

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

Project Title:

ENRTF ID: 129-D

Treating Invasive Species in Laker Ballast Water

Category: D. Aquatic and Terrestrial Invasive Species

Total Project Budget: \$ 347,840

Proposed Project Time Period for the Funding Requested: 2 years, July 2016 to June 2018

Summary:

The project will further development of a ballast water treatment system for Great Lakes freighters. Outcomes include refinement and testing of a treatment neutralization process using vessel engine emissions.

Name: Jeffrey Henquinet

Sponsoring Organization: Izaak Walton League of America - Minnesota Division

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Location

Region: NE

County Name: Cook, Lake, St. Louis

City / Township:

Alternate Text for Visual:

Great Lakes freighter routes and discharge quantities in the Great Lakes.

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



Environment and Natural Resources Trust Fund (ENRTF)

2016 Main Proposal

Project Title: Treating Invasive Species in Laker Ballast Water

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I. PROJECT STATEMENT

The project involves further development of a permanent shipboard ballast water treatment (BWT) system while meeting the unique demands of the Great Lakes freshwater bulk carrier fleet (Lakers). The project will test a neutralization process using vessel engine emissions.

The goal is to reduce the threat of new AIS in Minnesota from the ballast vector and thus provide protection to Minnesota's Lake Superior harbors and by extension inland lakes. The EPA identified ballast water from ships as the source of 65% of invasions from 1960-2006. Recent US Coast Guard and EPA rule developments will eventually lead to wide-scale installation of onboard BWT systems. However, Lakers are currently exempted from regulations and that includes some vessels that sail in coastal waters such as the St. Lawrence. Within the Great Lakes, 13 ships move 60% of the ballast between basins with more than 50 percent of the ballast water discharged occurring at Duluth/Superior and Two Harbors according to the US Coast Guard.

The US Geological Survey, working with the National Park Service and the American Steamship Company (ASC), has developed a BWT method works effectively under the extreme conditions of water flow rate and volume common on bulk carriers plying the Great Lakes. The methods developed are particularly attractive as unlike conventional oxidizing biocides, the elevated pH condition retards steel corrosion rates which is important given that Laker ballast tanks do not have protective coatings.

The treatment approach is based on application of a common base reagent (NaOH) to pH 11.5 or 12 followed by application of CO₂ to achieve a normal pH and the formation of the reaction product sodium bicarbonate, a common and important source of alkalinity in surface waters. Previous testing has relied on manufactured carbon dioxide (CO₂) for neutralization, however, a better option involves using CO₂ generated onboard by the propulsions systems and present vessel stack emissions. This is preferable for safety, costs, and pollution reduction reasons.

The project will further stepwise development of a BWT system for Lakers through testing of a neutralization process using vessel engine emissions. Overarching outcomes for the project include:

1. Inter-basin transfer of previously introduced invasive species is eliminated through implementation of hydroxide treatment of ballast.
2. Improving air quality by using waste products, CO₂ and sulfur, emitted from vessel smokestacks.
3. An extension of the useful life of the Great Lakes Fleet resulting from the steel corrosion retarding effects of elevated pH treatment of ballast- - reduced operating costs.
4. A reduction in the resources required to restore or manage ecosystems negatively impacted by invasive species

The project manager and USGS scientist would work with a University of Minnesota master's degree student to develop and construct the prototype and devise the testing plan. An initial set of tests would be conducted to confirm operation parameters of the system. A second set of tests would evaluate the residual toxicity of the treated water. All aspects of the project would be presented in a final report, possibly in the form of a master's thesis or a publication.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Prototype design and test plan development

Budget: \$ 127,840

The proposed effort will involve prototype design and construction. In operation, hot engine exhaust is pulled through a catalytic converter for reduction of carbon monoxide and particulates. A water jet exhauster mixes a



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recirculated scrubbing solution (water) with the gas to clean and cool it. Then water is separated back out of the gas for delivery of the gas into the high pH treated ballast water. A bench scale systems has been constructed and successfully tested. The prototype would involve a significant scale up. A test plan for the system will also be developed during this initial project phase.

