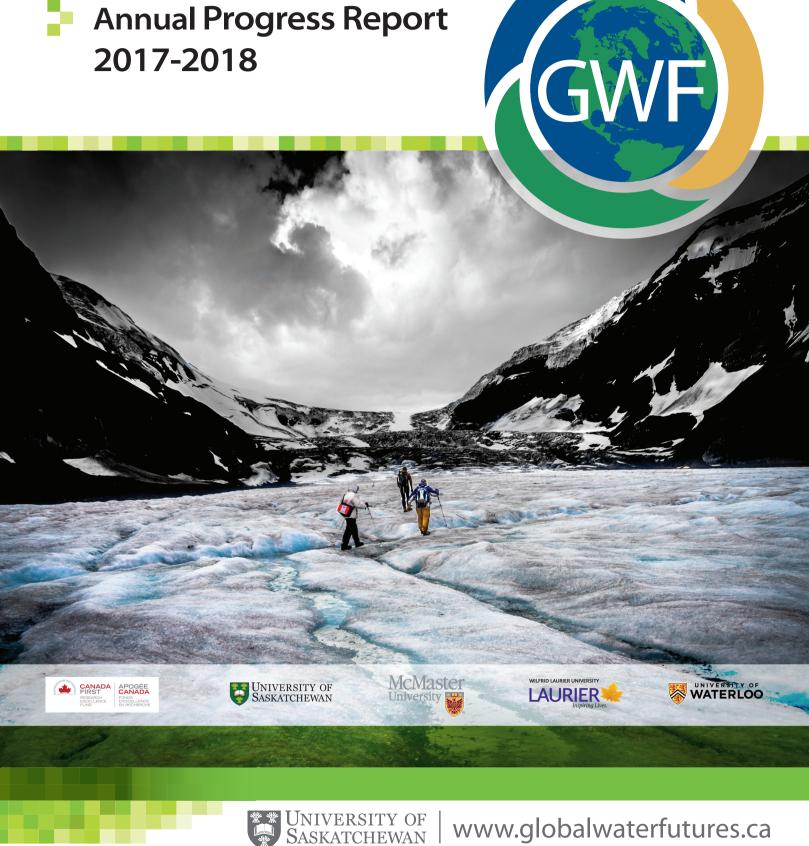
Global Water Futures

Annual Progress Report



GRAND CHALLENGE

How can we best prepare for and manage water futures in the face of dramatically increasing risks?

OUR MISSION

- **Improve disaster warning** develop scientific knowledge, monitoring and modelling technologies, and national forecasting capacity to predict the risk and severity of extreme events
- **Predict water futures** use Big Data to make informed decisions, better models to assess change in human/natural land and water systems
- Inform adaptation to change and risk management propose governance mechanisms, management strategies, and policy tools to reduce the risk of water threats, design adaptive strategies, and enhance economic opportunities

DIRECTOR'S MESSAGE

Welcome! It is with excitement, gratefulness, anticipation, some trepidation and great optimism that I write to you as the new Director of the Global Water Futures (GWF) Program.

Excitement because of the tremendous advances we have made during the first year of GWF, such as establishing the GWF Secretariat and launching 33 pan-Canadian research projects. There is just as much excitement for year two, as we roll out the Core Programs in observations, modelling, knowledge mobilization, and computer science.

Gratefulness for our substantial funding, the remarkable team of researchers and partners and the foresight, scientific vision,



Photo Courtsey of Erin Collins, CBC Reporter

and steady hand that Professor Howard Wheater has provided to all of us in designing and launching GWF over its first year. I am also grateful for the steadfast support and guidance from Dr. Karen Chad, Vice-President Research, University of Saskatchewan, and the Vice-Presidents of research at the University of Waterloo, Wilfrid Laurier University and McMaster University, who have worked so well together. This partnership is critical to GWF, and will bring many campus communities together through our shared vision.

Anticipation in light of the remarkable, innovative plans that we are developing for understanding, measuring, managing, conserving and predicting Canada's water and enhancing our water security. The comprehensiveness of GWF research is exemplary and the new drone, sensor and modelling technology is stunning. GWF is the largest and most comprehensive university-led water research project in the world and with an unprecedented and multi-faceted research program, will have much to offer our common understanding and capability to manage our water future.

Trepidation because we live in a time when dramatic climate change and development are threatening our water security and the environmental health of our blue planet. We will be surmounting great challenges in addressing complex and unprecedented water issues over the next six years.

Optimism because looking to the future, we will stay on track with GWF's objectives, to improve disaster warning, better predict water futures and inform adaptation and risk management. This unprecedented program is poised to make significant scientific contributions nationally and globally.

It is the best of times to be a water scientist in Canada and our future is bright. With GWF, we can offer substantial new scientific knowledge and capability to humanity as we all work to better predict and manage our common water futures.

Professor John Pomeroy

Canada Research Chair in Water Resources and Climate Change

Director, Global Water Futures Program

Director, Centre for Hydrology

TABLE OF CONTENTS

Grand Challenge	i
Mission	i
Director's Message	ii
Executive Summary	vi
1. Preface	01
2. Global Water Futures	02
3. Transformative and Transdisciplinary Science	04
3.1 Pillars 1-2 Transformative Science, Big Data and Decision Tools Projects	06
3.2 Pillar 3 Transdisciplinary User Questions-Led Projects	08
3.3 GWF Core Teams	09
4. Research Observatories and Major Facilities	11
4.1 Research Observatories	11
4.2 Major Facilities	15
5. Indigenous Communities Water Research Strategy	19
6. International Strategy and Engagement	21
7. Modelling and Forecasting	25
8. Significant Technical and Scientific Advances, and Knowledge Mobilization Initiatives	28
8.1 Technical Advances	28
8.2 Scientific Advances	29
8.3 Knowledge Mobilization	
9. Management – Breaking the Barriers	43
10. Performance Measurement Plan	46
11. Performance Indicators – GWF by Numbers	50
11.1 Evidence of Global Research Excellence	50
11.2 Attracting and Retaining the Best and Brightest Talent	52
11.3 Ability to Mobilize Knowledge for the Benefit of Society and the Economy	54
12. GWF Grants and Scholarships	57
12.1 Capacity Building Awards	57
12.2 Summer Student Internships	57
12.3 Sabbatical Research Grant	57
12.4 PhD Excellence Scholarships	58
13. GWF Young Professionals	59
14 Concluding Remarks	60

Appendix A – GWF Management	
Appendix B – List of Core Team Personnel	63
Appendix C – GWF Researchers and Highly Qualified Personnel	67
Appendix D – Leadership in International Research programs and Professional Societies	86
Appendix E – Major Awards and Recognitions	92
Appendix F – Publications and Academic Presentations	95
Appendix G – International Joint Faculty Appointment	128
Appendix H – Leveraged Cash and In-kind Contributions	130
Appendix I – Professional and Career Development Opportunities	131
Appendix J – List of Collaborators	139
Appendix K – Science and Public Outreach	147

EXECUTIVE SUMMARY

In September 2016, the University of Saskatchewan (UofS) was awarded \$77.8 million from the Canada First Research Excellence Fund (CFREF) to lead the "Global Water Futures (GWF): Solutions to Water Threats in an Era of Global Change" initiative—the largest university-led water research program ever funded worldwide. With additional partner funding, the initial program budget is \$143.7 million over seven years.

This UofS-led water research network involves more than 380 Canadian university researchers at 18 universities in a wide range of disciplines, and more than 210 users/ stakeholders including federal and provincial agencies, Indigenous communities and governments, industrial collaborators, non-governmental agencies, and international research institutes. In addition, researchers are also working with international organizations such as UNESCO, the World Climate Research Program and Future Earth, to develop the tools and models to mitigate water disasters, protect the environment and take advantage of economic opportunities.

GWF's mission is to position Canada as the global leader in water science for cold regions and to address the strategic needs of the Canadian economy in adapting to changing water and managing the risks of uncertain water futures and extreme events. GWF is achieving this mission by delivering risk management solutions—informed by leading-edge water science and supported by innovative decision-making tools—to manage water futures in Canada and other cold regions where global warming is changing landscapes, ecosystems, and the water environment.

End-user needs are our beacon, drive our strategy and shape our science as we focus on three main goals:

- Deliver new capability for providing disaster warning to governments, communities and the public, including Canada's first national flood forecasting and seasonal flow forecasting systems, new drought warning capability, and water quality models and monitoring that warn of hazards to health and drinking water supply;
- Diagnose and predict water futures to deliver improved scenario forecasting of changing climate, landscape and water for the future, with information outputs tailored to the needs of users. This will enable us, for example, to assess risks to human health from changing flood, drought and water quality; and
- Develop new models, tools and approaches to manage water-related risks to multiple sectors, integrating natural sciences, engineering, social and health sciences to deliver transformative decision-making tools for evidence-based responses to the world's changing cold regions. New models will define changing risk from floods and drought, and allow end-users to plan sustainable infrastructure investment to manage future risk.

GWF is formulated around three interrelated Pillars of activity:

- Pillar 1 Diagnosing and Predicting Change,
- Pillar 2 Developing Big Data and Decision Support Systems,
- Pillar 3 Designing User Solutions.

Its governance and management involves the Principal Investigator chairing the Oversight Committee of VPR from the four partner universities and the Director, a Director, chairing the Strategic Management Committee that takes advice from an International Advisory Panel and User Panels and a supporting Operations Committee composed of the projects and core teams. The governance and management structure for GWF was created to achieve the mission and vision of the GWF though these Pillars, whilst directed towards the CFREF criteria of global research excellence and leadership, and transdisciplinary research of economic benefit to Canada. In addition, the transdisciplinary structure ensures breaking down the traditional disciplinary and institutional barriers to ensure a holistic approach to what are inevitably comprehensive and complex water problems. The philosophy has been to establish a strong regional and topical research bases and then expand nationally and grow globally. Throughout the program, the principles of equity, diversity and inclusion has been primarily considered. As a network, in addition to achieving the mission to improve disaster warning, predict water futures, and inform adaptation to change and risk management, we are aiming to be known for engagement of Indigenous Communities in co-developing water research.

The first steps in defining GWF involved user engagement and the establishment of the Core Teams. By engaging with the user community across Canada with a series of discussions, a review of needs based on these discussions and finally a report on user needs and questions that we could address, GWF defined its Pillar 3 needs and set priorities for supportive science in Pillars 1 and 2. The Core Teams and their strategic activity plans were developed early on and now include modelling and forecasting, technical, data management, computer science, knowledge mobilization, and communications, which provide central capabilities and functions for Pillar 2 and support for the whole GWF program towards its mission and goals. Subsequent to the user needs survey and core team development, we initiated a formal request for proposals open to all members of the four partner universities and selected members of 14 other universities that were included with our original proposal. We instituted a rigorous international peer-review process to evaluate these with final recommendations by the Strategic Management Committee upon advice of the International Advisory Panel and overseen by the Oversight Committee. Subsequently, 12 stakeholder question-led transdisciplinary Pillar 3 projects were funded in July 2017, and 21 transformative science, big data, and decision-support tools Pillars 1 & 2 projects were funded in December 2017.

While going through the review and approval of the 33 projects, it was recognized that further efforts to address the needs of and to further engage Indigenous communities in water research were needed. Therefore, a year-long consultation process was undertaken to understand their needs and identify a path forward. As a result, a workshop was held in March, 2018 at the Wanuskewin Heritage Park in Saskatoon to co-develop and co-create a request for proposals,

which included co-development of the proposal outline, proposal development process, and evaluation criteria. Indigenous communities across Canada received this approach very positively. We have concluded evaluation of the expressions of interest and are inviting eight colled university and Indigenous community teams to submit full proposals by September 21, 2018.

GWF has established a strong research base in Canada and is now planning to expand globally as we develop international projects in alignment with the GWF mission and availability of external funds.

GWF by the Numbers

GWF has implemented a performance timeline to ensure that our program commitments are met and to track progress. This timeline focusses on three specific years, Year 0, Year 4 and Year 7. The 33 projects and 6 core teams have operated for less than a year in some cases and are just starting to produce scientific outcomes. Therefore, we expect a lag in program outcomes, which will result in not meeting target values for a few performance indicators in 2017-2018.

Currently, GWF has 466 highly qualified personnel (33 projects and core team personnel), including 43 undergraduate students, 103 master's students, 107 doctoral students, 68 postdoctoral fellows, 1 research engineer, 29 professional research associates, 21 research scientists, 48 technicians, 8 visiting fellows/professors, 4 knowledge mobilization specialists, 34 data and project managers. These personnel are actively supervised by 157 researchers from 15 Canadian Universities.

This past year, Global Water Futures members published 108 peer-reviewed journal articles, delivered 202 conferences presentations, delivered 117 invited, plenary and keynote lectures, published 3 books and book chapters, and published 13 non-refereed articles and data that were related to their GWF research. This is a remarkable dissemination of scientific information across Canada and the world and show early leadership through invited and keynote presentations.

GWF needs a substantial funding to grow and develop the program in order to meet our aspirations for international leadership. Funding from national and international governments, industries, communities and non-governmental organizations has assisted in attracting and attaining top international researchers and has allowed the growth of research facilities and programs. As of March 31, 2018, GWF has invested \$38.1 million (out of \$77.8 million total over seven years) in 33 projects and 6 core teams over next three years, which resulted in securing additional leveraged cash and in-kind funding of \$212.8 million from users/stakeholders/funding partners resulting in a total investment of \$292 million.

GWF has implemented a performance measurement plan to ensure that program commitments are met and to track the progression of the program. The performance indicators are broadly categorized under evidence of global research excellence, attracting and retaining the best and brightest talent, and ability to mobilize knowledge for the benefit of society and the economy.

Global Research Excellence	2017 - 2018	Year 4 (2019- 2020)	Year 7 (2022- 2023)	Below/ Meeting/ Exceeding
Number of international research programs and committee where GWF members are lead investigators and/or advisors. (see <i>Appendix D</i> for complete list)	26	4	10	Exceeding
Number of prestigious international, national and institutional awards, recognitions from professional societies, and national scholarships and fellowships. (see <i>Appendix E</i> for complete list)	72	100	200	Exceeding
Global leader in science impact - quality of research – rank in h-index (as per Web of Science on June 19, 2018)	3	2	1	Meeting
Global leader in science dissemination – rank in number of peer reviewed journal articles (see <i>Appendix F</i> for complete list of publications)	1	1	1	Exceeding
Number of presentations at international and national conferences (see <i>Appendix F</i> for complete list of publications)	202	500	1000	Exceeding
Number of international and national plenary, key note and invited speaking engagements (see <i>Appendix F</i> for complete list of publications)	117	130	200	Exceeding
Number of international visiting fellows see <i>Appendix C</i> for complete list of publications)	9	120	200	Below
Number of international joint faculty appointments (see <i>Appendix G</i> for complete list of publications)	23	50	100	Exceeding
Level of cash and in-kind research funding brought by GWF Projects from national and international governments, industries, communities, and nongovernmental organizations (see <i>Appendix H</i> for complete list of publications)	\$292M	\$250M	\$450	Exceeding
Attracting and Retaining the Best and Brightest Talent	2017 - 2018	Year 4 (2019- 2020)	Year 7 (2022- 2023)	Below/ Meeting/ Exceeding
Number of faculty recruited in the top 5% of peer group	9	16	30	Exceeding
% of GWF graduate students and PDFs holding major financial awards (see Appendix E for complete list)	14.5%	25%	35%	Meeting
Participation in skills-based short-courses and transdisciplinary boot camp (see Appendix I for complete list)	150	250	500	Exceeding

	THE PERSON NAMED IN			
Cross-institutional and user training opportunities, leadership workshops, and special seminars (see Appendix I for complete list)	71	250	500	Exceeding
Number of short-courses for early career researchers (see Appendix I for complete list)	14	12	20	Exceeding
Assignment of GWF mentors to early-career researchers (PDFs, research scientists and faculty <10y post PhD)	100%	100%	100%	Meeting
Ability to Mobilize Knowledge for the Benefit of Society and the Economy	2017 - 2018	Year 4 (2019- 2020)	Year 7 (2022- 2023)	Below/ Meeting/ Exceeding
Number of end users and partners linked to the program and engaged in the research process (see Appendix J for complete list)	335	300	500	Exceeding
Number of patent disclosures, licenses to industry, spin-off companies	0	300	500	Below
Number of policy briefs and meetings with governments (see Appendix K for complete list)	31	20	50	Exceeding
Number of jobs created (see Appendices A and B for complete list)	451	450	850	Exceeding
Access of user tools (see Appendix F for complete list)	3	20	50	Below
Hits to YouTube videos (see Appendix J for complete list)	12,622	10,000	100,00 0	Exceeding
Number of communities engaged in citizen science and public outreach (see Appendix J for complete list)	92	100	500	Exceeding

GLOBAL WATER FUTURES: SOLUTIONS TO WATER THREATS IN AN ERA OF GLOBAL CHANGE

Annual Progress Report – April 1, 2017 to March 31, 2018

1. Preface

In Canada, our greatest natural disasters come from floods, fires and droughts – and they are getting worse. They are wreaking havoc on the infrastructure of our communities and transportation networks, contributing to impoverishment of disadvantaged Canadians, diminishing our natural resources capital, disturbing ecosystems and reducing agricultural and energy production. Canada needs to be better prepared.

Last year, we had record drought over the southern Prairies, unrivalled dry conditions and forest fires in British Columbia and the Rocky Mountains, and unprecedented flooding in the Great Lakes-St. Lawrence River basin that left millions of Canadians reeling from either insufficient or excessive water. For many across Canada, drinking water supplies are at risk and severe water restrictions have happened.

For everyone involved in the "Global Water Futures: Solutions to Water Threats in an Era of Global Change" (GWF) Program, we see these issues as a call to action and a chance to keep from repeating the mistakes of the past. We can look to mitigate damages and to get people out of flood plains before the waters rise. We can identify areas that are likely to experience extreme fires or droughts. We can help manage our crop and food production across the prairies. We can ensure fresh drinking water for everyone. Our water future is precarious and we are doing everything we can to look after it.

2. Global Water Futures

In September 2016, the University of Saskatchewan (UofS) was awarded \$77.8 million from the Canada First Research Excellence Fund (CFREF) to lead the "Global Water Futures: Solutions to Water Threats in an Era of Global Change" (GWF) initiative—the largest university-led water research program ever funded worldwide. With additional partner funding, the total program base budget is \$143.7 million over seven years (2016-2023). GWF aims to transform the way communities, governments, and industries prepare for and manage water-related risks in an era of unprecedented change.

GWF's overarching goal is to deliver risk management solutions—informed by leading-edge water science and supported by innovative decision-making tools—to manage water futures in Canada and other cold regions where global warming is changing landscapes, ecosystems, and the water environment. Specifically, the GWF mission is to:

- Improve disaster warning—develop scientific knowledge, monitoring and modelling technologies, and national forecasting capacity to predict risk and severity of extreme events;
- **Predict water futures**—use Big Data to make informed decisions, with better models to assess change in human/natural land and water systems; and
- Inform adaptation to change and risk management—propose governance mechanisms, management strategies, and policy tools to reduce the risk of water threats, design adaptive strategies, and enhance economic opportunities.

GWF will achieve this through three interrelated pillars of activity (Figure 1).

 Pillar 1: Diagnosing and Predicting Change in Cold Regions will deliver transformative, transdisciplinary science on an unparalleled global scale across water, land and air and at the human-water interface. Informed by user needs, this comprehensive scientific approach will lead to a more complete understanding of our ecosystems and provide the necessary data that underpin cutting-edge technologies and forecasting models.

- *Pillar 2:* Decision Support Systems will create new water, snow and land sensing and modelling systems and deploy them across living laboratories in nature. These systems
 - will feed in to our science, dramatically raise our observational power to unmatched levels and lead to the generation of the 'Big Data' required to uncover key insights and support user needs.
- Pillar 3: Designing User Solutions will work with our communities of users to translate decision support systems into user-friendly solutions providing stakeholders with warning systems for impeding climate disasters, predictable water futures for planning and evidence-based decision support for

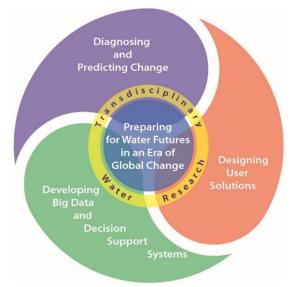


Figure 1: GWF Activity Pillars

optimal economic and health choices for populations.

3. Transformative and Transdisciplinary Science

Climate warming and human actions are altering precipitation patterns, reducing snow levels, accelerating glacier melting, intensifying floods, and increasing risk of droughts, while pollution from population growth and industrialization is degrading water systems. With such unprecedented change, it is clear that the historical patterns of water availability are no longer a reliable guide for the future. Adaptation to these changes will require *new science* to understand the changing earth system (changing climate, land, water and ecosystems and their interactions); *new modeling tools* that precisely capture these interconnected forces and their societal implications; *new monitoring systems* with greater capacity to warn of critical environmental changes; and *more effective mechanisms to translate new scientific knowledge into societal action.* This translates into the grand challenge for water science in Canada and globally: "How can we best prepare for and manage water futures in the face of dramatically increasing risks?"

Currently, we lack the scientific knowledge, monitoring and modeling technologies, and national forecasting capacity to predict the risk and severity of potentially catastrophic events in Canada. These knowledge gaps and technology barriers have resulted in significant loss of life and property in recent years. (B) *Predicting water futures*. The world lacks water data on a scale to make informed decisions, and we cannot forecast future climate impacts without better models to assess changes in our human/natural land and water systems. These limitations create risks for water supplies, water quality and sustainability. (C) *Adapting to change and managing risk*. Nationally and globally, we lack the governance mechanisms, management strategies, and policy tools needed to reduce the risk of water threats, design adaptive strategies to cope with uncertainty, and take advantage of economic opportunities that arise as change unfolds.

GWF focuses on major river basins and key ecological, climatological, and physiographic regions across Canada (Figure 2), which are representative of the scientific and societal issues faced globally, and especially within "cold regions". Cold regions are dominated by cold water processes including snow, ice, and frozen soils, and it is here where Canada as a whole is an exemplar and can have global impact. Canadian landscapes, ecosystems and the water environment are at the forefront of climate change. River basins are challenged by increasing water demands, high nutrient loads, warming temperatures, altered patterns of rainfall, snowfall, snowmelt and freeze-thaw cycling, glacier loss and permafrost thaw, and changes in river flow regimes. These changes have increased the severity and frequency of extreme events, leading Canada to experience catastrophic natural disasters in recent years; the 2013 Alberta floods, 2013 Toronto flood, 2016 Fort McMurray wildfire, and 2001-2004 Prairie droughts caused damages exceeding \$20B. Northwestern Canada is one of the most rapidly warming regions on Earth. The scale and rapidity of recently observed warming-induced changes throughout this region indicate that it is particularly sensitive to climate warming and capable of rapid responses

to perturbations. Systematic warming and cryospheric responses are leading to major landscape changes, including conversion of forests to wetlands, lakes to thaw lake basins, tundra to shrub vegetation, and changing the distribution and routing of water over the landscape, which confounds the prediction of eco-hydrological responses to combined warming and changes in precipitation regimes.

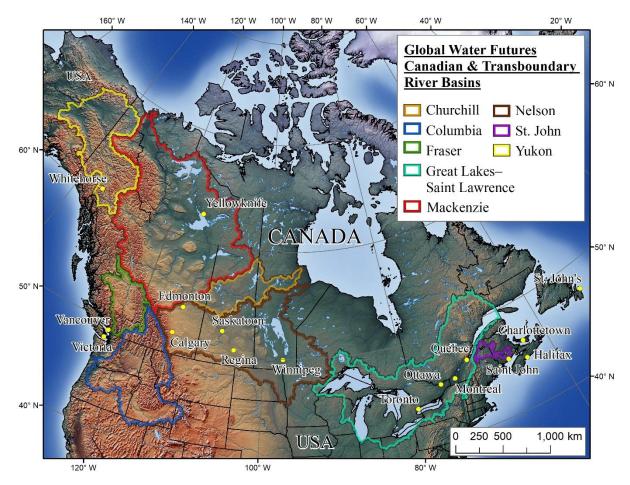


Figure 2. Map of the GWF geographic study domain across Canada and parts of the United States of America

In addition to global warming-induced changes, human interventions have significantly affected Canada's river basins. Infrastructure developments such as dams, diversions, and irrigation networks, along with industrialization and urbanization, have altered the natural water-cycle. Pollution from population growth, industrialization, and agriculture has degraded water quality in many regions. The implications of human-driven changes and their interactions with the natural environment, have not been adequately understood and characterized, however. Canada possesses a huge number of lakes, both large and small, that play a crucial role in water supply, food production, resource extraction, hydropower generation, transportation, recreation, biodiversity, and climate regulation. However, despite such water wealth, climate

change, agricultural intensification, shoreline development and urbanization are exerting mounting pressures on the health and ecosystem services of lakes, and their associated social and economic benefits. In the North, resource exploration and production is expected to expand dramatically in the coming years, which will include construction of new highways, pipelines and other infrastructure.

The GWF geographic domain includes five major regions (Figure 2): i) the Great Lakes and St. Lawrence in eastern Canada and the Maritimes (including the St. John Basin), ii) the prairies in central and western Canada (western Nelson River Basin), iii) the Boreal Forest across much of northern Canada (northern St. Lawrence, eastern Nelson, Churchill, and southeastern Mackenzie Basins), iv) the western Cordillera from the U.S. Pacific northwest up to the Sub-Arctic Mountains of the Yukon and Alaska (Columbia, Fraser, and Yukon Basins, and the headwaters of the Nelson and Mackenzie Rivers), and v) the Sub-Arctic Taiga, Tundra, and southern Arctic in the North (northern Mackenzie Basin). This vast domain includes large lakes and an East-West as well as North-South transect from temperate-humid to semi-arid to mountain glaciated to boreal and then polar climates. Each of the individual regions feature unique aspects in terms of the environmental and societal challenges faced, while some issues span multiple regions (e.g. agriculture, urbanization, etc.), and others span all regions (e.g. water management, governance, policy, etc.). Further, the boundaries between regions are generally indistinct and in some cases shifting, for example with northward movement of the prairie—boreal forest transition due to natural and human disturbance, and expansion of shrub tundra in the North.

3.1 Pillars 1-2 Transformative Science, Big Data and Decision Tools

A seven year \$10-million science budget has been created to support transformative research in advancing GWF capabilities. A first request for proposals for \$5 million over three years was announced in June 2017, which resulted in receipt of 36 letter of intent (LOIs). Out of these 22 LOIs were invited to submit full proposals by September 22, 2017. Consequently, 16 full proposals were received, asking for a total of \$7.0 million over three years. After a careful review of the proposals by the Strategic Management Committee (SMC), in conjunction with comments and advice from international peer reviewers, 14 projects were approved, with a budget of \$5.8 million. In addition to these projects, 7 smaller pilot and studentship projects were funded for a total of 21 projects with funding of \$6.6 million. The final allocation was increased from the \$5.0 million budget envelope originally allocated for this call, given the overall high quality and wideranging scope and balance of the proposals received.

These new 21 projects will deliver on two key areas: transformative science to help us understand, diagnose and predict change, and developing new decision support systems using new sensors, analytical procedures, and computer models. These projects will complement the user-question led Pillar 3 projects (see Section 3.2), and contribute to a better understanding of

snow and rain storms, floods and droughts, how to better measure and manage the quality of source waters, how deep groundwater is affected by the surface, how to improve water governance and even how to encourage global water citizenship. The list is as follows [website]:

- 1. Southern Forests Water Futures, Altaf Arain, McMaster University
- 2. Proof of Concept for Agent Based Modeling as a Tool to Investigate Comprehensive Indigenous Health Impacts of Flooding, **Lalita Bharadwaj**, University of Saskatchewan
- 3. Linking Water Governance in Canada to Global Economic, Social and Political Drivers, **Rob de Loe**, University of Waterloo
- 4. Old Meets New: Subsurface Hydrogeological Connectivity and Groundwater Protection, **Grant Ferguson**, University of Saskatchewan
- 5. Omic' and Chemical Fingerprinting Methodologies using Ultrahigh-resolution Mass Spectrometry for Geochemistry and Healthy Waters, **Paul Jones**, University of Saskatchewan
- 6. Evaluation of Ice Models in Large Lakes using Three Dimensional Coupled Hydrodynamic-Ice Models, **Kevin Lamb**, University of Waterloo
- 7. Short-duration Extreme Precipitation in Future Climate, **Yanping Li**, University of Saskatchewan
- 8. Prairie Drainage Governance, **Philip Loring**, University of Saskatchewan
- 9. Linking Stream Network Process Models to Robust Data Management Systems for the Purpose of Land-use Decision Support, **Bruce MacVicar**, University of Waterloo
- 10. Winter Soil Processes in Transition, Fereidoun Rezanezhad, University of Waterloo
- 11. Global Water Citizenship Integrating Networked Citizens, Scientists and Local Decision Makers, **Colin Robertson**, Wilfrid Laurier University
- 12. Sensors and Sensing Systems for Water Quality Monitoring, Ravi Selvaganapathy, McMaster University
- 13. Linking Multiple Stressors to Adverse Ecological Responses Across Watersheds, **Mark Servos**, University of Waterloo
- 14. Crowdsourcing Water Science, Graham Strickert, University of Saskatchewan
- 15. Storms and Precipitation Across the continental Divide Experiment (SPADE), Julie Theriault, University of Quebec at Montreal
- 16. SAMMS: Sub-Arctic Metal Mobility Study, Brent Wolfe, Wilfrid Laurier University
- 17. Adaptation Governance and Policy Changes in Relation to a Changing Moisture Regime Across the Southern Boreal Forest, **Colin Laroque**, University of Saskatchewan
- 18. Significance of Groundwater Dynamics within Hydrologic Models, **Walter Illman**, University of Waterloo
- 19. Diagnosing and Mitigating Hydrologic Model Uncertainty in High Latitude Canadian Watersheds, **Tricia Stadnyk**, University of Manitoba
- 20. Hydrological Processes in Frozen Soils, Andrew Ireson, University of Saskatchewan

21. Improved Estimates of Wetland Evaporation, Warren Helgason, University of Saskatchewan

In total, 94 researchers from 10 Canadian universities are involved in collaboration with 37 partners including international institutions, government agencies, industry partners, non-governmental organizations, and Indigenous communities. These projects will hire 100 highly-qualified personnel over the next three years. The projects are leveraging the GWF investment of \$6.6 million with an additional \$423,000 in cash and \$3.2 million of in-kind contributions from partners.

3.2 Pillar 3 User Questions-Led Projects

The SMC allocated \$28 million over seven years and envisioned funding trans-disciplinary proposals driven by user needs that could have a regional, river basin or pan-Canadian focus. To facilitate the call for proposals process, a team of four consultant were hired to survey 138 GWF partners and develop a user needs report in November-December 2016. Based on this report, GWF issued a request for proposals for "Transformative Solutions to User and Stakeholder Needs" for a budget of \$10 million over three years (2017-2020). The available funding was mostly for hiring highly qualified personnel, with the expectation that major equipment purchases will be met from other sources.

Simultaneously, in November-December 2016, the SMC held information sessions at the four partner institutions to inform researchers of the program progress, answer questions, and outline the process for developing letters of intent (LOI). On January 30, 2017, a total of 33 LOIs were received requesting funding of more than \$37 million. Subsequently, the LOIs were carefully reviewed by the SMC in conjunction with independent advice and recommendations from the International Science Advisory Panel (ISAP) against the six criteria outlined in the call for proposals. The SMC accepted the ISAP's recommendations and consequently 14 LOIs were invited to submit full proposals for this round of funding. Given the quality of the LOIs, the GWF program has funded 12 initial research projects across Canada totaling nearly \$16.9 million (up from initial \$10 million allocation for this round) over the next three years to tackle some of Canada's most pressing water-related challenges.

The funded projects research include protecting prairie agricultural lands from drought and floods, mitigating algae blooms in lakes, developing new monitoring systems for Canadian watersheds using drones and satellites, using environmental DNA to assess ecosystem health, understanding the impact that changes to mountain snow packs and glaciers will have on drinking water, and co-creating Indigenous water-quality tools with First Nations.

Four projects are led by the University of Saskatchewan, three by the University of Waterloo, three by McMaster University, one by Wilfrid Laurier University, and one is jointly led by the University of Manitoba and University of Victoria. The list is as follows [website]:

- Climate-Related Precipitation Extremes, Ronald Stewart, University of Manitoba; Francis Zwiers, University of Victoria
- 2. Northern Water Futures, Jennifer Baltzer and William Quinton, Wilfrid Laurier University
- 3. Next Generation Solutions to Ensure Healthy Water Resources for Future Generations, **John Giesy**, University of Saskatchewan
- 4. Forecasting Tools and Mitigation Options for Diverse Bloom-Affected Lakes, **Helen Baulch**, University of Saskatchewan
- 5. Agricultural Water Futures, **Merrin Macrae**, University of Waterloo
- 6. Boreal Water Futures, Mike Waddington, McMaster University
- 7. Prairie Water, **Colin Whitfield**, University of Saskatchewan and **Chris Spence**, Environment and Climate Change Canada
- 8. Integrated Modelling Program for Canada, Saman Razavi, University of Saskatchewan
- 9. Mountain Water Futures, **Sean Carey**, McMaster University
- 10. Lake Futures Enhancing Adaptive Capacity and Resilience of Lakes and their Watersheds, **Nandita Basu**, University of Waterloo
- 11. Transformative Sensor Technologies and Smart Watersheds for Canadian Water Futures, **Claude Duguay**, University of Waterloo
- 12. Co-creation of Indigenous Water Quality Tools, **Dawn Martin-Hill**, McMaster University

In total, 117 researchers from 15 Canadian universities are involved in the 12 projects. They are collaborating with 135 partners including international institutions, government agencies, industry partners, non-governmental organizations, and Indigenous communities. About 278 highly qualified personnel will be hired for the projects over the next three years.

The \$16.9 million investment in the projects has leveraged another \$26.4 million in cash from universities and partners, as well as \$116.5 million in in-kind contributions from partners.

3.3 GWF Core Teams

GWF core teams provide the necessary underpinning for core program objectives and deliverables, specifically:

- National capability for the modelling needed to deliver key programme goals;
- Capability for observational science, in particular with respect to key observatories; and
- Support for delivering research that is driven by user-led needs and solutions.

GWF core include the following teams that provide support to the programme as follows:

 Knowledge Mobilization Team – providing advice, guidance and support to facilitate user engagement and communication with research teams (leads are University of Saskatchewan – Lawrence Martz; Wilfrid Laurier University – Kelly Munkittrick; and University of Waterloo – Kevin Boehmer) [website]

- Computer Science Team providing advice, guidance and support for software development of improved models, model coupling and Human Computer Interfaces (leads are University of Saskatchewan Kevin Schneider; and University of Waterloo Jimmy Lin) [website]
- Data Management Team providing timely archiving and delivery of data to users. (University of Saskatchewan John Pomeroy; McMaster University Sean Carey; Wilfrid Laurier University William Quinton; and University of Waterloo Jimmy Lin) [website]
- Technical Team supporting field observatories, observational analysis and key laboratories. [website]
- Modelling and Forecasting Team developing national capability and frameworks for Hydrological and Water Quality Forecasting, Climate Modelling, Hydrological & Water Quality Modelling and Water Resources Modelling (leads are University of Saskatchewan – Alain Pietroniro and John Pomeroy; University of Waterloo – Phillippe van Cappellen; McMaster University – Sean Carey) [website]
- Communications Team to build profile to support collaborations and partnership building, recruitment of students and other research personnel, and communication of early findings and impacts (led by University of Saskatchewan – Kathryn Warden) [website]

A budget of \$14.6 million has been allocated over 2017-2020 to support core team activities and 80 highly qualified personnel who are ensuring that the GWF program stays on course to attain its objectives and mission.

4. Research Observatories and Major Facilities

4.1 Research Observatories

GWF will deliver transformative new capabilities for observation, focussed on development of our world-leading multi-scale observatories. Through small catchments instrumented with hundreds of observation stations within our large river basin observatories (Figure 3), we will diagnose environmental change in key biomes and develop the large-scale science associated with global-scale modelling, land-atmosphere feedbacks and landscape change.

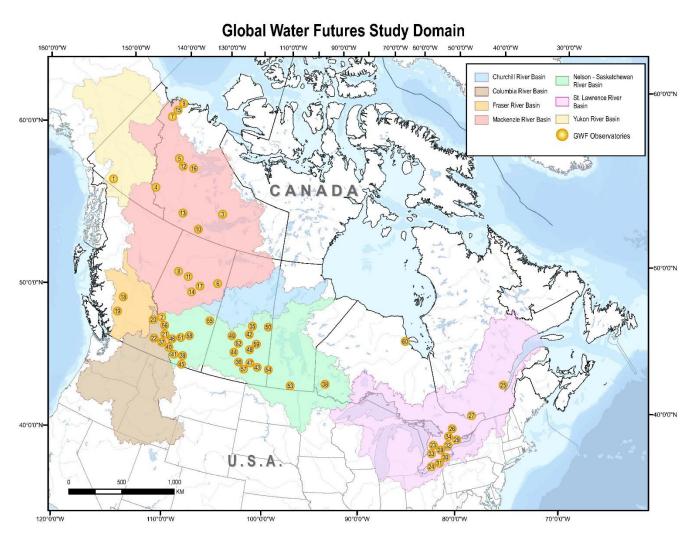


Figure 3. GWF's network of intensive surface observational sites across the country; see

Table-1 for list of site names

These observatories also provide a key platform for science integration to address management/governance dimensions. We will enhance the Mackenzie River Basin Observatory, expand the Saskatchewan River Basin Observatory to include the Nelson-Lake Winnipeg Basin,

and develop the international Columbia-Lake Okanagan, Fraser and Yukon as new basins (Figure 2). In Central Canada, we will focus on the Great Lakes and their basins, expanding the Southern Ontario Watershed Consortium's pioneering 'intelligent watershed' monitoring systems to include the Grand River Basin. Working with our partners from the information and communication technology sector, we will spawn a new generation of watersheds that will provide real-time data and analytics to support operational management of flows and treatment utilities. In Eastern Canada, we will focus on the international and interprovincial Saint John River Basin to better understand aquatic ecosystem and transboundary water management issues and Quebec's BEREV experimental basin.

We will develop and deploy new sensors and observing systems, linking them with state-of-the-art data retrieval, management, and distribution systems. A new drone platform and novel satellite data assimilation will transform the observation of large remote cold region areas by detecting change on short time scales, deploying LiDAR (laser-based distance measurement), snow sonar, high-resolution monitoring of water elevations, and multi-spectral monitoring of land and water systems. We will use new acoustic sensors to measure snowpack properties remotely for the first time, and GPS and neutron scattering to measure frozen/unfrozen soil moisture. We will develop new in-stream water quality sensors and further develop chemical fingerprinting and environmental-DNA techniques, transforming capability for ecological monitoring and risk assessment. A high-performance, cloud-based geospatial data platform will be used to collect, manage, and analyze large quantities of multi-dimensional data for decision support. We will work with Indigenous and other communities to develop citizen science monitoring capability.

Table 1. List of GWF intensive surface observational sites. The list is preliminary and growing as sites are added and the surface network expands to include both new and existing sites across Canada. While most are well-established legacy sites from previous initiatives such as Changing Cold Regions Network, some are at an earlier stage of development and are being enhanced to bring them up to standard as part of our integrated network.

	1	
1. Wolf Creek Research Basin	21. Lake O'Hara	41. Haig Glacier
2. Athabasca Glacier	22. Nipika Mountain Resort	42. James Smith Cree Nation
3. Baker Creek	23. Conestogo Lake	43. Katepwa Lake
		44. Kenaston/Brightwater Creek
4. Brintnell-Bologna Icefield	24. Eastern Lake Erie	Mesonet Site
		45. Lethbridge Irrigation
5. Dehcho First Nations	25. Forêt Montmorency	Demonstration Farm
6. Fort McMurray	26. Ganatsekaigon Creek	46. Marmot Creek Research Basin
	27. Gatineau River and Saint-	
7. Havikpak Creek	Maurice River watersheds, QC	47. Pasqua Lake
8. Helen Lake	28. Grand River Watershed	48. Quill Lakes, Saskatchewan

9. Inuvik to Tuktoyaktuk		49. Redberry Lake Biosphere
Highway	29. Morningside Creek	Reserve
10. Kakisa and Tathlina Lakes	30. Six Nations of the Grand River	50. Saskatchewan River Delta
11. Lubicon Lake Cree Nation	31. Turkey Point Sites	51. Sibbald Wetlands
12. Norman Wells/Tulita area	32. Western Basin Lake Ontario	52. St. Denis National Wildlife Area
13. Scotty Creek	33. Whitemann's Creek	53. Tobacco Creek
14. Slave Lake	34. Wilket Creek	54. Upper Qu'Appelle
	35. Boreal Ecosystem Research and Monitoring Sites (BERMS),	
15. Trail Valley Creek	White Gull Creek, SK	55. Vermilion Basin
16. Tsa Tue Biosphere Reserve	36. Buffalo Pound Lake	56. Wapta Icefield/Peyto Glacier
17. Wabasca	37. Burstal Creek	57. Wascana and Upper Qu'Appelle
18. Cariboo Alpine Mesonet	38. Expiremental Lakes Area	58. West Nose Creek
19. Marian Lake Watershed	39. Fort Macleod	59. Yellow Quill First Nation
20. Columbia Icefield	40. Fortress Mountain	60. Attawapiskat

Research capabilities, cutting-edge instrumentation, and transformative science conducted at our research observatories within the Nelson-Churchill River Basin are outlined in the following videos. Similar videos will be developed for other observatories in near future.



