March 13 - 14, 2013

Rainy River Community College

International Falls, Minnesota, USA

The information contained in this Proceedings report was compiled by the Lake of the Woods Water Sustainability Foundation, on behalf of the Organizing Committee of the 10th International Lake of the Woods Water Quality Forum, from summaries prepared by the Foundation for the March 13, 10th Anniversary Banquet, and from the March 13 & 14 symposium poster and presentation abstracts as supplied by the presenting authors.

The text herein does not reflect the official views of the International Joint Commission

We are grateful to the International Joint Commission for financial support to prepare this report.

Todd Sellers
Executive Director
Lake of the Woods Water Sustainability Foundation

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Executive Summary

The 10th annual International Lake of the Woods Water Quality Forum (the Forum) was held March 13-14th at the Rainy River Community College in International Falls, Minnesota. The Forum is the only professional symposium for researchers and resource managers working on research and management activities related to the Lake of the Woods and Rainy River watershed. The Forum's ecosystem focus encompasses all disciplines relevant to water quality and aquatic ecology in the Lake of the Woods and Rainy River watershed. The name of the Forum is perhaps a misnomer – a legacy of first Forum's focus in 2004 on the water chemistry of the lake.

The Forum is organized and hosted by a partnership of agencies led by the Lake of the Woods Water Sustainability Foundation. Ninety-three researchers, resource managers, and policy makers attended this year's Forum. Forum participants reflect a broad range of interests and engagement in the watershed, including representation from agencies of local governments, soil and water conservations districts, provincial and state governments, federal governments, US Tribes, industry and non-governmental organizations – all with the common connection of working on water or water-related issues in the Lake of the Woods and Rainy River watershed.

Attendee Summary

Bi-National Governance	4
Tribal / First Nations	3
Federal Agency	11
State Agency	19
Provincial Agency	10
County/City Gov.	7
Industry	7
NG0	17
University	14
Individual Citizens	1
Total	93

This year's Forum featured an extended program, with one and a half days of research presentations, and an expanded poster presentation session. Research topics presented covered a wide range of disciplines reflecting the broad interest in and research underway in the Rainy-Lake of the Woods watershed. Four of the presentations reported on studies funded by the IJC, either as part of the Rainy-Namakan 2000 Rule Curve Review or other IJC initiatives.

The 2013 Forum also featured a moderated panel discussion on "Futures: Issues and Challenges for the Next 10 years". A future planning and research needs session was held at the first Forum, 10 years ago. Much has been achieved in research and resource management in the ensuing years and many of the original research goals achieved or underway. It was time to look forward and begin planning for the next decade.

The panel discussion was moderated by Robert Sandford, EPCOR Chair, Canadian Partnership Initiative, United Nation's Water for Life Decade. The guest panel consisted of Steve Heiskary of the Minnesota Pollution Control Agency, Dr. Hugh MacIsaac from the Great Lakes Institute for Environmental Research, University of Windsor, and Dr. Norm Yan from the Department of Biology, York University. Each panellist delivered a keynote presentation and then participated in the moderated panel discussion with the Forum attendees.

Keynote panelists on "Futures: Issues and Challenges for the next 10 years".
From left: Steve Heiskary, Robert Sandford, Norm Yan, Hugh MacIsaac.

The Forum was opened with an introduction by Dr. Andrew Paterson of the Ontario Ministry of Environment, who has participated on the organizing committee since the first Forum, a decade ago. Dr. Paterson provided an overview of the history of the Forum, noting that it was established to:

1) share scientific knowledge;
2) establish working relationships among international researchers;
3) coordinate and focus research activities; and
4) identify research gaps.

Dr. Paterson commented that we have remained true to these objectives over the past 10 years,

Dr. Paterson presented a Wordle plot (www.wordle.net) synthesizing the words in the titles of all the research presentations and posters for the 10 years of the Forum and also a Wordle plot of the text of the IJC Task Force Report . Dr. Paterson noted common themes that emerge from the plots, including that our work has been strongly focused on water quality, nutrients, climate and watershed monitoring, assessment and management. Also, the Wordle plots from the Forum presentations and poster titles, and the IJC Task Force final report, are similar suggesting that science and policy are beginning to merge. He concluded that we are on the right track.

Wordle plot of a decade of Forum presentation and poster titles

Wordle plot of text of the IJC Task Force Report

Over its ten years, the Forum has become increasingly a “hub” for other groups working in the basin. Many groups, such as the International Multi-Agency Arrangement Working Group and its Technical Advisory Committee and the IJC’s 2000 Rainy River and Namakan Lake Rule Curve Review team, took advantage of the Forum as an opportunity to hold collaborative meetings. Leveraging the Forum as an opportunity for face-to-face meetings is extremely important, given the vast size of the watershed, researchers collaborating “at distance”, and the limited funds available in many agencies for travel.

The 10th Anniversary Banquet and poster session on the evening of March 13th provided a collegial atmosphere to review the day's work, discuss the research poster presentations and develop professional networks. The Honourable Gordon Mackintosh, Minister of Conservation and Water Stewardship for the Province of Manitoba, provided the keynote address at the banquet. In his remarks, he noted the importance of respecting and acting as subjects of Mother Earth and that this was a moral obligation. He spoke of the problems in Canada of insufficient sewage treatment and untreated discharge as indicative of our failing to commit to clean waters, noting the crisis in water quality on Lake Winnipeg. Minister Mackintosh noted that phosphorus loading was really "pollution" citing the good efforts to achieve international coordination and phosphorus management in the Lake of the Woods watershed as important to Lake Winnipeg, given that 15% of its phosphorus load comes from the Winnipeg River, which drains Lake of the Woods. Minister Macinstosh noted that he is interested in developing a "Lake Winnipeg Accord", among the jurisdictions in the broader Lake Winnipeg watershed, for joint efforts to reduce phosphorus pollution. Noting that good science is the foundation of good management, Minister Mackintosh closed his remarks with comments about the need to save the Experimental Lakes Area program from impending closure by the Canadian Government.

The Hon. Gord Mackintosh, Manitoba Minister of Conservation and Water Stewardship – keynote address.

The Kallemeyn Award was presented to Dr. Andrew Paterson of the Ontario Ministry of Environment in recognition of his outstanding professional achievements and contributions to research and resource management in the Rainy-Lake of the Woods watershed. The Wilson Stewardship Award was presented to Kelli Saunders of Kenora. Launched at last year's Forum, the Award recognizes the outstanding achievements of individuals, groups, or projects that have made a significant contribution to environmental stewardship in the Rainy-Lake of the Woods watershed.

Andrew Paterson (left), Kallemeyn Award recipient, and Kelli Saunders (right), recipient of the Wilson Stewardship Award, accompanied by Todd Sellers, LOWWSF. Thanks to Bev Clark (sunfish carving) and Minaki fishing guide Frank Bryant (guided fishing trip) for donating the gifts accompanying the awards.

The Poster Session (March 13) and Symposium Presentations (March 14) featured 16 presentation of research pertaining to Lake of the Woods and Rainy River watershed. The International Multi-Agency Arrangement presented an update on its activities during 2012 and priorities for 2013. Commissioner Rich Moy, IJC US-Section provided a presentation on the IJC and progress on the establishment of the new International Rainy-Lake of the Woods Watershed Board, including Board composition, duties, and studies to be undertaken. In addition, Mike Laitta, presented an update on the IJC's initiative to harmonize transboundary hydrologic data and systems across the border and specific progress in the Rainy-Lake of the Woods Watershed. Laitta presented an overview of the watershed delineation completed and an online demonstration of the new interactive mapping tools developed by the IJC for our watershed.

The 10th Anniversary Forum closed with a summary address by Robert Sandford, EPCOR Chair, Canadian Partnership Initiative, United Nation's Water for Life Decade, and moderator of our futures session. Mr. Sandford's Forum summary address is included in its entirety in these proceedings .

The 10th International Lake of the Woods Water Quality Forum is a significant milestone achievement. To sustain this event for a decade, organized by a volunteer group of researchers

and resource managers, speaks volumes to the passion and commitment of the professionals working on the Rainy-Lake of the Woods watershed. It also is indicative of the value that the people working on water quality and other ecosystem health issues in the watershed place of the Forum itself as a meeting place and venue for incubating research and international collaboration in our watershed. On this, the 10th Anniversary of the Forum, special thanks is due to all who have helped organize and run the Forum over the years and also a great thanks to our Forum Sponsors who have assisted with funding over the years.

Program At A Glance

MARCH 13

10 AM TO NOON – REGISTRATION TABLE OPEN

12:00 LUNCH

13:00 Welcome and Introductions

13:10 SESSION 1 – NUTRIENTS & PALEOLIMNOLOGY

1. **Minnesota's Draft River Eutrophication Standards.**
   Steven Heiskary. Minnesota Pollution Control Agency.
2. **Estimating Sediment and nutrient loading from southern shoreline erosion in Lake of the Woods.**
   Stephanie Johnson[1] and Corryn Trask[2]. [1]Houston Engineering; [2]Lake of the Woods County Soil and Water Conservation District.
3. **An Updated Total Phosphorus Budget for Lake of the Woods.**
   Jesse Anderson, Nolan Baratono, Steve Heiskary, and Bruce Wilson. Minnesota Pollution Control Agency.
4. **Reconstructing the history of Lake of the Woods: What lies beneath the lake floor?**
   Devin D. Hougardy, Mark B. Edlund, Steve M. Colman, Nigel J. Wattrus. University of Minnesota-Duluth, Large Lakes Observatory.
5. **A historical phosphorus budget for Lake of the Woods: Sedimentation in the southern basin.**
   Mark Edlund[1], E.D. Reavie[2], S. Schottler[1], D. Hougardy[3], N. Wattrus[3], N. Baratono[5], A.M. Paterson[4], D.R. Engstrom[1]. [1]St. Croix Watershed Research Station; [2]Natural Resources Research Institute, University of Minnesota Duluth; [3]Large Lakes Observatory, University of Minnesota Duluth; [4]Dorset Environmental Science Centre, Ontario Ministry of the Environment; [5]Minnesota Pollution Control Agency

14:50 Break

6. **A multi-indicator approach to describing the ecological history of the White Iron Chain of Lakes.**
   Euan D. Reavie[1], Amy R. Kireta[1] and Andrea M. Nurse[2]. [1]Natural Resources Research Institute, University of Minnesota Duluth; [2]Climate Change Institute, University of Maine

15:30 SESSION 2 – FISH, AIS & HABITAT

7. **Hydrologically-connected Systems Facilitate Long Distance Dispersal in Beavers.**
   Steve Windels. Voyageurs National Park.
8. **Changes in the fish community and walleye population recovery in Shoal Lake, Ontario following an invasion by rainbow smelt.**
   Tom Mosindy. Ontario Ministry of Natural Resources.
9. **Spiny Water Flea (Bythotrephes longimanus) Impacts on Zooplankton Communities of Voyageurs National Park.**
   Martin M. Hobmeier[1], Jodie K. Hirsch[2], W. Charles Kerfoot[1], Foad Yousef[1], Jaime F. LeDuc[1,3], and Ryan P. Maki[3]. [1]Michigan Technological University, [2]MN Department of Natural Resources, [3]National Park Service.
10. **Using moored temperature arrays to understand coldwater fish habitat in lakes at Voyageurs National Park.**
    Jaimie LeDuc and Rick Damstra. National Parks Service.
11. **Assessing aquatic vegetation as a habitat component for larval and young-of-the-year northern pike in Rainy Lake and Namakan Reservoir.**
    Anne Timm and Rod Pierce. USDA Forest Service.

17:10 Break

18:00 – 21:00 FOUNDATION BANQUET & POSTER SESSION (AMERICINN)

Guest Speaker

The Honourable Gord Mackintosh, Manitoba Minister of Conservation and Water Stewardship

- **Kallemeyn Award Presentation**
- **Wilson Award Presentation**

Poster Listings – See Next Page

POSTER SESSION

1. **The Kawishiwi Watershed Protection Project.**
   Derrick Passe and WICOLA
2. **A Water Resource Centre for our watershed: Pulling it all together.**
   Kelli Saunders. Lake of the Woods Development Commission
3. **International Lake of the Woods hydrology and water quality modeling.**
   Cindie M. McCutcheon, Seth J. Kenner, Julie A. Blackburn. RESPEC Water & Natural Resources
4. **An Updated Total Phosphorus Budget for Lake of the Woods**.
   Anderson, Jesse; Nolan Baratono, Steve Heiskary, and Bruce Wilson. Minnesota Pollution Control Agency
5. **Overview and Progress Report: International Joint Commission 2009 Plan of Study for the Evaluation of the IJC 2000 Order (Rule Curves) for Rainy Lake, Namakan Reservoir, and the Rainy River.**
   Geoffrey M. Smith and Ryan P. Maki. Voyageurs National Park, National Park Service
6. **In-transit collection of real time surface water quality: Data acquisition on the go.**
   Timothy Pascoe, Benoit Lalonde, Niels Madsen, Tana McDaniel. Environment Canada
7. **1924 Lake of the Woods – Rainy River IJC Map.**
   Michael Laitta. International Joint Commission
8. **The Forum 10 years after - Successes and achievements internationally.** Forum Organizing Committee

MARCH 14

7:30 – 8:15 COFFEE (COMMUNITY COLLEGE CAFETERIA)

08:15 SESSION 3 – GOVERNANCE UPDATES

1. **International Multi Agency Arrangement (IMA) Update.**
   Suzanne Hanson. IMA Workgroup Member - MPCA
2. **International Watershed Initiative Board – IJC Update.**
   Commissioner Rich Moy. International Joint Commission, Washington.
3. **Transboundary Data Harmonization Task Force – IJC Update.**
   Michael Laitta[1] and Conrad Wyrzykowski[2]. [1]International Joint Commission, Washington; [2]Agriculture & Agri-Food Canada

09:10 SESSION 4 – HYDROLOGY

4. **Development of a 1-dimensional HEC-RAS model of four pinch point channels in the Namakan chain of lakes.**
   David R. Stevenson and Aaron F. Thompson. Environment Canada.
5. **Development of a hydrologic response model for Rainy Lake and the Namakan Reservoir to assess the hydrodynamic changes of the 1970 and 2000 IJC Rule Curves.**
   Aaron F. Thompson. Environment Canada.

09:50 Break

10:20 SESSION 5 – KEYNOTE PRESENTATIONS

6. **Steve Heiskary.** A Look Back and A Look Ahead: The Next 10 Years for Lake of The Woods 10th Annual Forum. Minnesota Pollution Control Agency
7. **Hugh MacIsaac.** University of Windsor
8. **Norm Yan.** York University

12:00 Lunch

13:30 MODERATED PANEL DISCUSSION: "FUTURES: ISSUES AND CHALLENGES FOR THE NEXT 10 YEARS"

Robert Sandford – Moderator
Chair Canadian Partnership Initiative, UN Water For Life Decade

Steve Heiskary **Hugh MacIsaac** **Norm Yan**

15:30 – 15:50 CLOSING REMARKS – ROBERT SANDFORD

Forum Sponsors – 2013

The organizing committee would like to thank our 2013 sponsor's for assisting with the 10th Annual International Lake of the Woods Water Quality Forum. This event would not be possible without the assistance of the following groups:

- Lake of the Woods Water Sustainability Foundation
- International Joint Commission
- Minnesota Pollution Control Agency
- Manitoba Conservations and Water Stewardship
- Lake of the Woods District Property Owners Association
- Voyageurs National Park
- City of Kenora
- Municipality of Sioux Narrows – Nestor Falls
- Rainy River Community College
- St. Cloud State University
- Dorset Environmental Science Centre (OMOE)

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Shared Waters, Shared Management – Ten Years Later: Summary Observations on the Tenth International Lake of the Woods Water Quality Forum

Bob Sandford

EPCOR Chair
Canadian Partnership Initiative
United Nations
Water for Life Decade
&
Director
Western Watersheds
Climate Research Collaborative

Please allow me to thank the organizers of this Forum for their invitation to speak at this important 10th anniversary conference. This is the second time I have been invited to speak here and the second time also that I was invited to summarize these wide-ranging proceedings. It should be noted, however, that these observations are not meant to be an official record of the proceedings, but a summary only of what one observer derived from what was presented over the past two remarkable days.