Outcome	Completion Date
1. Design of a prototype scrubber system	<i>Fall 2016</i>
2. Test plan development	<i>Fall 2016</i>
3. Construction of prototype scrubber system	<i>Spring 2017</i>

Activity 2: Prototype construction, testing and reporting

Budget: \$ 220,000

The proposed effort will involve construction of the prototype scrubber. An initial round of testing will serve to establish scrubber performance versus select operating conditions including gas to liquid ratios, operating temperatures, water exchange rate and engine load. Second, Whole Effluent Toxicity tests following EPA guidelines using three standard freshwater test organisms will be conducted.

Outcome	Completion Date
1. Operational testing	<i>Summer 2017</i>
2. Residual toxicity testing	<i>Fall 2017</i>
3. Final Report	<i>Summer 2018</i>

III. PROJECT STRATEGY

A. Project Team/Partners

The Izaak Walton League of America – Minnesota Division, St. Paul, MN will be the LCCMR single point of contact, performing all contacting efforts and ensuring appropriate and timely reporting of progress. Environmental protection specialist, Dr. Jeffrey Henquinet, would serve as project manager and oversee permitting. **Partners Receiving Funding:** The University of Minnesota (specific campus to be determined) will receive funds to support an engineering graduate student for two years. Dr. Barnaby Watten, US Geological Survey, will head research and development efforts. Dr. Adria Elskus, US Geological Survey, will write residual toxicity report. Testing lab (to be determined) to conduct residual toxicity tests.

B. Project Impact and Long-Term Strategy

Extensive work has led to this final stage of development. Work to date has included 1) Engineering Practicality Study, 2) Biocide Materials Handling Review, 3) Bench Scale and Land-Based Biocide Testing conducted at USGS Leetown Science Center and the Great Ships Initiative, 4) Test Ship Outfitting on an American Steamship Company vessel, the M/V Indiana Harbor, 5) Mixing Studies and Ship Dye Trials (Funded through LCCMR Grant #33784), and 5) Full-scale ship trials of the BWT, but using liquid CO2 rather than stack emissions. Previous efforts have been significantly enhanced and supported by the American Steamship Company (ASC), its parent company GATX. ASC has contributed significant financial support on past work and is committed to adopting this technology should the technology prove itself.

C. Timeline Requirements

This project will span approximately 2 years with Activity 1 actions and outcomes in the first year and Activity 2 actions and outcomes in the second year. (See details above).

2016 Detailed Project Budget

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IV. TOTAL ENRTF REQUEST BUDGET 2 years

BUDGET ITEM (See "Guidance on Allowable Expenses", p. 13)	AMOUNT
Personnel:	\$ -
Grant manager: 6% FTE, contracting, communications, and reporting. (100% salary, 0% benefits, 2 years, 1 person in position)	\$ 7,200
Project Manager: 7% FTE, Project oversight and reporting. (100% salary, 0% benefits, 2 years, 1 person in position)	\$ 11,200
Professional/Technical/Service Contracts:	\$ -
US Geological Survey Support (Watten & Elskus)	\$ 93,840
University graduate student (2 years)	\$ 133,000
Residual toxicity tests: Contractor undetermined, will conduct RFP.	\$ 35,000
Equipment/Tools/Supplies:	\$ -
Prototype	\$ 45,000
Bulk Chemicals	\$ 500
Chemical sampling and handling supplies	\$ 2,000
Acquisition (Fee Title or Permanent Easements):	NA
Travel:	\$ -
USGS scientist, 3 trips to Minnesota for testing	\$ 10,500
Proj. manager (2 trips to Minneapolis for testing oversight)	\$ 3,600
Additional Budget Items:	\$ -
Rental of generator with load cell (4 weeks @ 1500/wk)	\$ 6,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 347,840

