MINUTES OF 43rd MEETING
COUNCIL OF GREAT LAKES RESEARCH MANAGERS

University of Windsor

Windsor, Ontario
March 22, 2006

Canadian Members Present

Harvey Shear (Canadian Co-chair)	University of Toronto at Mississauga, ON
William Meades	Forest Ecology, Natural Resources Canada, Canadian Forest Service, Sault Ste. Marie, ON
Jan Ciborowski	University of Windsor, GLIER, Lake Erie Millennium Network
Saad Jasim	Walkerton Clean Water Centre, Walkerton, ON

U.S. Members Present

Stephen Brandt (U.S. Co-chair)	Great Lakes Environmental Research Lab, NOAA, Ann Arbor, MI
Russell Kreis (Alternate for Janet Keough)	U.S. Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory Mid-Continent Ecology Division - Duluth Large Lakes and Rivers Forecasting Research Branch Large Lakes Research Station
Joseph DePinto	Limno-Tech, Inc., Ann Arbor, Michigan
Leon Carl	USGS Great Lakes Science Center, Ann Arbor, MI
Jeff Reutter	Ohio Sea Grant College Program; Ohio State University, Research Center, Columbus, OH
James Nicholas	USGS Water Resources Division, (Via Teleconference)

Other Invited Attendees

Vi Richardson	Environment Canada
Stuart Ludsin	National Oceanic and Atmospheric Administration Great Lakes Environmental Research Lab, Ann Arbor, Michigan
Thomas Switzer	University of Windsor, Information Technology Assistant
Lindsay Davidson	University of Windsor (recorder)

Secretary

Mr. Mark Burrows	IJC Great Lakes Regional Office, Windsor, ON.

IJC Representatives

Dr. Karen Vigmostad	Director, IJC Great Lakes Regional Office, Windsor, ON.
Mr. John Nevin	IJC, Washington, DC Section Office Liaison

Note: This meeting was originally scheduled for March 2, 2006 at the University of Windsor, but was postponed until March 22 due to weather. Council members Dan Bondy, Dale Henry, Janet Keough, Steve Colman, Jan Ciborowski, Jeff Reutter and Russell Kreis met informally on March 2 and provided input regarding prospective research coordination workshops and the research strategy. Notes from that meeting were sent to Council members separately in advance of the March 22 meeting.

Introductions & Approval of Agenda

The Council members introduced themselves. Russ Kreis attended the meeting in place of Janet Keough (USEPA). Jim Nicholas, Vi Richardson, Steve Brandt and John Nevin participated via teleconference. A short discussion of the status of the Great Lakes Water Quality review was added to the agenda.

Members indicated that access to the meeting documents via the Research Coordination Project website at: www.CanAmGLASS.org/rcs was adequate.

The Minutes from the last official CGLRM meeting held October 4-5, 2005 in Chicago were approved.

The group discussed the status of the Great Lakes water quality review from the IJC perspective and the Governments.

The IJC held a series of public hearings, and have drafted a report on comments received from 4000 people (including input from an internet consultation). Three IJC staff compiled the report for the commission. (Note: the IJC report: “Synthesis of Public Comment on the Forthcoming Review by the Federal Governments of Canada and the United States of The Great Lakes Water Quality Agreement A Report to the Governments of the United States and Canada January 2006” was officially released April 20, 2006, and is now available on the web at:

http://www.ijc.org/en/activities/consultations/glwqa/synth.php

On March 16th, proceedings of the review started and information is available on line at: www.epa.gov/glnpo and http://binational.net/glwqa_2006_e.html.

A call for participants to serve on review committees was been issued and volunteers were to apply by March 31, 2006. It is expected that the process could take from one to two years to complete. The group discussed the process of the review and whether it should start with a review of purpose, vision and general approach or start right into review of individual annexes. There was agreement that a general approach might be good to talk about first, followed by an annex by annex review. It was noted that in 1987 changes were made by protocol and the basic frame of the agreement is 30 years

old. In 1999 review and comments on individual annexes were provided by agency reviewers and that material is available for review this time around. The IJC is doing a separate report on the Commission's advice regarding the review of the agreement which is expected to be done by September.

The CGLRM secretary reported that the process for IJC reporting on the Council and Board's advice to the IJC has been changed for the 2005-2006 Biennial Report. The practice in the past was to report on the advice published by the Water Quality Board, Science Advisory Board, International Air Quality Advisory Board, and the Council of Great Lakes Research Managers in the 2003-2005 Priorities Report. However, in the upcoming IJC Biennial Report the focus will be government accountability and the Board/Council advice will be reported on in two other separate IJC reports: one on advice on the review of the agreement and another on urbanization. The Council co-chair requested a copy of the IJC letter regarding the change and it is attached as enclosure (2) to these minutes.

The group reviewed the status of membership and groups that should be represented on the CGLRM. Further changes to the CGLRM are pending the reorganization of Environment Canada. Dr. Shear's term as Canadian Co-chair was extended by the commissioners for a year until an Environment Canada representative is identified. After that, he will be able to continue with the Council as a representative of the University of Toronto. Dr. Patricia Chow-Fraser extended her services until the end of February 2006 as a representative of IAGLER. Dr. Joe DePinto will serve as an interim representative of IAGLR until a new executive director of IAGLR is hired and elects to serve as a representative. It was suggested that a representative of the Great Lakes Maritime Research Institute be considered for membership. Members requested that additional information be e-mailed to them about the Institute prior to making a decision.

Those present discussed other state, provincial and federal agencies that should be represented on the CGLRM and agreed that a representative of DFO should be identified to serve on the Council. It was suggested that the US Dept of Agriculture and, on the Canadian side, Provincial Agriculture be considered for representation. It was also noted that two areas of research are growing: Pathogens and Wetlands and that the Council should have members familiar with research aspects of these topics. A co-op student has been hired by the CGLRM to examine the Research Inventory and report on the status of the research as well as institutions conducting the research.

The CGLRM budget was reviewed. Approximately $45,000 dollars (Can) was spent by the Council during the Canadian fiscal year ending March 31, 2006. The expenditure for a white paper report regarding potential enhancements to a Great Lakes Observing System was postponed pending the completion of user needs studies being conducted for the NOAA Coastal Services Center and the Great Lakes Commission. A budget increase from the IJC requested in 2005 was approved and the CGLRM was allocated $30,000/yr to sponsor research coordination workshops.

A proposed contract with USGS for a white paper to review the government's response to IJC and CGLRM recommendations regarding research on ground water was discussed. Jim Nicholas (USGS, Lansing) will be helping to put together the proposed contract, which the IJC has budgeted $5000 for the Council's contribution to this multi-

board activity. Those present discussed the implications of contracting work from USGS and the need for a Canadian co-author. It was agreed that the Council secretary would provide more information to address these concerns prior to proceeding with the initiative. A copy of the draft statement of work was sent to CGLRM members, posted on the web and is attached as enclosure (3).

Research Inventory (http://ri.ijc.org)

A cooperative agreement has been implemented with the Great Lakes Monitoring Inventory operated by the Binational Executive Committee (BEC) on www.binational.net.

- Process changed to direct users to the most appropriate database
- Information sharing agreement; annual exchange of data of mutual interest
- Contacts: Brad Hill and Andrew Wightman (EC); Mark Burrows and Tom Switzer (IJC)

A project to with Hugh MacIsaac (University of Windsor) to determine the temporal patterns of funding for work on aquatic invasive species in the Great Lakes basin using data entered in the Research Inventory is underway. Data has been collected; however analysis and reporting remains to be done. A new co-op research assistant has been hired for summer 2006 to help with the analysis and report.

The NISbase-Projects contract with the Smithsonian Environmental Research Center (SERC) is underway.

- Adds a research project portal to the existing NISbase web site at www.NISbase.org
- Cost: $14,443 (U.S.), Contacts: Greg Ruiz (SERC), Brian Steves (SI)
- Deadline March 31, 2006

Co-Op students hired for summer 2006 term with the CGLRM:

- Research Assistant – project: Research Inventory analysis – Clayton Sereres, Honours Water Resource Science, Lakehead University
- Information Technology Assistant – project: Web Site Maintenance and Improvement and IM office support – Victor Parmar, Computer Science, University of Windsor

Science Vessel Coordination (www.CanAmGLASS.org)

On January 25-27, 2006 the 10th Annual Science Vessel Coordination Workshop was held in conjunction with the Great Lakes Captains Association's Industry Days in Traverse City, Michigan. There were approximately 150 attendees, with training at the Great Lakes Maritime Academy provided for approximately 100.

2007 Science Vessel Coordination Workshop scheduled for January 23-26, 2007; sub-committee meeting set for March 23, 2006 for 2007 conference. Steering committee will discuss steps to improve Canadian participation & potential Canadian events to compliment the Traverse City workshop.

Smaller size vessels such as the U.S. Fish and Wildlife Service Fishery Resources Office boats, and NOAA's Huron Explorer are being added to the science vessel inventory database. These vessels are being added to the database in order to present a wider range of options for research support to scientists and educators. There are currently 89 vessels listed in the database.

A science session was approved for May 25, 2006 at the International Association for Great Lakes Research (IAGLR) conference. It will be held from 8:00 am to 9:40 am. Title: Advances in Shipboard Research and Science Vessel Coordination. There will be 5 oral presentations in session 15, 1 oral presentation in session 30 and one poster presentation related to this topic. In addition, the Great Lakes Association of Science Ships (GLASS) display will be set up. Further information on the program is available at: http://www.IAGLR.org/conference/2006/program.php

The Great Lakes Observing System (http://www.GLOS.us)

Council members serving on GLOS steering committee are: Stephen Brandt, Harvey Shear, Leon Carl, Steve Colman, Joseph DePinto, Paul Horvatin, Jeffrey Reutter and Mark Burrows.

The GLOS steering committee is currently standing up the Regional Association (RA) board of directors – Harvey Shear is on the proposed slate along with 10 others. Slate: Alfred Beeton, Jeffrey Boehm, Mark Grazioli, Philip Keillor, Gail Krantzberg, Frank Kudrna, Dale Phenicie, Harvey Shear, Richard Stewart, Nelson Thomas and William Werick. The next meeting of the GLOS steering committee is scheduled for April 13, 2006 at 10 a.m., where the number of those on the slate for board of directors will be agreed on.

There was some debate during the last Great Lakes Observing System (GLOS) telephone conference about whether representation from outside the Great Lakes basin was needed on the GLOS board of directors. The background and qualifications of those on the slate were briefly discussed and Council members were urged to closely monitor progress on GLOS and to participate in the voting.

A technical workshop held in Port Huron regarding the hydraulic modeling of the Lake Huron to Erie Corridor was discussed. Jim Nicholas and Mark Burrows attended the "Technical workshop on Integrating Modeling, Monitoring and Observing Systems for the Huron to Erie Corridor" on March 16-17, 2006. During that workshop it was readily apparent that modelers are looking for support from the IJC's Upper Lakes Study in addition to funds secured for source water protection monitoring equipment at drinking water plants (Representative Candice Miller) to pursue this initiative. There is a potential role for the Council and IJC to promote binational collaboration in this effort. Eric Barnowski, DPW Assistant Superintendent, requested list of contacts for Canadian water plants on the Huron-Erie Corridor. Saad Jasim, CEO of the Walkerton Clean Water Centre, has agreed to contact Mr. Barnowski on behalf of the Council.

