Environment and Natural Resources Trust Fund
2009 Phase 2 Request for Proposals (RFP)

LCCMR ID: 067-B4

Project Title: Cooperative Habitat Research in Deep Lakes

Total Project Budget: $ $1,600,000

Proposed Project Time Period for the Funding Requested: 3 years, July 2009 to July 2012

Other Non-State Funds: $ $0.00

Priority: B4. Deep Water Lakes

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Sponsoring Organization: DNR

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NW, NE, Central,
Metro

Summary: Understanding, predicting, and responding to the consequences of large ecological drivers of change on water quality, habitats and fish populations in cold-water Minnesota lakes.

Main Proposal: 0908-2-008-proposal-LCCMR_DeepLakes_submit092908.doc

Project Budget: 0908-2-008-budget-LCCMR_2009_DeepLakes.xls

Qualifications: 0908-2-008-qualifications-LCCMR_mgr_quals_org_desc.doc

Map: 0908-2-008-maps-LCCMR_DeepLakes_Map_submit092908.doc

Letter of Resolution:

PROJECT TITLE (LONG): Assessing the consequences of ecological drivers of change on water quality and habitat dynamics of deep-water lakes with coldwater fish populations.

I.   PROJECT STATEMENT

Water quality, habitat, and fish in Minnesota lakes are or will be facing substantial levels of stress primarily due to two very large drivers of change: land use changes (both urban and agricultural) and climate change.   Incorporating several aspects of the recently completed Statewide Conservation and Preservation Plan recommendations and complementing efforts of ongoing LCCMR-funded work (e.g., intralake zoning project, NRRI climate change project), we propose a 3-yr cooperative study in several sentinel lake watersheds throughout the state that will help us understand, predict, and monitor the consequences of climate change and land cover alterations. Multiple national, state, and local government and academic partners are currently enrolled in a fledgling, large-scale effort called Sustaining Lakes in a Changing Environment (SLICE) that includes a focus on monitoring basic watershed, water quality, habitat, and fish indicators in 24 sentinel lakes across a gradient of ecoregions, depths, and nutrient levels. Efforts that began in 2008 have been largely funded from limited discretionary budgets from partners with little guarantee that efforts can be sustained from one year to the next. We are seeking LCCMR funding to conduct detailed assessments in a subset of the 24 sentinel lakes that includes 14 deep sentinel lakes. This work will assess cause-effect mechanisms affecting the past, present, and future status of cold-water habitat and identify the appropriate indicators to monitor to track the status of these habitats. Detailed assessment and modeling of past, present, and future conditions in our deep sentinel lakes will inform revisions to lake monitoring programs, provide an empirical foundation for proposed watershed "best management practices," and inform climate change adaptation policies related to lake management. Through the efforts of our partners on SLICE, in-kind contributions will match approximately 57% of our 3-year $1.6 million budget request.

II.   DESCRIPTION OF PROJECT RESULTS

Result 1: Establish 14 deep sentinel lakes and their associated watershed as focal points of collaborative long-term monitoring, research, and environmental education (see attached map). **Budget: $**800,000

Result 1 focuses on building interdisciplinary partnerships to conduct intensive monitoring of several physical, chemical, and biological parameters in 7 deep lakes with cold-water fish populations, and 7 deep lakes with cool and warmwater fisheries distributed across the 4 major ecoregions of the state. Efforts will be made to draw comparisons between the coldwater and cool-warm water lakes to simulate effects of climate and land use change and to evaluate indicators that respond to this gradient. In addition, we will establish meteorological and water quality sensors and flow gaging stations built and managed by the USGS in 3 "super" sentinel lakes that span a range a watershed conditions but still harbor cold water fish populations. Data from these lakes will be housed in the National Water Inventory System (NWIS) database and be used to facilitate predictive watershed and lake nutrient modeling discussed in Result 3.

