V-2023-02-28

Program Abstracts
20th Annual

RAINY-LAKE OF THE WOODS
WATERSHED
2023 FORUM
March 8 - 9, International Falls, MN

March 8 - 9, 2023

Minnesota North College, Rainy River Campus
501 U. S. Hwy 71, International Falls, MN

V-2023-02-28

Forum Partners – Sponsors

The organizing committee thanks our 2023 sponsors for assisting with the 20th annual International Rainy-Lake of the Woods Watershed Forum. This event would not be possible without them:

- Lake of the Woods Water Sustainability Foundation
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- Rainy River Community College
- Minnesota North College - Rainy River campus
- Dorset Environment Sciences Centre
- Rainy Lake Conservancy
- Rainy Lake Property Owners Association

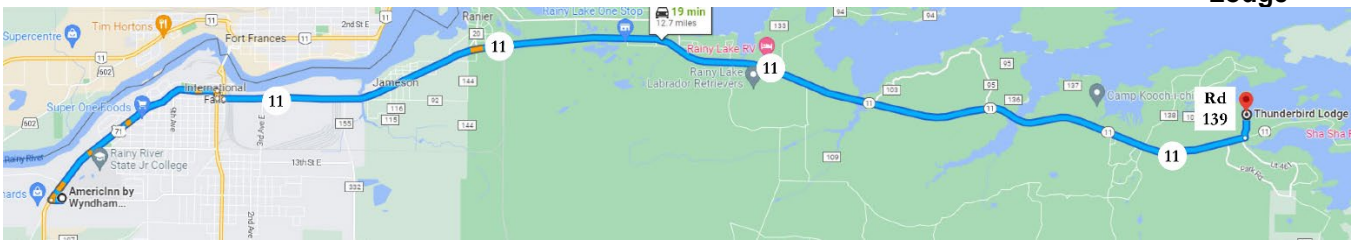
Table of Contents

Program At A Glance

DAY 1 – MARCH 8

Start	Mins	Symposium Sessions March 8
11:45	1:15	**Lunch**
1:00	0:40	**Traditional Protocols** Elder Priscilla Simard, Coochiching First Nation and Women's Council of Grand Council Treaty #3 **Greetings** U.S. Consul Bryan Koontz; Canadian Consul Colin McLeod
		Session 1 - Getting to Objectives (Fireside Chat Session)
1:40	0:10	Panelist Introductions and Instructions Moderator
1:50	0:20	New water quality objectives for the International Red River: A case study Nicole Armstrong, Manitoba Environment, Climate and Parks
2:10	0:20	Grand Council Treaty #3 perspectives on getting to objectives GCT3
2:30	0:30	Moderated Panel Discussion All
3:00	0:30	**Break**
		Session 2 - Watershed Updates: Research to Action
3:30	0:10	Moving to Action and Understanding on the US Side: Implementation and Further Research in Rainy Basin. Mike Kennedy, Amy Mustonen, Lindsey Krumrie, MPCA Duluth
3:40	0:20	Environment and Climate Change Canada Lake of the Woods Nutrients Update Daniel Rokitnicki-Wojcik, ECCC
4:00	0:20	International Rainy-Lake of the Woods Watershed Board Update Michael Goffin (ECCC), Col. Eric R. Swenson (US Army Corps)
4:20	0:10	IJC Objectives and Alerts Project Bev Clark, Consultant
4:30	0:20	GCT3 Geoportal Raeshawn Parsons, TPU GCT3
4:50		**DAY 1 END** **6 pm Dinner Reception at Thunderbird Lodge on Rainy Lake** • **Guest Speaker, David Malaher**: "*An historian's comparison of the Lake of the Woods Water Sustainability Foundation work in 2023 with problems in surveying the Canada-US boundary on Lake of the Woods and Rainy River in 1823*" • **Kallemeyn Award presentation**

AmericInn &College → 12 miles / 20 minutes → **Thunderbird Lodge**



DAY 2 – MARCH 9

Start	Mins	Symposium Sessions March 9
8:00	0:30	**Coffee available in cafeteria**
8:30	0:10	Day 2 Welcome and Introductions
		Session 3 - Planning and Governance
8:40	0:20	Centering Treaty in governing the Rainy-Lake of the Woods Watershed Johann Strube, Carleton University
9:00	0:20	International Rainy-Lake of the Woods Watershed Board Adaptive Management Committee's Climate Change Adaptation Activities Teika Newton, IRLWWB Adaptive Management Committee
9:20	0:20	Moving from data to decisions: How the Rainy Headwaters-Vermilion Watershed planning effort is utilizing extensive monitoring & research data to prioritize, target, & measure for implementation Becca Reiss, North St. Louis Soil and Water Conservation District
9:40	0:20	Nibi portal and curriculum Grand Council Treaty #3 Women's Council
10:00	0:30	**Break**
		Session 4 - Nutrients
10:30	0:20	A stream corridor sediment budget for the Little Fork River Anna Baker, USGS
10:50	0:20	Planned Study of Rainy River sediment-bound phosphorus as a potential driver of Lake of the Woods Algal Blooms Anna Baker, USGS
11:10	0:20	Lessons learned from a multi-year nutrient research program in the Canadian tributaries Catherine Eimers, Trent University
11:30	0:20	Nitrogen fixation may offset nitrogen demands in Lake of the Woods cHABs, and molecular techniques reveal species responsible for toxin production Kaela E. Natwora, University of Minnesota Duluth
11:50	1:20	**Lunch in the cafeteria**
		Session 5 - Emerging Issues & Technologies
13:10	0:20	Using Satellite-Derived Water Quality Data from an Automated High-Performance Computing Environment to Identify Lakes Prone to Cyanobacteria blooms in the Rainy-Lake of the Woods Watershed Leif Olmanson, Remote Sensing & Geospatial Analysis Lab, University of Minnesota
13:30	0:20	Adaptive Monitoring on the Lower Winnipeg River, Manitoba Madeline Stanley, International Institute for Sustainable Development
13:50	0:20	Assessing Vulnerability of Waters to Mining in the Rainy—Lake of the Woods Watershed Victoria G. Christensen, USGS Upper Midwest Water Science Center
14:10	0:20	Using a novel photoelectrochemical oxygen demand (peCOD) analyser to augment monitoring of greenhouse gas impacts on the dissolved carbon in boreal lakes Blake Cooney, IISD Experimental Lakes Area and U. Manitoba
14:30	0:20	Hydrologic Mapping Tool for Rainy Lake, Namakan Reservoir, and Rainy River to Support Adaptive Management of Lake Levels & USGS Web Informatics & Mapping Team Web Application Capabilities Julia Prokopec, USGS Upper Midwest Water Science Center
14:50	0:30	**Break**
		Session 6 - Ecology and Biodiversity
15:20	0:20	Impacts of Invasive Spiny Water Flea (Bythotrephes cederstroemi) on Mercury Accumulation in Northern Ontario Walleye James B. Wood, Lakehead U. Community Ecology and Energetics Lab
15:40	0:20	Community-Based Monitoring and Grand Council Treaty #3 led Monitoring Michaela Novak, Chris Herc, Grand Council Treaty #3
16:00	0:20	Whose track is that? Interpreting animal sign in Voyageurs National Park to determine semi-aquatic mammal presence Catherine Berrick, Voyageurs National Park
16:20	0:20	The effect of prescribed fire and flooding on hybrid cattail at Voyageurs National Park Erika Meints, Northern Michigan University and Voyageurs National Park
16:40	0:05	**Closing Remarks - Forum Ends 4:45 pm Central Time**