I would like to begin, as I did in 2011, by congratulating all of you on your collective good will; your well-orchestrated volunteer effort; attention to scientific rigor and shared understanding of the Lake of the Woods problem and how to address it. Once again I have concluded that this is a remarkable organization.

This initiative is being conducted cooperatively and collaboratively as if the players did not live in different countries but in the same watershed. This is not common in many transboundary situations. I hope you can make enough progress in desired timeframes to prevent this excellent relationship from changing. The beginnings of this organization are noteworthy. It started with cottage owners worried about the state of their lake. These people committed themselves to the development of public policy in support of their own interests and in support of the future of the lake ecosystem.

This organization is truly international. Though it recognizes jurisdiction, there is no boundary between Canada and the United States in manner in which you collectively think and act. You have governments at county, municipality, town, city, state, provincial and federal levels all working together toward the same ends.

It is clear that this organization was founded on scientific principles. Participants all have an informed, scientific and practical interest in the state of the Lake of the Woods. Statements made about the lake are based on evidence not emotion. Though many of the frightening threats that were predicted ten years ago have materialized, they did not overwhelm you. You continued to learn more about concerns such as eutrophication, invasive species and hydro-climatic change. As Andrew Patterson said, when science merges into policy then we know we are on the right track.

So what was presented over the past two days? In the opening presentation Steve Heiskary introduced us to Minnesota's new draft eutrophication standards. He explained the use of multiple lines of evidence in the development of criteria. He talked about linkages between residence time, light, temperature and eutrophication with a special focus on larger rivers in a regional context. He talked about merging water quality data with biology to determine thresholds of aquatic ecosystem change. He then explained how assessments of biological conditions are then based on mean values from a minimum of two summers and six or more observations in each of those summers. He also identified a threshold past which Minnesota Lakes would be deemed

eutrophied. He indicated that Minnesota was now doing assessments on all major rivers in the state. In summary he told us that some 500 lakes were now listed as impaired by excess nutrients. He noted in conclusion, however, that all the technical details were now available; and that new management rules were about to be published and that these rules could be in place as early as 2014. That is significant progress.

Stephanie Johnson talked about her efforts to estimate sediment and nutrient loading as a result of erosion of the south shoreline of the Lake of the Woods. She explained the process by which she updated the estimate of the amount of nutrient loading that occurred in the lake from this source. She showed how she used historic photographs from 1940 to 2009 to demonstrate the dynamic nature of the southern shoreline in terms of both loss and deposition over the past 70 years. She estimated the total amount of sediment eroded over that period contributed in the order of 75 metric tons of phosphorous to the system every year. She noted that this is a significant contribution and that data was now available related to how much of this phosphorous becomes bio-available.

Jesse Anderson also contributed to enhanced understanding of the phosphorous budget of the Lake of the Woods. Jesse acknowledged and praised the work upon which current research is founded. He explained the steady state “bathtub” model for understanding phosphorous loading that had been developed by William Walker in the 1980s. He explained the importance of updating and digitizing information that already existed so as to make it available to others. He noted the importance of incorporating the work of others such as Stephanie Johnson into a model projecting the total phosphorous budget of the lake. That model revealed a total phosphorous input into the Lake of the Woods of about 1147 metric tons a year. He concluded that researchers are finally getting a handle on phosphorous sources. Progress is being made on data gaps; models are becoming robust; and conditions in the lake appear to be stabilizing. Work will begin next on possible effects of climate change on algal blooms. What I got out of this was that the system can be managed.

David Hougardy then shared the outcomes of a reconstruction of the history of the Lake of the Woods. The goals of this project were to define where sediments accumulate and to determine the lithology of the basin so as to use the history of the lake as vehicle for imagining its future. A seismic survey was undertaken; and a bathymetric map created from which a deposition map was derived. We now know what changes took place in the past and where deposition of phosphorous takes place. The direction history appears to be take the lake is toward tectonic and other geophysical processes that will marginally increase shoreline erosion.

Mark Edlund also examined the historical phosphorous budget for the Lake of the Woods. He did this in a way that demonstrated complementary scientific approaches to answer common questions that need to be answered regarding nutrient loading. Edlund noted that though phosphorous declined in tributaries that fed the lake, eutrophication continues to be a problem. He noted also that there were major shifts in diatom communities in the past decade which implied in his words that “something is happening in the lake.” He also said that he found no indication of less phosphorous being buried in the sediment. The concentration of phosphorous in the sediments at the bottom of the Lake of the Woods had, in fact, increased two-fold compared to the period before European settlement. In some places phosphorous concentrations were three to five times higher than they were before settlement and damming. Mark also observed from direct personal experience that a tornado is a twister over land while a twister over water is called a water spout. Both, he indicated, elicit the same kind of terror.

Euan Reavie introduced us to a multi-indicator approach to describing the White Iron Chain of Lakes. This is just-breaking multi-disciplinary work that investigates the historical impacts and the effects of passive rehabilitation. This work also explores changes in organic elements in a variety of what turned out to be very different lake systems. Euan also explored accumulation of metals in various lakes before and after European settlement. Additional work concentrated on the pollen record over the same period. Changes in each lake system in the White Iron Chain of Lakes have occurred since European settlement. Some lakes show recovery while some continue to change. This is interesting research that will yield more outcomes in the future.

We then moved from the topics of limnology and nutrients to the domain of fish and habitat. Steve Windels passionately re-affirmed the role of the beaver as the centre of our eco-hydrological universe. He noted that understanding the population dynamics of beavers is critical to preserving aquatic ecosystem health. He explained how he tracked beaver dispersal by tagging animals. He noted that travel by water reduces predation risk, hostile interaction with other territorial beavers and reduced the amount of energy it took to move from one area to another. We learned that beavers can disperse as far as 140 kilometers from where they are born in Voyageurs National Park, which is a greater distance than noted historically elsewhere. Protected areas like national parks are beaver factories dispersing these creatures to do their heroic hydrological work widely. Beaver movement is facilitated by hydrologically connected systems. When provided with such connected systems beavers provide valuable ecosystem services.

Tom Mosindy described changes in the fish community and walleye recovery in Shoal Lake, which happens to be the water supply for the City of Winnipeg. Tom noted that commercial fishing began in the 1880s in Shoal Lake and pointed out that over-exploitation of walleye after 1960 led to the fishery being closed in 1983. The lake remains closed to fishing to this day because populations did not recover. Tom observed that walleye populations did not recover because in the interim the composition of the fish community in the lake changed. From Tom we learned that Walleye recovery is often dependent on changes in the lake's fish community. Walleye recovery in Shoal Lake was hampered by an invasion of rainbow smelt. In conclusion, Tom underscored the importance of maintaining strong pelagic predator populations to minimize smelt impacts on lake ecosystems that resemble that of Shoal Lake.

Martin Hobmeier introduced participants in the conference to the invasive world of the spiny water flea. In so doing he took the conversation started by Tom Mosindy down a trophic level by talking not about rainbow smelt but about invasive zooplankton that are expanding rapidly into inland lakes. Martin observed that predation on small zooplankton can lead to shifts in community composition, which can alter the entire food chain. Marten then demonstrated that these changes can be dramatic.

Jaimie LeDuc used moored temperature arrays to understand cold water fish habitat in lakes in Voyageurs National Park. From this presentation we learned that while lake trout and cisco were both under pressure from fishing, their populations were also being affected by water temperature and water quality. Both species require specific oxy-thermal conditions. These conditions have been combined into a single monitoring parameter known as TDO3 (temperature at 3 $mg \bullet L^{-1}$ of dissolved oxygen). Using this parameter the probability of occurrence of lake trout and cisco can be modeled and predicted. Warming waters diminish dissolved oxygen which suggests that lake trout and cisco still have a substantial oxy-thermal niche in some Voyageurs National Park lakes. In other lakes, however, the oxy-thermal niche collapses especially in July and August. It remains unclear, however, if competition from other species in these narrowing conditions may be the cause of the decline of lake trout and cisco in some lakes. More lakes need to be studied to confirm these results.

Anne Timm is working to determine if northern pike populations prosper under the 2000 International Joint Commission rule curves as compared to those imposed to control water levels in Rainy Lake and Namakan reservoir in 1970. The goal of this study is to verify that northern pike are using improved spawning and nursing habitat created under the new rule curves by sampling larval populations and young of the year in aquatic vegetation. Sample sites were chosen, light traps set, water depth and aquatic macrophyte species larva counted and total length measured. At this point in the research the results do not indicate that the rule curve changes made by the IJC in 2000 benefitted pike; but research is on-going.

Manitoba Minister of Conservation and Water Stewardship, the Honourable Gordon Mackintosh, began his dinner address by noting that we are all subjects of Her Majesty – Mother Earth. Working for the environment, he said, has a powerful moral dimension. He pointed out that we are not doing as good a job as we can in serving Mother Earth. There are 800 communities in Canada that pump raw sewage into surrounding waters. His own mother, Minister Mackintosh intimated, had taught him that nutrients were good for you. The nutrients we are putting into our

waters, are not good for you, he said. Call nutrients what you want, he argued, but what they really are is phosphorous pollution. Manitoba, he explained, was concerned about the Lake of the Woods for three reasons: Manitoba shares some of the shoreline; Winnipeg gets all of its drinking water from Shoal Lake which is part of the Lake of the Woods system; and the Winnipeg River is the second largest contributor of nutrients to Lake Winnipeg. The Minister then introduced the concept of a Lake Winnipeg Accord. Such an accord would need to include a science-based nutrient management program that engages the 50 to 60 NGOs with interests in the problem, all government agencies and important others. Blame, the Minister pointed out, is a difficult matter. It is not helpful to create urban versus rural tensions. We need to stop talking about waste-water and starting talking about Lake Winnipeg. The real issue, he said is water governance. European settlers came to Manitoba and tried to confine every land-use with a square. “I have never seen a square lake or a square watershed,” he said. Good science is critical. The Minister concluded his remarks by saying that it is one thing to cut science for reasons of budget; another for reasons of ideology. We need to restore the Experimental Lakes Area, he said, which was at the time of his speech two weeks away from having its federal funding terminated. The ELA matters, he concluded. His audience agreed.

Suzanne Hanson began the second day of the conference by updating the conference on the Lake of the Woods International Multi-Agency Arrangement (IMA). Suzanne identified the nine signatories engaged in trans-jurisdictional coordination and collaboration, data sharing and the planning and implementation of joint projects. She noted that while there are management gaps scientists are the drivers especially with respect to eutrophication and other concerns related to the overall state of the basin. Suzanne praised and offered support for the new IJC Watershed Initiative Board and working group and for the IJC Water Quality Plan of Study. The next steps in this collaboration, Suzanne explained, included connecting the IMA Working Group with IJC watershed board priorities; more communication; and the securing of funding for high priority projects.

IJC Commissioner Rich Moy then offered an update on the work of the International Watershed Initiative Board. Commissioner Moy observed that when IJC Commissioners are appointed they must swear an oath to the letter and spirit of the 1909 Boundary Waters Treaty between Canada and the United States. Commissioner Moy commented, as did Minister Mackintosh, on the importance of moral responsibility in the management of our shared waters referring specifically to inter-generational responsibility. Commissioner Moy then outlined the principles that drive the new board and its mandate and announced that appointments to that new board are immanent.

I wish to note that in my estimation the involvement of the International Joint Commission in this manner is a signature of the commitment of all the partners in this larger initiative and a hallmark of potential success.

Michael Laitta followed Commissioner Moy and talked on the crucial matter of the bi-national effort to harmonize data between the two countries that share the Lake of the Woods basin. Michael described the inter-agency task force that is working toward that harmonization. The goal is to monitor and report on the ecological health of the Lake of the Woods system by connecting islands of information, focusing on standards derived from systematic sharing of bi-national data. Mr. Laitta observed that the International Joint Commission is uniquely positioned to become major data stewards in support of more coherent and more sustainable management of the Lake of the Woods system. Considerable progress has been made since 2006. For the first time partners have access to seamless data interpretation of the Lake of the Woods system based on common hydrographic management units. Michael then demonstrated what this meant in terms of data availability. “The sky is the limit,” he said, ‘in terms of how this information can be used.

Aaron Thompson talked about Environment Canada’s development of a new hydraulic model used for regulation of water levels in the Lake of the Woods. Aaron outlined steps in the development of the model and outlined how obstacles are being overcome to ensure the model faithfully reproduces what actually happens in the system. Aaron then went on to describe the Rainy Lake Namakan Lakes Hydrologic Response Model. This project aims to support the 2015 IJC Rainy and Namakan Lakes rule curve review. This work complements and supports Anne

Timms' work on the population response of Northern Pike in response to the rule curve of change of 2000. Evidence to date seemed to suggest that the new rule curve does provide for better performance of the system. As an outside observer I couldn't help but feel this was a lot more important that it seemed given the importance of water levels to ecosystem health.

We were then favored by three very enlightening keynote presentations. Steve Heiskary went back 30 years to challenges posed by threats like acid rain and mercury contamination when lack of necessary data made it difficult to deal with these problems. Steve underscored the importance of good data that could only be derived through a commitment to on-going monitoring. He then pointed out that we found ourselves in a similar situation when algal toxins became a problem. There will be other problems in the future, he explained, where this same shortcoming will emerge. These problems include climate change, invasive species, emerging contaminants and increasing nitrogen concentrations. There will also be surprises, he noted, with respect to flood and drought. He strengthened this point by observing that some 51 lakes disappeared from the National Lake Association listing because they dried up. By keeping monitoring going, he said, we hope to provide future scientists with the data they need to position them to deal with challenges our generation had to wait for data to address. Steve went on also to underscore the value of the Experimental Lakes Area, especially in the context of eutrophication. Steve also noted rather ominously that there are likely to be further economic issues in the future that may hamper efforts to address issues related to the protection of systems like the Lake of the Woods.

Hugh MacIsaac began by arguing that the Great Lakes are very important as a vector of invasive species. Dr. MacIsaac noted that there are some 185 invasive species in the Great Lakes of which we are aware. He went on to dispute the view of some scientists that invasive species are not as serious an issue as they are made out to be. Dr. MacIsaac noted that the best management strategy is to keep invasive species out of our aquatic ecosystems if we can. He noted lines of evidence demonstrating the regulation of ballast water in ocean-going vessels entering the Great Lakes system had effectively reduced the invasive species threat. Six summers have passed since this regulation was put into place and not a single new invasive species has appeared. Still, there are at least 158 lakes in Ontario that have been colonized by invasive species of which many originated in the Great Lakes. If shipping is no longer a vector, Dr. MacIsaac asked, what then should the focus be in terms of preventing the further spread of these species? The spread, he said, was still associated with transportation; largely through fishing gear. The implicit assumption that species like water hyacinth and other exotics can't survive in Canada, he pointed out, no longer held in the context of warming water temperatures. Dr. MacIsaac then noted that there was an urgent need for formal risk assessments of plants being sold commercially in Canada to determine how they might react to changing hydro-climatic conditions. It was disturbing to be shown the extent to which zebra mussels are finding their way west to Colorado and even as far as California. Public awareness of the invasive species threat is critical. The conclusion I drew from Dr. MacIsaac's thoughtful presentation was that while we addressed the ballast issue in the Great Lakes, invasive species remain a huge problem.