> **Deliverable (Completion Date)**
> 1. Network of 14 sentinel monitoring and research sites (Sep. 2009)
> 2. Installation of flow, climate, and water quality monitoring systems in Carlos L., Douglas Co.; Elk L., Clearwater Co.; and Trout L., Cook Co. (July 2009)
> 3. Project coordinator to maintain and manage partnerships, and coordinate reporting (July 2009)

Result 2: Reconstruct post-European to present water chemistry, sedimentation, erosion, and hypolimnetic dissolved oxygen **Budget: $**150,000

For the 14 sentinel lakes, we will partner with the Science Museum of Minnesota to comprehensively evaluate post-European colonization changes in lake conditions and evaluate major environmental events that coincided with these changes through the use of sediment cores and diatoms.

> **Deliverable (Completion Date)**
> 1. Reconstruct historical water quality and habitat conditions in the deep sentinel lakes (July 2012)
> 2. Report explaining how past landuse and major environmental cycles (wet/dry, warm/cool) of the recent past shaped current water quality and habitat conditions in each sentinel lake (July 2012)

Result 3: Utilize watershed and lake mixing models to forecast future water quality conditions in deep lakes with cold-water fish populations lakes given different climate change and land-use scenarios. **Budget: $**100,000

We propose to work with the USGS and NRRI to build mechanistic watershed and lake models that could be used to forecast changes to water quality and habitat conditions given different climate change and land-use scenarios. Where data are sufficient, models will be used with historic data to "forecast" current conditions. Current data will be used to verify model predictions.

> **Deliverable (Completion Date)**
> 1. Models to form an empirical foundation for the development of watershed best management practices and climate change adaptation policies that will protect the resiliency of deep-water lakes. (July 2012)
> 2. Strategies for building future interactive web-applications of these models for state policy makers, educators, and local land use planners. (July 2012)

Result 4: Identification of a set of habitat and fish indicators sensitive to human-caused disturbances to serve as an early warning sign of lake ecosystem stress. **Budget: $**550,000

In the 14 deep-water sentinel lakes, we will collect information annually on a host of water quality, habitat, and fish indicators. The best indicators will be those that most closely reflect habitat, population, or community "status", fluctuate predictably with other indicators, are responsive to disturbances, yet are stable from year to year in undisturbed conditions. DNR will use these results to prioritize on-going data collection efforts that are part of our lake survey program and put us in a better position to address harmful impacts before damage occurs, or to better adapt to unavoidable consequences of climate change.

> **Deliverable (Completion Date)**
> 1. Use results to inform on-going monitoring programs in sentinel lakes and a broader-range of random lakes (July 2012)
> ~~1.~~2. Baseline maps of critical nearshore, benthic, and aquatic plant habitats (July 2012)
> ~~2.~~3. Hydroacoustic assessments of cisco (a key indicator cold-water fish) size and abundance and tests of whether catches from gillnets are accurate indicators of abundance (July 2012)

III. **PROJECT STRATEGY AND TIMELINE**
   A. Project Partners
   DNR Divisions of Parks, Waters, and Ecological Resources
   MN PCA – Env. Anal. Outcomes Div., Water Monitoring Section (Shannon Lotthammer program manager)
   US Forest Service – Superior National Forest (Ken Gebhardt Fisheries program manager)
   US Geological Survey – Water Science Center (Dr. Richard Kiesling, Limnologist)
   Natural Resource Research Institute (Dr. Lucinda Johnson)
   Science Museum of Minnesota (Dr. Mark Edlund)
   University of Minnesota – Departments of Fisheries, Wildlife and Conservation Biology (Dr. Raymond Newman) and Forest Resources (Dr. Joe Magner)
   B. Project Impact
   See Item D below

   C. Time
   We are requesting $800,000 during the first year to make one-time equipment purchases, hire staff, and initiate contracts and $400,000 during each of the following two years to pay for salaries and contracts.