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Day 1 – March 8, 2023

Session 1 – Getting to Objectives (Fireside Chat)

Presentations

Water quality objectives for the International Red River: A case study

Nicole Armstrong

Manitoba Environment, Climate and Parks

Overview

In November 2022 the governments of Canada and the United States approved four new water quality objectives for the Red River to continue improving water quality in the Red River basin, including downstream Lake Winnipeg. These water quality objectives are for the nutrients phosphorus and nitrogen and will be monitored by the International Red River Watershed Board to identify changes in water quality trends over time and provide key information to support efforts to improve water quality and reduce the occurrence of harmful algal blooms in the basin. The process for "getting to objectives" on the Red River will be presented as a case study, including lessons learned. Also examined will be the initiative through the Prairie Provinces Water Board, that led to 2021 updated water quality objectives the multi-jurisdictional setting within Canada.

Brief Bio

Nicole Armstrong is the Director of Water Science and Watershed Management Branch of Manitoba Environment Climate Change and Parks. She represents the Province of Manitoba on the Board of Directors of the Red River Basin Commission and as a member of the Prairie Provinces Water Board. Nicole is also the Canadian Co-Chair of IJC International Souris River Board and a Member of the IJC International Red River Watershed Board.

Grand Council Treaty #3 Perspective on Shared Water Governance

GCT3

Grand Council Treaty #3

Overview

The Canadian portion of the Rainy-Lake of the Woods Basin is entirely encompassed within the territory of the Anishinaabe Nation of Treaty #3. Perspectives will be presented on shared water governance within Treaty 3 territory which spans over 142,450 km^2, from west of Thunder Bay to north of Sioux Lookout, along the international border and into Manitoba. Treaty 3 is comprised of 28 First Nations with an estimated population of 25,000.

Brief Bio

TBD

Moderated "Fireside Chat" Discussion Session – All Participants

Moderated "Fireside Chat" Discussion Session – All Participants

Session 2 – Watershed Updates: Research to Action

Moving to Action and Understanding on the US Side: Implementation and Further Research in Rainy Basin

Mike Kennedy, Amy Mustonen, Lindsey Krumrie

MPCA-Duluth

Abstract

A brief update on the local watershed planning and other activities on US side of the Rainy Basin. We will highlight current research, the status of the One Watershed, One Plan (the local watershed planning effort post WRAPS and TMDL), and other activities.

Brief Bio

Mike, Amy, and Lindsey are Project Managers out of the Duluth MPCA Office and assist local partners in the Rainy Basin with water quality technical assistance.

Location of Study

U.S. portion of the Rainy-Lake of the Woods basin

Environment and Climate Change Canada Lake of the Woods Nutrients Update

Daniel Rokitnicki-Wojcik and Marie-Claire Doyle

Environment and Climate Change Canada, 867 Lakeshore Rd Burlington, ON L7S 1A1
Daniel.Rokitnickiwojcik@ec.gc.ca

Abstract

Environment and Climate Change Canada has implemented a science-based program in the Lake of the Woods since 2016. This has included research, modelling and monitoring to advance the understanding of the causes and consequences of harmful algal blooms in Lake of the Woods, as well as engagement on the development of ecosystem objectives and phosphorus reduction scenarios. This presentation will provide an update on the program, including key research, and communication and engagement activities that have occurred over the past year.

Brief Bio

Daniel Rokitnicki-Wojcik is a Program Coordinator, Strategic Policy Branch – Ontario Region, Environment and Climate Change Canada. He coordinates ECCC policy activities related to water quality and the management of nutrient loadings for the Rainy River-Lake of the Woods Basin and is a former Canadian secretary to the IJC's International Rainy-Lake of the Woods Watershed Board.

Location of Study

Canadian portion of the Rainy-Lake of the Woods Basin.

International Rainy-Lake of the Woods Watershed Board Update

IRLWWB Co-Chairs: Michael Goffin[1], Col. Eric R. Swenson[2]

[1]Environment and Climate Change Canada; [2]U.S. Army Corps of Engineers

Abstract

The presentation reviews the International Joint Commission's International Rainy-Lake of the Woods Watershed Board mandate and provides updates on the Board's activities from April 2022 to date. The role and activities of the Water Levels Committee will be discussed, with particular focus on flooding throughout the basin in 2022. This presentation will cover the Board's aquatic ecosystem health endeavors, with a special focus on working with the International Joint Commission and Governments to reduce phosphorus and address toxic algae. Current International Watershed Initiative projects such as the Objectives and Alerts Project and Core Monitoring Program, the Aquatic Invasive Species Coarse Scale Risk Assessment Project and the adaptive management of the Rainy – Namakan boundary waters will be discussed.

Brief Bio

In 2020, Michael Goffin took on a special assignment as Director General Canada Water Agency Project within Environment and Climate Change Canada.Prior to taking this assignment, Mr. Goffin was the Regional Director General for Ontario, responsible for leading Canada's efforts to restore and protect the water quality and ecosystem health of the Great Lakes.