Council members requested further information regarding the framework for the proposed hydraulic monitoring and the approach that would be taken. The workshop proceedings report will be circulated to the Council for review as soon as it is released.

The group briefly discussed the prospect of a research coordination workshop for the 2007 field year in Lake Huron. Dr. Leon Carl indicated that the USGS fisheries lab is interested in partnering with EPA, EC and other agencies involved in the intensive study of Lake Huron to be undertaken in 2007. All agreed to discuss the potential for CGLRM sponsored workshops prior to the 2007 season later in the agenda following Vi Richardson's presentation.

Discussion of Sea Grant GLRRIN Proposal

Dr. Jeff Reutter provided a summary of a recent research proposal to Sea Grant to establish a research network patterned after the successful Lake Erie Millennium Network (LEMN). In 1998 LEMN was established with 4 conveners to try to do a better job of identifying research priorities on Lake Erie. Representatives of one Federal agency from each side of the border and two universities serve on the steering committee. The LEMN effort has been successful in part because people understand and facilitate government agency processes. In the last IJC biennial report, the IJC recognized this success and suggested that other research networks be developed throughout the Great Lakes region.

Dr. Reutter outlined the process he undertook to develop a broad Sea Grant proposal by holding a series of teleconferences with representatives of agencies and universities. The request is $25k/lake/year for year's one and two to get the process set up followed by $50K /year for year's three to five to further refine and implement the plan. Although this is not viewed as a great deal of funding, it is a good start that could prompt further financial support from other sources.

The proposal intends to maximize the use of existing organizations (i.e. LaMPs/Lake Committees) to form a Great Lakes Regional Research and Information Network (GLRRIN) to facilitate communication/coordination across the region. The entire network is intended to be voluntary.

The Great Lakes Commission has agreed to fund one or two of the initial meetings of the regional network. The CGLRM secretary has agreed to provide staff support and Dr. Shear has agreed to represent the Council as a partner in the proposal.

There are 11 proposals competing for the NOAA funding. The NOAA plan appears to be to fund 6 proposals the first year and then 5 the following year. The Great Lakes proposal appears to be extremely competitive. There are 22 resumes attached to the Great Lakes proposal.

The group discussed ways to address organizational overlaps and how the network could be used to maximize information transfer and service to the Lakewide Management Planning groups and other organizations. It was noted that outreach committees always try to enhance the value/impact of the information; this network could be a mechanism to do that and support the Council's research coordination strategy.

The need for formal reporting mechanisms to ensure that important research issues are documented and transmitted through to the council was also noted.

A similar initiative on the Canadian side by NSERC to develop a Great Lakes Research Network was discussed. A workshop scheduled for April 19th at York University in Toronto was discussed. Dr. Shear and other representatives of the CGLRM intend to participate in the workshop and establish ties with the NSERC Strategic Network Grant (SNG) proposal. The SNG proposal will be seeking funding of up to 2.5M dollars over 5 years. More information regarding the results of the York University meeting and the NSERC proposal will be forwarded to the CGLRM as it becomes available. More information can be found on the web at:

http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=b2.

Discussion of Lake Erie Research Collaboration Survey results

The results of a survey conducted by the CGLRM of participants and managers involved in three large Great Lakes projects were presented. These projects were: the International Field Year on Lake Erie (IFYLE), Lake Erie Trophic Status (LETS) and the Erie Comprehensive Cooperative Study (ECCS).

83 people were contacted; 24 participants and 6 project managers responded and submitted survey forms.

Participant's response:

- Overall - positive response
- Ecosystem Approach & program leader communications received high marks

Areas for improvement

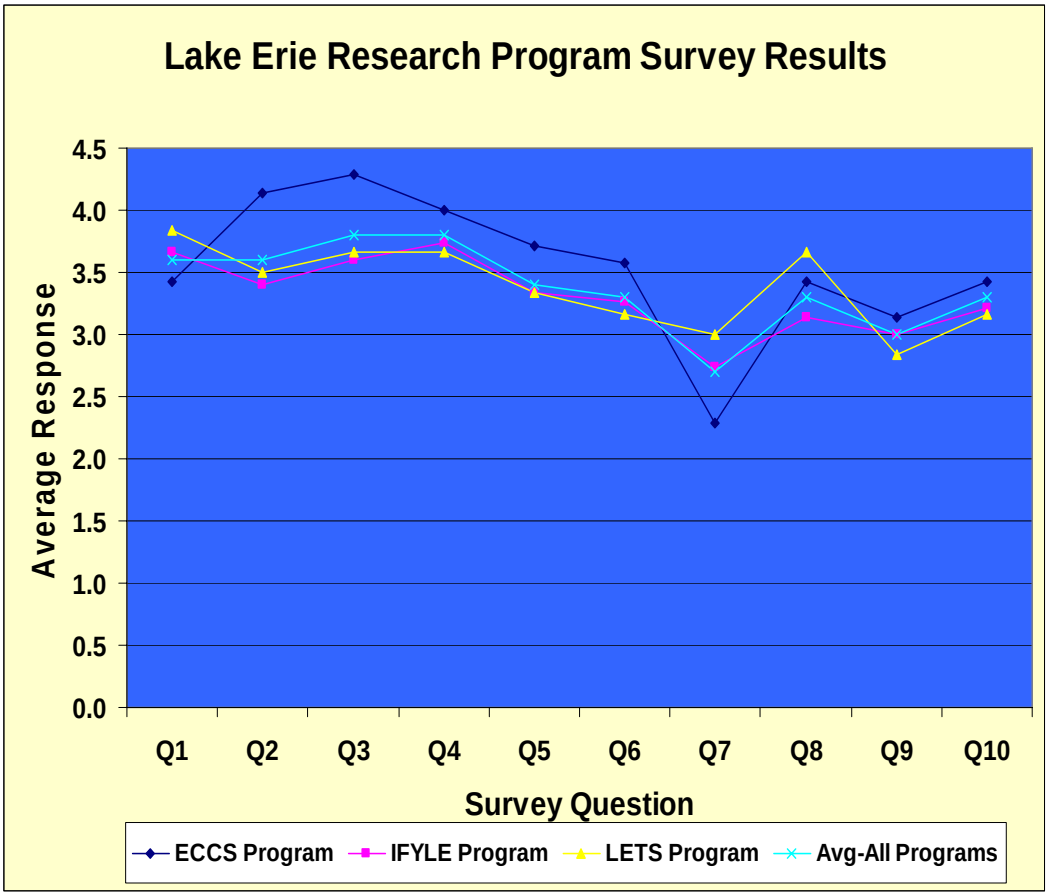
- Communications – between participants
- Providing a plan with sufficient time and resources

Survey Questions ***(Responses were: Strongly Disagree (1) → to Strongly Agree (5))***

Q1	The research program design/development considered a holistic, ecosystem approach.
Q2	The specific management and research focus of the program was well articulated in the RFP and in pre-project meetings with the participants.
Q3	The pre-project planning and coordination was sufficient to give you a good idea of how your research fit into the whole study.
Q4	There was good communication between the program leader/s and the research team during the study.
Q5	There was good communication and information sharing among the research participants during the study.
Q6	There were sufficient resources available for field and laboratory facilities (e.g., ship time and facilities) to accomplish the objectives of this program.
Q7	There were research components missing from this program that made it difficult to address the program objectives in a comprehensive manner.

Q8	The data management plan and implementation (including data delivery requirements) for this program was adequate and well-articulated.
Q9	There was a good plan and sufficient time and resources built into the program for interpretation and synthesis/modeling to ensure that the overall program questions were addressed.
Q10	There was a good plan for communication of the results to managers, the research community, and the general public at the appropriate level for each.

Results of the participant's survey are summarized in the following chart:



Note: Question 7 was worded incorrectly and a low score on that particular question is a better score. The blue line shows the average for all the programs.

The one question where scores consistently indicated room for improvement was question number 9: Was there sufficient time and resources built into the program? People felt that the project was carried off very well but they lacked time. In many cases, samples have not been completely processed long after the field work has been done. Most agreed that is a very common problem, saying there just never is sufficient time to really understand and synthesis all the data. The focus of the project is generally getting the data. Integrating the follow-up work into a project plan along with data collection and analysis is important. Databases are a thankless job, and it is a common problem to run out of time and resources for this work at the end of a project.

Other comments/observations made during the discussion included:

There was a considerable difference between the number of investigators involved and the funding that came from different agencies.

The Green Bay and mass balance studies benefited from an upfront planning effort, lessons learned from history and previous data collection.

The solution is to have research proposals ready to go “on the shelf” when funding opportunities arise.

Appropriate upfront planning is essential.

Processing and integrating data from tributaries, air, water and sediment is time-consuming and difficult. Managers must know that some tasks, such as analyzing samples for toxic chemicals, will take a great deal of time and factor a realistic time frame into the plan.

Discussion of Project Manager Survey

The group reviewed the survey questions and responses – comments follow and a detailed report of the responses is included as enclosure (4).

Question 1: Comment on the process form specifying the overall focus and or hypothesis of the project.

Nearly all of the responses were Yes. Some comments: Yes it was looked at using a holistic perspective. I didn't really see much disagreement.

Question 2: Comment on the selection of participants for the project. Some common threads were the need for more lead time to gather higher quality proposals, that it was useful to have mailing lists and helpful to regularly get together and allow for a more organized planning process.

It was also pointed out that Canadian side doesn’t have an RFP process like the U.S.

Question 3: Comment on the process for coordination, the work plan, personnel and if there was adequate peer review.

Generally we received consistent answers. There was a type of QA/QC and it would have been great to have external review. That was impossible. Holding regular PI meetings was a good idea. Projects need more staff assigned to help project leaders. Advanced planning would eliminate disruptions in the ship schedule. Provide adequate lead time and predictable funding. It is really important that programs have the resources necessary to have a QA/QC program and a peer review - preferably an ongoing peer review. Everyone must recognize that both of these aspects cost extra money. The group discussed examples where studies would have benefited from a well organized peer review. A strong QA/QC program should be specified in the request for proposals and funding allocated for it. The limiting factor is always funding.

Question 4 - Comment on the process for synthesis interpretation and presentation/publication of the project research results. Comments seemed to indicate that data sharing was a common pitfall. Council members agreed that a cooperative agreement specifying that after a set time period the data becomes public is a good way

to manage the problem. This is especially desirable for university researchers. Vi Richardson offered to send a copy of a model data sharing agreement to members who wanted one.

In the case of the U.S. EPA, any data that is collected is public because it is paid for by taxpayers. This is an area where conflict with researchers occurs and contracts are helpful. It is also important to address ownership of the modeling code. It was recommended that after a couple years modeling code become public. This allows the Principle Investigator some time to get the information processed and then after a matter of time it becomes public. A modeler should make a distinction between making the model available to other researcher and to the public. Participants should feel comfortable to share the model within the organization for peer review.