D. Long-Term Strategy (if applicable)

Work outlined in this proposal will lay the necessary ground work for ongoing monitoring and assessment. Work proposed here represents a significant adaptation of DNR Fisheries lake survey program to better assess lake habitat conditions and factors affecting habitat. We expect that equipment utilized, data collected, and models built for the proposed project will continue to be utilized and built upon long after this project expires. Understanding the myriad of factors driving changes to lake habitats will require a long-term adaptive approach. Support from LCCMR will kick-start this effort and help prioritize future monitoring efforts with operating budgets.

DNR Cooperative Deep Lake's Habitat Project Budget

IV. TOTAL PROJECT REQUEST BUDGET (3 year totals)

BUDGET ITEM *(See list of Eligible & Non-Eligible Costs, p. 17)*	AMOUNT	% FTE
Personnel:		
Project Coordinator - partner coordination, data management (salary, benefits, travel, fleet); Seeking Unclassified appt. for Classified DNR employee (see Mgr Quals. Doc)	$ 240,000	100%
Habitat Research Biologist - shoreline assessment protocol and testing (salary, benefits, travel, fleet); Unclassified	$ 156,000	100%
Habitat Specialist - hydroacoustic mapping of fish and habitats (Salary, benefits, travel, fleet); Unclassified	$ 140,400	100%
Zooplankton student worker - sample processing (salary); Unclassified	$ 60,000	50%
Invertebrate biologist - zooplankton indicator analysis and reporting (Salary, benefits); Game and Fish funds currently subsidizing Classified DNR biologist's preliminary work at the 20% FTE level	$ 21,000	20%
Interns (8 positions) - PCA and DNR data collection efforts (salary, travel, fleet); Unclassified	$ 168,000	25%
USGS Hydrology Technician (salary, benefits, travel - 74 site visits); Classified employees but salary is paid with soft money	$ 100,954	60%
USGS Hydrologist - Watershed & Lake modeling and reporting (Salary, benefits, travel); Classified employee but salary is paid with soft money	$ 47,845	40%
Contracts: *With whom and for what? List out by item.*	$ -	
Dr. Mark Edlund - Science Museum of Minnesota - Sediment Core analyses	$ 150,000	
Dr. Tom Hrabik - U of MN-Duluth - Cisco assessment consulting	$ 20,000	
Department of Health - Water Quality lab analysis	$ 176,835	
Equipment/Tools: *What? List general description of needs.*	$ -	
3 continuous meteorological and water quality data collection platforms in operation for 3 yrs (manufactered and maintained by USGS)	$ 173,000	
12 Seasonal tributary gages (water level loggers) in operation for 3 yrs (manufactered and maintained by USGS)	$ 23,200	
BioSonics echosounder and software-substrate, vegetation, and fish mapping	$ 80,000	
Nets, electrofishing, WQ probes, and other miscellaneous survey equipment	$ 23,666	
Zooplankton counting hardware and software	$ 19,100	
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ 1,600,000	

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Superior National Forest (Staff time, fleet, travel)	$ 22,600	*Secured*
USGS Cooperative Funds (Staff time, fleet, travel)	$ 100,000	*Secured*
USGS Cooperative Funds (Staff time, fleet, travel)	$ 47,845	*Pending*
	$ 170,445	
Other State $ Being Spent During Project Period:	$ -	
PCA (Staff time, fleet) - Clean Water Legacy	$ 101,216	*Secured*
DNR Fish and Wildlife (Staff time, fleet) Game and Fish Fund	$ 180,530	*Secured*
DNR Ecological Resources (Staff time, fleet) - Clean Water Legacy	$ 162,230	*Secured*
Past Spending:		
DNR Fish and Wildlife (Staff time, fleet,) Game and Fish Fund	$ 175,270	
PCA (Staff time, fleet, lab costs) - Clean Water Legacy	$ 72,658	
DNR Ecological Resources (Staff time, fleet) - Clean Water Legacy	$ 52,500	
Superior National Forest (Staff time, fleet, travel)	$ 7,530	
Total in-kind spending	**$ 874,534**	*Secured*
Total in-kind spending	**$ 47,845**	*Pending*

Organization Description
The mission of the Minnesota Dept. of Natural Resource's Division of Fish and Wildlife is to conserve and manage Minnesota's aquatic resources and associated fish communities for their intrinsic values and long-term ecological, economic, and recreational benefits to the people of Minnesota.