Video File: St. Denis National Wildlife Area



Video File: Brightwater Creek



Video File: Canadian Rockies Hydrological Observatory



Video File: Forecasting Extreme Weather Events



Video File: E.B. Campbell Dam – Saskatchewan River Delta



Video File: Sediment and Nutrient Transport

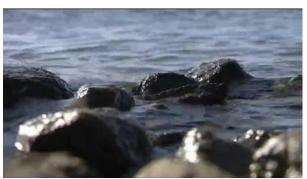
Modelling



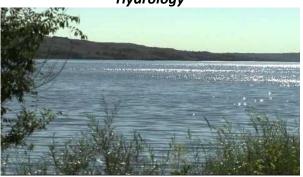
Video File: Swift Current Research Site



Video File: Rosethern Research Site – Prarie Hydrology



Video File: Lake Diefenbaker



Video File: Buffalo Pound



Video File: Lake Diefenbaker – Toxicology & Water Quality



Video File: Swift Current Creek – Urban Municipal Drainage



Video File: Modelling Riverine Processes



Video File: Socio-Hydrology

Video File: Integrated Watershed Modelling



Video File: Mine Overlay Site Testing Facility

4.2 Major Facilities

Centre for Hydrology: The UofS Centre for Hydrology addresses Saskatchewan's water sustainability problems and provides national leadership in hydrological research and training. The centre includes unique facilities with equipment for stable isotope analysis, strong expertise in water and wastewater treatment, efficacy of constructed wetlands, mine reclamation site remediation, balance and water modelling, hydrogeochemistry. The centre has six labs: Cryospheric Environmental Lab (an experimental cold room for cryospheric simulation); Cool Sample Lab; Hydrological Modelling Lab (computer modelling with PC and Unix); Hydrological Instrumentation Lab; Hydrological Sampling Lab; and Ecohydrology Lab (natural water chemistry). [website]

Centre for Cold Regions and Water Science: The WLU Centre for Cold Regions and Water

- Science (CCRWS) is a collaborative research facility that houses four research centres/groups and a variety of state-of-the-art analytical equipment. The facility, which opened in 2013, is funded by Laurier, the Government of the Northwest Territories, the Canada Foundation for Innovation (CFI), the Ontario Ministry of Research and Innovation (MRI), and the Federal Economic Development Agency for Southern Ontario (FedDev Ontario) [website].
- Coldwater Laboratory: In Alberta, the Centre for Hydrology maintains premises at the Coldwater Laboratory in Canmore, AB. The Coldwater Laboratory places over 20 researchers and students in the headwater region of 3 major river basins (Saskatchewan, Columbia and Mackenzie river basins) to study the impacts of climate change and extreme events on water resources in the region. This facility includes offices and a laboratory and



Centre for Cold Regions and Water Science,
Wilfrid Laurier University



UofS Coldwater Lab, Canmore, AB

provides easy access to over 35 high elevation stations within the southern Canadian Rockies. [website]

• Mine Overlay Site Testing Facility (MOST): The MOST facility is a research and testing facility that serves as a hub for the development of hillslope hydrological models in relation to mine cover systems and landscape engineering. The facility is funded by the Western Economic Diversification and includes a strong partnership with O'Kane Consulting, a world leader in mine cover design. The facility is the first of its kind to provide pilot scale cover trials with replications of key processes (placement, climate, slope/aspect, vegetation) and the ability to evaluate and characterize the key mechanisms controlling the water dynamics in mine reclamation cover design. [website]

- Green Roof Environment and EngiNeering Facility (GREEN): The GREEN facility is a research and testing place for industry to enhance and develop green technologies and all other aspects involved in the construction and efficient operation of green roof systems, specifically targeted to cold regions. Our multidisciplinary team of engineers, green roof consultants, water, soil and plant scientists created a new state-of-the-art facility at the UofS to test cold region green roof designs. This facility serves as a research and green technology development platform that integrates fields of hydrology, soil physics, plant ecology, civil engineering, architecture and building science and provide a space to troubleshoot existing design challenges in this sector, enabling us to reduce the cost of new projects by providing proof of concept testing in cold regions prior to costly implementation.
- Toxicology Research Centre: The UofS Toxicology Centre is the largest academic research and training centre in the area of aquatic and environmental toxicology in Canada. The centre provides broad-based expertise from the molecular to the ecosystem level, with partners from around the globe. It focuses on investigating the effects of water pollution on ecosystem and human health with an aim towards sustainability and stronger environmental stewardship. [website]
- Aquatic Toxicology Research Facility (ATRF): The ATRF, the only facility of its type in Canada and one of only a few in the world, is a highly sophisticated laboratory for aquatic toxicology research. Located at the Toxicology Centre, the 7,100 sq-ft laboratory was specifically designed to provide areas with different water qualities and temperatures to perform both static and dynamic toxicological experiments with algae, crustaceans, insects, clams, amphibians or fish. In-house research facilities include five walk-in controlled-environment chambers and an analytical laboratory for water quality analysis. [website]
- Smart Water Systems Laboratory (SWSL): The SWSL was recently created with support from Western Economic Diversification Canada to develop novel water and snow sensing technologies and bring them to pre-commercialization and commercialization stage. The SWSL will transform the observation of Canadian waters by detecting change in water quantity and quality at high resolutions. SWSL is developing novel sensors that measure snowpacks, ice, open water, flooding, streamflow, soil moisture, wetlands, vegetation and algal growth. Many of these sensors will be deployed on specialized all-weather drones (unmanned aerial systems) for rapid deployment across Canada with first applications in the Prairies and the mountain headwaters of the Saskatchewan River Basin. [website]
- Aqueous Geochemistry Laboratory (AGL): The AGL is an analytical facility for water chemistry, which is providing high-quality and timely quantitative elemental analyses for both academic and non-academic clients. This laboratory supports comprehensive

elemental analysis of aqueous samples ranging from fresh to brackish water. The laboratory houses several major pieces of analytical equipment to support a variety of methods including: i) inductively coupled plasma — mass spectrometry (ICP-MS); ii) inductively coupled plasma — optical emission spectroscopy (ICP-OES); iii) ion chromatograph (IC); iv) high performance liquid chromatography (HPLC); v) gas chromatography (GC); and vi) spectrophotometry. Ancillary equipment to support routine and unique sample processing requirements are also available in the laboratory. [website]

- Environmental Geochemistry and Isotope Lab: Located at Unviersity of Waterloo, it is focused on watershed biogeochemistry and multidiscplinary problems. The lab extensively uses isotopic tools and tracers in addition to other geochemical techniques, which are listed at the following website [website] The Environmental Isotope Lab at Waterloo develops and applies isotope technology to the Environment. The lab resources are used primarily in the fields of Earth Sciences and Biology. Many other environmental applications are also available. [website]
- Saskatchewan Water Chemistry and Ecology Lab: The lab has expertise in aquatic ecosystem ecology and biogeochemistry, specifically, understanding the effects of changing climate and nutrient loads on aquatic ecology and biogeochemistry. [website]

5. Indigenous Communities Water Research Strategy

Over the last year, the GWF program has reached out to numerous researchers, Indigenous community partners and other partners for advice on what water research GWF and Indigenous communities can conduct together to help address the water issues experienced by Indigenous communities. Consequently, a workshop was organized in Saskatoon, SK on April 17-18, 2018, and involved 62 attendees including 31 Indigenous community representatives to promote further discussion and action on these research ideas through development of Indigenous community — university partnership projects that both meet Indigenous community needs and are in alignment with the GWF vision/mission. These projects will be supported with up to \$2 million of operating funds and provision of our core data from climate and water models, remote sensing and surface observations. This workshop provided an opportunity for Indigenous community members and GWF academic researchers to co-develop a strategy for Indigenous community water research.

While many GWF researchers had existing relationships and research projects in progress with their Indigenous partners, the workshop provided the first in-person opportunity for everyone to come together from across the country.

The workshop included introductory presentations and working sessions aimed at identifying the funding opportunity from GWF, and co-designing expressions of interest and the proposal evaluation criteria of importance to research with Indigenous communities. The workshop was highly interactive with the discussions and working sessions focused on building on existing relationships, identifying new potential partnerships, identifying common research themes and community needs, co-designing proposal elements and evaluation criteria, and identifying leveraging opportunities with funding partners.

While sharing ideas and potential projects that were emerging, the following research themes were identified as key importance to research with and in Indigenous communities by the group, and which could be focus areas for collaboration and knowledge mobilization across projects (not an exhaustive list):

- Citizen science (capacity building; monitoring; data acquisition)
- Decision support and visualization (web of knowledge; data sharing; computer apps)
- Impacts of floods, droughts, climate change, forestry and water management on water flow
- Environmental flows (quantity; quality; habitat; sediment)
- Western and traditional science (overlap; differences; standing)
- Cultural strengthening as an outcome of research
- Water and health (linking environmental and human health and livelihoods)
- GIS and remote sensing tools (permafrost mapping; drones; autonomous sensors)

Governance and policy (legislation; knowledge; sharing; decision-making impact)

In essence, the workshop started and concluded on very positive notes with a commitment to co-develop and evolve GWF's Strategy for Indigenous Community Water Research. It was agreed that this was a great beginning to new relationships and a new way of engagement between academic research and Indigenous communities that could be the foundation for the much needed partnerships, knowledge, and capacity to address the water and climate issues affecting Indigenous communities across Canada. The primary outcome of the workshop was the development of the request for proposals for the expressions of interest, which was issued on April 23, 2018. Subsequently, a total of 11 Expressions of Interest were received requesting funding of \$3.4 million over three years. In consultation with three Academic Indigenous Advisors, the SMC invited 8 EOIs to submit full proposals by September 21, 2018.

6. International Strategy and Engagement

The biggest challenge today among water researchers globally is the fragmented approach to science, which fails to leverage the collective intellectual power needed to address real-world problems. No single university can address these critical needs. GWF is integrating research and development efforts from multiple disciplines within the fields of natural science, health science, social science, engineering and computer science, drawing upon the entire spectrum of Canadian water expertise in universities, corporations, and government agencies, strong global networks and a broad range of stakeholders from industry, government, communities and the non-profit sector. The GWF is creating a transdisciplinary water research partnership on an unprecedented scale—the world's first large-scale multi-site research consortium—to advance water security and cross-site learning and exploit opportunities to apply new big-data technologies to water problems. We are focusing on regions dominated by 'cold' water processes, including snow, ice and frozen soils, where Canada as a whole is an exemplar and can have impact. 'Cold regions' are at the forefront of global warming, supply water for 50% of the world's population and face urgent societal needs, with rapidly changing landscapes, ecosystems, and water environments. We are developing the much-needed climate change-focused science, predictive models and market-oriented decision-support tools (software, models, apps, etc.) to enable communities, First Nations, agriculture, industries, and governments in Canada and beyond to prepare for and manage risk from floods, droughts, unsustainable water use and degrading water quality.

Canada has established a long history of excellence in research associated with water and cold regions. GWF is organizing, coordinating, and managing Canada's water scientists to realize synergies, minimize duplication, and focus resources on the strategic issues. We are also focusing and coordinating the water science community's linkages with colleagues in industry and government. These organizational improvements, the GWF research strategy, and the additional



Development of GWF International Strategy – Howard Wheater Symposium, March 2018

resources associated with the program are improving our ability to address the scientific questions and to deliver the technologies required to address the grand challenge of global water security. We will disseminate globally the new knowledge we generate through collaborative projects and our leadership and participation in global research initiatives.

GWF will establish Canada as the leader in water science and management for cold regions and the partner of choice for managing water risks in a changing world. GWF outcomes will benefit

the U.S.A, China, Chile, Spain, India, Nepal, the Middle East, and all other regions where climate change and warming of cold regions may affect water security, supply chains, and regional conflicts. We will support GEWEX's International Network for Alpine Research Catchment Hydrology (INARCH) to develop better mountain water resource predictions and measurements in the Hindu-Kush-Himalaya, the Tibetan Plateau, the Andes, the U.S. Rockies, and the European Alps and Pyrenees. GWF envisions promoting an International Year of Snow and Ice through the U.N. to focus international attention on the declining snow and ice coverage and its impacts on water resources in Canada, international cold regions, and areas serviced by cold region water.

Here are a few projects and initiatives that GWF has embarked on during the last reporting period:

- Howard Wheater Symposium: A landmark event to celebrate the achievement of the GWF Founding Program Director and Canada Excellence Research Chair in Water Security, to develop international strategy for GWF, and to develop vision and identify grand challenges in the field of hydrology of societal relevance. The symposium reflected on developments in hydrology, science and practice over the last 40 years, and projections of future directions for the next 40 years. Thirty-five leading international scientists shared their vision and provided valuable feedback to further the GWF international agenda. [website]
- **GWF Engagement with Future Earth:** GWF is the Canadian node for the Sustainable Water Future program of Future Earth. As part of this engagement, GWF will share its expertise and outcomes with larger Sustainable Water Future community. A proposal has been submitted by the GWF to lead a working group on Global Climate Impacts as part of the INARCH project which is a Global Hydroclimate Project of GEWEX-WCRP. In addition, Anik Bhaduri, Executive Director has agreed to give a Plenary talk during the Annual Science Meeting on June 3-6, 2018 at Hamilton, ON.
- World Climate Research Program: A proposal has been submitted to the Global Energy and Water Exchanges project with World Climate Research Program to establish GWF as a Regional Hydroclimatic Program. As part of the proposal, GWF has included all major river basins in Canada (Figure 2) that the core team is modelling with particular emphasis on including terrestrial ecology and human effects in addition to traditional GEWEX interests in atmospheric and hydrological systems.
- Critical Zone Observatory: Philippe van Cappellen from University of Waterloo is leading GWF efforts with the Critical Zone Observatory in the North of China bordering Russian on permafrost research. This is an excellent opportunity for GWF to develop a Canada-China-Russia three-way collaboration. China is contributing money and personnel to conduct research in this area, while GWF will provide in-kind support.

- **UNESCO:** The Canadian National Committee for IHP (CNC-IHP) has been reactivated effective March 2018 and GWF is an integral part of this committee. The CNC-IHP provided a comprehensive report on a number of activities/initiatives undertaken by the Canadian hydrological community (including GWF) that contribute to the framework of the IHP.
- University Corporation for Atmospheric Research (UCAR): In 2017, UofS became a member of UCAR which aims to train the next-generation workforce and collaborate with partners in government and the private sector to advance our understanding of the Earth system for the betterment of society.
- Institute of Tibetan Plateau Research, Chinese Academy of Sciences: Discussions are at an advanced level with the Pan-Third Pole Environment Program, Institute of Tibetan Plateau Research, China to implement MESH and CRHM models in the Tibetan Plateau. As part of this collaboration, four exchanges of highly qualified personnel including student, postdoctoral fellow, and research scientist are planned for each year. One visiting professor is at UofS over 2017-2018. The exchanges are supported by the University of Saskatchewan.
- Indian Institute for Sciences Bangalore, India: Collaborations have been formalized with counterparts from the Devacha Institute for Climate Sciences, IISc Bangalore, India to implement MESH modelling strategy in Ganga River Basin and Himalayas. This includes exchange of two doctoral students for a period of 3-6 months per year and also recruitment of a postdoctoral fellow. The funds for these collaborations have been secured from the University of Saskatchewan.
- Israel: Alain Pietroniro, lead for the GWF Core Modelling and Forecasting team gave a presentation at the European Geophysical Union conference on GWF modelling and forecasting strategy. Consequently, the delegates from Israel expressed interest in implementing MESH on their river basins and would provide access to Israel drought models to GWF core team. Israel is proceeding to implement MESH.
- CSIRO (Commonwealth Scientific and Industrial Research Organization) Australia: Discussions are in progress with CSIRO Australia, which has expressed interest in funding a project to implement MESH model in Indus River Basin through Australia Aid.
- Iran: Currently, the GWF Core Modelling and Forecasting team and the Pillar 3 project Integrated Modelling Project for Canada is in the process of implementing MESH in Iran, which is envision to happen via transfer of knowledge through a scientist who is currently visiting University of Saskatchewan.
- Upper Nile River Basin: John Pomeroy is leading a funding application to the International Development Research Centre on "Enhancing Community and Ecosystem Resilience to Climate Change Impacts and Ensuring Food Security in the Nile Basin" in collaboration

- with University of Dar es Salaam Tanzania, University of Nairobi Kenya, Makerere University Uganda, University of Addis Ababa Ethiopia.
- Government of Kazakhstan: Discussions are in progress with the government of Kazakhstan to develop a CRHM modelling strategy for selected river basins in collaboration with the GWF Core Modelling and Forecasting team.
- **Europe:** The GWF Core Modelling and Forecasting team is in discussion with partners in Luxembourg about applying MESH to the Mosel River in Europe.
- Joint Institute for Climate and Water Sciences (JICWS): Since 2016, GIWS is leading
 efforts in inception and implementation of the JICWS between University of
 Saskatchewan and Beijing Normal University, China which will likely be finalized in the Fall
 2018.

7. Modelling and Forecasting

The GWF modelling strategy (Figure 4) is based around a sequence of atmospheric driving models, linked to terrestrial, riverine and management models, with a hierarchy of time horizons and objectives that scale from short term/real time operations to medium term predictions at weekly to seasonal scales to long term predictions at seasonal to multi-decadal time scales as described in the diagram below. The core modelling team deals with most models and the core computer science team develops advanced visualization methods and improved operations and software engineering of model architecture and operation to take advantage of high performance computing.

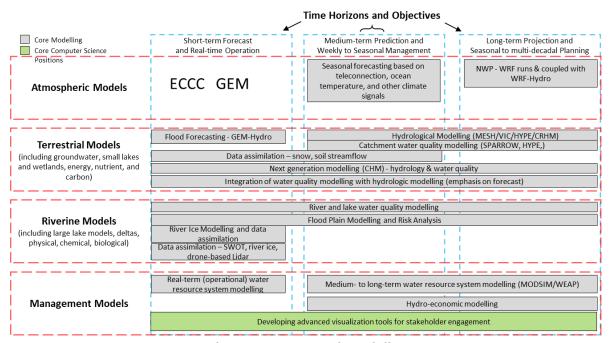


Figure 4. The GWF Integrated Modelling Strategy

In order to achieve the integrated modelling strategy, various modelling tools have been developed through the core modelling and forecasting team and Pillar 3 project outcomes (Section 3.2) that will include the following elements of the modelling systems:

Atmospheric models or forcing: A series of coupled, uncoupled, historical or re-analyzed forcing data are required to drive the water, ecosystem, and energy modelling systems. These data can be derived from numerical weather prediction models (NWP), NWP reanalysis models, and climate models using various forms of interpolation, ensemble outputs, statistical downscaling and dynamical downscaling.

Hydrological and Water Quality Models: These are focused around hydrological models and land-surface schemes that can resolve the coupled energy and water budget of the land surface at multiple scales, including features pertinent to cold regions such as lakes, wetlands, snow,

frozen soils and glaciers. These models are coupled to or may include detailed models of groundwater storage and flow, permafrost, glacier dynamics, ecosystem landscape dynamics, fire, crop growth, non-point nutrient/contaminant fate and transport, and quantification of environmental flows within watersheds.

River Models: These models will be coupled physical/chemical/biological schemes dealing with flow, velocity, depths, energy (temperature and ice formation), ice break-up, biological attributes such as trophic state, chemical attributes, such as hyporheic exchanges of nutrients and contaminants, and export fluxes to receiving water bodies.

Small Lake/Large Lake/Reservoir Models: These models will couple physical and bio-chemical processes to simulate in-lake and outflow conditions, dynamics in lake/reservoir storage capacity, temporal and spatial variability of phytoplankton, dissolved oxygen, nutrients, and algal blooms, ice cover, ice thickness, and vertical temperature structure and mixing conditions on various time scales. The applied models will be of variable complexity, ranging from simple one-dimensional (1-D) models to more complex dynamic 3-D models. These models will incorporate the results from numerical weather predictions and climate modeling to assess and predict the impact of climate change and various land use practices in the watershed on lentic (still water) ecosystems.

Water Management Models: These models simulate anthropogenic impacts on water resulting from small and large storages, drainage, irrigation and other abstractions, including groundwater extractions. At a basic level, these effects will be represented in land surface schemes and hydrological models. More generally, integrated water management modelling is needed to address longplanning short term and operational management of water



Integrated Modelling Project for Canada Pillar 3
Project Kick Off Workshop, September 2017

resource systems under varying hydroeconomic conditions. Decision-making must integrate climate change, land management, water quality and hydrological considerations to meet human and ecosystem needs. Water management models can provide a new level of integrated modelling to support Canada's needs in these areas.

These various modelling systems require consideration of time-prediction elements within their design and implementation. Prediction systems for watershed management require different consideration for short-term forecasting, seasonal or longer term forecasting and "open loop"

simulations. The latter are characterized as either analysis of either past events or future climate projections.

Now-casting and forecasting: These use 0-14 day ensembles of simulations for assessing floods, high and low flows, snowcover and snowpacks, soil moisture, river ice breakup, wind-setup on large lakes, irrigation scheduling, reservoir operation, hydroelectricity production, in-stream flow needs, water quality, sediment transport, contaminant transport from spills, trophic state and environmental flows. Day-0 simulations (now-casting) are typically required for assessing ungauged or unmeasured basins. Projections can be extended from 10 days to multiple months.

Open Loop Simulations: Long-term simulations are used for planning, design and/or climate projections. In a hind-cast (historical model), these types of simulations are used for management studies, carrying out "what if scenarios", assessing ungauged attributes, examining land and water management impacts, assessing future cryosphere, vegetation and water quality implications, calculating risk and probabilities and looking at trends. Special attention must also be given to long-lasting effects of pollution legacies and biological adaptation on water quality. Hind-cast simulations are further useful for calibration and validation of numerical models. In a future climate context, these type of simulations are used to understand and ascribe future impacts on water and river basins and look at management implications including potential mitigation. Ideally these would be extended to include coupled modelling of land-atmosphere feedbacks.

8. Significant Technical and Scientific Advances, and Knowledge Mobilization Initiatives

This section outlines the significant technical and scientific advances and knowledge mobilization initiatives by 33 funded Pillars 1-2-3 projects. Majority of the User/Stakeholder question-led Pillar 3 projects that were funded in June 2017 have made significant scientific and technical advances, however, only a few of the transformative science, big data and decision tools Pillars 1-2 projects reported advances as they were funded in December 2017.

8.1 Technical Advances

Next generation solutions to ensure healthy water resources for future generations: The team has made significant advances and developed detailed study plans for a total of 12 GWF Pillars 1-2-3 projects. They also developed 40 standard operating procedures for all phases of sample collection and archiving, sequencing and data analyses. In order to support this initiative and position themselves, extensive training on eDNA techniques have been provided to researchers, graduate students and highly qualified personnel. The team also constructed Fish eDNA metabarcoding, Mesocosm studies, early warning of invasive zebra mussel in Saskatchewan using eDNA barcoding, and eDNA metabarcoding of benthis macroinvertebrates, developed techniques for isolating and characterizing the microbiome of guts of fishes as indicator of stress.

Transformative Sensors Technologies and Smart Watersheds [website]: The team is developing, deploying and commercializing System for Acoustic Sounding of Snow 3 (SAS3), a Portable Waveguide Spectrometer (PWS) for the identification of water pollutants, multi-spectral instrument design and testing for water analysis, and reflectometer design and testing for soil moisture and snow depth, identify and assess currently instrumented watersheds hosted by GWF researchers and partner institutions for inclusion as hydrologic observatories, initiate the process of developing 'Smart' sensor networks for data logging and deploying and testing 'transmitters' for communication from observatories to satellites and/or across Canada, and Microsatellite Water Management Mission design with Honeywell is underway.

Northern Water Futures [website]: The team has purchased, installed and maintained \$2M worth of instruments and support system as part of the Changing Arctic Net infrastructure at NWF sites across the NWT to enhance the NWF research capacity. In addition, significant progress has been made to facilitate an enhanced understanding of the ecohydrology of the high latitude boreal forests. Development of water level archive for Scotty Creek for the period 1999-present is nearing completion, which will enable them in evaluation of long-term water storage changes for the Scotty Creek drainage basin and for each of its major land cover types.

Boreal Water Futures [website]: The team has a number of Boreal Observation Network (BON) sites up and running and are in the process of synthesizing the data, this includes three eddy

covariance stations in Wolf Creek, Yukon, including above a tall white spruce forest, new forest sites in the Fort McMurray area (on mine sites), flown new LiDAR in Fort McMurray in 2017, and have collected a large number of remote sensing products in association with NASA's ABOVE program. All of this will allow them to improve characterization of forests and other vegetation structure. In addition, the team has moved forward in standardizing historical data from the BON network and moving it to the GWF data repository for ease of use and access by others.

Developing 'Omic' and Chemical Fingerprinting Methodologies using Ultrahigh-Resolution Mass Spectrometry for Geochemistry and Healthy Waters: Development of methods for the analysis of persistent organic pollutants (POPs), polycyclic aromatic hydrocarbons (PAHs) and fatty acids - During the first year the instruments have been developed or modified for a range of methods. This includes methods for the analysis of toxic POPs, PAHs, and fish tissue fatty acids. The analysis of POPs is of significance since to date the only 'certified' method for the analysis of dioxins required the use of a complex magnetic sector mass spectrometer. The high resolution OrbiTrap MS system has proved so far exceed the analytical capabilities of all previous mass spectrometry systems to a point where we believe it will enable the development of new QA/QC and chemical identification paradigms. For example we have developed methods that permit analysis of dioxins at levels of mass resolution far exceeding current US-EPA QA/QC criteria and also simultaneously acquiring MS/MS data for the same sample. This provides previously unheard of levels of certainty in compound identification. Development of Robotic Sample Handing procedures for the simultaneous determination of organic and inorganic mercury (Hg) in fish tissues - A technique has been developed for the analysis of both organic and inorganic Hg species in samples. The technique involves a simple tissue or sample digestion followed by ethylation using the robotic sample handling system and analysis on the high resolution GC-MS instrument. This technique provides additional isotope ratio data compared to existing techniques. They are currently investigating the applicability of this system to the analysis of other trace metals of environmental concern. Methods for the analysis of dissolved organic matter - Using high resolution direct infusion mass spectrometry the team was able to assign chemical formulae to all compounds that constitute the DOM (dissolved organic matter) fraction in surface water samples. Although the team can generate formulae at this time, however, are not able to generate unequivocal structures for these compounds so the complexity of the DOM fraction is generally assessed using van Krevalin diagrams which ordinate chemical formulae based on C:O and C:H ratios. The accurate mass determination also permits the determination of the presence of other atoms such as N, P and S which are believed to be indicative of the source and environmental properties of the DOM.

8.2 Scientific Advances

Transformative Sensors Technologies and Smart Watersheds [website]: The team is assessing and working on improving drone platforms and sensors for operation in cold weather in order to

provide intermediary-scale measurements, and also working on improving spatially-distributed measurements of snow water equivalent (SWE) and near surface soil moisture/freeze-thaw state.

Forecasting Tools and Mitigation Options for Diverse Bloom-Affected Lakes [website]: Risk Communication - A partnership is being built with Yellow Quill First Nation and James Smith Cree Nation in Saskatchewan to undertake a community-based participatory project on Indigenous needs for HAB risk communication. Primary data collection on risk communications is currently underway. The key narrative that emerged after a scoping review of 273 articles was: HABs present a public health threat. Transdisciplinary solutions and collaborations are required for decision making, and messages must be culturally appropriate. A three step sequence of messaging has been proposed for the public (caution-warning-danger), and 3 steps for agencies (continue to monitor, alert and increase monitoring, and alarm and emergency management). Forecasting - Buoy deployment was continued successfully on Buffalo Pound Lake, with continued use of the buoy in managing plant operations. It was a significant bloom year, and analyses to date suggest the sensor-based data show good agreement with discrete measurements by their field crew, and also by water treatment plant chemists, hence they have growing confidence in buoys to collect monitoring information. The team's statistical methodologies are showing promise in short-term forecasting approaches, however, archiving of weather forecasts is required to fully understand the window over which forecasting is feasible, and are in the process of determining how these can be accessed. From Drivers to Mitigation -The team implemented an ambitious field program to understand limitation, and intensified sampling to capture antecedent conditions to onset and collapse to collect information on key drivers, including different thermal and biogeochemical triggers. Through their initial experiments at Conestogo Lake and Buffalo Pound Lake, the team has hypothesized that there may be potential (under non-flood conditions) to manage for lake water quality, for example, by altering the dissolved organic matter (DOM) character entering the system (Buffalo Pound Lake), or manage the thermal structure (Conestogo Lake). The team has received approval for a whole lake experiment at the International Institute for Sustainable Development Experimental Lake Area (IISD-ELA), and will seek additional support to test the role of dissolved oxygen depletion on cyanobacteria bloom formation. This is an important 'proof of concept' project with major potential to improve approaches to bloom management globally in different types of eutrophic systems (lakes, reservoirs, shallow, deep, hard water, soft water, saline, north temperate to tropical). Work has begun on New Toolbox development with a focus on Buffalo Pound Lake, which includes securing the dates when satellite passes over the areas and attempt to match sampling times to those passes, securing drones permits for Ontario.

Northern Water Futures [website]: A recent paper published by the team in the journal Limnology and Oceanography focusing on effects of flooding on lakes in the Peace-Athabasca

Delta due to long-term drying show that the delta continues to display evidence of increasing water loss by evaporation and aridity (despite widespread river flooding of the delta in 2014), a trend that began in the early to mid-20th century and is unprecedented during the past 400 years. These results align with evidence of climate-driven decline in freshwater supplied by rivers draining the hydrographic apex of western North America. Findings serve multiple users, especially Parks Canada, who are currently formulating a plan to address 17 recommendations listed in the recent WHC/IUCN (2017) report [Reactive monitoring mission to Wood Buffalo National Park, Canada; mission report, March 2017. United Nations Educational, Scientific and Cultural Organization].

Southern Forests Water Futures [website]: Significant advances have been made in micrometeorological and biometric measurements, ecological, tree-ring, and stable isotope studies, and forest management studies at Turkey Point Observatory forest sites, which are located near Lake Erie in southern Ontario. These studies will help in evaluating changes in growth and water use efficiency, effect of climate variability and extreme events, and determine how to promote higher forest growth and improve stand water status. In collaboration with scientists from Environment and Climate Change Canada, the team is working on integrating C and N coupled model, CLASS-CTEM+N subroutines in the MESH Hydrological system. The model performance has already been evaluated at five different sites across Canada and will soon be implemented for catchment scale studies.

Old Meets New - Subsurface Hydrogeological Connectivity and Groundwater Protection [website]: Several members of the research team are co-authors of a paper in review with Geophysical Research Letters that represents a substantial improvement of our understanding of salinity in deep groundwater environments. While another paper in review examined the relationship between water chemistry in deep aquifers in Saskatchewan and the permeability of those formations.

Evaluation of Ice Models in Large Lakes using Three-Dimensional Coupled Hydrodynamic-Ice Models [website]: The MITgcm has been run at a 200 m horizontal resolution for the whole of Lake Erie. A three month simulation took approximately seven days using 256 cores demonstrating that these resolutions are feasible. A matlab script that can generate bathymetries in and specified rectangular subdomain of the lake at arbitrary resolutions.

Linking multiple stressors to adverse ecological responses across watersheds [website]: Estimating contaminant fate and exposure - A model has been developed for estimating the exposure of the central Grand River in Ontario to selected estrogens (i.e. estrone, 17β estradiol and 17α -ethinylestradiol). The model integrates three components: 1) A source model that uses prescription sales data and population statistics; 2) Estimates for removal during treatment; and 3) A river model based on WASP. Estimating thresholds for effects - Studies have continued to

better understand the linkages of estrogen exposure and responses. A lab experiment was conducted to determine the sensitive window of exposure for fish. The preliminary results demonstrate that intersex in rainbow darter respond to 17α -ethinylestradiol in a dose dependent way and at concentration predicted to be present in the river.

Boreal Water Futures [website]: Extremes and Wildfire — The team has collated historical reconstructions of Fire Weather Indices (FWI) and associated weather at a range of spatial scales (as fine as 3km). They also have CMIP5 3 GCMs and 3 RCPs at 40 km out to 2100. They will initiate analyses with these products in the event there is a delay on WRF runs from the CMIP6 analyses. Extreme value analysis has been initiated with respect to FWI. Soils — The team has initiated soil sampling for detailed hydrophobicity analysis at their Fort McMurray Boreal Observation Network site. Initial research indicates that peat burn severity has a large control on soil hydrophobicity with an increase in water repellency with moderate burning and this water repellency becomes more hydrophilic with greater burning. Initial discussions among their Canadian Forest Service users has initiated on how these dynamics be best represented in hydrological and wildfire fire (fusion) models.

Lake Water Futures [website]: Watersheds - One of the notable achievements was the development of a catchment biogeochemical classification system based on catchment topography, climate and land use for all the Great Lakes Watersheds. The other major achievement was the creation of an urban nutrient budget for the Greater Toronto Area, including all the major stores and fluxes. The team also made progress in their sub-project on quantification of legacy accumulation in reservoirs. With the help of Grand River Conservation Authority as their partner organization, they have collected sediment cores in the Conestoga and Belwood Reservoirs in the Grand River Watershed (GRW) and analyses is currently underway. The team also focused on crop modeling and reviewed available modeling options in HYPE. Lakes - The team made headway in simulations of the Grand River plume in Lake Erie by developing input datasets (bathymetry, meteorological forcing and river inputs) and conducting preliminary high-resolution simulations. They (1) coupled a vertically resolved sediment diagenesis module with the 1D lake model MyLake, (2) built a biogeochemical reaction network model that seamlessly couples water column and sediment processes. The application of the model to a boreal lake shows the capacity of the model to simulate daily water quality and sediment-water exchange fluxes dynamically over a long historical period. The team (a) developed time series of satellite-based temperature and chlorophyll concentration for lake St. Clair, Lake Erie, and Lake Ontario, (b) developed time series of satellite-based land surface temperature for Lake Erie and Ontario watersheds, (c) compiled historical data for discharge and nutrient loading, and (d) developed an algorithm for ice concentration and ice phenology based on optical satellite observations for Lake Erie. These datasets will be used to develop statistical models that can link algal distribution in Lake Erie to their environmental drivers. Ecosystems – The team has worked

toward the development of indicators that measure temporal and spatial changes in the environmental health along the watershed-lake continuum. The Grand River and the interface with Lake Erie was selected as the case study. The work is linking human activity to adverse environmental consequences (e.g., eutrophication, algal blooms) using fuzzy cognitive mapping (FCM) and graph theory models that build on past workshops to identify the causes of algal blooms in the Western Basin of Erie. The team is identifying effective indicators of change in watersheds such as the Grand River and nearshore of Lake Erie. The work was initiated in selected case studies as sub-basins of the Grand River where considerable biological monitoring has occurred in the past and large data sets are available (e.g., Mill Creek, Blair Creek, central Grand River). Economics - Notable achievements include the development of an overview of existing hydro-economic models to assess the cost-effectiveness of best management practices (BMPs) in agriculture to reduce P-runoff, and the economic valuation of the damage costs of eutrophication. The latter are used to economically justify further investments in P-reduction technologies to avoid future eutrophication events. Integration - Notable achievements include the development of hydrology and a nitrate and a phosphorus model for the GRW. The team also developed an approach to deal with this complexity of LGLs, by creating multi-dimensional chain models that integrate coupled hydrodynamic and water quality models of different complexities ranging from simple steady state box-type models (0-D: zero-dimensional) to more complex vertically resolved 1-D models to very advanced fully dynamic 3-D models. The applied models are those that were widely used or being currently used by Environment and Climate Change Canada including the Total Phosphorus Model for the Great Lakes (0-D model), GLM-FABM-AED model (1-D coupled hydrodynamic and water quality model; former DYRESM-CAEDYM model) and AEM3D model (3-D model; former ELCOM-CAEDYM model).

Integrated Modelling Project for Canada [website]: Integrated Earth Systems Modelling – A new water quality modelling functionality and integration have been developed, in particular the coupling of an instream river water temperature model to MESH. A coupling allows to predict the water temperature year round along all stream and river in the Athabasca River basin. River freeze-up and ice-cover breakup dates can also be predicted, which is particularly useful for climate change studies of ice phenology. Also in the context of climate change, the water temperature model will provide information on how fish habitat locations will change in future. MESH has also been coupled to a sediment transport model. The coupling is currently being calibrated and validated. Test basin is again the Athabasca River but sub-basins of the South Saskatchewan River will also be drawn upon (e.g. Swift Current Creek). Model Inter-comparison - The HYPE (hydrology and water quality) model is being evaluated in comparison for the integration of nutrient transport routines into the sediment transport model coupled to MESH. Next steps is to integrate WASP water quality model into MESH. The team has made progress in refining the Variable Infiltration Capacity (VIC) macroscale hydrology model for application to the SaskRB. The initial focus has been on improving the representation of land surface heterogeneity

(mainly for vertical processes) and they completed a new implementation of the VIC model based on the Group Response Unit (GRU) concept. The team has set up this implementation for a part of the South Saskatchewan River Basin, and soon plan to extend the model to the whole of the SaskRB. The HYPE hydrological model was calibrated for Nelson-Churchill River Basin using SMHI's (Swedish Meteorological and Hydrological Institute) Global Forcing Data (Watch-ERA-Interim) and NARR (North American Regional Reanalysis) as the forcing input data. Sensitivity Analysis based on VARS (Variogram Analysis of Response Surfaces) was carried out to determine the sensitive parameters of the HYPE model for NCRB basin. The calibrated HYPE model was run with bias corrected GCM data (19 GCMs, leveraged from the Baysys project) to analyze the future projected runoff and uncertainty in the Nelson Churchill River Basin. The uncertainty analysis on the runoff due to different forcing input data will be carried out to have a better understanding of the model response and the projected runoff. Characterization of Model Uncertainty - Most existing techniques for sensitivity and uncertainty analysis ignore, or at best, do not directly account for correlation and interdependence of the different hydro-climatic or water resource variables. This often limits the credibility of the assessments provided by such techniques for water resources problems. To address this issue, the team began developing new approaches to handle correlated variables in sensitivity and uncertainty analysis. While the approaches developed will be general purpose, however, the focus will be on their application on hydrologic modelling and water management issues in the IMPC. This will be implemented in VARS-TOOL, which is a toolbox for comprehensive, efficient, and robust sensitivity and uncertainty analysis. So far, we have investigated several methods such as the orthogonnalization and variance decomposition and tested them with simple examples. A new release of VARS-TOOL as a MATLAB toolbox is also expected to be complete in a couple of months. Water Management Modelling and Coupling Human-Driven and Natural Systems - Significant progress has been made in developing new and assessing existing water resources models for the Saskatchewan River Basin, which is a large, multi-jurisdictional river basin that spans the provinces of Alberta, Saskatchewan, and Manitoba, and the US State of Montana. Consequently, the team has assessed Water Evaluation and Planning (WEAP) and MODSIM models for representing the existing operating policy of the SaskRB as modelled in the Water Resources Management Model (WRMM) of Alberta Environment. The Water Resources Integrated Modelling System 2 (WRIMS 2) is another model that has recently been evaluated. All the three water resources management models investigated show some promise, but also limitations. It is unlikely that one single model would fulfil all the requirements of the IMPC to achieve IWRM within Canada's large river basins, and it is more likely that a suite of models and tools will be recommended. Decision Making Under <u>Uncertainty</u> - An Environmental Scan process to identify the state of scenario development and a list of feasible policy options for the basin is underway.

Mountain Water Futures [website]: Mountain Climate Extremes - Two major precipitation events (January 10-11, 2010 over B.C., and March-April 2015 in Kananaskis) have been identified

to be used in WRF simulations. WRF simulations have been compared against the available observations and they captured many of the key observed precipitation patterns. Collaboration with members of pillar 1 project SPADE and pillar 3 project Climate-Related Precipitation Extremes has been ongoing, and a special atmospheric observation period has been organized in May-June 2019 and it will be linked with SPADE. The Cryosphere - VIC-GL has been modified by PCIC, and coupled with the Clarke regional glaciation model, enabling simulation of glacier mass balance and dynamics. In late September, 2017 the team acquired full waveform (Riegl Q780) laser altimetry data for alpine regions described in the proposal and inception report where complementary research is to be undertaken. Gridded (bare earth and non-bare earth) data is now available for other Future Mountain West and GWF investigators. Surface-Groundwater Interactions - Groundwater monitoring networks at Fortress Mountain in the Rockies are established across multiple hydrogeological response units. Subsurface geophysics has been completed over-winter in Wolf Creek and summer drilling plans are underway. Distributed stream temperatures in Wolf Creek have been completed at two headwater streams. Initial investigations of distribution of permafrost and frozen ground in Wolf Creek, Yukon, using resistivity mapping have been accomplished. This includes comparing transects along north and south facing slopes. Forest and Vegetation - Eddy covariance systems have been set up and successfully run for multiple seasons in tangent with a soil and vegetation monitoring network in a mixed-conifer stand at Fortress Mountain, across multiple canopy densities. Three eddy covariance stations are now set up in Wolf Creek with an additional fourth understory system. Sapflow sensors are being installed at forests at Fortress Mountain and Wolf Creek. Wetland <u>Function</u> - Three intensive sites have been selected: a high (alpine), mid (sub-alpine), and lowaltitude (foothill) sites and have been instrumented in anticipation of the 2018 field season. An additional sub-alpine site (Burstall Creek) was also recently selected to support this research, and will be instrumented in the summer of 2018. They will collect ecosystem scale measurements of evapotranspiration, and the latent and sensible heat fluxes (using eddy covariance), precipitation, air temperature and relative humidity profiles. Augmenting these measurements will be soil tension, moisture and temperature pits to quantify the ground heat flux and soil moisture dynamics, and transects of wells crossing the wetlands into the adjacent hillslopes to characterize the direction of flow through the systems and the scale of the hydrologic connections with those uplands.

Climate Related Precipitation Extremes: Estimation of Probable Maximum Precipitation - A new probabilistic PMP estimation technique was developed that improves on the operational moisture maximization approach that is frequently used by engineers. The new method has a firm foundation in statistical extreme value theory and allows quantification of the uncertainty in PMP estimates — something that was not possible hitherto. This work has been communicated to user communities informally on a couple of occasions (briefings where BC Hydro and Manitoba Hydro representatives were present) so far. Temperature Scaling - A large ensemble of 35 North

American regional climate simulations (1951-2100) was used to investigate how much data is required to well-estimate temperature scaling relationships in non-stationary analyses of annual precipitation extremes for different accumulation periods. Both local analyses and spatially pooled analyses using the index flood approach were considered. It was determined that due to internal variability, records that are the equivalent length of many multiples of historical observational records are required to robustly identify temperature scaling relationships, even when using the index flood approach. This suggests that precipitation trends estimated with available observations cannot provide reliable guidance for future planning at local spatial scales. Thus, climate models remain an indispensable tool for understanding the response of extreme precipitation to warming. In this study, the team found well organized patterns of positive temperature scaling rates in the climate simulated by the RCM (CanRCM4) for extreme sub-daily precipitation almost everywhere across Canada. It was shown that a well-constrained temperature scaling relation provides a robust projection of changes in moderate precipitation extremes especially in regions where extreme precipitation response to global warming is dominantly thermodynamic. In addition, the team has studied whether "binning scaling" would provide an option for projecting changes in extreme sub-daily precipitation and concluded that binning scaling relationships are not suitable for projecting future change, but rather, that they describe a physical characteristic of the climate.

Prairie Water [website]: Notable accomplishments during Year 1 are development of a first generation catchment classification based on watershed topography, geology, hydrology, climate, and land use, parameterization of the Vermilion study basin for use in virtual basin modeling, a pesticide distribution map for the Prairies, and analysis of climate and land use interactive effects on wetland biota. CRHM prairie basin models have been developed for several basin types in Alberta, Saskatchewan and Manitoba with an initial focus on wetland impacts on prairie hydrology. In particular, drafting of manuscripts has begun for the catchment classification and biodiversity studies.

8.3 Knowledge Mobilization

The GWF Program promises state-of-the-art knowledge mobilization (KM) in conjunction with its scientific objectives of predicting change in cold regions, developing Big Data and support systems, and designing user solutions to focus on real world problems. Explicit in these objectives is robust engagement with a diverse end-user community.

Strong GWF-funded project-level KM initiatives will build robust overall outcomes for GWF and a variety of GWF program-level initiatives will foster stronger internal and external relationships and connections. A strong KM network will develop and share best practices and resources with all projects, researchers and staff, and build KM capacity across the entire GWF network. The KM Core Team envisions a GWF legacy that has fostered innovation in researcher-practitioner co-

creation and has led to policy advancements and positive social change for water science and management in Canada.

Some of the significant project-based KM activities that happened over last reporting year include:

Prairie Water [website]: The Prairie Water User Community Advisory Committee has been established to represent organizations across the three Prairie Provinces to reflect the Prairie Water user community diversity. The Committee consists of 9 members, representing SK, AB, and MB and non-governmental, Indigenous, government, and industrial organizations. The Advisory Committee, including Prairie Water co-PI's and project manager, have met on three occasions during this funding cycle and have co-created a Terms of Reference that outlines the expectations, contributions, and operations of the committee in the Prairie Water project. The committee has been active in reviewing, providing feedback, and contributing to workshops, data requisition, and reporting.

The project held its inaugural kickoff user meeting in January 2018. Representatives from 18 user groups were present. The workshop was interactive and provided space for activities where users expressed their needs and potential contributions to the research. The workshop was a successful example of knowledge mobilization as it identified areas where the project team should enhance efforts, such as enhancing collaborations with current initiatives and relating research to story-telling and local experience. In addition, the Prairie Water project has worked to increase engagement of its students and young professionals in outreach goals and professional development through workshops introducing knowledge mobilization, skills in plain language writing, and strategies for science communication. Insights and workshops developed within this space can eventually contribute to other GWF-wide KM capacity building goals.

Mountain Water Futures [website]: Research team members were involved in four policy briefs and meeting with government agencies that have led to knowledge exchange for research priorities both within government and the project, including Environment and Climate Change Canada, Meteorological Service of Canada, and Government of Northwest Territories. The team as also participated in workshops and presentations with non-profit organizations, and has exemplified leadership on multiple international advisory panels as well as working with the Swedish Nuclear Fuel and Waste Management Company on a groundwater-permafrost knowledge gaps program.

Transformative Sensor Tech and Smart Watersheds [website]: The project team has developed a strong partnership with the Government of the Northwest Territories (GNWT) and the Sahtu Environmental Science and Research Board (ESRB). Researchers have attended workshops in the Sahtu region to explain and further develop research objectives with direct input and advice from First Nations collaborators. Communication with Honeywell is underway in the form of discussions and meetings and a workshop was held with Honeywell in January 2018 to gauge the needs of the water research community and the capability of the TSTSW project to meet those

needs. Together, a list of parameters to consider measuring throughout the project was established and Honeywell has provided an outline of next steps involved in moving forward with design.