Question 5 - Comment on the process of interaction with the public. Generally all the comments were similar and strongly supported public education and interaction.

International; Field Year of Lake Erie (IFYLE) Presentation

Stuart Ludsin, National Oceanic and Atmospheric Administration, Great Lakes Environmental Research Lab, Ann Arbor, Michigan provided an overview of the IFYLE project. A copy of the complete presentation is attached as enclosure (5).

IFYLE Program

Statistics

- Approximately $5M Direct Costs
- 5 Research Vessels
- 13 Moorings (NOAA and Environment Canada)
- 45 Scientific Investigators
- 18 Universities & Private Institutions
- 33 Investigators (7 US states, Canada, Sweden, Italy)
- 10 federal, state, & provincial agencies
- NOAA, EPA-GLNPO, USGS, Army Corps, Environ. Canada
- 5 Lake Erie fishery management agencies
- 130 ship days
- 2,100 Person-Days at Sea

Objectives

- The overarching goal is to provide Lake Erie agencies with ecological understanding & forecasting tools. This will allow for development of integrative ecosystem-based approaches to resource management.
- Develop tools to forecast the timing, extent and magnitude of hypoxia in central Lake Erie

- Quantify the ecological impacts (e.g., fish production) of hypoxia and develop tools to forecast them
- Explore the causes of Harmful Algal Blooms (HAB) formation in Lake Erie and provide the understanding and necessary tools to forecast HAB formation

Timeline

February 2005:	Develop collaborations, find funding
March 2005:	Identify university partners
April 2005:	All Principal Investigators meet to finalize 2005 plans
May – October 2005:	Field season
1-2 March 2006:	All Principal Investigators meet to plan for 2006
Rest of 2006:	Process/analyze data; refine hypotheses
Spring-Fall 2007:	More focused field season
2008:	Process/analyze data; synthesize findings

Positive Aspects

- Agency support has been outstanding
- Lots of in-kind and monetary support for research
- RFP was a success (14 of 41 proposals funded)
- Lots of good science proposed
- External PIs have been great
- Willingness to do “applied” work, share data, collaborate
- Cruises happened as planned → safe, productive
- Lots of good data collected
- Optimistic that we will be able to do “meaningful” science

Areas for Improvement

- Long delay in getting out RFP → held up by National Sea Grant; now addressed by new granting mechanism will help
- Some problems with last minute changes in ship availability
- Some data gaps, stress for project manager and chief scientists
- Set shipboard schedule once and stick by it
- Difficult finding proposal reviewers due to short turn-around
- Coordination with Environment Canada and U.S. Environmental Protection Agency coordinated monitoring schedule.

- Providing money to PIs was an onerous, slow process – led to new granting mechanism
- Uncertainty about future…money & ship time - Makes future planning difficult & last-minute
- Not enough time:
  - ✓ to flesh out research program before & after PIs on board
  - ✓ to do peer-review on research/cruise plans
  - ✓ to develop modeling/synthetic goals *a priori*
  - ✓ to get full "buy in" by researchers/agencies
  - ✓ to build database so data disseminated in timely manner

Recommendations

- A list of potential reviewers & disciplines would be useful
- Formal granting mechanism now in place at NOAA GLERL provides a big improvement
- Seek multi-year commitments for money/ship time
- Planning, planning, planning – be prepared in the event $$ appears

Discussion

The International Field Year of Lake Erie proposal was broad and brought in many agencies. The whole background to this project was to set the stage for future. The Lake Erie science planning workshop was pivotal for IFYLE. It was a departure from previous Lake Erie programs, in terms of money/scale – an effort to bring in a big research platform so a lot of researchers could work at the same time. The focus isn't so much on the physics but also on the biology; - biophysical coupling.

Large scale proposal was written earlier, but was not funded – the proposal was later revisited and funded with a fairly short lead time. There were previous conversations with other agency representatives leading to a $450 000 contribution from EPA, received a lot of money from NOAA, and National Sea Grant kicked over a quarter million dollars. Environment Canada provided access on the water; there were about three meetings with the Lake Erie fisheries agencies.

All together we estimate about 5 million was contributed to the project in direct costs.

What sets IFYLE apart was the biology behind it… Does hypoxia affect food levels? Another unique aspect was the focus on algal blooms. In the future there will be more focus on the hypothesis. In terms of a timeline the project started in Dec 22, and by the beginning of February tried to get funding. Organizers held only one meeting to coordinate field operations, so there wasn't much time to talk about science.

Projects require both ship time and the dollars to support researchers. EPA has been wonderful in providing ships, external Principal Investigators have been great and there was a willingness to do "applied" work, share data and collaborate.

The group discussed the prospect of concentrating work on Lake Erie and carrying out multi-year studies at the expense of visiting multiple lakes. Most agreed that room must be made to conduct operations in more than one lake at a time. Funds may be justified by a particularly hot issue in a certain region and multi-year studies make good scientific sense, however long delays between lake visits is not acceptable. When there is a centralized focus, it doesn't mean that there is an exclusion of the other lakes or an "all or nothing" approach. IFYLE efforts will continue along with the cooperative monitoring program, which continues in Lake Huron in 2007 and Lake Ontario in 2008.

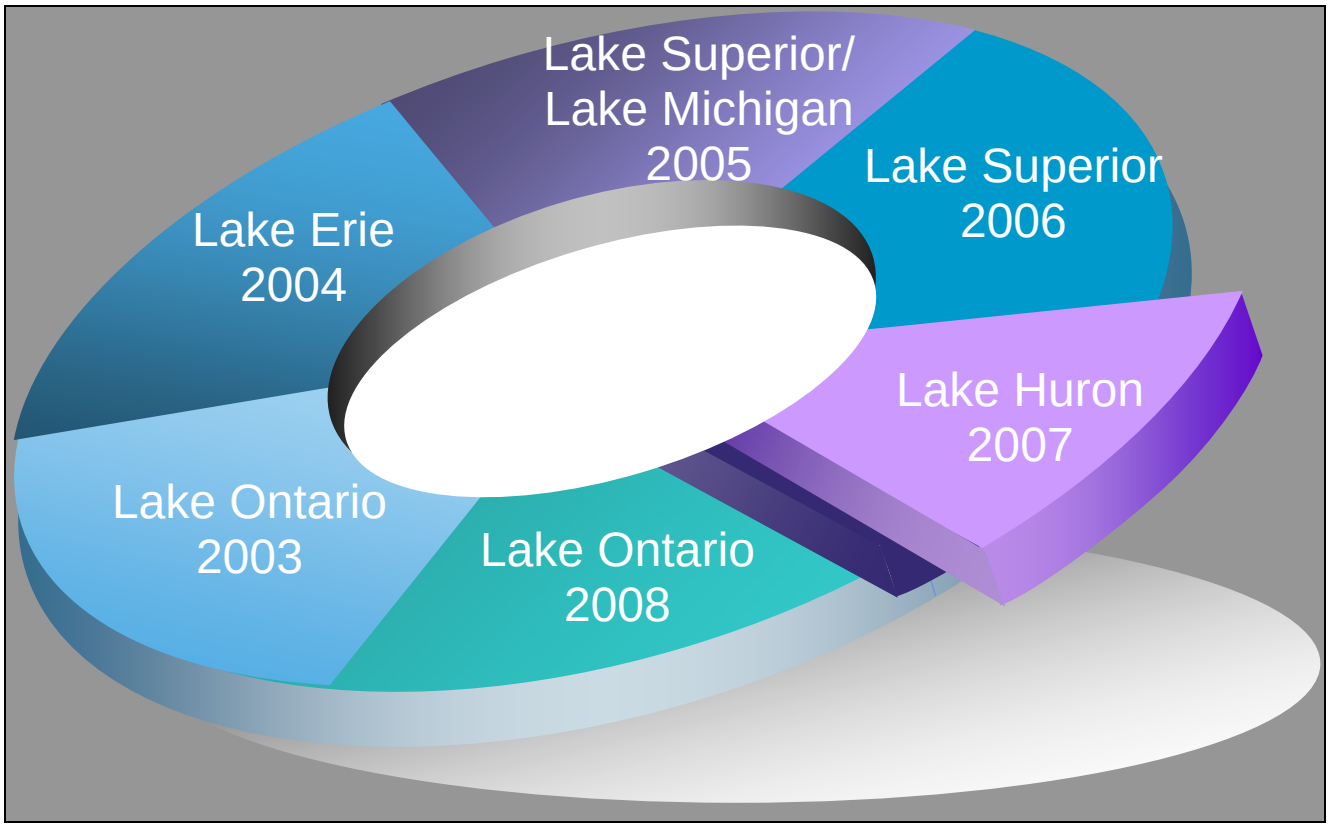
IFYLE was congratulated for not going back into the field in 2006 and ensuring that they had a chance to plan. IFYLE researchers and managers will be spending the next 6 to 8 months doing the analysis, developing a full conceptual model, firming up the hypothesis and creating a better plan in preparation for the 2007 work.

Cooperative Monitoring in the Great Lakes Presentation

Vi Richardson, Environment Canada, provided an overview of the cooperative monitoring initiative. This is a bi-national initiative on the part of Environment Canada and the U.S. Environmental Protection Agency to better coordinate monitoring on the Great Lakes. It is an initiative driven by the Bi-national Executive Committee (BEC) where coordinated monitoring is led by both agencies, one lake per year, based on a rotational cycle. The initiative started in 2003 with Lake Ontario.

Vi provided a brief overview of operations, an idea of past efforts and lessons learned. A copy of the complete presentation is attached as enclosure (6).

<u>The Cooperative Monitoring Cycle</u>



The 2003 work in Lake Ontario focused on three areas:

- Lake Ontario Lower Foodweb Assessment - Understanding Changes in a Post Zebra Mussel Foodweb – This involved multiple cruises to assess the status of the lower food web.
- Lake Ontario Atmospheric Deposition Study involving air and land sampling to improve atmospheric loading estimates.
- Interagency comparison study for trace organics in water to determine any differences in results among agencies and to identify the reasons why.

The 2004 work in Lake Erie focused on the following three areas:

- Distribution and abundance of mussels, where more than 280 stations were sampled with various vessels and divers.
- Interbasin transport and lake physics, where moorings were deployed. This part was continues in 2005 as part of NOAA's IFYLE program.
- Nutrient cycling post mussel invasion, where multiple lakewide surveys were conducted sampling for nutrients.

The study of nutrient loadings from tributaries will be continued in 2007.

