen), Wildlife Research (John Erb), and Stream Habitat Coordinator (Brian Nerbonne) will provide access to data and input during all phases of the project.

**B. Project Impact and Long-term Strategy:**

This project will develop management recommendations that will optimize both stream dwelling brook trout and beaver populations and the associated ecological services they provide under current and future climate scenarios. Future funding is needed to evaluate how management actions affect individual movements, survival, and population growth of trout and beaver using radio tags and other techniques.

**C. Funding History:**

Funding Source and Use of Funds	Funding Timeframe	\$ Amount
MN DNR Fisheries and Wildlife spends money annually on beaver dam removal as part of their management actions. The total amount spent on these action in the past is very difficult to estimate.		\$
		\$
		\$

**VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS: NONE REQUIRED**

**IX. VISUAL COMPONENT or MAP(S):**

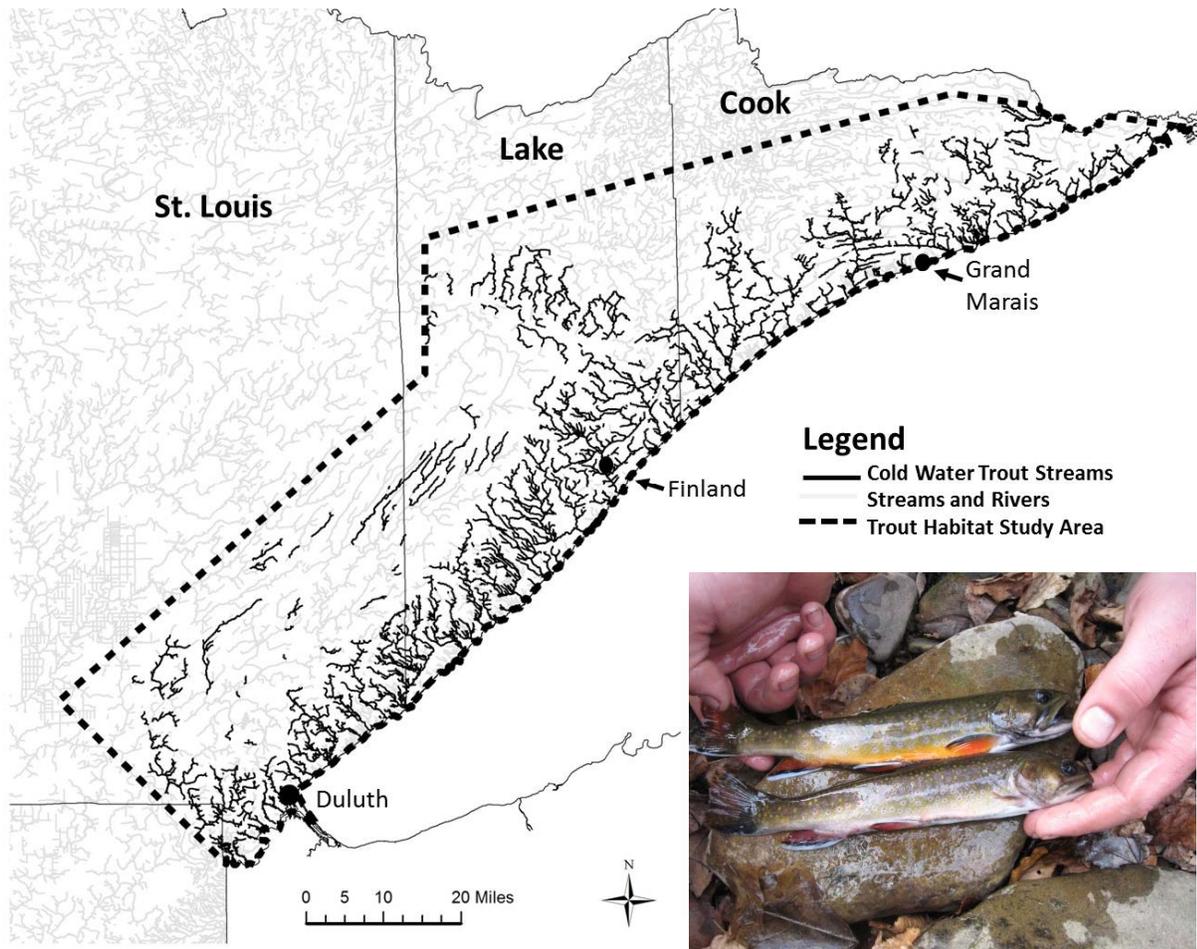


Figure 1. Location of cold water trout streams (Designated Trout Streams) where the effects of beavers on brook trout habitat will be studied.

