

2010 Environment and Natural Resources Trust Fund (ENRTF) Work Program

Date of Report: 24 November 2009
Date of Next Progress Report: January 2011
Date of Work Program Approval:
Project Completion Date: 30 June 2013

I. PROJECT TITLE: **Assessing Cumulative Impacts of Shoreline Development**

Project Manager: Bruce Vondracek
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Research Unit
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Location: Aitkin, Becker, Cass, Crow Wing, Douglas, Hubbard, Morrison, Otter Tail, Todd

| | | | |
|------------------------------------|----------------------------|-----------|----------------|
| Total ENRTF Project Budget: | ENRTF Appropriation | \$ | 300,000 |
| | Minus Amount Spent: | \$ | 0 |
| | Balance: | \$ | 300,000 |

Legal Citation: M.L. 2010, Chp. 362, Sec. 2, Subd. 5h

Appropriation Language:

\$300,000 is from the trust fund to the Board of Regents of the University of Minnesota to evaluate near-shore, in-water habitat impacts from shoreline development activities to assist in the design and implementation of management practices protecting critical shorelands and aquatic habitat. This appropriation is available until June 30, 2013, by which time the project must be completed and final products delivered.

II. PROJECT SUMMARY AND RESULTS: Human structures related to shoreline development, such as docks, boatlifts, and other structures, and disturbance from recreational activity may have a cumulative impact on aquatic ecosystems. Near-shore areas (less than 4 meters deep) often contain most of the vegetation and are generally the spawning area for fish. Few studies have addressed the effects of incremental changes on lake ecosystems despite ongoing concerns about the rate and extent of near-shore, in-water habitat alterations, and expansion of in-lake structures. The lack of scientific knowledge on the cumulative effects of human activities on aquatic habitat, water quality, and fish populations has hindered regulatory authorities and lake managers who need better information to guide landowners toward lower impact practices. To address this lack of information, we will assess the extent of near-shore vegetation, fish, and macroinvertebrates along a gradient of shoreline development and develop a framework to assess cumulative impacts on whole lake systems. We will use aerial photos and existing DNR data to measure whole lake disturbances of ~100 lakes in the Northern Lakes and Forests Ecoregion. We will also conduct assessments of a subset of lakes (~30) at the individual lot scale, to quantify impacts to vegetation, fish, and macroinvertebrates along a gradient of shoreline development and shoreline types. We will use our research develop a model to predict the cumulative impact of development on aquatic ecosystems, providing a tool to guide

lake managers toward sustainable near-shore, in-water development.

III. PROGRESS SUMMARY AS OF

IV. OUTLINE OF PROJECT RESULTS:

RESULT/ACTIVITY 1: Assess near-shore, in-water habitat on lake ecosystems

Description: We will acquire aerial photographs for ~100 study lakes to assess the number buildings and in-water structures per kilometer of shoreline and assess the coverage of aquatic vegetation. The study lakes will be restricted to the Northern Lakes and Forests Ecoregion to control for the inherent productivity of the lakes and the watersheds. Using existing DNR fishery surveys, we will explore relationships among shoreline development, coverage of aquatic vegetation, and aspects of the fish community.

Summary Budget Information for Result/Activity 1: ENRTF Budget: \$8,816
Amount Spent: \$ 0
Balance: \$8,816

| Deliverable/Outcome | Completion Date | Budget |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------|
| 1. Provide a measure of the number and coverage of in-water structures from a subset of lakes with and without shoreline structures in north-central Minnesota. | June 2012 | \$4408 |
| 2. Develop and evaluate models that relate the amount of shoreline development to aquatic vegetation and fish communities. | June 2012 | \$4408 |