Other efforts conducted in Lake Erie included:

- Determination of total organic carbon, nutrients and stable isotopes in Western basin – University of Windsor
- Periphyton and pipelic pigment concentrations – University of Pennsylvania
- OC compounds in sediment – University of Windsor
- Sediment cores for assessing role of microbial biotransformation in trace metal bioavailability – University of Windsor
- Trace metals in sediment – University of Windsor
- Sediment cores taken for analysis of OC compounds that bioaccumulate in food web- University of Windsor
- Surficial sediment for analysis of organic compounds – Environment Canada

In Lake Superior in 2005 the work included studies of:

Chemical Concentrations in the Basin

- Air – on land and ship based sampling
- Water
- Precipitation
- Bottom Sediment
- Fish
- Lower Food Web including bacteria
- Lake Siskiwit, Isle Royale: Water, Sediment, Zooplankton, Fish
- Tributary Screening Survey of 55 Canadian tributaries and 51 US tributaries

Lower Food Web Status

- Open Lake Sampling: 11 stations were sampled for lower food web in the open lake during three cruises. The Spring, summer and fall open lake work has been completed. USEPA-GLNPO sampled additional 20 sites during the fall only for benthos, zooplankton, mysids and nutrients
- Nearshore sampling at 4 sites: Three seasons (impacted vs. unimpacted) - spring, summer and fall surveys completed.
- Nearshore sampling: Transects from nearshore to offshore open lake sites and hydroacoustic surveys conducted during the summer cruise.

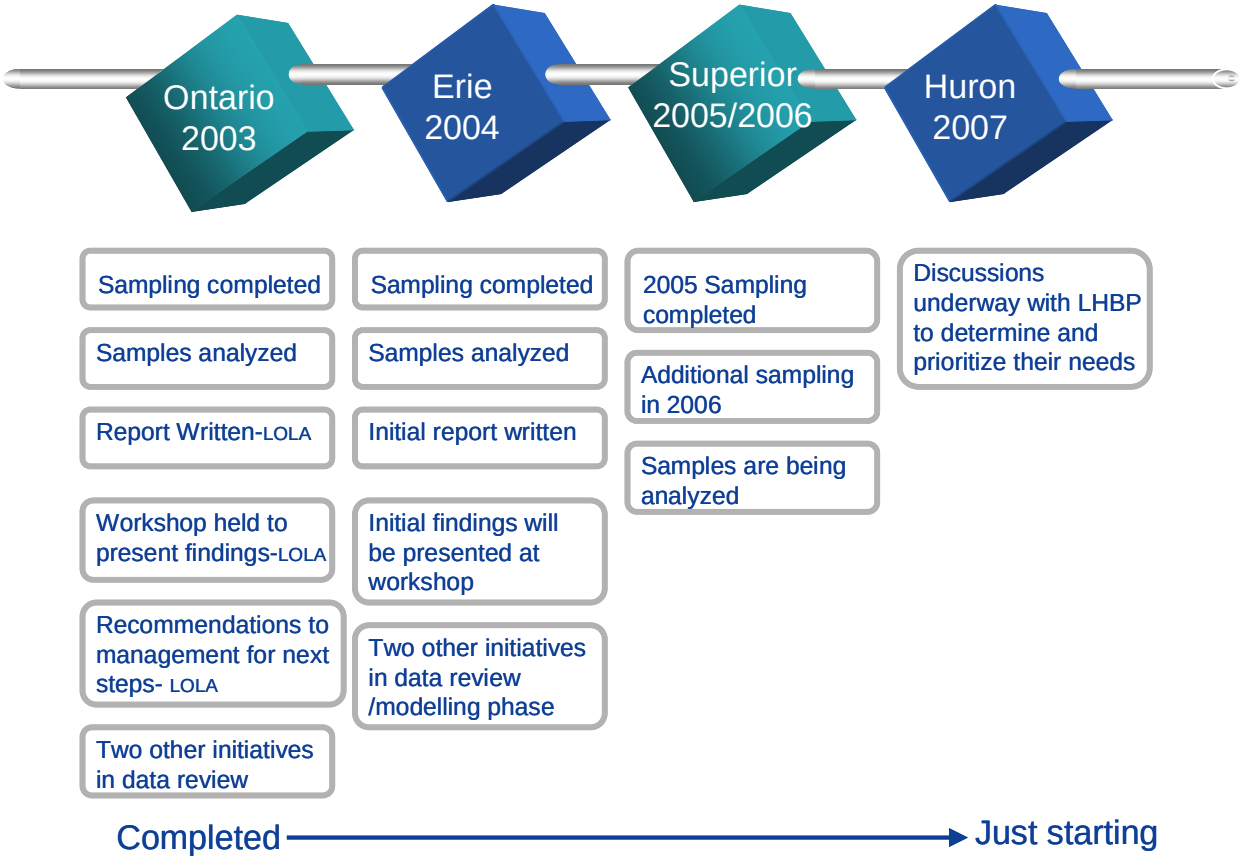
Other 2005 efforts in Lake Superior included:

- Mysid RNA/DNA
- Fish distribution (abundance, biomass), community structure, diets, and stable isotope signatures (OMNR)
- Comparative broad-scale picture of food web structure and energy flux (bioenergetics)
- Biomass size spectrum study (MN Sea Grant)
- Food web analysis (GLFC proposal)
- Critical pollutants and emerging chemicals in fish (DFO/EC)
- Support for Consortium for Lake Atmospheric Modeling Studies (EC/U of Guelph/McGill U/McMaster U)
- Index Station Monitoring at 15 stations, seasonally (MOE)
- Monitoring in support of AOCs (MOE)

Plans for additional work in Lake Superior in 2006:

- Additional chemical sampling and analysis for dioxins and emerging chemicals
- Multi-agency fish intercomparison study - Great Lakes basin-wide; 3 phases (survey, standards, Certified Reference Material).
- Herptile Monitoring Pilot Study - GLNPO grant given to Gary Casper and Steve Hecnar, to determine appropriate monitoring protocols.

Status of Cooperative Monitoring Studies



Discussion

Questions and comments: What is the path forward? How we do continue to carry out cooperative monitoring?

- Phase 1: Meet with the Lakewide Management Plan work group to identify and prioritize information needs for each Lake.
- Phase 2: Design a program to address the needs, this takes about a year to get the logistics sorted out
- Phase 3: Monitoring programs are conducted
- 5 year rotational cycle between all the Great Lakes

Question - When you say you are heading to Lake Huron in 2007 - what does that mean?

Answer – We are just starting conversations about what needs to be done. What the binational committee decides will be done during the 2007 field work.

The near shore study work being planned for IFYLE could piggyback onto cooperative monitoring follow-up work being planned for 2007 by BEC in Lake Erie where tributaries are going to be sampled.

Lake Superior work is still going on.

What we learned – How to get funding. This is also one of the challenges – although we still manage to get the funding, it's not guaranteed.

Workload – Once someone hears that a project is going on, you get a lot more partners and work done than originally planned- it's a lot of work to coordinate things and the projects do grow.

Question - Can you give us an idea about the previous operations in the area, In Ontario, roughly how many resources were available?

Answer - For lake Ontario, the cost was $120 000.

Second question - Is there a formal publications of the data? Does Lake Ontario have a data sharing agreement?

Answer – Yes, Data has become public in two years.

The group discussed the fact that the rotation cycle of cooperative monitoring through the Lakes is not well known and that many members of the Council were not aware of the schedule, and that it should be better publicized.

For the EPA, one of the program drivers is the Clean Water Act, bringing in and stimulating the academic community.

Lake Erie Trophic Status (LETS) Presentation

Jan Ciborowski, University of Windsor, and Canadian Co-director of the Lake Erie Millennium Network provided an overview of the LETS project, development, findings, conclusions and recommendations for future work. A copy of the complete presentation is attached as enclosure (7).

The LETS project was a single collaborative project based on a Request For Proposals (RFP) which was put out by the U.S. EPA Great Lakes National Program Office dealing with anoxia. Things really took off with Zebra mussels, because the water in Lake Erie was clear and it was thought that the Zebra Mussels were eating all the phosphorus. There was even some talk suggesting that phosphorus should be added to the lake.

In 1999, researchers worked on the food web to attempt to figure these things out and then a sudden rise of nutrients led to hypoxia. The RFP and the LETS project at a meeting in 1999 constructed the food web model and asked: How does this all connect (fish, zebra mussels, hypoxia..etc)?

Possible explanations for changes were seen to be due to a list of factors - environmental influences, increased phytoplankton… etc.

When the RFP came out, Gerry Matisoff, Case Western Reserve University on the U.S. side and Jan Ciborowski on the Canadian side organized a discussion about how to address all relevant scientific questions .

Anyone was encouraged to participate, to submit a proposal and 23 different investigators came up with their own research questions. These were put together to form a list of parameters which covered the research questions and formed the basis of a draft proposal.

This group of researchers had only 6 weeks to get their proposal together and handed in. An EPA research needs meeting was held in December 2001.

Planning field work and dealing with the uncertainty of funding both in Canada and U.S. created some real challenges.

Chronology of LETS Program

Date	Event
Dec/01	EPA research needs meeting
Jan/02	RFP released
Mar/02	Proposal submitted
Apr/02	Logistics meeting
May/02	Proposal Approved
June/02	Sampling starts
Aug/02	First funds received
Aug/02	First field report
Nov/02	First progress meeting
May/03	Presentations at LEMN and IAGLR
Summer/03	Compiling metadata
Nov/03	Second progress meeting –> results to LAMP [feedback for ECCS]
May/04	Presentations at IAGLR
May/04	First manuscripts submitted to JGLR special issue
Sept/05	Final manuscripts reviewed
Dec/05	Special issue accepted and in press (2005)
March/06	Presentations of final results at LEMN and IAGLR
May/06	Final report submitted to EPA GLNPO

Questions Addressed by the LETS Project

Are there environmental/loading changes in the central basin of Lake Erie?

Nutrient/ Oxygen demand Processes:

- Loadings of Total Phosphorus (TP) are dominated by interannual variation in tributary discharge (regional effect reflecting climate)
- TP concentration & Hypolimnetic Volume Oxygen Demand (HVOD) have risen through 90's
- TP concentration & HVOD depend on previous year's TP loading through 80's
- HVOD but not TP concentration depend on previous year's TP loading since 90's
- Winter discharge contributes higher TP load than summer discharge

Conclusions: There is no strong evidence of dreissenid effects on Total Phosphorus concentration or HVOD in central basin;

Are there Dreissenid effects in the central basin of Lake Erie?

Pelagic processes:

- no correlation between dreissenid distribution & central basin hypoxia (Patterson et al. 2005; Conroy et al. 2005)
- no evidence of increased SOD (Schloesser 2005; Matisoff 2005)
- poor correlation between dreissenid abundance & turbidity (Rockwell et al. 2005)
- seasonal patterns of hypolimnetic production controlled by nutrients & clarity, independent of dreissenids (Carrick et al. 2005; Ostrom 2005; Guildford et al. 2005)
- phytoplankton productivity regulation by nutrients (Guildford et al. 2005; Twiss et al. 2005; Smith et al. 2005; McKay et al.; Porta et al.)
- microbial productivity regulation by DOC (Heath et al. 2005)

Conclusions: There is no strong evidence of dreissenid effects on hypoxia in central basin; regional regulation over interannual scale

Is there evidence of dreissenid effects in the nearshore zone?

