

**Environment and Natural Resources Trust Fund
2015 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 052-B

Mapping and Classifying North Shore Vernal Pools

Category: B. Water Resources

Total Project Budget: \$ 525,846

Proposed Project Time Period for the Funding Requested: 3 years, July 2015 - June 2018

Summary:

We propose a novel approach to map >100,000 vernal pools along Minnesota's North Shore. With maps, resource managers can better protect vernal pools, which provide important habitat and hydrologic functions.

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Sponsoring Organization: U of MN - Duluth NRRI

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Location

Region: NE

County Name: Cook, Lake, St. Louis

City / Township:

Alternate Text for Visual:

LiDAR and aerial photography (map shows one mapped and seven previously unmapped seasonal pools), develop classification system (images of seasonal pools show examples of potential classifications), predict seasonal pool water storage and value as habitat for whole watersheds based on the mapping and classification system.

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



PROJECT TITLE: Mapping and Classifying North Shore Vernal Pools

I. PROJECT STATEMENT

Along Minnesota’s North Shore, up to 100,000 vernal pools form each year from snow melt, rain, and rising water tables, and then dry up. Foresters and other land use managers may not incorporate vernal pools into their planning efforts because the pools are not always full of water and, therefore, not conspicuous. A recently-funded study aimed at protecting flows in North Shore streams for fish and wildlife will not consider the importance of vernal pools for stream flows or groundwater because their sizes and locations have not been mapped. The size of many vernal pools is too small to be included in current work by MNDNR, which targets wetlands > 0.5 acres in size, to update the state’s National Wetland Inventory maps. Therefore, there is an immediate need to develop a map depicting the size and location of North Shore vernal pools.

Vernal pools are small (or tiny) wetlands that may be wooded and usually are only flooded in the spring and early summer. Due to their size and ephemeral nature, they often go unnoticed, yet they provide important ecological linkages between Minnesota’s forests and streams. Vernal pools contribute to North Shore watershed water storage by storing surface water and thereby reducing flood peaks and stream erosion. Many of these pools also provide important amphibian and invertebrate habitat, thereby linking aquatic and terrestrial food webs. Some pools may recharge groundwater. Vernal pools, however, are threatened by climate and land use change. If vernal pools are destroyed, so too is the wildlife that depend on these ephemeral habitats. We propose to map the locations and assess the ecological importance of these very numerous wetland areas in 30 North Shore watersheds.

We will use recent technological advancements to map vernal pools with existing LiDAR data, which can produce highly detailed topographic maps, and aerial photography. We will use GIS to map the location and size of vernal pools within a landscape context, i.e., in relation to receiving stream networks, land cover, soil types, and other nearby aquatic habitats. We will classify vernal pools into 4 to 6 pool -types using a statistical approach. Pool classes will incorporate information from surrounding habitat, inundation patterns, and insect and amphibian communities. The classification will help prioritize public lands within a management framework. This work will add value to a NOAA-funded study examining the impact of land cover and climate change on North Shore streams. Maps and data products from this study will be used to protect vernal pools by advising natural resource managers of vernal pond locations and their ecological importance. Study products will include:

- (1) the first comprehensive maps of vernal pools in 30 North Shore watersheds,
- (2) a new vernal pool classification system, and
- (3) a printed citizen guide and monitoring program for these pools.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Map vernal pools in 30 North Shore watersheds using LiDAR & photography Budget: \$167,215

Previous studies reported 5-6 vernal pools per 100 acres in NE MN; therefore, there may more than 100,000 vernal pools in our study area. Information on the size, location, and ecological significance of these vernal pools would be of immediate value to land use managers. We will map pools using LiDAR imagery and aerial photography and verify our results against field checked vernal pool locations. Unlike similar studies, our approach will specifically target and identify vernal pools down to 0.025 acres in size.

Outcome	Completion Date
1. Create GIS maps (data layers) for 30 North Shore watersheds using LiDAR and airphotos showing pool locations and sizes.	February 2016
2. Verify map accuracy using available existing data and field surveys of 64 pools.	May 2016



3. Classify North Shore watershed vernal pools using information from surrounding habitat, inundation patterns, and biological data.	March 2016
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Activity 2: Assess ecosystem support provided by vernal pools in 30 North Shore watersheds for amphibian and invertebrates using the vernal pool classification scheme **Budget: \$294,925**

To assess the ecological significance of vernal pools, we will collect data on pool habitat, water storage and length of inundation, and support for amphibians (breeding and biomass) and aquatic invertebrates (biomass and diversity), and relate these characteristics to 4 to 5 classes of vernal pools identified in Activity 1.