Northern Water Futures [website]: The project team has undertaken a number of strong knowledge mobilization initiatives. The health and risk communication component of this project uses a collaborative and participatory mixed-methods approach with community co-researchers. Terminology workshops were held to find ways to express key words from the Contaminant Biomonitoring project in Sahtúot', ne Yatí (North Slavey) with help from local Elders to share their knowledge with researchers to help build important understanding and common language around relevant terms such as "contaminant" and "risk" and facilitate more meaningful language use and communication. The Ka'a'gee Tu Youth On-the-Land Camp was held in the community of Kakisa by the Ka'a'gee Tu First Nation in partnership with students from Wilfrid Laurier University. The camp was a great opportunity for youth to build relationships with each other, Elders and the land as well as learning new skills and approaching new challenges. Researchers were able to collect fish samples and demonstrated to the kids what they do with the fish and also showed them the anatomy of the fish. Graduate students worked with the youth to collect, identify and sort bugs as part of the research. A Northern Water Futures collaborator attended the annual Dehcho K'éhodi meeting to provide updates on past research, consult on upcoming projects and discuss next steps in the research. The Dehcho K'éhodi program combines Dene knowledge of the land – interweaving traditional land use, cultural practices and language – with environmental monitoring based in Western science. The project team has also been collaborating with the Sahtu Renewable Resources Board to develop school programming that would support environmental monitoring by the students.

FORMBLOOM [website]: FORMBLOOM's knowledge mobilization with partner organizations has followed a path built through past collaborations and based on concerns about user fatigue and risk of having too many points of GWF and FORMBLOOM contact with key user groups. Though the project team hoped to foster growing partnerships and awareness across organizations, the priorities these groups have expressed are distinct (and sometimes in conflict). Hence, following the lead and needs of these partners on how they want to participate, we have chosen separate meetings with partner agencies, rather than a large launch meeting. A partnership is being built with Yellow Quill First Nation and James Smith Cree Nation in Saskatchewan to undertake a community-based participatory project on Indigenous needs for harmful algal bloom risk communication. Two meetings with Indigenous Chief and Councils occurred, using proper protocols throughout with traditional offerings, blessings with Elders, and shared food. Councillors for James Smith Cree Nation identified the experiences of members with algal blooms in waterways in and surrounding their reserve and traditional lands and would be interested in sharing their experiences to inform the research project, especially given their concerns about agricultural practices around their research. Councillors from Yellow Quill First Nation noted that many of their members were uninformed of blooms risks, but had much interest as Nut Lake is

perceived to be "unhealthy." They indicated that they wish to learn about algal blooms and share information with their members in culturally sensitive ways and agreed to allow risk communication surveys and interviews in their community. While natural science knowledge of bloom risk is expanding, examination of social science and risk communications effectiveness has not been a focus of work to date, leaving important gaps in the literature – the project has been emphasizing the importance of communication effectiveness (knowledge mobilization) in the work program.

Co-creation of Indigenous Water Quality Tools: The project has knowledge mobilization inherently embedded in its design and implementation with partners. The research team has acquired permission and support for the project from the Confederacy Chiefs and Clanmothers of the Six Nations of the Grand River, who requested interim briefings, and the Elected Council of Six Nations. Ethics was approved by the community. The project team has organized a number of community engagement events in partnership with fellow GWF project "Sensors and Sensing Systems for Water Quality Monitoring". A World Water Day community engagement event was held at Six Nations of the Grand River, where the project was presented to the community and round table discussions occurred to determine community priorities. An Indigenous Youth Leadership Summit, featuring panelists and workshop facilitators, was held at McMaster University. The project team members have participated in cultural orientations and workshops to familiarize themselves with the history, culture, and beliefs of the communities and build relationships with community members.

Next generation solutions to ensure healthy water resources for future generations: A few of the team members serve on the Saskatchewan Aquatic Invasive Species (AIS) task force, and will continue to report results back to relevant authorities in a timely manner, allowing a timely response in the event of a detection of invasive species in Saskatchewan water bodies. In addition, based on discussions resulting from these interactions the Saskatchewan Wildlife Federation and the Province of Saskatchewan together with the team intend to establish a community education program on AIS and eDNA monitoring approaches. Members also serves on the Grand River Recreational Fisheries Committee (with broad end user representation at each level of government (municipal. provincial, federal), the Conservation Authority and NGOs (Trout Unlimited, Friends of the Grand River, Ontario Fish and Hunting Association, etc.) and has discuss the project progress at each of the meetings (every 2-3 months). In addition, to boost cooperation with industrial end users and KM, the team members visited Orano Canada Inc. (Former name: AREVA Resources Canada Inc.). They gave a presentation on "Environmental DNA: A novel approach to characterize biodiversity", and provided baseline training and introduced SOPs for field sampling of water and sediments for eDNA analyses in remote areas. Subsequently, Orano Canada Inc. contracted a consulting company to apply these eDNA field sampling methods for the collection of sediments and surface water samples as part of their routine monitoring activities under their mandate to comply with Canada's EEM program. The first field campaign

was successfully completed and samples were received in good condition by the team, demonstrating successful translation of eDNA field collection methodology to one of our key industry partners.

Linking multiple stressors to adverse ecological responses across watersheds [website]: The team has held formal meetings with several partners (e.g. Region of Waterloo, City of Guelph, GRCA, OMECC and ECCC) to discuss their research progress and plans. In addition, the team had an important opportunity to have some of their research influence the National Expert Panel on Wastewater that released their report officially in May 1, 2018 (Canada's Challenges and Opportunities to Address Contaminants in Wastewater). This report will greatly influence the federal and other government agencies related to water and wastewater management across Canada as it makes many recommendations related to how more than \$10B in future infrastructure may be directed more effectively to deal with contaminants in wastewater. The team members also interviewed for several media stories on wastewater management and contaminant fate and effects (Water Canada, The Waterloo Record). Earlier in the year the team members were also interviewed by numerous news agencies about the recent finding on the recovery of intersex after the treatment process upgrades in the Grand River wastewater plants.

Agriculture Water Futures [website]: Since project inception, the team has held routine meetings to share knowledge, including an Inception Meeting, a Project Meeting, and Work Package meetings (four per work package over the past year). These include outcomes such as streamlining field and data protocols and planning future manuscripts, and sharing knowledge regarding how to include socio-economic data into existing models. These routine meetings have advanced the research considerably. The project team met with the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) regarding the advancement of the development of the Phosphorus Loss Assessment Tool for Ontario (PLATO) and governance for water quality and land stewardship. A meeting was held with the USDA-ARS regarding the assessment of water use efficiency and drought stress in crops and the use of the eddy covariance technique. The project team has briefed the Saskatchewan, Manitoba and Alberta governments on the project progress and plans. They have met with the Grand River and Upper Thames Region Conservation Authorities on numerous occasions through small group meetings and workshops. The team members participated in an Expert Panel with the Canadian Water Network on Better Management Practices efficacy and non-growing season processes in Toronto, Ontario. The project team has worked with the Bruce Peninsula Biosphere Association on water quality (phosphorus) and land management strategies. This includes aspects of citizen science where volunteers collect water samples and assess stream health. The project's KM strategy has been to share information with users and co-create the knowledge through ongoing dialogue.

Boreal Water Futures [website]: The project team has worked with Syncrude to coordinate the proposed research with their ongoing efforts to assess the long-term hydrological performance

of their closure landform. They are particularly interested in updating mine closure hydrology model with future climate as well as future 'weather' modelling. Syncrude has recommended that the project team revisit their current mine closure hydrology modelling and assist them to update those hydrological models and integrate them with estimates of chemical loading from their closure landforms. Consequently, the team has worked with two of their consultants to develop an appropriate plan in which the proposed research can be applied to their current closure plan to identify hydrological and environmental risk. In addition, the team has been and will continue to actively obtain, synthesize and standardize data collected at the De Beers Group of Companies Victor mine from research, government and industry led monitoring programs. The team has identified expertise at major engineering consulting firm to begin a series of informal interviews aimed at understanding how firms are incorporating climate change into their operations. The development and continual support of iWetland, a crowdsourced water level monitoring project, engages citizens to participate in hydrological data collection by texting in the water level at various locations within the Georgian Bay Biosphere Reserve.

Lake Futures [website]: The Lake Futures team has expanded the number of users involved in the project since its inception. It was realized that for the decision making tools to be of use to the user community, expansion of the end-user organization list was critical. The major knowledge gaps identified by the stakeholders were the lack of ability to link activities on the landscape to water quality in lakes, and the need to harmonize across data sources and models. Recommendations from the stakeholders with respect to communication and engagement were included in a stakeholder report. The kickoff meeting demonstrated that our research design was well integrated with stakeholder needs, and identified the most effective ways to engage the stakeholder community. A KM Steering Committee (KMSC) has also been created, comprised of user group representatives, project leads and KM experts for the purpose of ensuring that Lake Futures successfully adheres to both the principles and spirit of GWF's KM Strategy. Stakeholders have participated in the HQP meetings and have visited Waterloo to give invited lectures and attend lunches with the team to discuss collaboration and project progress. Collaborators were invited to give talks at Waterloo, and Lake Futures researchers were invited to give talks at various user organizations. These interactions enabled the sharing of ideas, and building stronger collaborations.

Integrated Modelling Program for Canada [website]: IMPC has made significant progress on their Knowledge Mobilization (KM) activities facilitated by a full-time User-Engagement Specialist. Their focus has been mainly to shape the KM strategy for IMPC program through user-engagement and outreach activities, designing a user survey, developing a KM plan and Participatory Working Groups (PWGs) for each project, and meeting on a monthly basis with the Knowledge Mobilization Oversight Committee (KMOC). Work Package PWGs exist to ensure each collaborator has user representatives on the project team, and that models, decision problems

and solutions are co-designed and co-produced. The project team is near to completing a defined user group for each Work Package. During the last year, Investigators were contacted to identify current working collaborators. Additional recommendations were solicited from the KMOC. The current phase includes re-contacting Investigators to link them with additional recommended contacts, officially requesting the participation of representatives from collaborating communities and organizations, and workshopping mechanisms for regular communication between the parties.

Climate Related Precipitation Extremes: The research objectives of this project are built around discussions with key sectors that are faced with everyday operations and policy decisions affected by Canada's increasing extreme precipitation patterns - engineering, agriculture, utilities, insurance and public health. Strong relationships have been established with Manitoba Hydro and NB Power and an investigation of four major freezing precipitation events of importance to and identified by Manitoba Hydro has been conducted to assess driving mechanisms and to place these into a longer-term perspective. Manitoba Hydro is committed to supporting the research as an active partner and hosted the project kickoff meeting in their new Winnipeg office in November 2017. Health Canada has been an active partner, contributing critical indicators of importance that are related to the project. Through collaboration with CatlQ (Catastrophe Indices and Quantification), the project is selecting several significant extreme events based on insurance losses and type of event. A strong relationship has been developed with the National Research Council (NRC), the body that oversees the evolution of the National Building Code of Canada. The research team has participated in NRC committees that contribute to the development of code changes. The project has assisted the BC Ministry of Transportation and Infrastructure (MOTI) and Engineers and Geoscientists of BC through the Pacific Climate Impacts Consortium to develop guidance for engineers to follow the mandate to consider future climate information in all design and construction projects. This work has led to MOTI's online climate information tools specifically to meet the needs of engineers in BC.

The project has been working in collaboration with National Centre Atmospheric Research (NCAR) on solving a warm and dry bias over the land surface in modelling, and including the ground water option before launching new extended domain North America runs. The team has also developed a new, probabilistic PMP estimation technique that improves on the operational moisture maximization approach that is frequently used by engineers. The new method has a firm foundation in statistical extreme value theory and allows quantification of the uncertainty in PMP estimates – something that was not possible hitherto. This work has been communicated to user communities—BC Hydro and Manitoba Hydro—informally so far.

9. Management – Breaking the Barriers – Disciplinary Silos and Institutional Divide

A significant care has been observed while devising and implementing a governance and management structure for GWF program. The GWF governance structure builds on lessons learned from previous experiences and established a lean matrix structure reflecting the trans-Canadian breadth of this partnership and the importance of inter- and trans-disciplinary collaboration and mobilization of solutions/information to end-users (Figure 5). Research excellence has been the mantra, however, principles of equity, diversity and inclusion (Gender Summit 11 North America) have been the common thread while creating the governance structure. The structure primarily consists for three layers of decision making. The topmost decision making body is called the *Oversight Committee*, which consists of the Vice-President Research from four partner institutions (Karen Chad, UofS; Charmaine Dean, University of

Waterloo; Robert Baker, McMaster University; Robert Gordon, Wilfrid Laurier University) and the GWF Program Director John Pomeroy. This committee ensures the vision, mission, and objectives are achieved, monitor progress, holds the program to the highest standards of research and training excellence, and promotes broad engagement across the university, partner universities, and national and international partners and key stakeholders.



Celebrating Excellence - the International Women Day during the Howard Wheater Symposium, March 2018

The second layer comprises of the *Strategic Management Committee (SMC)*, chaired by the Program Director John Pomeroy which provides direction and ensures delivery of transformational science, and oversees the GWF-CFREF budget, allocating it among partner institutions and investigators by issuing strategic proposal calls. Distinguished scientists from academia and government serves on the committee. The current membership include Helen Baulch (Water and Environment), Patricia Gober (Socio-hydrology), Lawrence Martz (Water Resources Management and Communities) and John Pomeroy (Program Director) from UofS, David Rudolph (Big Data, Urban Communities and Groundwater) and Phillippe van Cappellen (University of Waterloo lead) from University of Waterloo, Sean Carey (McMaster University lead), Jennifer Baltzer (Wilfrid Laurier University lead), Ronald Stewart (Climate and Atmospheric Science), University of Manitoba, and Alain Pietroniro (Stakeholders/Users, government, Measurements, Modelling and Forecasting), Environment and Climate Change Canada.

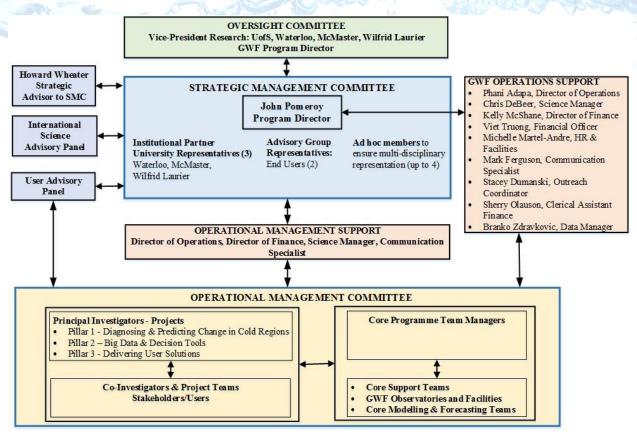


Figure 5: Governance and Management Structure for GWF Program

The third layer of decision making is called the *Operational Management Committee*, which comprises of the leads and program managers from 12 user questions-led projects [website], 21 transformative science, decision tools and big data projects [website], and 5 core support teams that implements the transformative and transdisciplinary science programs to achieve the overarching goals of the GWF Scientific Strategy.

The *SMC* is supported by the *International Science Advisory Panel* which offers guidance on strategic program direction to ensure delivery of transformational science that addresses the needs of Canada and the world. Composed of internationally recognized scientists and research leaders, this committee includes Dennis Lettenmaier (University of California at Los Angeles), Anthony Jakeman (Australian National University), Eric Kasischke (University of Maryland/NASA), Claudia Pahl-Wostl (University of Osnabrueck and Future Earth), Xin Li (CAREERI, Chinese Academy of Sciences), and Blanca Jimenez Cisneros (UNESCO).

The **SMC** is in the process of forming a **User Advisory Panel**, a high-level, strategic cross-sectoral committee which will ensure GWF delivers risk management solutions aligned with federal strategies and provincial, industrial and community needs of benefit to Canada. This panel will have representation from: provincial/territorial and federal (Environment and Climate Change Canada, Agriculture and Agri-Food Canada, Health Canada, Parks Canada, Natural Resources

Canada) government agencies; industry (insurance, mining and minerals, oil and gas), urban and rural communities; and Indigenous communities.

Howard Wheater, Canada Excellence Research Chair Laureate and former Program Director for GWF-CFREF has been appointed as the Strategic Advisor to the SMC.

The GWF Secretariat is jointly led by Phani Adapa, Director of Operations, Kelly McShane, Director of Finance, and Chris DeBeer, Science Manager. Together, they support the Program Director, SMC, Operations Management Committee, and assumes responsibility for day-to-day management of the GWF Secretariat, overseeing and coordinating operational support leads and teams including HR, Finance, Communications and Marketing, Stakeholder Outreach & Engagement, Commercialization & IP, Data Management & Training functions.

Please refer to Appendix A for list of personnel associated with the GWF Oversight Committee, Strategic Management Committee, International Science Advisory Panel and the Secretariat.

10. Performance Measurement Plan

The governance and management structure for GWF (Figure 5) was created to achieve the mission and vision of GWF while targeted towards the CFREF criteria of global research excellence and leadership, and transdisciplinary research of economic benefit to Canada. GWF's mission is to position Canada as the global leader in water science for cold regions and to address the strategic needs of the Canadian economy in adapting to changing water and managing the risks of uncertain water futures and extreme events. GWF is achieving this mission by delivering risk management solutions—informed by leading-edge water science and supported by innovative decision-making tools—to manage water futures in Canada and other cold regions where global warming is changing landscapes, ecosystems, and the water environment.

GWF is formulated around three interrelated Pillars of activity:

- Pillar 1 Diagnosing and Predicting Change,
- Pillar 2 Developing Big Data and Decision Support Systems,
- Pillar 3 Designing User Solutions.

Its governance and management involves the Principal Investigator chairing the Oversight Committee of Vice-President Research from the four partner universities and the Director, a Director, chairing the Strategic Management Committee that takes advice from an International Advisory Panel and User Panels and a supporting Operations Committee composed of the projects and core teams. The governance and management structure for GWF was created to achieve the mission and vision of the GWF through these Pillars, whilst directed towards the CFREF criteria of global research excellence and leadership, and transdisciplinary research of economic benefit to Canada. In addition, the transdisciplinary structure ensures breaking down the traditional disciplinary and institutional barriers to ensure a holistic approach to what are inevitably comprehensive and complex water problems. The philosophy has been to establish a strong regional and topical research bases and then expand nationally and grow globally. Throughout the program, the principles of equity, diversity and inclusion has been of primary consideration. As a network, in addition to achieving the mission to improve disaster warning, predict water futures, and inform adaptation to change and risk management, we are aiming to be known for engagement of Indigenous communities in co-developing water research. Please see Appendix A for list of GWF Strategic Management Committee Members.

The first steps in defining GWF involved user engagement and the establishment of Core Teams. By engaging with the user community across Canada with a series of discussions, conducting a review of needs based on these discussions and finally developing a report on user needs and questions that we could address, GWF defined its Pillar 3 needs and set priorities for supportive science in Pillars 1 and 2. The Core Teams and their strategic activity plans were developed early on and now include modelling and forecasting, technical, data management, computer science,

knowledge mobilization, and communications, which provide central capabilities and functions for Pillar 2 and support for the whole GWF program towards its mission and goals. (please see *Appendix B* for list of core team personnel)

Subsequent to the user needs survey and core team development, we initiated a formal request for proposals open to all members of the four partner universities and selected members of 14 other universities that were included with our original proposal. We instituted a rigorous international peer-review process to evaluate these with final recommendations by the Strategic Management Committee upon advice of the International Advisory Panel and overseen by the Oversight Committee. Subsequently, 12 stakeholder question-led transdisciplinary Pillar 3 projects were funded in July 2017, and 21 transformative science, big data, and decision-support tools Pillars 1 & 2 projects were funded in December 2017. Please see *Appendix C* for list of GWF Researchers, Graduate Students, and Highly Qualified Personnel by Projects.

All funded 33 Pillar 1-2-3 projects and core teams were requested to develop inception reports by April 30, 2018. The purpose of an Inception Report for each project was to establish a set of short-term plans and broader long-term plans, including contributions by specific coinvestigators, collaborators, and teams within the project; timelines and deliverables; and anticipated difficulties or gaps that need further consideration. It is intended as a guidance document to help in the planning and execution of project activities, as a benchmark to gauge progress, and as a tool to help identify and resolve key problematic areas, such as lack of resources, commitments, or person-power. The Inception Report also clarifies important changes as the project has evolved and as users have been brought in since the funding announcement.

GWF has adopted a common management strategy, including monthly and quarterly reporting contributing to reviews of scientific and technical progress by the Operational Management Committee (OMC) (leads from 33 funded projects and core modelling and forecasting, computer science, knowledge mobilization, and technical teams), and an Annual Science Meeting to provide a broad perspective of scientific progress from the entire GWF program, to stimulate transdisciplinary discussions and interactions amongst researchers, students and partners, and to showcase and celebrate the scientific and technical advancements emerging from the GWF program. We have developed a common understanding of who needs what information, when they need it, how they want to receive it, and who is responsible to provide it. Each quarter, task leaders and theme leaders are reviewing project activities, measuring critical indicators, and issuing yearly formal reports to the management team. We are using critical path analysis to help plan sequential tasks that must be completed in such a large program (e.g., develop a master schedule, resource planning, monitoring progress), taking remedial steps (restructuring, adding resources, etc.) when tasks fall behind.

An Operations Management Support (OMS) team has been constituted whose role is to communicate closely with the OMC to oversee development of inception reports, track and assist projects (budget spends, meeting objectives, etc.), report on core functions, identify any

impending concerns, and assist with common management issues, and finally report back to the Strategic Management Committee (SMC) on a regular basis. The primary objectives of the OMS include:

- Facilitate Interactions: The Pillars 1-2-3 projects (33 projects) are grouped into 7 themes (e.g. Agriculture, Energy and Natural Resources, Indigenous communities, Water Environment, Urban and Rural Communities, Government and Governance, and other industry) to facilitate interactions among the PI and Co-Is to share best practices in conceptualizing, implementing and meeting project objectives, interacting with users, and sharing information on optimal operation of projects.
- **Identify Gaps:** During the interactions within the above themes, identify research gaps that needs further consideration.
- **Identify Opportunities:** Identify resources to provide additional support, develop efficiencies and incentives to address the above identified gaps.
- Track Progress 33 Projects and 6 Core Teams: Track milestones and deliverables outlined in individual and core teams inception reports to update their status to the SMC and also compile annual progress reports to CFREF. Report on progress in operations, coordination and opportunities to the SMC.
- **Identify Financial Issues:** During thematic meetings and annual progress reports, identify financial issues that needs special attention.
- **Identify Communication Needs:** Develop and implement a communication strategy to identify communication needs and deliverables for GWF.

OMS Reporting and Project Tracking Schedule: The following notes are to support and justify the activities listed in the timeline chart in Figure 6 below:

- Operations Management Committee: The OMC comprises the leads and co-leads for Pillars 1-2-3 projects, core modelling and forecasting, computer science, knowledge mobilization, and technical teams, and meets in-person twice in a year. This meeting will be in conjunction with the GWF Annual Science Meeting to be scheduled in the month of May (for 2018 the Annual Science Meeting is scheduled for June 3-6) and the second in the month of November.
- Operations Management Support Thematic Panels: The OMS (particularly the Director
 of Operations and the Science Manager) will meet with thematic groups four times a year.
 Two of these meeting will be in conjunction with the OMC meeting and two will be held
 via conference calls in the months of February and August. User Panels that correspond
 to the thematic groups may be invited to these meetings
- Operations Management Support Project Progress: The progress of individual projects supporting Pillars 1-2-3 will be tracked three times a year: 1) twice during the OMC meetings, and 2) to secure information to complete the April GWF annual progress report.

- Operations Management Support Core Teams: The OMS (particularly the Director of Operations and the Science Manager) will meet with the PIs of the core teams four times a year. Two of these meeting will be in conjunction with the OMC meeting and two will be held via conference calls in the months of February and August.
- **Project Progress Reports:** To fulfill GWF reporting requirements to CFREF against the performance indicators, individual PIs are required to provide written reports in April.
- Project Financial Reports: Reports will be required from the PIs twice per year (April and October) indicating whether they are in compliance with the budgets included in their inception reports. PIs will be required to provide justification, if there is more than 20% variance in individual line items and seek approval if the line items are expected to deviate by more than 20% over the entire project. In addition, any impending issues raised during OMC meetings will be conveyed to the Director of Finance for resolution.
- **Communications:** GWF project, core team and secretariat communications will be discussed on an ongoing basis and will adhere to the Communications Strategy approved by the SMC. An electronic monthly newsletter is sent to all GWF participants and stakeholders.

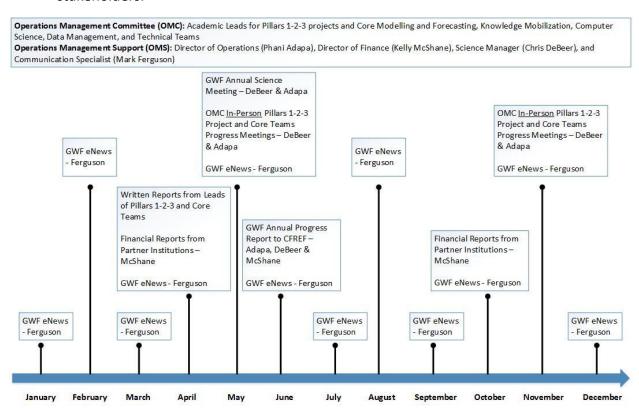


Figure 6: OMS Reporting and Tracking Schedule

11. Performance Indicators - GWF by Numbers

GWF is a seven year pan-Canadian research program focusing on solutions to water threats in the era of global change. As such, GWF has implemented a performance timeline to ensure that program commitments are met and to track the progression of the program. The performance timeline will align the project with targeted goals from the programs infancy to maturity. GWF will focus on two specific years (mid-point at year-four and end-point at year-seven) to assess the progression. It is important to note that GWF program has now funded 33 Pillars 1-2-3 projects and 6 core teams that just started to produce scientific outcomes. Therefore, we expect a lag in program outcomes for a few performance indicators in year 2.

11.1 Evidence of Global Research Excellence

Global Research Excellence	2017 - 2018	Year 4 (2019- 2020)	Year 7 (2022- 2023)	Below/ Meeting/ Exceeding
Number of international research programs and committee where GWF members are lead investigators and/or advisors. (see <i>Appendix D</i> for complete list)	26	4	10	Exceeding
Number of prestigious international, national and institutional awards, recognitions from professional societies, and national scholarships and fellowships. (see <i>Appendix E</i> for complete list)	72	100	200	Exceeding
Global leader in science impact - quality of research – rank in h-index (as per Web of Science on June 19, 2018)	3	2	1	Meeting
Global leader in science dissemination – rank in number of peer reviewed journal articles (see <i>Appendix F</i> for complete list of publications)	1	1	1	Exceeding
Number of presentations at international and national conferences (see <i>Appendix F</i> for complete list of publications)	202	500	1000	Exceeding
Number of international and national plenary, key note and invited speaking engagements (see <i>Appendix F</i> for complete list of publications)	117	130	200	Exceeding
Number of international visiting fellows see <i>Appendix C</i> for complete list of publications)	9	120	200	Below
Number of international joint faculty appointments (see <i>Appendix G</i> for complete list of publications)	23	50	100	Exceeding
Level of cash and in-kind research funding brought by GWF Projects from national and international governments, industries, communities, and nongovernmental organizations (see <i>Appendix H</i> for complete list of publications)	\$292M	\$250M	\$450	Exceeding

During last reporting year, GWF investigators led or were part of 26 international research programs and committee where GWF members are lead investigators and/or advisors. Some of the notable achievements include, Changing Cold Regions Network – a Regional Hydroclimate Project of the Global Energy and Water Exchanges (GEWEX) project of the World Climate Research Programme's (WCRP) and also the International Network for Alpine Research Catchment Hydrology (INARCH) of the WCRP's GEWEX & UNESCO's International Hydrological Program. A proposal has been submitted to GEWEX to establish GWF as a project within the Regional Hydroclimatic Program. In addition, GIWS is the Canadian node for the Sustainable Water Futures Program of Future Earth.

Members of Global Water Futures have been recognized globally, nationally and locally for their research excellence this past year with a total of 72 awards. Of these, 16 were prestigious international and national awards, and recognitions from professional societies. Jeffrey McDonnell, Associate Director GIWS and Howard Wheater, CERC Laureate, Former Director of GWF and Director GIWS were awarded the 2016 and 2018 Dooge Medal, respectively by IAHS to



Jeffrey McDonnell (centre) receiving the 2016 Dooge Medal



John Pomeroy (centre) receiving the 2017 J.
Tuzo Medal

recognize their outstanding achievements in the field of hydrology. John Pomeroy, Director of GWF, and Canada Research Chair in Water Resources and Climate Change was awarded the 2017 J. Tuzo Wilson Medal by the Canadian Geophysical Union to recognize his outstanding contribution to the field of geophysics in Canada. Masaki Hayashi was awarded the Henry Darcy Distinguished Lecturer, U.S. National Groundwater Association for his research excellence.



Howard Wheater (centre) receiving the 2018

Dooge Medal

This past year, Global Water Futures members published 108 peer-reviewed journal articles, delivered 202 conferences presentations, delivered 117 invited, plenary and keynote lectures, published 3 books and book chapters, and published 13 non-refereed articles and data that were related to their GWF research.

A significant effort has been placed on leveraging opportunities to grow the GWF program. Consequently, significant amount of cash and in-kind support has been secured from national and international governments, industries, communities and non-governmental organizations. As of March 31, 2018, GWF has invested \$38.1 million (out of \$77.8 million total over seven years) in 33 projects and 6 core teams over next three years, which resulted in securing additional leveraged cash and in-kind funding of \$212.8 million from users/stakeholders/funding partners resulting in a total investment of \$292 million.

11.2 Attracting and Retaining the Best and Brightest Talent

Over last year, GWF has recruited 9 new top and brightest faculty members who are at various stages of their career. They are:

- 1. James Famiglietti, Canada 150 Research Chair in Hydrology and Remote Sensing and Incoming Executive Director GIWS, UofS
- Kelly Munkittrick, Professor and Executive Director of Cold Regions and Water Science Initiatives, Wilfrid Laurier University
- 3. Karen Kidd, Stephen A. Jarislowsky Chair in Environment and Health, McMaster University
- 4. Corrine Schuster-Wallace, Associate Professor, Water and Health, UofS
- 5. Patrick Lloyd Smith, Assistant Professor, Socio-economics, UofS
- 6. Simon Papalexiou, Assistant Professor, Statistical Hydrology and Stochastic Processes, UofS
- 7. Colin Whitfield, Assistant Professor, Water Quality Modelling, UofS
- 8. Markus Brinkmann, Assistant Professor, Exposure and Risk Management Modelling, UofS
- 9. Derek Gray, Assistant Professor, Freshwater Ecology, Wilfrid Laurier University

Global Water Futures currently has 466 highly qualified personnel (33 projects and core team personnel), including 43 undergraduate students, 103 master's students, 107 doctoral students, 68 postdoctoral fellows, 1 research engineer, 29 professional research associates, 21 research scientists, 48 technicians, 8 visiting fellows/professors, 4 knowledge mobilization specialists, 34 data and project managers. These personnel are actively supervised by 157 researchers from 15 Canadian Universities.

Attracting and Retaining the Best and Brightest Talent	2017 - 2018	Year 4 (2019- 2020)	Year 7 (2022- 2023)	Below/ Meeting/ Exceeding
Number of faculty recruited in the top 5% of peer group	9	16	30	Exceeding
% of GWF graduate students and PDFs holding major financial awards (see <i>Appendix E</i> for complete list)	14.5%	25%	35%	Meeting
Participation in skills-based short-courses and transdisciplinary boot camp (see <i>Appendix I</i> for complete list)	150	250	500	Exceeding
Cross-institutional and user training opportunities, leadership workshops, and special seminars (see <i>Appendix I</i> for complete list)	71	250	500	Exceeding
Number of short-courses for early career researchers (see <i>Appendix I</i> for complete list)	14	12	20	Exceeding
Assignment of GWF mentors to early-career researchers (PDFs, research scientists and faculty <10y post PhD)	100%	100%	100%	Meeting

The talent and training excellence achieved by the students and postdoctoral fellows at Global Waters Futures can be assessed by the number of honours and awards received. During 2017-2018, 278 members consisted of graduate students (masters and doctoral) and postdoctoral fellows, of which 14.5% held major financial awards.

Opportunities to extend knowledge and skills are available through skills-based-short courses and transdisciplinary boot camps. So far, 150 GWF members were given such opportunities.

11.3 Ability to Mobilize Knowledge for the Benefit of Society and the Economy

Ability to Mobilize Knowledge for the Benefit of Society and the Economy	2017 - 2018	Year 4 (2019- 2020)	Year 7 (2022- 2023)	Below/ Meeting/ Exceeding
Number of end users and partners linked to the	335	300	500	Exceeding
program and engaged in the research process (see <i>Appendix J</i> for complete list)				
Number of patent disclosures, licenses to industry, spin-off companies	0	300	500	Below
Number of policy briefs and meetings with governments (see <i>Appendix K</i> for complete list)	31	20	50	Exceeding
Number of jobs created (see <i>Appendices A and B</i> for complete list)	451	450	850	Exceeding
Access of user tools (see <i>Appendix F</i> for complete list)	3	20	50	Below
Hits to YouTube videos (see <i>Appendix J</i> for complete list)	12,622	10,000	100,000	Exceeding
Number of communities engaged in citizen science and public outreach (see <i>Appendix J</i> for complete list)	92	100	500	Exceeding

In the first two years of GWF, over 335 end users and partners have been linked to the program and engaged in the research process. These end users and partners include, 107 Canadian and international academic institutions, 66 industry partners, 70 provincial and federal agencies, 32 Indigenous communities and 62 non-governmental organizations. Here are two examples of how GWF is enabling knowledge mobilization:

• The Integrated Modelling Project for Canada (IMPC) is developing modelling capability for the prediction and management of change in Canada's seven major river basins. The project has employed a user engagement specialist to facilitate knowledge mobilization (KM) between researchers, partners and collaborators across the large and technical project with 14 subtheme research areas. The project began with a kick-off meeting attended by 70 individuals from 16 academic, regulatory and industrial organizations interested in contributing to the research and applying integrated water and climate modelling tools for large river management. KM within IMPC is guided by an Oversight Committee with representation from key transboundary and regional water organizations, and a user survey and social network analysis was conducted to better understand the preferred mechanisms for engagement, collaborator interest in research themes, and to measure the success of KM over the life of the project. This spirit of cocreation and continuous commitment to research iteration has already resulted in an annual meeting that is designed to be engaging, interactive and end-user oriented and specific and detailed KM plans and participatory working groups formed for each subresearch theme to ensure each has user representation informing the co-design and coproduction of models, decision problems and tools and meaningful engagement between

collaborators and investigators. These efforts have led to direct input into research methods, including from the International Joint Commission, US Army Corps of Engineers, Manitoba Hydro and the National Atmospheric and Oceanic Administration into the framework and principles guiding the project's inter-comparison of models.

The Next Generation Solutions to Ensure Healthy Water Resources for Future **Generations** project is creating, validating and applying next generation technologies to new biomonitoring protocols for water ecosystem assessments. The team is working closely with key industry partner, Orano Canada Inc. (formerly AREVA Resource Canada), a Saskatchewan-headquartered mining company who has contributed more than \$30,000 this past year in in-kind support to assist in parallel field sample collection and methodology validation. Researchers provided baseline training and Standard Operation Procedures for field sampling of water and sediments for eDNA analyses in remote areas. Subsequently, Orano Canada Inc. deployed the protocols as part of their monitoring activities under their mandate to comply with Canada's federal mining regulations (Environmental Effects Monitoring (EEM) program). The first field campaign achieved samples in good condition, demonstrating successful transfer of eDNA field collection methodology. Interviews, surveys and meetings with other key potential end users in government (i.e. Alberta Environment and Saskatchewan Ministry of Environment), NGOs (i.e. Saskatchewan Wildlife Federation), and industry (i.e. Shell Canada) are underway to identify opportunities and barriers for uptake of these cutting-edge eDNA technologies into regulatory and community-based monitoring efforts across Canada.

Since GWF is in early stages of its inception and operation, it has no patent disclosures, licenses to industry or spin off companies during 2017-2018 year. Similarly, it is expected that access to user tools will increase significantly as the network matures towards year 4.

A total of 495 jobs were created, which included hiring of 9 new faculty members and 486 (projects and core teams) highly qualified personnel.

This year alone, 26 promotional videos were developed from the program; resulting in 12,622 views on YouTube. These promotional videos range from educational short documentaries to grad student experiences. Three user tools have been developed from two different GWF projects, Northern Waters Futures and Integrated Modelling for Prediction and Management (IMPC). Northern Waters Futures has been supporting the development a user tool called EducKit, a software used to teach Northern Youth about mapping and monitoring. While, IMPC has created a novel sensitivity analysis tool called Variogram Analysis of Response Surfaces (VARS) and a virtual visualization model thus far from the ongoing research. Please see Appendix J for list of user tools.

As of March 30, 2018, 9 different communities across Canada were engaged in citizen science. These experiences allowed for communities to collaborate with the professionals of GWF. A noteworthy citizen science project was developed from Boreal Waters Futures (BWF). BWF created iWetland, which is used to assess the suitability of crowd-sourced data to monitor the water levels in the Georgian Bay Biosphere Reserve. Please see Appendix J for list of citizen science projects.

12. GWF Grants and Scholarships

In addition to the project-based and core team funding, GWF has piloted Capacity Building Awards, Summer Student Internships, Sabbatical Research Grants, and PhD Excellence Scholarships at UofS to further strengthen our research capacity and attract best-of-the-best graduate students globally. A brief description of these initiatives are as follows:

12.1 Capacity Building Awards (up to 5 awards of \$25,000 for one year)

These are established A) To stimulate novel research, through workshops or similar activities, and/or B) to build and support research teams who are working to secure grants for new research in Water Security of high promise in terms of innovation and sustainability of longer term funding in alignment with GWF Mission of improving disaster warning, predict water futures and inform adaptation to change and risk management. It would normally be expected that these activities would engage researchers from various units and Colleges across the U of S campus. Funding could also be provided in support of development of national or international collaboration or research with indigenous communities.

12.2 Summer Student Internships (up to 5 internships for \$8,000 each per year)

These were established A) To provide additional technical support for various research projects of strategic relevant to the Global Water Futures (GWF) program mission of improving disaster warning, predict water futures and inform adaptation to change and risk management, and/or B) to train and provide professional development opportunity to undergraduate students. It would normally be expected that these activities would engage students from various units and Colleges across the U of S campus.

12.3 Sabbatical Research Grant (partial financial support of up to \$25,000 per sabbatical)

To host leading international researchers who could bring significant expertise to aid in achieving the Global Water Futures mission of improving disaster warning, predict water futures and inform adaptation to change and risk management. In addition, it is envisioned that these sabbatical visits will lead to enhanced relationships with their respective home institutions.

12.4 PhD Excellence Scholarships (up to \$45,000 per year per student for three years)

To provide entrance scholarships for first-time PhD candidates who have outstanding academic records, show research promise, have exceptional communication, interpersonal and leadership abilities, and who are planning involvement in a research program in alignment with the <u>Global Institute for Water Security (GIWS)</u> and <u>Global Water Futures (GWF)</u> areas of research that include: 7 GIWS research themes, hydrometeorology and climate change, hydrology and terrestrial ecosystems, water quality and aquatic ecosystems, human-water systems, and water

and health and at the time of application have not yet been accepted or registered at the University of Saskatchewan.

13. GWF Young Professionals

A GWF Young Professionals (GWF-YP) group was formed to coordinate efforts amongst all young professionals under the GWF program, including undergraduate and graduate students and postdoctoral fellows from 18 Canadian academic intuitions. In addition, one of the major aspects of the GWF-YP is to provide professional development opportunities, scientific writing, and career advancement tips to be successful in a research career.

Particularly, the following goals and priorities have been identified for the GWF-YP group:

- Provide a sense of community among the GWF Young Professionals (YP) from all participating institutions (nationally and internationally) through open communication, including undergraduate students, graduate students and postdoctoral fellows.
- Provide professional development opportunities
- Organize and promote GWF-YP activities, achievements and social events
- Act as GWF ambassadors within their regions

To facilitate this process, a GWF-YP Executive group was formed comprising of 4 chapters (one each for UofS, University of Waterloo, McMaster University and Wilfrid Laurier University) and respective 4 Chapter Chairs. Each chair was appointed for one year term and are eligible for renewal or re-election. One of the Chapter Chairs was chosen as the President. The position of "President" will be rotated among institutional partners on a yearly basis. The President will have an option to seek advice from the GWF Outreach Coordinator Stacey Dumanski from time to time. In addition, the President of the Canadian Young Hydrologic Society (CYHS) was added as the 5th Executive member. The executive team for the year 2018-19 is as follows:



Holly Annand, PhD, UofS Chapter Chair & GWF-YP President



Samina Hayat, MSc, Waterloo Chapter Chair



Erin Nicholls, PhD, McMaster Chapter Chair



Cory Wallace, PhD, WLU Chapter Chair



Nadine Shatilla, CYHS Chapter Chair (CYHS Co-Presidents)



Kelly Biagi, CYHS Chapter Chair (CYHS Co-Presidents)

Additional information in GWF-YP and their activities is available at: https://gwf.usask.ca/Students--Postdocs/gwf-youngprofessionals.php#Executive

14. Concluding Remarks

Eventhough GWF is a network of 18 Canadian institutions, it is functioning as a single team. This cohesion is exceptional in science and brings great strength to GWF. Excellence is the primary criteria across the program in addressing the GWF mission and vision. Equity, diversity and inclusion has been the common threads in initiation, development and implementation of our research program.

2017-2018 was a remarkable and productive year for GWF and members. A major focus was on establishment of 6 core research teams and 33 pan-Canada research projects. In addition, GWF has taken significant steps in engaging Indigenous Communities in Water Research, which to our knowledge has never been done by any of the large research networks.

As we move forward, we will continue to develop substantial research projects and activities in collaboration with our international partners. This will allow us to further strengthen our capabilities and also establish GWF as a global leader in water science for cold regions.

Even though GWF is in its infancy, our recent performance indicators are a testament to our excellence and effective governance and management.

In this brief overview of the recent work of GWF it has not been possible to do full justice to the work of our members, and we encourage those interested to visit individual project web-sites (Pillars 1-2 & Pillar 3) or to contact our members/ secretariat directly. We welcome students and postdoctoral researchers to either join our team or spend time with us as visiting researchers. We especially welcome academic colleagues from across Canada and around the world for short or longer visits to our partner academic institutions. Our Director of Operations, Dr. Phani Adapa phani.adapa@usask.ca is always available for contact regarding the work of GIWS and welcomes enquiries from individuals, governments, industry and others concerning research collaboration.

