Environment and Natural Resources Trust Fund
2011-2012 Request for Proposals (RFP)

LCCMR ID: 034-B

Project Title: Pure Oxygen Injection Demonstration for Water Quality Improvement

Category: B. Water Resources

Total Project Budget: $ $230,000

Proposed Project Time Period for the Funding Requested: 4 yrs, July 2011 - June 2015

Other Non-State Funds: $ 0

Summary:

Injecting pure oxygen above deep lake sediments prevents release of phosphorus and methylmercury. This novel application of proven big-reservoir technology will provide a new method of delisting impaired suburban/urban lakes.

Name: David Austin

Sponsoring Organization: Riley Purgatory Bluff Creek Watershed District

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Mendota Heights MN 55120

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Web Address www.rileywd.org

Location

Region: Metro

Ecological Section: Minnesota and NE Iowa Morainal (222M)

County Name: Carver

City / Township: Chanhassen

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

I. PROJECT STATEMENT:
In many lakes the problems of excess phosphorous and mercury contamination of fish are manifestations of the same process: loss of oxygen at the lake bottom. This project will demonstrate the use of a method to restore oxygen to the bottom of impaired, high-use Minnesota lakes. The technology – pure oxygen injection – is proven in large reservoirs, but to date has not been used in small recreational-use lakes. There are three main benefits of this demonstration project:

1) **Prevent formation of methylmercury**. Mercury enters lakes through the atmosphere, but only contaminates fish when it forms methylmercury. Our technology will reduce mercury content in fish populations hatched after oxygenation begins.
2) **Lock phosphate and other nutrients in sediments**. Phosphate and nutrients enter lakes attached to sediment or dirt particles. Adding oxygen will keep these nutrients attached to the sediment where algae cannot use it. This will improve water quality
3) **Recover ecosystem health**. Restoring oxygen to the lake bottom will restore a cool or cold-water fish habitat in impaired lakes.

Deep lakes stratify during the summer. A cold, stagnant layer forms on the bottom and a warm, mixed layer forms on top. Bacteria in the bottom of the lake, in the sediments, rapidly consume all the oxygen in the bottom layer of water in the lake. After loss of oxygen ("anoxic" conditions), reactions can occur that release phosphate to the water and allow methylmercury to form and accumulate in fish. Phosphate causes algae to grow, which degrades water quality. Methylmercury is toxic and ends up in fish tissue where humans and other higher organisms can consume it.

Managers of large reservoirs, such as the Tennessee Valley Authority, have embraced the technology of deep lake injection of pure oxygen to prevent formation of conditions that cause these problems (phosphate and methylmercury release/formation) in deep waters. Multiple scientific studies document large improvements to water quality when this technology is used. Oxygenation is not aeration. Air is approximately 21% oxygen. Pure oxygen injection instead of simple aeration is about five times more efficient than what has been tried in Minnesota.

We recognize, however, that big-reservoir technologies need modification to be effective in high-use Minnesota urban/suburban lakes. Lake depths are very different in areas where this technology has been used before (200-feet deep dammed reservoirs, rather than our 40-feet deep lakes). Oxygen supply is also an issue. It is not reasonable to install a large liquid oxygen tank in a residential neighborhood. Instead, on-site oxygen generators can safely supply oxygen and be no more noticeable than a small pump station. This technology is off-the-shelf and requires no scientific research to implement. It does, however, require thoughtful application, scale-down, and testing to generate the needed information to widely apply this technology and solve many of Minnesota's water quality problems—harmful and unattractive algae blooms and toxic methylmercury buildup in fish.

The project location for scale-down and testing is Lake Ann, City of Chanhassen, Carver County. It is at the headwaters area of Riley Creek in the Riley-Purgatory-Bluff Creek Watershed district. Lake Ann is on the 303(d) list for fish consumption because of elevated methylmercury in fish tissue. It has a highly anoxic bottom-lake area. Lake Ann has both fishing and swimming enjoyed by a large public base. This lake is an excellent, high-profile candidate for the use of pure oxygen injection to improve water quality and, potentially, delist the lake for mercury contamination. The District is aware of three other recreational lakes in our watershed alone that are candidates for application of this method.

II. DESCRIPTION OF PROJECT ACTIVITIES

Budget: $ 230,000

The Riley-Purgatory-Bluff Creek Watershed District will conduct this project through the District Engineer, CH2M HILL, who will be responsible for project management and technical elements of this project. **At project completion, the District is projected to have funded approximately sixty percent ($382,000) of total project costs ($612,000)**.