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:	NA	NA
Other State \$ To Be Applied To Project During Project Period:	NA	NA
In-kind Services To Be Applied To Project During Project Period:	NA	NA
Funding History:	\$ -	
NaOH Practicality Study funded by Great Lakes Fisheries Trust (2009)	\$ 78,200	
NaOH 2011 Shiptrial funded by Great Lakes Restoration Initiative (2010)	\$ 776,320	
NaOH Technology Development Testing funded by US Geological Survey (2010)	\$ 250,000	
Stack Gas Emissions Development funded by Great Lakes Restoration Initiative (2011)	\$ 270,012	
NaOH Mesocosm Trials funded by National Park Service (2015)	\$ 110,000	
Remaining \$ From Current ENRTF Appropriation:	NA	NA

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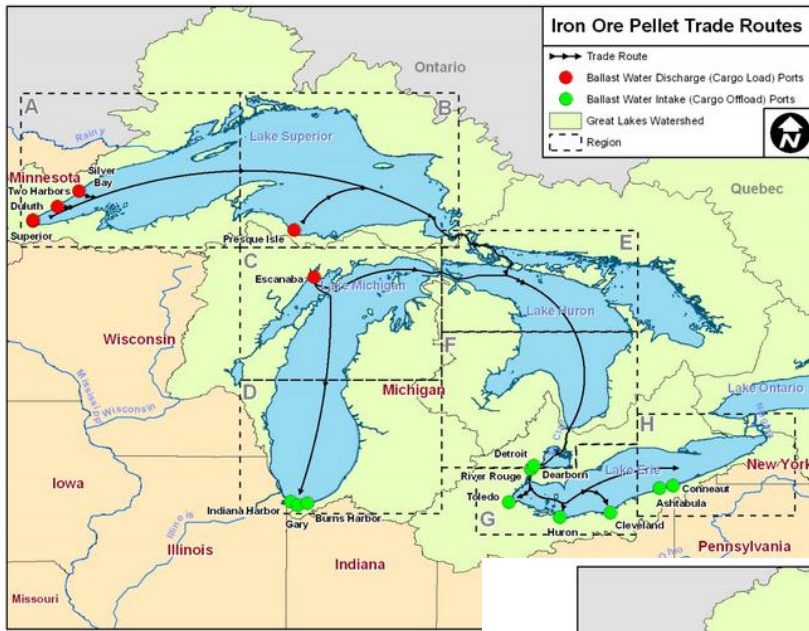


Figure 1. Iron ore pellets trad

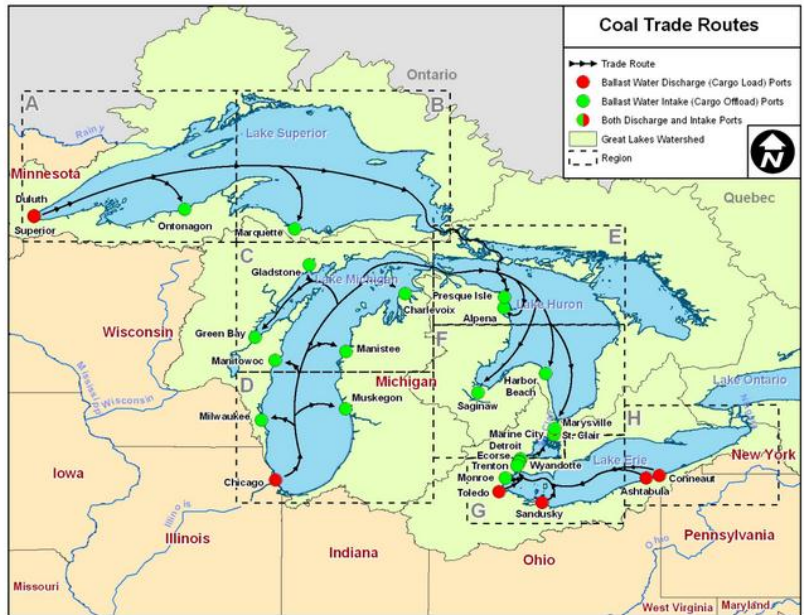


Figure 2. Coal trade routes.