Project Manager – Dr. Donald Pereira
I am the Fisheries Research and Policy Manager for the DNR. I obtained my B.S. in Biology from the University of Vermont, and graduate degrees (M.S. and Ph. D.) in Fisheries from the University of Minnesota. In my 28 years of experience in fisheries and aquatic sciences, I have co-authored 21 peer-reviewed articles related to fish behavior, recruitment, community ecology, and habitat interactions. I spent 17 years as a DNR Research Biologist and 7 years as a Research Supervisor. I also currently maintain an adjunct faculty appointment at the University of Minnesota's Department of Fisheries, Wildlife, and Conservation Biology where I have advised five M.S. students and served on the graduate committees of ten students. In April 2007, I was hired as the Fisheries Research and Policy Manager and currently oversee a research unit of 24 biologists and 2 Research Supervisors with extensive fisheries and aquatic research and management experience. Many of these biologists have been involved in the proposed project and along with our partners, will be involved with data collection, analysis, and dissemination of results through in-kind efforts.

In particular, Ray Valley, a Senior Research Biologist in the Fisheries Research Unit has been diligently working since October 2006 to shape the design of the Sustaining Lakes in a Changing Environment (SLICE) program and lining up partnerships. SLICE represents the backbone for the proposed project. I am endorsing Mr. Valley as the project coordinator who will report to me, but will be primarily responsible for day-to-day coordination of partnerships and work. Thus far, Mr. Valley has brought many partners to the table, including PCA (our primary partner on the overall SLICE program), USGS, NRRI, US Forest Service, and many local partners with mutually shared objectives for clean water and healthy lake habitats and fish populations. This has included Mr. Valley organizing several prior meetings with partners to discuss the direction of SLICE and various partner roles. In-kind efforts by partners will bring a substantial match to LCCMR's contribution to this project. Pending approval of the proposal, Mr. Valley will continue to work internally and externally with other project managers to coordinate and complement this work with previously funded LCCMR projects (e.g., NRRI's Climate Change Indicators project, DNR Ecological Resource's Intra-lake zoning project). Up to now, Mr. Valley's work has largely been voluntary and has far exceeded what has been outlined in his position description. This important coordination work cannot be guaranteed in the future without the proposed coordinator position since declining payrolls in the Division have increased workloads for fisheries staff and could potentially redirect scarce staff resources towards other priority projects. The Division intends to backfill Mr. Valley's position during the proposed 3-yr temporary appointment.