Pelagic processes:

- Correlation between local fluorometric measures of chlorophyll a & local dreissenid abundance (Ghadouani & Smith 2005)
- Increased nearshore water clarity (various)

Benthic processes:

- Cladophora beds expanding (Higgins et al. 2005); anoxic beneath
- Dreissenids stimulate Cladophora production (Davis & Hecky 2005)
- Dreissenids & Cladophora influence LOI & SOD locally (various)
- Altered zoobenthic composition & distribution (Barton et al. 2005)
- Dreissenid - goby interactions & TP increases (Barton et al. (2005) Bunnell et al (2005))

Conclusions: Nearshore nutrient dynamics and trophic structure are regulated by local benthic-pelagic coupling and feedback loops over seasonal time scales.

Summary of Findings

- Offshore nutrient dynamics and trophic structure are regulated by regional processes and annual time scales.
- Weather conditions likely play a significant role (short and long-term).
- Nearshore nutrient dynamics and trophic structure are regulated by local benthic-pelagic coupling and feedback loops over seasonal or shorter time scales.

- Dreissenids and local nutrient sources are likely important.

Recommendations

- Assess open water processes at basin-scale and annual time steps (multibox model), with integrative sampling and observing systems.
- Assess nearshore processes at contributing watershed scale and subseasonal time steps.
- Integrate nearshore/basin-scale exchange processes and transfer rates with 3-D modeling.

Discussion

The final will be presented at the next IFYLE meeting and was discussed at the last LEMN conference.

Started off with a checklist for possible explanations, Strong inference came from data collected by Dolan and McGunagle. Total Phosphorus levels leveled off in 1990; after that levels were dominated by tributary loadings. This was very strongly correlated to the previous years. Levels were declining for tributary loadings of Phosphorus.

The same trend was noted with total phosphorus load to the central basin in previous years (tonnes). We got the critical data between 1995- 2003, when we found out about respiration demand.

Central basin: No strong evidence of Dreissinid effects on Total Phosphorus Concentrations.

There is very strong evidence for nearshore effects in Lake Erie. We concluded that we need overlapping models and we are following up with this.

Question – I was involved in the initial planning and part of the proposal and recall that there was pretty limited money for each person. What I said at the time was, let's use the resources for collecting data. I just want to point out that was a bad idea. We should have taken the $25,000 and used it to help develop a conceptual model. We should have thought about it a lot more. This is a common problem and it's something that we need to guard against. The group discussed the importance of modeling and agreed that it was an important element of the project plan and that models could help influence how some of the sampling went.

Discussion of potential research coordination workshops

Council members discussed aspects of the cooperative monitoring effort and the time needed to help facilitate the process. After discussing the progress of the 2007 field work in Lake Huron, a process well underway, it was decided to focus on the 2008 coordinated monitoring planned for Lake Ontario. The Council Secretary was directed to make the appropriate contacts and notify them about the availability of CGLRM funding for research coordination workshops.

Next Teleconference/Meeting(s) -

A teleconference was scheduled for May 8, 2006 at 10 am eastern time. A decision about the next face to face CGLRM meeting was deferred until after the teleconference.

Enclosures:

(1) Council Meeting Agenda, Revised March 20, 2006

(2) Letter to Co-Chairs of the Great Lakes Advisory Boards and CGLRM dated February 23, 2006

(3) Draft Groundwater Research White Paper contract deliverables, Rev. April 14, 2006

(4) Lake Erie Research Collaboration Survey for Program Managers and Program Leaders, Compilation of Responses

(5) International Field Year on Lake Erie (IFYLE) PowerPoint Slides

(6) Erie Comprehensive Cooperative Study (ECCS) PowerPt Slides

(7) Lake Erie Trophic Status (LETS) PowerPoint Slides

Enclosure (1) to CGLRM March 22, 2006 Meeting Notes

Agenda

43rd Meeting of
Council of Great Lakes Research Managers
10:00 – 4:00 pm
Wednesday, March 22, 2006
Oak Room, Vanier Hall
University of Windsor

Time	Item	Topic	Responsibility
10:00	1	Welcome	Shear
	2	Introductions	
	3	Approval of Agenda	
	4	Approval of minutes from the October 4-5, 2005 Meeting	
10:45	5	Membership & Budget Science Vessel Coordination Workshop/IAGLR session Research Inventory & NISbase-Projects portal Proposed work on groundwater research Observing system	Burrows
	6	Great Lakes Regional Research and Information Network Plan	Reutter
	7	Lake Erie Research Program Survey – Questionnaire Results	Burrows
12:00	8	Lunch – University of Windsor faculty club	All
13:00	9	Lake Erie Trophic Status (LETS)	Jan Ciborowski
13:30	10	International Field Year on Lake Erie (IFYLE)	Stuart Ludsin
14:00	11	Erie Comprehensive Cooperative Study (ECCS)	Violeta Richardson
	12	Questions & Answers regarding lessons learned and recommendations for improved coordination	All
	13	Discussion of potential research coordination workshops	All
16:00	14	Next Meeting	Brandt
		Adjourn	

Teleconference Information:

For those members who need to participate via conference call -

Dial: (866) 646-2080, Conference Code: 923591

Enclosure (2) to CGLRM March 22, 2006 Meeting Notes

February 23, 2006

To: Co-Chairs of the Great Lakes Water Quality and Science Advisory Boards
Council of Great Lakes Research Managers
International Air Quality Advisory Board

c.c.: Board and Council Secretaries

From: Secretaries and Great Lakes Regional Office Director

At their recent February Executive meeting, the IJC Commissioners discussed the format and focus of the upcoming 13th Biennial Report on Great Lakes Water Quality. Commissioners decided to take a different approach, using a shorter, less technical format.

At the February meeting, staff had presented a proposed approach to Commissioners on "Urbanization: The unrecognized threat to the Great Lakes" that would consider impacts from urbanization and land use practices, as well as identify new tools, methods, and approaches to land use management. While Commissioners acknowledged the importance of this issue, they indicated their desire to focus their comments in the 13th Biennial Report on a theme of accountability in implementing the Great Lakes Water Quality Agreement.

Commissioners noted that the considerable work of the Great Lakes Boards and Council over the years has provided the impetus to focus the 13th Biennial Report on accountability. To address the important issue of urbanization, Commissioners have requested that staff work closely with the Boards and Council secretaries to develop a report on urbanization and land use impacts to the Great Lakes that would be made available later this year or early next year. This report would take into account valuable advice provided in the recent *2003-2005 Priorities Report* and subsequent work developed under in the 2005-2007 priorities cycle.

We look forward to working with you in the coming months to complete this report.

Enclosure (3) to CGLRM March 22, 2006 Meeting Notes

Draft Groundwater Research White Paper contract deliverables, Rev. April 14, 2006

BACKGROUND

The Council of Great Lakes Research Managers was created by the International Joint Commission to serve as a principal advisor on research programs and needs. The Council's purpose is to enhance the ability of the IJC to provide effective leadership, guidance, support and evaluation of Great Lakes research as it applies to the provisions of the Great Lakes Water Quality Agreement. One of the responsibilities assigned to the Council is to review the impact of research recommendations made by itself, the Great Lakes Science Advisory Board (SAB), the Great Lakes Water Quality Board (WQB) and the IJC.

Both the IJC and the Council have emphasized the need for research related to groundwater over the past six years in the reports listed below.

- "Protection of the Waters of the Great Lakes – Review of the Recommendations in the February 2000 Report," Recommendation VII. Groundwater, IJC, August 31, 2004
- "Priorities 2001-2003 Priorities and Progress under the Great Lakes Water Quality Agreement," Section 4.3.5 The Effect on Ground Water, Council of Great Lakes Research Managers, September, 2003
- "11th Biennial Report Great Lakes Water Quality," Section 9, pg 63-65, IJC, September, 2002
- "Priorities 1999-2001 Priorities and Progress under the Great Lakes Water Quality Agreement," Section 3.4 "Understanding the Interaction of Ground Water and Surface Water in the Great Lakes Basin," Council of Great Lakes Research Managers, September, 2001
- "Protection of the Waters of the Great Lakes," Recommendation VII, IJC, February 2000

The impact of the groundwater research recommendations contained in these reports relates to many interrelated environmental issues including urban land use, source water protection, water withdrawal and climate change effects. This work will inform the Council's input to collaborative IJC priority work being carried out with the SAB, the WQB and the International Air Quality Advisory Board (IAQAB).

AUTHORITY

The authority for the IJC and USGS to enter into this agreement is the Economy Act, 31 USC § 1535.

TERMS AND CONDITITIONS

USGS Agrees: to review the governments' progress, or lack of progress on groundwater research and report on the degree to which the recommendations made by the IJC and Council of Great Lakes Research Managers have been addressed and what gaps remain to be addressed. The report will be in the form of a white paper and will be from 15 to 20 pages in length. A draft white paper is to be received by August 1, 2006. The report should be electronically formatted as a Microsoft Word document, with background papers, and related materials (graphs, tables, etc.) inserted as appropriate. USGS will achieve full cost recovery for the goods and services it is providing under this agreement, not to exceed $5,000.

Enclosure (4) to CGLRM March 22, 2006 Meeting Notes

Lake Erie Research Collaboration Survey
For Program Managers and Program Leaders
Compilation of Responses

1. Comment on the process for specifying the overall focus and/or hypothesis of the project:
a) Was the project designed/developed by considering a holistic, ecosystem perspective?
b) Who was involved in deciding upon the focus? Scientists? Managers? Both?
c) Describe the specific management and research questions being addressed by the program.

Responses:

a) *The LETS project was designed with an ecosystem perspective but was specifically targeted in scope toward the hypoxia issue.*

b) In evaluating the process for deciding the focus, several facets were considered. The Lake Erie Millennium Network (LEMN) had examined research and management priorities based upon Lakewide Management Plan (LaMP) issues and priorities, as well as issues developed through federal, state, and academic participants. There was an all inclusive call for research topics, themes, and issues across different interest groups (managers and scientists), which resulted in over 100 issues which were discussed in open forum. Several of these issues or themes were further developed in workshops, primarily devoted to research questions, but with management implications. This process should most likely be regarded as highly successful.

c) The specific research question being addressed is the changing status, linkages, and processes in Lake Erie related to the presently observed hypoxia. Implicit in the research question are the primary management questions – what is the cause(s) of the hypoxia and what can be done to address it?

a) Was the project designed/developed by considering a holistic, ecosystem perspective?
Yes. Our ultimate program goal was to provide understanding and eventually tools that could improve the ability of Lake Erie agencies to use an ecosystem approach to management. In so doing, we recognized the need to consider all components of the ecosystem, including biological, physical, and chemical. Within the biological realm, we made a concerted effort to include most (if not all) components of the Lake Erie food web including scientists working with phytoplankton, microzooplankton, macrozooplankton, the microbial food web, fish, benthic inverts., and fish.

b) Who was involved in deciding upon the focus? Scientists? Managers? Both? The initial foci of hypoxia and HABs were determined primarily by GLERL scientists. However, these two foci were chosen, based on needs and concerns of managers, as determined from interactions through Lake Erie Committee meetings and a recent GLERL Lake Erie Science planning

workshop. Additionally, once these two focal issues were identified, managers were included on IFYLE's Strategic Planning team (e.g., a rep from LaMP, the Lake Erie Committee, EPA members) to ensure that management needs were addressed.

c) Describe the specific management and research questions being addressed by the program. 1. Hypoxia. Essentially, we are trying to provide an understanding of whether Lake Erie fishery managers need to be concerned with hypoxia when managing their fisheries. Ideally, we seek to understand how hypoxia influences the distribution and behavior of economically and ecologically important fishes (e.g., yellow perch, walleye, rainbow smelt, lake whitefish), and in turn, their growth, condition/health, and potential for production. Ultimately, we hope to provide tools and understanding that can be used to understand past and future recruitment variation.

