Environment and Natural Resources Trust Fund
2014 Request for Proposals (RFP)

Project Title: **ENRTF ID: 043-B**

Will Superior Sediment Plumes Produce Harmful Algal Blooms?

Category: B. Water Resources

Total Project Budget: $ 413,443

Proposed Project Time Period for the Funding Requested: 2 Years, July 2014 - June 2016

Summary:

Floods and changing lake conditions may trigger harmful algal blooms along Superior's shorelines. We will produce a tool to better protect Minnesotans by understanding conditions leading to nearshore algal blooms.

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Sponsoring Organization: U of MN Duluth - Large Lakes Observatory

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Web Address

Location

Region: Northeast

County Name: St. Louis

City / Township: Duluth/ North Shore Lake Superior

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

PROJECT TITLE: Will Superior Sediment Plumes Produce Harmful Algal Blooms?

I. PROJECT STATEMENT

- Rare algal blooms in nearshore Lake Superior last year underscore the need to understand factors that trigger algal populations.
- Water temperature, ice cover, thermal stratification, and hydrologic inputs are diverging from decadal patterns.
- Human activity has changed the St. Louis River. Minnesota has invested in restoring habitat.
- Are there unexpected consequences of these changes that could impact restoration success or human health?

The June 2012 flood event sent lots of nutrients and sediments into nearshore Lake Superior, leading to 100-fold increases in total phosphorus in the plume-impacted region of the western lake. Within a few weeks, dramatic algal blooms were observed around the St. Louis River and the Apostle Islands National Seashore, but not in the open portion of Lake Superior. Are sediment plumes harbingers of nearshore harmful algal blooms? Understanding conditions leading to nearshore algal blooms is critical as the nearshore region is where most interactions between people and the lake occur and because the region provides important nursery habitats for key fish species. Historically, the St. Louis River and nearshore Lake Superior have been designated as 'impaired' because of excess nutrient and sediment loads yet we have not seen the algal blooms in Lake Superior that have commonly plagued the lower Great Lakes for decades. What was it about summer 2012 that produced these algal blooms? We know that Lake Superior is changing: water temperatures are warmer and ice cover is diminishing. Will large runoff events have even more dramatic impacts on the Lake Superior nearshore algal communities as water temperature and mixing conditions change?

We already know that Lake Superior algal populations are held in check by the availability of nutrients and light; therefore, should more nutrients suddenly become available along with sufficiently clear waters, algal populations would be expected to rapidly bloom. The algal blooms that occurred in nearshore Lake Superior last July (which included a blue-green algae bloom in the Apostle Islands) may be the result of this combination of factors. Blue-green algae are known to produce toxins that result in cellular death, nervous system impairment, and liver damage of organisms. Patterns in blue-green algal populations and toxin production are not well understood in the St. Louis River and nearshore Lake Superior. The movement of river sediments and the nutrients they carry may not only affect the lake's nearshore aesthetics and aquatic communities but also human health at Minnesota beaches. We propose this study to develop a better understanding of the relationship between river sediment plumes and harmful algal blooms.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Predicting sediment and nutrient export — Budget: $181,710.10

We will add nutrient probes to existing USGS monitoring stations at the entrances to the St. Louis and the Knife Rivers to measure nutrients and will develop monthly estimates of nutrient and sediment inputs. This work compliments work currently being performed by USGS and the National Estuarine Research Reserve (NERR)

Outcome	Completion Date
1. Report describing the relationship between suspended sediment and sediment-bound nutrients in the St. Louis and Knife Rivers	*July 2016*
2. A management tool that relates turbidity and nutrients to algal populations	

Activity 2: Relating nutrients in sediment plumes to nearshore harmful algal blooms — Budget $218,863.90

We will establish upriver-to-lake sampling transects (at least 10 stations in the St. Louis River) for monthly measurements of nutrients, total suspended solids, particulate and dissolved organic carbon, and algal

community composition in May through October. We will also make these measurements after 3 storm events. When samples indicate potential for algal toxin production, we will field screen for algal toxins. If screening confirms algal toxin presence, we will conduct a detailed laboratory analysis.

Outcome	Completion Date
1. Report describing seasonal and spatial patterns in water quality, algal communities, and the presence of algal toxins	*July 2016*
2. Description of the relationship between water quality and algal communities, and potential human health risks	

Activity 3: Public outreach **Budget $12,869 .00**

We will produce outreach materials (at least 2 webpages with photo/video links and 2 brochures) that will be distributed through MN Sea Grant and National Estuarine Research Reserve. We will also develop press releases, regular updates through social media outlets, and facilitation of media interviews involving project investigators. Sea Grant will also produce short videos and other new media. Sea Grant will publish two newsletter stories about the work.