Dr. Norman Yan discussed emerging issues for northern lakes. He began his presentation by noting that globally there were more frequent natural disasters. With Hurricane Sandy we have now seen the first environmental refugees in North America. Dr. Yan observed that we are approaching a number of environmental thresholds. He demonstrated that multiple stressors are on the rise as evidenced by the impact these stressors are having on plankton. These stressors include physical factors such a freeze time and duration and warming lake temperatures that lead to food quality declines. Water quality is also changing. As a consequence of these stressors, living communities are changing. Dr. Yan then went on to demonstrate how stressors can interact. Some of the things our children can expect to see include climate effects, reduced food quality in lakes, decalcification, more people, and more stressors resulting in environmental and ecological surprises. These combined effects will result in a loss of aquatic community richness. Dr. Yan also noted that many of our current stressors are advancing westward. Are we prepared? No. There is much to do. What we need is knowledge and a will to act. The will to act will require a strengthened democracy. Dr. Yan noted that the theme of this conference was a ten year retrospective on progress toward improvement of the ecosystem health of the Lake of the Woods.

Ten years into the future, Dr. Yan predicted, invasive species will be more of a natural disaster than pollution. Invasive species are coming. Popular lakes for boating will be big vectors. “What,” Dr. Yan asked, “are the critical things we need to do to set the agenda for the next ten years?” He answered that question by noting we are working on many of these things now. They include monitoring, data collection and sharing. There is a huge need, he said, to carry on with productive collaboration. On-going knowledge gap analysis will be required. Calcium concentrations in lake systems have to be part of this new synthesis of incoming data. The further strengthening of the bridge between science and public policy may require more involvement of the social sciences. Public outreach will matter more than ever; he noted, as will conferences of this kind.

Conclusions

As an outside observer I am left with the following conclusions. What impressed me – and the most important impression I am taking away from this conference – relates to a comment Minister Mackintosh made in his dinner presentation. A great many of the people who attended this conference have had their personal identity established by their relationship to the Lake of the Woods. As Andrew Patterson demonstrated in accepting an award at this conference there is among this group great pride in association, pride in accomplishment and pride in promise. Kelly Saunders echoed the same pride when she spoke of her on-going, caring commitment not just to the Lake of the Woods cause but especially to those who care as much as she does about the lake and the organization that exists to save it. “There is no border as far as I am concerned,” she said. She is right. Socially, economically, scientifically and politically you are all in this together.

As Mark Edlund indicated in his closing remarks, “big lakes, big problems. More work to be done.” I wish you all the best of luck in doing that work. I will characterize this conference to others by referring to a sign that was posted at the entrance to the college in which it was held. The sign said “Water Quality: This Way.” Below these words was an arrow pointing to where you were meeting. Yes: this way. Go this way.

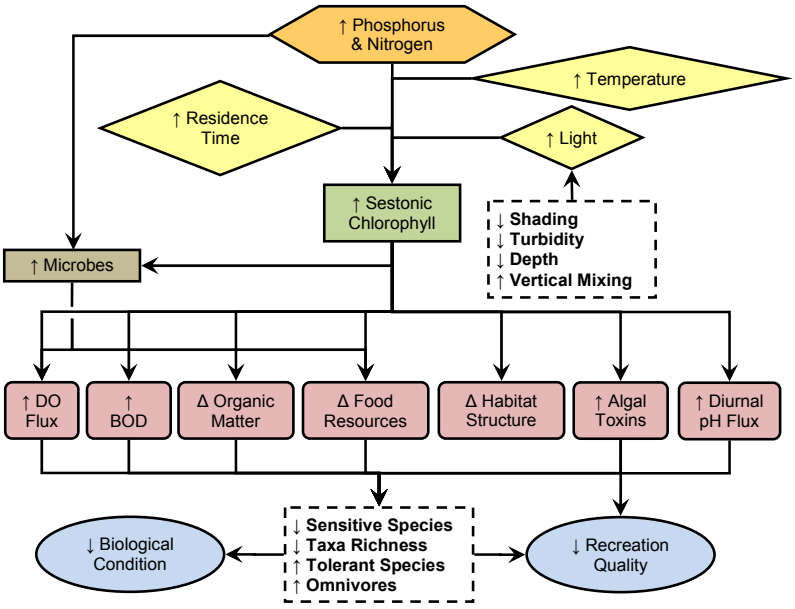
Bob Sandford
EPCOR Chair
Canadian Partnership Initiative
United Nations
Water for Life Decade
&
Director
Western Watersheds
Climate Research Collaborative

Presentation Abstracts

Minnesota's Draft River Eutrophication Standards

Heiskary, Steven

Environmental Analysis & Outcomes Division, Minnesota Pollution Control Agency, 520 Lafayette Road, St. Paul, MN 55155



Conceptual model of the impact of nutrient enrichment on biological condition and recreational quality for medium to large rivers.

Draft river eutrophication criteria by River Nutrient Region for Minnesota

	Nutrient		Stressor	
Region	TP µg/L	Chl-a µg/L	DO flux mg/L	BOD_5 mg/L
North	≤50	≤7	≤3.0	≤1.5
Central	≤100	≤18	≤3.5	≤2.0
South	≤150	≤35	≤4.5	≤3.0

Abstract

Excess nutrients are an important focus for USEPA and states have been charged with developing nutrient (eutrophication) standards as a part of their state water quality standards. In 2008, Minnesota promulgated lake eutrophication standards as a part of this national effort.

The Minnesota Pollution Control Agency (MPCA) has developed draft river eutrophication standards as a part of its current revision of Minnesota Rule Chapter 7050 standards rulemaking. Proposed standards and associated technical support documents are out for public review and comment. This presentation will provide an overview of the technical basis for the standards, discuss implementation and assessment issues related to the proposed standards, and address questions as they may relate to the Lake of the Woods and the Rainy River watershed.

Estimating Sediment and nutrient loading from southern shoreline erosion in Lake of the Woods

Stephanie Johnson, Ph.D., P.E.[1]; Corryn Trask[2]

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Abstract

The southern shoreline of Lake of the Woods (LOW) is experiencing significant erosion problems. This erosion threatens unique fish and wildlife habitat that provides refuge for a number of federally threatened and endangered species. The eroding sediments are also, likely, a consequential source of nutrient loading to the lake, which is impaired for eutrophication and biological indicators. The primary goals of this study were to: identify areas of major shoreline erosion from 1940 to 2009 and from 2003 to 2009; estimate the annual rates and overall volumes eroded during these time periods; and estimate the nutrient load entering LOW from shoreline erosion during these times.

The examination of eight sets of aerial photos, taken between 1940 and 2009, show a dynamic shoreline. Some areas have receded by nearly a mile over the past seventy-years, while others (particularly near Rocky Point and Bostic Bay) have seen significant deposition. Areas with extreme erosion are typically found in mucky soils and have bank heights of less than five feet. Final results of the study show an estimated average erosion rate from the southern shoreline (between Warroad and the Rainy River) of 4.6 million cubic feet per year. The estimated total deposition was 0.4 million cubic feet per year.

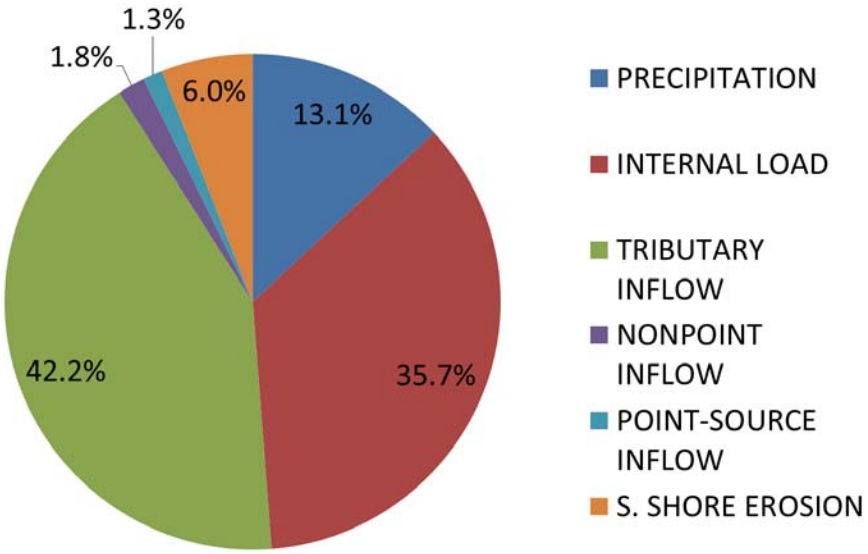
Sediment cores were taken to characterize nutrient contents within the shoreline soils. Results of that analysis were combined with the erosion estimates to compute average annual nutrient loadings (to the lake) from shoreline erosion. Final results show an estimated average total phosphorus loading of 82 tons per year.

The focus of this presentation will be to discuss the methods used to investigate and estimate erosion and nutrient loading along the southern shoreline and also to present the findings of the work. Additional information to be presented includes a discussion of how the shoreline erosion volumes and nutrient loads are being integrated into overall nutrient budgets for LOW.

An Updated Total Phosphorus Budget for Lake of the Woods

Anderson, Jesse; Nolan Baratono, Steve Heiskary, and Bruce Wilson

Minnesota Pollution Control Agency - 525 South Lake Ave., Suite 400, Duluth, MN 55802. (218)302-6621; jesse.anderson@state.mn.us'



Relative sources of phosphorus to LOW, estimated at 1,147 metric tons per year (excluding 55% retained)

Abstract

In the past several years a significant amount of water quality monitoring, modeling, and research has taken place on Lake of the Woods, which allows for more refined models and predictions of water quality. Building on the recent work of our colleagues, an updated total phosphorus budget for the southern, eastern, and central basins for Lake of the Woods will be presented, using 2010 conditions as a baseline. The BATHTUB model was used, developed by the US Army Corps of Engineers, which combines mass-balances with empirical relations to diagnose and predict trophic responses. Lake of the Woods was divided into 5 segments based on observed differences in water quality and bathymetry – Four Mile Bay, Big Traverse and Buffalo Bays, Muskeg Bay, Sabaskong Bay and Northeast Big Traverse, and Little Traverse Bay / Northwest Angle. Revised bathymetry data from Environment Canada, measurements of internal phosphorus loading (laboratory aerobic release rates), and revised phosphorus loads from the Rainy River (based on recent event-based sampling) were incorporated into the model. The total phosphorus budget was estimated at 1,147 metric tons per year, partitioned into 6 categories-tributary inflow (principally the Rainy River) 42%, internal load 36%, precipitation 13%, shoreline erosion 6%, non-point inflow 2%, and point sources, 1%. BATHTUB estimates that 55% of the phosphorus is retained within the lake. The model's predicted area-weighted mean concentrations of total phosphorus, chlorophyll-a, and Secchi depth were similar to observed values. When excluding internal loading estimates (not modeled previously), results were similar to previous investigations. The model's output will help guide restoration options for the eutrophication impairment and provide a baseline for the Total Maximum Daily Load Study on the US portion of Lake of the Woods.

Reconstructing the history of Lake of the Woods: What lies beneath the lake floor?

Devin D. Hougardy, Mark B. Edlund, Steve M. Colman, Nigel J. Wattrus

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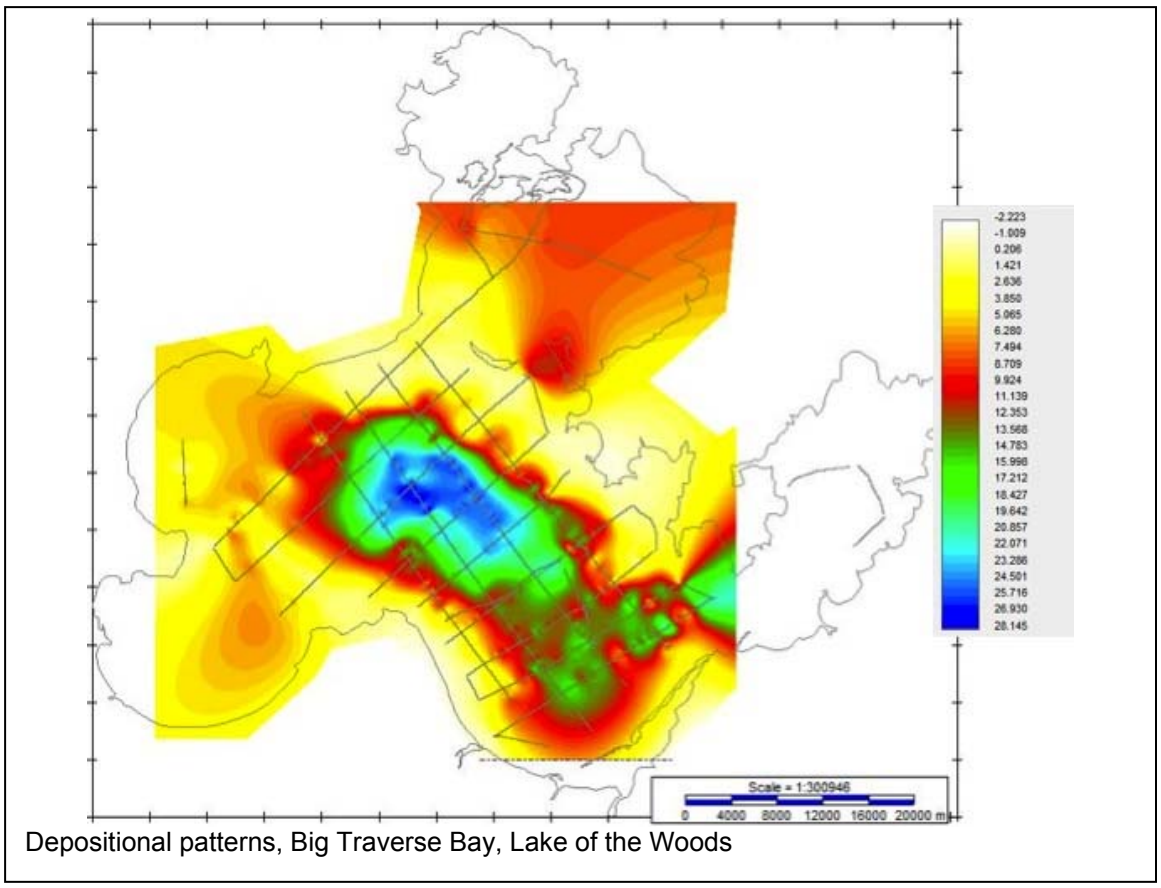


Depositional patterns, Big Traverse Bay, Lake of the Woods

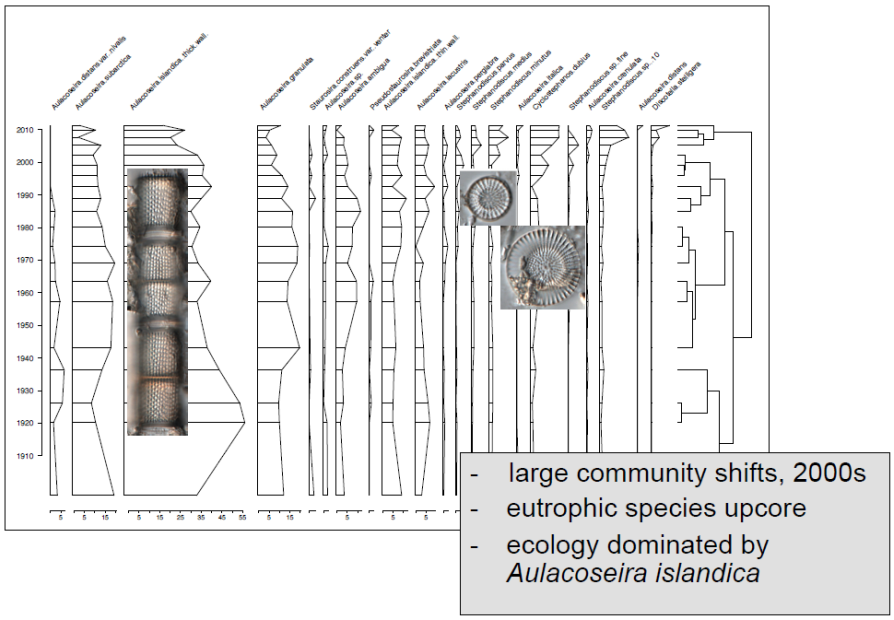
Abstract

Seismic-reflection data collected from Lake of the Woods reveal a detailed sequence of stratigraphy penetrating to depths of as much as 25 m below the present day lake floor. Stratigraphic changes are likely due to large changes in the water storage going back in time as far as the Last Glacial Maximum. An abrupt change in stratigraphy occurs at ~3-5 m depth shifting from a thick package of sub-parallel horizons to a relatively thin package of massive sediment. This shift is thought to indicate the transition from Lake Agassiz to Lake of the Woods derived sediments.