In 2012 he was lead negotiator for Canada responsible for the negotiation of the Canada-United States Great Lakes Water Quality Agreement. Mr. Goffin has been a long serving member of the International Joint Commission's Great Lakes Water Quality Board, and also currently serves as Canadian Co-chair of the International Joint Commission's International Rainy Lake of the Woods Watershed Board.

Over the course of his more than thirty-year career in the Public Service of Canada, Mr. Goffin has been engaged in policy develop and program delivery in areas which include environmental protection, wildlife management, meteorology, water and ecosystem management, intergovernmental affairs and community outreach and engagement.

Colonel Eric R. Swenson is the Commander and District Engineer, U.S. Army Corps of Engineers – St. Paul District. He serves as the U.S. Co-chair for the International Rainy-Lake of the Woods Watershed Board, the Water Levels Committee, the International Lake of the Woods Control Board, and the International Red River Watershed Board. He is also a member of the International Souris River Board.

Location of Study

The Board's geographic mandate includes the entire Rainy-Lake of the Woods Watershed.

IJC Objectives and Alerts Study

Bev Clark

Consultant

Abstract

An update on the IJC Objectives and Alerts project is presented. Phase one has been completed and provides recommendations for developing international objectives for phosphorus for Lake of the Woods and Rainy River and alert levels for other concerns. Phase 2 is being planned to get underway and a 50,000 ft overview of what might be considered is presented.

Brief Bio

Bev Clark is a consultant who has been involved in Lake of the Woods monitoring and research since the 1980s. He has been involved extensively in the State of the Basin Reports, as well as Phase I of the IJC Objectives and Alerts Study.

Location of Study

International Rainy-Lake of the Woods Watershed.

GCT3 Geoportal

Raeshawn Parsons

Territorial Planning Unit, Grand Council Treaty #3

Abstract

The Geoportal is an interactive tool for data storage and sharing across the Anishinaabe Nation in Treaty #3. The Geoportal allows Treaty #3 communities and organizations a secure location to store and share data, alongside public information acting as a comprehensive solution for all data needs. Through the portal the Anishinaabe Nation in Treaty #3 and Treaty #3 communities can view and share information across the 55 000 square miles of the Territory to understand ongoing resource activities, economic opportunities, identify gaps, share knowledge and teachings and protect sacred sites throughout the Territory that will support decision making as a Nation through Manito Aki Inakonigaawin (Treaty #3 Great Earth Law).

The purpose of the Geoportal is to support the Anishinaabe Nation in Treaty #3 and communities to access, protect, and share public and private spatial and non-spatial data. Communities can upload and save projects and documents as well have access to online mapping tools with diverse collections of Treaty #3 specific data layers. The Geoportal provides the ability to have singular community access, access shared between multiple communities, and as a Nation for each piece of data saved. Documents like impact assessments, forest management plans, land use studies, mineral surveys, emergency plans, housing developments and project outlines can all be connected with spatial GIS layers to make custom maps or share with project teams.

Brief Bio

Hello, my name is Rae (they/them) and I'm the Grand Council Treaty #3 GIS Specialist. I am from southwestern Ontario and have been with GCT3 since June of 2021. I have a background in Nature Conservations, GIS, and Horticulture. Basically, my job as a GIS Specialist is to make the maps everyone uses in monitoring, planning, researching, and spatial analysis.

Location of Study

Treaty #3 Territory

Day 2 – March 9, 2023

Session 3 – Planning & Governance

Centering Treaty in governing the Rainy-Lake of the Woods Watershed

Johann Strube

Carleton University, School of Public Policy and Administration

Abstract

The coexistence of Indigenous Peoples, Settlers, and more-than-human kin in the Rainy-Lake of the Woods Watershed is based on mutual responsibilities agreed upon in treaties. It is through Treaty 3 and the 1854 and 1866 treaties that First Nations, Tribes, Canada, and the United States recognized each other's sovereignty. In addition, the Anishinaabe closed treaties with non-human nations that prescribe a sustainable life of mutual respect and care. Finally, the 1909 Boundary Waters Treaty coordinates the governance of waters shared by the United States and Canada. The Boundary Water Treaty undergirds the local system of water governance in the Rainy-Lake of the Woods Watershed, but the other treaties have received little recognition. In this presentation, I review the different treaties in the watershed, reflect on their pertinence to water governance in the Rainy-Lake of the Woods Watershed, and suggests ways in which the current water governance system could be reformed to honor our mutual treaty responsibilities.

Brief Bio

Johann Strube is a sociologist with a focus on food, environmental governance and justice. He earned his PhD in Rural Sociology from the Pennsylvania State University studying the impacts of water level governance on wild rice and Indigenous Nations on Rainy Lake. Besides his ongoing work in Rainy Lake of the Woods Watershed, Dr. Strube is involved in research on Indigenous fisheries in the Arctic, the decolonization of rural sociology, and sustainable agriculture. In March, Dr. Strube will begin in a new position as Policy Analyst with the Grand Council of Treaty #3.

Location of Study

International Rainy-Lake of the Woods Watershed

International Rainy - Lake of the Woods Watershed Board Adaptive Management Committee's Climate Change Adaptation Activities

Teika Newton

Adaptive Management Committee, International Rainy-Lake of the Woods Watershed Board

Abstract

The Adaptive Management Committee (AMC) is one of four core committees of the International Rainy - Lake of the Woods Watershed Board. The AMC was established in 2020 with a primary function to monitor whether the latest rule curves perform as expected. In addition, the AMC is also responsible for overseeing the Board's implementation of the International Joint Commission's climate change adaptation guidance framework, an adaptive management protocol for Boards to assess and respond to known and anticipated climate change impacts. In this presentation, we provide an update on the AMC's activities since 2020 to support this watershed's adaptation to climate change and discuss upcoming work for 2023 and beyond.