Appendix A – GWF Management Committee Members

Name	Title	Organization		
Oversight Committee				
Baker, Robert	Vice-President Research	McMaster University		
Chad, Karen	Vice-President Research	University of Saskatchewan		
Dean, Charmaine	Vice-President Research	University of Waterloo		
Gordon, Robert	Vice-President Research	Wilfrid Laurier University		
Pomeroy, John	GWF Director	University of Saskatchewan		
Strategic Management Committee				
Baltzer, Jennifer	Canada Research Chair in Forests and Global Change	Wilfrid Laurier University		
Baulch, Helen	Assistant Professor	University of Saskatchewan		
Carey, Sean	Professor	McMaster University		
Gober, Patricia	Professor	University of Saskatchewan		
Martz, Lawrence	Vice-Dean of Faculty Relations, Arts & Science	University of Saskatchewan		
Pietroniro, Alain	Executive Director	Environment Canada Water and Climate Services		
Pomeroy, John	GWF Director	University of Saskatchewan		
Rudolph, David	Professor and Head, Earth and Environmental Sciences	University of Waterloo		
Stewart, Ronald	Professor	University of Manitoba		
Van Cappellen, Philippe	Canada Excellence Research Chair	University of Waterloo		
Strategic Advisor – Strate	egic Management Committee			
Wheater, Howard	Canada Excellence Research Chair Laureate	University of Saskatchewan		
Phare, Merrell-Ann	Indigenous Communities Engagement	The Phare Law Corporation		
International Science Advisory Panel				
Jakeman, Anthony	Professor and Director, Integrated	Australian National		
	Catchment Assessment and Management Centre	University		
Cisneros, Blanca Jimenez	Director, Division of Water Sciences	UNESCO		
Kasischke, Eric	Professor	University of Maryland, USA		
Lettenmaier, Dennis	Distinguished Professor	University of California at Los Angeles, USA		
Li, Xin	Director of Laboratory of Remote Sensing and Geospatial Science at CAREERI	Chinese Academy of Sciences		
Pahl-Wostl, Claudia	Professor	University of Osnabrück, Germany		

Rasmussen, Roy	Senior Scientist	National Center for
		Atmospheric Research, USA
Secretariat		
Adapa, Phani	Director of Operations	University of Saskatchewan
DeBeer, Chris	Science Manager	University of Saskatchewan
Dumanski, Stacey	Outreach Coordinator	University of Saskatchewan
Ferguson, Mark	Communications Specialist	University of Saskatchewan
Martel-Andre, Michelle	Human Resources and Facilities	University of Saskatchewan
McShane, Kelly	Director of Finance	University of Saskatchewan
Olauson, Sherry	Clerical Assistant Finance	University of Saskatchewan
Pomeroy, John	GWF Program Director	University of Saskatchewan
Truong, Viet	Financial Officer	University of Saskatchewan
Zdravkovic, Branko	Data and IT Manager	University of Saskatchewan

Appendix B – List of Core Team Personnel

Name	Title	Responsibility	Institution/
Nandalling and Fausasati			Supervisor
Modelling and Forecasti		Climate	LL-CC AND
Asong, Elvis	Postdoctoral Fellow	Climate	UofS - Wheater
Brown, Tom	Research Engineer	Next Generation Modelling	UofS - Pomeroy
Costa, Diogo	Postdoctoral Fellow	Catchment, Lake & River Water Quality	UofS - Wheater/Pomeroy
Elshamy, Mohamed	Research Scientist	Hydrological Modelling	UofS - Wheater
Fang, Xing	Research Officer	Next Generation Modelling	UofS - Pomeroy
Gharari, Shervan	Postdoctoral Fellow	Hydrological Modelling	UofS - Razavi
Kheyrollah Pour, Homa	Research Scientist	Cold regions lake modeling: ice dynamics, circulation, nutrient cycles and algal blooms	Waterloo - PVC
Kinar, Nicholas	Research Scientist	Autonomous & Remote Sensing	UofS - Pomeroy
Li, Hongxiu	Postdoctoral Fellow	Ecosystem services valuation, water accounting and hydroeconomic modeling	Waterloo - Brouwer
Li, Zhenhua	Research Associate	Seasonal & Drought Forecasting	UofS - Li
Loukili, Youssef	Research Scientist	Flood Forecasting	UofS - Pomeroy
Mai, Julianne	Postdoctoral Fellow	Multiscale watershed hydrological flow and water quality modeling	Waterloo - Tolson
Marsh, Chris	PhD	Next Generation Modelling	UofS - Pomeroy
McCarter, Colin	Postdoctoral Fellow/ Research Scientist	Biogeochemical reaction networks for carbon, nutrients and contaminants	Waterloo - PVC
Morales, Luis	Postdoctoral Fellow	Catchment, Lake & River Water Quality	UofS - Lindenschmidt
Prasad, Siva	Postdoctoral Fellow	River Ice Modelling	UofS - Lindenschmidt
Princz, Daniel	Postdoctoral Fellow	Hydrological Modelling	UofS - Wheater
Slaughter, Andrew	Postdoctoral Fellow	Water Resources	UofS - Razavi
Shook, Kevin	Research Scientist	Next Generation Modelling	UofS - Pomeroy
Tesemma, Zelalem	Postdoctoral Fellow	Data Assimilation	UofS - Pomeroy
Tsurata, Kai	Postdoctoral Fellow	Hydrological Modelling – VIC	PCIC-UVic - Zwiers
Vionnet, Vincent	Research Scientist	Flood Forecasting	UofS - Pomeroy
Wayand, Nic	Postdoctoral Fellow	Data Assimilation & CHM Modeller	UofS - Pomeroy
Woldegiorgis, Befekadu	Postdoctoral Fellow	Water Quality	UofS – Baulch/ Lindenschmidt
Xu, Teng	Postdoctoral Fellow	Model-data assimilation systems for inland water	Waterloo – Duguay

5000		quality forecasting and	
		analysis	
Yassin, Fuad	PhD	Water Resources	UofS - Razavi
Zhang, Zhe	PhD	Climate	UofS - Li
TBD	Postdoctoral Fellow	Floodplains	McMaster - Coulibaly
TBD	Postdoctoral Fellow	Regional flow and chemical fluxes within the variably saturated subsurface	Waterloo - Rudolph
TBD	Postdoctoral Fellow	Catchment, Lake & River Water Quality	McMaster - Carey
TBD	Research Scientist	Water Resources	UofS - Razavi
Computer Science Team	ו		
Alam, Mahabin	MSc	Software Architecture, and Platform for Hydrological Modelling	UofS – Schneider/Roy
Green, Kevin	Postdoctoral Fellow	Hydrological Model Evaluation	UofS - Spiteri
Ll, Yukun	Undergraduate	Software Architecture, Co- Evolution and Platform for Hydrological Modelling	UofS – Modal/Roy
Magnus, Alexander	Undergraduate	Interactive Visualization	UofS - Mondal
Mondal, Manishankar	Postdoctoral Fellow	Software Architecture, Co- Evolution and Platform for Hydrological Modelling	UofS - Schneider/Roy
Rahman, Shahriar	Undergraduate	Software Architecture, and Platform for Hydrological Modelling	UofS - Schneider/Roy
Roy, Banani	Professional Research Associate	Software Architecture, and Platform for Hydrological Modelling	UofS - Schneider
Rudnitskiy, Ilia	Research Technician	Interactive Visualization	UofS - Mondal
Saha, Bishal	Undergraduate	Software Architecture, and Platform for Hydrological Modelling	UofS - Schneider/Roy
Sengupta, Paromita	Undergraduate	Software Architecture, and Platform for Hydrological Modelling	UofS - Schneider/Roy
Wang, Sean	Undergraduate	Hydrological Model Evaluation and Interactive Visualization	UofS - Schneider- Mondal
TBD	Research Scientist	Software Architecture, and Platform for Hydrological Modelling	Waterloo - Lin
TBD	MSc	Managing Environmental Monitoring Data	Waterloo - Lin
Knowledge Mobilization	n Team		
Goucher, Nancy	KM Specialist	Pillar 3 Projects	Waterloo - Boehmer

Merrill, Stephanie	KM Specialist	Pillar 3 Projects	UofS - Martz
Morningstar, Stephanie	KM Specialist - Indigenous	Pillar 3 Projects	McMaster - Martin- Hill
Spring, Andrew	KM Specialist	Pillar 3 Projects	WLU - Munkittrick
•	•	Filial 3 Flojects	WLO - WIGHTRICK
Data Management Team		CIME	NAC Acctor
Dukacz, Krysha	Data Manager	GWF	McMaster -
Calaa Carral	Data Managan	CIAIE	Waddington
Saha, Gopal	Data Manager	GWF	WLU - Steelworthy
Zdravkovic, Branko	Data Manager	GWF	UofS - Pomeroy
TBD	Data Manager	GWF	Waterloo - Lin
Technical Team	ı		
Alistair Wallace	Manager, Smart Water Systems Laboratory	Airborne Cold Regions Observatory	UofS - Pomeroy
Kim Janzen	Research Technician	Water Isotope Ecohydrology Laboratory	UofS - McDonnell
Bruce Johnson	Research Technician	Prairies & Boreal Forest	UofS - Helgason
Nugent, Katy	Research Technician	Prairies	UofS - Baulch
Eric Courtin	Research Technician	Canadian Rockies Hydrological Observatory	UofS - Pomeroy
Greg Galloway	Research Technician	Canadian Rockies Hydrological Observatory	UofS - Pomeroy
Kiana Zolfaghari	Research Technician/ Scientist	Remote Sensing	Waterloo - Duguay
Po-Jun Huang	Research Technician	Smart Sensors	Waterloo - Liu
Bijendra Bajracharya	Research Technician	Water Quality and Aquatic Ecosystem	Waterloo - Servos
Marianne Vandergriendt	Research Technician	Smart Watershed	Waterloo - Rezanezhad
Aaron Vandenhoff	Research Technician	Smart Watershed	Waterloo - Rudolph
Tyler de Jong	Research Technician	Yukon Research Sites	McMaster - Carey
David Barrett	Research Technician	Yukon Research Sites	McMaster - Carey
lan Martin	Research Technician	Northern Boreal Plains	McMaster - Waddington
Keegan Smith	Research Technician	Ontario Observatories	McMaster - Carey
Ana Snidherhan	Research Technician	Ecosystem Resilience	WLU - Baltzer
Ryan Connon	Research Technician	Hydrometeorology	WLU - English
Ashley Rudy	Research Technician	Permafrost	WLU - Phil Marsh
Jenny Hickman	Research Technician	Water Quality	WLU - Vekiteswaran
Heather Dixon	Research Technician	Biomonitoring	WLU - Andrea Lister
- 2	3555		(for Deb MacLatchy)
Pillar 3 Project Managers and Support Staff			
Meghan Brockington	Project Manager	Northern Water Futures	WLU - Baltzer
Harriet Bigas	Project Manager	Agriculture Water Futures	Waterloo - Macrae

Jared Wolfe	Project Manager	Prairie Water	UofS - Spence/ Whitfield
Amin Haghnegahdar	Project Manager	Integrated Modelling for Prediction and Management	UofS - Razavi
Hayley Carlson	Knowledge Mobilization	Integrated Modelling for Prediction and Management	UofS - Razavi
Maria Anyusheva	Project Manager	Co-Creation of Indigenous Knowledge	McMaster - Martin- Hill
Marie Hoekstra	Project Manager	Sensor Technologies and Smart Watershed	Waterloo - Duguay
Sarah Irvine	Project Manager	Mountain Water Futures	McMaster - Carey
Tatjana Milojevic	Project Manager	Lake Water Futures	Waterloo - Basu
Rana Attalla	Project Manager	Sensors and Sensing Systems for Water Quality Monitoring	McMaster- Selvaganapathy
Katie Black	Project Manager	Boreal Water Futures	McMaster – Mike Waddington
Dhouha Ouali	Project and KM Manager	Climate-Related Precipitation Extremes	UVic – Zwiers; Manitoba – Stewart
Communications Team		,	
Kathryn Warden	Director of Research Profile & Impact	Office of Vice-President Research	UofS
Mark Ferguson	Communication Specialist	Global Water Futures	UofS
Stacey Dumanski	Outreach Coordinator	Global Water Futures	UofS
Allie Dusome	Communication Officer	Water Institute	Waterloo
Lori Dillon	Manager – Research Communication	Office of Vice-President Research	McMaster
Shawna Reibling	Knowledge Mobilization Officer	Office of Research Services	WLU
Kim Elworthy	Research Communications Officer	Office of Research Services	WLU

Appendix C – GWF Researchers, Graduate Students, and Highly Qualified Personnel by Projects

GWF Researchers by Projects (Principle Investigators)

Last, First	Professor/ Associate/ Assistant/ Adjunct	Academic Institution	
Southern Forests Water Futu	res (Arain)		
Arain, M. Altaf	Professor	McMaster University	
Boyce, Joe	Professor	McMaster University	
Chen, Jing	Professor	University of Toronto	
Khomik, Myroslava	Research Associate	University of Waterloo	
Kim, Sang-Tae	Professor	McMaster University	
Pisaric, Michael	Professor	McMaster University	
Slater, Greg	Professor	McMaster University	
Linking Water Governance in	Canada to Global Economic, Socia	al and Political Drivers (de Loe)	
de Loe, Rob	Project Leader	University of Waterloo	
Garrick, Dustin	Project Leader	Oxford University	
Old Meets New: Subsurface (Connectivity and Groundwater Pro	otection (Ferguson)	
Barbour, Lee	Professor	University of Saskatchewan	
Ferguson, Grant	Associate Professor	University of Saskatchewan	
Hendry, Jim	Professor	University of Saskatchewan	
Lindsay, Matt	Assistant Professor	University of Saskatchewan	
McDonnell, Jeff	Professor	University of Saskatchewan	
		igh-resolution mass spectrometry	
for geochemistry and healthy			
Giesy, John	Professor	University of Saskatchewan	
Hecker, Markus	Professor	University of Saskatchewan	
Jones, Paul	Associate Professor	University of Saskatchewan	
Pomeroy, John	Distinguished Professor	University of Saskatchewan	
Ice Modelling (Lamb)			
Lamb, Kevin	Professor	University of Waterloo	
Scott, Andrea	Assistant Professor	University of Waterloo	
Stastna, Marek	Professor	University of Waterloo	
Linking Stream Network Process Models to Robust Data Management Systems for the Purpose of Land-Use Decision Support (MaVicar)			
Alencar, Paulo	Research/Adjunct Professor	University of Waterloo	
Courtenay, Simon	Professor	University of Waterloo	
Cowan, Don	Distinguished Professor Emeritus	University of Waterloo	

MacVicar, Bruce	Associate Professor	University of Waterloo
Murphy, Stephen	Professor	University of Waterloo
Winter Soil Processes in Tra		Offiversity of Waterloo
Baltzer, Jennifer	Associate Professor	Wilfrid Laurier University
Basu, Nandita	Associate Professor	University of Waterloo
Hug, Laura	Assistant Professor	University of Waterloo
Macrae, Merrin	Associate Professor	University of Waterloo
McCarter, Colin	Postdoctoral Fellow	University of Waterloo &
		University of Toronto
Parsons, Chris	Research Assistant Professor	University of Waterloo
Quinton, William	Associate Professor	Wilfrid Laurier University
Rezanezhad, Fereidoun	Assistant Professor	University of Waterloo
Rudolph, Dave	Professor	University of Waterloo
Smeaton, Christina	Research Scientist	University of Waterloo
Smith, Scott	Professor	Wilfrid Laurier University
Spence, Chris	Adjunct Professor	University of Saskatchewan
Stewart, Ronald	Professor	University of Manitoba
Van Cappellen, Philippe	Professor	University of Waterloo
(Robertson)		ientists and Local Decision Makers
English, Michael	Professor	Wilfrid Laurier University
Feick, Rob	Associate Professor	University of Waterloo
Robertson, Colin	Associate Professor	Wilfrid Laurier University
	for Water Quality Monitoring (Se	
Deen, Jamal	Professor	McMaster University
DeLannoy, Charles	Assistant Professor	McMaster University
Kruse, Peter	Associate Professor	McMaster University
Liber, Karsten	Professor	University of Saskatchewan
Liu, Juewen	Professor	University of Waterloo
Martin-Hill, Dawn	Associate Professor	McMaster University
McGreer, James	Professor	Wilfrid Laurier University
Ren, Carolyn	Professor	University of Waterloo
Sekerinski, Emil	Associate Professor	McMaster University
Selvaganapathy, Ravi	Professor	McMaster University
Smith, Scott	Professor	Wilfrid Laurier University
Van Cappellen, Philippe	Professor	University of Waterloo
Wahid, Khan	Professor	University of Saskatchewan
Xu, Chang-qing	Professor	McMaster University
Linking multiple stressors to	adverse ecological responses ac	·
Craig, Paul	Professor	University of Waterloo
Parker, Wayne	Professor	University of Waterloo
Servos, Mark	Professor	University of Waterloo

ANTI- CO. A. A.				
Crowdsourcing Water Scie	nce (Strickert)			
Deters, Ralph	Professor	University of Saskatchewan		
Lambert, Simon	Associate Professor	University of Saskatchewan		
Strickert, Graham	Assistant Professor	University of Saskatchewan		
Storms and Precipitation A	Across the continental Divide Exper	riment (SPADE) (Theriault)		
Déry, Stephen	Professor	University of Northern British		
		Columbia		
Pomeroy, John	Distinguished Professor	University of Saskatchewan		
Stewart, Ronald	Professor	University of Manitoba		
Thériault, Julie	Associate Professor	Université du Québec à		
		Montréal		
SAMMS (Sub-Arctic Metal	Mobility Study) (Wolfe)			
Blais, Jules	Professor	University of Ottawa		
Couture, Raoul-Marie	Associate Professor	Laval University		
English, Michael	Professor	Wilfrid Laurier University		
Hall, Roland	Professor	University of Waterloo		
McGeer, James	Professor	Wilfrid Laurier University		
Schiff, Sherry	Professor	University of Waterloo		
Smith, Scott	Professor	Wilfrid Laurier University		
Stevens, Kevin	Associate Professor	Wilfrid Laurier University		
Venkiteswaran, Jason	Assistant Professor	Wilfrid Laurier University		
Whitfield, Colin	Assistant Professor	University of Saskatchewan		
Wolfe, Brent	Professor	Wilfrid Laurier University		
Governance Adaption (Lar	oque)			
Laroque, Colin	Professor	University of Saskatchewan		
Climate-Related Precipitat	ion Extremes (Stewart)			
Hanesiak, John	Professor	University of Manitoba		
Kelly, Mary	Professor	Wilfrid Laurier University		
Li, Yanping	Assistant Professor	University of Saskatchewan		
Stewart, Ronald	Professor	University of Manitoba		
Theriault, Julie	Associate Professor	University of Quebec at		
		Montreal		
Zwiers, Francis	Professor /Director of PCIC	Pacific Climate Impacts		
		Consortium, University of		
		Victoria (PCIC/UVIC)		
Northern Water Futures (Baltzer)				
Baltzer, Jennifer	Associate Professor	Wilfrid Laurier University		
Blay-Palmer, Alison	Associate Professor	Wilfrid Laurier University		
English, Michael	Professor	Wilfrid Laurier University		
Gray, Derek	Assistant Professor	Wilfrid Laurier University		
Hall, Roland	Professor	University of Waterloo		
Hayashi, Masaki	Professor	University of Calgary		
· · ·	<u> </u>	<u>, , , , , , , , , , , , , , , , , , , </u>		

Laird, Brian	Assistant Professor	University of Waterloo
MacLatchy, Deborah	Professor	Wilfrid Laurier University
Marsh, Phillip	Professor	Wilfrid Laurier University
McKenzie, Jeff	Associate	McGill University
Quinton, William	Associate Professor	Wilfrid Laurier University
Rudolph, Dave	Professor	University of Waterloo
Schiff, Sherry	Professor	University of Waterloo
Skinner, Kelly	Assistant Professor	University of Waterloo
Sonnentag, Oliver	Associate Professor	University of Montreal
Swanson, Heidi	Assistant Professor	University of Waterloo
Turetsky, Merritt	Associate Professor	University of Guelph
Venkiteswaran, Jason	Assistant Professor	Wilfrid Laurier University
Wolfe, Brent	Professor	Wilfrid Laurier University
Next Generation Solutions (Giesy)	
Craig, Paul	Assistant Professor	University of Waterloo
Doxey, Andrew	Assistant Professor	University of Waterloo
Giesy, John P.	Professor	University of Saskatchewan
Hecker, Markus	Professor	University of Saskatchewan
Jardine, Timothy	Assistant Professor	University of Saskatchewan
Jones, Paul D.	Associate Professor	University of Saskatchewan
Katzenback, Barb	Assistant Professor	University of Waterloo
Noble, Bram	Professor	University of Saskatchewan
Servos, Mark R.	Professor	University of Waterloo
FormBloom (Baulch)		
Baulch, Helen	Assistant Professor	University of Saskatchewan
Bharadwaj, Lalita	Assistant Professor	University of Saskatchewan
Duguay, Claude	Professor	University of Waterloo
Higgins, Scott	Adjunct Professor	University of Saskatchewan/
		University of Waterloo
Ingalls, Brian	Associate Professor	University of Waterloo
Schiff, Sherry	Professor	University of Waterloo
Venkiteswaran, Jason	Assistant Professor	Wilfrid Laurier University
Agricultural Water Futures (AWF): Stressors and Solutions (Ma	acrae)
Baulch, Helen	Assistant Professor	University of Saskatchewan
Brouwer, Roy	Professor	University of Waterloo
de Loe, Rob	Professor	University of Waterloo
Deadman, Peter	Associate Professor	University of Waterloo
Elliott, Jane	Adjunct Professor	University of Saskatchewan
Fonstad, Terry	Associate Professor	University of Saskatchewan
Gordon, Robert	Professor	Wilfrid Laurier University
Helgason, Warren	Associate Professor	University of Saskatchewan
Li, Yanping	Assistant Professor	University of Saskatchewan

Macrae, Merrin	Associate Professor	University of Waterloo
Petrone, Rich	Professor	University of Waterloo
Pomeroy, John	Distinguished Professor	University of Saskatchewan
Robinson, Derek	Associate Professor	University of Waterloo
Wandel, Johanna	Associate Professor	University of Waterloo
Boreal Water Futures (Wadd	ington)	
Barbour, Lee	Professor	University of Saskatchewan
Carey, Sean	Professor	McMaster University
Chow-Fraser, Pat	Professor	McMaster University
de Lannoy, Charles-François	Assistant Professor	McMaster University
Doubleday, Nancy	Professor	McMaster University
Flannigan, Mike	Professor	University of Alberta
Jutras, Sylvain	Assistant Professor	Laval University
McKnight, Brent	Assistant Professor	McMaster University
Petrone, Rich	Professor	University of Waterloo
Pomeroy, John	Distinguished Professor	University of Saskatchewan
Price, Jonathan	Professor	University of Waterloo
Waddington, Mike	Professor	McMaster University
Prairie Futures (Spence/Whit	field)	
Basu, Nandita	Associate Professor	University of Waterloo
Baulch, Helen	Assistant Professor	University of Saskatchewan
Bedard-Haughn, Angela	Associate Professor	University of Saskatchewan
Belcher, Ken	Associate Professor	University of Saskatchewan
Bharadwaj, Lalita	Associate Professor	University of Saskatchewan
Clark, Bob	Research Scientist	Environment and Climate
·		Change Canada
Ferguson, Grant	Associate Professor	University of Saskatchewan
Hayashi, Masaki	Professor	University of Calgary
Liber, Karsten	Professor	University of Saskatchewan
Morrissey, Christy	Associate Professor	University of Saskatchewan
Pomeroy, John	Distinguished Professor	University of Saskatchewan
Reed, Maureen	Professor	University of Saskatchewan
Shook, Kevin	Research Scientist	University of Saskatchewan
Spence, Chris	Adjunct Professor, Research	Environment and Climate
	Scientist	Change Canada
Strickert, Graham	Assistant Professor	University of Saskatchewan
Whitfield, Colin	Assistant Professor	University of Saskatchewan
	diction and Management of Char	nge in Canada's Major River Basins
(IMPC) (Razavi)		
Brouwer, Roy	Professor	Executive Director, Water
·		Institute, University of Waterloo
Coulibaly, Paulin	Professor	McMaster University

Elshorbagy, Amin	Professor	University of Saskatchewan
Gober, Patricia	Professor Emeritus	University of Saskatchewan
Gutwin, Carl	Professor	University of Saskatchewan
Jardine, Tim	Assistant Professor	University of Saskatchewan
Li, Yanping	Assistant Professor	University of Saskatchewan
Lindenschmidt, Karl-Erich	Associate Professor	University of Saskatchewan
Pietroniro, Al	Adjunct Professor	University of Saskatchewan,
,		Environment Canada Water and
		Climate Services
Pomeroy, John	Distinguished Professor	University of Saskatchewan
Razavi, Saman	Assistant Professor	University of Saskatchewan
Stadnyk, Tricia	Associate Professor	University of Manitoba
Strickert, Graham	Assistant Professor	University of Saskatchewan
Tolson, Bryan	Associate Professor	University of Waterloo
Wheater, Howard	Professor	University of Saskatchewan
		Offiversity of Saskatchewaii
Mountain Water Futures (Ca	Professor	McMastar University
Carey, Sean		McMaster University
Déry, Stephen	Professor	University of Northern British Columbia
Hayashi, Masaki	Professor	University of Calgary
McKenzie, Jeffrey	Associate Professor	McGill University
Menounos, Brian	Associate Professor	University of Northern British
		Columbia
Petrone, Richard	Professor	University of Waterloo
Pomeroy, John	Distinguished Professor	University of Saskatchewan
Rooney, Rebecca	Assistant Professor	University of Waterloo
Stewart, Ronald	Professor	University of Manitoba
Thériault, Julie	Assistant Professor	Université du Québec à
		Montréal
Westbrook, Cherie	Associate Professor	University of Saskatchewan
Zwiers, Francis	Professor	University of Victoria
Lake Futures: Enhancing Ada	ptive Capacity and Resilience of L	akes and their Watersheds (Basu)
Basu, Nandita	Associate Professor	University of Waterloo
Brouwer, Roy	Professor	University of Waterloo
Krantzberg, Gail	Professor	McMaster University
Lamb, Kevin	Professor	University of Waterloo
Servos, Mark	Professor	University of Waterloo
Van Cappellen, Philippe	Professor	University of Waterloo
	1.0.0001	
Roberts, Steven	Associate	Wilfrid Laurier University
·		Wilfrid Laurier University

Duguay, Claude	Professor	University of Waterloo
Kelly, Richard	Professor	University of Waterloo
Petrone, Richard	Professor	University of Waterloo
Pomeroy, John	Distinguished Professor	University of Saskatchewan
Ren, Carolyn	Professor	University of Waterloo
Rezanezhad, Fereidoun	Assistant Professor	University of Waterloo
Rudolph, David	Professor	University of Waterloo
Salehian, Armaghan	Associate Professor	University of Waterloo
Schiff, Sherry	Professor	University of Waterloo
Selvaganapathy, Ravi	Professor	McMaster University
Servos, Mark	Professor	University of Waterloo
Sudicky, Ed	Professor Emeritus	University of Waterloo
Indigenous Water Tools (Mar	tin-Hill)	
Chow-Fraser, Pat	Professor	McMaster University
Martin-Hill, Dawn	Associate Professor	McMaster University
Samaan, Constantine	Associate Professor	McMaster University

Highly Qualified Personnel by Projects (Undergraduates, Postdoctoral Fellows, Professional Research Associates, Research Associates, Research Scientists, Technicians, Visiting Fellows, and Others)

Last, First	Supervisor	Personnel
Southern Forests Water	Futures (Arain)	
Xu, Bing	A. Arain, McMaster	Postdoctoral Fellow
Brodeur, Jason	McMaster	Others
Nesic, Zoran	UBC	Others
Yawar, Sadia	McMaster	Others
You, Guangyong	A. Arain, McMaster	Visiting Fellows/Professors
	gerprinting Methodologies using Ultrahigh-F emistry and Healthy Waters (Jones)	Resolution Mass
Gong, Yufeng	P. Jones, UofS	Postdoctoral Fellow
Short-Duration Extreme	Precipitation in Future Climate (Li)	
Sun, Qiaohong	F. Zwiers, UVIC	Postdoctoral Fellow
Zhao, Xi	Y. Li, (UofS	Postdoctoral Fellow
Winter Soil Processes in	Transition	
Duff, Dave	F. Rezanezhad, Waterloo	Undergraduate Student
Sensors and Sensing Systems for Water Quality Monitoring (Selvaganapthy)		
Frechette, Erik	C. de Lannoy, McMaster	Undergraduate Student
Bantegui, Auristela	P. Van Cappellen, F. Rezanezhad, Waterloo	Undergraduate Student
Tan, Ricardo	E. Sekerinski, McMaster	Undergraduate Student

Zhao, Pei	C. Ren, Waterloo	Postdoctoral Fellow	
Aryasomayajula, Aditya	R. Selvaganapathy, McMaster	Others	
Attalla, Rana	R. Selvaganapathy, McMaster	Others	
Moon, Woohyun	J. Liu, Waterloo	Research Scientist	
Harder, Phillip	J. Pomeroy, UofS	Postdoctoral Fellow	
Coles, Anna	J. Baltzer, WLU	Postdoctoral Fellow	
Dusome, Allie	Waterloo	Professional Research	
Busonie, rune	Waterioo	Associates	
Hearne, Kara	Waterloo	Professional Research	
Treatme, nara	Water 100	Associates	
Hoekstra, Marie	C. Duguay, Waterloo	Professional Research	
Trocketa) Warre	or Duguay, Wateries	Associates	
Zolfaghari, Kiana	C. Duguay, Waterloo	Research Scientist	
Vandenhoff, Aaron	D. Rudolph, Waterloo	Technician	
,	rs to Adverse Ecological Responses Across V		
Burton, Erika	M. Servos, Waterloo	Undergraduate Student	
Hodgson, Rhiannon	J. Craig, Waterloo	Undergraduate Student	
Ju, Kaiying Sally	M. Servos, Waterloo	Undergraduate Student	
Maier-Downing, Colby	W. Parker, Waterloo	Undergraduate Student	
McLaren, Bill	W. Parker, Waterloo	Undergraduate Student	
Bragg, Leslie	M. Servos, Waterloo	Technician	
Hicks, Keegan	M. Servos, Waterloo	Postdoctoral Fellow	
	Across the Continental Divide Experiment		
Morris, Jeremy	S. Déry, UNBC	Undergraduate Student	
Aksamit, Nikolas	J. Pomeroy, UofS	Postdoctoral Fellow	
Almonte, Juris	R. Stewart, UofM	Research Associates	
SAMMS: Sub-Artic Meta		Research Associates	
Connon, Ryan	M. English, WLU	Professional Research	
Comion, Nyan	With English, WES	Associates	
Jasiak, Izabela	B. Wolfe, WLU	Undergraduate Student	
Leclerc, Emilie	R.M. Couture, ULaval	Undergraduate Student	
Schultz, Mackenzie	J. Venkiteswaran, WLU	Undergraduate Student	
Elgood, Richard	S. Schiff, Waterloo	Technician	
MacLean, Alex	S. Doherty, WLU	Technician	
Hickman, Jennifer	J. Venkiteswaran, WLU	Professional Research	
Thekinan, Jennie	J. Venkiteswaran, WEO	Associates	
Spring, Andrew	A. Blay-Palmer, WLU	Professional Research	
Spring, Aliai CW	, a stay i diffici, well	Associates	
Climate-Related Precipitation Extremes (Stewart)			
Veilleux, Karel	J. Thériault, UQAM	Undergraduate Student	
Ali Ben Alaya,	F. Zwiers, PCIC/UVIC	Postdoctoral Fellow	
Mohamed		1 Saturdation of Chow	
Li, Lintao	Y. Li, UofS	Postdoctoral Fellow	
LI, LIIILAO	1. 1., 0013	1 OSTAUCTOTAL 1 EILUW	

Liu, George	R. Stewart/ J. Hanesiak, UofM	Research Scientist
Northern Water Future		
Roy, Jean Roy	B. Laird, Waterloo	Undergraduate Student
Degre-Timmons,	J. Baltzer, WLU	Technician
Genevieve		
Friesen, Dirk	J. Craig, Waterloo	Technician
Coles, Anna	J. Baltzer, WLU	Postdoctoral Fellow
Day, Nicola	J. Baltzer, WLU	Postdoctoral Fellow
Dearborn, Katherine	J. Baltzer, WLU	Postdoctoral Fellow
Dieleman, Catherine	M. Turetsky, UGuelph	Postdoctoral Fellow
Haynes, Kristine	W. Quinton, WLU	Postdoctoral Fellow
Pappas, Christoforos	O.Sonnentag, J.Baltzer, WLU	Postdoctoral Fellow
Baker, Leanne	H. Swanson, Waterloo	Professional Research
		Associates
Next Generation Soluti	ons to Ensure Healthy Water Resources	for Future Generations (Giesy)
Jain, Niteesh	J. Giesy, UofS	Undergraduate Student
Lin, Shiming	J. Giesy, UofS	Undergraduate Student
Lemire, Danielle	T. Jardine, UofS	Technician
Zee, Jenna	T. Jardine, M. Hecker, UofS	Technician
Guo, Wei	J. Giesy, UofS	Postdoctoral Fellow
Marjan, Patricija	M. Servos, A Doxey, Waterloo	Postdoctoral Fellow
Saari, Gavin	J. Giesy, UofS	Postdoctoral Fellow
Xie, Yuwei	J. Giesy, UofS	Postdoctoral Fellow
FORMBLOOM (Baulch)		
Besermenji, Darja	H. Baulch, UofS	Undergraduate Student
Cornell, Thomas	S. Schiff, Waterloo	Undergraduate Student
Gruber, Bethany	R. Elgood, Waterloo	Undergraduate Student
Kobylinski, Stephanie	R. Elgood, Waterloo	Undergraduate Student
Witham, Stephanie	H. Baulch, C. Whitfield, UofS	Undergraduate Student
Elgood, Richard	S. Schiff, Waterloo	Technician
Henderson, Rachel	S. Schiff, Waterloo	Technician
Hoggarth, Cameron	H. Baulch, UofS	Technician
McQuay, Eric	R. Elgood, Waterloo	Technician
Nugent, Katy	H. Baulch, UofS	Technician
Sine, Sarah	R. Elgood, Waterloo	Technician
Larsen, Megan	J. Venkiteswaran, WLU	Postdoctoral Fellow
Salk, Kateri	S. Schiff, Waterloo	Postdoctoral Fellow
Bradford, Lori	L. Bharadwaj, UofS	Research Scientist
Zolfaghari, Kiana	C. Duguay, Waterloo	Research Scientist
Kehoe, Michael	H. Baulch, UofS	Professional Research
		Associates

Wolfe, Jared	J. Venkiteswaran, WLU	Professional Research Associates
Boreal Water Futures (Waddington	Associates
Braaten, Morgan	J. Pomeroy, UofS	Undergraduate Student
Cameron, Rebecca	R.Petrone, Waterloo	Undergraduate Student
Fairban, Dana	J.Price, Waterloo	Undergraduate Student
Stephenson, William	N. Doubleday/B. McKnight, McMaster	Undergraduate Student
Threndyle, Ryan		
Verkaik, Gregory	M.Waddington, McMaster M.Waddington, McMaster	Undergraduate Student Undergraduate Student
		Postdoctoral Fellow
Helbig, Manuel	M.Waddington, McMaster	
Khomik, Myroslava	R.Petrone, Waterloo	Postdoctoral Fellow
Newell, Sarah	N. Doubleday/B. McKnight, McMaster	Postdoctoral Fellow
Rasouli, Kabir	J. Pomeroy UofS	Postdoctoral Fellow
Richard, Dominique	J. Pomeroy UofS	Postdoctoral Fellow
Robinne, François- Nicolas	M.Flannigan, UofA	Postdoctoral Fellow
Loukili, Youssef	J. Pomeroy, UofS	Research Scientist
Whitfield, Paul	J. Pomeroy, UofS	Research Scientist
Black, Katherine	M.Waddington, McMaster	Others
Brown, Tom	J. Pomeroy UofS	Professional Research Associate
Prairie Water (Spence)		
Anderson, Erik	C. Mantyka-Pringle, R.Clark, UofS	Undergraduate Student
Hill, Brandon	M. Hayashi, UofC	Technician
Hoggarth, Cameron	H. Baulch, UofS	Technician
Witham, Stephanie	H. Baulch, C. Whitfield, UofS	Technician
Asare, Eric	K. Belcher, UofS	Postdoctoral Fellow
Malaj, Egina	C. Morrissey, UofS	Postdoctoral Fellow
Mantyka-Pringle, Chrystal	R. Clark, H. Baulch, UofS	Postdoctoral Fellow
Mekonnen, Balew	J. Pomeroy, UofS	Postdoctoral Fellow
Negm, Amro	M. Hayashi, UofC	Postdoctoral Fellow
Shook, Kevin	J. Pomeroy, UofS	Research Scientist
Bradford, Lori	L. Bharadwaj, UofS	Research Scientist
Brown, Tom	J. Pomeroy, UofS	Research Engineer
Wolfe, Jared	C. Whitfield, C. Spence, UofS	Professional Research Associates
Integrated Modelling F	Program for Canada (Razavi)	<u>'</u>
Brown, Tom	J. Pomeroy, UofS	Research Engineer
Espana, Cristian	C. Gutwin, UofS	Technician
Fang, Xing	J. Pomeroy, UofS	Research Scientist
Sotoodeh, Ehsan	C. Gutwin, UofS	Technician

Costa, Diogo	J. Pomeroy, UofS	Postdoctoral Fellow
Cuong Do , Nhu	S. Razavi, UofS	Postdoctoral Fellow
Gharari, Shervan	S. Razavi, J. Pomeroy, UofS	Postdoctoral Fellow
Li, Zhaoqin	K. Lindenschmidt, UofS	Postdoctoral Fellow
Mai, Juliane	B. Tolson, Waterloo	Postdoctoral Fellow
Morales Marin, Luis	K. Lindenschmidt, UofS	Postdoctoral Fellow
Pinto, Rute	R. Brouwer, Waterloo	Postdoctoral Fellow
Rasouli, Kabir	J. Pomeroy, UofS), M. Hayashi, UofC	Postdoctoral Fellow
Richard, Dominique	J. Pomeroy, UofS	Postdoctoral Fellow
Rokaya, Prabin	K. Lindenschmidt, UofS	Postdoctoral Fellow
Tesemma, Zelalem	J. Pomeroy, UofS	Postdoctoral Fellow
Wayand, Nicholas	J. Pomeroy, UofS	Postdoctoral Fellow
Haghnegahdar, Amin	S. Razavi, UofS	Research Scientist
Loukili, Youssef	J. Pomeroy, UofS	Research Scientist
Shook, Kevin	J. Pomeroy, UofS	Research Scientist
Whitfield, Paul	J. Pomeroy, UofS	Research Scientist
Budhathoki, Sujata	K. Lindenschmidt, UofS	Professional Research
		Associates
Carlson, Hayley	P. Gober, UofS	Professional Research
		Associates
Bahremand, Abdolreza	S. Razavi, UofS	Visiting Fellows/Professors
Luo, Siqiong	J. Pomeroy, UofS	Visiting Fellows/Professors
Slaughter, Andrew	S. Razavi, UofS	Visiting Fellows/Professors
Vionnet, Vincent	J. Pomeroy, UofS	Visiting Fellows/Professors
Mountain Water Future	s (Carey)	
Braaten, Morgan	J. Pomeroy, UofS	Undergraduate Student
Barrett, David	S. Carey, McMaster	Technician
Courtin, Eric	J. Pomeroy, UofS	Technician
de Jong, Tyler	S. Carey, McMaster	Technician
Galloway, Greg	J. Pomeroy, UofS	Technician
Khomik, Myroslava	R.Petrone, Waterloo	Postdoctoral Fellow
Mukherjee, Kriti	B.Menounos, UNBC	Postdoctoral Fellow
Rasouli, Kabir	J. Pomeroy, UofS, M. Hayashi, UofC	Postdoctoral Fellow
Richard, Dominique	J. Pomeroy, UofS	Postdoctoral Fellow
Tesemma, Zelalem	J. Pomeroy, UofS	Postdoctoral Fellow
Wayand, Nicholas	J. Pomeroy, UofS	Postdoctoral Fellow
Loukili, Youssef	J. Pomeroy, UofS	Research Scientist
Shea, Joseph	J. Pomeroy, UofS	Research Scientist
Aubry-Wake, Caroline	J. Pomeroy, UofS	Others
Reid, Kirsten	J. Pomeroy, UofS	Others
Treberg, Mike	S. Carey,McMaster	Others

Brown, Tom	J. Pomeroy, UofS	Professional Research
	- J	Associates
Fang, Xing	J. Pomeroy, UofS	Professional Research
		Associates
Ignacio Lopez Moreno,	J. Pomeroy, UofS	Visiting Fellow
Juan		
Luo, Siqiong	J. Pomeroy, UofS	Professional Research
		Associates
Ul Islam , Siraj	S.Déry, UNBC, F. Zwiers, UVic,	Professional Research
	B.Menounos, UNBC	Associates
Vionnet, Vincent	J. Pomeroy (Saskatchewan)	Professional Research
		Associates
Whitfield, Paul	J. Pomeroy (Saskatchewan)	Professional Research
		Associates
Lake Futures (Basu)		
Babaran, Dara	S. Courtenay, Armitage, Waterloo	Undergraduate Student
Dechant, Sara	N. Basu, Waterloo	Undergraduate Student
Jordan, Megan	Milojevic, Waterloo	Undergraduate Student
Miller, Linea	N. Basu, Waterloo	Undergraduate Student
Pereira Wilson,	K. Pour, Waterloo	Undergraduate Student
Matthew		
Jawed, Zobia	Krantzberg, McMaster	Postdoctoral Fellow
Liu, Haiyan	R. Brouwer, Waterloo	Postdoctoral Fellow
Pour, Homa Kheyrollah	P. Van Cappellen, Waterloo	Research Scientist
Van Meter, Kim	N. Basu, Waterloo	Research Scientist
Ives, Jessica	R. Rooney, Waterloo	Others
Bocaniov, Serghei	P. Van Cappellen, Waterloo	Professional Research
		Associates
Transformative Sensor T	echnologies and Smart Watersheds for Ca	anadian Futures (Duguay)
Galloway, Greg	J. Pomeroy, UofS	Technician
Vandenhoff†, Aaron	D. Rudolph, Waterloo	Technician
Coles, Anna	J. Baltzer, WLU	Postdoctoral Fellow
Harder, Phillip	J. Pomeroy, UofS	Postdoctoral Fellow
Huang, Xiang	D. Rudolph, Waterloo	Postdoctoral Fellow
Zolfaghari, Kiana	C. Duguay, Waterloo	Research Scientist
Dusome, Allie	Waterloo	Professional Research
		Associate
Hearne, Kara	Waterloo	Professional Research
		Associate
Hoekstra, Marie	C. Duguay, Waterloo	Professional Research
		Associate

Spring, Andrew	WLU	Professional Research		
		Associate		
AWF: Stressors and Solutions (Macrae)				
Aziz, Uswah	J. Pomeroy, UofS	Undergraduate Student		
Nugent, Katy	H. Baulch, UofS	Technician		
Costa, Diogo	J. Pomeroy, H. Wheater, UofS	Postdoctoral Fellow		
Harder, Phillip	W. Helgason, J. Pomeroy, UofS	Postdoctoral Fellow		
Liu, Haiyan	R. Brouwer, Waterloo	Postdoctoral Fellow		
Liu, Jian	H. Baulch, UofS	Postdoctoral Fellow		
Pinto, Rute	R.Brouwer, Waterloo	Postdoctoral Fellow		
Plach, Janina	M. Macrae, Waterloo	Postdoctoral Fellow		
Shook, Kevin	J. Pomeroy, UofS	Research Scientist		
Frank, Anna	R. de Loë, R. Brouwer, P. Deadman,	Professional Research		
	Waterloo	Associate		
Kompanizare, Mazda	R. Petrone, M. Macrae, Waterloo	Professional Research		
		Associate		
Roste, Jen	H. Baulch, J. Elliott; UofS and	Professional Research		
	Environment and Climate Change	Associate		
	Canada			
Bigas, Harriet	Waterloo	Visiting Fellows/Professors		
Brown, Tom	J. Pomeroy, UofS	Visiting Fellows/Professors		
Fang, Xing	J. Pomeroy, UofS	Visiting Fellows/Professors		
Prairie Drainage Govern	ance (Loring)			
Breen, Sarah-Patricia	P. Loring, H. Baulch, UofS	Postdoctoral Fellow		
UW Team				
Dhiyebi, Hadi	M. Servos, Waterloo	Technician		
Huang, Po-Jun	J.Liu, Waterloo	Technician		
Vandenhoff, Aaron	D.Rudolph, Waterloo	Technician		
Vandergriendt,	F. Rezanezhad, Waterloo	Technician		
Marianne				
Huang, Xiang	D. Rudolph, Waterloo	Postdoctoral Fellow		
Li, Hongxiu	R. Brouwer, Waterloo	Postdoctoral Fellow		
Mai, Juliane	B. Tolson, Waterloo	Postdoctoral Fellow		
McCarter, Colin	P. van Cappellen, Waterloo	Postdoctoral Fellow		
Kheyrollah Pour, Homa	P. van Cappellen, Waterloo	Research Scientist		
Zolfaghari, Kiana	C.Duguay, Waterloo	Research Scientist		
Hearne, Kara	Waterloo	Others		
Bocaniov, Serghei	P. van Cappellen, Waterloo	Professional Research Associate		