A historical phosphorus budget for Lake of the Woods: Sedimentation in the southern basin

Edlund, M.B.[1*], Reavie, E.D.[2], Schottler, S.[1], Hougardy, D.[3], Wattrus, N.[3], Baratono, N.[5], Paterson, A.M.[4], Engstrom, D.R.[1]

[1]St. Croix Watershed Research Station, Science Museum of Minnesota, Marine on St. Croix, MN 55047
[2]Center for Water and the Environment, Natural Resources Research Institute, University of Minnesota Duluth, 1900 East Camp Street, Ely, MN 55731
[3]Large Lakes Observatory & Department of Geological Sciences, 10 University Dr., Duluth, MN 55812
[4]Dorset Environmental Science Centre, Ontario Ministry of the Environment, 1026 Bellwood Acres Road, P.O. Box 39, Dorset, ON, P0A 1E0
[5]Minnesota Pollution Control Agency, 909 Riverside Drive, International Falls, MN 56649



Downcore diatom profiles from Big Traverse Bay core 3 show that although the diatom ecology of the lake is still dominated by *Aulacoseira islandica*, there has been a distinct community change since the 1990s to include greater abundance of eutrophic species such as *Stephanodiscus minutus* and *Cyclostephanos dubius*. The lack of change in other core proxies including phosphorus concentration and sedimentation rates provides multiple signals that the lake continues to show high algal productivity in spite of decreased external phosphorus loading.

Abstract

Ongoing efforts to reconstruct a historical phosphorus budget for Lake of the Woods (LoW) require two pieces of information—the amount of phosphorus (P) historically lost from outflow and the amount of P buried in the sediment. The sum of these two quantities over time provides the historical record of P loading to the lake, a key piece of information needed by resource managers to address water quality and cyanobacterial issues currently impacting LoW. To determine patterns of sedimentation in the southern basin of LoW, we conducted seismic profiling and sediment coring throughout the basin. Short gravity cores (<25 cm long) were used to define depositional zones and groundtruth seismic data. Seven index cores (piston cores, ~1 m long) were also collected from Big Traverse (2 cores), Little Traverse, Sabaskong, Muskeg, Buffalo Bay, and Big Narrows and are the focus of intensive analytical efforts including dating, geochemistry (LOI, phosporus, silica), diatom communities, and fossil pigments. Piston cores have been subjected to LOI analysis to differentiate sediment constituents and radioisotopically

dated using 210-Pb and 7-Be to develop date-depth models and determine mixing at the sediment-water interface. Results of profiling and coring show that much of the southern basin of LoW is a depositional environment. The last 200 years of sedimentation are limited to the top 25-35 cm depending on core site, and all cores show the top 1-2 cm are well mixed, likely through bioturbation at the sediment-water interface. Sediments are dominated by inorganics (>80% by dry weight) with more minor organic and carbonate contribution. Most cores show decreasing inorganics and increasing organics and carbonates during the last 200 years. Sedimentation rates across the southern basin generally increase two-fold between pre-1900 and modern times, with the cores from Big Traverse Bay showing three- to five-fold increases in sedimentation rates. Muskeg and Sabaskong bays have the highest sedimentation rates among the southern bays. Two areas of the lake with odd sedimentation patterns include Muskeg Bay, where much of the lake bottom appears non-depositional and lined with exposed Agassiz clays, and Buffalo Bay, where sediment accumulation may not have begun until water levels were raised at Kenora. Initial geochemical and diatom analysis will also be discussed.

A multi-indicator approach to describing the ecological history of the White Iron Chain of Lakes

Reavie, Euan D.[1], Kireta, Amy R.[2] and Andrea M. Nurse[3]

[1]Center for Water and the Environment, Natural Resources Research Institute, University of Minnesota Duluth, 1900 E. Camp St., Ely, MN 55731
[2]Center for Water and the Environment, Natural Resources Research Institute, University of Minnesota Duluth, 1900 E. Camp St., Ely, MN 55731
[3]Climate Change Institute, University of Maine, 112 Sawyer Research Building, Orono, Maine 04469

Abstract

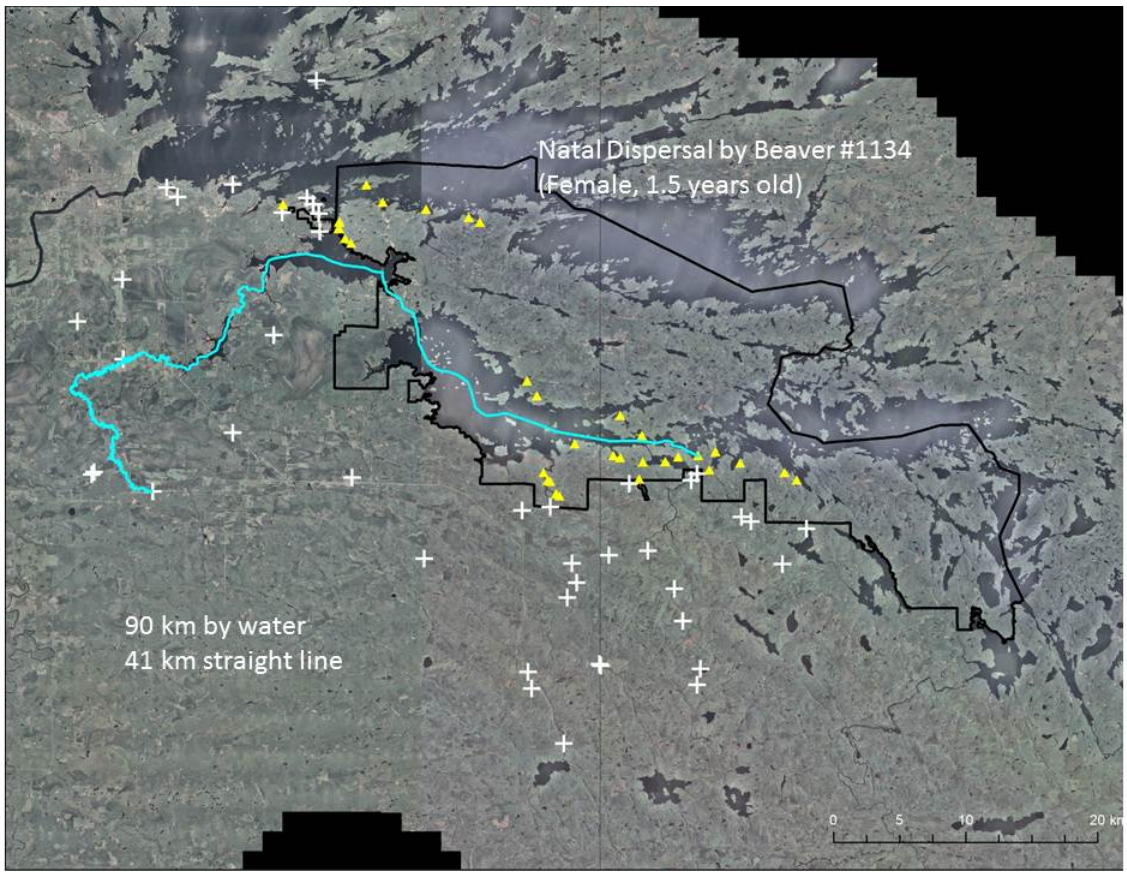
The White Iron Chain of Lakes (WICOL) comprises the lower portion of the Kawishiwi Watershed, draining an area of more than 3,000 km^2 of northern Minnesota's Rainy River Basin. Since human settlement of the region the WICOL has been affected by damming, catchment development, nutrient enrichment (untreated domestic wastewater, agricultural and urban runoff), species invasions, bank instability and erosion. The sensitivity of the lakes in the WICOL to environmental insults is not well understood, so the response of these systems to future impacts similarly unknown. In the case of the WICOL, watershed development is likely to continue in the forms of housing, resorts and mining. By describing in detail impacts caused by past environmental insults, we may be able to predict the impacts of future development scenarios.

Even with the ongoing monitoring program for the WICOL, there is little evidence to adequately describe the long-term impacts human activities have had on environmental quality. A time-integrated assessment of the environmental status of the WICOL was undertaken using paleolimnology, the historical study of inland aquatic environments, to provide pre-settlement baselines, environmental trends, and the timing and magnitude of changes related to human activities. This presentation will summarize preliminary results for sedimentary indicators analyzed from five cores in the WICOL (Fall, Farm, White Iron, Garden and Birch lakes). Four indicators were investigated: (1) diatoms, to evaluate water quality, particularly past nutrient concentrations; (2) geochemistry, to determine past inputs of metals and other trace materials; (3) pollen, to track historical terrestrial activities such as logging; and (4) overall organic and inorganic sediment content, to evaluate changes in accumulation rates.

Hydrologically-connected Systems Facilitate Long Distance Dispersal in Beavers

Windels, Steve K.

Voyageurs National Park, International Falls, MN 56649



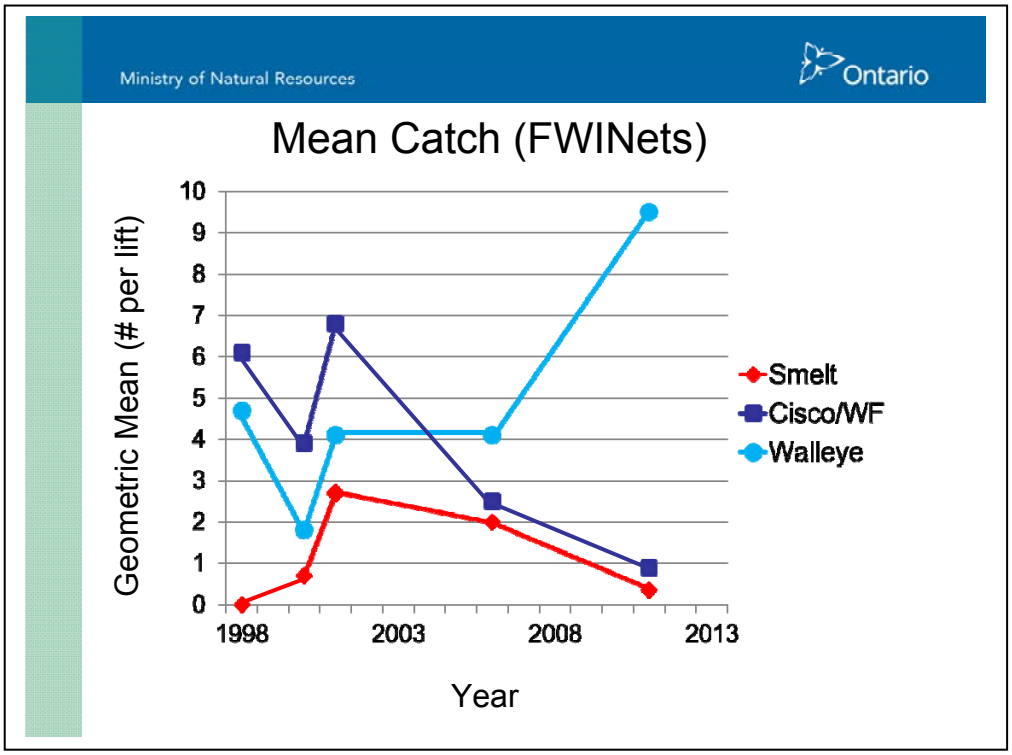
Abstract

Beavers typically disperse from natal areas between 2-3 years of age. Mean dispersal distances reported in the literature have generally not exceeded 10 km in northern systems, as predation risk from wolves and bears limit overland travel. Six-hundred-thirty-five (635) beavers were ear-tagged from 2006-2012 in Voyageurs National Park (VNP), an 88,000 ha protected area dominated by large, interconnected lake systems. Trapping is not allowed in VNP and beaver densities exceed 1.0 lodges/km^2. Fifty-five (55) ear-tagged beavers were reported legally trapped outside of the park between 2008 and 2012, of which 48 were determined to be dispersal events. Mean (±SE) estimated dispersal distance by water was 31.4 km (±3.8). Maximum dispersal distance was 99.9 km, with 10 others also exceeding 50 km. Dispersal was female-biased (62.5% of events), and females also dispersed farther than males (35.0 ±5.0 km vs. 24.2 ±5.0 km). Timing of dispersal events by beaver age class and time of year will be discussed. Results suggest that long-distance dispersal by beavers is facilitated in hydrologically-connected systems.

Changes in the fish community and walleye population recovery in Shoal Lake, Ontario following an invasion by rainbow smelt

Mosindy, Tom

Ontario Ministry of Natural Resources, Lake of the Woods Fisheries Assessment Unit, 808 Robertson Street, Kenora, ON P9N 3X9



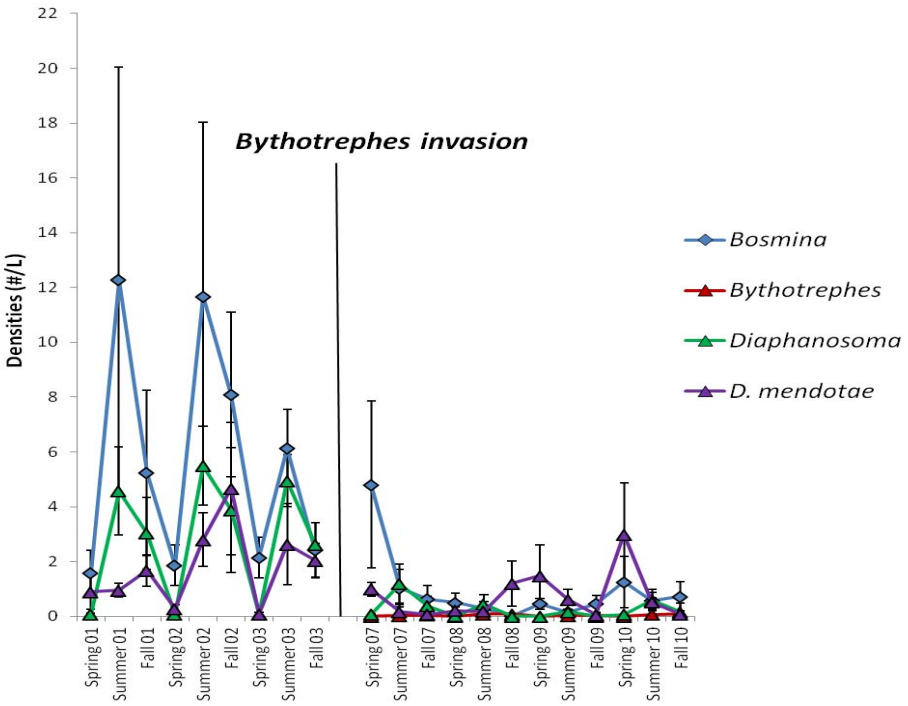
Abstract

Both commercial and sport fishing for walleye (*Sander vitreus*) on Shoal Lake were closed in the spring of 1983, following a drastic population decline from over fishing. As late as 2006, regular monitoring indicated that a protracted recovery was occurring but adult biomass and survival have remained low, partly attributable to continuing fishing mortality from a subsistence fishery. Increases in northern pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*) and smallmouth bass (*Micropterus dolomieu*) abundance have been observed. Rainbow smelt (*Osmerus mordax*), an anadromous marine fish species native to Atlantic Canada, were first detected in 1999. This paper focuses on recent fish community changes that have seen declines in native coregonid populations, especially cisco (*Coregonus artedii*), and improvements in recruitment and survival of walleye which are finally leading to a recovery; three decades after the fishery closure.