Brief Bio

Teika Newton is the Canadian Co-Chair of the Adaptive Management Committee of the International Rainy-Lake of the Woods Watershed board. She is also the International Watershed Coordinator with the Lake of the Woods Water Sustainability Foundation. Teika is a long-time participant in regional watershed science, policy, and governance activities. She has served as a board member for the International Joint Commission's International Rainy–Lake of the Woods Watershed Board, and co-chaired the Board's Community Advisory Group, Engagement Committee, and currently the Adaptive Management Committee. Teika also has been helping to guide the IJC Board's work on climate adaptation since 2016. Teika joined LOWWSF in January 2023, after several years at Climate Action Network - Réseau action climat Canada, where she helped grow the network to 150 civil society member organizations and cultivate a powerful team of diplomats and climate policy experts under her leadership as Managing Director. At the local level, Teika continues to contribute as a member of the City of Kenora's Sustainability Advisory Committee.

Location of Study

International Rainy-Lake of the Woods Watershed

Moving from data to decisions: How the Rainy Headwaters-Vermilion Watershed planning effort is utilizing extensive monitoring and research data to prioritize, target, and measure for implementation.

Becca Reiss[1], Phil Norvitch[1], Tara Solem[2], Kari Hedin[2], Ilena Hansel[3], Erin Loeffler[4], Moriya Rufer[5]

[1]North St. Louis SWCD; [2]Lake County SWCD; [3]Cook County SWCD; [4]MN Board of Water and Soil Resources; [5]Houston Engineering

Abstract

The One Watershed, One Plan (1W1P) Process is underway in the Rainy Headwaters-Vermilion River Watershed. 1W1P is a Minnesota Board of Water and Soil Resources program facilitating development of a science-based comprehensive watershed plan that aligns state strategies with local priorities. Acknowledging we can't do everything, everywhere, the planning process integrates Minnesota Pollution Control Agency and citizen monitoring data, Department of Natural Resources data analyses, and research from other sources in order to prioritize which issues and resources will be addressed in the 10-year plan. Using this data along with local knowledge helped the team prioritize lakes and streams that will be the focus of restoration, enhancement, and protection activities. These results will be shared.

Brief Bio

Becca Reiss is the Community Conservationist for the North St. Louis Soil & Water Conservation District (SWCD) and is helping steer the planning effort for the Rainy Headwaters-Vermilion River Watershed along with Lake and Cook SWCDs and Counties, Houston Engineering, and the Minnesota Board of Water and Soil Resources.

Location of Study

Rainy Headwaters-Vermilion River Watershed

Nibi portal and curriculum

GCT3 Women's Council

Treaty #3 Women's Council

Abstract

Through guidance from the Treaty #3 Women's council, knowledge keepers and technicians this online space was created in order to share teachings, experiences and responsibilities in relation to Nibi. Based on the values of the Nibi Declaration, the Nibi Portal is a continuation of the work that we must strive to do to preserve, protect and respect all Nibi. The space will be ever evolving with additions of videos, teachings, and support for the Nibi Declaration that can continue to guide decision making and our relationships to Nibi.

Brief Bio

(To come)

Location of Study

Treaty #3 Territory

Session 4 - Nutrients

A stream corridor sediment budget for the Little Fork River

Faith Fitzpatrick[1], Shelby Sterner[1], Anna Baker[1]*, Sam Soderman[2], Mike Kennedy[3], Phil Norvitch[4], Andy Kasun[5], Karen Gran[5], Jesse Anderson[3], Matt Gutzmann[6]

[1]U.S. Geological Survey Upper Midwest Water Science Center abaker@usgs.gov , [2]Koochiching County Soil and Water Conservation District, [3]Minnesota Pollution Control Agency, [4]North St. Louis Soil and Water Conservation District, [5]University of Minnesota – Duluth, [6]Itasca Soil and Water Conservation District

Abstract

The Little Fork River has been identified as a disproportionate source of sediment to downstream waters. The Minnesota Pollution Control Agency (MPCA) has identified large sections of the Little Fork with sediment related impairments and has developed Total Maximum Daily Load regulations to address these impairments. However, the MPCA is in need of more detailed information describing sediment sources in the basin to help guide management for reduction of sediment loads. In collaboration with MPCA, the Soil and Water Conservation Districts of Koochiching, North St. Louis, and Itasca Counties, and the University of Minnesota, the USGS has been working to delineate sediment sources throughout this 4,850 square kilometer river basin, using sediment budget and sediment fingerprinting techniques. This presentation will share the results of a recently completed sediment budget constructed for the Little Fork stream corridor.

The development of the stream corridor sediment budget was supported by the collection of field-based reach-scale Rapid Geomorphic Assessment (RGA) data describing the channel morphology and major geomorphic processes, with specific measurements of eroding banks and valley sides, soft sediment deposition, and areal distribution of bars for a full range of channel sizes and geomorphic settings. Field data collected during the 2021 field season were applied to a stream network delineated for this project using a 10-meter digital elevation model and a small (0.02 km^2) basin threshold for stream delineation. Importantly, this newly delineated network included ravines with ephemeral channels, which are potentially important sources of sediment to the mainstem of the river and are not included in the perennial stream-based Minnesota Department of Natural Resources stream layer or USGS National Hydrologic Dataset. The more detailed network was broken into 60-meter segments and then categorized by stream order, channel slope, and proximity of steep valley sides, and riparian vegetation. Field measurements of stream corridor erosion and soft sediment deposition from the RGAs were extrapolated along the network of segments, resulting in a delineation of areas anticipated to be important contributors to sediment load, and estimates of erosion and soft sediment deposition along the stream corridors. Preliminary results indicate 130,000 Mg/yr of corridor erosion and 840,000 Mg of soft sediment stored in channels. These estimates will be used to compliment the geochemical fingerprinting apportionments of both upland and corridor sources of sediment and sediment-bound phosphorus.

Brief Bio

Anna Baker is a hydrologist with the USGS Upper Midwest Water Science Center, and has been working in Minnesota since 2017. She obtained her masters in Water Resources Science at the University of Minnesota in 2018.