IFYLE research also will increase our basic understanding of how hypoxia influences other components of the ecosystem, including the microbial food web, phytoplankton, zooplankton and their interactions. There is a lot of novel science being conducted.

2. Harmful algal blooms. A subset of the IFYLE team is working on issues related to harmful algal blooms (HABs). A couple of researchers are trying to understand the role of nutrients (e.g., phosphorus, iron) in limiting HABs formations, which may in turn have ramifications for nutrient management in the watershed. Another set of researchers are trying to develop algorithms to describe HABs distributions, which could then be used to forecast distributions when linked to hydrodynamics models. There also is a set of projects focusing on algal toxin production lakewide, with the goals of understanding how recent distributions compare with historical ones.

a) Yes, the program was designed/developed by considering a holistic, ecosystem perspective. The issue of foodweb disruption and the potential role of dreissenids in the disruption had been the focus of several informal research meetings convened in various locations around the Lake Erie basin in the late 1990s, and had been identified by several Lake Erie agencies as a possible cause of poor condition of the Lake Erie fishery.

b) Food web disruption was also one of the key research areas identified by agency representatives at the inaugural Lake Erie Millennium Network (LEMN) 'priority needs' workshop. Findings from a subsequent two-day LEMN synthesis workshop guided some of the perspectives that ultimately organized the Lake Erie Trophic Structure (LETS) proposal. A Council of Great Lakes Research Managers'-sponsored modeling workshop was convened at the 2000 IAGLR meeting in Cleveland OH. The 7 scientists who presented Lake Erie food web models emphasized the need to study links among nutrients, dreissenids and phytoplankton. Many of these individuals presented their ideas at an EPA-sponsored research needs identification meeting. The information discussed there partly guided the EPA's focus in drafting the RFP that ultimately funded the LETS project.

c) Following public release of the RFP, expressions of interest and proposed research topics were drafted by individual investigators. Many of the individual scientists brought their own perspectives to the proposal, and the two senior coPI's then worked to tie them together to make a coordinated project. Individual proposals were classified according to question and integrated

within the previously defined framework. Specific management and research questions addressed by the project are listed in the summary proposal abstract (Appendix A).

a) Was the project designed/developed by considering a holistic, ecosystem perspective?
Yes, the project was conceived as an ecosystem research and monitoring program, including all relevant ecosystem components.

b) Who was involved in deciding upon the focus? Scientists? Managers? Both?
Due to the nature of EPA funding requirements, the focus of the program was determined by EPA managers and scientists with initial information coming from a large group of Lake Erie scientists.

c) Describe the specific management and research questions being addressed by the program.
The main focus of the project was to determine the causes of the observed increases in total phosphorus in Lake Erie's central basin, and continual occurrence of a hypoxic zone. The specific questions addressed dealt with the sources of phosphorus, whether internal or external, the history of hypoxia, and the sediment's role in hypoxia.

a) Yes – LaMP/LEMN
b) Both scientists and managers
c) 3 specific questions, several sub-questions, all relating to the effects of Zebra Mussels

2. Comment on the process for seeking research participants for the project:

a) Was there an RFP for the project?

i) If so, how were proposals reviewed and selected?

ii) If not, how were project participants found?

b) Were there setbacks/limitations in finding suitable project participants?

c) Are there suggestions for improving how participants are found for the project?

Responses:

a) The process for seeking research participants was conducted pursuant to USEPA procedures and regulations for such research projects. A workshop was held, primarily with federal partners, in order to fully flesh out scientific issues prior to the RFP. A RFP was issued and reviews were conducted by the USEPA and their designees.

b) There does not appear to be limitations/setbacks in finding suitable participants, there appears not to be any suggestions for the process, and the general process was pursuant to procedural policy and appeared to be appropriate. The RFP specifically stated that a consortium with a wide range of expertise would be desirable. Within the scientific community in response to the RFP, participants, internal and external to LEMN were contacted.

c) For the most part, if researchers were not included in the research team, it was generally their choice not to participate in LEMN, the proposal response, or their research did not fit the emphasis on the hypoxia zone.(LETS)

a) Was there an RFP for the project? Yes. The RFP was put together by a subset of GLERL scientists, with input from the funding sponsors (National Sea Grant and all state Sea Grants).

i) If so, how were proposals reviewed and selected?

Proposals were reviewed by both internal (GLERL) and independent external reviewers. Each reviewer received a scoring sheet with defined criteria. We sought 2 internal and 2 external reviewers per proposal. Afterwards, a panel consisting of five GLERL PIs was assembled to synthesize reviews and make decisions about funding. Final decisions were based on scientific quality and novelty, the importance of the project to the overall goals, a willingness to work as a team to provide understanding that would benefit both basic science and management, and PI credentials.

ii) If not, how were project participants found?

b) Were there setbacks/limitations in finding suitable project participants?

I don't think so. We had 41 applications, totaling $1.2 million in requested funds, for the $325K available. In total, we funding 14 proposals plus allowed others that needed only ship time to participate. I will say that making decisions was difficult because of lots of decent science.

But, perhaps if the RFP could have circulated for longer (giving the investigators more time to put a project together), we could have gotten a better/different set of projects.

c) Are there suggestions for improving how participants are found for the project?

The major constraint we ran into was a lack of time. It took a very long time to find a mechanism to administer the RFP. In turn, by the time the RFP went out, investigators had little time to prepare a proposal. Fortunately, GLERL now has granting authority, which will save time in the future.

A NOAA-GLERL Lake Erie Science Planning Workshop was held prior to learning about the money to kick start IFYLE. This workshop was quite valuable in helping us define our goals, and I would recommend that workshops be held ahead of time where possible.

a) Our project was organized in response to a PI information meeting organized by EPA. Our proposal was formally submitted for funding by EPA GLNPO in response to an RFP included in the annual announcement of grant opportunities in 2002. Initial expressions of interest were solicited from selected researchers by the senior coPIs followed by a later general invitation to participate that was sent to all researchers on the LEMN mailing list and personally contacted by the PIs. Most project participants responded directly to these notices. One or two joined the group later, when they were advised of the research teams forming.

Each proponent was invited to submit a 1-2 page introduction/backgrounder to their research interests, a work plan, variables that would be measured and the specific questions that would be addressed, and a short budget. The senior coPI's organized these proposals into 4 research themes and integrated the topics within themes. A one-day organizational researchers' planning workshop provided a forum for members of each theme to coordinate their efforts and harmonize

methodology. Overall sampling plans and timing were also defined at that meeting. Ultimately, individual proposals and budget amounts were recommended by the two senior coPI's for acceptance by each of the researchers.

b) The short timelines between RFP release and the proposal due date resulted in some difficulties in resolving the logistics of administering funds through subcontracts among multiple universities. Ultimately, all the Canadian researchers were funded from a single grant to the University of Windsor and all the US and NZ researchers were funded by a single grant to Case Western Reserve University. All but three potential participants were written into the proposal and received grant funds. Two of the three felt unready to participate; miscommunication on the organizers' part resulted in the third participant being given inadequate opportunity for input or to describe resource needs prior to the closing date. Although these individuals didn't take part in the research, all remained affiliated with the program and attended progress report and data interpretation meetings.

c) Large-scale collaborative projects are rare, and typically depend on windfalls of funding that may require novel matching requirements or creativity in accounting and contracting agreements. This is usually coupled with short timelines. The implementation of the concept of regularly recurring 'collaborative years' on each of the Great Lakes will considerably help managers and researcher set time frames that will allow a more organized planning process. Every effort should be made to provide sufficient advance warning of an impending RFP and the amount of funding that will accompany it. The uncertainty associated with boom-bust cycles of funding for large lakes research also impedes researchers' ability to develop projects that may require multiyear data collection. Funding sources that provide a reduced but assured level of funding over a 3-4 year period would permit greater flexibility in the kinds of questions that can be addressed.

a) Was there an RFP for the project? Yes

i) If so, how were proposals reviewed and selected? The proposals were reviewed within EPA, and by two outside reviewers. Selection was based on the reviews.

ii) If not, how were project participants found?

b) Were there setbacks/limitations in finding suitable project participants? While there was only one proposal submitted, the investigators involved with the proposal covered all relevant areas of research.

c) Are there suggestions for improving how participants are found for the project?

No, advertisement in relevant publications and websites seems sufficient.

a) No/Yes – EC does not have RFP's, but GLNPO had RFP

ii Various means were used, EC, GLNPO, COA$ plus a great deal of in-kind support.

b) No, in fact we were overbooked for piggy-backings as well as the regular program

c) Basically word-of-mouth, LaMP members, - the scientific community doing GL work is small; you know someone working in that field.

3. Comment on the process for coordination and implementation of the project:

a) Was a work plan developed and vetted?

b) Was the project timeline and budget adequate and consistent with the project work plan?

c) Was the personnel and equipment available adequate and consistent with the project work plan?

d) Was there an adequate QA/QC plan for the project?

e) Was there an adequate peer review plan for the project?

f) Was there good communication among the research participants during the course of study?

Responses:

a-d) A work plan, project timeline, budget, personnel needs, equipment needs, and Quality Assurance Project Plan were prepared and documented for the project. These appeared to be adequate.

e) It is unclear whether or not a specific or formal peer review plan was developed. However, there was self-peer review via project participants, the USEPA funding agency, and other individuals and groups as the project proceeded through investigator meetings, LEMN meetings, meetings with LaMP operatives, and other technical meetings and workshops; these generally are not regarded as formal external peer review.

f) Given that communication can always be improved, communication for this project should be considered to be very good to outstanding.

a) Was a work plan developed and vetted? Yes. We made a set of cruise plans at our first (and only) all-PI meeting before the start of the field season and carried out that plan. Through email exchanges and another smaller meeting at the IAGLR meeting, plans were modified as necessary. Overall, the cruises played out as expected for the most part.

b) Was the project timeline and budget adequate and consistent with the project work plan?

I believe so. We had a two-year timeline for products to be generated. I think that most external PIs will adhere to this goal. The exception may be the fish-ZP collections made by GLERL researchers. Our program was bolstered considerably relative to what was originally planned, owing to complete use of the Lake Guardian and Laurentian for the diel and transect cruises. Thus, more time (or money) likely will be needed for this aspect of this project. Importantly, this project was internally funded (i.e. no money was provided from the RFP).

c) Was the personnel and equipment available adequate and consistent with the project work plan?