Spiny Water Flea (*Bythotrephes longimanus*) Impacts on Zooplankton Communities of Voyageurs National Park

Martin M. Hobmeier[1], Jodie K. Hirsch[2], W. Charles Kerfoot[1], Foad Yousef[1], Jaime F. LeDuc[1,3], and Ryan P. Maki[3]

[1] Michigan Technological University, [2] Minnesota Department of Natural Resources, [3] National Park Service



Seasonal Trends Pre- and Post Invasion for Select Cladoceran Zooplankton

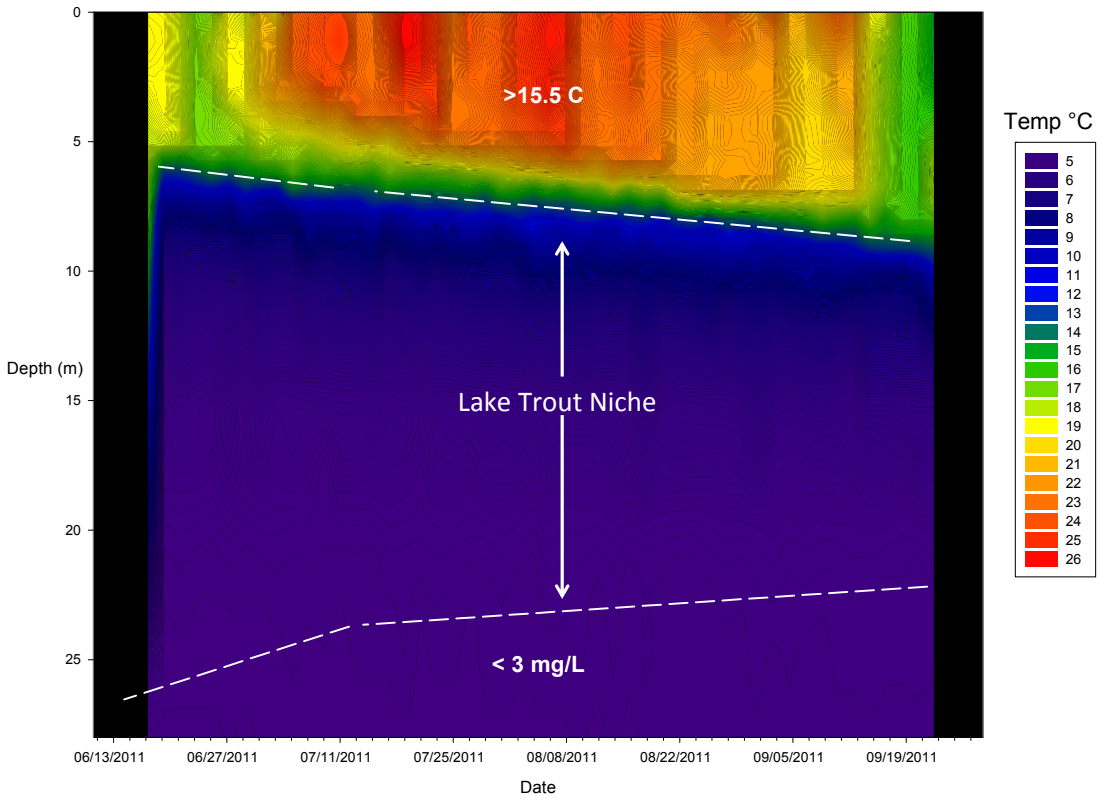
Abstract

Bythotrephes longimanus, an invasive cladoceran from Northern Europe, is rapidly spreading through the northern Great Lakes region along a temperature-dependent latitudinal band, and has become established in the large interconnected lakes of Voyageurs National Park (VOYA) in Northern Minnesota. As a voracious predator, *Bythotrephes* consume up to 40 smaller invertebrates per day per individual, and has been shown to be capable of changing zooplankton abundances and community compositions in invaded lakes. Here, we conducted long-term zooplankton surveys of 5 large VOYA lakes (Rainy, Namakan, Kabetogama, Sandpoint and Crane) in order to investigate if zooplankton communities have changed after *Bythotrephes* invasion. Additionally, we conducted a spatial contrast test between those lakes with high *Bythotrephes* densities (Rainy, Namakan and Kabetogama) and those with significantly lower densities (Sandpoint and Crane) using another data set. We found that zooplankton community composition was drastically altered in post-invasion samples compared to pre-invasion temporal contrast ones, as well as in the high density lake samples compared to low density spatial contrast ones. Dominance shifted towards copepods and larger bodied or gelatinous cladoceran species, while overall zooplankton biomass was reduced by 40-60%. Most cladoceran species showed severely decreased populations and changing seasonal abundances, suggesting a gradual and accumulative effect of *Bythotrephes*. Importantly, *Bythotrephes* also seems to have important non-consumptive effects on native competitor species like *Leptodora kindtii* and predaceous copedpods. Foodweb implications for the affected ecosystems and VOYA fisheries are evident.

Using moored temperature arrays to understand coldwater fish habitat in lakes at Voyageurs National Park

LeDuc, Jaime * and Rick Damstra

National Park Service



Abstract

Lake trout (*Salvelinus namaycush*) and cisco (*Coregonus artedii*) are pelagic coldwater fishes native to some lakes in Voyageurs National Park (VOYA). Where they occur, lake trout are an important sport fish and cisco are an important native forage species. Both species are ecological indicators, due to their reliance on relatively cold, well-oxygenated water to thrive. Many lakes where coldwater species once were abundant have experienced greatly reduced populations or local extirpation due to local anthropogenic factors, such as eutrophication and overfishing. As climate change extends the ice-free season and warms lakes, these fishes are expected to experience local population reductions and extirpations, especially in more southern portions of their range, including the northern United States and southern Canada.

With the goal of collecting water temperature data to gain insights into lake stratification and mixing, we deployed moored temperature arrays at Little Trout and Mukooda Lakes within the park. Both are deep, cold, oligotrophic lakes with lake trout and cisco populations. The arrays consisted of temperature probes arranged from the lake surface to the bottom; temperature was measured hourly. Using year round continuous data from the arrays, discrete sample visits in the summer, along with published temperature and dissolved oxygen levels preferred by each species, we explored habitat available to coldwater fish in each lake. This research is ongoing and will help managers plan and set priorities for fisheries management, now and in the future. Management actions, such as changes to fishing regulations, or habitat manipulations could be applied to protect these populations during times of oxythermal stress, where appropriate.

IMA Update

Suzanne Hanson
IMA Workgroup Member - MPCA

Abstract

An update on progress, activities and priorities of the IMA Workgroup is presented.

IJC IWI NEW BOARD Update

IJC Commissioner Rich Moy

International Joint Commission – US Section, Washington

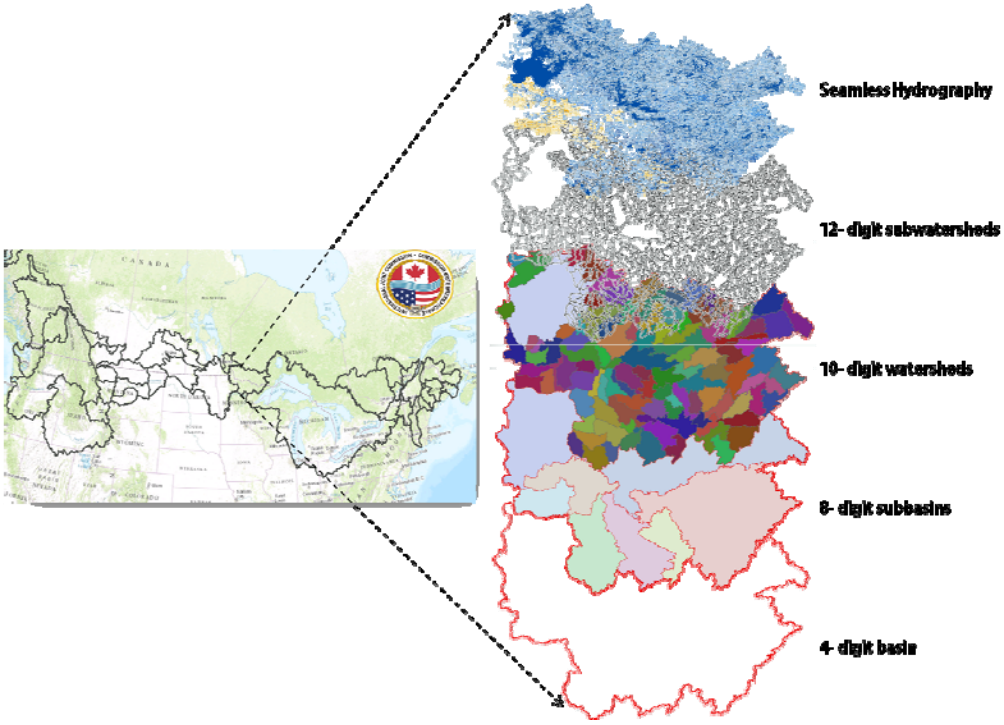
Abstract

Commissioner Rich Moy, IJC US Section, presents an update on transboundary governance initiatives in the Lake of the Woods and Rainy River Basin. An overview of the IJC, the Boundary Waters Treaty, the role and responsibilities of Commissioners, and the focus on the Commission's International Watershed Initiative (IWI) are presented. The IWI principles that underlie the soon-to-be-established International Rainy-Lake of the Woods Watershed Board are described.

Transboundary Data Harmonization Task Force – IJC Update

Michael Laitta[1] and Conrad Wyrzykowski[2]

[1]International Joint Commission, Washington; [2]Agriculture & Agri-Food Canada



Abstract

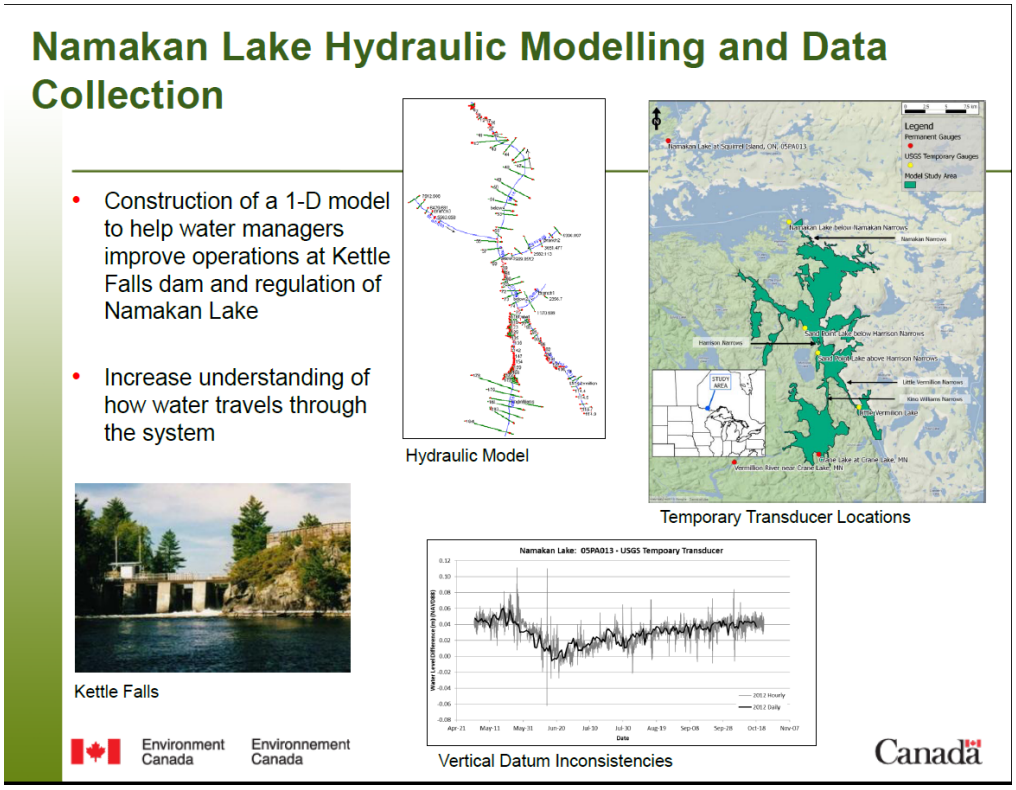
Michael Laitta, Geospatial Coordinator for the International Joint Commission presented on the bi national hydrographic data harmonization effort. The harmonization effort is focusing on eliminating border artifacts from federal, provincial and state geospatial datasets; creating seamless and sustainable hierarchical drainages and a connected hydrographic framework for the Lake of the Woods – Rainy River Drainage Basin. This effort is a key component that will support the mandate of the new IWI Board. The harmonization standards were developed by Federal, Provincial and State data stewards; now there is one common interpretation of the LOW/RR basin. This unified view comprises 109 subwatersheds identified and then common subwatershed units for both U.S./Canada – this is the first basin to be done this far along the Canada/U.S. border. Agencies can now "hang" data onto these subwatersheds (e.g., aquatic vegetation, fish populations, temperature, total phosphorus etc.). The website can also have tabs to other data rather than have everything linked to the basin map. The brand new IJC website is allowing them to promote the shared geography and real time data that are linked to the mapping. There is talk happening about doing a binational Sparrow model for our basin – the IJC is interested in ensuring IMA-TAC is involved and can comment. If researchers can get chemical and flow data from outlets identified by the subwatersheds, this will help determine core monitoring needs/strategy – fewer monitoring sites may be required to identify indicators; the IMA-TAC can utilize the hydrological framework of the IJC web to delineate core monitoring sites. Mike discussed the possibility of having this website linked to WRC and LOWWSF websites, but making it obvious so people can see the geography and data available.

An update and live demo of the IJC's Transboundary Data Harmonization initiative work will be presented.

Development of a 1-dimensional HEC-RAS model of four pinch point channels in the Namakan chain of lakes

Stevenson, David R. and Aaron F. Thompson, P.Eng.