Result Completion Date: December 2012

Result Status as of: January 2011

RESULT/ACTIVITY 2: Assess impacts of shoreline development on near-shore habitat

Description: We will quantify docks, boat lifts, watercraft, rafts, or any other recreational structures in the water in 30 lakes along 30 m transects at a site. We will note and estimate the linear distance of retaining walls or rip-rap along the shore, as well as the note vegetative cover type(s) adjacent to the wall or rip-rap. Coarse woody structure (CWS) will also be inventoried on each lot. We will estimate macrophyte (distribution, density, biovolume, and species composition), macroinvertebrate (species composition), and fish (distribution and species composition; and calculate a Fish-Index of Biological Integrity). We will evaluate macrophytes, macroinvertebrates, and fish for at least 5 dock sites per lake, plus an additional 10 randomly chosen sites. We will visually estimate plant coverage at each site using the scale: no plants, <10%, 10-40%, 40-70%, 70-100%, and 100%. In addition, we will estimate aquatic vegetation density using stem density and Robel pole cover in digital underwater photographs. We will use activity and light traps to assess larval fish and macroinvertebrates. We will also collect invertebrates associated with macrophytes from 0.1 m² quadrats spaced at 3 m intervals or at selected sites based on the distribution of aquatic macrophytes at a site. All plant material in a quadrat will be clipped at the sediment interface and immediately placed in a sealable bag underwater, returned to a boat, and immediately placed on ice. Macroinvertebrates will be sorted and identified to the lowest taxonomic level possible. We will sample the nearshore fish

community with a backpack electrofisher and a seine. We will sample fish using a boat electrofisher or visual observations parallel to the shoreline at each site. Transects will be along a 2m depth contour or 60m from the shoreline, whichever is closer.

We will relate the number of structures, rip-rap and CWS to measurements of macrophytes, macroinvertebrates, and fish to estimate the effect of near-shore, in-water alterations on the biological community.

Summary Budget Information for Result/Activity 2: ENRTF Budget: \$235,395
 Amount Spent: \$ 0
 Balance: \$235,395

| Deliverable/Outcome | Completion Date | Budget |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------------|
| 1. Develop an index of shoreline development by measuring a number of variables that reflect human activity including buildings, terrestrial vegetation, physical alterations such as riprap, and in-lake structures. | June 2013 | \$79,437 |
| 2. Measure characteristics of aquatic vegetation, woody debris, macroinvertebrates, and fish communities at these sites. | June 2013 | \$155,958 |

Result Completion Date: Data collection completed by September 2012; analysis completed by June 2013

Result Status as of: January 2011

RESULT/ACTIVITY 3: Assess impacts of shoreline development on near-shore habitat

Description: We will develop a model to evaluate human development on lakes by creating a framework to link our fine-scale data on near-shore habitat at 30 lakes (Result 2) to the whole-lake data for 100 lakes (Result 1) to evaluate cumulative impacts.

Summary Budget Information for Result/Activity 3: ENRTF Budget: \$55,791
 Amount Spent: \$ 0
 Balance: \$55,791

| Deliverable/Outcome | Completion Date | Budget |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------|
| 1. Develop a framework for assessing the cumulative impact of development that will allow lake managers to model consequences of different development scenarios. | June 2013 | \$55,791 |

Result Completion Date: Model development completed by June 2013

Result Status as of: (January 2011):

Result Status as of: (September 2011):

Result Status as of: (January 2012):

Result Status as of: (September 2012):

Result Status as of: (January 2013):

V. TOTAL ENRTF PROJECT BUDGET: \$300,000

Personnel: \$276,096 (*There will be four University personnel for this project: 1. A PhD student 0.5 FTE for three years \$105,788, 2. a MS student 0.5 FTE for two years \$70,337, 3. A Research Fellow 1.0 FTE for two years \$76,251, and 4. An undergraduate student 1.0 FTE during two summers and 0.25 TE during the academic year \$23,721*)

Contracts: \$ \$81,438 A temporary DNR employee will be contracted for about 22 months beginning 1 July 2011.

Equipment/Tools/Supplies: \$7,204 (*\$500 for alcohol to preserve fish, macroinvertebrates, and plants for identification; \$2,717 for Nalgene sample jars; and \$400 for nets to collect fish*)

Acquisition (Fee Title or Permanent Easements): \$0

Travel: \$12,200 (*in-state travel; \$11,600 for mileage @\$0.50/mile and \$3,500 for food and lodging during data collection trips*)

Additional Budget Items: \$0

VI. PROJECT STRATEGY:

A. Project Partners:

We will work directly with several employees with the Minnesota Department of Natural Resources, who will provide in-kind services (see VI. C. below).

B. Project Impact and Long-term Strategy: Our research will provide shoreline owners and lake managers with information about the impacts of development on aquatic ecosystems. Lakeshore managers may use this information to guide shoreland management practices and to focus protection or restoration strategies on sensitive areas. Research has been conducted on one or more of the aspects we will assess, but no single project has addressed all aspects we propose in a single study. A DNR employee will be hired to assist with data collection and analysis. No non-state money will be spent on the project during the funding period.

C. Other Funds Proposed to be Spent during the Project Period: The Project Manager is an employee of the U.S. Geological Survey and will provide in-kind support.