Table 3. Ballast discharge volumes by region with top 5 discharging vessels (for each regional transport of ballast water).

Rank	Departure Region	Arrival Region (AR)	Total Annual Coastwise Ballast Transported (mt)		Vessels with Greatest Discharge				
			AR Total Discharge	Percent of Total	1st	2nd	3rd	4th	5th
1	S Lake Michigan	W Superior	7,899,425	18.6%	Edgar B. Speer	Burns Harbor	Stewart J. Cort	Edwin H. Gott	American Spirit
2	West Erie	W Superior	6,739,416	15.9%	Paul R. Tregurtha	American Integrity	Presque Isle	Walter J. McCarthy Jr.	Edwin H. Gott
3	S Huron	W Superior	4,012,489	7.9%	Paul R. Tregurtha	American Century	American Century	James R. Barker	American Integrity
4	E Erie	W Superior	3,984,870	9.4%	American Century	Edgar B. Speer	Edwin H. Gott	Roger Blough	Presque Isle

Table 3 yields two significant pieces of information: (1) In 2010, more than half of the total ballast water discharged by U.S. vessels into the Great Lakes was discharged into western Lake Superior ports by 13 vessels, all but one being 1000-foot, all transiting from lower-lake ports. (2) All sizes of Lakers are responsible for *intra*-regional movement of ballast, even 1000-foot Lakers.

Project Manager Qualifications & Organization Description

Project Manager:

Dr. Jeffrey Henquinet, 906-281-2002

Qualifications:

Dr. Henquinet has extensive experience in the areas of environmental law and policy, NEPA compliance, and project/program management. In recent years, he has been heavily involved in research related to preventing the introduction and spread of invasive species in the Great Lakes. Dr. Henquinet served as project manager on two projects focused on the treatment of ballast water in ships to prevent the introduction or spread of invasive species:

1. A \$500,000 Great Lakes Restoration Initiative funded selection and installation ballast treatment system aboard the NPS passenger vessel, Ranger III.
2. A \$1,046,000 Great Lakes Restoration Initiative funded research project on the development of a permanent treatment system for Great Lakes freshwater-only vessels using sodium hydroxide as the biocide.

Dr. Henquinet has worked with all of the partners involved in the proposed projects. He has been involved in mixing and active biocide trials with the ballast tank mixing technology used in the prototype system. Dr. Henquinet has also been working with the partners to develop the biocide dosing and monitoring protocol for this project.

Dr. Henquinet has received a Ph.D. Fisheries & Wildlife from Michigan State University, a J.D. from Lewis and Clark Law School, and a B.Sc. (cum laude) Biology with chemistry minor from University of Wisconsin – La Crosse.

Organization Description:

Founded in 1922, the Izaak Walton League is one of the nation's oldest and most respected conservation organizations. With a powerful grassroots network of more than 250 local chapters nationwide, the League takes a common-sense approach toward protecting our country's natural heritage and improving outdoor recreation opportunities for all Americans. The League's mission is to conserve, restore, and promote the sustainable use and enjoyment of our natural resources, including soil, air, woods, waters, and wildlife. Chapters were formed throughout the Midwest to rally the League's pledge "to defend soils, woods, water, and wildlife". The IWLA's Minnesota Division and local chapters have a long history of action and are involved in conservation issues through education, lobbying, and a multitude of local conservation projects. The Minnesota Division has a regional office located in Saint Paul, Minnesota and concentrates on issues in the Mississippi River states with emphasis on energy efficiency, hydro-power, and sustainable agriculture.

The Division successfully oversaw a \$200,000 LCCMR grant from 1999-2001 with Barbara Toren serving as project manager. The project involved planning and implementing statewide sustainability forums.