Environment Canada, MSC Operations Ontario



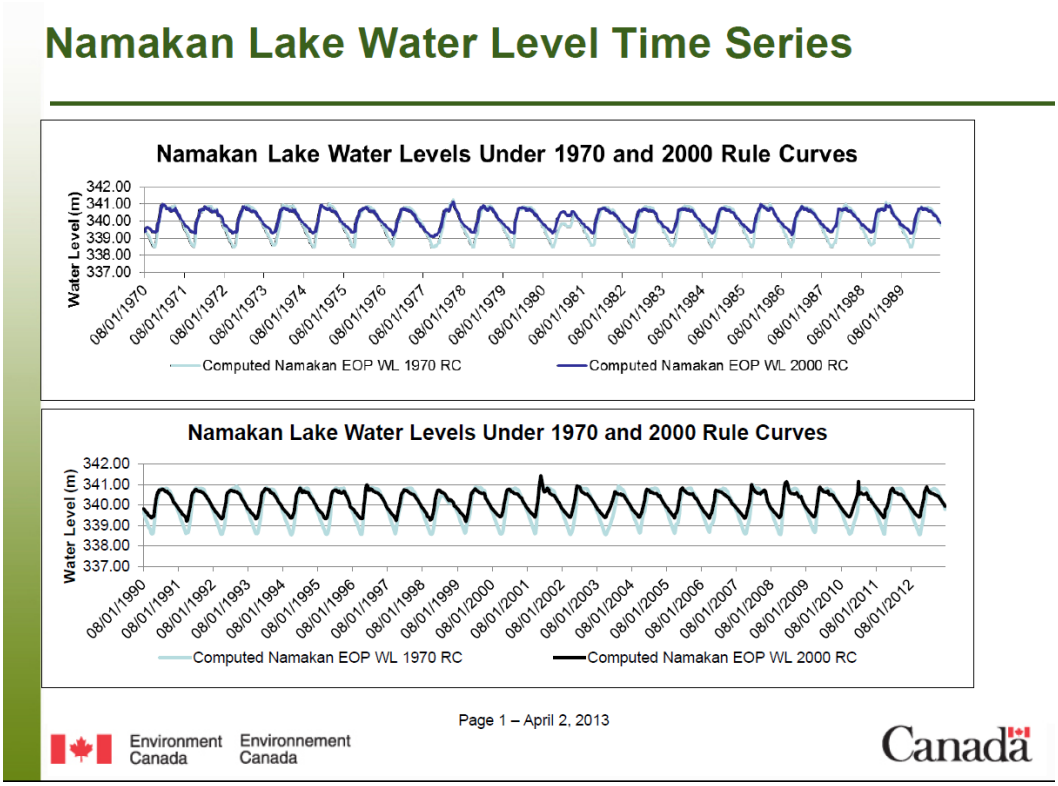
Abstract

Water levels on Rainy and Namakan lakes are regulated according to the rule curve specified in the 2000 Orders of Approval from the International Joint Commission (IJC). The IJC provided funding through their International Watershed Initiative program to develop a one-dimensional model which would improve the understanding of the relationship between water levels and hydraulics in the Namakan Reservoir system to aid managers implementing the rule curve. The system, which includes Namakan, Kabetogama, Sand Point, Crane, and Little Vermillion lakes, is connected by a series of four narrow channels. Established gauges at Gold Portage (Kabetogama Lake), Kettle Falls (Namakan Lake), and Crane Lake monitor water levels and their relationship to the current IJC rule curve band. Lake level readings from these gauges are generally in close agreement. However, water elevations at the lower end of the Namakan chain of lakes at Kettle Falls and Gold Portage may differ by as much as one foot from water levels at the head of the chain at Crane Lake during periods of high inflow to the lakes. A HEC-RAS model was developed incorporating multi-beam echosounder bathymetry collected during summer 2011 with previously available GIS data. The HEC-RAS model includes the four narrows as well as the interconnecting lakes. Temporary water level gauges installed throughout the system during the ice-free seasons of 2011 and 2012 provided calibration and validation data for the model. Discharge data for the four narrows collected by USGS using an Acoustic Doppler Current Profiler (ADCP) has also been used to verify model results. This presentation will provide an overview of model development and will analyze model simulation results with respect to observed data. It will also discuss potential sources of error related to vertical datums and the harmonization of collected bathymetry data with temporary and permanent water level gauge data.

Development of a hydrologic response model for Rainy Lake and the Namakan Reservoir to assess the hydrodynamic changes of the 1970 and 2000 IJC Rule Curves

Thompson, Aaron F.

Environment Canada, MSC Operations Ontario



Abstract

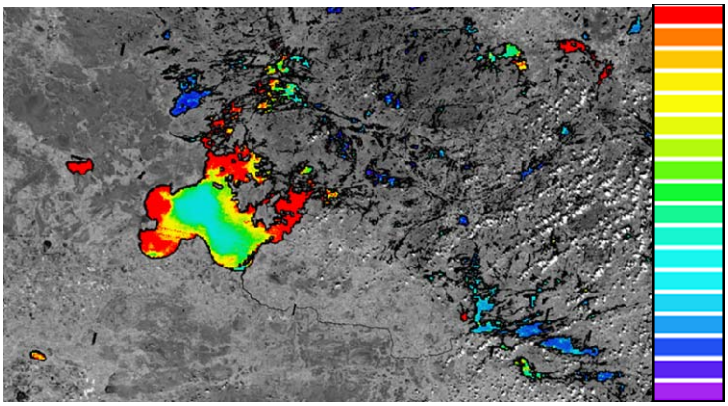
In 2015, the International Joint Commission will review the 2000 Orders of Approval for the water level regulation of Rainy and Namakan lakes. Prior to this review, the IJC is executing a plan of study to conduct the various monitoring and modelling analyses required to gather the information necessary for the 2015 review. One component of this plan of study is the development of a hydrologic reservoir routing (hydrologic response) model for Rainy and Namakan Lakes. The hydrologic response model calculates quarter monthly water levels and discharges for the Rainy Lake and Namakan Reservoir using inflows, stage-volume relationships, stage-discharge relationships and the operating rules specified in the IJC orders of 1970 and 2000. The observed water levels for the two reservoirs, concurrent inflows and regulation plan operation rules validated the model. The model developed two time series of water levels for the Rainy Lake and Namakan Reservoir that researchers who will be conducting the habitat and flooding evaluation work in the next stages of the plan of study will use. In addition, the stage-volume relationships for Rainy Lake and Namakan Reservoir were updated using recent bathymetry provided by LakeMaster Inc. a subsidiary of Johnson Outdoor Marine Electronics. This presentation will briefly describe how the model works, its key assumptions, the resulting time series under the 1970 and 2000 operating rules, and the limitations of the model.

Keynote 1 – A Look Back and a Look Ahead: The Next Ten Years

Steven Heiskary, Research Scientist III

Environmental Analysis and Outcomes Division, Minnesota Pollution Control Agency

ELA Lake 226



2005 MODIS satellite image depicting spatial patterns in chlorophyll-a (algal blooms) in LOW (red implies >20 ppb grading to purple <1 ppb)

Abstract

Much has been accomplished since the first Lake of the Woods Forum ten years ago. I and the other keynote speakers were invited to look ahead at what the major environmental challenges and issues will be for Lake of the Woods (LOW) and the two nations that share this important border water.

Before looking ahead, I chose to look back at some important environmental issues and assemble some "lessons learned" that may be of value in addressing future challenges. In that vein, I reviewed some work on acid rain, mercury, eutrophication, and harmful algal blooms. With respect to each threat, the State of Minnesota initially lacked the needed data and research to address the issue. Monitoring, public education, development of applicable air and water quality standards, and using these standards for permitting and assessment was (and remains) critical to addressing these and future threats. Distinct progress has been made on some of these issues but in most cases, work remains.

I compiled a list of current and future issues for LOW based on conversations with scientists and environmental program managers and review of Minnesota's Water Sustainability Framework (2011). The current and future issues I shared include: climate change, invasive species, emerging contaminants, economic challenges, mining, development of water quality standards, water quantity, shallow lakes management, and nitrogen impacts within and downstream of Minnesota. For each I provided examples and made linkages to LOW and the Rainy River Basin when possible.

As we face these and future challenges we must continue to learn from the past. We need to monitor water and air quality, conduct targeted and collaborative research, develop and apply meaningful environmental standards, and continue to educate the public and elected officials on the need and appropriate ways to address these threats. With this in mind, continued data collection and applied research in the Experimental Lakes Area, Minnesota's Sentinel Lakes Program, and related efforts are essential to our collective ability to address current and future threats to LOW, its watershed and waters throughout Minnesota.

Keynote 2 – Invasion ecology of aquatic invasive species: Threats, prevention and lessons learned from the Great Lakes

Hugh MacIssaac

University of Windsor

Abstract

Invasion ecology's virtual adoption of a stage-based approach to the invasion process (Blackburn et al., 2011) provides researchers with opportunities to identify factors important to success at each stage. When combined with previous studies on the economic virtue of prevention, a case can be made that resources need to be focused on factors important to success of initial introductions, the converse of which will assist us in preventing species invasions.

In a popular paper, Lockwood et al. (2009) disassembled species introductions into two components, propagule pressure and colonization pressure, the former representing the number of individuals introduced, the latter the number of species introduced. Mathematically, we expect that propagules originating from a single species pool will exhibit a nonlinear relationship between colonization and propagule pressure: colonization pressure (of distinct species) will saturate with repeated introductions, as initially common species are added followed much later by the rarest ones. Mean propagule pressure will continue to increase as larger and larger discharges occur, as inclusion of rare species at low population size is more than compensated by large increases in the most common ones.

Experiences on the Laurentian Great Lakes reveal a significant reduction in propagule pressure and a small but insignificant reduction in colonization pressure (of risky species) since the introduction of mandatory ballast water exchange/flushing for all international vessels (Bailey et al. 2011). The fact that invasions have not been reported in almost seven years suggests that propagule load does not need to be brought to zero in order to prevent invasions. While we might expect this relationship to vary somewhat based on species' life histories - with asexual or parthenogenetic species posing the highest risk - it appears that simply reducing propagule pressure, and perhaps colonization pressure, can pay dividends for managers attempting to reduce invasions in their native waters.

Preventing invasions in inland waters must focus on eliminating propagule supply to the systems. The Great Lakes have been devastated by a number of invertebrate invasions, including spiny waterfleas and zebra and quagga mussels. The former began to spread to inland lakes in 1989, mainly through transfer on fishing line of 'resting eggs' produced by the species. Knots of dried bodies containing resting eggs adhere to fishing line (and nets) in invaded lakes; if this gear is not thoroughly decontaminated by dislodgement of all eggs, subsequent use of the gear on non-invaded lakes may cause the mass to fall off, the eggs to swell and hatch into parthenogenetic females. Some lakes appear to serve as 'hubs' for widespread dispersal of the species to new lakes, thus attention should be focused on educating boaters and anglers on invaded lakes not to use their unwashed gear on non-invaded lakes. Thus far, the picture is not encouraging, as at least 158 lakes have been invaded in Ontario alone. Minnesota is far less invaded, perhaps owing to active work by Sea Grant and others to educate anglers and boaters.

Experiences with zebra and quagga mussels parallel those of spiny waterfleas. While initially introduced to the Great Lakes, both species have spread extensively, initially locally in and adjacent to the Great Lakes basin, but increasingly to western USA. More than 20 mechanisms may spread these species, so control is daunting, though prevention centred on preventing movement of pleasure boats fouled with live mussels (either on the boat itself or on the trailer or plants stranded on the trailer). Our experiences on the Great Lakes, therefore, indicate that once species are brought in via ballast water of commercial ships, an array of other, more local, pathways can transmit the species to inland waters. Managerial efforts must be focused on reducing the importance of these pathways through a combination of education and, where needed, regulation.

As the importance of commercial shipping has waned, other pathways may rise to the fore in terms of importance to overall invasion rate. The aquarium and water garden trade has the potential to indirectly introduce a substantial number of potentially highly injurious species. In our case, the tropical plants water lettuce and water hyacinth are sold to the public through live garden facilities across Ontario (and likely most provinces and states). Both species have recurred in Lake St. Clair in three consecutive years, though neither species can survive the severity of our current winters. Water hyacinth produces viable seed, which if germinated at the appropriate conditions (we used 28C), may result in generations of plants in areas where the plants grow. Water lettuce does not reproduce in the Great Lakes, thus it appears wholly dependent on annual reintroduction. Warming winters over the past century indicate that if such patterns continue, we might get overwinter survival at some point in the future. Many other invasive macrophytes are sold in the Great Lakes region, including some (water soldier, hydrilla) that are candidates for eradication campaigns. Governments across Europe and North America need to review species involved in live trade as unexpected problems may be occur.

Keynote 3 – Emerging issues for northern lakes: the increasing threat of multiple environmental stressors, but reduced government engagement

Norm Yan

York University

Abstract

Using 40 years of data, I will prove that the physics, chemistry and predator regimes of south-central Ontario lakes near Dorset, Ontario, are changing. Wind-speeds have fallen while fall air temperature have risen, thus lakes are warmer in the fall, and are freezing up later that in the past. The lakes are also more oligotrophic, coloured, and salty, but less acidic and softer. Chrysophytes have replaced diatoms as the dominant phytoplankton, and the invading spiny water flea, where present, is preventing recovery of biodiversity from historical acidification. Adding to these complications, these stressors interact, and have lead to sudden changes in biota, eg. the loss of 5 Ca-rich daphniid species in one low-Ca lake, and the sudden increase of jelly-clad biota in several lakes. With these changes as a background I will make several predictions about near-term changes in these lakes, and consider how well prepared we are in Canada to manage the predicted changes. I will review our understanding of the roles of environmental science (status and trend assessment with respect to standards, diagnosis, prognosis, recovery assessment) in the environmental management process concluding that Canadians have a clear understanding of how to manage large-scale environmental problems, having done so with success on many past occasions. I will suggest that the number, kind and interaction of current environmental stressors argues that this is not a time for governments to disengage from active environmental management. Finally, I will argue that the best predictors of both human and environmental health at a national scale are non-authoritarian governments, and, as these have been on the rise over the last few decades, this bodes well for environmental condition.

Poster Abstracts

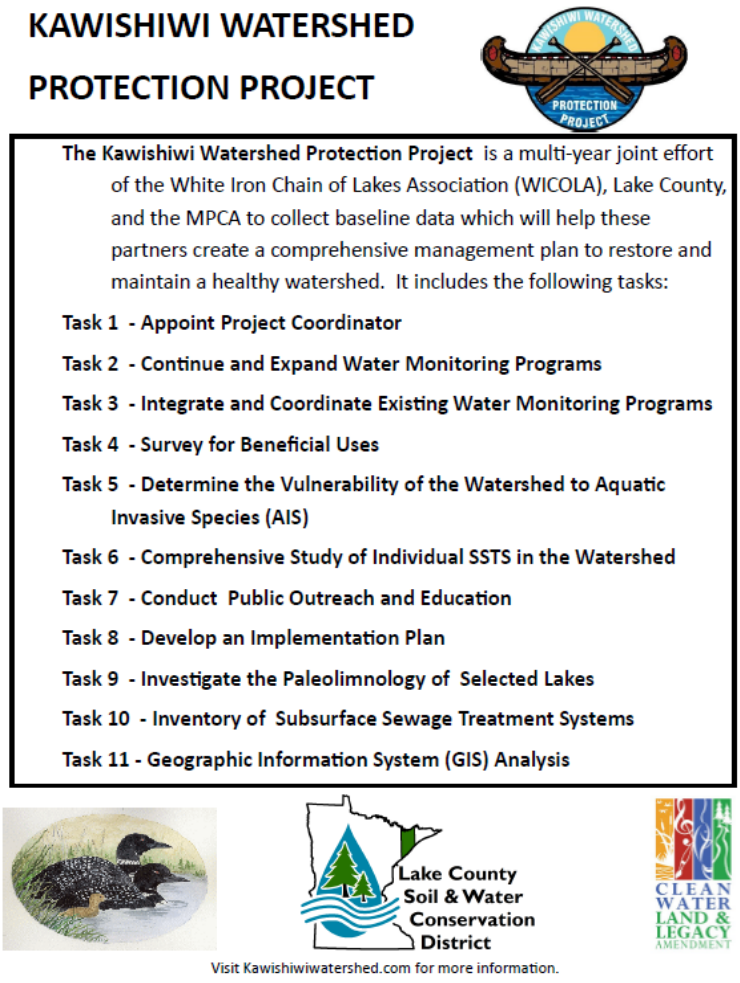
The Kawishiwi Watershed Protection Project

Derrick Passe and WICOLA

White Iron Chain of Lakes Association

Abstract

The Kawishiwi Watershed is a 1225 square miles watershed located at the headwaters of the Rainy River near Ely, Minnesota. 95% of the watershed is located in the Superior National Forest and a third of it is in the Boundary Waters Canoe area. At the Outlet of the Watershed is a chain of Lakes known as the White Iron Chain of Lakes. In 1993, the White Iron Chain of Lakes Association (WICOLA) began monitoring nutrient levels in the White Iron Chain of Lakes. They continued to monitor these lakes at 5 locations on a monthly basis, working with MPCA to measure pH, temperature, DO, nitrogen, phosphorus and chlorophyl-A. In 2010, WICOLA successfully secured two grants from the Minnesota Pollution Control Agency, totaling over a million dollars, to assess the Water Quality and threats thereto of the entire Kawishiwi Watershed.