Outcome	Completion Date
1. We will assess mapped North Shore vernal pool water storage by calculating their volume using LiDAR and aerial photography for all pools. We will verify locations and volumes by visiting 64 pools. Thirty-two of the 64 pools will be used to characterize habitat, water quality, inundation, and vegetation.	September 2017
2. We will visit 14 pools to characterize amphibian breeding activity, taxa, and biomass, and will sample 6 pools to characterize invertebrate diversity.	April 2018
3. We will statistically compare pool classes (Activity 1) with biotic and habitat variables to determine the ecological value of vernal pools for 30 North Shore watersheds.	June 2018

Activity 3: We will develop a stakeholder Outreach Program to engender appreciation, foster understanding, and promote preservation of vernal pools throughout the state **Budget: \$63,706**

Creation of citizen science vernal pool monitoring program, with workshops to train citizens, land managers, and volunteers; printed educational materials on vernal pool value and conservation.

Outcome	Completion Date
1. Build a website and a citizen science-based vernal pool monitoring program.	December 2016
2. Each year: 4-6 training workshops for the general public; 2 educational programs for regional developers/local government officials. Develop and print 500 copies of a vernal pool resource guide. Final report and publications for managers, policy makers, and scientists.	June 2018

III. PROJECT STRATEGY

A. Project Team/Partners: NRRI: Dr. Ralph Garono, PI; Dr. Valerie Brady, Researcher; Dr. George Host, GIS; Dr. Kirk Stueve, GIS; Dr. Jennifer Olker, Researcher; Ryan Huffmeier, Research & Outreach. Supported by ENRTF funds. NRRI personnel are not University professors and are funded primarily through grants.

USFS: Dr. Sue Eggert, Researcher, no support, effort provided as match for the project.

B. Project Impact and Long-Term Strategy: Landscape and climate change may significantly reduce the number and distribution of vernal pools and the ecological systems they support. This study will provide much-needed information to land managers, such as those in the National Forest and presently working on North Shore tributary stream flows.

C. Timeline Requirement: 3 years

2015 Detailed Project Budget

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IV. TOTAL ENRTF REQUEST BUDGET 3 years