Outcome	Completion Date
1. Distribution of outreach materials to the interested public	*July 2016*

III. PROJECT STRATEGY

A. Project Team/Partners:

U of M Duluth Large Lakes Observatory: Dr. Ralph J. Garono (project management, algal communities, water quality), Dr. Elizabeth Austin-Minor (water quality, lake sampling, and carbon)
U. S. Geological Survey: Dr. Richard L. Kiesling (nutrients, sediments, algal toxins, and communities)
MN Sea Grant: Cindy Hagley (Outreach)
Lake Superior National Estuarine Research Reserve: Dr. Shon S. Schooler (Water Quality Data, Sentinel Site) will assist in outreach and coordination at no cost to the project.

B. Timeline Requirements

We are requesting funds to begin work in July 2014. In addition to regularly scheduled cruises, we will sample 2 or 3 flood events.
2014: July-October, monthly sampling of transects and storm-event sampling. November & December , analysis of data. January and February, season 1 report and development of outreach materials.
2015: April-October monthly sampling of transects and storm-event sampling. November and December, analysis of data. January and February, writing of season 2 report, further development of outreach materials.
2016: March, synthesis of 2014 and 2015 data. April –May, one early-season sampling; analysis of data. May and June: Final report preparation.

C. Long-Term Strategy and Future Funding Needs

This project will build upon and tie together several existing programs/ projects and fill important data gaps that will ultimately enable resource managers to evaluate the relationship between sediment plumes and harmful algal blooms in nearshore Lake Superior. Water quality and algae community data will be directly used by and disseminated by MN Sea Grant, the NERR, UMD, and other researchers. The NERR, which operates an array of continuous monitoring equipment, is currently working to understand the sources and transport of sediments in the St. Louis River. We anticipate developing a robust research program linking coastal watershed ecosystem processes with the nearshore Lake Superior ecosystem, and eventually with the blue water research programs of UMD's LLO.

2014 Detailed Project Budget

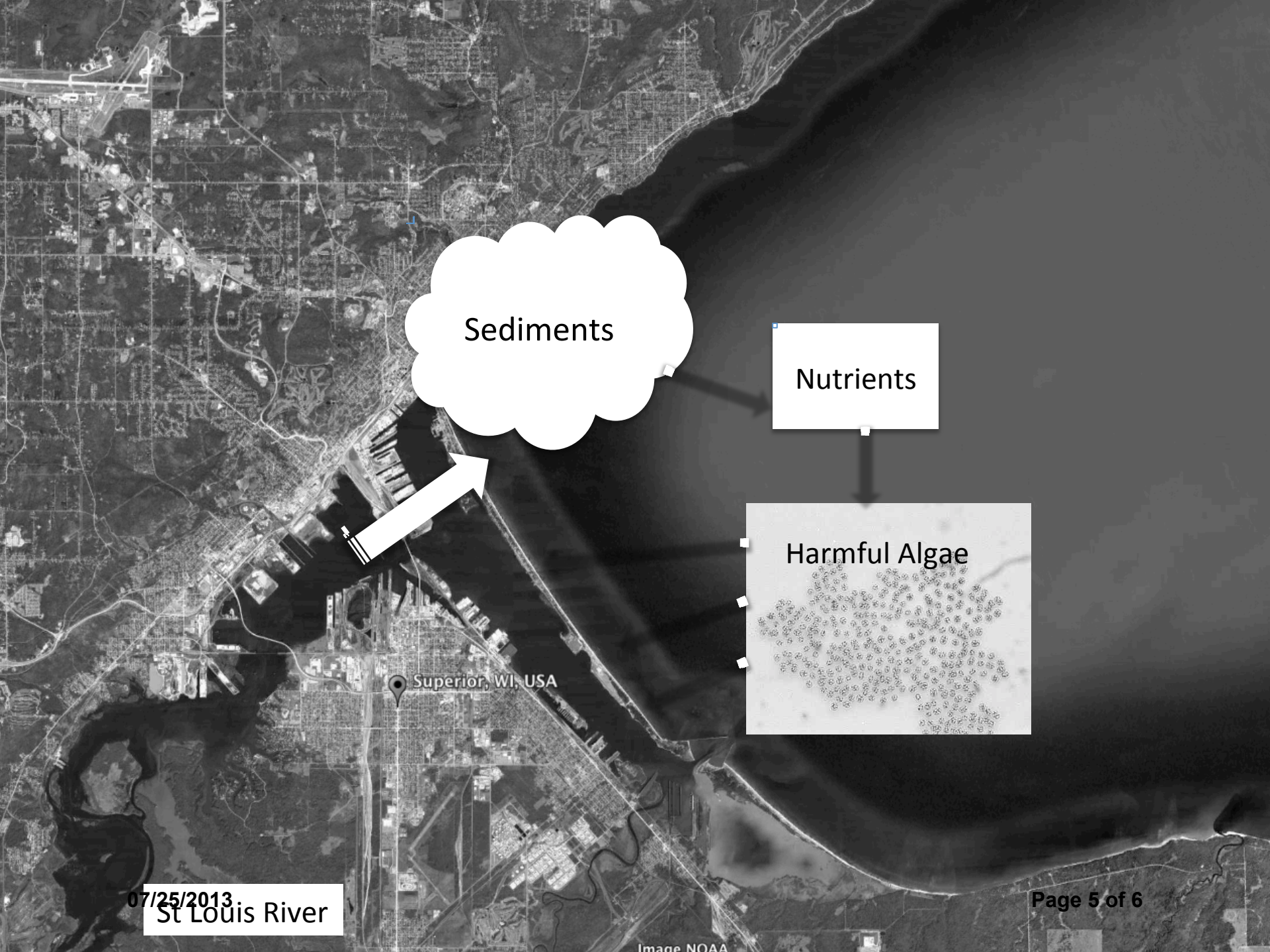
Project Title: Will Superior Sediment Plumes Produce Harmful Algal Blooms?