Location of Study

Little Fork River Basin

Planned Study of Rainy River sediment-bound phosphorus as a potential driver of Lake-of-the-Woods Algal Blooms

Anna Baker[1*], Faith Fitzpatrick[1], Paul Reneau[1], Adam Heathcote[2], Mark Edlund[2], Sam Soderman[3], Mike Hirst[4], Joe Vrtacnik[4], Mike Kennedy[5], Jesse Anderson[5], Kevin Stroom[5], Phil Norvitch[6], Shelby Sterner[1], James Blount[1]

[1]U.S. Geological Survey Upper Midwest Water Science Center, [2]St. Croix Watershed Research Station, Science Museum of Minnesota, [3]Koochiching County Soil and Water Conservation District, [4]Lake of the Woods Soil and Water Conservation District, [5]Minnesota Pollution Control Agency, [6]North St. Louis Soil and Water Conservation District

Abstract

Lake of the Woods (LoW) is a vital ecosystem impacted by recurring harmful algal blooms. The Rainy River basin comprises 80% of the total drainage area to LoW and contributes 45-75% of the total phosphorus (TP). Despite major reductions in total phosphorus concentrations in the Rainy River, blooms persist in downstream Lake of the Woods. Previous investigations have explored the inputs of phosphorus from the Rainy to LoW, but none to date have explored the detailed phosphorus chemistry of sediments in storage and in transport in this large river network. As a result, we lack understanding of how sediment-bound phosphorus, which may accumulate in the river network over time and be slowly remobilized and transported, may serve to fuel blooms downstream now and into the future.

This year, a research team will begin work on addressing this gap by delineating areas of sediment-bound phosphorus deposition within the Rainy River and Fourmile Bay, and by exploring the detailed phosphorus chemistry of sediment in storage and in transport. The study will use geophysical tools to examine fine sediment deposit extent and thickness and will analyze how phosphorus is bound to sediment in the stream bed and in suspension throughout the Rainy River and in three key tributaries on the U.S. side of the river. Long-sediment cores will be collected in Fourmile Bay to link the results of this investigation of sediment-bound phosphorus storage to the longer-term history of sediment deposition in this dynamic river mouth, and in the lake itself. The results of this study will provide critical information for resource managers, identifying hotspots of phosphorus introduction and of legacy phosphorus storage within the network. This study will identify the in-stream source areas with greatest potential to contribute to the bioavailable pool of phosphorus downstream and to fuel algal blooms into the future.

Brief Bio

Anna Baker is a hydrologist with the USGS Upper Midwest Water Science Center, and has been working in Minnesota since 2017. She obtained her masters in Water Resources Science at the University of Minnesota in 2018.

Location of Study

Lower Rainy River, Fourmile Bay

Lessons learned from a multi-year nutrient research program in the Canadian tributaries

*[1]Catherine Eimers, [1,2]Wes Greenwood, [1,3]Andrew Williams, [3]Andrew Paterson

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ceimers@trentu.ca ; 705-748-1011;
[2]Alberta Ministry of Environment and Protected Areas;
[3]Ontario Ministry of Environment, Conservation and Parks.

Abstract

In this talk we describe the primary 'take home messages' from an ongoing research and monitoring program in the Canadian portion of the Lake of the Woods watershed. Two plus years of temporally intensive and spatially extensive measurements of water quality and quantity indicate the importance of both high and low flow events for phosphorus and nitrogen concentrations and budgets. Comparison of river discharge patterns across sites demonstrated the critical need for site-specific flow monitoring and the high sensitivity of nutrient export to variation in climate. Nutrient loads in atmospheric deposition were surprisingly high, and deposition may account for a larger proportion of lake nutrient budgets than previously estimated. Nitrogen levels as nitrate are variable across the basin but are rising in agricultural rivers that feed the Rainy River. Expansions of tile-drainage and corn and soybean production in the Rainy River sub-basin affect both nutrient levels and stream flow and should be monitored into the future. While phosphorus has been the sole nutrient targeted for management historically, the dynamic nature of nitrogen loading as well as recent research on the influence of nutrient stoichiometry suggest a multi-nutrient approach to eutrophication management may be prudent.

Brief Bio

Catherine Eimers is a professor at Trent University. She has been involved in a tributary and deposition loading study within the Canadian portion of the LoW basin since 2018.

Location of Study

Canadian tributaries to the Rainy River and Lake of the Woods

Nitrogen fixation may offset nitrogen demands in Lake of the Woods cHABs, and molecular techniques reveal species responsible for toxin production

Kaela E. Natwora, Cody S. Sheik, Adam Heathcote, and Mark Edlund

University of Minnesota Duluth, Large Lake Observatory, 2205 E 5th St, Duluth, MN 55812
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Abstract

Cyanobacterial harmful algal blooms (cHABs) continue to threaten the ecosystem services supported by the waters of Lake of the Woods (LOW). LOW cHABs are increasing in frequency and toxicity despite phosphorous mitigation practices. One heavily supported trigger of cHABs is dual nutrient control of both phosphorus (P) and nitrogen (N). It has traditionally been assumed that freshwater systems are limited by P. However, not all systems are equal, and a "P-only Paradigm" has shifted to include the potential of co-nutrient limitation when understanding drivers of HABs, specifically N and P. LOW consistently becomes N-limited prior to the peak of the blooms, suggesting nitrogen availability is likely a strong driver of bloom extent and productivity. Thus, we sought to quantify how internal cycling of nitrogen through nitrogen fixation could help with the proliferation of cHABs in LOW. Nitrogen fixation is a microbial mediated process in which inaccessible, atmospheric nitrogen (N_2) is fixed to ammonia (NH_3), which is then available to be incorporated into biomass. Interestingly, the cyanobacteria *Aphanizomenon* and *Dolichospermum* that populate LOW cHABs, can fix nitrogen and in some species produce cyanotoxins. We found that nitrogen fixation rates increase exponentially as the bloom increases in intensity throughout the growing season. Using 16S rRNA gene sequencing, we saw significant shifts in the microbial community composition throughout the bloom season. A concomitant increase in the cyanotoxin toxin, microcystin, was also seen during our sampling. To determine the potential cyanobacterial culprits producing microcystin, we used a genome-based survey of the genera present at LOW. Using the secondary metabolite prediction program ANTISMASH, we were able to determine toxigenic cyanobacteria species and the diversity of associated toxins produced by them. Interestingly, at LOW cyanobacteria that were in low abundance like *Lyngba, Microcystis, Planktothrix and Raphidiopsis* are likely responsible, and contribute to toxin production. These findings are in line with the stoichiometry of LOW and suggests that N-limitation is likely suppressing toxin production, as microcystin has high nitrogen content per molecule. Together, our finding suggest that nitrogen fixation may alleviate N-demand during N-limitation ultimately supporting cHAB growth, and that low abundant cyanobacteria may contribute to toxin production in LOW. Given that it is likely the nitrogen environment in LOW is structuring the microbial community composition and influencing toxin production, further monitoring of inorganic N will be important for management implications.