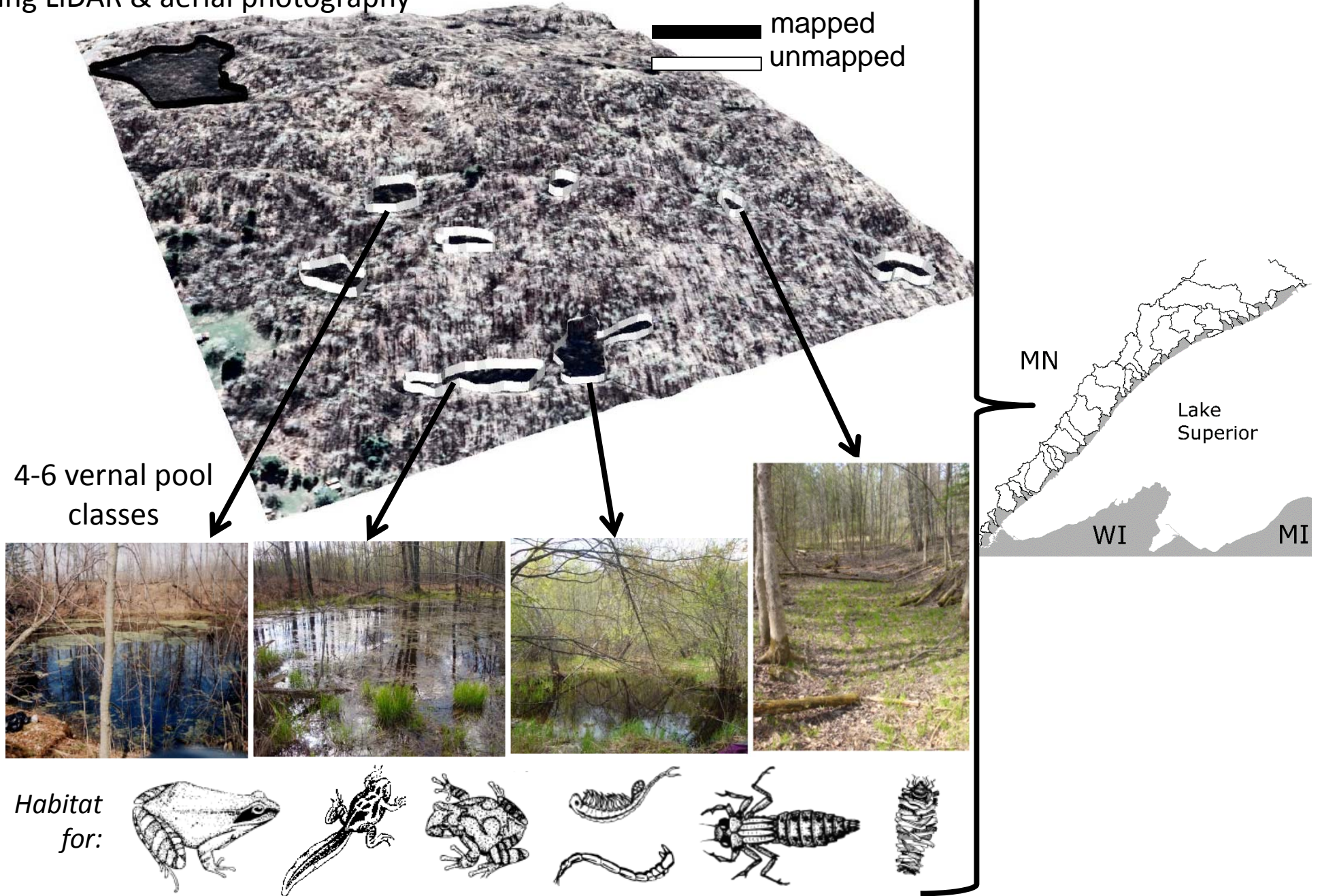
BUDGET ITEM	AMOUNT
Personnel: (all personnel are NRRRI researchers or techs; none are profs in UM departments)	
Ralph Garono, Principal Investigator (66.4% salary, 33.6% benefits); 20% FTE, 3 yrs	\$ 70,093
co PI V. Brady, wetland specialist (66.4% salary, 33.6% benefits); 10% FTE, 3 yrs	\$ 28,695
co PI J. Olker, amphibian specialist/outreach (66.4% salary, 33.6% benefits); 10% FTE, 3 yrs	\$ 20,048
co PI G. Host, landscape ecologist (66.4% salary, 33.6% benefits); 4% FTE summer, 3 yrs	\$ 17,863
K. Stueve, computer programmer, aerial photo/LiDAR specialist (66.4% salary, 33.6% benefits); 31% FTE, 3 yrs	\$ 84,404
R. Huffmeier, taxonomist, outreach (63.2% salary, 36.8% benefits); 43% FTE, 3 yrs	\$ 84,122
J. Dumke, field crew lead, GIS lab tech (66.4% salary, 33.6% benefits); 50% FTE yrs 1-2, 4% yr 3	\$ 64,675
Undergrad (100% salary, 0% benefits), field/lab work; 10% FTE yrs 1-2, 20% yr 3; 30% summers	\$ 16,900
Temp, field/lab worker (63.2% salary, 36.8% benefits); 20% FTE yrs 1-2, 25% yr 3	\$ 29,498
Contracts:	
ProWest & Assoc; Flying air photos of pools @ \$6k per flight, 5 flights	\$ 30,000
Print service: print vernal pool field guides, quote, \$10 each, need 500	\$ 5,000
Equipment/Tools/Supplies:	
Computer data storage, 10 terabytes at \$500/terabyte	\$ 5,000
Invert lab supplies (laser range finders, waterproof paper, rain gear, vials, forceps, ethanol)	\$ 2,100
Field water level instruments (recording rain gauges, water level continuous loggers; \$2140/pool for 7 pools; borrowing WL loggers for some pools, so other 7 pools cost \$1400/pool). Rest for year 2 re-instrumentation of pools.	\$ 26,500
Travel:	
8 workshops per year * 100 mi ea * \$.56/mi federal reimbursement rate	\$ 1,344
Field wk: \$22904 mileage, \$1800 UMD/NRRRI vehicle use rate, \$6000 lodging (\$100/day*60 d), \$4800 food @ \$40/day (follows UM travel guidelines for field crews)	\$ 35,504
Additional Budget Items:	
GIS work @ NRRRI (\$4.10/ hr U-approved charge for 1000 hrs; GIS lab is solely grant-funded)	\$ 4,100
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 525,846