Donna Dustin, Senior Biologist and Cynthia Tomcko, Senior Biologist with the Minnesota Department of Natural Resources will provide in-kind support for data collection and model development. Paul Radonski, Senior Project Consultant with the Minnesota Department of Natural Resources will provide in-kind support for model development.

Laboratory space, assigned to the Project Manager, will be provided in Hodson Hall at the University of Minnesota.

D. Spending History: No previous funding

VII. DISSEMINATION: We will collaborate several people, such as Paul Radomski, Natural Resources Program Coordinator, with the Minnesota Department of Natural Resources who works on a project "Score Your Shore", to disseminate the information to agency managers and lakeshore owners. We will also collaborate with the appropriate Sheriff departments, who have

jurisdiction over structures that are anchored in the study lakes.

VIII. REPORTING REQUIREMENTS: Periodic Work Program progress reports will be submitted not later than January 2011, September 2011, January 2012, September 2012, January 2013.

Final Report – August 2013.

IX. RESEARCH PROJECTS: Initial proposal draft sent to Sponsored Projects Administration, University of Minnesota 23 November 2009. A final proposal will be sent to Sponsored Projects Administration, University of Minnesota following revisions related to peer review.

| Attachment A: Budget Detail for 2010 Projects - Summary and a Budget page for each partner (if applicable) | | | | | | | | | | | |
|-----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------|-----------------------|---------------------------------------------------------------|--------------------------------------|-----------------------|---------------------------------------------------------------|--------------------------------------|-----------------------|------------------|------------------|
| Project Title: <i>Fill in your project title</i> | | | | | | | | | | | |
| Project Manager Name: <i>Bruce Vondracek</i> | | | | | | | | | | | |
| Trust Fund Appropriation: \$ 300,000 | | | | | | | | | | | |
| 1) See list of non-eligible expenses, do not include any of these items in your budget sheet | | | | | | | | | | | |
| 2) Remove any budget item lines not applicable | | | | | | | | | | | |
| 2010 Trust Fund Budget | <u>Result 1 Budget:</u> | <u>Amount Spent</u> <i>(date)</i> | <u>Balance (date)</u> | <u>Result 2 Budget:</u> | <u>Amount Spent</u> <i>(date)</i> | <u>Balance (date)</u> | <u>Result 3 Budget:</u> | <u>Amount Spent</u> <i>(date)</i> | <u>Balance (date)</u> | TOTAL BUDGET | TOTAL BALANCE |
| | Assess near-shore, in-water habitat on lake ecosystems | | | Assess impacts of shoreline development on near-shore habitat | | | Assess impacts of shoreline development on near-shore habitat | | | | |
| BUDGET ITEM | | | | | | | | | | | |
| PERSONNEL: wages and benefits <i>(List individual names, amount budgeted and %FTE; add rows as needed)</i> | | | | | | | | | | | |
| Research Assistant (PhD) | 8,816 | | | 79,343 | | | 17,632 | | | 105,791 | 105,791 |
| Research Assistant (MS) | | | | 52,752 | | | 17,584 | | | 70,336 | 70,336 |
| Undergraduate Research Assistant | | | | 23,720 | | | | | | 23,720 | 23,720 |
| Contracts | | | | | | | | | | | |
| Professional/technical (MN DNR NR Speialist (6L) assist in data collection, data analysis, and model development) | | | | 60,863 | | | 20,575 | | | 81,438 | 81,438 |
| Supplies (list specific categories) | | | | | | | | | | | |
| Dip nets | | | | 400 | | | | | | 400 | 400 |
| Thermo Scientific* Nalgene* Transparent Polymethylpentene Jars ~\$18.00/jar | | | | 2,717 | | | | | | 2,717 | 2,717 |
| Alcohol to preserve fish and macroinvertebrates | | | | 500 | | | | | | 500 | 500 |
| Travel expenses in Minnesota | | | | | | | | | | | |
| Mileage for University of Minnesota vehicle in car pool of the Minnesota Cooperative Fish and Wildlife Research Unit @\$0.50/mile | | | | 11,600 | | | | | | 11,600 | 11,600 |
| Per diem @ \$50/day | | | | 3,500 | | | | | | 3,500 | 3,500 |
| COLUMN TOTAL | \$8,816 | \$0 | \$8,816 | \$235,395 | \$0 | \$235,395 | \$55,791 | \$0 | \$55,791 | \$300,002 | \$300,002 |