Brief Bio

Kaela Natwora is a Ph.D. student at the University of Minnesota-Duluth studying nitrogen dynamics and microbial community structure associated with harmful algal blooms. Kaela works in Dr. Cody Sheik's aquatic microbiology lab at the Large Lake Observatory. In summer of 2021, Kaela collaborated with Drs. Heathcote and Edlund integrating nitrogen fixation quantifications and molecular techniques into their existing monitoring efforts on Lake of the Woods in hopes of telling the nitrogen story and revealing the toxigenic cyanobacteria species in LOW.

Location of Study

Southern Basin of Lake of the Woods (Muskeg Bay, Big Traverse and MPCA2)

Session 5 – Emerging Issues and Technologies

Using Satellite-Derived Water Quality Data from an Automated High-Performance Computing Environment to Identify Lakes Prone to Cyanobacteria blooms in the Rainy-Lake of the Woods Watershed

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Abstract

The Rainy-Lake of the Woods Watershed is one of the fastest-warming areas in the continental USA. With warming temperatures, longer open water seasons, and more intense storms delivering more nutrients to our lakes, the occurrence of harmful algal blooms (HABs) and threats to fish habitats are increasing. Water temperature is one of the most important physical characteristics of aquatic systems, regulating many chemical and biological processes. Increasing water temperatures limit the fish habitat and increase the competitive advantage for cyanobacteria blooms. Lakes warm slower than air temperatures and the rate of warming depends on water clarity, lake depth, and size characteristics. Small shallow turbid lakes warm faster than large deep clear lakes. While water temperature measurements are relatively scarce, they are essential for determining lakes where high temperatures and associated low oxygen threaten fish habitats and where HABs are likely to occur.

Using Landsat imagery, we have been assessing lake water clarity in Minnesota, USA, and ~10,000 lakes in the Rainy-Lake of the Woods Watershed for over 25 years. We used empirical methods and in situ Secchi calibration data for early assessments. Recent advances in satellite technology (improved spatial, spectral, radiometric, and temporal resolution) and atmospheric correction, along with cloud and supercomputing capabilities, have enabled the development of automated regional-scale measurements of water quality and temperature. These new capabilities provide opportunities to improve lake and fisheries management and identification of lakes prone to HABs by measuring more variables (chlorophyll, colored dissolved organic matter (CDOM), and total suspended matter, the main determinants of water clarity) and temperature more frequently. Lakes prone to cyanobacteria blooms can be identified using historical water quality data along with lake temperature since the lakes that bloom tend to do so in a predictable manner due to climatic conditions and nutrient levels. Near real-time water quality and temperature data and modeling can be used to forecast HAB probability.

Brief Bio

Leif Olmanson is a Researcher at the University of Minnesota with over 20 years' experience developing remote sensing applications to create temporally and spatially rigorous datasets of water and land resources for large area ecosystem characterization. He is particularly interested in developing field validated image processing methods implemented in automated geospatial analysis systems such as Google's Earth Engine and Minnesota Supercomputing Institutes super computers to gain a better understanding of the natural environment. He currently leads a team of researchers and computer scientists to build a near real-time water quality monitoring system for Minnesota's >10,000 lakes using satellite imagery to providing critical water quality information for lake management.

Location of Study

US portion of the Rainy-Lake of the Woods Watershed

Adaptive Monitoring on the Lower Winnipeg River, Manitoba

Madeline Stanley[1]*, Thomas Saleh[2], Jeff Simpson[3], Steven Simpson[3], Connor Riach[3], Joey Simoes[1], Pauline Gerrard[2]

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Abstract

The Winnipeg River is a region of cultural, spiritual, ecological, and socioeconomic significance, and yet it is difficult to assess its integrity and quality due to data limitations. Monitoring along the Winnipeg River, and in many watersheds in Canada, are led by various Federal, Provincial, or Community-based programs that are limited by space, time, and finances. Each have their own goals and priorities, and thus, each program may act independently. This limits our ability to compare sites, to fully understand the integrity of aquatic ecosystems, and ultimately, to make effective decisions. To address this gap, IISD-ELA and Aquatic Life Ltd have partnered to explore Adaptive Monitoring through the deployment of higher frequency, near real-time water quality sensors to better understand changes in the river to inform decision makers. Our project aims to explore how an adaptive monitoring program can improve the shared understanding of the river, develop surrogate models and near-term forecasting, and use spectral fingerprints to isolate phosphorus and nitrogen. To date, we have deployed three sensors along the Winnipeg River that collect and transmit ≤ hourly data on a variety of water quality parameters to test these questions.

Brief Bio

Madeline is a Policy Advisor with IISD's Water Program with a background in ecology and is also a PhD Candidate at the University of Manitoba, studying the use of engineered floating wetlands to remediate oil spills.

Location of Study

Lower Winnipeg River Basin, Manitoba

Assessing Vulnerability of Waters to Mining in the Rainy—Lake of the Woods Watershed

Victoria G. Christensen[1], Aliesha Krall[1], Eric Boisvert[2], and Hazen Russell[2]

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[2]Geological Survey of Canada

Abstract

The impacts of mining—past, present, and potential—have been of concern within the Rainy Lake of the Woods basin for many years. In 2020, the Health Professionals Advisory Board (HPAB) completed work on a preliminary map of mining activity that can affect common waters of Canada and the United States. However, the data sets supporting this effort had various purposes and thus data for some drainage basins affected by mines were not readily found and information on proposed mines was limited. The HPAB collaborated with the International Rainy—Lake of the Woods Watershed Board to support a case study for binational map harmonization of Rainy—Lake of the Woods watershed. This complex issue will require a multi-year, phased approach.