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	n/a	
Foregone by UMN ICR funding (52% MTDC, excluding \$5,000 of contractor cost in yr 3)	\$ 273,440	<i>Secured</i>
In-kind Services To Be Applied To Project During Project Period: \$8,810 - U.S. Forest Service's Northern Research Station \$8,400 - Loan of water level continuous recorders/loggers (Garono) \$380,000 - FLOHA funding	\$ 397,210	<i>Secured</i>
Funding History	n/a	
Remaining \$ From Current ENRTF Appropriation	n/a	

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Map vernal pools
using LiDAR & aerial photography



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Dr. Ralph Garono is a Research Associate at NRRI, University of Minnesota Duluth (UMD). He has published more than 60 scientific articles and technical reports. He recently worked to establish the NOAA-funded Lake Superior National Estuarine Research Reserve, serving as the Manager/Director during its first two years of operation. He has managed numerous grant-funded research projects including those from the U.S. Army Corps of Engineers, U. S. EPA, NOAA, and the National Park Service. Dr. Garono has served on committees for national and international scientific organizations.

Relevant research projects:

- Assessment of Biocontrol Agent Populations on the Columbia River Estuary
- Watershed Assessment of (1) The Luckiamute River Basin, (2) The Siuslaw River Estuary, (3) The Midcoast Region of Oregon, and (4) Rock Creek (Siletz)
- Developing A Hierarchical, Spatially Linked Data Set Describing Estuarine Cover Types Along The Lower Columbia River
- Using Invertebrates To Assess The Impact Of Purple Loosestrife In The Columbia River Estuary
- Landscape Change Analysis Of The Lower Columbia River Estuary
- Using Invertebrates to Assess Restoration Success in (1) Tidal Wetlands Along the Yaquina River and (2) Wet Prairie Wetlands in the West Eugene Wetlands

Relevant publications:

- Garono, R. J., C. A. Simenstad, R. Robinson, C. Weller, and S. Todd. 2009. Using high spatial resolution Compact Airborne Spectrographic Imager (CASI) imagery to examine patterns in intertidal eelgrass landscapes along Hood Canal, WA. Special Session of ASPRS Meeting hosted by PNAMP.
- Garono, Ralph J., Richard L. Kiesling, James G. Kooser, Eric N. Wold, Shon S. Schooler, and David D. Bradsby. 2001. Adult Insect Assemblages as a Conservation Planning Tool. *Verh. Internat. Verein. Limnol.* 27:4032-4041.
- Garono, R. J. and J. G. Kooser. 1994. Ordination of wetland insect populations: evaluation of a potential mitigation monitoring tool. In *Global Wetlands: Old World and New* [W. J. Mitsch, ed.] 509-516.

The **Natural Resources Research Institute** (NRRI) is a part of the University of Minnesota Duluth. NRRI's mission is to promote private sector employment based on natural resources in an environmentally sensitive manner. NRRI scientists have extensive experience in applied ecological research on terrestrial and aquatic systems.

- The Natural Resources Geographic Informational Systems (NRGIS) laboratory at NRRI was established in 1988 through a National Science Foundation grant and matching funds from the University of Minnesota. The NRGIS lab provides NRRI and other university researchers with access to advanced GIS methods for applied and basic natural resources research, derives new research methods in spatial analyses, and serves data to public and private agencies to fulfill public research and education needs. The lab provides the equipment, software, and computing power needed to analyze large spatial datasets such as the LiDAR data, land cover/land use data, and aerial photography that will be used in this project.
- The NRRI Microscopy Laboratory is staffed by experienced taxonomists and technicians who are skilled at evaluating aquatic habitat conditions for fish, amphibian, macroinvertebrate, and periphytic communities. The facility accommodates field preparations and logistics to successfully complete aquatic sample collections, catalogue and store samples, and process samples under strict quality assurance/quality control protocols. The lab is equipped with a variety of research-grade compound and stereomicroscopes. Laboratory protocols follow published Standard Operating Procedures and field sampling guidelines that are refined for each project's objectives. Laboratory staff provides technical expertise for both public and private organizations as part of federal and state-sponsored monitoring and research activities. Invertebrate taxonomists are skilled at identifying aquatic macroinvertebrate taxa, calculating their biomass, and determining their functional relationships. Our USFS collaborator will provide taxonomic QC as match.