Yes. The EPA's Lake Guardian was well staffed and equipped. The Lake Guardian's crew was more than willing to find workarounds to allow the research to be done. Ditto for the Laurentian's crew. The only real limitation was during August when multiple GLERL PIs were competing for use of the Laurentian; hence, there was no trawling for fish during July because another GLERL program got use of the Laurentian.

The only other "headache" that occasionally emerged was the EPA contacting us to say that the Lake Guardian had other commitments, thus forcing us (the IFYLE program) to work around their "new" schedule. While things worked out fine in most cases, these last-minute requests by the EPA caused some stress for me (and researchers) and in some places interfered with making all of our collections. While I fully appreciate the EPA's cooperation overall, it would be nice to only have to work out the schedule once at the beginning of the field season, with interruptions only being caused by weather/equipment failures. But, again, overall I was very pleased with how the field season went.

d) Was there an adequate QA/QC plan for the project?

No. We are double checking all manual data entries, and have a mechanism in place to allow PIs to notify database managers of errors. However, we need to adopt a formal procedure.

e) Was there an adequate peer review plan for the project?

No. Right now, self-evaluation and surveys such as this one are the only forms of peer review. Additionally, presentations will be given to management agencies (e.g., I will be presenting results to the Lake Erie Committee), who then will be able to comment. Had more time been available at the beginning, it would have been great to have external people review our proposed goals and field design.

f) Was there good communication among the research participants during the course of study?

Yes. I did my best to keep all participants apprised of program updates, meetings, breaking news/data, etc., on a regular basis. Additionally, email exchanges proved quite valuable when discussing sampling protocols, cruise routes, and discussing miscellaneous topics. We have tried to hold an all-PI meeting every 6 months to discuss progress, end-goals, and the future.

I will say that running a program as large as IFYLE, and maintaining my other research, has been a challenge. As such, communication was not as frequent as I would like, thus leading to mass e-mailings (many of which likely went ignored). I highly recommend that any future project leaders have a staff of people to delegate things too (which I have had for the most part).

I'm not sure how much collaboration amongst PIs has gone on behind the scenes. I will learn more about this later this week at our closed-door sessions.

a) The work plan and logistics of sampling were formalized in one-day planning meetings followed by conference calls among research subgroups; opportunities for revision and feedback were limited by the short time between notice of grant approval and the start of the field season; researchers' willingness to travel to planning meetings with no assurance of funding was a limiting factor

b,c) The project work plan was built according to the constraints of the budget and budget timeline; personnel and equipment were adapted to available resources; the granting agency and collaborating agencies provided tremendous logistic and in kind support that greatly enhanced the effectiveness of the research; the project could not have been undertaken without these agency-sponsored facilities being provided. The budget was ultimately inadequate to complete the entire work plan as originally proposed, largely due to currency fluctuations, which eroded 25% of the value of the funds awarded to researchers at Canadian institutions. Most of their field expenses were covered, but resources that had been budgeted to the project for QAPPs, integrative data interpretation, synthesis, and compilation were partially used to offset the loss in purchasing power.

d) Detailed QA/QC plans were drafted prior to final approval of the project. Agency help in constructing the QA/QC and QAPP was invaluable.

e) Peer review individuals were identified at the start of the project; these and other individuals attended and participated in planning and progress report meetings as well as reviewing progress reports.

f) Detailed communication was necessary among research participants during the years of field work in order to coordinate the timing of boarding and departing ships, the provision of supplies and equipment, and ensuring that all participants had been assigned adequate space and received suitable training; semiannual planning and/or progress meetings also facilitated communication. Participant interaction led to additional, coordinated studies and subsequent publications after completion of the LETS project.

a) Was a work plan developed and vetted? This was, of course, the work of the two coordinators, and was accepted by EPA.

b) Was the project timeline and budget adequate and consistent with the project work plan? This is probably not for me to answer, but more funding is always needed.

c) Was the personnel and equipment available adequate and consistent with the project work plan? From an EPA standpoint, the personnel were exceptional.

d) Was there an adequate QA/QC plan for the project? Yes

e) Was there an adequate peer review plan for the project? Yes

f) Was there good communication among the research participants during the course of study?

a) A work plan was developed and vetted by the LaMP.

b) Yes

c) Yes. If a certain group did not have certain equipment, then we were able to loan it to them, e.g. box cores, ponars, integrators

d) QUAPP for U.S. side; EC protocol/DFO

e) Yes. LaMP workgroups were presented with projects and given ample opportunity to comment.

f) Yes – e-mails, phone & meetings

4. Comment on the process for synthesis, interpretation, and presentation/publication of the project research results

a) Was there adequate planning and full understanding of data ownership, data sharing, data delivery, and model/synthesis use of the data?

b) Was there a synthesis/modeling component built into the project to ensure collaboration among investigators and to ensure management problems were addressed?

c) Is there a centralized repository (i.e., database) for the data to facilitate use by involved researchers?

d) Describe the methods used to facilitate ample collaboration and synthesis?

Responses:

a) *In general, the synthesis and presentation of project results has not been completed at this time and an analysis of this aspect is only preliminary. Some of the synthesis will appear in the Journal of Great Lakes Research and has been made available to a range of researchers. The issue of data ownership, sharing, etc. is a difficult topic area whether it is or is not clearly laid out in a plan. Many times it is, and at the end of a project, these facets of data use and sharing do not completely work well, even when there is contractual or semi-contractual language existing in documentation. Scientists are notorious for data ownership and publication rights, and many times will not share data until published. This appears to be a cultural phenomenon, no matter what the plan is.*

b) A modeling component was not explicitly built into the project but, was planned as discussed in the planning process through several meetings and that the USEPA intended to conduct modeling studies as the data became available.

c) There appears to be a database composed of metadata and some specific data, however, at this time, a complete database with investigator data and data from the PARTIES does not exist.

d) Collaboration and facilitation have been discussed in responses above, but generally various meetings and workshops within the all inclusive nature of the LETS project and in the spirit of LEMN have aided these aspects.

a) Was there adequate planning and full understanding of data ownership, data sharing, data delivery, and model/synthesis use of the data? Yes. All PIs were notified ahead of time that their data would be put into an IFYLE database and that at some point in the future (4 years), their data would become public. PIs also were notified that their data could not be used by other PIs, without their consent. Towards this end, our IFYLE database will have multiple levels of security: community data (e.g., CTDs, size-fractionated chla) will be available to all PIs via a common password; PI-specific data will be available, if the PI wants to make it available. Our data policy also outlines the procedures and timelines re getting data into the database.

In terms of model synthesis, there is one funded project that will attempt to integrate the suite of data using a modeling approach developed for toxicology (CASM). However, little time has been spent by IFYLE participants to date talking about integrative modeling efforts, although it is on the docket for the March 2 IFYLE meeting (at the conclusion of the LEMN workshop). Thus, modeling did NOT drive our data collections; any future models will be developed from the suite of available data.

Also, IFYLE program managers have been working with some IFYLE researchers and non-IFYLE researchers to develop a modeling framework to make use of the IFYLE data (submitted Coastal Oceans Project ECOFORE proposal). The downside is that I feel kind of crappy that this effort did not include all IFYLE researchers, and had wished that this proposal had originated with IFYLE PIs (not university collaborators external to the project). However, if funded, that modeling effort would provide an immediate use for IFYLE data, which will lead to publications for IFYLE researchers.

b) Was there a synthesis/modeling component built into the project to ensure collaboration among investigators and to ensure management problems were addressed?

One of the funded projects is a synthetic modeling effort. However, no others have been discussed to date. We have, however, requested PIs to think about potential independent MSs, as well as collaborative ones. Additionally, IFYLE program managers have become involved in a modeling proposal designed to synthesize the IFYLE data (see point 4a above).

c) Is there a centralized repository (i.e., database) for the data to facilitate use by involved researchers?

Yes. We have been putting together a great database, which will be easy to use and good for querying. There will be multiple levels of security for different kinds of data. For example, community data such as ship CTDs will have a low-level password that all PIs know. Additionally, PIs can password-protect their own data; the types of collections made by these PIs will be made known, however, so that other PIs know what data are available. The PIs can release their password, once contacted by other PIs.

Data will be able to be queried by ship, date, sampling station, sampling procedure or month (or any combination of these).

d) Describe the methods used to facilitate ample collaboration and synthesis?

1. Having PIs generate not only individualistic manuscripts, but also synthetic ones that require collaboration.

2. PI meetings, where hypotheses and future goals are discussed. Additionally, at these PI meetings (which all PIs are required to attend), PIs are charged with presenting the types of data collected and preliminary conclusions/hypotheses generated, which then may lead to collaborations.

3. Attempting to integrate our program with other Lake Erie researchers. In fact, our decision to merge our all-PI meeting with the LEMN meeting was geared to facilitate collaboration.

4. A common, shared, interactive database with metadata files and a log of all data collected also will facilitate data sharing.

a) Was there adequate planning and full understanding of data ownership, data sharing, data delivery, and model/synthesis use of the data?

All of these were discussed and defined during the planning phase of the project; funds were designated for a data manager who would be responsible for collecting and compiling metadata, data delivery and ultimately, 'data mining.' Results were shared in timely fashion at semiannual reporting meetings and/or special sessions of conferences. However, the short term of the project and loss of purchasing power eroded the resources available to maintain the data manager position for a long enough period of time to actually acquire the final data and prepare it in a format suitable for modeling or synthesis purposes.

b) Was there a synthesis/modeling component built into the project to ensure collaboration among investigators and to ensure management problems were addressed? This was built into the work plan but not adequately completed due to time and funding constraints. All researchers contributed at least one peer-reviewed paper to a special journal issue. However, the manuscripts were largely written in isolation of one another. A final synthesis paper is anticipated but has not been completed. Although metadata describing all data have been compiled, and researchers' raw data are available for compilation, resources are not in place to support this final phase of the project.

c) Is there a centralized repository (i.e., database) for the data to facilitate use by involved researchers? Metadata have been placed in a searchable, centralized repository. However, those wishing the data themselves must contact the data owners.

d) Describe the methods used to facilitate ample collaboration and synthesis? Plans for regular planning, progress, and summary results meetings were written into the original work plan over the life of the project, as well as researchers' commitment to contribute papers to a special journal issue and to contribute their data to a common pool following its use in the literature. Several participants have submitted joint proposals to other agencies to continue their work on Lake Erie.

a) Was there adequate planning and full understanding of data ownership, data sharing, data delivery, and model/synthesis use of the data? This aspect of the project took some time to develop but is, I believe adequate.

b) Was there a synthesis/modeling component built into the project to ensure collaboration among investigators and to ensure management problems were addressed? This is underway.

c) Is there a centralized repository (i.e., database) for the data to facilitate use by involved researchers? - Yes

d) Describe the methods used to facilitate ample collaboration and synthesis?- n/r

a) We are still at the preliminary stages of report findings

b) Yes, the data will be used to better understand the function of the 9 box (now 15 box) model. There have been changes assoc. w/ Zebra Mussels that are making the models validity for TP inaccurate

c) No – All data usually is given to the group writing the report.

d) – n/r

5. Comment on the process for interaction with and input to the public decision process

a) Was there adequate communication of the project results to stakeholders and the public in an understandable way and in a way that contributes to the decision process?

b) Who will benefit from the information attained on the project?