The U.S. Geological Survey and Geological Survey of Canada were selected to compile data and participate in a data gap analysis associated with the cumulative effect of mining on this transboundary basin. Erosion of soils is a concern, along with metals, sulfate, acidity, and other constituents or contaminants associated with particular mineral deposits. Key static and temporal environmental datasets include earth materials, terrestrial and aquatic biological systems, and water. Other available datasets may include human occupation and activities within the watershed, for example old mine sites.

Issues pertaining to the impact of mining fall under the jurisdiction of multiple federal, state/province, and Indigenous groups on both sides of the border. Data has been collected over many decades, by multiple individuals and agencies, operating with different sampling and analytical protocols.

An attempt will be made to provide some context on the extent of data integration. A discussion of how to maintain harvested datasets, continuous updates, and potential storage and retrieval options of data will be reviewed. Local agencies and Indigenous communities will be contacted, as they may collect local water and aquatic indicators that are not widely published or accessible online.

In summary, the agencies will provide an update of the data obtained from a variety of reports, publications, and agency files and a preliminary analysis of what is known, what is not known, and the gaps of information that are required to fully assess the vulnerability of the Rainy—Lake of the Woods watershed to mining.

Brief Bio

Dr. Victoria Glenn Christensen is a research hydrologist with the Upper Midwest Water Science Centre of the USGS, who studies HABs, algal toxins, and cyanobacteria. She is a member of the Environmental Health Program's Algal Toxin Team and serves as the acting Communications Coordinator for the Water Mission Area.

Location of Study

International Rainy – Lake of the Woods Watershed

Using a novel photoelectrochemical oxygen demand (peCOD) analyser to augment monitoring of greenhouse gas impacts on the dissolved carbon in boreal lakes

Blake Cooney[1,2], Robert Menegotto[3], Mark Hanson[2], Vince Palace[1]

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[2]University of Manitoba; [3]MANTECH Inc

Abstract

Anthropogenic carbon outputs are an important consideration in limnology. As atmospheric monitoring of greenhouse gases continues, the impact of the changing atmosphere on freshwater is an important parameter to study. Questions surrounding the carbon budget of boreal lakes are complex and continued monitoring as environmental modelling improves is necessary. At the IISD-Experimental Lakes Area in Northwestern Ontario, we are implementing photoelectrochemical oxygen demand (peCOD) analysis into routine carbon monitoring. PeCOD analysis has shown a strong correlation with dissolved organic carbon (DOC) in several boreal lakes with varying DOC compositions and concentrations. The understanding of the transfer of terrestrial DOC to aquatic systems is evolving and peCOD analysis may offer a useful insight into the nature of carbon being transferred. Furthermore, peCOD analysis is a convenient tool for rapid analysis of organic carbon and delivers a more nuanced interpretation of the health of aquatic ecosystems in the boreal region. While we already use peCOD analysis to inform experiments involving organic contaminants, we are expanding its use to target long-term ecological effects on boreal lakes from increased carbon in the atmosphere.

Brief Bio

I am a chemist at the IISD Experimental Lakes Area, currently pursuing an M.Sc. through IISD-ELA Head Scientist Vince Palace, co-supervised by Mark Hanson at the University of Manitoba. I am going on my 6th year at IISD-ELA, starting as a student in 2018. While all limnology is certainly of interest, most of my research has been geared towards integrating environmental analytical chemistry with long-term monitoring and short-term contaminant detection in boreal lakes, with remediation of affected areas a constant consideration. I am an avid outdoorsman and enjoyer of our wonderful region!

Location of Study

Across the IISD-Experimental Lakes Area on several lakes

Hydrologic Mapping Tool for Rainy Lake, Namakan Reservoir, and Rainy River to Support Adaptive Management of Lake Levels and USGS Web Informatics & Mapping Team Web Application Capabilities

Julia Prokopec[1] and Nick Estes[1]

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Abstract

The US Geological Survey (USGS) Web Informatics and Mapping Team (WIM) in cooperation with the International Joint Commission (IJC) is tasked to create a Hydrologic Visualization Tool web application for Rainy Lake, Namakan Reservoir, and Rainy River in support of adaptive management of lake levels. This effort will provide a tool to assist the IRLWWB and its committees in assessing lake level management scenario modeling output showing performance of existing and alternate rule curves. The tool will built off of the hydrologic response models and digital elevation models completed for Rainy Lake, Namakan Reservoir, and Rainy River as part of the Plan of Study for the Evaluation of the International Joint Commission (IJC) 2000 Order for Rainy and Namakan Lakes and Rainy River (Kallemeyn et al., 2009). This project will also enhance and add benefit to a flooding and ice damage project completed through that plan of study and the associated performance indicator that was used in the review of the 2000 Rule Curves.

Web Informatics and Mapping (WIM) develops web-based tools that support USGS science and other federal science initiatives. Our projects range from full-featured database applications to limited-scope data visualizations. WIM team members combine collective expertise in cartography, science, and web technology to create custom products that are practical, intuitive, and focused on our cooperators' needs. Our work includes digital cartography, data visualization, data management, data analysis, and decision support. All of our applications are created with the latest web technology, including Angular and ArcGIS. You can view the code for our public projects on our GitHub at **github.com/USGS-WIM.**

Brief Bio

Julia Prokopec is a hydrologist, project manager, and USGS Water Mission Area liaison for WIM. She received her B.S. in Environmental Studies with an emphasis in Geohydrology from Bemidji State. Julia has worked on projects studying groundwater and surface water interaction, persistence of pesticides in groundwater and surface water, and water quality monitoring. Her focus is hydraulic modeling and flood-inundation mapping where she has led studies to be used by communities for hazard mitigation.