WICOLA and other volunteers sample and analyze water quality at more than 10 Lake sites and 11 streams in the Kawishiwi Watershed. In addition to the Water Quality Monitoring, the project includes GIS analysis of sensitive areas, an inventory of all septic systems within the Watershed, a paleo limnology study to determine legacy effects of past disturbances, a historical study of nutrient loadings in the watershed, assessment of AIS infestations in the Watershed and public education and outreach.

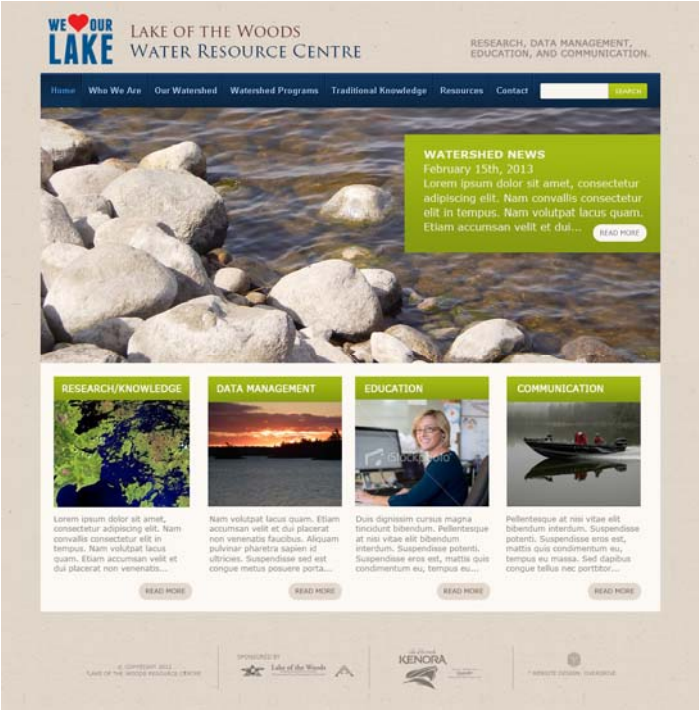
The goal of this Project is to educate of watershed users, provide guidance to agencies managing the watershed and determining the current trends of water quality in the Kawishiwi Watershed. We are currently assembling reports on all the project components into an Implementation Plan that will be used to manage and protect the watershed for years to come.

Our partner list includes numerous State, Federal, and local agencies as well as resorts, camps and universities.

A Water Resource Centre for our Watershed: Pulling it all Together

Saunders, Kelli

Lake of the Woods Development Commission



Abstract

In March, 2012, the Lake of the Woods Development Commission initiated the *Lake of the Woods Project* as a way for the City of Kenora and its partners to take a leadership role in environmental stewardship and provide a model for other communities to follow. The project has three main goals:

1. Continue to support the International Joint Commission (IJC) in its binational watershed efforts in the basin
2. Establish a Water Resource Centre, focused on the Lake of the Woods/Rainy River watershed and based in Kenora
3. Develop partnerships and projects that promote citizen involvement in environmental stewardship

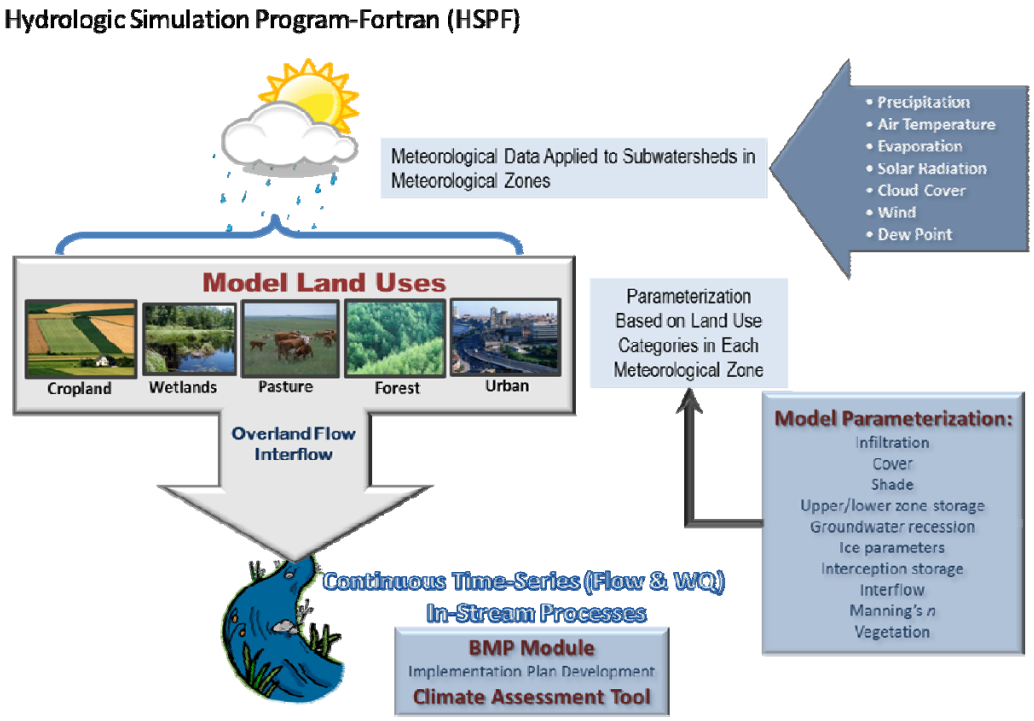
The *Lake of the Woods Project* builds on the success and increased awareness created by the work of the many agencies and organizations that have a concern and a stake in the health of this watershed, including the Lake of the Woods District Property Owners Association, the Lake of the Woods Water Sustainability Foundation, the International Lake of the Woods and Rainy River Watershed Task Force, resource agencies in Minnesota, Ontario and Manitoba, Treaty 3, First Nations and Tribes and the International Multi-Agency Working Group. This presentation will briefly cover all three components of the Lake of the Woods Project, but will focus mainly on the establishment of a Water Resources Centre and a networking website for the basin.

The concept of a Water Resources Centre for this basin was first conceived in the early 2000s and the Commission is rejuvenating the idea, and would like to establish the centre in Kenora. Its main purpose would be to serve as a data warehouse for all of the research ongoing in the basin, and to provide education and communication resources for citizens and researchers around water science and management. Following a November 2012 brainstorming session to determine the feasibility of such a centre, a small working group was developed to determine next steps and to focus on one of the first priorities – a networking website for the watershed with a focus on water quality and protection. It is currently under construction and will post research documents, traditional knowledge, citizen-based stewardship information, allow for sharing of information and updates on environmental conditions in the basin, link like-minded groups and individuals through stewardship initiatives and be a focal point for the great work going on in this watershed. Following the models of similar centres and websites elsewhere, this concept will evolve as key individuals, agencies and institutions come together to determine how it can best serve this watershed and, perhaps, a broader audience.

International Lake of the Woods hydrology and water quality modeling

Cindie M. McCutcheon[1], Seth J. Kenner[2], Julie A. Blackburn[3]

[1,2] Water Resources Engineer, RESPEC Water & Natural Resources, P.O. Box 725, Rapid City, SD 57709;
[3] Minnesota Area Manager, RESPEC Water & Natural Resources, 1935 West County Road B, Suite 320, Roseville, MN 55113;



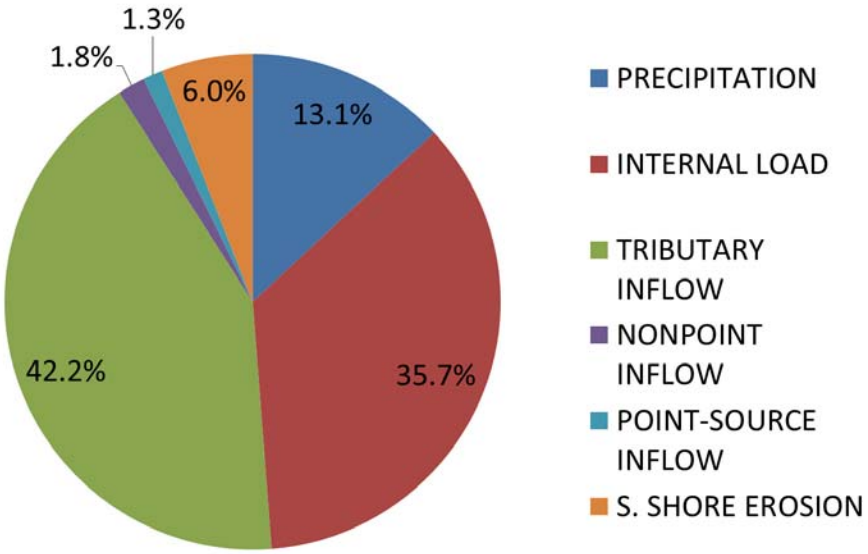
Abstract

Hydrological Simulation Program-FORTRAN (**HSPF**) was used to develop model applications for the Little Fork and Big Fork Watersheds, which drain to the Rainy River and for the entire Lake of the Woods Watershed. HSPF is a primary tool used by MPCA for a holistic approach to watershed-scale monitoring, assessment, and TMDL development. The HSPF model applications developed for the Little Fork and Big Fork Watersheds have been calibrated to simulate hydrology and water quality and will be used to help address water quality impairments. The Little Fork River Watershed has multiple turbidity impaired stream segments and one fish bioassessment impaired stream segment, while the Big Fork River Watershed has three nutrient impaired lakes. An HSPF model application is also being used to simulate hydrology (and ultimately water quality) in the entire Lake of the Woods Watershed. The Lake of the Woods Watershed has multiple nutrient impaired lakes (including Lake of the Woods) and dissolved oxygen impaired stream segments, as well as previously listed Big Fork and Little Fork impairments. To maximize the use of available data and to contend with data gaps, the Lake of the Woods Watershed model application follows a phased approach patterned after applications such as the Chesapeake Bay Model and the Connecticut Watershed Model. The phased approach involves development and calibration of multiple test basin model applications, extrapolation of test basin parameters to larger calibration basins, and ultimately extrapolation of parameters to all basins. This presentation will focus on both the results of the Little Fork River and Big Fork River watershed model applications and the methodology being used to model the entire Lake of the Woods Watershed.

An Updated Total Phosphorus Budget for Lake of the Woods

Anderson, Jesse; Nolan Baratono, Steve Heiskary, and Bruce Wilson

Minnesota Pollution Control Agency - 525 South Lake Ave., Suite 400, Duluth, MN 55802. (218)302-6621; jesse.anderson@state.mn.us



Relative sources of phosphorus to LOW, estimated at 1,147 metric tons per year (excluding 55% retained)

Abstract

In the past several years a significant amount of water quality monitoring, modeling, and research has taken place on Lake of the Woods, which allows for more refined models and predictions of water quality. Building on the recent work of our colleagues, an updated total phosphorus budget for the southern, eastern, and central basins for Lake of the Woods will be presented, using 2010 conditions as a baseline. The BATHTUB model was used, developed by the US Army Corps of Engineers, which combines mass-balances with empirical relations to diagnose and predict trophic responses. Lake of the Woods was divided into 5 segments based on observed differences in water quality and bathymetry – Four Mile Bay, Big Traverse and Buffalo Bays, Muskeg Bay, Sabaskong Bay and Northeast Big Traverse, and Little Traverse Bay / Northwest Angle. Revised bathymetry data from Environment Canada, measurements of internal phosphorus loading (laboratory aerobic release rates), and revised phosphorus loads from the Rainy River (based on recent event-based sampling) were incorporated into the model. The total phosphorus budget was estimated at 1,147 metric tons per year, partitioned into 6 categories-tributary inflow (principally the Rainy River) 42%, internal load 36%, precipitation 13%, shoreline erosion 6%, non-point inflow 2%, and point sources, 1%. BATHTUB estimates that 55% of the phosphorus is retained within the lake. The model's predicted area-weighted mean concentrations of total phosphorus, chlorophyll-a, and Secchi depth were similar to observed values. When excluding internal loading estimates (not modeled previously), results were similar to previous investigations. The model's output will help guide restoration options for the eutrophication impairment and provide a baseline for the Total Maximum Daily Load Study on the US portion of Lake of the Woods.

Overview and Progress Report: International Joint Commission 2009 Plan of Study for the Evaluation of the IJC 2000 Order (Rule Curves) for Rainy Lake, Namakan Reservoir, and the Rainy River

Geoffrey M. Smith and Ryan P. Maki

Voyageurs National Park, National Park Service

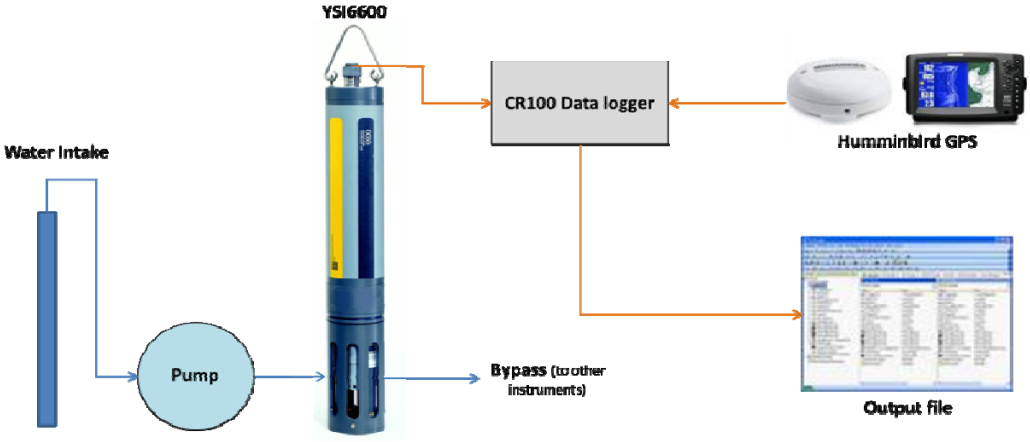
Abstract

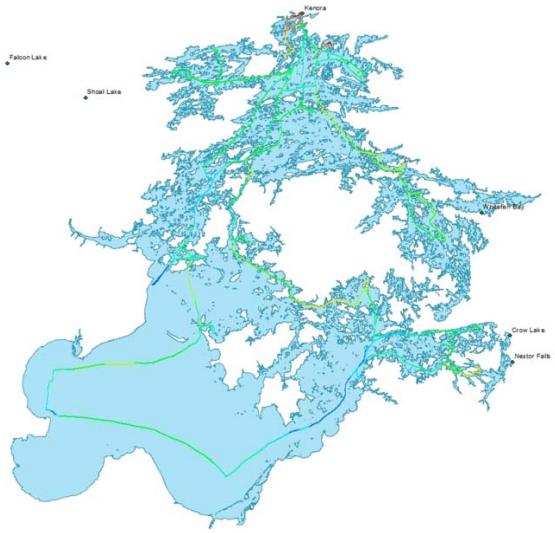
The International Joint Commission (IJC), through federal funding from the United States and Canada, implemented the recommendations of their 2009, "Plan of Study for the Evaluation of the IJC 2000 Order for Rainy and Namakan Lakes and Rainy River" that outlined research needed to evaluate the rule curve changes prescribed in the IJC 2000 Order. These revised rule curves, governing dam operation on Rainy Lake and Namakan Reservoir, Minnesota and Ontario, were designed to more closely mimic the natural water level fluctuation in these water bodies with the intent of benefitting the aquatic ecosystems. Eighteen studies have been developed and are in various stages of completion. They encompass a wide range of disciplines, including natural resources investigations such as walleye and northern pike spawning evaluations, Rainy River fisheries assessments, habitat and hydrologic modeling projects for the reservoirs and the Rainy River, cultural resources studies, and economic studies that assess the effects of the rule curve changes on resorts and property owners. These studies will provide scientifically-derived data that will form the basis for evaluating the effectiveness of the 2000 Rule Curves in achieving the intended ecosystem benefits and their effects on the cultural resources and economics of the region. The studies are due to be completed in 2015 at which time the IJC will begin a review that will culminate in a decision to either maintain the 2000 Order or adjust the rule curves.