Deliverables:

Outcome	Completion Date
Complete basis of design report.	December, 2010
Complete preliminary design.	April, 2011
Complete coordination activities with Chanhassen	July, 2011
Complete final design and obtain all permits	December, 2011
Installation of oxygenation system	May, 2012
Commission oxygenation system	June, 2012
Monitor results of oxygen injection	June, 2012 – June 2015

III. PROJECT STRATEGY

A. Project Team/Partners

The Riley-Purgatory-Bluff Creek Watershed District is the requesting organization. The District Engineer, CH2M HILL, will provide design, construction management, and other technical services. The District Engineer will contract continued water quality monitoring, operation and assessment of the system. The District will coordinate with the City of Chanhassen and citizen stakeholders.

The District seeks partial funding of the project from LCCMR. District funds spent to date on this project are approximately $30,000. An additional $82,000 has been secured for 2010. Pending funds for 2011 total $270,000. Total District funds allocated for this project are $382,000. Long term monitoring and operations/maintenance funding is planned at approximately $20,000 per year, starting one year after installation of the oxygenation system.

B. Timeline Requirements

The project will be designed and constructed in the allotted three years. The District has committed to operating the oxygenation system for an estimated twenty (20) years.

C. Long-Term Strategy and Future Funding Needs

This project will demonstrate use of deep lake (hypolimnetic) oxygenation to control release of phosphate and prevent generation of methylmercury from sediments in a recreational-use lake. ***There is currently no demonstrated method of controlling in-lake mercury methylation in impaired lakes*** and phosphorous control is traditionally limited to Alum, which requires repeated applications every 5 to 10 years and often fails altogether. Although not applicable to all lakes in Minnesota, this oxygenation method is potentially applicable to many impaired high-value, high-use lakes. Demonstration of this technology and thoughtful scale-down and testing will provide Minnesota water quality managers with a novel method and clear implementation guidelines so that these water quality improvements can be realized across the state.

There are no additional anticipated future funding needs for this project. The District will conduct all operations, maintenance, and monitoring activities needed to support the demonstration on an ongoing basis.

2011-2012 Detailed Project Budget

IV. TOTAL TRUST FUND REQUEST BUDGET *3* years

BUDGET ITEM *(See list of Eligible & Non-Eligible Costs, p. 13)*	**AMOUNT**
Personnel: Project Manager (1) - budget, procurement management, construction engineer, design oversight, oversight of comissioning, warranty issues. 3 years; 7.5% of full-time employment; 45% toward salary; 55% toward benefits.	$ 46,000
Contracts: Installation of the oxygen generation equipment. Company providing oxygen generation equipment will be contracted with to deliver and start up equipment as well as train District Engineer to operate and maintain system.	$ 5,000
Contracts: Electrical equipment cost. Bring in 3-phase 270/440 VAC from Powers Blvd (Excel Energy). Install transformer (Excel Energy). Install power from transformer to oxygen generation unit (Electrical contractor).	$ 42,000
Contracts: Installation of the in-lake diffusers. Cost to install piping from oxygen generator to edge of lake, proposed horizonatal directional drilling installation.	$ 25,000
Contracts: Design and construction of a 250 square foot utility structure for oxygen generation and associated equipment.	$ 35,000
Equipment/Tools/Supplies: Oxygen Generation equipment for onsite generation of the oxygen input to Lake Ann.	$ 115,000
Equipment/Tools/Supplies: Diffuser system for the in-lake delivery of the oxygenation water. Includes necessary piping and associated equipment.	$ 150,000
TOTAL COST	$ 418,000
DISTRICT CONTRIBUTION (45%)	$ 188,000
ENVIRONMENT & NATURAL RESOURCES TRUST FUND $ REQUEST	**$ 230,000**

V. OTHER FUNDS

SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ Being Applied to Project During Project Period: Baseline monitoring 2008-2009. Preliminary analysis of oxygenation feasiability	$ 30,000	Completed
Other Non-State $ Being Applied to Project During Project Period: Baseline monitoring 2010.	$ 15,000	Secured
In-kind Services During Project Period: Consultation and coordination by the City of Chanhassen is being provided at no cost to the District.	$ -	
Funding History: Preliminary design of the hypolimnetic oxygenation system by the District Engineer (2010 approved District budget).	$ 67,000	Secured
Funding History: Final design and constructrion observation of the hypolimnetic oxygenation system by the District Engineer, CH2M HILL (2011 District budget line item to be approved December 2010).	$ 67,000	Pending