Graduate Students by Projects (Masters and Doctoral)

Last, First	Supervisor	Student
Southern Forests Water Future	es (Arain)	
Beamsderfer, Eric	A. Arain, McMaster	Doctoral Student
Bodo, Alanna	A. Arain, McMaster	Doctoral Student
Lau, Kei	J. Chen, UofT	Masters Student
Liu, Yihong	J. Chen, UofT	Masters Student
Ma, David	A. Arain, McMaster	Masters Student
McKenzie, Shawn	A. Arain, McMaster	Doctoral Student
Sauer, Stéfan	A. Arain, McMaster	Masters Student
Linking Water Governance in C	anada to Global Economic, Social and Politi	ical Drivers (de Loe)
Murphy-Mills, Erin	R. de Loë, Waterloo	Doctoral Student
Omic' and Chemical Fingerprin	ting Methodologies using Ultrahigh-Resolu	tion Mass
Spectrometry for Geochemistr	y and Healthy Waters (Jones)	
Tendler, Brett	P. Jones, Saskatchewan	Masters Student
Vien, Alex	P. Jones, Saskatchewan	Masters Student
Evaluation of Ice Models in Lar Models	ge Lakes using Three-Dimensional Coupled	Hydrodynamic-Ice
Walsh, Sarah	K. Lamb, A. Scott, M. Stastna, Waterloo	Masters Student
Grace, Andrew	K. Lamb, A. Scott, M. Stastna, Waterloo	Doctoral Student
	ss Models to Robust Data Management Sys	tems for the Purpose
of Land-Use Decision Support (
Abedin, Sayed	B. MacVicar, Waterloo	Doctoral Student
Gunsolus, Etta	B. MacVicar, Waterloo	Doctoral Student
Tavares, Christina	P. Alencar, Waterloo	Doctoral Student
Hyung, Patricia	S. Murphy , Waterloo	Doctoral Student
Turecek, Jessica	S. Murphy , Waterloo	Doctoral Student
Winter Soil Processes in Transi	tion (Rezanezhad)	
Krogstad, Konrad	F. Rezanezhad, Waterloo	Masters Student
Jensen, Grant	L. Hug, Waterloo	Masters Student
Global Water Citizenship - Integrating Networked Citizens, Scientists and Local Decision Makers		
Yee, Lauren	C. Robertson, WLU	Masters Student
	or Water Quality Monitoring (Selvaganapth	
Alam, Arif	J. Deen, McMaster	Doctoral Student
Courtney, Matt	C. Ren, Waterloo	Doctoral Student
Esther, Beatriz	K. Liber, UofS	Masters Student
Fadhel, Muntazir	E. Sekerinski,McMaster	Masters Student
Gill, Gaganprit	S. Smith, J. Mgeer, WLU	Doctoral Student
Hasan, Mohammed Rubiul	K.Wahid, UofS	Masters Student
Kneller, Joshua	C. Xu, McMaster	Masters Student

Mohammad Ali Ehsan ur	K. Wahid, UofS	Doctoral Student
Rahman, Gazi	Wallia, Cols	Doctor at Stadent
Nguyen, Anna	C. Ren Waterloo	Doctoral Student
Pan, Si	J. Deen, McMaster	Doctoral Student
Park, Spencer	E.Sekerinski,McMaster	Masters Student
Peixoto Mendes, Maíra	K. Liber, UofS	Doctoral Student
Saha, Dipankar	Dr. Peter Kruse (McMaster)	Doctoral Student
Wang, Xi	E.Sekerinski,McMaster	Masters Student
Zha, Rong	C. Xu, McMaster	Masters Student
Zhang, Nan	C. DeLannoy McMaster	Doctoral Student
Zhang, Yushan	C. Xu, McMaster	Doctoral Student
Zubiarrain, Ana	P. Kruse,McMaster	Masters Student
Linking Multiple Stressors to A	dverse Ecological Responses Across Waters	heds (Servos)
Hayat, Samina	M. Servos, Waterloo	Masters Student
Hodgson, Rhiannon	J. Craig, Waterloo	Masters Student
Jacobsen, Susanna	J. Craig, Waterloo	Masters Student
Nikel, Kirsten	M. Servos, Waterloo	Masters Student
Srikanthan, Nivetha	M. Servos, Waterloo	Masters Student
Zeeb, Elijah	W. Parker, Waterloo	Masters Student
Arlos, Maricor	M. Servos, W. Parker, Waterloo	Doctoral Student
Jamal, Soundus	W. Parker, M. Servos, Waterloo	Doctoral Student
Crowdsourcing Water Science	(Strickert)	
Azar, Maryam	G. Strickert, UofS	Masters Student
Jain, Tanvi	R. Deters, UofS	Doctoral Student
Storms and Precipitation Acro	ss the Continental Divide Experiment (SPAD	E) (Theriault)
Desroches Lapointe, Aurélie	J. Thériault, UMontreal	Masters Student
Mitchell, Selina	S. Déry, UNBC	Masters Student
Bertoncini, André	J. Pomeroy, UofS	Doctoral Student
Muñoz, Oscar Rojas	J. Thériault, UMontreal	Doctoral Student
Aksamit, Nikolas	J. Pomeroy, UofS	Doctoral Student
SAMMS: Sub-Artic Metal Mob	ility Study (Wolfe)	
Jasiak, Izabela	R. Hall, B. Wolfe, Waterloo	Masters Student
Leathers, Jeremy	J. Venkiteswaran, WLU	Masters Student
Leclerc, Emilie	R.M. Couture, ULaval	Masters Student
Schultz, Mackenzie	J. Venkiteswaran, B. Wolfe, WLU	Masters Student
Telford, James	B. Wolfe, R. Hall,WLU	Masters Student
Cheney, Cynthia	J. Blais, UOttawa	Doctoral Student
•	olicy Changes in Relation to a Changing Moi	sture Regime Across
the Southern Boreal Forest (La	roque)	
Andrews-Key, Sheri	C. Laroque, UofS	Doctoral Student
Climate-Related Precipitation	Extremes (Stewart)	
McFadden, Vanessa	J.Thériault, UMontreal	Masters Student

Tropea, Brock	R. Stewart, UofM	Masters Student
Northern Water Futures (Ball	tzer)	
Bill, Kristen	M. Turetsky, UGuelph	Masters Student
Brandow, Danielle	K. Skinner, Waterloo	Masters Student
El-Amine, Mariam	O. Sonnentag, UMontreal	Masters Student
Faber, Jelle	B. Wolfe, WLU	Masters Student
Fung, Leicester	B. Laird, Waterloo	Masters Student
Glass, Brittney	D. Rudolph, Waterloo	Masters Student
Klimpemt, Wynonan	B. Wolfe, R. Hall, WLU	Masters Student
Kok, Kaitlin	A. Blay- Palmer, WLU	Masters Student
Malandra, Michelle	A. Blay- Palmer, WLU	Masters Student
Mills, Maggie	A. Blay- Palmer, WLU	Masters Student
Neary, Laura	B. Wolfe, WLU	Masters Student
Owca, Tanner	B. Wolfe , WLU	Masters Student
Packull-McCormick, Sara	D. Rudolph, Waterloo	Masters Student
Pretty, Thomas	Derek Gray, WLU	Masters Student
Telford, James	B. Wolfe, WLU	Masters Student
Warkentin, Meagan	J. Baltzer, WLU	Masters Student
Wicke, Andrew	D. Rudolph, Waterloo	Masters Student
Yamaguchi, Ari	D. MacLatchy, WLU	Masters Student
Amiri, Erfran	J. Craig, Waterloo	Doctoral Student
Gibson, Carolyn	M. Turetsky UGuelph	Doctoral Student
Kay, Mitch	B. Wolfe, WLU	Doctoral Student
Kershaw, Geoff	W. Quinton, WLU	Doctoral Student
Perron, Nia	O. Sonnentag and J. Baltzer, WLU	Doctoral Student
Remmer, Casey	B. Wolfe, WLU	Doctoral Student
Salman, Maxime	D. Rudolph, Waterloo	Doctoral Student
Standen, Katherine	J. Baltzer, WLU	Doctoral Student
Wallace, Cory	J. Baltzer. WLU	Doctoral Student
Next Generation Solutions to	Ensure Healthy Water Resources for Futu	ure Generations (Giesy)
Ankley, Phillip	J. Giesy, UofS	Doctoral Student
DeBofsky, Abigail	J. Giesy, UofS	Doctoral Student
Giovanini, Renata	T. Jardine, B. Noble, UofS	Masters Student
Mont'Alverne B.		
Ikert, Heather	P. Craig, B. Katzenback, Waterloo	Doctoral Student
Weber, Alana	J. Giesy, UofS	Doctoral Student
FORMBLOOM (Baulch)		
Boyer, Lisa	H. Baulch, UofS	Masters Student
McAleer, Esther	H. Baulch, UofS	Masters Student
Shah, Puru	J. Venkiteswaran, WLU	Masters Student
Ramkissoon, Naveeta	L. Bradford, L. Bharadwaj, UofS	Masters Student
Chegoonian, Amir Masoud	C. Duguay, Waterloo	Doctoral Student

Carlow, Ryan M. Macrae, Waterloo Masters Student Grant, Kirsten M. Macrae, Waterloo Masters Student Higgins, Stephanie M. Macrae, Waterloo Masters Student Marshall, Meredith M. Macrae, Waterloo Masters Student Price, Dylan M. Macrae, Waterloo Masters Student Price, Dylan M. Macrae, Waterloo Masters Student Mirnasl P. Deadman, Waterloo Masters Student Mirnasl Guo, Liuyi (Zoe) P. Deadman, Waterloo Masters Student Eicher-Sodo, Mitchell R. Gordon, Waterloo Masters Student De Haan, Kevin R. Petrone, Waterloo Masters Student Annand, Holly J. Pomeroy and H. Wheater, UofS Doctoral Student Vivekanthan, Kokulan M. Macrae, Waterloo Doctoral Student Revilla , Fabiola Alvarado R. de Loë, Waterloo Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Kurkute, Sopan Y. Li, UofS Doctoral Student Kurkute, Sopan Y. Li, UofS Doctoral Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy, McMaster Masters Student Deane, Patrick M. Waddington, McMaster Masters Student Peane, Patrick R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Mast	Brockman, Keenan	J. Pomeroy, UofS	Masters Student
Grant, Kirsten M. Macrae, Waterloo Masters Student Higgins, Stephanie M. Macrae, Waterloo Masters Student Marshall, Meredith M. Macrae, Waterloo Masters Student Price, Dylan M. Macrae, Waterloo Masters Student Bonab, Sayedeh Nayyer P. Deadman, Waterloo Masters Student Mirnasl Macrae, Waterloo Masters Student Masters Student R. Gordon, Waterloo Masters Student De Haan, Kevin R. Petrone, Waterloo Masters Student De Haan, Kevin R. Petrone, Waterloo Masters Student Annand, Holly J. Pomeroy and H. Wheater, UofS Doctoral Student Vivekanthan, Kokulan M. Macrae, Waterloo Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Agyeman, Richard Y. Li, UofS Doctoral Student Kurkute, Sopan Y. Li, UofS Doctoral Student Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy, McMaster Masters Student Deane, Patrick M. Waddington, McMaster Masters Student Deane, Patrick M. Waddington, McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Pabra, Jorge N. Doubleday, B. McKnight, McMaster Doctoral Student Nu, Yichen C. de Lannoy, McMaster Doctoral Student Nu, Yichen C. de Lannoy, McMaster Doctoral Student Nu, Yichen C. Dectoral Student Prentice, Student N. Doubleday, B. McKnight, McMaster Doctoral Student Nu, Yichen C. Chow-Fraser, McMaster Doctoral Student Nu, Yichen P. Chow-Fraser, McMaster Doctoral Student Mikinson, Sophie M. Waddington, McMaster Doctoral Student Mikinson, Sophie M. Waddington, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Popovic			
Higgins, Stephanie M. Macrae, Waterloo Masters Student Marshall, Meredith M. Macrae, Waterloo Masters Student Price, Dylan M. Macrae, Waterloo Masters Student Bonab, Sayedeh Nayyer P. Deadman, Waterloo Masters Student Mirnasl Guo, Liuyi (Zoe) P. Deadman, Waterloo Masters Student Eicher-Sodo, Mitchell R. Gordon, Waterloo Masters Student De Haan, Kevin R. Petrone, Waterloo Masters Student Ober Haan, Kevin R. Petrone, Waterloo Masters Student Ober Haan, Kevin M. Macrae, Waterloo Masters Student Ober Haan, Kevin M. Macrae, Waterloo Doctoral Student Ober Masters Ober Master Ober Masters Ober Master Ober Mas			Masters Student
Marshall, Meredith M. Macrae, Waterloo Masters Student Price, Dylan M. Macrae, Waterloo Masters Student Bonab, Sayedeh Nayyer P. Deadman, Waterloo Masters Student Eicher-Sodo, Mitchell R. Gordon, Waterloo Masters Student De Haan, Kevin R. Petrone, Waterloo Masters Student Vivekanthan, Kokulan M. Macrae, Waterloo Doctoral Student Vivekanthan, Kokulan M. Macrae, Waterloo Doctoral Student Vivekanthan, Kokulan M. Macrae, Waterloo Doctoral Student Revilla , Fabiola Alvarado R. de Loë, Waterloo Doctoral Student Al-Bahouh, Mariam R. Gordon, WLU Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Kurkute, Sopan Y. Li, UofS Doctoral Student Workanthan, Kokulan Y. Li, UofS Doctoral Student Mayeman, Richard Y. Li, WofS Doctoral Student Mayeman, Richard Y. Li, WofS Doctoral Student Mayeman, Richard Y. Li, WofS Doctoral Student Deane, Patrick M. Waddington, McMaster Masters Student Deane, Patrick M. Waddington, McMaster Masters Student Deane, Patrick M. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Wu, Yichen R. Petrone, Waterloo Masters Student Wu, Sichen R. Petrone, Waterloo Doctoral Student Deard, Jorge N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Deards, Jorge N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Deptice, Waterloo Doctoral Student Newell, Sarah R. Petrone, Waterloo Doctoral Student Doptoral Student Propovic, Natasa R. Petrone, Waterloo Doctoral Student Doptoral Student Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Doptoral Student Popovic, Natasa R. Petrone, Water			Masters Student
Price, Dylan M. Macrae, Waterloo Masters Student Bonab, Sayedeh Nayyer P. Deadman, Waterloo Masters Student Mirnasl Guo, Liuyi (Zoe) P. Deadman, Waterloo Masters Student Eicher-Sodo, Mitchell R. Gordon, Waterloo Masters Student De Haan, Kevin R. Petrone, Waterloo Masters Student De Haan, Kevin R. Petrone, Waterloo Masters Student Annand, Holly J. Pomeroy and H. Wheater, UofS Doctoral Student Vivekanthan, Kokulan M. Macrae, Waterloo Doctoral Student Quo, Lijie W. HelgasonUofS Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Al-Bahouh, Mariam R. Gordon, WLU Doctoral Student Al-Bahouh, Mariam R. Gordon, WLU Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Al-Bahouh, Mariam R. Gordon, WLU Doctoral Student Rurkute, Sopan Y. Li, UofS Doctoral Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy, McMaster Doctoral Student Deane, Patrick M. Waddington, McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Van Beest, Christine R. Petrone, Waterloo Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Macaccio, James P. Chow-Fraser, McMaster Doctoral Student Macaccio, James P. Chow-Fraser, McMaster Doctoral Student Propovic, Natasa R. Petrone, Wate			Masters Student
P. Deadman, Waterloo Masters Student	·		Masters Student
Mirnasl Guo, Liuyi (Zoe) P. Deadman, Waterloo Masters Student Eicher-Sodo, Mitchell R. Gordon, Waterloo Masters Student De Haan, Kevin R. Petrone, Waterloo Masters Student De Haan, Kevin R. Petrone, Waterloo Masters Student Vivekanthan, Kokulan M. Macrae, Waterloo Doctoral Student Revilla , Fabiola Alvarado R. de Loë, Waterloo Doctoral Student Revilla , Fabiola Alvarado R. de Loë, Waterloo Doctoral Student Revilla , Fabiola Alvarado R. de Loë, Waterloo Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Al-Bahouh, Mariam R. Gordon, WLU Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Agyeman, Richard Y. Li, UofS Doctoral Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy, McMaster Deane, Patrick M. Waddington, McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Balliston, Nicole J. Price, Waterloo Masters Student Balliston, Nicole J. Price, Waterloo Doctoral Student Mwewell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Mikinson, Sophie M. Waddington, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Propovic, Natasa R. Petrone, Waterloo Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student			Masters Student
Eicher-Sodo, Mitchell R. Gordon, Waterloo Masters Student De Haan, Kevin R. Petrone, Waterloo Masters Student Annand, Holly J. Pomeroy and H. Wheater, UofS Doctoral Student Vivekanthan, Kokulan M. Macrae, Waterloo Doctoral Student Revilla , Fabiola Alvarado R. de Loë, Waterloo Doctoral Student Al-Bahouh, Mariam R. Gordon, WLU Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Al-Bahouh, Mariam R. Gordon, WLU Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Kurkute, Sopan Y. Li, UofS Doctoral Student Murkute, Sopan Y. Li, UofS Doctoral Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy, McMaster Masters Student Deane, Patrick M. Waddington, McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Fetah, Sarah R. Petrone, Waterloo Masters Student Fetah, Sarah R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Van Beest, Christine R. Petrone, Waterloo Masters Student Van Beest, Christine R. Petrone, Waterloo Masters Student Fabra, Jorge N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Uymes, Nick P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctora	Mirnasl	,	
De Haan, Kevin R. Petrone, Waterloo Masters Student Annand, Holly J. Pomeroy and H. Wheater, UofS Doctoral Student Vivekanthan, Kokulan M. Macrae, Waterloo Doctoral Student Revilla , Fabiola Alvarado R. de Loë, Waterloo Doctoral Student Al-Bahouh, Mariam R. Gordon, WLU Doctoral Student Agyeman, Richard Y. Li, UofS Doctoral Student Kurkute, Sopan Y. Li, UofS Doctoral Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy, McMaster Masters Student Deane, Patrick M. Waddington, McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Fetah, Sarah R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student van Beest, Christine R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Fabra, Jorge N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Balliston, Nicole J. Price, Waterloo Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Milkinson, Sophie M. Waddington, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Newell, Sarah P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James R. Petrone, Waterloo Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student McMarcaccio, James P. Chow-Fraser, McMaster Doctoral Student McMarcaccio, J	Guo, Liuyi (Zoe)	P. Deadman, Waterloo	Masters Student
Annand, Holly J. Pomeroy and H. Wheater, UofS Doctoral Student N. Macrae, Waterloo R. de Loë, Waterloo Doctoral Student R. Gerdon, WLU Doctoral Student Bouchi, Mariam R. Gordon, WLU Doctoral Student Bouchijie W. HelgasonUofS Doctoral Student Masters Student Masters Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy, McMaster Deane, Patrick M. Waddington, McMaster Masters Student Masters Student Remeron, Rebecca R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Van Beest, Christine R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Wu, Sarah R. Petrone, Waterloo Masters Student Van Beest, Christine R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Pootoral Student Pootoral Student Pootoral Student Pootoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Pootoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Pootoral Stud	Eicher-Sodo, Mitchell	R. Gordon, Waterloo	Masters Student
Vivekanthan, Kokulan Revilla , Fabiola Alvarado R. de Loë, Waterloo Doctoral Student Revilla , Fabiola Alvarado R. de Loë, Waterloo Doctoral Student R. Gordon, WLU Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Algyeman, Richard Y. Li, UofS Doctoral Student Kurkute, Sopan V. Li, UofS Doctoral Student Kurkute, Sopan Ruiz Caldas, Maria C. de Lannoy,McMaster Masters Student Deane, Patrick M. Waddington,McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Fetah, Sarah R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy,McMaster Doctoral Student Fabra, Jorge N. Doubleday, B. McKnight,McMaster Doctoral Student Balliston, Nicole J. Price, Waterloo Doctoral Student Wikinson, Sophie M. Waddington,McMaster Doctoral Student Wuymes, Nick P. Chow-Fraser,McMaster Doctoral Student Marcaccio, James P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Rrandon R. Petrone, Waterloo Doctoral Student Rupasinghe, Randon R.	De Haan, Kevin	R. Petrone, Waterloo	Masters Student
Revilla , Fabiola Alvarado R. de Loë, Waterloo Doctoral Student Al-Bahouh, Mariam R. Gordon, WLU Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Agyeman, Richard Y. Li, UofS Doctoral Student Kurkute, Sopan Y. Li, UofS Doctoral Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy,McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Van Beest, Christine R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy,McMaster Doctoral Student Wu, Yichen C. de Lannoy,McMaster Doctoral Student Pabra, Jorge N. Doubleday, B. McKnight,McMaster Doctoral Student Balliston, Nicole J. Price, Waterloo Doctoral Student Wikinson, Sophie M. Waddington,McMaster Doctoral Student Warcaccio, James P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Masters Materloo Doctoral Student Rupasinghe, Masters Materloo Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS	Annand, Holly	J. Pomeroy and H. Wheater, UofS	Doctoral Student
Revilla , Fabiola Alvarado R. de Loë, Waterloo Doctoral Student Al-Bahouh, Mariam R. Gordon, WLU Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Agyeman, Richard Y. Li, UofS Doctoral Student Kurkute, Sopan Y. Li, UofS Doctoral Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy,McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Van Beest, Christine R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy,McMaster Doctoral Student Wu, Yichen C. de Lannoy,McMaster Doctoral Student Pabra, Jorge N. Doubleday, B. McKnight,McMaster Doctoral Student Balliston, Nicole J. Price, Waterloo Doctoral Student Wikinson, Sophie M. Waddington,McMaster Doctoral Student Warcaccio, James P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Masters Materloo Doctoral Student Rupasinghe, Masters Materloo Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS	Vivekanthan, Kokulan	M. Macrae, Waterloo	Doctoral Student
Al-Bahouh, Mariam R. Gordon, WLU Doctoral Student Guo, Lijie W. HelgasonUofS Doctoral Student Agyeman, Richard Y. Li, UofS Doctoral Student Kurkute, Sopan Y. Li, UofS Doctoral Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy, McMaster Masters Student Deane, Patrick M. Waddington, McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Fetah, Sarah R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Van Beest, Christine R. Petrone, Waterloo Masters Student Van, Yichen C. de Lannoy, McMaster Doctoral Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Fabra, Jorge N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James R. Petrone, Waterloo Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James R. Petrone, Waterloo Doctoral Student Popovic, Natasa C. Whitfield, A. Bedard-Haughn, UofS Masters Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, H. Baulch, UofS			
Guo, Lijie W. HelgasonUofS Doctoral Student Agyeman, Richard Y. Li, UofS Doctoral Student Kurkute, Sopan Y. Li, UofS Doctoral Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy,McMaster Masters Student Deane, Patrick M. Waddington,McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Fetah, Sarah R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student van Beest, Christine R. Petrone, Waterloo Masters Student van Beest, Christine R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy,McMaster Doctoral Student Fabra, Jorge N. Doubleday, B. McKnight,McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight,McMaster Doctoral Student Wilkinson, Nicole J. Price, Waterloo Doctoral Student Wilkinson, Sophie M. Waddington,McMaster Doctoral Student Uuymes, Nick P. Chow-Fraser,McMaster Doctoral Student Marcaccio, James P. Chow-Fraser,McMaster Doctoral Student Marcaccio, James P. Chow-Fraser,McMaster Doctoral Student Popovic, Natasa P. P. Chow-Fraser,McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS			
Agyeman, Richard Y. Li, UofS Doctoral Student Kurkute, Sopan Y. Li, UofS Doctoral Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy, McMaster Masters Student Deane, Patrick M. Waddington, McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Pretah, Sarah R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Wu, Yichen R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Fabra, Jorge N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS	,		Doctoral Student
Kurkute, Sopan Y. Li, UofS Doctoral Student Boreal Water Futures (Waddington) Ruiz Caldas, Maria C. de Lannoy, McMaster Masters Student Deane, Patrick M. Waddington, McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Fetah, Sarah R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Van Beest, Christine R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Fabra, Jorge N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Balliston, Nicole J. Price, Waterloo Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Luymes, Nick P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student			Doctoral Student
Ruiz Caldas, Maria C. de Lannoy,McMaster Masters Student Deane, Patrick M. Waddington,McMaster Masters Student Cameron, Rebecca R. Petrone, Waterloo Masters Student Fetah, Sarah R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student van Beest, Christine R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy,McMaster Doctoral Student Fabra, Jorge N. Doubleday, B. McKnight,McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight,McMaster Doctoral Student Balliston, Nicole J. Price, Waterloo Doctoral Student Wilkinson, Sophie M. Waddington,McMaster Doctoral Student Luymes, Nick P. Chow-Fraser,McMaster Doctoral Student Marcaccio, James P. Chow-Fraser,McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser,McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Paulice, Masters Student Paulice, Amy C. Whitfield, H. Baulch, UofS Masters Student			Doctoral Student
Ruiz Caldas, Maria C. de Lannoy, McMaster Masters Student Meane, Patrick M. Waddington, McMaster R. Petrone, Waterloo Masters Student Fetah, Sarah R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Van Beest, Christine N. Doubleday, B. McKnight, McMaster Doctoral Student N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Wilkinson, Nicole J. Price, Waterloo Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Doctoral Student P. Chow-Fraser, McMaster Doctoral Student Popovic, James R. Petrone, Waterloo Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Pairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	,	·	
Deane, Patrick M. Waddington, McMaster R. Petrone, Waterloo Masters Student Fetah, Sarah R. Petrone, Waterloo Masters Student Prentice, Tyler R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Fabra, Jorge N. Doubleday, B. McKnight, McMaster Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Wilkinson, Nicole J. Price, Waterloo Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Luymes, Nick P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Paudoin-Galaise, Maxime S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	•		Masters Student
Cameron, RebeccaR. Petrone, WaterlooMasters StudentFetah, SarahR. Petrone, WaterlooMasters StudentPrentice, TylerR. Petrone, WaterlooMasters StudentTyler, KarisaR. Petrone, WaterlooMasters Studentvan Beest, ChristineR. Petrone, WaterlooMasters StudentWu, YichenC. de Lannoy, McMasterDoctoral StudentFabra, JorgeN. Doubleday, B. McKnight, McMasterDoctoral StudentNewell, SarahN. Doubleday, B. McKnight, McMasterDoctoral StudentBalliston, NicoleJ. Price, WaterlooDoctoral StudentWilkinson, SophieM. Waddington, McMasterDoctoral StudentLuymes, NickP. Chow-Fraser, McMasterDoctoral StudentMarcaccio, JamesP. Chow-Fraser, McMasterDoctoral StudentRupasinghe, PrabhaP. Chow-Fraser, McMasterDoctoral StudentPopovic, NatasaR. Petrone, WaterlooDoctoral StudentVan Huizen, BrandonR. Petrone, WaterlooDoctoral StudentBeaudoin-Galaise, MaximeS. Jutras, ULavalDoctoral StudentPrairie Water (Spence)McFarlan, LauraC. Whitfield, A. Bedard-Haughn, UofSMasters StudentHergott, AmyC. Whitfield, H. Baulch, UofSMasters Student	•	-	Masters Student
Prentice, Tyler R. Petrone, Waterloo Masters Student Tyler, Karisa R. Petrone, Waterloo Masters Student van Beest, Christine R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Fabra, Jorge N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Balliston, Nicole J. Price, Waterloo Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Luymes, Nick P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Beaudoin-Galaise, Maxime S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student			Masters Student
Tyler, Karisa R. Petrone, Waterloo Masters Student van Beest, Christine R. Petrone, Waterloo Masters Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student Fabra, Jorge N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Balliston, Nicole J. Price, Waterloo Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Luymes, Nick P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Beaudoin-Galaise, Maxime S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	Fetah, Sarah	R. Petrone, Waterloo	Masters Student
van Beest, Christine R. Petrone, Waterloo Doctoral Student Wu, Yichen C. de Lannoy, McMaster Doctoral Student N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Balliston, Nicole J. Price, Waterloo Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Luymes, Nick P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Beaudoin-Galaise, Maxime S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS	Prentice, Tyler	R. Petrone, Waterloo	Masters Student
Wu, YichenC. de Lannoy,McMasterDoctoral StudentFabra, JorgeN. Doubleday, B. McKnight,McMasterDoctoral StudentNewell, SarahN. Doubleday, B. McKnight,McMasterDoctoral StudentBalliston, NicoleJ. Price, WaterlooDoctoral StudentWilkinson, SophieM. Waddington,McMasterDoctoral StudentLuymes, NickP. Chow-Fraser,McMasterDoctoral StudentMarcaccio, JamesP. Chow-Fraser,McMasterDoctoral StudentRupasinghe, PrabhaP. Chow-Fraser,McMasterDoctoral StudentPopovic, NatasaR. Petrone, WaterlooDoctoral StudentVan Huizen, BrandonR. Petrone, WaterlooDoctoral StudentBeaudoin-Galaise, MaximeS. Jutras, ULavalDoctoral StudentPrairie Water (Spence)McFarlan, LauraC. Whitfield, A. Bedard-Haughn, UofSMasters StudentHergott, AmyC. Whitfield, H. Baulch, UofSMasters Student	Tyler, Karisa	R. Petrone, Waterloo	Masters Student
Fabra, Jorge N. Doubleday, B. McKnight, McMaster Doctoral Student Newell, Sarah N. Doubleday, B. McKnight, McMaster Doctoral Student Balliston, Nicole J. Price, Waterloo Doctoral Student Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Luymes, Nick P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Beaudoin-Galaise, Maxime S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	van Beest, Christine	R. Petrone, Waterloo	Masters Student
Newell, SarahN. Doubleday, B. McKnight, McMasterDoctoral StudentBalliston, NicoleJ. Price, WaterlooDoctoral StudentWilkinson, SophieM. Waddington, McMasterDoctoral StudentLuymes, NickP. Chow-Fraser, McMasterDoctoral StudentMarcaccio, JamesP. Chow-Fraser, McMasterDoctoral StudentRupasinghe, PrabhaP. Chow-Fraser, McMasterDoctoral StudentPopovic, NatasaR. Petrone, WaterlooDoctoral StudentVan Huizen, BrandonR. Petrone, WaterlooDoctoral StudentBeaudoin-Galaise, MaximeS. Jutras, ULavalDoctoral StudentPrairie Water (Spence)McFarlan, LauraC. Whitfield, A. Bedard-Haughn, UofSMasters StudentHergott, AmyC. Whitfield, H. Baulch, UofSMasters Student	Wu, Yichen	C. de Lannoy, McMaster	Doctoral Student
Balliston, Nicole J. Price, Waterloo Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Luymes, Nick P. Chow-Fraser, McMaster Doctoral Student P. Chow-Fraser, McMaster Doctoral Student P. Chow-Fraser, McMaster Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	Fabra, Jorge	N. Doubleday, B. McKnight, McMaster	Doctoral Student
Wilkinson, Sophie M. Waddington, McMaster Doctoral Student Luymes, Nick P. Chow-Fraser, McMaster Doctoral Student Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Beaudoin-Galaise, Maxime S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	Newell, Sarah	N. Doubleday, B. McKnight, McMaster	Doctoral Student
Luymes, Nick P. Chow-Fraser, McMaster Doctoral Student P. Chow-Fraser, McMaster Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Beaudoin-Galaise, Maxime S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	Balliston, Nicole	J. Price, Waterloo	Doctoral Student
Marcaccio, James P. Chow-Fraser, McMaster Doctoral Student Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Beaudoin-Galaise, Maxime S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	Wilkinson, Sophie	M. Waddington, McMaster	Doctoral Student
Rupasinghe, Prabha P. Chow-Fraser, McMaster Doctoral Student Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Beaudoin-Galaise, Maxime S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	Luymes, Nick	P. Chow-Fraser,McMaster	Doctoral Student
Popovic, Natasa R. Petrone, Waterloo Doctoral Student Van Huizen, Brandon R. Petrone, Waterloo Doctoral Student Beaudoin-Galaise, Maxime S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	Marcaccio, James	P. Chow-Fraser,McMaster	Doctoral Student
Van Huizen, BrandonR. Petrone, WaterlooDoctoral StudentBeaudoin-Galaise, MaximeS. Jutras, ULavalDoctoral StudentPrairie Water (Spence)McFarlan, LauraC. Whitfield, A. Bedard-Haughn, UofSMasters StudentHergott, AmyC. Whitfield, H. Baulch, UofSMasters Student	Rupasinghe, Prabha	P. Chow-Fraser,McMaster	Doctoral Student
Beaudoin-Galaise, Maxime S. Jutras, ULaval Doctoral Student Prairie Water (Spence) McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	Popovic, Natasa	R. Petrone, Waterloo	Doctoral Student
Prairie Water (Spence)McFarlan, LauraC. Whitfield, A. Bedard-Haughn, UofSMasters StudentHergott, AmyC. Whitfield, H. Baulch, UofSMasters Student	Van Huizen, Brandon	R. Petrone, Waterloo	Doctoral Student
McFarlan, Laura C. Whitfield, A. Bedard-Haughn, UofS Masters Student Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	Beaudoin-Galaise, Maxime	S. Jutras, ULaval	Doctoral Student
Hergott, Amy C. Whitfield, H. Baulch, UofS Masters Student	Prairie Water (Spence)		
	McFarlan, Laura	C. Whitfield, A. Bedard-Haughn, UofS	Masters Student
Duffy, Ashleigh G. Strickert, UofS Masters Student	Hergott, Amy	C. Whitfield, H. Baulch, UofS	Masters Student
	Duffy, Ashleigh	G. Strickert, UofS	Masters Student

Thapa, Anuja	G. Strickert, UofS	Masters Student
Annand, Holly	J. Pomeroy, H. Wheater, UofS	Doctoral Student
Mora Garces, Maria	L. Bharadwaj, G. Strickert, UofS	Doctoral Student
Integrated Modelling Program	for Canada (Razavi)	
Beiraghdar, Parya	Asadzadeh, T. Stadnyk, UofM	Masters Student
Jin Kim , Su	Asadzadeh, T. Stadnyk, UofM	Masters Student
Keshavarz, Kasra	S.Razavi,UofS	Masters Student
Mustakim Ali Shah, Syed	S.Razavi, H.Wheater, UofS	Masters Student
Robichaud, Hailey	J. Pomeroy, W. Helgason, UofS	Masters Student
Aubry-Wake, Caroline	J. Pomeroy (Saskatchewan)	Doctoral Student
Bajracharya, Ajay	J. Pomeroy (Saskatchewan)	Doctoral Student
Bertonicini, André	J. Pomeroy (Saskatchewan)	Doctoral Student
Das, Apruba	J. Pomeroy (Saskatchewan)	Doctoral Student
Eamen, Leila	S. Razavi, UofS), R. Brouwer, Waterloo	Doctoral Student
Gardounzadeh, Farzaneh	K. Lindenschmidt, UofS	Doctoral Student
Ghoreishi, Seyedmohammad	S. Razavi, A. Elshorbagy, UofS	Doctoral Student
Holmes, Tegan	T. Stadnyk, UofM	Doctoral Student
Islam, Amin	C. Gutwin, UofS	Doctoral Student
Krogh, Sebastian	J. Pomeroy, UofS	Doctoral Student
Leroux, Nicolas	J. Pomeroy, UofS	Doctoral Student
Lv, Zhibang	J. Pomeroy, UofS	Doctoral Student
Marsh, Chris	J. Pomeroy and H. Wheater, UofS	Doctoral Student
Pradhananga, Dhiraj	J. Pomeroy, UofS	Doctoral Student
Scaff, Lucia	Y. Li, UofS	Doctoral Student
Sheikholeslami, Razi	S. Razavi, UofS	Doctoral Student
Shen, Hongren	B. Tolson, Waterloo	Doctoral Student
Zaghloul, Mohanad	A. Elshorbagy, UofS	Doctoral Student
Zhang, Zhe	Y. Li, UofS	Doctoral Student
Mountain Water Futures (Care	y)	
Almonte, Juris	R.Stewart, UofM	Masters Student
Beamish, Laura	M.Hayashi, UofC	Masters Student
He, Jesse	M.Hayashi, UofC	Masters Student
Hoenmans, Greg	J.Pomeroy, UofS	Masters Student
Hrach, Dylan	R.Petrone, Waterloo	Masters Student
Langs, Lindsey	R.Petrone, Waterloo	Masters Student
Leipe, Sean	S., McMaster	Masters Student
Lyon, Laura	J. McKenzie, McGill	Masters Student
Mercer, Jason	C.Westbrook, UofS	Masters Student
Reynolds, Jordan	R.Rooney, Waterloo	Masters Student
Robichaud, Hailey	J.Pomeroy, UofS	Masters Student
Roesky, Ben	M.Hayashi, UofC	Masters Student

Ronnquist, Amanda	C. Westbrook, UofS	Masters Student	
Williamson, Jessica	R.Petrone, Waterloo	Masters Student	
Aksamit, Nikolas	J. Pomeroy, UofS	Doctoral Student	
Aubry-Wake, Caroline	J. Pomeroy, UofS	Doctoral Student	
Bertonicini, André	J. Pomeroy, UofS	Doctoral Student	
Lei, Calvin	Rebecca Rooney	Doctoral Student	
Leroux, Nicolas	J. Pomeroy, UofS	Doctoral Student	
Lv, Zhibang	J. Pomeroy, UofS	Doctoral Student	
Marsh, Chris	J. Pomeroy, UofS	Doctoral Student	
Nicholls, Erin	S. Carey, McMaster	Doctoral Student	
Pradhanaga, Dhiraj	J. Pomeroy, UofS	Doctoral Student	
Sanchez Garces, Mariá	C.Westbrook, UofS	Doctoral Student	
Sharma, Aseem	S.Déry, UNBC	Doctoral Student	
Shatilla, Nadine	S. Carey, McMaster	Doctoral Student	
Tang, Weigang	S. Carey, McMaster	Doctoral Student	
Tchuem, Obert	J.Thériault, UQAM	Doctoral Student	
Tennant, Christina	B. Menounos, UNBC	Doctoral Student	
Lake Futures (Basu)			
Chowdhury, Qualbe	N. Basu, Waterloo	Masters Student	
Shadman			
Dony, John	N. Basu, Waterloo	Masters Student	
Quinn-Austin, Hillary	M. Servos, Rooney, Waterloo	Masters Student	
Samson, Melani-Ivy	N. Basu, Waterloo	Masters Student	
Vien, Alex	P. Jones, UofS	Masters Student	
Han, Ming	B. Tolson, Waterloo	Doctoral Student	
Ho, Elaine	S. Courtenay, Trant, Waterloo	Doctoral Student	
Markelov, Igor	P. Van CappellenWaterloo	Doctoral Student	
Yang, Xinyuan (Wilson)	Insley, Waterloo	Doctoral Student	
Transformative Sensor Techno	logies and Smart Watersheds for Canadian	Futures (Duguay)	
Glass, Brittney	D. Rudolph, Waterloo	Masters Student	
Wicke, Andrew	D. Rudolph, Waterloo	Masters Student	
Ju, Joey	D. Rudolph, Waterloo	Doctoral Student	
Lv, Zhibang	J. Pomeroy, UofS	Doctoral Student	
Pardo, Renato	A. Berg, UGuelph	Doctoral Student	
Salman, Max	D. Rudolph, Waterloo	Doctoral Student	
Co-Creation of Indigenous Water Quality Tools (Martin-Hill)			
Sims, E. Danielle	R. Samaan, McMaster	Masters Student	
Tedeschi, Alana	P. Chow-Fraser, McMaster	Masters Student	

Appendix D – Leadership in International Research programs and Professional Societies

Number of international research programs and committee where GWF members are lead investigators and/or advisors are presented in "Italics"

Baltzer, Jennifer

- Plot PI, Smithsonian Institute's ForestGEO Program.
- Review Editor, Forest Ecophysiology, Frontiers in Forests and Global Change.
- Member, NASA ABoVe Wildfire Working Group
- Institutional Representative, Canadian Society for Ecology and Evolution.
- Associate Editor for Functional Ecology

Blay-Palmer, Alison

- Director, Viessmann European Research Centre.
- Scientific Advisor, United Nations, Food and Agriculture Organization.

Bocaniov, AS.

- Involved in international Multi-Lake Comparison Project (MLCP; Phase 1: Physics) to compare results and knowledge from numerical models of 32 lakes.
- Involved in Global Lake Ecological Observatory Network -Inter-Sectoral Impact Model Inter-comparison Project (GLEON-ISIMIP) working group (The aim of GLEON-ISIMIP is to better understand climate impacts across sectors using a multi-impact model framework. The second phase of this international effort (ISIMIP2b) is designed to provide robust information about the impacts of 1.5°C and 2°C global warming, as solicited by the IPCC's special report on this topic. ISIMIP provides consistently processed GCM forcing for various impact models, including lake models. The focus of the first round of lake sector simulations will be to evaluate the effects of projected climate change on lake thermal stratification at local to global scales.

Carey, Sean

Associate Editor, Hydrological Processes.

Craig, James

- Vice-president, Canadian Society for Hydrologic Sciences.
- Board Member, Canadian Water Resources Association.
- Chair, External Advisory Board, Canadian Hydrology Features (ChyF) initiative (NRCan/USGS).
- Associate Editor, Groundwater.

Coulibaly, Paulin

Associate Editor, ASE Journal of Hydrologic Engineering.

Duguay, Claude

• Editor, The Cryosphere (a journal of the European Geoscience Union).

Ferguson, Grant

 Chair, International Associations of Hydrogeologists – Groundwater and Energy Commission.

Giesy, John

Fellow of Royal Society of Canada

Haghnegahdar, Amin

- Associate Editor, Water Resources Research.
- Co-convener, Session of Diagnostics, Sensitivity, and Uncertainty Analysis of Earth and Environmental Models, 2017 CGU Annual Meeting.
- Primary Convener, Session on insights into Environmental/Hydrological Models Using Sensitivity and Uncertainty Analysis and Information Theory, 2017 CGU Annual Meeting.
- Founding Chair, Large Scale Watershed Modelling and Analysis committee, Canadian Geophysical Union-Hydrology.

Hecker, Markus

- Chair, "Healthy Society and Environment" group of the College of the Royal Society of Canada.
- Board Member, Society of Environmental Toxicology & Chemistry North America.
- Editor, Environmental Science and Pollution Research; Editor of Environmental Sciences Europe.

Helgason, Warren

• Member, Local Organizing Committee, 2018 International Conference and 69th International Executive Committee meeting of the International Commission on Irrigation and Drainage (ICID), Saskatoon, SK Aug 12-17, 2018.

Li, Yanping

- Committee Member, Canadian Meteorological and Oceanographic Society (CMOS), Saskatchewan section
- Representative of University of Saskatchewan for UCAR (University Corporation for Atmospheric Research)
- Editor, Special issue of "Hydrology and Earth System Sciences" (HESS), European Geosciences Union Journal, appointed in 2017.
- Earth System Science Advisory Committee (ESSAC) member, Canadian Space Agency (CSA), 2017-2022.

Li, Zhenhua

• Committee Member, Canadian Meteorological and Oceanographic Society (CMOS) Saskatchewan section, 2018-present.

Lui, Jian

 Associate Editor, Journal of Environmental Quality, American Society of Agronomy – Crop Science Society of America – Soil Science Society of America; appointed in 2018.

Macrae, Merrin

- Associate Editor, Journal of Environmental Quality, American Society of Agronomy Crop Science Society of America – Soil Science Society of America, appointed Jan 2016.
- Associate Editor, Agricultural and Environmental Letters, American Society of Agronomy
 Crop Science Society of America Soil Science Society of America, appointed Jan 2015.
- Associate Editor, Canadian Water Resources Journal, appointed July 2017.

Marsh, Philip

• Appointed by Polar Knowledge Canada as a Canadian Representative to the International Arctic Science Committee – Terrestrial Working Group.

McKenzie, Jeffrey

- Working with Swedish Nuclear Fuel and Waste Management Company (SKB) on groundwater-permafrost knowledge gaps program.
- Member, International research group studying numerical modeling of groundwater and permafrost (based out of France).