IV. TOTAL ENRTF REQUEST BUDGET 2 years

BUDGET ITEM	AMOUNT	
Personnel:	$	-
R. Garono (UM-D/ LLO; Project Management, Algae, Water Quality; includes 33.6% Frin	$ 61,140	0.5
R. Kiesling (USGS; Turbidity Model, Water Quality; includes 33.6% Fringe)	$ 26,400	0.2
E. Minor-Austin (UM-D/ LLO; Water Quality; includes 33.6% Fringe)	$ 14,010	0.2
C. Hagley (MN Sea Grant; Outreach; includes 33.6% Fringe)	$ 8,809	0.1
Research Tech (UM-D/ LLO; Laboratory & Field Analysis, Algae, Water Quality; includes	$ 24,745	0.5
Graduate Student (UM-D/ LLO; Laboratory & Field Analysis, Algae, Water Quality; includ	$ 52,193	2
Undergraduate Student (UM-D/ LLO; 2 Students 2 Summers; Laboratory & Field; include	$ 17,281	1
Equipment/Tools/Supplies:	$	-
Plankton Nets (4 @$500 ea.) various mesh sizes to sample algae in river and lake	$ 2,000	
Laboratory and Field Supplies: reagents, disposal, gloves, tubing, etc. for$2500 per yr. for 2 yrs.	$ 9,135	
Probes/ Equipment (Nitrate 2 @ $8500 ea. and Fluroprobe @ $2000 per yr. for 2 yr.) to sample nutrients and algal pigments	$ 21,315	
Additional Budget Items:	$	-
USGS Laboratory Analysis: 120 algal samples @ $50 and 120 pigment samples @ $60	$ 13,200	
USGS Collection and analysis of 25 suspended sediment samples for load analysis	$ 13,600	
USGS Laboratory Analysis (ELISA & GC/MS): Screening of 60 samples for 11 toxins/contaminants	$ 32,890	
LLO WQ: Testing of 200 samples (@ $50 ea.) for CDOM and other water quality components	$ 10,150	
Outreach Materials: webpage updates, color brochures, PowerPoint slides.	$ 4,060	
R/V Blue Heron (10 trips @ $8900 per day- 5 per yr.)	$ 90,335	
Shallow Draft River Boat (20 trips @$500 per day)	$ 10,150	
Shipping of 20 water sample containers from Dul to Minn @ $100 ea.	$ 2,030	
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$	413,443

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period:		
Matching Federal Salary (0.2 FTE) for R. Kiesling(USGS)	$ 26,400	*Secured*
In-kind Services During Project Period: Two R/V Blue Heron Cruises Provided by LLO	$ 17,800	*Secured*
Matching Monitoring by USGS	$ 24,000	*Secured*
Funding History: *Previous LCCMR Funding to LLO - will extend the funded project into nearshore waters and coastal rivers*	$ 600,000	Secured


Sediments
Nutrients
Harmful Algae
Superior, WI, USA
St Louis River
Image NOAA

Project Manager Qualifications

Ralph Garono is a Senior Research Associate at the Large Lakes Observatory at the 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.

Organization Description

The **Large Lakes Observatory** (LLO) is a research institute at the University of Minnesota Duluth. LLO was established in 1994 to make systematic use of oceanographic techniques in lake studies. We have grown (currently 10 faculty members) to have a global outlook and an international reputation with field programs and collaborators on 6 continents. In addition to housing a vibrant graduate program (we have attracted students from Malawi, Tanzania, Uganda, Ghana, China, Malaysia and the Netherlands), LLO provides unique research opportunities to undergraduates; in the past few years UMD undergraduates have participated in field programs in Indonesia, Mexico, Malawi, as well as on Lake Superior. Close ties have been formed with institutes in Canada, Uganda, France, Norway, Kyrgyzstan, Kenya, Nicaragua, Malawi, Tanzania and England, as well as with many universities within the United States. We are working to understand how lakes function, how they behaved in the past, and what will happen to them in the coming years.

The LLO operates the largest university-owned research vessel in the Great Lakes. The R/V Blue Heron was purchased with LCMR support in 1997, and is the only member of the University National Oceanographic Laboratory System (UNOLS) on the Great Lakes. The ship is outfitted with state-of-the-art research equipment that provides unique capabilities for observing Lake Superior. Although LLO is the lead organization on this proposal, researchers from other parts of the University of Minnesota Duluth, the University of Minnesota Twin Cities, and the Minnesota Department of Natural Resources will be involved in the collaborative research we propose.

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