Figure 1. Proposed project site, Lake Ann, Chanhassen, Carver County

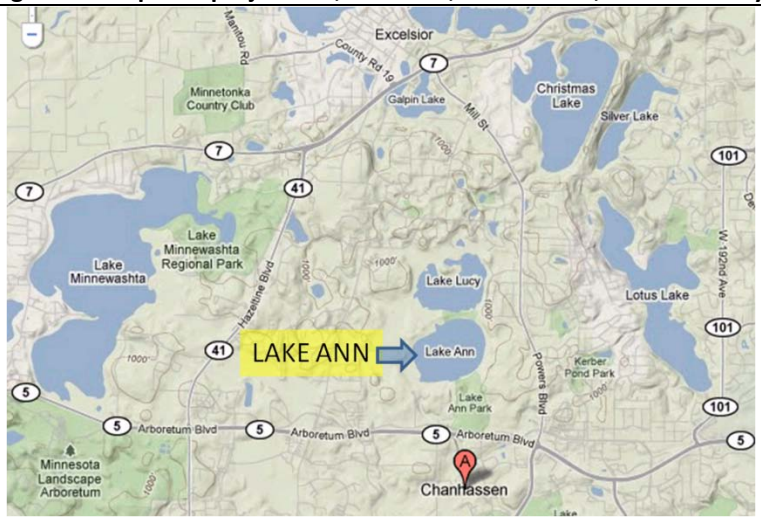

Figure 2. Pure oxygen linear diffuser schematic

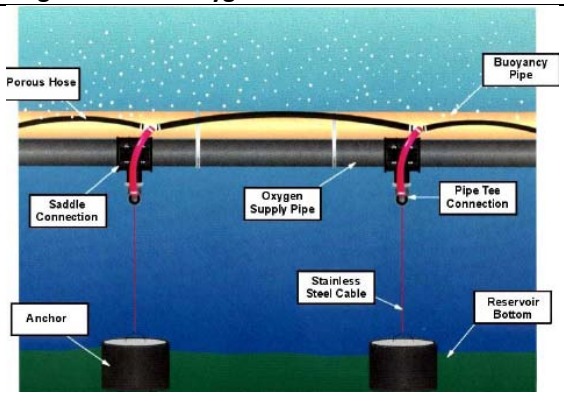

Figure 3. Linear diffuser deployment before sinking

Figure 4. Example of on-site oxygen generation system (2,200 lb/day, dimensions 8' x 8' x 8').

Requesting Organization: Riley-Purgatory-Bluff Creek Watershed District

The Riley-Purgatory-Bluff Creek Watershed District (the "District") is the watershed planning organization for a nearly 50 square mile portion of the southwestern Twin Cities Metropolitan Area. Marked by 40 years of progressive water management, the District continues to operate with a strong conservation ethic. Five principles characterize this conservation ethic:

- Focus on "One Water" resource management
- Reliance on citizen priorities and leadership
- Determination to restore and protect
- Create solutions that are resource specific
- Evaluate progress with measurable benefits

These principles provide a direct link between what citizens want and what government can deliver with a mandate to restore and protect a natural resource all value dearly – our waters.

Project Manager: David Austin, P.E.

Professional registrations:

- Professional Environmental Engineer (MN, NM, NC)
- Certified Senior Ecologist, Ecological Society of America

Education:

- B.A., Mathematics (1984), University of Minnesota – Twin Cities
- M.S., Water Resources Management (1993), University of Wisconsin-Madison
- M.S., Civil and Environmental Engineering (1996), University of California-Davis

Distinguishing qualifications:

- Treatment wetland technology and design expert
- Limnologist leading multiple lake restoration projects for the Riley Purgatory Bluff Creek Watershed District, Minnesota
- Technical lead on evaluation of hypolimnetic aeration projects on Vadnais and Pleasant Lakes for Saint Paul Regional Water Services, Minnesota
- Aquatic ecologist with expertise in environmental microbiology, aqueous biogeochemistry, lake nutrient dynamics, and plankton ecology
- Lead designer/project manager in over two dozen wastewater treatment projects
- Principal author of eleven US patents in wastewater technology

Work History:

- Principal Technologist Natural Treatment Systems, CH2M HILL (since January, 2008)
- Senior Design Engineer, Jacques Whitford NAWE, Inc., 2007 - 2008
- Vice President of Ecological Design, NAWE, LLC, 2005 - 2007
- Director of Research and Development, Living Designs Group, LLC, 2000 - 2005
- Director of Wastewater Operations, Living Technologies, Inc., 1996 - 2000
- United States Navy Reserve, Marine Salvage & Diving Officer, 1985 – 1995 (active duty to June 1989)