In-transit collection of real time surface water quality: Data acquisition on the go

Timothy Pascoe, Benoit Lalonde, Niels Madsen, Tana McDaniel

Environment Canada, Science and Technology Branch, PO Box 5050, 867 Lakeshore Rd E, Burlington, ON L7R 4A6





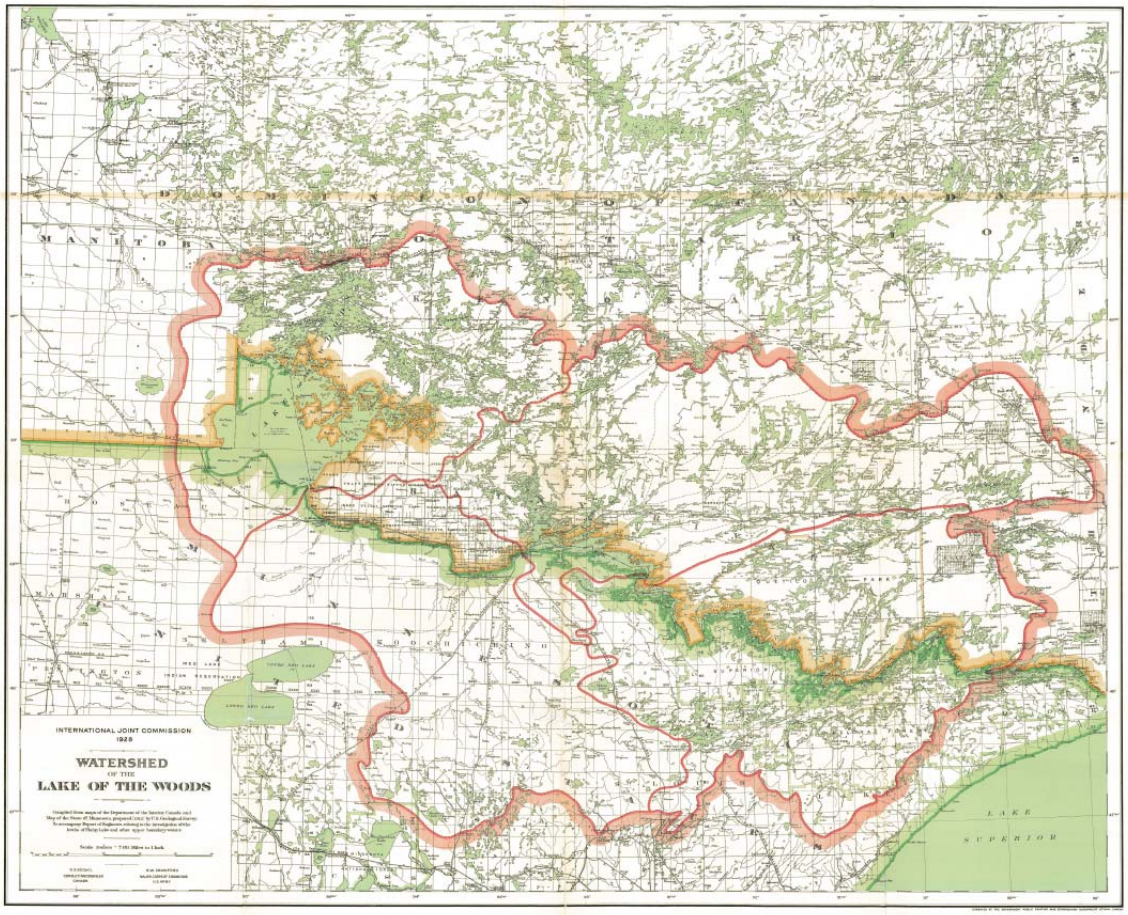
Abstract

Environment Canada has been conducting point (station) based sampling for water quality on Lake of the Woods (LoW) since 2009. Water quality conditions at these stations are then used to extrapolate conditions for larger portions of the lake. On a large lake such as LoW, stations are typically tens of kms apart, resulting in long transit times between sampling locations. The ability to collect continuous water quality data while traveling between stations could both enhance spatial coverage while taking advantage of previously unproductive travel time. A real-time YSI-based data acquisition system to collect data while traveling on the lake at cruising speed (20 knots) by boat was designed. Water is collected via a water intake at the stern of the boat at a depth of 1 meter, and parameters are measured every 5 seconds using a YSI6600 sonde with a flow through cup. Water quality parameters include chlorophyll-a, pH, temperature, turbidity and phycocyanin. Water quality data can then be matched with position data from a Humminbird GPS, and stored using a CR300 data logger. Currently, the data is being used to aid in the evaluation of spatial trends in water quality on Lake of the Woods.

1924 Lake of the Woods – Rainy River IJC Map

Michael Laitta.

International Joint Commission



Abstract

A historic map of the watershed is presented – published in 1928 by the International Joint Commission, the map delineates the watershed as it was understood at the time. Remarkably, it has close agreement to the watershed delineation developed by the IJC Transboundary Data Harmonization Task Force.

The Forum 10 years after – Successes and achievements internationallly

10th Annual Forum Organizing Committee

Moderated Panel Discussion – Futures: Issues and Challenges for the Next 10 years

R.W Sandford, Moderator;
Panelists: Steven Heiskary, Minnesota Pollution Control Agency;
Hugh MacIsaac, University of Windsor;
Norm Yan, York University

Bob Sandford – Loss of Hydrologic Stationarity and its Consequences

Mr. Sandford discussed evidence that increasing temperatures are accelerating the rate at which water is moving through the earth's hydrologic cycle. In the Arctic and Boreal regions, water that has been trapped as ice is now in rapid decline due to global warming – that water is moving to places where we can't use it and the water left on land after the last glaciation is evaporating and is fuelling more frequent storm events.

Mr. Sandford noted that the water holding capacity of the earth's atmosphere increases by 7% per degree Celsius, a phenomenon known as the "Clausius–Clapeyron Relation". He indicated that the fundamental threat that climate change poses is to the earth's hydrologic "stationarity" – the notion that natural phenomena fluctuate within an envelope of predictability so we can manage it with some certainty – the loss of stationarity means we lose that predictability and manageability. Stationarity is no longer a viable theory to use when managing water – flooding is on the rise, storm events are more severe, all of which cost millions of dollars to clean up. Mr. Sandford noted that storms can impact water quality – for example, mobilization of fecal coliform during an intense storm is much greater than during a normal thunderstorm. With a rise in temperature and agricultural intensity increasing, microcystins in water will increase as a result. With stationarity gone, it becomes increasingly difficult to define the terms water, border, weather, average, sustainability, risk, security. Even the literature has begun to change as we reflect on how humans respond to disaster and change.

Mr. Sandford noted that the insurance sector is threatening to not insure municipalities who do not maintain their infrastructure and this may then result in more reliance on government emergency funding. The question of who is liable arises and will continue to be an issue; leadership may change as a result. Mr. Sandford indicated that cutting emissions will not be enough to eliminate these phenomena, but leadership will and this is the real challenge for our generation – we just need the will to do it.

Open Question – Answer Session from Keynote Presentations

Q1. There seems to be a preoccupation with silver carp in the Chicago Canal – What are the plans being laid to reduce penetration of AIS through Mississippi drainage?

- Millions of dollars have been dedicated to prevention of two invasive carp species – only answer is hydrological separation e.g. providing vessels with a holding spot for cleaning before they are allowed to transfer from one basin to another.
- Minnesota's fear is movement up through the system and getting into systems like Lac des Milles Lacs – need to convince legislators that this needs to be addressed.

Q.2 EDNA analysis – what is it and is it effective?

- Environmental DNA – trying to detect existence of a species through this process is underway where more traditional methods are not very effective; the analysis uses species specific segments of DNA as a probe to see if there are any hits in a water body – if there is a hit, it indicates that that particular species may be in the water; highly diagnostic and likely the next generation of early detection of AIS.
- This method can detect a fish exists, but not that it will become established

- AIS is more of a natural disaster than contaminants are – we can remediate contaminants; prevention of AIS costs money and requires a huge political will and communication/education strategy – no chance for remediation.
- No builders object to building a home to withstand an earthquake, but that commitment to prevention of AIS does not currently exist
- Member of Audience Comment on EDNA: There are other ways that DNA can show up in systems; technique not yet perfected, lots of false positives; careful balance to prevent spread of invasive carp and maintaining migration patterns of native species (e.g., need to be careful with barriers installed).
    - Panel Response to comment: Use of EDNA to detect carp in Great Lakes – method needs to consider all other possible reasons why the DNA would be in the lake other than the live fish (e.g., fish market dumps, etc.)

Q3. Given the path we are on and the convergence of science and policy, what would you see as the one or two critical things we need to do to set the agenda for next ten years and key priorities for how to do it?

- Baseline science seems to be available; working through the TMDL will allow us the information on major threats to the system.
- Need to continue the collaboration and ongoing monitoring of the system; build on the progress that's been made last 10 years.
- Consider a gap analysis; build appreciation within government that there are issues and funding doors should open; put together a comprehensive package of studies that need to be done.
- Consider publishing as a group a series of papers (e.g. special issue in Canadian Journal of Fisheries and Aquatic Sciences or Journal of Great Lakes Research); this will allow people in scientific community to access information on our system all in one place; provides fodder for accessing funding opportunities (include gap analysis) – series volume provides momentum.
- Consider what the strengths are in the system – e.g. return of the sturgeon and return of the pelican – these all took a long time and so our new successes will take long too.
- There are strong links between science and policy in this basin – result of communication between scientists and stakeholders – consider bringing in social scientists to study the situation and make recommendations.
- Obvious gaps in our knowledge – need a few more years of fundamental research showing that algal blooms are driven by top down and bottom up forces.

Q4. Regarding the apparent decrease in calcium - where is it going, what is its relationship to pH; is there a relationship between lakes with zebra mussels and Ca/pH?

- Biota can influence Calcium cycle in lakes.
- In soft water lakes, like LOW, calcium is always low, tree growth removes Calcium from soil; calcium added to soil by atmosphere; this affects forestry practices.

Q5. Ontario's Lake Partner Program has 700 volunteers; a subset are "super stewards" who do more monitoring; what should be their role in the future and what advice can we give them?

- Volunteers are a critical conduit for getting to other citizens who live around a lake to provide information coming from the science and best management practices (BMP); protection of zone where shore meets the land needs more focus.

- Consider using super stewards to get feedback from them on what they are concerned with on their lake, what their priorities are, what science focus may need to be; continue to challenge them.
- Consider setting up washing stations to prevent AIS on a particular lake – go after "hub" lakes to set up washing stations - hub lakes are the lakes that are most popular for boating.
- Make sure there is good PR and communications in conjunction with the program.

Q6. What is the interaction between capitalism, freedom and environmental protection? If recreational boating is a vector, how do we convince people to make the right choice about cleaning their boats, what are the legislation needs?

- Linking capitalism and freedom and environmental condition is being actively studied now in ecological geography courses – there is a correlation between the economic and environmental condition of countries; freedom still plays a huge role.
- Both Canada and U.S. could improve their environmental performance despite that they are free countries.
- Re convincing people to protect against AIS – people are willing to do the right thing; very few prefer legislation – there is benefit in education of the public – consider tacking a few dollars onto a fishing license and the money goes towards AIS prevention.
- In MN, DNR does a great deal of educating and slowing the spread of AIS; legislation did become necessary that allow for fines and inspections, so this is a serious item in MN and it seems to be working.
- Washing stations and drying stations are effective.

Q7. Regarding need for more research on food web interactions: is there a good understanding of changes in zooplankton, interactions and blue greens?

- In oligotrophic lakes, likely not a good understanding.
- In mesotrophic lakes, yes there is a good understanding.
- There are techniques for food web modeling to help answer these questions.
- Some work been done on Saginaw Bay seeing relationship between mussels and blue green algae – perhaps that is the process of filtering water, the mussels can detect anything large/chemical and the mussel spits out the "bad" stuff like microcystis cells, which then go back out into the water.

Q8. Comment: Countries with freedom can also have significant inequality like Britain and U.S.

- Agreed. Second comment from member of audience was a recommendation to read "The Spirit Level: Why Greater Equality Makes Societies Stronger" by Richard Wilkinson and Kate Pickett with a Forward by Robert B. Reich and "The Price of Inequality: How Today's Society Endangers Our Future" by Joseph E. Stiglitz, Nobel Prize Winner in Economics.

Q9. Should water managers be building more stormwater basins, planning ahead and investing in the future through wetland development, etc.?

- Need to consider conservation first; we have built infrastructure to accommodate overuse; now we have an infrastructure debt – can't afford to maintain what we've built.
- Need more integration between land use and water; where we have changed the landscape the most is where we see the most impact from climate change.

- Where large retention basins have been built to accommodate large storms, they can be successful.
- Living corridors adjacent to large parking lots are effective – this involves drainage from a parking lot going into vegetated areas to evaporate and reduce the drainage into the sewer system.
- In MN, new design standards are being developed with recalculated "design" storms.
- Sudbury – Laurentian U. – designed parking lot/wetland area to ensure water leaving this land will be cleaner than the rainwater.

Closing Remarks from Panelists

Steve Heiskary:

Current and future issues in the basin are seen to be climate change, AIS, emerging contaminants, economic challenges of development, mining, developing water quality standards, addressing impairments, and nitrogen. It is very important to continue to monitor and track successes. Comment made that he is hopeful the ELA can remain open – data from there are critical.

Hugh MacIsaac:

Great strides have been made in this basin through collaboration already and this needs to continue. Accessing funding is more successful as a group rather than as an individual.

Norm Yan:

Continue to press the government about the ELA closure. Flooding experiments, nanoparticle, hormone, eutrophication experiments, aquaculture experiments are all still of great ongoing policy importance.

Even though additional funding for environmental work would be great, it is all about ensuring people respect their environment, understand the threats and know what to do to protect the environment…will is more important than the money.

Bob Sandford – Summary Remarks:

A unique group has formed and has been effective in forming collaboration and erasing the border. Scientific principles are the basis for what goes on within the Rainy-Lake of the Woods watershed – some predictions made 10 years ago have come true. As Dr. Andrew Paterson noted in the conference introduction, science is beginning to informing policy – so you're on the right track.

Mr. Sandford then recounted highlights of each talk (see "Shared Waters, Shared Management – Ten Years Later: Summary Observations on the Tenth International Lake of the Woods Water Quality Forum" on page 1). In his conclusion, he stated that solutions do exist to some of the problems we are experiencing and encouraged the participants to keep working in the direction we have been moving.