Petrone, Rich

- President, Canadian Geophysical Union.
- President, Canadian National Committee to the International Union of Geodesy and Geophysics.
- Vice President, International Committee on Coupled Land-Atmosphere Systems, International Association of Hydrologic Sciences.
- Senior Canadian Representative, International Association of Hydrologic Sciences.
- Canadian Representative, UNESCO International Hydrology Program.
- President, Canadian National Committee to the International Union of Geodesy and Geophysic.
- Organizer, 4th International Water Conference "The Role of Water technology Innovation in the Blue Economy", 10-13 September 2017, University of Waterloo, Canada.

Pietroniro, Alain

- President, International Association of Hydrological Sciences Commission of Remote Sensing.
- Canadian Delegate, WMO Commission of Hydrology.

Pomeroy, John

- Chair, International Network for Alpine Research Catchment Hydrology A Global Hydroclimate Project of the World Climate Research Program and UNESCO's International Hydrological Program
- Pan-Third Pole Environment Program, Institute of Tibetan Plateau Research, China to implement MESH modelling strategy in the Tibetan Plateau
- Indian Institute of Sciences, Bangalore, India to implement MESH modelling strategy on the Ganges River Basin
- Government of Kazakhstan to develop a modelling strategy for major river basins in collaboration with the GWF Core Modelling and Forecasting team
- Applied for a research project in the Upper Nile River Basin in collaboration with University
 of Dar es Salaam Tanzania, University of Nairobi Kenya, Makerere University –
 Uganda, University of Addis Ababa Ethiopia
- GWF as the Canadian Node for the Sustainable Water Future Program, Future Earth
- Member, UNESCO International Hydrological Programme (IHP) National Committees.
- Representative of University of Saskatchewan for UCAR (University Corporation for Atmospheric Research).
- Associate Editor, Hydrological Research
- Associate Editor, Journal of Arid and Cold Regions Science
- Guest Editor, Earth System Science Data (2015-2018)
- Guest Editor, Hydrology and Earth System Science (2016-2018)

Razavi, Saman

- Associate Editor, Journal of Hydrology, 2016-present.
- Co-Chair, Large Scale Watershed Modelling and Analysis committee, Canadian Geophysical Union-Hydrology section, 2017-present.
- Deputy Chair, Hydrologic Uncertainty committee, American Geophysical Union, 2017present.
- Editorial Board, Environmental Modelling & Software, 2015-present.
- Member, Surface Water Hydrology Technical Committee, American Society of Civil Engineers, 2016-present.
- Member, "Thirsty Future: Energy and Food Impacts on Water" working group of the IAHS
 (The International Association of Hydrological Sciences) scientific decade 2013–2022
 (Panta Rhei: Everything Flows).

Rooney, Rebecca

 Board of Directors Member and Membership Committee Chair, International Association for Great Lakes Research.

Rudy, Ashley

Communications Director, Inaugural Canadian Permafrost Association. This not-for-profit
organization supports national and international permafrost research in Canada, bringing
together communities, researchers and practitioners to advance understanding of
permafrost environments.

Servos, Mark

- Science Council, Water Research Centre for Agriculture and Mining (CRHIAM; Centro de recursos hidricos para la agricultura y la minera). Senior international panel to provide advice and direction to a major research network on mining issues in Chile. http://www.crhiam.cl/
- Proto-Synthesis Visitor, Eawag Swiss Federal Institute of Aquatic Science and Technology, ETH, Dübendorf, Switzerland. A visiting fellow at the institute working on a key knowledge synthesis activity; the relevance of wastewater-born microcontaminants in different ecological and socio-economic settings and the implications for water management. 2018-19.

Sonnentag, Oliver

- American Geophysical Union Fall Meeting Program Coordinator for the Biogeosciences section (3-year term).
- Subgroup co-lead of the Committee on Earth Observation Satellites Working Group on Calibration and Validation (2014-2017) and ICOS Ancillary Vegetation Measurement protocols.
- Member, Centre d'études Nordiques, U. Laval

St. Maurice, Jean-Pierre

- NSERC CAP (Canadian Association of Physicists) liaison committee, 2018
- Committee member, Canadian Space Agency (CSA)'s Solar-Terrestrial Science Advisory Committee (STSAC), 2017-2022.

Stadynk, Trish

 Purveyor, GLORIOUS: http://climateservice-global.eu/gwf_description/ This project focuses on knowledge mobilization resulting from our contributions to the GWF-IMPC project.

Thériault, Julie

• Member, International Commission on Clouds and Precipitation.

Turetsky, Merrit

- Canadian University Liaison, NASA ABoVE.
- Founding member, Permafrost Carbon Network.
- Associate Editor, Ecosystems.

Wheater, Howard

- Changing Cold Regions Network A Regional Hydroclimate Project with Global Energy and Water Exchanges Project of the World Climate Research Program
- Member, University Consortia for Atmospheric Research, USA
- UNESCO G-WADI Steering Committee
- Committee Member, The national Academies of Sciences, Engineering and Medicine Committee on Future Water Resources Needs for the Nation: Water Science at Research at the U.S. Geological Survey.
- Consultant, State of Nevada, USA concerning a proposed US Department of Environment licenses application for nuclear waste repository at Yucca Mountain, 2003 to present.
- Council Member, Prince Sultan bin Abduaziz International Prize for Water, 2007 to present.
- Expert consultant, Republic of Chile concerning a water conflict between Chile and Bolivia before the International Court of Justice.
- Primary/co-convener, 2017 AGU Fall Meeting, New Orleans, 11-15 December 2017.

Zwiers, Francis

- Editor, The Cryosphere (a journal of the European Geoscience Union).
- Advisory Panel, DSC Independent Science Panel, New Zealand Deep South National Science Challenge (large NZ Climate project the size and scope of a Canadian NCE).
- Advisory Panel, EUPHEME The European Prototype demonstrator for the Harmonization and Evaluation of Methodologies for attribution of extreme weather Events.
- Advisory Panel, FACETS Framework for Assessing Climate's Energy-water-land nexus using Targeted Simulations), DOE Funded.
- Associate Editor, Journal of Climate.
- Associate Editor, JGR-Atmospheres.
- Co-Chief Editor, Advances in Statistical Climatology, Meteorology and Oceanography.

Appendix E – Major Awards and Recognitions

Name	Award Name	Date
International Awards		•
Howard Wheater	International Association of Hydrological Sciences, 2018, Dooge Medal	2018
Masaki Hayashi	Henry Darcy Distinguished Lecturer	2018
Nomination for a REMI at World Fest Houston International Film Festival	Remi	2018
Razi Sheikholeslami	Outstanding Reviewer Award, Oct. 2017, Journal Of Hydrology	2017
Jeffrey McDonnell	International Association of Hydrological Sciences, 2016, Dooge Medal	2016
National Awards		
Chrystal Mantyka-Pringle	Mitacs Elevate Research Fellow	2017
Howard Wheater	Canada Excellence Research Chair (CERC) in Water Security	2010-2017
Jennifer Baltzer	Member, Royal Society of Canada's College of New Scholars, Artists and Scientists	2017
John Pomeroy	Canada Research Chair Tier 1 (Renewal)	2017-2024
John Pomeroy	J. Tuzo Wilson Medal, Canadian Geophysical Union	2017
Juewen Liu	McBryde Medal from Canadian Society for Chemistry	2018
Mark Servos	NSERC Engage Grant (Nestle Waters Canada)	2017-2018
Merritt Turetsky	AAAS Leshner Fellow	2018-2019
Mike Waddington	Canada Research Chair Tier 1	2017
Rebecca Rooney	Ontario Early Researcher Award	2017
Institutional Awards		
(Note: Due to file size limit of 200K	B, we are only providing summary of our insti	tutional

awards; complete list can be made available upon request)
Institutional awards: 11

Student Scholarships		
Alex Bevington	NSERC PGS-D	2018
André Bertoncini	University of Saskatchewan Department of Geography and Planning Scholarship	2017-20
André Bertoncini	University of Saskatchewan Department of Geography and Planning Scholarship	
Aurelie Desroches Lapointe	NSERC	
Calvin Lei	University of Waterloo, Faculty of Science Award	2018-2019
Caroline Aubry Wake	NSERC Vanier Scholarship	2018-2021

Caroline Aubry-Wake	University of Saskatchewan Dean's Scholarship- Doctoral	2017 – 2018
Caroline Aubry-Wake	NSERC Alexander Graham Bell Canada Graduate Scholarship-Doctoral	2018-2021
Caroline Aubry-Wake	NSERC Vanier Scholarship for Caroline Aubry- Wake	2018-2021
Carolyn Gibson	Malcolm Ramsay Award	2018
Casey Remmer	NSERC PGSD	2018
Christina Tennant	NSERC Alexander Graham Bell	Sept. 2018
Cory Wallace	NSERC PGSD	2018
Dave Duff	NSERC Undergraduate Student Research Awards (USRA)	2018
Erin Nicholls	NSERC PGS-D3	2018
Erin Nicholls	NSERC PGS-D	2018
Geoff Kershaw	NSERC PGSD	2017
Hailey Robichaud	NSERC CGS-M	2017-2018
Holly Annand	NSERC Post-graduate Scholarship – Doctoral	2017-2019
Katherine Standen	NSERC PGSD	2017
Laila Eamen	University of Saskatchewan Deans Scholarship- Doctoral	2017
Laila Eamen	SENS PhD Excellence scholarship, University of Saskatchewan	2017
Lisa Boyer	NSERC CGS-M	2018
Lisa Boyer	NSERC CREATE	2018
Maria Mora Garces	Saskatchewan Innovation & Opportunity Scholarship	2017
Maria Mora Garces	SENS PhD Standard Scholarship	2017
Maria Sanchez Garces	Dean's Scholarship	2017
Max Salman	KEGS Foundation 2017, Heiki Limion Award	2017
Maxime Salman	Heiki Limion Award	2017
Nicole Balliston	NSERC Postgraduate Scholarship- Doctoral	2018-2021
Nicole Balliston	University of Waterloo President's Graduate Scholarship	2018-2022
Sara Packull-McCormick	Northern Scientific Training Program	2017
Sara Packull-McCormick	Provost Graduate Scholarship	2017
Sara Packull-McCormick	NSERC Alexander Graham Bell Canada Graduate Scholarship	2018
Sara Packull-McCormick	President's Graduate Scholarship	2018
Seyedmohammad Ghoreishi	SENS PhD Excellence Scholarship, University of Saskatchewan	2017
Sophie Wilkinson	Howard. P. Whidden Graduate Scholarship	2018
Sophie Wilkinson	Mithilesh Nandan Prasad Graduate Scholarship	2017
Postdoctoral Awards	<u> </u>	

Colin McCarter	NSERC PDF	2018
Nicola Day	Forest Fungal Ecology Postdoctoral Research Award, Mycological Society of America	2017
. 007	Award, Mycological Society of America	
Best Paper Awards		
Anastasia Sniderhan	Editor's Choice for Sniderhan AE, McNickle GG, Baltzer JL. 2018. Assessing local adaptation vs. plasticity under different resource conditions in seedlings of a dominant boreal tree species. AoB PLANTS 10: ply004; doi: 10.1093/aobpla/ply004	2018
Nikolas Aksamit	Best Doctoral Thesis	2018
Sophie Wilkinson	CGU 2017 Best Student Paper Award	2017
Best Presentations Awards		
Eloise Devoie	Best student poster	2018
Kirsten Grant	Best Poster in Interdisciplinary Research	2018

Appendix F - Publications and Academic Presentations

Summary:

•	Peer-reviewed journal publications:	108
•	Conference Presentations – Invited, Plenary & Keynote:	117
•	Conference Presentations:	202
•	Books and Book Chapters:	03
•	Non-refereed publications including model code:	13
•	Graduate and undergraduate theses:	14

Peered Reviewed Journal Publications

- Aksamit NO, Pomeroy JW. 2017. The Effect of Coherent Structures in the Atmospheric Surface Layer on Blowing-Snow Transport, Boundary-Layer Meteorology, 167 (2): 211 233.DOI: 10.1007/s10546-017-0318-2
- Aksamit NO, Pomeroy JW. 2018. Scale Interactions in Turbulence for Mountain Blowing Snow, Journal of Hydrometeorology, 19(-): 305 320. DOI: 10.1175/JHM-D-17-0179.1
- Gupta, H.V., and Razavi, S. 2018. Rethinking the Fundamental Basis of Sensitivity Analysis for Dynamical Earth Systems Models, Water Resources Research, (submitted).
- Werner, A.T., R.R. Shrestha, A.J. Cannon, M.S. Schnorbus, F.W. Zwiers, G. Dayon, F. Anslow, 2018.
 A long-term temporally, gridded daily meteorological dataset for northwest North America. Submitted, Scientific Data. (PCIC supported)
- Appels, W., Bradford, L.E.A., Chun, Kwok, Coles, A., Strickert, G. E.H. 2017. DIY meteorology: use of citizen science to monitor snow dynamics in a data-sparse city. FACETS https://doi.org/10.1139/facets-2017-0030
- Arlos, M.J., W.J. Parker, J.R Bicudo, P. Law; K.A. Hicks, M. Fuzzen, S. Andrews, M.R. Servos. 2018. Modeling the exposure of wild fish to endocrine active chemicals: potential linkages of total estrogenicity to field-observed intersex. Water Research 139:187-197. https://doi.org/10.1016/j.watres.2018.04.005
- Arlos, M.J., W.J. Parker, Pam Law, José Bicudo, Patricija Marjan, S.A. Andrews, M.R. Servos. 2018. Multi-year prediction of estrogenicity in municipal wastewater effluents. Science of the Total Environment 610-611C:1103-1112. http://doi.org/10.1016/j.scitotenv.2017.08.171
- Asong, Z.E., Razavi, S., Wheater, H.S., Wong, J.S. 2017. Evaluation of Integrated Multisatellite Retrievals for GPM (IMERG) over Southern Canada against Ground Precipitation Observations: A Preliminary Assessment. Amer. Meteor. doi: 10.1175/JHM-D-16-0187.1
- Barszcz, A., J. A. Milbrandt, J. M. Thériault. 2018. Improving the explicit prediction of freezing rain in a km-scale numerical weather prediction model [Submitted Weather and Forecasting, WAF-D-17-0136]
- Baulch, H.M., Elliott, J.A., Cordeiro, M.R.C., Flaten, D.N., Lobb, D.A., and Wilson, H.F. 2018. Soil and water management practices: A review of opportunities to mitigate nutrient losses to surface waters in the Northern Great Plains. In review: Journal of Environmental Quality

- Ben Alaya, M.A., F.W. Zwiers, X. Zhang. 2018a. Probable maximum precipitation: its estimation and uncertainty quantification using bivariate extreme value analysis. Journal of Hydrometeorology, accepted. (CNRCWP network supported)
- Ben Alaya, M.A., F.W. Zwiers and X. Zhang. 2018b. Evaluation and comparison of CanRCM4 and CRCM5 to estimate probable maximum precipitation over North America. To be submitted to Journal of Hydrometeorology. (CNRCWP network supported up to 31 Mar 2018; to be completed with GWF Climate Related Precipitation Extremes (CRPE) project support)
- Ben Alaya, M.A., F.W. Zwiers and X. Zhang. 2018d. Probability of compound extreme precipitation events to inform engineering design. To be submitted to Hydrol. Earth Sys.Sci. (CNRCWP network supported up to 31 Mar 2018; to be completed with GWF CRPE project support)
- Brimelow, J.C., W.R. Burrows and J.M. Hanesiak. 2017. The changing hail threat over North America in response to anthropogenic climate change. Nat. Clim. Change, DOI: 10.1038/NCLIMATE3321
- Brouwer, R. and Sheremet, O. 2017. The economic value of river restoration. Water Resources and Economics, 17: 1-8.
- Chu, T., Das, A. and Lindenschmidt, K.-E. 2017. RADARSAT-2 based digital elevation models derived from InSAR for high latitudes of northern Canada. Journal of Applied Remote Sensing 11(3): 035013. http://dx.doi.org/10.1117/1.JRS.11.035013
- Chun, K.P., Mamet, S.D., Metsaranta, J., Barr, A., Johnstone, J., Wheater, H. 2017. A novel stochastic method for reconstructing daily precipitation times-series using tree-ring data from the western Canadian Boreal Forest. Dendrochronologia. doi: 10,1016/j.dendro.2017.01.003.
- Cober, J., Macrae, M.L. and Van Eerd, L. 2018. Nutrient release from living and terminated cover crops under variable freeze-thaw cycle magnitudes. Agronomy Journal. 110:1036-1045. doi:10.2134/agronj2017.08.0449
- Connon, R., É. Devoie, M. Hayashi, T. Veness, and W. Quinton. 2018. The influence of shallow talks on permafrost thaw and active layer dynamics in subarctic Canada. Journal of Geophysical Research: Earth Surface. 123. DOI: 10.1002/2017JF004469.
- Costa D, Roste J, Pomeroy J, Baulch H, Elliott J, Wheater H, Westbrook C. 2017. A modelling framework to simulate field-scale nitrate response and transport during snowmelt: The WINTRA model, Hydrological Processes, 32 (3): 4250-4268. DOI: 10.1002/hyp.11346
- Curry, C.L. and F.W. Zwiers. 2018. Examining controls on peak annual streamflow and floods in the Fraser River Basin of British Columbia. Hydrol. Earth Syst. Sci, doi:10.5194/hess-2017-531. (CanSISE supported).
- Curry, C.L., S.U. Islam, F.W. Zwiers and S.J. Dery and F.W. Zwiers. 2018. Projected changes in the flooding regime of the Fraser River Basin, British Columbia. To be submitted to Hydrol. Earth Sys. Sci. (CanSISE supported).
- Das, A., Reed, M. and Lindenschmidt, K.-E. 2018. Sustainable ice-jam flood management for socio-economic and socio-ecological systems. Water, 10: 135 http://dx.doi.org/10.3390/w10020135
- DeBeer C M, Pomeroy J W. 2017. Influence of snowpack and melt energy heterogeneity on snow cover depletion and snowmelt runoff simulation in a cold mountain environment, Journal of Hydrology, 553(1): 199 213. DOI: 10.1016/j.jhydrol.2017.07.051

- Farjad, B., Gupta, A., Razavi, S., Faramarzi, M., & Marceau, D. J. 2017. An Integrated Modelling System to Predict Hydrological Processes under Climate and Land-Use/Cover Change Scenarios. Water, 9(10), 767.
- Ferguson, G., McIntosh, J.C. Grasby, S.E., Hendry, M.J. Jasechko, S., Lindsay, M.B.J and Luijendijk, E. Accepted. The Persistence of Brines in Sedimentary Basins. Geophysical Research Letters.
- Fisher, J.B., Hayes D.J., Schwalm, C.R. et al. incl. Sonnentag, O. 2018. Missing pieces to modelling the Arctic-Boreal puzzle. Environmental Research Letters, 13, 020202.
- Gharari, S. and Razavi, S. 2018. Hysteresis in Hydrology and Hydrological Modelling: Memory, Path-Dependency, and Missing Physics, Journal of Hydrology (submitted).
- Guerrero, J.L., Pernica, P., Wheater, H., Mackay, M. and Spence, C. 2017. Parameter sensitivity analysis of a 1-D cold region lake model for land-surface schemes. Hydrol. Earth Syst. Sci., 21, 6345-6362, doi: 10.5194/hess-21-6345-2017
- Haghnegahdar A. and Razavi, S. 2017. Insights into Sensitivity Analysis of Environmental Models:

 On the Impacts of Parameter Perturbation Scale and Model Metric Choice, 95, 115–131

 https://doi.org/10.1016/j.envsoft.2017.03.031
- Haghnegahdar A., Razavi S., Yassin F., and Wheater H. 2017. Multi-criteria sensitivity analysis as a diagnostic tool for understanding model behavior and characterizing model uncertainty, Hydrol. Process., 1-15, https://doi.org/10.1002/hyp.11358
- Halofsky, J., Andrews-Key, S., Edwards, J., Johnston, M., Nelson, H., Peterson, D., Schmitt, K., Swanston, C., Williamson., T. 2018. Adapting forest management to climate change: The state of science and applications in Canada and the United States. Forest Ecology and Management, 421.
- Harder P, Pomeroy J, Helgason W. 2017. Local-Scale Advection of Sensible and Latent Heat During Snowmelt, Geophysical Research Letters, 44: 9769 9777. DOI: 10.1002/2017GL074394
- Harrington, J.S., Hayashi, M. and Kurylyk, B.L. 2017. Influence of a rock glacier spring on the stream energy budget and cold-water refuge in an alpine stream. Hydrological Processes, 31: 4719–4733.
- Helbig, M., Quinton, W. L., Sonnentag, O. 2017. Warmer spring conditions increase annual methane emissions from a boreal peat landscape with sporadic permafrost. Environmental Research Letters, 12, 115009.
- Hernández-Henríquez, M. A., Sharma, A. R., Taylor, M., Thompson, H. D. and Déry, S. J. 2018. The Cariboo Alpine Mesonet: Subhourly hydrometeorological observations of British Columbia's Cariboo Mountains and surrounding area since 2006, submitted to Earth System Science Data.
- Islam, S. U., Curry, C. L., Déry, S. J., Zwiers, F. W. 2018. Quantifying projected changes in runoff variability and flow regimes of the Fraser River Basin, British Columbia, submitted to Hydrology and Earth System Sciences.
- Jawed, Z. and Krantzberg, G. 2017. A comparative analysis of practitioners' experience in sediment remediation projects to highlight best practices, Water Quality Research Journal (Submitted and reviewed)
- Johnston, L. and Flannigan, M.D. 2018. Mapping Canadian wildland fire interface areas. International Journal of Wildland Fire. 27:1-14. https://doi.org/10.1071/WF16221

- Jones, P.D. and Giesy, J.P. 2017. Quantification of Dioxins by GC-Orbitrap MS. Organohalogen Compounds, (In Press)
- Kahsay, T., Kuik, O., Brouwer, R., van der Zaag, P. 2017. The economy-wide impacts of climate change and irrigation development in the Nile basin: A computable General Equilibrium approach. Climate Change Economics, 8(1): 1750004-1-30.
- Karran D, Westbrook CJ, Bedard-Haughn A. 2018. Beaver-mediated water table dynamics in a Rocky Mountain fen. Ecohydrology 11(2): DOI: 10.1002/eco.1923.
- Kharin, V.V., G.M. Flato, X. Zhang, N.P. Gillett, F.W. Zwiers, K. Anderson. 2018. Risks from climate extremes change differently from 1.5°C to 2.0°C depending on rarity. Accepted, Earth's Future. (ECCC and PCIC supported)
- Kochtubajda, B., C. Mooney and R.E. Stewart. 2017. Characteristics, atmospheric drivers and occurrence patterns of freezing precipitation and ice pellets over the Prairie Provinces and Arctic Territories of Canada: 1964 2005. Atmos. Res., 191, 115–127.
- Krantzberg, G. 2018. Stormwater as an Asset: Perspectives on Climate Change Resilience and Infrastructure Innovations. Renew Canada (in press)
- Kythreotis A.P., Mantyka-Pringle C., Mercer T.G., Whitmarsh L.E., Corner A., Paavola J., Chambers C.D., Miller B., Light A. and Castree N. 2018. Citizen Social Science for more integrative and effective climate action and policy. In review: Sustainability Science.
- Levin-Koopman, J., Kuik, O., Tol, R. and Brouwer, R. 2017. The potential of water markets to allocate water between industry, agriculture, and public water utilities as an adaptation mechanism to climate change. Mitigation and Adaptation Strategies for Global Change, 22(2): 325. doi:10.1007/s11027-015-9662-z.
- Li Y., Szeto K, Stewart R, Theriault J, Chen L, Kochtubajda B, Liu A, Boodoo S, Goodson R, Mooney C, Kurkute S. 2017. The June 2013 Alberta Catastrophic Flooding: Water vapor transport analysis by WRF simulation. Journal of Hydrometeorology, Vol. 18, 2057-2078.
- Li, C., X. Zhang, F.W. Zwiers, G. Li. 2018. How much information is required to well-constrain local estimates of future precipitation extremes? To be submitted to Earth's Future. (ECCC and PCIC supported)
- Li, C., X. Zhang, F.W. Zwiers, Y. Fang, A.M. Michalak. 2017. Recent very hot summers in northern hemispheric land areas measured by wet bulb globe temperature will be the norm within 20 years. Earth's Future, doi:10.1002/2017EF000639
- Li, Z. and Lindenschmidt, K.-E. 2018. Coherence of Radarsat-2, Sentinel-1, and ALOS-1 PALSAR for monitoring spatiotemporal variations of river ice covers, Canadian Journal of Remote Sensing 44(1): 1-15. https://doi.org/10.1080/07038992.2018.1419424
- Li, Z., Li, Y., Bonsal, B., Manson, A., and Scaff, L. 2018. Combined Impacts of ENSO and MJO on the 2015 Growing Season Drought over the Canadian Prairies. Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-56.
- Lindenschmidt, K.-E. and Li, Z. 2018, accepted. Monitoring river ice cover progression at a large spatial scale using the Freeman-Durden decomposition of quad-pol Radarsat-2 images. Journal of Applied Remote Sensing.
- Lyu, H., K.A. McColl, X. Li, C. Derksen, A. Berg, T.A. Back, E. Euskirchen, M. Loranty, J. Pulliainen, T. Rowlandson, A. Roy, A. Royer, A. Langlois, J. Stephens, H. Lu, D. Entekhabi. 2018. Validation of the SMAP freeze/thaw product using categorical triple location. Remote Sensing of Environment. 205, 329-337.

- Maavara, T., Slowinski, S., Rezanezhad, F., Van Meter, K., and Van Cappellen, P. 2018. The role of groundwater discharge fluxes on Si:P ratios in a major tributary to Lake Erie. Science of the Total Environment, 622-623, 814-824. doi:10.1016/j.scitotenv.2017.12.024.
- MacDonald M, Pomeroy J, Essery R. 2018. Water and energy fluxes over northern prairies as affected by chinook winds and winter precipitation, Agricultural and Forest Meteorology, 248: 372 385. DOI: 10.1016/j.agrformet.2017.10.025
- Martin T.G., Kehoe L., Mantyka-Pringle C., Chades I., Wilson S., Bloom R., David S., Fisher R., Mehl K., Prieto D., Wayland M., Wellicome T., Zimmer K., and Smith P. 2018 Prioritizing recovery funding to maximize conservation of endangered species. In review: Conservation Letters.
- Masud, M.B., Khaliq, M.N., Wheater, H.S. 2017. Future changes to drought characteristics over the Canadian Prairie Provinces based on NARCCAP multi-RCM ensemble. Clim. Dynam. doi: 10.1007/s00382-016-3232-2.
- Masud, M.B., Khaliq, M.n., Wheater, H.S. 2017. Projected changes to short-and-long-duration precipitation extremes over the Canadian Prairie Provinces. Clim. Dynam. doi: 10.1007/s00382-016-3404-0.
- Mehdi, H., F.H. Dickson, L.M. Bragg, M.R. Servos, P.M. Craig. 2018. Impacts of wastewater treatment plant effluent on energetics and stress response of rainbow darter (Etheostoma caeruleum) in the Grand River watershed. Comparative Biochemistry and Physiology, Part B. In press. https://doi.org/10.1016/j.cbpb.2017.11.011
- Moore PA, Lukenbach MC, Kettridge N, Petrone RM, Devito KD, Waddington JM. 2017. Peatland water repellency: Importance of soil water content, moss species, and burn severity. Journal of Hydrology 554: 656-665, doi: 10.1016/j.jhydrol.2017.09.036.
- Morales-Marín, L., Wheater, H. and Lindenschmidt, K.-E. 2018. Estimating sediment loadings in the South Saskatchewan River catchment, Water Resources Management 32(2): 769-783. http://dx.doi.org/10.1007/s11269-017-1838-8
- Morales-Marin, L., Wheater, H.S., and Lindenschmidt, K.-E. 2017. Assessment of nutrient loadings of a large multipurpose prairie reservoir. J. Hydrol. doi: 10.1016/j.jhydrol.2017.04.043.
- Morrison A, Noble BF, Westbrook CJ. 2018. Flood risk management in the Canadian Prairie provinces: Defaulting towards flood resistance and recovery versus resilience. Canadian Water Resources Journal doi: 10.1080/07011784.2018.1428501.
- Naveau, P., A. Ribes, F.W. Zwiers, A. Hannart, A. Tuel, P. Yiou. 2018. Revising return periods for record events in a climate event attribution context. Journal of Climate, doi:10.1175/JCLI-D-16-0752.1
- Pappas, C, Matheny, AM, Maillet, J, Sonnentag, O, Baltzer, J, et al. 2018. Boreal tree hydrodynamics: asynchronous, diverging, yet complementary. Tree Physiology, doi:10.1093/treephys/tpy043.
- Parsons, C.T., Rezanezhad, F., O'Connell, D.W., and Van Cappellen P. 2017. Sediment phosphorus speciation and mobility under dynamic redox conditions. Biogeosciences, 14, 3585-3602, doi:10.5194/bg-14-3585-2017.
- Pattison-Williams JK, Pomeroy JW, Badiou P, Gabor S. 2018. Wetlands, Flood Control and Ecosystem Services in the Smith Creek Drainage Basin: A Case Study in Saskatchewan, Canada, Ecological Economics, 1(47): 36 47. DOI: 10.1016/j.ecolecon.2017.12.026

- Pavlovskii, E., Hayashi, M. and Lennon, M.R. 2018. Transformation of snow isotopic signature along groundwater recharge pathways in the Canadian Prairies. Journal of Hydrology (in press).
- Pechlivanidis, I.G., McIntyre, N., Wheater, H.S. 2017. The significance of spatial variability of rainfall on simulated runoff: an evaluation based on the Upper Lee catchment, UK. Hydrol. Res. doi: 10.2166/nh.2016.038.
- Peters, R., Fonti, P., Frank, D., Poyatos, R., Pappas, C. et al. incl. Sonnentag, O. 2018. Quantification of uncertainties in tree sapflow measured with the thermal dissipation method. New Phytologist, accepted.
- Plach, J., Macrae, M.L., Ali, G., Brunke, R.I., English, M.C., Ferguson, G., Lam, W.V., Lozier, T.M., McKague, K., O'Halloran, I.P., Opolko, G., and Van Esbroeck, C. 2018. Supply and transport limitations on phosphorus losses from agricultural fields in the Lower Great Lakes Region, Canada. Journal of Environmental Quality. 47(1):96-105. Doi:10.2134/jeq2017.06.0234
- Powley, H.R., Krom, M.D., and Van Cappellen, P. 2018. Phosphorus and nitrogen trajectories in the Mediterranean Sea (1950-2030): Diagnosing basin-wide anthropogenic nutrient enrichment. Progress in Oceanography, in press, doi: 10.1016/j.pocean.2018.03.003.
- R. Connon, É. Devoie, M. Hayashi, T. Veness, and W. Quinton. 2018. The influence of shallow talks on permafrost thaw and active layer dynamics in subarctic Canada. Journal of Geophysical Research: Earth Surface. 123. DOI: 10.1002/2017JF004469.
- Razavi S., and Vogel, R. 2018. Prewhitening of hydroclimatic time series? Implications for inferred change and variability across time scales, Journal of Hydrology, 557, 109-115, doi:10.1016/j.jhy
- Remmer CR, WH Klemt, BB Wolfe and RI Hall. 2018. Inconsequential effects of flooding in 2014 on lakes in the Peace-Athabasca Delta (Canada) due to long-term drying. Limnology and Oceanography (in press). doi: 10.1002/lno.10787.
- Robinne, F.-N., Bladon, K.D., Miller, C., Parisien, M.A., Mathieu, J. and Flannigan M.D. 2018. A spatial evaluation of global wildfire-water risks to human and natural systems. State of the Total Environment. 610:1193-1206. DOI: 10.1016/j.scitotenv.2017.08.112
- Rokaya, P., Budhathoki, S. and Lindenschmidt, K.-E. 2018. Trends in the Timing and Magnitude of Ice-Jam Floods in Canada, Nature Scientific Reports 8(1): 5834. http://dx.doi.org/10.1038/s41598-018-24057-z
- Rowlandson, T.L., A.A. Berg, A. Roy, E. Kim, R. Pardo Lara, J. Powers, K. Lewis, P. Houser, K. McDonald, P. Toose, A. Wu, E. De Marco, C. Derksen, J. Entin, A. Colliander, X. Xu, Alex Mavrovic. Capturing Agricultural Soil Freeze/Thaw State through Remote Sensing and Ground Observations: A Soil Freeze/Thaw Validation Campaign. Remote Sensing of Environment. 211, 59-70.
- Sadeghian, A., Chapra, S., Hudson, J., Wheater, H., Lindenschmidt, K.-E. 2018. Improving in-lake water quality modeling using variable chlorophyll a/algal biomass ratios, doi: 10.1016/j.envsoft.2017.12.009
- Sadeghian, A., Hudson, J., Wheater, H., and Lindenschmidt, K. E. 2017. Sediment plume model a comparison between use of measure turbidity data and satellite images for model calibration. Environ. Sci. Pollut. Res. doi: 10.1007/s11356-017-9616-y

- Shafii, M., Basu, N., Craig, J.R., Schiff, S.L., and Van Cappellen, P. 2017. A diagnostic approach to constraining flow partitioning in hydrologic models using a multiobjective optimization framework. Water Resources Research, 53, 3279-3301. doi:10.1002/2016WR019736.
- Sheikholeslami, R., and Razavi, S. 2017. Progressive Latin Hypercube Sampling: An efficient approach for robust sampling-based analysis of environmental models, Environmental Modelling & Software, 93: 109–126 doi: 10.1016/j.envsoft.2017.03.010
- Sheikholeslami, R., and Razavi, S. 2018. Avoiding the Guise of an Anonymous Review, Eos, Transactions of American Geophysical Union, (in Press).
- Sheikholeslami, R., Yassin, F., Lindenschmidt, K.-E., and Razavi, S. 2017. Improved Understanding of River Ice Processes Using Global Sensitivity Analysis Approaches. Journal of Hydrologic Engineering 22(11): 04017048 https://doi.org/10.1061/(ASCE)HE.1943-5584.0001574
- Sillmann, J., T.L. Thoranisdottir, N. Schaller, L. Alexander, G.C. Hegerl, S.I. Seneviratne, R. Vautard, X. Zhang, F.W. Zwiers. 2017. Understanding, modeling and predicting weather and climate extremes: Challenges and opportunities. Weather and Climate Extremes, 18, 65-74, doi:10.1016/j.wace.2017.10.003
- Sniderhan, A., G. McNickle, and J. Baltzer. 2018.). Assessing local adaptation vs. plasticity under different resource conditions in seedlings of a dominant boreal tree species. AoB PLANTS. 10: 1. DOI: 10.1093/aobpla/ply004 Designated *Editor's Choice*
- Sprenger M, Tetzlaff D, Buttle J, Carey SK, McNamara JP, Laudon H, Shatilla NJ, Snelgrove J, Soulsby C. 2018. Storage, mixing and fluxes of water in the critical zone across northern environments inferred by stable isotopes of soil water. Hydrological Processes, Accepted.
- Stott, P.A., D.J. Karoly, F.W. Zwiers. 2017. Is the choice of statistical paradigm critical in extreme event attribution studies? Climatic Change, 144, 143-150, doi:10.1007/s10584-017-2049-2
- Mridul K. Thomas, Simone Fontana, Marta Reyes, Michael Kehoe, Francesco Pomati. 2018. The predictability of a lake phytoplankton community, over time-scales of hours to years. Ecology Letters.
- Van Meter, K. J., & Basu, N. B. 2017. Time lags in watershed-scale nutrient transport: an exploration of dominant controls. Environmental Research Letters, 12(8), 084017. https://doi.org/10.1088/1748-9326/aa7bf4
- Van Meter, K. J., Van Cappellen, P., & Basu, N. B. 2018. Legacy nitrogen may prevent achievement of water quality goals in the Gulf of Mexico Science http://doi.org/10.1126/science.aar4462
- Wada, Y., Bierkens, M. F.P., de Roo, A., Dirmeyer, P., Famligietti, J., Hanasaki, N., Konar, M., Liu, J., Schmied, H.M., Oki, T., Pokhrel, Y., Sivaplan, M., Troy, T., van Dijk, A., van Emmerik, T., Van Huijgevoort, M., Van Lanen, H., Vorosmarty, C., Wanders, N., Wheater, H. 2017. Human-water interface in hydrological modelling: current status and future directions. Hydrol. Earth Syst. Sci., 21, 4169-4193, doi: 10.5194/hess-21-4169-2017
- Walker, XJ, Baltzer, JL, Cummings, SR, Day, NJ, Johnstone, JF, Rogers, BM, Turetsky, MR, Mack, MC. (2018). Estimating depth of burn in boreal black spruce and jack pine stands of the NWT, Canada. International Journal of Wildland Fire 27(2) 125-134.
- Warren, RK, Pappas, C, Helbig, M, Chasmer, LE, Berg, AA, Baltzer, JL, Quinton, WL, Sonnentag, O. 2018. Minor contribution of black spruce transpiration to evapotranspiration in boreal permafrost peatlands. Ecohydrology, DOI: 10.1002/eco.1975

- Whitfield PH*, Pomeroy JW. 2017. Assessing the quality of the streamflow record for a long-term reference hydrometric station: Bow River at Banff, Canadian Water Resources Journal, 42(4): 391 415. DOI: 10.1080/07011784.2017.1399086
- Wilkinson S, Moore PA, Flannigan MD, Wotton BM, Waddington JM. 2018. Did enhanced afforestation cause high severity peat burn in the Fort McMurray Horse River wildfire? Environmental Research Letters 13: 014018, doi: 10.1088/1748-9326/aaa136.
- Williamson, M, T.R. Rowlandson, A.A. Berg, A. Roy, P. Toose, C. Derksen, L. Arnold, E. Tetlock. 2018. L-band radiometry freeze/thaw validation using air temperature and ground measurements. Remote Sensing Letters. 9(4), 403-410.
- Williamson, M., J.R. Adams, A.A. Berg, C. Derksen, P. Toose, A. Walker. 2018. The detection of soil freeze/thaw using soil moisture probes: Implications for remote sensing validation networks. Hydrology Research. 49(1), 1-16. 10.2166/nh.2017.183
- Wong, J.S., Razavi, S., Bonsal, B.R., Wheater, H.S., Asong, Z.E. 2017. Inter-comparison of daily precipitation products for large-scale hydro-climatic applications over Canada, Hydrol. Earth Syst. Sci. doi: 10.5194/hess-21-2163-2017.
- Yanping Li, Kit Szeto, Ron Stewart, Julie Theriault, Liang Chen, Bob Kochtubajda, Anthony Liu, Sudesh Boodoo, Ron Goodson, Curtis Mooney, Sopan Kurkute, 2017: A Numerical Study of the June 2013 Flood-Producing Extreme Rainstorm over Southern Alberta. Journal of Hydrometeorology, vol. 18, 2057-2078.
- Yassin, F., Razavi, S., Wheater, H., Sapriza-Azuri, G., Davison, B., Pietroniro, A. 2017. Enhanced Identification of a Hydrologic Model using Streamflow and Satellite Water Storage Data: A Multi-criteria Sensitivity Analysis and Optimization Approach. Hydrol. Process. doi: 10.1002/hyp.11267
- Yuwei Xie, Xiaowei Zhang, Jianghua Yang, Seonjin Kim, Seongjin Hong, John P. Giesy. 2018. Un Hyuk Yim, Won Joon Shimg, Hongxia Yu, Jong Seong Khim. eDNA-Based Bioassessment of Coastal Sediments Impacted by an Oil Spill. Environ. Pollu., 238: 739–748.
- Z. Li, Y. Li, B. Bonsal, A. Manson, L. Scaff. 2018. Combined Impacts of ENSO and MJO on the 2015 Growing Season Drought over the Canadian Prairies, Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-56.
- Zhang, T.Q., Zheng, Z.M., Lal, R., Lin, Q., Sharpley, A.N., Shober, A.L., Smith, D., Tan, C.S., and Van Cappellen, P. 2018. Environmental indicator principium with case references to agricultural soil, water, and air quality and model-derived indicators. Journal of Environmental Quality, 47. doi: 10.2134/jed2017.10.0398.
- Zhang, X., G. Li, A. Cannon, T. Murdock, S. Sobie, F.W. Zwiers, K. Anderson, B. Qian. 2018. Indices of Canada's future climate for general and agricultural adaptation applications. Accepted, Climatic Change. (ECCC, AAFC and PCIC supported)
- Zhenhua Li, Alan Manson, Yanping Li, Chris Meek. 2017. Circulation Characteristics of Persistent Cold Spells in Central-Eastern North America. Journal of Met. Res., Vol. 31, 250-260.
- Zhenhua Li, Yanping Li, Barrie Bonsal, Alan Manson, Lucia Scaff. 2018. Combined Impacts of ENSO and MJO on the 2015 Growing Season Drought over the Canadian Prairies, Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-56

Books and Book Chapters

- Gober, Patricia. 2018. Building Resilience to Uncertain Water Futures. Cham Switzerland: Palgrave MacMillan.
- Gober, Patricia. 2018. Environmental Risks and Hazards from a Cognitive-behavioral Perspective. In Handbook of Behavioral and Cognitive Geography, edited by Daniel L. Montello, 322-333. Chapter 18. Cheltenham, UK: Edward Elgar.
- Powley, H.R., Van Cappellen, P., and Krom, M.D. (2017) Nutrient cycling in the Mediterranean Sea: The key to understanding how the unique marine ecosystem functions and responds to anthropogenic pressures. In Mediterranean Identities Environment, Society, Culture (Editor: Borna Fuerst-Bjelis), Chapter 3, pp. 47-77, ISBN:978-953-51-3586-9, InTechOpen.

Non-Refereed Publications including Model Code

- Brouwer, R., Liu, H. and Neverre, N. (2017). A Survey of Hydro-Economic Models in Canada. Global Water Futures Report, University of Waterloo, October 2017. 12 pp.
- Exposure, Nutritional Status, and County Food Use (Fort Providence Results). Prepared for Chief and Council of Fort Providence First Nation. pp 1-37.
- Glass, B. (2018). Locating priority groundwater monitoring locations in the Central Mackenzie Valley using thermal and optical band Landsat imagery. Graduate class paper and journal publication draft.
- Invited Comments: Razavi, S. (2017), Feature: When Uncertainty Matters, American Geophysical Union, Hydrology Section, December 2017 Newsletter.
- Li, H. (2018). A Practical Guide to Build the Input-output Model of Water Consumption in Canada. Global Water Futures Report, University of Waterloo, February 2018. 20 pp.
- Ratelle M*, Laird BD. (2017). Community Report for Contaminant Biomonitoring in the Northwest Territories Mackenzie Valley: Investigating the Links Between Contaminant Exposure, Nutritional Status, and County Food Use (West Point Results). Prepared for Chief and Council of West Point First Nation. pp 1-38
- Ratelle M*, Laird BD. (2018). Community Report for Contaminant Biomonitoring in the Northwest Territories Mackenzie Valley: Investigating the Links Between Contaminant Exposure, Nutritional Status, and County Food Use (Deline Results). Prepared for Deline Gotine Government. pp 1-38.
- Ratelle M*, Laird BD. (2018). Community Report for Contaminant Biomonitoring in the Northwest Territories Mackenzie Valley: Investigating the Links Between Contaminant Exposure, Nutritional Status, and County Food Use (Kakisa Results). Prepared for Chief and Council of Ka'a'gee Tu First Nation. pp 1-38.
- Ratelle M*, Laird BD. (2018.) Community Report for Contaminant Biomonitoring in the Northwest Territories Mackenzie Valley: Investigating the Links Between Contaminant
- Wolfe BB and JJ Venkiteswaran. 2018. SAMMS (Sub-Arctic Metal Mobility Study) Newsletter Winter 2018. Newsletter distributed to SAMMS research partners. Available at http://samms.ca.
- Zwiers, F.W. and X. Zhang, 2018: Synthesis of key issues and challenges Urban/Coastal/Riverine Flood and Climate Change. In International workshop on floods and climate change: Codes and standards perspective, Attar, A., Z. Lounis and M. Armstrong, Eds., National Research Council, Ottawa

- Zwiers. VIC-GL model, which integrates the Clarke regional glaciation model into VIC, is being further developed by the Pacific Climate Impacts Zwiers. We are actively running our upgraded version of VIC (see below) on drainage basins in BC and, in some cases, extending beyond BC (e.g., the entire Columbia basin). It is anticipated that completed simulations will begin to find their way onto our PCIC data portal later this year. (PCIC supported).
- Zwiers. We are also developing a data portal that will allow users to obtain simulated stream flow at any point on the drainage network of basins that we have simulated. Anticipated release is sometime this year. (PCIC supported).