Mr. Valley graduated with a B.S. in Fisheries and Wildlife with high distinction from the University of Minnesota and obtained his M.S. in Fisheries from Michigan State University with specialization in Ecology, Evolution, and Behavioral Biology. Mr. Valley has 11 years of research experience and has authored 8 peer-reviewed articles related to aquatic plant and fish ecology. Mr. Valley has served on several internal and external committees related to advising directions in aquatic plant management, Clean Water Legacy, National Fish Habitat Initiative, and climate change adaptation. Mr. Valley recently completed a 2-yr leadership training course sponsored by University of Minnesota College of Continuing Education. As a result of Mr. Valley's previous training and experience, I believe he is well suited to formally serve as coordinator for this project.
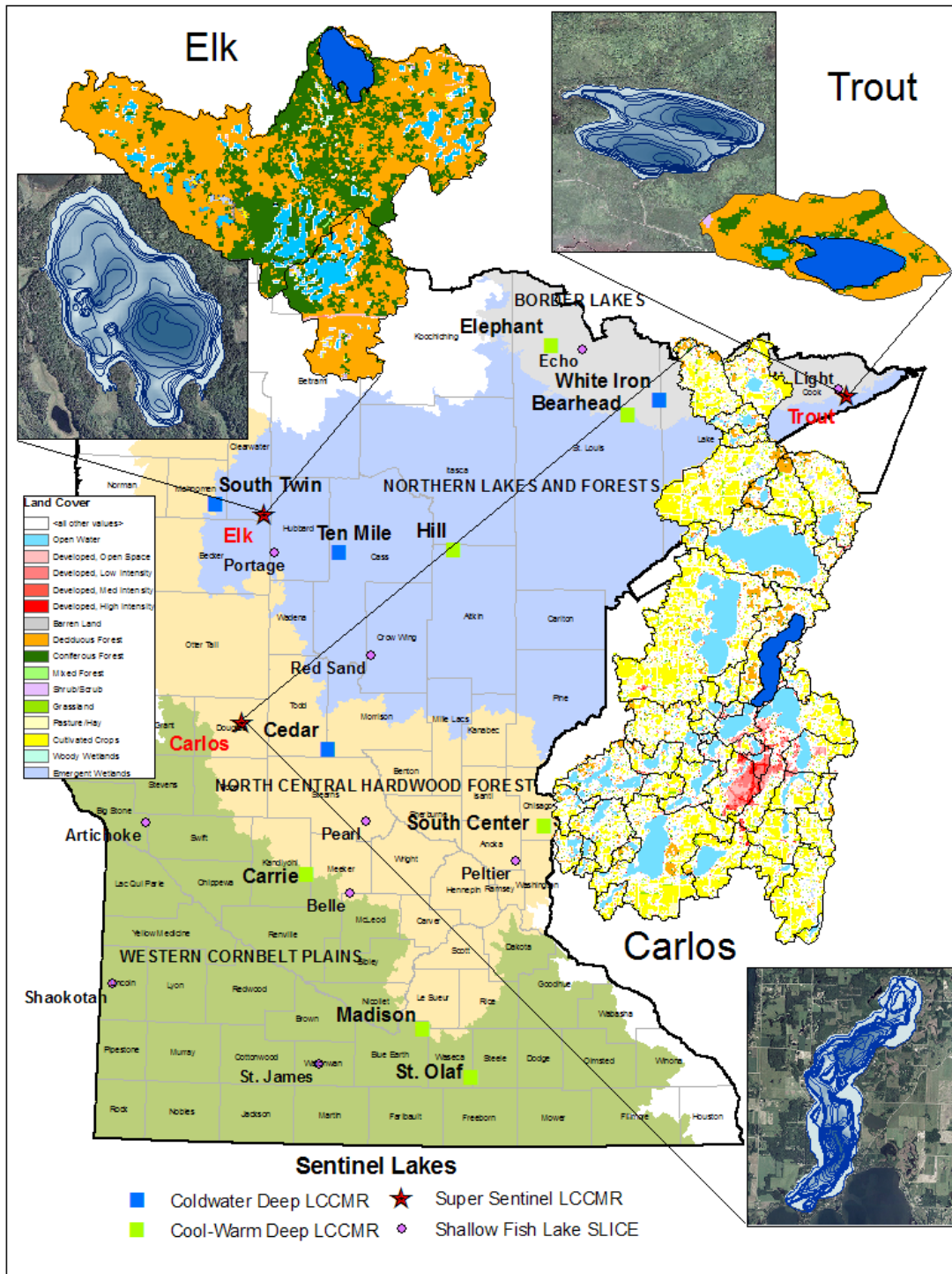
Figure 1. Lakes part of the cooperative Sustaining Lakes in a Changing Environment (SLICE) program. Sentinel lakes that are cool to warm water deep lakes and coldwater deep lakes are the focus of this proposal. The three super-sentinel candidate lakes will be sites of sophisticated meterological and water quality sensor buoys that will facilitate mechanistic watershed and lake modeling. The watersheds and land use of the super sentinel lakes and their basin morphometry are shown in greater detail.