Location of Study

Rainy Lake, Namakan Reservoir, and Rainy River

Session 6 – Ecology & Biodiversity

Impacts of Invasive Spiny Water Flea (*Bythotrephes cederstroemi*) on Mercury Accumulation in Northern Ontario Walleye

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Abstract

Invasive species pose significant threats to aquatic biodiversity. The spiny water flea (*Bythotrephes cederstroemi*) has been investigated for its role in damaging zooplankton communities and its potential impact on contaminant accumulation in sportfish. This study aims to assess the impacts of *Bythotrephes* on the size-mercury (Hg) relationship in walleye by (a) comparing the size-Hg relationship of walleye in lakes invaded by *Bythotrephes* against lakes that are uninvaded for the same time, and (b) comparing the size-Hg relationship of walleye in lakes with sufficient data both before and after *Bythotrephes* invasions. Preliminary findings indicate no significant differentiation in the size-Hg relationship between invaded and uninvaded lakes, but significant differences between pre and post invasion size-Hg relationships in walleye. The greatest differences observed before and after *Bythotrephes* invasion were in Pickerel Lake and Namakan Lake, which were among the most data rich ecosystems available for evaluation. By contrast, no significant difference in the size-Hg relationship over time was detected in uninvaded lakes, indicating that in the absence of *Bythotrephes* invasion, the size-Hg relationship in Walleye regionally should be relatively stable. These preliminary results suggest that there is some effect of *Bythotrephes* invasions on the accumulation of mercury in walleye on a temporal scale, but that between-lake differences are large enough to obscure any potential differences between invaded and non-invaded lakes. Further examination of this potential effect includes conducting temporal analysis on additional lakes and refining the spatial comparison to account for more individual waterbody variation. Additional planned analyses that may inform the cause of this relationship include: The examination of biomagnification slopes that might reveal broader ecosystem changes related to the accumulation of contaminants, and the inclusion of a bioenergetics/mercury-mass-balance model that will show if walleye bioenergetics are significantly impacted by the presence of *Bythotrephes*.

Brief Bio

James (Ben) Wood is a master's candidate currently writing his thesis at Lakehead University and is a current member of the Community Ecology and Energetics Lab (CEELab). His research is primarily focused on Quetico Provincial Park where he has been collecting data for the last two summers. Before starting his master's, he had worked several seasons with the MNRF: Upper Great Lakes Management Unit. Ben graduated from Dalhousie University in 2021 with a bachelor's degree in Marine Biology and Environmental Science.

Location of Study

Quetico Provincial Park and Rainy River watershed

Community-Based Monitoring and Grand Council Treaty #3 led Monitoring

Michaela Novak and Chris Herc

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Abstract

Grand Council Treaty #3 helps protect the traditional waters of the Anishinaabe peoples through environmental monitoring and a Community-Based Monitoring (CBM) program. Grand Council Treaty #3-led environmental monitoring occurs across the territory, where water chemistry and invasive species (including zebra mussel veligers, purple loosestrife, and phragmites) data are collected. The CBM program has been operational since 2018 to collect baseline data, develop monitoring across the territory, and prioritize youth engagement. The program has expanded in capacity-building and participating communities. Overall, the 2022 year for the CBM program and Grand Council-led monitoring has been considered a success, strengthening the objective to protect the traditional waters of the Anishinaabe peoples.

Brief Bio

Michaela Novak has recently earned a B.Sc. in Biology and Certificate in Indigenous Studies from Dalhousie University, where she focused her education on aquatic life and conservation through a holistic perspective. Currently, she is the environmental monitoring coordinator for Grand Council Treaty #3, completing community-based monitoring across Treaty #3 Territory.

Chis Herc is an Environmental Specialist with Territorial Planning Unit, Grand Council Treaty #3.

Location of Study

Caviar Lake, Dogpaw Lake, Eagle Lake, Island Lake, Kenora ON, Lake of the Woods, Lake Winnipeg, Laurenson's Creek, Rainy Lake, Rainy River, Wabigoon River, Winnipeg River.

Whose track is that? Interpreting animal sign in Voyageurs National Park to determine semi-aquatic mammal presence

Catherine Berrick[1], Steve Windels[1], Adam Ahlers[2]

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Abstract

Invasive hybrid cattails (*Typha x. glauca*) dominate wetland vegetation communities throughout many lacustrine wetlands in Voyageurs National Park (VNP). Once established, hybrid cattail can form dense, monoculture stands which degrade habitat quality for many wetland plant and animal species. In 2016, VNP initiated the Voyageurs Wetland Restoration Project to restore wetlands and establish a monitoring program focused on several key indicator groups. As part of our restoration efforts, we are studying the relationship between hybrid cattail occurrence and habitat use by four semi-aquatic mammals. Track board and walking surveys each offer a non-invasive method to determine species-specific presence at sites. These surveys allow investigators to record observations of animal sign such as tracks, trails, scat, feeding piles, huts, and lodges. From 2016 to 2022, 39-71 wetland sites within VNP were surveyed for the presence of muskrat, mink, otter, and beaver each year. We present preliminary results documenting changes in semi-aquatic mammal use in response to restoration efforts.

Brief Bio

Cat is a Wildlife Technician at Voyageurs National Park. She previously worked as a wildlife and fisheries technician in Nebraska, Utah, Idaho, Washington, and Minnesota. She graduated from the University of Nebraska in 2019 with a BS in Fisheries and Wildlife and a BA in Spanish. She enjoys foraging, crafting, and exploring the woods in her free time.

Location of Study

Voyageurs National Park (Rainy Lake, Kabetogama Lake)

The effect of prescribed fire and flooding on hybrid cattail at Voyageurs National Park

Erika Meints

Northern Michigan University and Voyageurs National Park

Abstract

Hybrid cattail is one of the most invasive plants in North America. The plant exhibits hybrid vigor and displaces native flora by rapidly forming dense monotypic stands that can break free from the substrate and form floating mats when established. The current, most successful management techniques use multiple methods to control the growth of hybrid cattail. Current research focuses mainly on populations of rooted hybrid cattail in shallow wetlands and there is little information on prescribed fire and flooding treatments impacts on floating mats. We looked at the effect of prescribed burning, flooding, and flooding following burning in rooted and floating cattail mats in Rainy and Kabetogama Lakes in Voyageurs National Park in northern Minnesota. We surveyed four wetlands that were burned in late winter of 2020-21, and six that were not burned. Pre-burn data was also collected for all ten wetlands. Pre-flooding data from other wetlands within The Park were used to compare and highlight the impacts of the historic flood of 2022 on hybrid cattail.

Brief Bio

Erika Meints is a M.S. candidate in the Biology Department at Northern Michigan University in Marquette, Michigan. She has worked as a Biological Science Technician for Voyageurs National Park for the past three summers. Erika's masters research is looking at the impact of prescribed fire and flooding on hybrid cattail in The Park.

Location of Study

Rainy and Kabetogama Lakes, Voyageurs National Park, Minnesota