Graduate and Undergraduate Theses (under project investigator supervision)

- Anderson, E. (2018) Quantifying ecosystem services for Agricultural Wetlands: A global review. Supervised: C Mantyka-Pringle and R. Clark. Undergraduate thesis. Submitted
- BES Honours Undergraduate thesis: Babaran, D. 2018. The adoption of VEC monitoring and multivariate analysis on the Blair Creek sub-watershed as a model for CEA. Bachelor of Environmental Studies Honours Thesis. School of Environment, Resources and Sustainability, University of Waterloo, Waterloo, ON. 84 p.
- Black, KE. (2017). Influence of topography and moisture and nutrient availability on green alder function on the low arctic tundra, NT. Wilfrid Laurier University
- Brock Tropea- Ronald Stewart- U of Manitoba: Freezing precipitations and wet snow events affecting Manitoba Hydro
- Cornell T. Fe Analysis in Natural waters using the FeLumeII: Is high DOC a concern? Co-op Workterm Report 4A Biology, Environmental Science (Ecology Specialization)
- Cornell T. Preliminary Investigation of Algal Bloom Formation in Conestoga Lake, a Temperate Reservoirs Lake Located in the Grand River Watershed. Co-op Work-term Report 3A Biology, Environmental Science (Ecology Specialization)
- Jordan Harrington, MSc, Principal Supervisor, The Hydrogeology of a Rock Glacier and Its Effect on Stream Temperature, 2017 (Completed)
- Laird MJ. (2018). Dietary Exposure Assessment and Contaminants Biomonitoring in the Dehcho Region, Northwest Territories: Exploring the Relationship Between Mercury Exposure, Omega-3 Fatty Acid Status, and Fish Consumption. M.Sc. Thesis. School of Public Health and Health Systems, University of Waterloo.
- Nikolas Aksamit, PhD, Doctorate, Principal Supervisor, Alpine Turbulence and Blowing Snow, 2013 to 2017 (Completed)
- Qualbe Shadman Chowdhury, 2018. Biogeochemical Signatures in Intensively Managed Great Lakes Watersheds, Masters thesis, Department of Civil and Environmental Engineering, University of Waterloo, Waterloo, ON
- Reid, KA. (2017). Effects of wildfires on tree establishment in conifer-dominated boreal forests in southern Northwest Territories. Wilfrid Laurier University
- Threndyle R. Effect of burn severity on post-fire peat hydrophobicity. BSc thesis (25 pages) submitted to the School of Geography and Earth Sciences, McMaster University. Supervised by JM Waddington.
- Vanessa Mcfadden-Julie Thériault-UQAM: Freezing rain in the Maritime Provinces

White, A. (2018). Drivers of post-fire vascular plant regeneration in the conifer-dominated boreal forest of southern Northwest Territories. Wilfrid Laurier University.

Conference Presentations (Invited, Plenary, Keynote)

- Baltzer, JL. (2018). Ecological resilience in northern watersheds. The Howard Wheater Symposium. University of Saskatchewan, Saskatoon, SK.
- Basu, N.B. (2017). Biogeochemical Hotspots: Role of Small Water Bodies in Watershed Nutrient Processing. Credit Valley Corporation (CVC), Toronto, November 23rd, 2017.
- Basu, N.B. (2017). Biogeochemical Hotspots: Role of Small Water Bodies in Watershed Nutrient Processing. Toronto and Region Conservation Authority (TRCA), January 2018.
- Basu, N.B. (2017). Nutrient Legacies and Time Lags: Implications for Water Quality, Canada Center for Inland Waters, Environment and Climate Change Canada, Burlington, May 2018
- Basu, N.B. (2018) and Van Meter, KJ. Landscape Legacies: Long-Term Nitrogen Trajectories in the Mississippi River Basin and Beyond, Sixth Interagency Conference on Research in Watersheds (ICRW), July 23-26th, 2018, at the National Conservation Training Center (NCTC), Shepherdstown, West Virginia
- Basu, N.B. (2018). Biogeochemical Hotspots: Role of Small Water Bodies in Watershed Nutrient Processing, Webinar on Wetlands: From Science to Action organized by Canadian Freshwater Alliance, September 25, 2018 (https://www.freshwateralliance.ca/fresh_ideas_wetlands)
- Basu, N.B. and Van Meter, KJ (2018). Modelling Nutrient Legacies and Dynamics in Human Dominated Landscapes, Invited Keynote Speaker, Integrated Hydrosystems Modeling, University of Tubingen, Tubingen, Germany.
- Basu, N.B. and Van Meter, KJ (2018). Nutrient Legacies in Anthropogenic Catchments: Implications for Water Quality. Invited Lecture at Canada Center for Inland Waters, Environment and Climate Change Canada, Burlington, ON, May 4, 2018.
- Basu, N.B. and Van Meter, KJ (2018). Nutrient Legacies in Anthropogenic Catchments: Implications for Water Quality. Invited Lecture at University of Illinois at Urbana Champaign, Urbana, IL April 20, 2018.
- Basu, N.B., K. J. Van Meter, P. Van Cappellen. Landscape Legacies: Long-Term Nitrogen Trajectories in Human-Impacted Watersheds. Canadian Geophysical Union Joint Meeting, Niagara Falls, Canada, June 2018
- Baulch, H.M. (2018) Prairie Water Futures. Red River Basin Commission. Winnipeg MB, January 2018. INVITED
- Bedard-Haughn, A. (2018) Wetland Functions on the Prairies. Agricultural Producers Association of Saskatchewan Mid-term meeting. Saskatoon, SK. March 27, 2018 INVITED
- Canadian Institute of Forest SEEK Special Session September 2017: "Vulnerability and Adaptation to Climate Change in Sustainable Forest Management and the Forest Industry in Saskatchewan". Ottawa, Canada.
- Carey SK, Shatilla NJ, Tang W. What can high frequency data tell us about hydrological and biogeochemical processes in a permafrost-underlain watershed that we do not already know? Presented at the American Geophysical Union Annual General Meeting, New Orleans, USA. December 2017.

- Connon, R. and W. Quinton. Permafrost thaw induced changes to hydrological connectivity. 2017

 American Water Resources Association Spring Conference: The emerging science of aquatic system connectivity. Salt Lake City, Utah, USA. May 1-3, 2017. Invited Presentation.
- Connon, R. Co-convener of 'Permafrost Hydrology' session at 2018 European Conference on Permafrost in Chamonix, France.
- Connon, R. Wilfrid Laurier University research initiatives in the Northwest Territories. 2018 Northern Association of Professional Engineers and Geoscientists, Yellowknife, Northwest Territories. Mar. 16-17, 2018. Invited Presentation.
- Costa D, Pomeroy J, (2017). Non-point source modelling (HYPE and future of MESH/CHM). GWF Integrated Modelling Program for Canada (IMPC) kick-off Workshop, Saskatoon, September 14, 2017.
- de Loë, R. (Invited) Agriculture in the evolving landscape of water governance. Leadership Summit, Christian Famers Federation of Ontario. Waterloo, Ontario. March 27, 2018.
- de Loë, R. (Invited) Where does agriculture fit in the water governance landscape? Water Stewardship Workshop, Christian Farmers Federation of Ontario. Guelph, Ontario. September 28, 2017.
- DeBeer C, Pomeroy J, (2017). International Network for Alpine Research Catchment Hydrology (INARCH). 2017 GHP-TPE Meeting, Kathmandu, October 17, 2017
- DeBeer C, Wheater H, Pomeroy J, (2018). CCRN status and future directions as a GEWEX RHP. Changing Cold Regions Network Annual General Meeting "The CCRN Finale", Saskatoon, March 5, 2018
- Fereidoun Rezanezhad, T. Milojevic, D. Oh, C. Smeaton, C. T. Parsons, C. McCarter and P. Van Cappellen.
- Ferguson, G. Energy and Pore Space Management. Keynote Lecture at German Geological Society
 Hydrogeology Section Meeting. March 21-24, 2018. Bochum, Germany.
- Ferguson, G. Is Deep Groundwater Really Stagnant? Invited Lecture at University of Arizona. January 25, 2018, Tucson, Arizona.
- Ferguson, G. Hydrogeological Lessons Learned from Deep Subsurface Development of the Williston Basin, Canada. Invited Lecture to International Association of Hydrogeologists Australian National Chapter. April 8, 2017, Sydney, Australia.
- Forest Products Association of Canada (FPAC) Adaptation/Mitigation Workshop, March 13th & 14th. Presenter on: "Vulnerability and Adaptation to Climate Change in Sustainable Forest Management In Saskatchewan: Mistik Case Study". Edmonton, Alberta.
- Francis Zwiers, A brief update on climate science, Southern Interior Silviculture Committee 2018 Winter Workshop, Kamloops, February 13, 2018 (keynote speaker)
- Francis Zwiers, Changing weather extremes: Why it isn't an alternative fact, TISED, Faculty of Engineering, McGill University, August 30, 2017 (invited seminar)
- Francis Zwiers, Climate Uncertainty: Are we facing an increase in the frequency and severity of extreme events? Okanagan Water Stewardship Board, Kelowna, December 14, 2017 (invited speaker)
- Francis Zwiers, Probable maximum precipitation estimation and uncertainty quantification using bivariate extreme value analysis, Department of Statistics, University of Manitoba, October 19, 2017 (invited seminar)

- Francis Zwiers, Probable maximum precipitation estimation and uncertainty quantification using bivariate extreme value analysis, International Workshop on Tropical-subtropical Weather, Climate and Oceans, Sun Yat-sen University, Guangzhou, China, November 20, 2017 (invited lecture)
- G. Krantzberg. Governance challenges for a resilient Great Lakes basin ecosystem. Keynote ELLS-IAGLR Conference, Lake Geneva, France, September 2018
- G. Krantzberg. If we really aren't sure can we take action? International Association for Great Lakes Research. June 18-22, 2018 [Abstract accepted, invited]
- Giesy, J.P. . "Environmental Forensics: What is it and What can it do?" To: Symposium in Honor of Prof. Giesy. Beijing China, March 16, 2018. Invited
- Giesy, J.P. "Environmental Forensics: What is it and What can it do?" To: School of Biological Sciences of the University of Hong Kong, Hong Kong, SAR, Peoples Republic of China, February 2, 2018. Invited
- Gober, Patricia. (2018), The Challenge of Non-stationarity for Water Research and Management: A social Science Perspective. Howard Wheater Symposium, Saskatoon, SK, March 9, 2018.
- Haghnegahdar A. (2017), Advances in Addressing Challenges Facing Water Resources in Canada under a Changing Climate and Environment, Water Crisis Symposium- Tehran, Iran, July 18-19, 2017.
- Haghnegahdar A. (2017), Overview of the Integrated Modelling Program for Canada (IMPC), School of Civil Engineering, Shiraz University, Shiraz, Iran, August 23rd, 2017.
- Harder, P.*, Pomeroy, J., Helgason, W. (Poster) Diagnosing stubble management and climate variability impacts on runoff and infiltration in cold semi-arid agricultural regions. AGU Fall Meeting. New Orleans, LA. December 11, 2017.
- Hecker, M., Jardine T., Jones P., Xie Y., DeBofsky A., Giesy, J. "Environmental DNA: A novel approach to characterize biodiversity." Presentation to AREVA Resources. February 27, 2018. Invited
- Hecker, M., Zee, J., Gerhart, A. Doering, J., Jardine, T. "eDNA as an Early Detection Tool for the Potential Spread of Zebra Mussels (Dreissena polymorpha) to Saskatchewan Lakes. Presentation to Fish and Wildlife Development Fund. Saskatoon, SK, November 2017. Invited
- Hecker, M., Zee, J., Gerhart, A. Doering, J., Jardine, T. "eDNA as an Early Detection Tool for the Potential Spread of Zebra Mussels (Dreissena polymorpha) to Saskatchewan Lakes." Presentation to Saskatchewan Environment Aquatic Invasive Species Task Force. Saskatoon. January 19, 2018. Invited
- Hecker, M., Zee, J., Gerhart, A. Doering, J., Jardine, T. "eDNA as an Early Detection Tool for the Potential Spread of Zebra Mussels (Dreissena polymorpha) to Saskatchewan Lakes." Presentation to Saskatchewan Wildlife Federation. Prince Albert. March 9, 2018. Invited
- Howard Wheater (2017), CWRA National Conference 2017, June 5-7, 2017, Lethbridge, Alberta.
- Howard Wheater (2017), Water Futures in Changing Cold Regions, 51st CMOS Congress 2017, June 4-8 2017, Toronto, Canada.
- Howard Wheater (2017), Western University, Department of Civil and Environmental Engineering, London, Ontario.
- Jardine, T., Abu, R., Andrews, E., Baines, S., Belcher, K., Bharadwaj, L., Bradford, L., Mantyka-Pringle, C., Steelman, T., Reed, M., and Strickert, G. 2017. Canada's inland deltas: Complex

- social-ecological systems in need of environmental flows. Workshop on Social and Ecohydrological Connections for Environmental Flows, June 20-23, 2017, National Socio-Environment Synthesis Center, Annapolis, MD.
- Laird, BD. (2017). Biomonitoring in the Northwest Territories Mackenzie Valley. Northern Contaminants Program Results Workshop. Yellowknife, Canada (Invited Platform).
- Liu J., Baulch H., Roste J., and Elliott J. (2018) Agricultural water quality on the prairies: Challenges, choices and solutions. Saskatchewan Drainage Water Management Conference. Melfort, Saskatchewan. January 23, 2018.
- Macrae, M.L., Brunke, R.I., English, M.C., Ferguson, G., Lam, V., Lozier, T., McKague, K., O'Halloran, I., Plach, J.*, Van Esbroeck, C.* (Invited) Impacts of Land Management Practices on Phosphorus Losses from Agricultural Fields and Watersheds in Ontario, Canada. Annual Meeting of SERA-17. Oregon, Ohio, August 14-17, 2017.
- Macrae, M.L., Brunke, R.I., English, M.C., Ferguson, G., Lam, V., Lozier, T., McKague, K., O'Halloran, I., Plach, J.*, Van Esbroeck, C.* (Invited) Importance of Climate Drivers and Land Management Practices on Runoff and Phosphorus Losses. 60th Annual Meeting of the International Association for Great Lakes Research. Detroit, MI, USA. May 16-19, 2017.
- Mantyka-Pringle C., Messmer D., Leston L., Asong E., Bayne E., Bortolotti L., Sekulic G., Wheater H., Howerter D., and Clark R. (2018) Interaction Effects of Climate, Climate change and Agricultural Land-use on Avian and Food-web communities. Research presented at the Prairie Habitat Joint Venture Science Committee Annual Meeting, Winnipeg, MB. February 27, 2018 INVITED
- Marsh C*, Pomeroy J, Wheater H, (2017). Simulating Complex, Cold-region Process Interactions
 Using a Multi-scale, Variable-complexity Hydrological Model. American Geophysical
 Union Fall Meeting, New Orleans, December 11, 2017
- Marsh C, Pomeroy J, Wheater H, (2017). Simulating Complex, Cold-region Process Interactions Using a Multi-scale, Variable-complexity Hydrological Model. American Geophysical Union Fall Meeting, New Orleans, December 11, 2017.
- Ministry of Environment, Forest Services Branch Policy and Adaptation Workshop, March 27th, 2018. Presenter on: "Vulnerability and Adaptation to Climate Change in Sustainable Forest Management In Saskatchewan: Mistik Case Study".
- Mistik Management Ltd. Public Advisory Group. Presenter on: "Vulnerability and Adaptation to Climate Change in Sustainable Forest Management In Saskatchewan: Mistik Case Study". November, 2017.
- P. Van Cappellen. 23rd Biannual Symposium on Environmental Biogeochemistry. Cairnes, Australia, September 2017
- P. Van Cappellen. Damming of rivers as a driver of global environmental change. Howard Weather Symposium. Saskatoon, Canada, March 2018
- P. Van Cappellen. Damming profoundly changes riverine nutrient delivery to the global coastal zone. International Workshop on Surface-Earth System Science. Tianjin, China, March 2018
- P. Van Cappellen. Innovation in Integrated Water Management. 2nd International Summit on Water Environmental Management. Nanjing, China, November 2017

- Pomeroy J (2017). Cold regions hydrology in mountain and northern river basins: measurements, processes and modelling. High Altitudes meet High Latitudes: Globalizing Polar Issues Conference, Crans-Montana, Switzerland, September 11, 2017
- Pomeroy J (2017). The big thaw, Canada and the Global Water Futures Programme. Grantham Institute Seminar, London, October 27, 2017
- Pomeroy J (2017). Wolf Creek as an Outdoor Hydrology and Climate Laboratory 25 years of Contributions to Understanding Global Energy and Water Cycling. Wolf Creek Summit, Whitehorse, September 28, 2017
- Pomeroy J (2018). Cold regions process and modelling studies. Changing Cold Regions Network Annual General Meeting "The CCRN Finale", Saskatoon, March 5, 2018
- Pomeroy J (2018). Upcoming projects and work by Global Water Futures. Government of Alberta Workshop on Floodplain Mapping and Climate Change, Edmonton, March 20, 2018
- Pomeroy J and INARCH members, (2017). Climate Change and Mountain Hydrology: Results from the Global Energy and Water Exchange Project's International Network for Alpine Research Catchment Hydrology. Knowledge Forum on Water Security and Climate Change: Innovative Solutions for Sustainable Water Resources Management, Paris, October 18, 2017.
- Pomeroy J, (2017). Canadian Prairie Hydrology and Runoff Generation. Prairie WATERSAVE Brown Bag Meeting, Saskatoon, October 3, 2017.
- Pomeroy J, (2017). Cold regions hydrology in mountain and northern river basins: measurements, processes and modelling. High Altitudes meet High Latitudes: Globalizing Polar Issues Conference, Crans-Montana, September 11, 2017
- Pomeroy J, (2017). The big thaw, Canada and the Global Water Futures Programme. Grantham Institute Seminar, London, October 27, 2017
- Pomeroy J, (2017). The Global Water Futures Programme and its Science Contributions to the UN's Sustainable Development Goals and the Paris Climate Agreement. Knowledge Forum on Water Security and Climate Change: Innovative Solutions for Sustainable Water Resources Management, Paris, October 18, 2017
- Pomeroy J, (2017). The Global Water Futures Programme and the National Water Prediction and Forecasting System. Canadian Dam Association Conference & Exhibition, Kelowna, October 14, 2017.
- Pomeroy J, (2017). Wolf Creek as an Outdoor Hydrology and Climate Laboratory 25 years of Contributions to Understanding Global Energy and Water Cycling. Wolf Creek Summit, Whitehorse, September 28, 2017
- Pomeroy J, (2018). Cold regions process and modelling studies. Changing Cold Regions Network Annual General Meeting "The CCRN Finale", Saskatoon, March 5, 2018
- Pomeroy J, (2018). Introduction, GWF overview, and aims & objectives for the meeting. Global Water Futures Inception Meeting, Waterloo, January 22, 2018.
- Pomeroy J, (2018). Upcoming projects and work by Global Water Futures. Government of Alberta Workshop on Floodplain Mapping and Climate Change, Edmonton, March 20, 2018
- Pomeroy J, Carey S (2017). Wolf Creek Research Basin Yukon's Own Water and Climate Science Catalyst. Yukon Science Institute, Whitehorse, September 26, 2017

- Pomeroy J, Helgason (2018). Theme B overview and synthesis: CCRN Special Observation and Analysis Period (SOAP). Changing Cold Regions Network Annual General Meeting "The CCRN Finale", Saskatoon, March 5, 2018
- Pomeroy J, Pradhananga D*, Brown T*, Anderson E*, Demuth M, (2017). Modelling Changing Glacier Hydrological Processes using an Object Oriented Cold Regions Hydrological Model and Long-term In-situ and Remote Sensing Information. AGU Fall Meeting, New Orleans, December 11, 2017
- Pomeroy J, Rasouli K, Fang X, Whitfield P, Marks D, Janowicz R, (2017). Water Futures for Cold Mountain Ecohydrology under Climate Change Results from the North American Cordilleran Transect. AGU Fall Meeting, New Orleans, December 11, 2017.
- Pomeroy J, Shook K, Fang X, Annand H, Krogh S, (2017). Overview of CRHM development and application at the observatories, including long term diagnostic CRHM runs using WRF PGW, station downscaled RCM and statiscally dowscaled RCM, including transient change impacts. Discussion on insights from fine-scale results for large-scale modelling and next steps. Changing Cold Regions Network Modelling and Theme D Workshop, Canmore, November 2, 2017.
- Pomeroy, J. (2017). The big thaw, Canada and the Global Water Futures Programme. Grantham Institute Seminar, London, October 27, 2017 INVITED
- Pomeroy, J. (2018). Upcoming projects and work by Global Water Futures. Government of Alberta Workshop on Floodplain Mapping and Climate Change, Edmonton, March 20, 2018
- Pomeroy, J. (Invited) Cold regions process and modelling studies. Changing Cold Regions Network Annual General Meeting "The CCRN Finale". Saskatoon, SK. March 5, 2018.
- Pomeroy, J. (Keynote). The Global Water Futures Programme and the National Water Prediction and Forecasting System. CDA Conference & Exhibition. Kelowna, BC. October 14, 2017.
- Pomeroy, J., Shook, K.*, Fang, X.*, Annand, H.*, Krogh, S.*(Invited) Overview of CRHM development and application at the observatories, including long term diagnostic CRHM runs using WRF PGW, station downscaled RCM and statiscally dowscaled RCM, including transient change impacts. Discussion on insights from fine-scale results for large-scale modelling and next steps. Changing Cold Regions Network Modelling and Theme D Workshop. Canmore, AB. November 2, 2017.
- Rasouli K, Krogh S, Pavlovskii I, Hayashi M, Pomeroy J, (2017). The role of soil freezing and thawing in hydrological processes: Canadian case studies. The 2nd Asian Conference on Permafrost, Sapporo, July 2, 2017.
- Razavi, S. (2017), A New Framework for Comprehensive, Efficient, and Robust Global Sensitivity Analysis, The European Commission Joint Research Centre (JRC) Ispra 2 May 2017.
- Razavi, S. (2017), Observation, Diagnosis, and Prediction of Hydroclimatic Change: A Canadian Approach, Ferdowsi University, Mashad, Iran May 9, 2017.
- Razavi, S. (2017), Observation, Diagnosis, and Prediction of Hydroclimatic Change: A Canadian Approach, International Conference on Climate Change, Ministry of Energy, Tehran, Iran 27-28 February, 2017.
- Razavi, S. (2017), Observation, Diagnosis, and Prediction of Hydroclimatic Change: A Canadian Approach, University of Tehran, Tehran, Iran, April 23, 2017.

- Rudolph, D. L. (2018). Wrestling with Recharge: Quantifying Surficial Mass Flux for Diffuse Pollution Problems. Integrated Hydrosystem Modelling: How Complex Should Integrated Models Be? April 3-6, 2018, University of Tübingen, Germany (invited)
- Salk, KR. Exploring the nitrogen cycle in Lake 227 and beyond. Experimental Lakes Area Seminar Series, July 2017
- Salk, KR. Salk Illuminating a changing nitrogen cycle in lakes using stable isotopes. Norwegian Institute for Water Research Faglunsj Seminar Series, October 2017
- Salk, KR. Upstream and in-lake drivers of harmful algal blooms. Heidelberg University, March 2018
- Salman, M*. (2017). Geophysical methods for mapping permafrost. Canadian Exploration Geophysical Society Mini Symposium, December 2017, Toronto, ON. (invited)
- Shook, K.*, Pomeroy, J. (Poster) Classification of Prairie basins by their hysteretic connected functions. AGU Fall Meeting. New Orleans, LA. December 11, 2017
- Strickert, G.E.H. (2018), Connecting with Communities: Adventures in Community Engaged Scholarship, Assiniboine River Basin Initiative. Holiday Inn, Regina, Saskatchewan, February 14th, 2018.
- Strickert, G.E.H. (2018), Water Quality in the Saskatchewan River Basin, Who is Worried About What?, Partners for the Saskatchewan River Basin Annual Conference. Le Duke, Alberta.
- Strickert, G.E.H., Hassanzedah, E., Jardine, T., and Bradford, L.E.A. (2017). Water Quality in the Saskatchewan River Basin: Who is worried about what? Partners for the Saskatchewan River Basin Annual Conference: Le Duke, Alberta. October 18, 2017. INVITED
- Swanson, H.K. (2018). We Want to Eat the Fish: investigating levels of mercury in northern fish. Invited Lubinsky Memorial Public Lecture, University of Manitoba, Winnipeg, MB, March 1, 2018
- Thériault, J M (2017), Winter precipitation types, Canadian Geophysical Union Congress, Vancouver, British Columbia, Canada (Invited, OP)
- Turetsky, M. (2018). International collaborations between NASA and Global Water Futures/Northern Water Futures. All Scientist Meeting for NASA Arctic Boreal Vulnerability Experiment, Seattle, USA
- Turetsky, M. (2018). Understanding and scaling change in lowland permafrost: Cross-scale feedbacks to hydrology and carbon. Arctic Systems Change Workshop. Plenary Speaker. UCAR, Boulder Colorado, USA
- US Forest Service, Southwest Oregon Forestry Adaptation Workshop, April 17th & 18th, 2018.

 Presenter on: "Vulnerability and Adaptation to Climate Change in Sustainable Forest Management In Saskatchewan: Mistik Case Study".
- Westbrook CJ. "Leave it to Beaver", presented at: Putting Beavers to Work for Watershed Resiliency and Restoration Symposium, 7 December 2017, Cochrane, AB. Held jointly by: Miistakis Institute and the Alberta Riparian Habitat Management Society (gave invited talk and sat on a Q&A panel)
- Wetlands hydrogeochemical processes under changing winter conditions. Invited talk at the 53rd Central Canadian Symposium on Water Quality Research, February 22nd 2018, University of Toronto. Invited by Dr. Ron Hofmann.
- Wolfe, J.D. (2018) Prairie Water Overview. Global Water Futures Indigenous Partners meeting, Saskatoon SK. January 8, 2018. INVITED

- Zwiers, F.W: A brief update on climate science, Southern Interior Silviculture Committee 2018 Winter Workshop, Kamloops, February 13, 2018 (keynote speaker)
- Zwiers, F.W: Changing weather extremes: Why it isn't an alternative fact, TISED, Faculty of Engineering, McGill University, August 30, 2017 (invited seminar)
- Zwiers, F.W: Climate Uncertainty: Are we facing an increase in the frequency and severity of extreme events? Okanagan Water Stewardship Board, Kelowna, December 14, 2017 (invited speaker)
- Zwiers, F.W: Probable maximum precipitation estimation and uncertainty quantification using bivariate extreme value analysis, Department of Statistics, University of Manitoba, October 19, 2017 (invited seminar)
- Zwiers, F.W: Probable maximum precipitation estimation and uncertainty quantification using bivariate extreme value analysis, International Workshop on Tropical-subtropical Weather, Climate and Oceans, Sun Yat-sen University, Guangzhou, China, November 20, 2017 (invited lecture)
- Zwiers, F.W: Probable maximum precipitation estimation and uncertainty quantification using bivariate extreme value analysis, Workshop on Environmental Risk Modelling, Centre de Recherches Mathematique, Universite de Montreal, August 30,2017
- Zwiers, F.W: Update on extremes, with a focus on engineering applications, BC Hydro Adaptation Working Group, Burnaby, BC, September 27, 2017
- Zwiers. (2017). Climate Uncertainty: Are we facing an increase in the frequency and severity of extreme events? Okanagan Water Stewardship Board, Kelowna, December 14 (invited speaker)
- Zwiers. A brief update on climate science, Southern Interior Silviculture Committee 2018 Winter Workshop, Kamloops, February 13 (keynote speaker)

Conference Presentations (non-invited)

- A. Bieniada, L. Hug, C. Parsons, P. Van Cappellen, M. Strack. Methanogenic and methanotrophic communities in extracted and restored peatlands. Canadian Geophysical Union Annual Meeting 2018, Niagara Falls, Ontario, June 12, 2018
- A. Werenka, K.J. Van Meter, B. Tolson, N.B. Basu. Too Much Phosphorous: Is Investment in Biogas Plants a Viable Alternative for Water Quality Improvement? Canadian Geophysical Union Joint Meeting, Niagara Falls, Canada, June 2018
- Abstract submitted for the GWF Annual Science Meeting in June, 2018: Nancy C. Doubleday, "Envisioning Polycentric Water Governance in a Canadian Context".
- Anis, M. R, Pietroniro, A., Elshamy, M., Razavi, S., and Wheater, H., (2017), Effects of irrigation on the water and energy balances of the Bow river basin in Alberta, Canada, Canadian Geophysical Union (CGU) Annual Scientific Meeting, May 28-31, 2017, Vancouver (Oral Presentation).
- Anis, M.R., Haghnegahdar, A., Razavi, S., and Wheater, H. (2017), Global Sensitivity Analysis of the WASIM hydrological model using VARS, European Geosciences Union (EGU) General Assembly, April 23-28, 2017, Vienna, Austria (Poster Presentation).
- Anis, M.R., Razavi, S., and Wheater, H. (2017), An integrated modelling framework for regulated river systems in Land Surface Hydrological Models, European Geosciences Union (EGU) General Assembly, April 23-28, 2017, Vienna, Austria (Oral Presentation).

- Balliston & Price, 2018. Long-term impacts of high volume groundwater extraction on sub-arctic peatlands: developing hydrological and ecological process-based feedback models. Poster presented at the Canadian Geophysical Union Hydrology Section Student Conference 2018, London, Ontario.
- Baltzer, JL and 22 other authors. (2017). A global assessment of drivers of post-fire regeneration in boreal forests. Arctic Change 2017, Quebec City, QC.
- Baulch, H., J. Elliott, H.F. Wilson, M.R.C. Cordeiro, D.N. Flaten and D. Lobb. Soil and water management for nutrient control in the Northern Great Plains. Society of Canadian Limnologists, Canadian Conference for Fisheries Research. Edmonton, Alberta. Jan 4-7, 2018.
- Black, K*, Baltzer, J. (2017). Seasonal thaw and topography determine tall shrub function on the low arctic tundra. Arctic Change 2017, Quebec City, QC.
- Bodo A and Arain M.A., 2018. Investigating the effects of variable harvesting applications on tree transpiration in a red pine plantation. Poster presentation at the Canadian Geophysical Union (CGU) Eastern Student meeting held in London, Ontario on March 17, 2018.
- Boyer, L., S. Higgins, P. Leavitt and H. Baulch. The dynamics of nitrogen-fixing cyanobacterial in prairie lakes. SCL, Edmonton, Alberta. January 2018
- Bruneau, J. & J. Hanesiak, 2017: Future Changes in Convective Precipitation & Severe Weather Environment in Western Canada, CMOS Congress, June 4-8, Toronto, Canada
- Bruneau, J., J. Hanesiak and William Burrows: Future Changes in Precipitation and Severe Weather Environments, 5th (final) Changing Cold Regions Network (CCRN) Meeting, March 5-6, 2018, Saskatoon, SK
- C. McCarter, F. Rezanezhad, B. Gharedaghloo, J. Price, P. Van Cappellen. Influence of peat depth on solute transport in peat. 2017 AGU Fall Meeting, 11-15 December 2017, New Orleans, Louisiana.
- Carlow*, R., Macrae, M.L., Plach*, J., Brunke, R.I. How low can you go? The use of Geotextiles as a Filter for Phosphorus in Overland Flow in Agricultural Croplands of Southern Ontario. Poster Presentation. Canadian Soil Science Society Annual Meeting. Peterborough, Ontario. June 12-14, 2017.
- Cober*, J.R., Macrae, M.L., and Van Eerd, L.L. Relationship between cover crop species and winter phosphorus release to runoff in a field setting. Oral Presentation. Canadian Soil Science Society Annual Meeting. Peterborough, Ontario. June 10-14, 2017.
- Connon, R., É. Devoie, M. Braverman and W. Quinton. Over-winter flowpaths through talik networks in discontinuous permafrost terrains. 2017 Yellowknife Geoscience Forum, Yellowknife, Northwest Territories. Nov. 14-16, 2017.
- Connon, R., Impacts of thawing permafrost at the Scotty Creek Research Station, NWT, Canada. Changing Cold Regions Network Annual Meeting, Saskatoon, SK. March 5-6, 2018.
- Connon, R., W. Quinton, É. Devoie and M. Hayashi. The role of taliks as tipping points for permafrost thaw. Canadian Geophysical Union Annual General Meeting, Vancouver, British Columbia. May 29-31, 2017.
- Costa D, Pomeroy J, Wheater H, (2017). PULSE: A numerical model for the simulation of snowpack solute dynamics to capture runoff ionic pulses during snowmelt. 2017 AGU Fall Meeting, New Orleans, December 11, 2017.

- D. Byrnes, K.J. Van Meter, N.B. Basu. Biogeochemical Asynchrony: Anthropogenic and Landscape Drivers of Nutrient Seasonality Across the Great Lakes Basin and Beyond. Canadian Geophysical Union Joint Meeting, Niagara Falls, Canada, June 2018
- D.H. Oh, F. Rezanezhad, I. Markelov, C. P. R. McCarter, P. Van Cappellen. Effect of freeze-thaw cycles on greenhouse gas fluxes from peat soils. 2017 AGU Fall Meeting, 11-15 December 2017, New Orleans, Louisiana.
- Das A., Rokaya, P. and Lindenschmidt, K.-E. (2017), Assessing the impacts of climate change on ice jams along the Athabasca River at Fort McMurray, Alberta, Canada. CGU HS Committee on River Ice Processes and the Environment, 19th Workshop on the Hydraulics of Ice Covered Rivers, Whitehorse, Yukon, Canada, July 9-12, 2017. http://cripe.ca/docs/proceedings/19/Das-et-al-2017.pdf
- DeHaan, K., Petrone, R.M. Preliminary planning for water use efficiency study of cereal and non-cereal crops in southern Ontario for future application in Cold Regions Hydrological.

 Canadian Geophysical Union Eastern Student Conference. London, Ontario. March 17, 2018.
- Devoie, É., J. Craig, W. Quinton and R. Connon. Quantifying thaw mechanisms in discontinuous permafrost: Is talik formation a tipping point? 2017 Yellowknife Geoscience Forum, Yellowknife, Northwest Territories. Nov. 14-16, 2017.
- Devoie, É., R. Connon, W. Quinton, and J. Craig. Modelling the effects of talk development in discontinuous permafrost. Changing Cold Regions Network Annual Meeting, Saskatoon, SK. March 5-6, 2018.
- Dixon, H. J., A. Lister, D. MacLatchy and H. K. Swanson. Investigating walleye movement in Tathlina Lake, Northwest Territories. Great Lakes Acoustic Telemetry Observation System Coordination Meeting, Ann Arbor, Michigan. Feb 27-Mar 1, 2018.
- Duffy, A. and Thapa, A. (2018) Incorporating stakeholder viewpoints into water quality modeling and decisions" World Water Day 2018 Symposium (GIWS, University of Saskatchewan). March 22, 2018. (Poster)
- É. Devoie, J. Craig, W. Quinton and R. Connon. Quantifying thaw mechanisms in discontinuous permafrost: Is talik formation a tipping point? (2017) Yellowknife Geoscience Forum, Yellowknife, Northwest Territories.
- English, M. (2017). 'Antecedent conditions governing flow in an unregulated arctic watershed and implications for hydroelectric power generation in the Northwest Territories' Oral presentation at the international Arctic Change conference in Quebec City.
- English, M. (2017). 'Towards understanding hydrological patterns producing low flow in the Snare River system, Northwest Territories' Poster presentation at the 45th annual Geoscience Forum in Yellowknife.
- English, M., J. Hickman, S. Kokelj and P. Marsh. Towards an understanding of the relationships between precipitation and surface discharge in unregulated basins of the Snare River watershed. International Arctic Change 2017 Conference. Quebec City, Quebec. Dec. 11-15, 2017.
- Ensom TP on behalf of Marsh P, Mann P, Walker B, Toure A, Wilcox E, Sonnetag O, Derksen C. (2017). Integrating High Resolution Field Observations and Modelling to Improve Our Understanding of Climate Change Induced Hydrological Change. Permafrost Modelling

- and Monitoring Session, 45th Yellowknife Geoscience Forum, Yellowknife, NWT. 14 November 2017. Oral Presentation.
- Ensom TP, Marsh P, Kokelj SV. (2017). Hydrothermal Regime of Stream Channels in Tuktoyaktuk Coastlands and Anderson Plain, Northwest Territories. Permafrost Hydrology Session, 45th Yellowknife Geoscience Forum, Yellowknife, NWT. 16 November 2017. Oral Presentation.
- Ensom TP, Marsh P, Kokelj SV. (2017). Hydrothermal Regime of Stream Channels: Tuktoyaktuk Coastlands and Anderson Plain. Cold Regions Research Centre Symposium, Wilfrid Laurier University, Waterloo ON, 1 December 2017. Oral Presentation.
- Ensom TP, Marsh P, Kokelj SV. (2017). Hydrothermal Regimes in small channels and water tracks of the Tuktoyaktuk Coastlands and Anderson Plain. ArcticNet Arctic Change 2017 Conference, Quebec City, QC. December 2017. Poster Presentation.
- F. Cheng, N.B. Basu. Biogeochemical hotspots: The importance of small water bodies in landscape nutrient processing. Canadian Geophysical Union Joint Meeting, Niagara Falls, Canada, June 2018
- F. Rezanezhad, C.P. R. McCarter, B. Gharedaghloo, C. Kleimeier, T. Milojevic, H. Liu, T. K. D. Weber, J. S. Price, W.L. Quinton, B. Lennartz, P. Van Cappellen. Structure of peat soils and implications for biogeochemical processes and hydrological flow. 2017 AGU Fall Meeting, 11-15 December 2017, New Orleans, Louisiana.
- F. Rezanezhad, T. Milojevic, D. Oh, C. Smeaton, C. Parsons, C. McCarter, P. Van Cappellen. Soil hydrogeochemical processes under changing winter conditions. Canadian Geophysical Union Annual Meeting 2018, Niagara Falls, Ontario, June 13, 2018
- F. Rezanezhad, T. Milojevic, D. Oh, C.T. Parsons, C. M. Smeaton, C. McCarter and P. Van Cappellen. Wetlands hydrogeochemical processes under changing winter conditions. 53rd Central Canadian Symposium on Water Quality Research, February 22nd 2018, University of Toronto
- Faber J*, Owca T*, Kay M, Wiklund J, Wolfe B, Hall RI. (2018). Understanding the effects of industry on the Peace-Athabasca Delta (Canada): developing baseline hydrological conditions and sediment metal concentrations using paleolimnology. Canadian Geophysical Union Hydrology Section Ontario Student Conference, Western University, London.
- Faber J*, T Owca*, BB Wolfe and RI Hall. (2017). Establishing baseline hydrological conditions and sediment metal concentrations for the Peace River Floodplain in the Peace in the Peace-Athabasca Delta, using paleolimnology. Cold Regions Research Centre Day, Wilfrid Laurier University.
- Fortin V, Vionnet V, Dimitrijevic M, Abrahamowicz M, Gauthier N, Garnaud C, Belair S, Milbrandt J, Pomeroy J, Forecasting of rain-on-snow events in alpine region using a fully coupled atmosphere/snowpack/hydrology model. 2017 AGU Fall Meeting, New Orleans, December 11, 2017. (poster)
- Fouché, J., Sonnentag, O., Helbig, M., Wischnewski, K., Hould Gosselin, G., Quinton, W.L., Moore, T. (2018), Dissolved organic carbon export and its contribution to the carbon budget in a boreal peat landscape undergoing rapid permafrost thaw (oral). 5th European Conference on Permafrost, June 23-July 1, Chamonix-Mont Blanc, France.

- Fouché, J., Sonnentag, O., Hould Gosselin, G., Hould Gosselin, G., Hanisch, J., Quinton, W.L., Moore, T.R. (2017). Dissolved organic carbon export and its contribution to the carbon budget in a boreal peat landscape undergoing rapid permafrost thaw (oral). Abstract B31J-04, December 11-15, New Orleans, Louisiana, USA.
- Francis Zwiers, Probable maximum precipitation estimation and uncertainty quantification using bivariate extreme value analysis, Workshop on Environmental Risk Modelling, Centre de Recherches Mathematique, Universite de Montreal, August 30, 2017
- Francis Zwiers, Update on extremes, with a focus on engineering applications, BC Hydro Adaptation Working Group, Burnaby, BC, September 27, 2017
- G. J. Pronk, A. Mellage, T. Milojevic, C. Smeaton, F. Rezanezhad, P. Van Cappellen. Depth dependent microbial carbon use efficiency in the capillary fringe as affected by water table fluctuations in a column incubation experiment. 2017 AGU Fall Meeting, 11-15 December 2017, New Orleans, Louisiana.
- Gharari, S. and Razavi, S. (2017), Do small-scale hysteretic processes affect the larger-scale behavior of watersheds?, European Geosciences Union (EGU) General Assembly, April 23-28, 2017, Vienna, Austria (Oral Presentation).
- Gharari, S., and Razavi, S., (2017), Do small-scale hysteretic processes affect the larger-scale behavior of watersheds?, Canadian Geophysical Union (CGU) Annual Scientific Meeting, May 28-31, 2017, Vancouver (Oral Presentation).
- Gharari, S., Safaei, S., Razavi, S., and Wheater, H., (2017), On the closure of the water balance in the catchments of the Canadian Rockies, Canadian Geophysical Union (CGU) Annual Scientific Meeting, May 28-31, 2017, Vancouver (Oral Presentation).
- Gharari, S., Safaei, S., Sheikholeslami, R., Haghnegahdar, A., and Razavi, S. (2017), Estimation of rainfall over the Canadian Rockies by approximating the water balance component, European Geosciences Union (EGU) General Assembly, April 23-28, 2017, Vienna, Austria (Poster Presentation).
- Giering Y, McPhee J, Pomeroy J, Landscape-based discretization for modeling of hydrological processes in the semi-arid Andes Cordillera: a case study in Morales Basin. AGU Fall Meeting, New Orleans, December 11, 2017
- Grant*, K.N., Macrae, M.L., Rezanezhad, F., Lam*, W.V. Phosphorus movement and solute transport in frozen and unfrozen soil under no-till management with different fertilizer application strategies. Poster Presentation. Canadian Soil Science Society Annual Meeting. Peterborough, Ontario. June 11-14, 2017.
- Haghnegahdar, A., Elshamy, M, Yassin, F., Princz, D., Razavi, S., Wheater, H., and Pietroniro, A., (2017), A comprehensive sensitivity assessment approach for analyzing the behavior of a land surface-hydrology model, Canadian Geophysical Union (CGU) Annual Scientific Meeting, May 28-31, 2017, Vancouver (Oral Presentation).
- Haghnegahdar, S., Razavi, S., and Sheikholeslami, R. (2017), Dealing with Model Crashes in Global Sensitivity Analysis, Canadian Geophysical Union (CGU) Annual Scientific Meeting, May 28-31, 2017, Vancouver (Oral Presentation).
- Hanesiak, J. & K. Ziolkowski, 2017: Influence of Bores on Nocturnal Convective Initiation During PECAN and on the Canadian Prairies: A Case Study Analysis, 17th Conference on Mesoscale Processes, June 24-28, San Diego, CA

- Hanesiak, J. et al: Weather / Climate extremes and NECI Processes, 5th (final) Changing Cold Regions Network (CCRN) Meeting, March 5-6, 2018, Saskatoon, SK
- Hanke*, K.M., Macrae, M.L., Basu, N., Michaud, A. Seasonal impacts of climate change on hydrology, nutrients and sediment loads in the Medway Creek watershed in southern Ontario. Oral Presentation. Canadian Soil Science Society Annual Meeting. Peterborough, Ontario. June 11-14, 2017.
- Harder P, Pomeroy J, Helgason W, Diagnosing stubble management and climate variability impacts on runoff and infiltration in cold semi-arid agricultural regions. 2017 AGU Fall Meeting, New Orleans, December 11, 2017. (poster)
- Helbig, M., Quinton, W.L., Sonnentag, O. (2017). Warmer spring in the sporadic permafrost zone increases annual methane emissions from a boreal peat landscape (oral). Abstract B11J-06, December 11-15, New Orleans, Louisiana, USA.
- Hewitt, K.L. and Ferguson, G. (2017) Management of an Intertill Aquifer in the East Regina Area, Saskatchewan. Joint Annual Meeting of the Canadian Geotechnical Society and the International Association of Hydrogeologists Canadian National Chapter. Oct 1–4. Ottawa, Ontario.
- Hickman, J., M. English and S. Kokelj. Antecedent conditions governing flow in an unregulated arctic watershed and implications for hydroelectric power generation in the Northwest Territories. International Arctic Change 2017 Conference. Quebec City, Quebec. Dec. 11-15, 2017.
- Hickman, J., M. English and S. Kokelj. Identification of patterns in hydrological conditions governing flow in an unregulated river basin in the Northwest Territories, and implications for downstream hydroelectric power generation. 5th European Conference on Permafrost, Chamonix, France, June 22-29, 2018.
- Hickman, J., M. English and S. Kokelj. Towards understanding hydrological patterns producing low flow in the Snare River system, Northwest Territories. 2017 Yellowknife Geoscience Forum, Yellowknife, Northwest Territories. Nov. 14-16, 2017.
- Hrach, D., Petrone, R. Quantifying seasonality and role of shading dynamics on a subalpine wetland, Kananaskis, Alberta. CGU Eastern Student Section Meeting 2018, poster presentation.
- Hurkuck, M., Marsh, P., Quinton, W.L., Humphreys, E., Lafleur, P. Helbig, M., Hould Gosselin, G., Sonnentag, O. (2017), A meso-network of eddy covariance towers across the Northwest Territories to assess high-latitude carbon and water budgets under increasing pressure (poster). Abstract B21F-2014, December 11-15, New Orleans, Louisiana, USA.
- J. Ives, R. Rooney, S. V. Ivanova, J. Ciborowski, N. Barker, J. Gannon. Assessing drivers of human-induced change in Lake Erie using fuzzy cognitive mapping. International Association for Great Lakes Research Conference, Toronto, Canada, June 2018
- J. Mai and B. Tolson (2018). Model Variable Augmentation MVA for Online Diagnostic Assessment of Sensitivity Analysis Results. EGU2018-9947. EGU General Assembly. Vienna, Austria. 09-13/04/2018
- Jasiak I*, Kay M, Wolfe BB and Hall RI. (2018). Clear as mud: Reconstructing the hydrology and contaminant deposition at a lake in the Peace-Athabasca Delta, Canada. World Water Day, University of Waterloo, Waterloo.