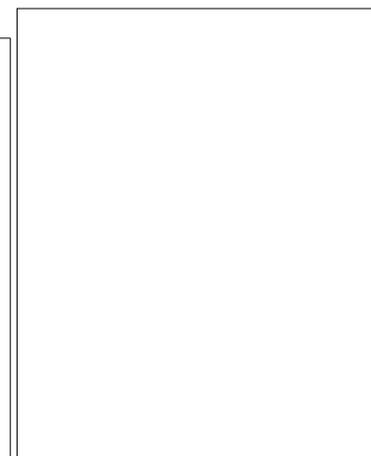


Figure 2. Photo of a beaver dam that was recently removed from a NE MN brook trout stream (left). Also included are photos of a beaver (center) and a stream reach in which beaver activity is limited (right).

**X. RESEARCH ADDENDUM:**

**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:** Improving Brook Trout Stream Habitat Through Beaver Management

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

**Project Manager:** Andrew Hafs

**Organization:** Bemidji State University

**M.L. 2016 ENRTF Appropriation:** \$ 225,000

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

**Date of Report:** May 29, 2016

<b>ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET</b>	<b>Activity 1 Budget</b>	<b>Amount Spent</b>	<b>Activity 1 Balance</b>	<b>Activity 2 Budget</b>	<b>Amount Spent</b>	<b>Activity 2 Balance</b>	<b>TOTAL BUDGET</b>	<b>TOTAL BALANCE</b>
<b>BUDGET ITEM</b>	<i>Effects on trout habitat characteristics</i>			<i>Beaver activity - past and present</i>				
<b>Personnel (Wages and Benefits)</b>	\$90,140		\$90,140	\$77,500		\$77,500	\$167,640	\$167,640
Andrew Hafs, Project Manager: \$10,540 (81% salary, 19% benefits); 10% FTE each year for 3 years								
1 Graduate Research Assistant, BSU: \$52,800 (90% salary, 10% benefits); 100% FTE for 3 years, \$11,800 for tuition and fees								
1 Graduate Research Assistant, UMD: \$48,000 (80% salary, 20% benefits); 25% FTE for 2 years								
1 Undergraduate Research Assistant, BSU: \$15,000 (90% salary, 10% benefits); 33% FTE for 3 years								
1 Undergraduate Research Assistant, UMD: \$20,000 (100% salary:0% benefits); 35% FTE for 18 mo, 75% for 6 mo.								
1 GIS Technician, UMD: \$9,500 (92% salary:8% benefits); 15% FTE for 2 years								
<b>Equipment/Tools/Supplies</b>	\$26,360		\$26,360				\$26,360	\$26,360
72 Temperature loggers @ \$130 apiece (\$9,360)								
24 Depth/temperature loggers @ \$500 apiece (\$12,000)								
Flow meter (not to exceed \$5,000)								
<b>Travel expenses in Minnesota</b>								
Travel to and between field study sites. Mileage: \$6000; lodging: \$3000; meals: \$3000	\$12,000		\$12,000				\$12,000	\$12,000
In-state travel for UMD personnel. Mileage: \$3000; lodging: \$1500; meals: \$1500				\$6,000		\$6,000	\$6,000	\$6,000
<b>Other</b>								
Aerial imagery; publicly available imagery will used whenever possible, but additional imagery, either digital or hard copy, may need to be purchased to maximize coverage of study watersheds located in NE MN.				\$11,000		\$11,000	\$11,000	\$11,000
GIS lab fee for UMD				\$2,000		\$2,000	\$2,000	\$2,000
<b>COLUMN TOTAL</b>	<b>\$128,500</b>	<b>\$0</b>	<b>\$128,500</b>	<b>\$96,500</b>	<b>\$0</b>	<b>\$96,500</b>	<b>\$225,000</b>	<b>\$225,000</b>