Responses:

a) Interaction with various sectors is still ongoing, so all input to the decision-making process has not been completely accomplished. The typical scientific forums as discussed in the previous responses generally apply. However, primary interaction with the Lake Erie LaMP has been a paramount outreach activity with a known purpose. Another clear example at the beginning of the project was the testimony to the Senate hearings held on Lake Erie hypoxia and changing relationships.

b) Few projects have this type of ability or impact. In a preliminary assessment, a wide array of international federal, state and local governments, the tribes and scientists will benefit from the study. In general, this project will have substantial, if not significant, impact on management decisions, policy, and future research directions. The project should be regarded as highly successful to outstanding in this regard. (LETS)

a) Was there adequate communication of the project results to stakeholders and the public in an understandable way and in a way that contributes to the decision process? The project is still ongoing, but thus far, we have kept agencies (fish management ones in particular) apprised of our results by making frequent presentations. For example, last year I spoke at the annual Lake Erie Committee meeting, an informal Lake Erie Committee meeting, at an annual Michigan DNR meeting, and provided updates on our project to the Lake Erie LaMP Working Group on two occasions. Additionally, we have interacted substantially with the press, both print and radio. In fact, NPR's Living on Earth program did a segment on our research, numerous newspaper articles have been written, and several radio appearances have occurred.

b) Who will benefit from the information attained on the project? Fishery management agencies will benefit the most by learning whether they need to be concerned by hypoxia. Likewise, through management agencies, as well as interactions with media, the public and user groups can learn about the importance of hypoxia. In the end, those that manage beaches and water quality will benefit by learning more about what causes HAB formations, as well as by receiving improved remote sensing capabilities.

a) Was there adequate communication of the project results to stakeholders and the public in an understandable way and in a way that contributes to the decision process? Progress reports were given annually at local (LEMN biennial conference) and more regional (IAGLR conference) meetings. Results were summarized in the biennial Lake Erie LAMP reports and in progress reports to the funding agency. Senior PI's gave many presentations on request to managing agencies and to the public around the Great Lakes. The level of technical detail was adjusted to match the expertise of the particular audience in a way to maximize understanding and to provide the key information needed by decision-makers.

b) Who will benefit from the information attained on the project? Managers and regulatory agencies, planners (modelers) and the research community will all benefit directly from the information attained. The broader Lake Erie community should benefit from the ensuing management actions.

a) Was there adequate communication of the project results to stakeholders and the public in an understandable way and in a way that contributes to the decision process? There were numerous newspaper articles, and several congressional hearings on the work while in progress.

b) Who will benefit from the information attained on the project? The benefits will be to managers involved with nutrient input to the lake, to fisheries managers and to the public who use the lake.

a) Public? – Do they comment on research / monitoring?

b) We are still in the data analysis and preliminary results stage for Lake Erie.

Appendix A – Proposal Summary

ABSTRACT

1. SORTING CODE: EPA GNLPO - Trophic Status of Lake Erie.

2. TITLE: Trophic Status of Lake Erie: Investigating Mechanisms and Extent of Internal Phosphorus Loading in Support of Modeling.

3. 4. INVESTIGATORS AND INSTITUTIONS:

Dr. Gerald Matisoff, Case Western Reserve University, Cleveland, OH [***project co-director***]
Dr. Jan J.H. Ciborowski, University of Windsor, Windsor, ON [***project co-director***]
Murray N. Charlton, Environment Canada, Burlington, ON, Canada [***cooperator & co-director***]
Dr. Russell G. Kreis, Jr., US EPA, Grosse Ile, MI [***cooperator and co-director***]
Dr. Jeffrey P. Reutter, Ohio Sea Grant-F.T. Stone Laboratory, Ohio State University, Columbus, OH [***cooperator & co-director***]
Co-Principal Investigators*:* Drs. David R. Barton, Stephanie J. Guildford, Robert E. Hecky, Ralph E.H. Smith & Michael Stone, University of Waterloo, Waterloo, ON
Johan Biberhofer, Drs. Lee. N. Grapentine & Chris H. Marvin, Environ. Canada, Burlington, ON
Dr. Noel M. Burns, Lakes Consulting, Pauanui, New Zealand
Dr. Hunter J. Carrick, Pennsylvania State University, University Park, PA
Dr. David A. Culver, Ohio State University, Columbus, OH
Dr. David M. Dolan, University of Wisconsin at Green Bay, Green Bay, WI
Dr. G. Douglas Haffner, University of Windsor, Windsor, ON, Canada
Dr. Timothy B. Johnson, Ontario Ministry of Natural Resources, Wheatley, ON, Canada
Dr. Michael Ketterer, Northern Arizona University, Flagstaff, AZ
Cary T. Knight, Ohio Department of Natural Resources, Fairport Harbor, OH
Dr. Steven Lozano, Great Lakes Environmental Research Laboratory, NOAA, Ann Arbor, MI
Dr. R. Michael L. McKay, Bowling Green State University, Bowling Green, OH.
Dr. Nathaniel E. Ostrom, Michigan State University, East Lansing, MI
Dr. Beverly Saylor, Case Western Reserve University, Cleveland, OH
Donald W. Schloesser, Great Lakes Center, US Geological Survey, Ann Arbor, MI
Dr. Michael R. Twiss, Ryerson Polytechnical University, Toronto, Ontario, Canada
Other Cooperators: Drs. P. Chow-Fraser, McMaster Univ.; R. Dermott, S. Millard & O. Johannsson, DFO Canada; L.D. Corkum, Univ. Windsor; J.V. DePinto, Limno-Tech Inc; J.R. Johansen, John Carroll Univ.; K. Krieger, Heidelberg College; E.T. Howell, ON Ministry of Environment; RA. Stein, Ohio State Univ.

5. PROJECT PERIOD April 1, 2002 to March 31, 2004

6. PROJECT COST $487,302

7. SUMMARY Recent observations by various investigators have found that ***i***) biomass of phytoplankton (Chlorophyll *a*) in the central and eastern basins is at historically low levels, despite the fact that ***ii***) concentrations of total phosphorus (TP) have been increasing over the past 5 years, even though ***iii***) TP loadings to Lake Erie have not risen; ***iv***) central basin oxygen demand has not changed through the 1990s, and v) central basin hypolimnial oxygen depletion continues to occur. Such patterns are inconsistent with predictions and dynamics of models of internal lake function originally developed to guide management of Lake Erie's nutrient budget. These observations may represent situations that have naturally occurred at times prior to monitoring re-

cords. Alternatively, they may reflect consequences of novel environmental and biological pressures modifying energy and nutrient flow through the ecosystem.

The compartments and transfer pathways hypothesized to be most important in explaining recent changes in energy flow patterns are:

- allochthonous particulate and dissolved organic carbon inputs;
- carbon fixation through benthic primary production, phytoplanktonic primary production and, increasingly, microbial food web production;
- particulate detrital carbon production (dreissenid feces and pseudofeces; feces from other zoobenthos and zooplankton) - sedimentation processes, resuspension processes or sublittoral-to-profundal particulate transport ('nearshore shunt' of Smith et al. 2000);

Possible explanations of observations i-***v*** that involve the key compartments/pathways are:

A) reduced size and/or increased persistence of central basin hypolimnion, possibly accompanied by increased rate of oxygen demand or changed autotrophic: heterotrophic carbon fixation ratio;

B) reduced benthic/planktonic primary production caused by 1) grazing pressure; 2) limited nutrients; 3) trace metal limitation and/or; 4) UV/contaminant-induced photosynthesis inhibition;

C) increased net rates of organic carbon accumulation in hypolimnetic areas.

The relative likelihood of explanations **A-C** for observations ***i-v*** will be evaluated by coordinated, cooperative field work to measure or inventory the key compartments and pathways.

Objectives: We will conduct a 1-yr biological inventory to characterize the distribution and flux of biomass and materials (phosphorus, carbon, oxygen) in Lake Erie that will clarify the mechanisms and extent of internal phosphorus loadings, especially within the central basin. Planned and ongoing research programs will be expanded to achieve the following:

1) estimate historical frequency and extent of episodic anoxia in the hypolimnial central basin from geochemical markers (stable isotopes, chemical species of trace materials), ostacodes, and other indicators of environmental change derived from sediment cores;
2) a simulated reconstruction of the areal extent, volume, duration, and oxygen depletion of the central basin hypolimnion through the 1990s;
3) a lakewide quantitative assessment of dominant zoobenthos populations and distributions, especially dreissenids, oligochaete worms, chironomids, burrowing mayflies, and amphipods;
4) an evaluation of the accuracy and utility of remote-sense technology (side-scan sonar, ROV, videography) in analyzing sediment composition and dreissenid distribution;
5) bioenergetic model of benthic energy and nutrient transfer through benthivorous round gobies;
6) estimates of sediment-water boundary exchanges through sublittoral and profundal measurements of sediment oxygen demand, benthic primary production, solute and particle advection induced by physical processes, and bioturbation, and sedimentation rates;
7) estimates of vertical distribution of nutrients, oxygen, phytopigments and particulate matter;
8) estimates of epilimnetic and hypolimnetic primary production, respiratory demand, and cycling efficiency using both established and novel approaches;
9) determination of factors and cofactors (nutrients, trace metals) limiting primary production;
10) determination of lake-wide phosphorus loading, among-basin transport, and net export;
11) an improved conceptual model of nutrient dynamics that better explains trends in nutrient behavior, primary production, and hypolimnetic oxygen depletion than currently used models.

Groups of scientists will participate in monthly cruises aboard the RV Lake Guardian and/or CCCV Limnos along predefined transects and at key offshore stations, emphasizing the central basin. Shallow-water, nearshore sampling will be conducted from small boats along transects extending from coastal margins to depths of 20 m. We will 1) measure water-related attributes, 2) measure sediment-related attributes, 3) conduct a zoobenthic inventory, 4) derive

and extrapolate energy processing and nutrient transfer from zoobenthos though round gobies, and 5) quantify particle transport processes and nutrient sources among compartments.

C. Expected Results or Benefits: We combine the diverse expertise, in-kind support, and contemporaneously collected data necessary to understand and ultimately model nutrient/energy flow and its consequences for L. Erie. Our binational data set will let us distinguish among key energy limitation hypotheses. Data (provided to EPA) will be amenable to mass-budget system modeling, critical to understanding this complex issue from a management perspective. Findings will be presented and synthesized at dedicated workshops and binational conferences. Summaries and syntheses will be submitted for publication as a multi-paper, peer-reviewed compilation. The collaborations developed through this project will facilitate implementation of projects needed to address other lake-wide challenges (modeling efforts, research problems, index assessment, routine monitoring) facing the Lake Erie LaMP and SOLEC.

8. SUPPLEMENTAL KEYWORDS: carbon, dissolved oxygen, Dreissenidae, hypolimnion, modeling, nutrient dynamics, phosphorus, primary production, round goby, sedimentation, stable isotope, trace metals, zoobenthos.