- Jasiak I*, M Kay, BB Wolfe and RI Hall. (2018). Reconstructing hydrological conditions and contaminant deposition in the Peace-Athabasca Delta, Alberta. Canadian Geophysical Union Hydrology Section Ontario Student Conference, Western University, London.
- Jasiak I*, M Kay, BB Wolfe and RI Hall. (2018). Reconstructing the hydrology and contaminant deposition at a lake in the Peace-Athabasca Delta, Canada. World Wetlands Day, University of Waterloo, Waterloo.
- Jason Flemke, Yanping Li, Changhai Liu, 2017: Central U.S. WRF composite radar verification using MODE-Time Domain, 51st CMOS Congress Annual Meeting, Toronto, ON, Canada, June 5, 2017
- Jason Flemke, Yanping Li, Changhai Liu, 2017: Central U.S. WRF composite radar verification using MODE-Time Domain. 18th Annual WRF User's Workshop, Boulder, CO, USA, June 14, 2017
- Jason Flemke, Yanping Li, Changhai Liu, 2018: Central U.S. WRF Statistical Verification of Simulated Composite Radar. 22nd Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface (IOAS-AOLS) and 98th American Meteorological Society Annual Meeting, Austin, Texas, January 10, 2018
- Jorge S*, CR Remmer*, BB Wolfe and RI Hall. (2018). Use of aquatic cellulose δ 180 in surface sediments to track differences in basin hydrology of lakes across the Peace-Athabasca Delta, northern Alberta. Canadian Geophysical Union Hydrology Section Ontario Student Conference, Western University, London.
- K. G. Lamb, S. Bryne-Mamahit, M. Stastna. Idealized numerical simulations of Ontario's Grand River plume. EGU General Assembly 2018. Vienna, Austria. April 8-13, 2018.
- K. J. Van Meter, P. Van Cappellen, N. B. Basu. Past, Present, and Future: Quantification of Long-Term Phosphorus Legacies in Canada's Grand River Watershed. Canadian Geophysical Union Joint Meeting, Niagara Falls, Canada, June 2018
- K. Zolfaghari, S. Bird, G. Wilkes, D. Ellis, K.D.M. Pintar, N. Gottschall, E. Topp, C.R. Duguay, H. McNairn, D.R. Lapen. A Comparison of Lab- and Field-based Water Quality Measurements for Agricultural Surface Waters. International Association for Great Lakes Research. June 18-22, 2018. [abstract submitted]
- Kay ML*, C Remmer*, J Vucic, L Neary*, MacDonald, K Wesenberg, K Thomson, K Brown, JA Wiklund, B Wolfe and RI Hall. (2017). Discerning the effects of major energy projects, climate change and distributary flow on hydrology of lakes in the Athabasca Delta using paleolimnology. Canadian Association of Geographers Ontario Division Annual Meeting, Queen's University, Kingston.
- Kay ML, C Remmer*, J Vucic, L Neary, MacDonald, K Wesenberg, K Thomson, K Brown, JA Wiklund, B Wolfe and RI Hall. (2018). Use of a binary mixture model to reconstruct 300 years of Athabasca River sediment metal concentration from floodplain lake cores. Canadian Geophysical Union Hydrology Section Ontario Student Conference, Western University, London.
- Kehler, S. & J. Hanesiak, 2017: Cases of Elevated Convection Initiation on Frontal Surfaces in 2015, CMOS Congress, June 4-8, Toronto, Canada.
- Kehoe, M.J. and H. Baulch. Using high frequency buoy data to forecast harmful algal blooms. Society of Canadian Limnologists (SCL), Edmonton, Alberta. January 2018.

- Klemt W*, RI Hall and BB Wolfe. (2017). Use of floodplain sediments to determine pre-industrial baseline and extent of metal pollution of the Athabasca River in the Alberta Oil Sands Region. Cold Regions Research Centre Day, Wilfrid Laurier University.
- Klemt W*, RI Hall and BB Wolfe. (2018). Defining the natural range of variation and extent of metal pollution of the Athabasca River in the Alberta oil sands region: an approach using floodplain lake sediments. Canadian Geophysical Union Hydrology Section Ontario Student Conference, Western University, London.
- Klemt W*, RI Hall and BB Wolfe. (2018). Floodplain lakes as archives of natural and anthropogenic trace metal deposition in the Alberta oil sands: a journey through time. World Water Day, University of Waterloo, Waterloo.
- Klemt W*, RI Hall and BB Wolfe. (2018). Flood-prone lakes as archives of natural and anthropogenic trace metal deposition in the Alberta oil sands. World Wetlands Day, University of Waterloo, Waterloo.
- Klemt W*, RI Hall and BB Wolfe. (2018). Use of floodplain lake sediments to determine pre-industrial baselines and extent of metal pollution of the Athabasca River in the Alberta oil sands region. Canadian Conference for Fisheries Research / Society of Canadian Limnologists, Edmonton.
- Krogh S, Pomeroy J, (2017). Determining hydrological changes in a small Arctic treeline basin using cold regions hydrological modelling and pseudo-global warming approach. 2017 AGU Fall Meeting, New Orleans, December 11, 2017.
- Langs, L., Petrone, R. Investigating alpine forest water use during variable growing season and climate conditions in the Canadian Rocky Mountains, Kananskis, Alberta. CGU Eastern Student Section Meeting 2018, poster presentation.
- Li Y., Kurkute S, and Chen L. (2018), Projected Changes over Western Canada Using Convection-Permitting Regional Climate Model. 31st Conference on Climate Variability and Change and 98th American Meteorological Society Annual Meeting, Austin, Texas, January 7-11, 2018.
- Li Y., Kurkute S., and Chen L. (2017), Projected changes over western Canada using convectionpermitting regional climate model and the pseudo-global warming method. 2017 AGU Fall Meeting, New Orleans, Louisiana, December 11-15, 2017.
- Li, Y., and Co-authors. Projected changes over western Canada using convection-permitting regional climate model and the pseudo-global warming method. 2017 AGU Fall Meeting. New Orleans, Louisiana. December 13, 2017.
- Li, Y., Chen, L., Chen, F., Barlage, M. Evaluate the surface coupling strength of the continental scale 4-km WRF regional climate simulations. 51st CMOS Congress Annual Meeting. Toronto, Ontario. June 5, 2017.
- Li, Y., Kurkute, S. The Lagrangian identification of moisture sources for precipitation over Western Canada. 51st CMOS Congress Annual Meeting. Toronto, Ontario. June 5, 2017.
- Li, Z., Li, Y., Bonsal, B., Manson, A. Madden-Julian Oscillation and Summer Precipitation over the Canadian Prairies. 2017 AGU Fall Meeting. New Orleans, Louisiana. December 14, 2017.
- Lindenschmidt, K.-E. (2017), Modelling probabilities of ice jam flooding from artificial breakup of the Athabasca River ice cover at Fort McMurray. CGU HS Committee on River Ice Processes and the Environment, 19th Workshop on the Hydraulics of Ice Covered Rivers,

- Whitehorse, Yukon, Canada, July 9-12, 2017. http://cripe.ca/docs/proceedings/19/Lindenschmidt-2017.pdf
- Liu, N., Kells, J. and Lindenschmidt, K.-E. (2017), Two-way fluid-structure interaction model of waves propagating in a channel with an ice cover. CGU HS Committee on River Ice Processes and the Environment, 19th Workshop on the Hydraulics of Ice Covered Rivers, Whitehorse, Yukon, Canada, July 9-12, 2017. http://cripe.ca/docs/proceedings/19/Liu-etal-2017.pdf
- Lyon L, McKenzie JM, Langston G, Effects of groundwater flow on permafrost distribution in a subarctic watershed. GEOTOP Student Meeting. (Poster). La Malbaie, Canada, March 23, 2018
- M. P. Wilson, H. Kheyrollah Pour, Nandita Basu, P. Van Cappellen. Variability of Chlorophyll-a and Temperature in Lake Erie and lake St. Clair using remotely-sensed observations. 9th annual World Water Day, University of Waterloo, Waterloo, Canada, March 22, 2018.
- M. P. Wilson, H. Kheyrollah Pour, Nandita Basu, P. Van Cappellen. Variability of Chlorophyll-a and Temperature in Lake Erie and lake St. Clair using remotely-sensed observations. World Wetland Day 2018, University of Waterloo, Waterloo, Canada, February 2, 2018.
- M. Samson, K. J. Van Meter, N. Basu. Urban Metabolism of the Greater Toronto Area: A Study of Nitrogen and Phosphorus Across an Urban, Suburban, and Rural Continuum. Canadian Geophysical Union Annual Meeting 2018, Niagara Falls, Ontario, June 13, 2018
- Macrae, M.L., Brunke, R.I., English, M.C., Ferguson, G., Lam*, V., Lozier*, T., McKague, K., O'Halloran, I., Plach*, J., Van Esbroeck*, C. Improving water quality in agricultural watersheds in the Great Lakes region with best management practices. 2nd Sino-Canada Water Environment Workshop. Waterloo, Ontario. September 18-20, 2017.
- Macrae, M.L., Brunke, R.I., English, M.C., Ferguson, G., Lam*, V., Lozier*, T., McKague, K., O'Halloran, I., Plach*, J., Van Esbroeck*, C. Phosphorus losses from agricultural fields in Ontario: Importance of the non-growing season. Seminar in the Dept. of Geography, York University. Toronto, Ontario. October 6, 2017.
- Marinier, S, J M Thériault (2017), Case study of an ice pellet storm over the Toronto area in a climate change context, CMOS Congress, Toronto, Ontario, Canada [OP]Discovery Grant
- Marsh C*, Wayand N*, Pomeroy J, Wheater H, Spiteri R, (2017). A finite volume, scalar-transport blowing snow model for use with variable resolution meshes. AGU Fall Meeting, New Orleans, December 11, 2017
- Marsh C, Wayand N, Pomeroy J, Wheater H, Spiteri R, (2017). A finite volume, scalar-transport blowing snow model for use with variable resolution meshes. AGU Fall Meeting, New Orleans, December 11, 2017
- Marsh CB, Spiteri RJ, Pomeroy JW, Wheater HS, PBSM3D: A complex terrain blowing snow model for use with variable resolution meshes. 3rd annual INARCH workshop at Schneefernerhaus Zugspitze, Germany, February 8, 2018
- Mathieu, E., R. Connon, W. Quinton, and O. Sonnentag. The impact of a low-severity burn on the trajectory of permafrost thaw: Scotty Creek, Northwest Territories, Canada. Changing Cold Regions Network Annual Meeting, Saskatoon, SK. March 5-6, 2018.
- Matte, D, J M Thériault, and R Laprise (2017), Climate change study of mixed precipitation over southern Quebec using a Regional Climate Models, CMOS Congress, Toronto, Ontario, Canada [PP] Discovery Grant

- Mavrovic, A., Roy, A., Royer, A., Sonnentag, O., Pappas, C*, Filali, B., Boone, F. (2017), Vegetation dielectric characterization using an open-ended coaxial probe (poster). Abstract B23E-2129, December 11-15, New Orleans, Louisiana, USA.
- Menounos et al. (2017). Estimates of Glacier Mass Change for Western North America. American Geophysical Union
- Morales-Marin L.A., Rokaya P, Wheater H.S., and Lindenschmidt K.-E. (2017), A stream temperature model for the Peace-Athabasca River basin, 2017 AGU Fall Meeting, New Orleans, Louisiana, December 11-15, 2017.
- Neary L*, C Remmer*, M Kay, W Klemt*, B Wolfe and R Hall. (2018). Widespread photosynthetically-induced CO2 invasion in numerous lakes across the Peace-Athabasca Delta (Alberta, Canada). World Water Day, University of Waterloo, Waterloo.
- O. Al-Dabbag and G. Krantzberg. The Effects of Nitrogen Dynamics on Toxic, Non-Diazotrophic Microcystis spp. in Eutrophic Lakes International Association for Great Lakes Research. June 18-22, 2018 [Abstract accepted].
- O. Sonnentag, M. Helbig, R. Connon, G. Gosselin, E. Haughton, K. Wischnewski, J. Hanisch, T. Moore and W. Quinton. (2017). The subcatchment-and catchment-scale hydrology of a boreal headwater peatland complex with sporadic permafrost. Canadian Geophysical Union Annual General Meeting, Vancouver, British Columbia.
- Owca T, C Remmer, M Kay, R Hall and B Wolfe. (2017). Determining sources, pathways and spatial distribution of metals in lakes of the Peace-Athabasca Delta from concentrations in periphytic algae and surface sediment. Canadian Association of Geographers Ontario Division Annual Meeting, Queen's University, Kingston.
- Owca T, C Remmer, M Kay, R Hall and B Wolfe. (2017). Determining sources, pathways and spatial distribution of metals in lakes of the Peace-Athabasca Delta from concentrations in periphytic algae and surface sediment. Cold Regions Research Centre Day, Wilfrid Laurier University.
- Pappas, C., Baltzer, J.L., Barr, A., Black, T.A., Bohrer, G., Detto, M., Maillet, J., Matheny, A.M., Roy, A., Sonnentag, O. (2017), Boreal tree light- and water-use: asynchronous, diverging, yet complementary (oral). Abstract B23F-2122, December 11-15, New Orleans, Louisiana, USA.
- Pisek, J., Buddenbaum, H., Camacho, F. et al. incl. Sonnentag, O. (2017), Photon recollision probability as a useful concept for compatibility check between leaf area index and foliage clumping products (poster). Abstract B31D-2005, December 11-15, New Orleans, Louisiana, USA.
- Plach, J., Macrae, M.L., Williams, M. King, K. Risk of Phosphorus loss from agricultural soils in the lower Great Lakes Region of Canada and USA. Annual Meeting of SERA-17. Oregon, Ohio. August 14-17, 2017.
- Plach, J., Macrae, M.L.., Williams, M., King, K. Risk of Phosphorus loss from surface and subsurface soils in tile drained agricultural croplands in the lower Great Lakes Region of Canada and the USA. Oral Presentation. Canadian Soil Science Society Annual Meeting: Soil and the Environment. Peterborough, Ontario. June 10-14, 2017.
- Plach, J., and Macrae, M.L. Soil Management Impacts on Water Quality. Oral Presentation. Soil Summit on Canadian Soil Health 2017. Soil Conservation Council of Canada (SCCC). August 22-23, 2017. Guelph, Ontario.

- Quinton, W., R. Connon, É. Devoie, M. Braverman. Toward understanding the trajectory of hydrological change in the southern Taiga Plains, NWT. Canada. 21st International Northern Research Basins Symposium and Workshop. Yakutsk, Russia. August 5 12, 2017.
- Quinton, W., R. Connon, et al. (25 authors). Summary of the Changing Cold Regions Network (CCRN) hydrological research at Scotty Creek. Changing Cold Regions Network Final Meeting, Saskatoon, SK, Mar. 5-6, 2018.
- R. Connon and W. Quinton. Permafrost thaw induced changes to hydrological connectivity. (2017). American Water Resources Associtation Spring Conference: The emerging science of aquatic system connectivity. Salt Lake City, Utah, USA.
- R. Connon, É. Devoie, M. Braverman and W. Quinton. Over-winter flowpaths through talik networks in discontinuous permafrost terrains. 2017 Yellowknife Geoscience Forum, Yellowknife, Northwest Territories.
- R. Connon, W. Quinton, É. Devoie and M. Hayashi. (2017). The role of taliks as tipping points for permafrost thaw. Canadian Geophysical Union Annual General Meeting, Vancouver, British Columbia.
- Rasouli K, Pomeroy J, (2017). Permafrost Response to Transient Vegetation and Climate Changes in a Northern Mountain Basin, Canada. The 2nd Asian Conference on Permafrost, Sapporo, July 2, 2017
- Rasouli K, Pomeroy J, Hayashi M, Fang X, Gutmann E, Li Y, Assessment of the Suitability of High Resolution Numerical Weather Model Outputs for Hydrological Modelling in Mountainous Cold Regions. 2017 AGU Fall Meeting, New Orleans, December 11, 2017. (poster)
- Ratelle M, Bouchard M, Laird BD. (2017). Metals Biomonitoring in Hair Blood, and Urine in the Northwest Territories, Canada. International Symposium on Biological Monitoring. Naples, Italy (Poster).
- Ratelle M, Laird M, Swanson H, Laird BD. (2017). Contaminant and Nutrient Biomonitoring in the Northwest Territories, Canada: Shedding Light on the Risks and Benefits of Food Choices. International Symposium on Biological Monitoring. Naples, Italy (Platform)
- Remmer C, WH Klemt, BB Wolfe and RI Hall. (2017). Spatial and temporal approaches for monitoring changes in climate change and flooding on hydro-limnological conditions in a northern freshwater delta. Arctic Change 2017, Quebec City.
- Remmer C, WH Klemt, BB Wolfe and RI Hall. (2017). Spatial and temporal approaches for monitoring impacts of climate change and flooding on low water levels in a northern, freshwater delta. Cold Regions Research Centre Day, Wilfrid Laurier University.
- Remmer CR, T Owca, BB Wolfe and RI Hall. (2018). Multi-year landscape scale assessment of hydrological processes controlling lake water balance in a northern, freshwater delta using water isotope tracers. Canadian Geophysical Union Hydrology Section Ontario Student Conference, Western University, London.
- Rohanizadegan, M., Petrone, R., Pomeroy, J., Warren, H. Improving meteorological forcing of mountain evapotranspiration calculations. 18th Annual WRF User's Workshop, Boulder, Colorado, June 12-16, 2017

- Rohanizadegan, M., Petrone, R., Pomeroy, J., Warren, H. Improving meteorological forcing of mountain evapotranspiration calculations. Canadian Geophysical Union Annual Meeting 2017, poster presentation.
- Rokaya, P., Das, A. and Lindenschmidt, K.-E. (2017), Exploring flow operation schemes for sustainable ice-jam flood management along the Peace River in western Canada. CGU HS Committee on River Ice Processes and the Environment, 19th Workshop on the Hydraulics of Ice Covered Rivers, Whitehorse, Yukon, Canada, July 9-12, 2017. http://cripe.ca/docs/proceedings/19/Rokaya-et-al-2017.pdf
- Rokaya, P., Wheater, H. and Lindenschmidt, K-E. (2017), Quantifying the drivers of water security risks in a complex northern deltaic ecosystem, 2017 AGU Fall Meeting, New Orleans, USA, 11-15 December 2017. (poster)
- Roy, A., Sonnentag, O., Derksen, C., Toose, P., Pappas, C, Mavrovic, A., El Amine, M., Royer, A., Berg, A.A. (2017), Use of ground-based radiometers for L-Band freeze/thaw retrieval in a boreal forest site (oral). Abstract B24-01, December 11-15, New Orleans, Louisiana, USA.
- Roy, A., Toose, P., Mavrovic, A., Pappas, C. et al. incl. Sonnentag, O. (2018). Use of L-bandground-based radiometers for freeze/thaw retrieval in a boreal forest site. 38th IEEE International Geosciences and Remote Sensing Symposium (IGARSS).
- Rudy A, Connon R, É. Devoie, M. Braverman, E. Wilcox, B. Walker, J. Baltzer, W. Quinton and P. Marsh. Implications of thawing permafrost on water in the Northwest Territories. (2017). Yellowknife Geoscience Forum, Yellowknife, Northwest Territories.
- Rudy, A., R. Connon, É. Devoie, M. Braverman, E. Wilcox, B. Walker, J. Baltzer, W. Quinton and P. Marsh. Implications of thawing permafrost on water in the Northwest Territories. 2017 Yellowknife Geoscience Forum, Yellowknife, Northwest Territories. Nov. 14-16, 2017.
- S. Bocaniov, H. Kheyrollah Pour, D. Scavia, P. Van Cappellen. Understanding the role of physical processes in algal bloom formation in Lake St Clair. International Association for Great Lakes Research. June 18-22, 2018 [Abstract accepted].
- Savage CAM, CR Remmer, BB Wolfe and RI Hall. (2018). Field-testing the cellulose-water oxygen isotope fractionation factor using periphytic algae for paleohydrological reconstructions. Canadian Geophysical Union Hydrology Section Ontario Student Conference, Western University, London.
- Savage CAM, CR Remmer, BB Wolfe and RI Hall. (2018). Field-testing the cellulose-water oxygen isotope fractionation factor using periphytic algae for paleohydrological reconstructions. World Water Day, University of Waterloo, Waterloo.
- Scaff L, Prein A.F., Li Y, Liu C, Rasmussen R, Ikeda K (2017), Simulating the convective precipitation diurnal cycle in a North American scale convection-permitting model. 2017 AGU Fall Meeting, New Orleans, Louisiana, December 11-15, 2017.
- Shah P, Venkiteswaran JJ, Molot LA. Phytoplankton Fractionation of Iron. The 2nd Interdisciplinary Freshwater Harmful Algal Blooms Workshop, bringing together leading experts from across North America on Toronto ON, April 16-18, 2018
- Shea J, Harder P, Pomeroy J, Kraaijenbrink P, Improved quantification of mountain snowpack properties using observations from Unmanned Air Vehicles (UVAs). AGU Fall Meeting, New Orleans, December 11, 2017
- Sheikholeslami, R., and Razavi, S. (2017), An Efficient and Robust Sampling Strategy for Uncertainty and Sensitivity Analysis of Environmental Systems Models, Canadian

- Geophysical Union (CGU) Annual Scientific Meeting, May 28-31, 2017, Vancouver (Oral Presentation).
- Shook K, Pomeroy J, Classification of Prairie basins by their hysteretic connected functions. 2017 AGU Fall Meeting, New Orleans, December 11, 2017. (poster)
- Shook, K. and Pomeroy, J. (2017) Classification of Prairie basins by their hysteretic connected functions. AGU Fall Meeting, New Orleans, December 11, 2017
- Sniderhan, A, Mamet, S, Baltzer, J. (2017) Black spruce growth dynamics in northwestern Canada: contrasting trends and climatic drivers from tree-line to tree-line. Ecological Society of America Annual Meeting, Portland, OR
- Sniderhan, A, Mamet, S, Baltzer, J. (2017). Treeline to treeline: latitudinal variability in black spruce growth dynamics in northwestern Canada. Arctic Change 2017, Quebec City, QC.
- Sniderhan, A., Mamet, S., Baltzer, J. Treeline to treeline: Latitudinal variability of black spruce growth dynamics in northwestern Canada. International Arctic Change 2017 Conference. Quebec City, Quebec. Dec. 11-15, 2017.
- Sonnentag, O. (2017). Changing land-atmosphere interactions of thawing boreal forest landscapes in northwestern Canada. College of Science seminar series, September 21, Swansea University, Swansea, Wales, United Kingdom.
- Sonnentag, O. (2017). Changing land-atmosphere interactions of thawing boreal forest landscapes in northwestern Canada. Department of Building, Civil and Engineering seminar series, November 14, Concordia University, Montr eal, Québec, Canada.
- Sonnentag, O. (2017). Changing land-atmosphere interactions of thawing boreal forest landscapes in northwestern Canada. Ecosystem Sciences seminar series, October 9, Swedish Agricultural University, Umea, Vaesterbotten, Sweden.
- Sonnentag, O. (2017). Changing land-atmosphere interactions of thawing boreal forest landscapes in northwestern Canada. Life and Environmental Sciences seminar series, December 20, University of Iceland, Reykjavik, Iceland.
- Sonnentag, O., Helbig, M., Hould Gosselin, G., Ryu, Y., Wischnewski, K., Hanisch, J., Moore, T.R., Quinton, W.L. (2017), The subcatchment- and catchment scale hydrology of a boreal head-water peatland complex with sporadic permafrost (oral). Abstract H43U-03, December 11-15, New Orleans, Louisiana, USA.
- Sonnentag, O., M. Helbig, R. Connon, G. Gosselin, E. Haughton, K. Wischnewski, J. Hanisch, T. Moore and W. Quinton. The subcatchment-and catchment-scale hydrology of a boreal headwater peatland complex with sporadic permafrost. Canadian Geophysical Union Annual General Meeting, Vancouver, British Columbia. May 29-31, 2017.
- Stewart, R.E., M. Brugman, R. Mo, G. Bramwell, J. Bau, M. MacDonald and J. Goosen, 2017: Recent high impact freezing rain events in BC. Can. Geoph. Union Conf., Vancouver.
- St-Pierre M, J M Thériault, D Paquin (2017), Influence of the model spatial resolution on atmospheric conditions leading to freezing rain in regional climate simulations, CMOS Congress, Toronto, Ontario, Canada [OP] Discovery Grant
- Swanson, H.K., Branfireun, B., and Low, G. (2017). Understanding in-lake versus catchment controls on fish mercury levels in northern Canadian lakes. Oral presentation at: The 13th International Conference on Mercury as a Global Pollutant, July 16-21, 2017, Providence, RI.

- Swanson, H.K., Low, G., and Branfireun, B.A. (2017). Among-lake variability in food fish mercury concentrations in the Dehcho region, NT. Oral presentation at: Northern Contaminants Meeting 25th Anniversary Results Workshop, September 26-28, 2017, Yellowknife, NT.
- Swanson, H.K., Low, G., Evans, M., and Branfireun, B. (2017). Understanding and predicting fish mercury levels in the Dehcho region, NT. Poster presentation at: at: Society for Ecotoxicology and Chemistry North America Meeting, November 12-16, 2017
- T. Chandrakumaran, M. Stone, N. B. Basu, M. Emelko. Spatial and Temporal Trends in Phosphorus and Suspended Solids Yields along an Urban River Reach. International Association for Great Lakes Research Conference, Toronto, Canada, June 2018
- T. Milojevic, F. Rezanezhad, C. Parsons, C. Smeaton, P. Van Cappellen. Multi-Fibre Optode Sensors: affordable designs for monitoring oxygen in soils under varying environmental conditions. 2017 AGU Fall Meeting, 11-15 December 2017, New Orleans, Louisiana.
- Tang W, Carey SK. Utilizing Wavelet Analysis to assess hydrograph change in northwestern North America. Presented at the American Geophysical Union Annual General Meeting, New Orleans, USA. December 2017.
- Turetsky, M. (2017). A cross-scale framework of peatland resilience based on long-term research in interior Alaska and the Northwest Territories, Canada. American Geophysical Union Annual Meeting, New Orleans, USA
- Turetsky, M.R., Kane, E.S., Baltzer, J.L., Quinton, W.L., Euskirchen, E.S., Sonnentag, O., Wal-drop, M.P., Neumann, R., Douglas, T. (2017). A cross-scale framework of peatland resilience based on long-term research in interior Alaska and the Northwest Territories, Canada (oral). Abstract B14A-03, December 11-15, New Orleans, Louisiana, USA.
- Union (EGU) General Assembly, April 23-28, 2017, Vienna, Austria (Oral Presentation).
- Van Meter, K.J., N.B. Basu (2017) "Changing waters: Are climate-driven changes in discharge regimes increasing eutrophication risk in the Great Lakes Basin?" IAGLR 2017, Detroit, Michigan.
- Vionnet V, Wayand N, Marsh C, Fortin V, Pomeroy JW, Snowdrift-resolving atmospheric downscaling for snow hydrological forecasting in alpine regions. 3rd annual INARCH workshop at Schneefernerhaus Zugspitze, Germany, February 8, 2018. (poster)
- Vivekananthan, K., Macrae, M.L., Ali, G.A., Lobb, D.L. Climatic controls on activation of runoff pathways in a vertisolic heavy clay soil in an artificially drained near-level landscape. Oral Presentation. CGU and CSAFM Join Annual Scientific Meeting, Vancouver, British Columbia. May 28-31, 2017.
- Vivekananthan, K., Macrae, M.L., Lobb, D.L., Ali, G.A. Evaluating runoff water quality in a vertisolic clay soil in an artificially drained near-level landscape in Red River Valley. Poster Presentation. Canadian Soil Science Society Annual Meeting. Peterborough, Ontario. June 11-14, 2017.
- W. Quinton, R. Connon, É. Devoie, M. Braverman. (2017). Toward understanding the trajectory of hydrological change in the southern Taiga Plains, NWT. Canada. 21st International Northern Research Basins Symposium and Workshop. Yakutsk, Russia.
- Waddington, 2017. Managing wildfires in an era of drought and warming. The Ohio State University. November 2, 2017.

- Waddington, 2018. Did enhanced afforestation cause high severity peat burn in the Fort McMurray Horse River wildfire? Society of Ecological Restoration. Restoration for Resilience. Vancouver. February 16, 2018.
- Waddington, 2018. Ecohydrology: Shifting paradigms in an era of shifting ecosystems. University of California Berkeley. March 23, 2018.
- Waddington, 2018. Mitigating wildfire carbon loss through peatland restoration. Society of Ecological Restoration. Restoration for Resilience. Vancouver. February 16, 2018.
- Wallace, C, Baltzer, J. (2017). The influence of Alnus viridis shrub patches on fine-scale environmental conditions on the Canadian low-Arctic tundra. Ecological Society of America Annual Meeting, Portland, OR
- Wallace, C, Baltzer, J. (2017). The influence of Alnus viridis shrub patches on understory vegetation community composition in the low-Arctic of the Northwest Territories. Arctic Change 2017, Quebec City, QC.
- Wang, J., Sulla-Menashe, D.J., Woodcock, C.E., Sonnentag, O., Friedl, M.A. (2017). Multidecadal rates of disturbance- and climate change-induced land cover change in Arctic and boreal ecosystems over western Canada and Alaska inferred from dense Landsat time series (oral). Abstract B14A-07, December 11-15, New Orleans, Louisiana, USA.
- Warren, S., Puestow, T., Richard, M., Khan, A.A., Khayer, M. and Lindenschmidt, K.-E. (2017), Near Real-time ice-related flood hazard assessment of the Exploits River in Newfoundland, Canada. CGU HS Committee on River Ice Processes and the Environment, 19th Workshop on the Hydraulics of Ice Covered Rivers, Whitehorse, Yukon, Canada, July 9-12, 2017. http://cripe.ca/docs/proceedings/19/Warren-et-al-2017.pdf
- Watts, J.D., Kimball, J.S., Du, J., Zona, D., Euskirchen, E.S., Helbig, M., Sonnentag, O., et al. (2017). Detecting recent changes in the Arctic-Boreal carbon sink using satellite remote sensing, flux tower data and biophysical models (oral). Abstract B11J-03, December 11-15, New Orleans, Louisiana, USA.
- Wayand N, Marsh C, Shea J, Pomeroy J, (2017). Remotely Sensed Snow Redistribution Indices. AGU Fall Meeting, New Orleans, December 11, 2017
- Wheater H, Xu L, Gober P, Pomeroy J, Wong J, Resilience of Socio-Hydrological Systems in Canadian Prairies to Agricultural Drainage: Policy Analysis and Modelling Approach. 2017 AGU Fall Meeting, New Orleans, December 11, 2017. (poster)
- Williamson, J., Petrone, R. Assessing the role of tree growth patterns on the spatial variability of evapotranspiration on a subalpine hill slope in Kananaskis, Alberta. CGU Eastern Student Section Meeting 2018, poster presentation.
- Wilson, H.G., J.A. Elliott and A.J. Glenn. The influences of changing weather patterns and land management on runoff biogeochemistry in a snowmelt dominated agricultural region. American Geophysical Union, Fall Meeting. New Orleans, Louisiana. Dec 11-15, 2017.
- Yanping Li, and Co-authors, 2017: Projected changes over western Canada using convectionpermitting regional climate model and the pseudo-global warming method. 2017 AGU Fall Meeting, New Orleans, Louisiana, December 13, 2017
- Yanping Li, and Co-authors, 2018: Projected Changes over Western Canada Using Convection-Permitting Regional Climate Model. 31st Conference on Climate Variability and Change and 98th American Meteorological Society Annual Meeting, Austin, Texas, January 9, 2018

- Yanping Li, Liang Chen, Fei Chen, Mike Barlage, 2017: Evaluate the surface coupling strength of the continental scale 4-km WRF regional climate simulations, 51st CMOS Congress Annual Meeting, Toronto, ON, Canada, June 5, 2017
- Yassin F, Anis M.R., Razavi S., and Wheater H. (2017), Towards an Improved Representation of Reservoirs and Water Management in a Land Surface-Hydrology Model, 2017 AGU Fall Meeting, New Orleans, Louisiana, December 11-15, 2017. (poster)
- Yassin, F., Razavi, S., and Wheater, H., (2017), Improved representation of water management and reservoirs in a land surface-hydrology model, Canadian Geophysical Union (CGU) Annual Scientific Meeting, May 28-31, 2017, Vancouver (Oral Presentation).
- Z. Jawed and G. Krantzberg, Use of Decision Support tools to Address emerging issues in the Great Lakes, GWF Annual Science Meeting, McMaster University, June 3-6, 2018 (Abstract in Progress and will be submitted soon)
- Zee, J., Hecker, M., Gerhart, A., Doering, J., and Jardine, T. 2017. eDNA as an early detection tool for the potential spread of zebra mussels (Dreissena polymorpha) to Saskatchewan lakes. Canadian Ecotoxicity Workshop, Guelph, October 1-4.
- Zhang Z., Li Y, Chen F, Barlage M (2018), The Importance of Soil Moisture to Influence and Predict Summer Extreme Heat Events in North America. 32nd Conference on Hydrology and 98th American Meteorological Society Annual Meeting, Austin, Texas, January 7-11, 2018.
- Zhang, F. and Lindenschmidt, K.-E. (2017), River ice hydraulic modeling of the Slave River Delta. CGU HS Committee on River Ice Processes and the Environment, 19th Workshop on the Hydraulics of Ice Covered Rivers, Whitehorse, Yukon, Canada, July 9-12, 2017. http://cripe.ca/docs/proceedings/19/Zhang-Lindenschmidt-2017.pdf
- Zhe Zhang, Yanping Li, Fei Chen, Michael Barlage, 2018: Climate- Groundwater Interaction on Modeling Wetlands in Prairie Pothole Region. 8th GEWEX Science Conference, 6-11 May 2018 in Canmore, Alberta, Canada
- Zhe Zhang, Yanping Li, Fei Chen, Michael Barlage, 2018: The Importance of Soil Moisture to Influence and Predict Summer Extreme Heat Events in North America. 32nd Conference on Hydrology and 98th American Meteorological Society Annual Meeting, Austin, Texas, January 8, 2018
- Zhe Zhang, Yanping Li, Fei Chen, Mike Barlage, 2017: One-way downscale on a 4-km continental scale climate simulation and test on land surface coupling strength. 18th Annual WRF User's Workshop, Boulder, CO, USA, June 14, 2017
- Zhenhua Li, Yanping Li, Barrie Bonsal, Alan Manson, 2017: Madden-Julian Oscillation and Summer Precipitation over the Canadian Prairies. 2017 AGU Fall Meeting, New Orleans, Louisiana, December 14, 2017
- Zhenhua Li, Yanping Li, Barrie Bonsal, Alan Manson, 2018: Madden–Julian Oscillation and Summer Precipitation/Drought in the Canadian Prairies. 32nd Conference on Hydrology and 98th American Meteorological Society Annual Meeting, Austin, Texas, January 8, 2018
- Zwieback, S., S. Westermann, M. Langer, J. Boike, P. Marsh, A. Berg. 2018. Can satellite soil moisture retrievals improve permafrost monitoring? European Geophysical Union Meeting. Vienna, Austria.

Appendix G - International Joint Faculty Appointment

Summary: International joint faculty appointments: 23

Arain, Altaf

• Adjunct Professor, United Nations University – Institute of Water Environment and Health (UNU-INWEH). Participation in research, HQP training and outreach activities in collaboration with UNU-INWEH team members. 2017 to Present.

Doubleday, Nancy

- Adjunct Professor, United Nations University Institute of Water Environment and Health (UNU-INWEH). Water, Health, Environment student projects (re R. Narro; S. Newell); Water and Peace (A. Debray and N. Nagabhatla). January, 2016 to January, 2018.
- Adjunct Professor, United Nations University Institute of Water Environment and Health (UNU-INWEH). Water, Health, Environment student projects (re R. Narro; S. Newell);
 Water and Peace (A. Debray and N. Nagabhatla). January, 2018 to January, 2020.

Giesy, John

- Distinguished Visiting Professor, University of Hong Kong. Grant proposals and joint projects, and manuscripts, advising students and teaching. November 2017 to December 2018.
- Concurrent Professor, Nanjing University. Grant proposals and joint projects, and manuscripts, advising students and teaching. 2003 to present.
- Guest Professor, Xiamen University. Grant proposals and joint projects, and manuscripts, advising students and teaching. 2008 to present.
- Member, Board of Directors. Program Review. City University Hong Kong, State Key Laboratory in Marine Pollution. 2006 to present.
- Distinguished Visiting Professor, Hong Kong Baptist University. Grant proposals and joint projects, and manuscripts, advising students. 2014 to present.
- Visiting Professor and Graduate Faculty, Baylor University. Grant proposals and joint projects, and manuscripts, advising students. 2016 to present.
- Einstein Professor, Chinese Academy of Science. Lectures and seminars. 2009 to present.

Hecker, Markus

• Guest Professor, Xiamen University. Joint projects and manuscripts, advising students and teaching.

Helgason, Warren

• Special Lecturer, Beijing Normal University. Deliver graduate course in Land-Atmosphere. 2010 to 2018.

Krantzberg, Gail

 Adjunct Professor, United Nations University – Institute of Water Environment and Health (UNU-INWEH). Research collaboration, curriculum development, joint policy briefs. March 15th, 2018 to TBD.

Liber, Karsten

• Distinguished Professor, Institute of Loess Plateau, Shanxi University, Shanxi, China

McDonnell, Jeffrey

- 6th Century Chair in Hydrology, University of Aberdeen
- University Distinguished Professor of Hydrology (Adjunct), Oregon State University
- Honorary Professor, Nanjing Hydraulic Research Institute
- Visiting Professor, Hohai University

Petrone, Rich

• Adjunct Professor, University of KwaZulu-Natal. PhD Committee Member. January 2018 to present.

Pomeroy, John

- Visiting Professor, Chinese Academy of Sciences, Lanzhou, China
- Honorary Professor, Dept. of Geography & Earth Sciences, Aberystwyth University, UK

Van Cappellen, Philippe

- Honorary Professor, Tianjun University. Students and PDF exchanges on joint project on nutrients in dam and reservoirs. April 2018 to TBD.
- Honorary Professor, Tianjun University. Students and PDF exchanges on joint project on nutrients in dam and reservoirs. March 25th, 2018 to TBD.

Appendix H – Leveraged cash and in-kind contributions by Pillars 1-2-3 projects (2016-2020) and additional major endeavours

Project Title	Cash	In-kind
Climate-Related Precipitation Extremes	\$165,000	\$765,000
Northern Water Futures	\$5,800,380	\$10,754,290
Next Generation Solutions to Ensure Healthy Water Resources	\$2,370,250	\$1,641,750
for Future Generations		
Forecasting Tools and Mitigation Options for Diverse Bloom-	\$1,398,720	\$4,699,095
Affected Lakes		
Agricultural Water Futures	\$1,113,000	\$9,955,600
Boreal Water Futures	\$8,341,663	\$3,478,300
Prairie Water	\$404,000	\$36,204,900
Integrated Modelling Program for Canada	\$505,400	\$11,845,480
Mountain Water Futures	\$2,211,400	\$621,000
Lake Futures	\$249,200	\$4,737,441
Transformative Sensor Technologies and Smart Watersheds	\$624,039	\$26,341,701
for Canadian Water Futures		
Co-creation of Indigenous Water Quality Tools	\$35,000	\$1,590,520
Pillars 1-2 Projects	\$423,000	\$3,200,000
Canada 150 Research Chair in Remote Sensing and Hydrology	\$7,000,000	-
Smart Water Systems Laboratory – Western Economic	\$1,374,576	-
Diversification		
Green Roof Technology – Western Economic Diversification	\$643,702	-
Airborne Cold Regions Observatory – Canada Foundation for	\$200,000	-
Innovation		
Computer Canada – Research Platforms and Portals	\$900,000	-
University of Saskatchewan	\$27,500,000	-
University of Waterloo	\$15,000,000	-
McMaster University	\$12,136,287	-
Wilfrid Laurier University	\$10,580,000	-
Global Water Futures, Canada First Research Excellence Fund	\$77,840,000	
Total	\$176,615,617	\$115,835,074

Appendix I – Professional and Career Development Opportunities

Short Courses Open to Professionals

Adaptation Governance and Policy Changes in Relation to a Changing Moisture Regime Across the Southern Boreal Forest (Laroque)

 Sheri Andrews-Key worked with Mistik Management Ltd. at their November 2017 Public Advisory Group Workshop to aid in informing and incorporating science and traditional knowledge with communities, stakeholders and community representatives from across the Mistik Forest Management Area on climate change and adaptation.

Crowdsourcing Water Science (Strickert)

 Ashliegh Duffy and Anuja Thapa of Prairie Water participated in Water Quality Modelling workshop lead by Karl Eric Lindenschmidt, Luis Morales, and Graham Strickert. We had participants from the WSA and the Agriculture Ministry.

Integrated Modelling Program for Canada (IMPC) (Razavi)

• Hayley Carlson, Certificate and Course in University Web Content Management System, November 21, 2017, University of Saskatchewan.

Northern Water Futures (Baltzer)

- Indigenous Canada, run by Coursera but developed by the University of Alberta. Course based on Indigenous matters from a historical and present day Canadian standpoint
- Climate Change and the Health of Canadians Faculty of Environment (University of Waterloo). Workshop held by Health Canada in conjunction with the Faculty of Environment at UW to broaden understandings of environmental health matters through Canada.
- Climate Change and the Health of Canadians Faculty of Environment (University of Waterloo). Workshop held by Health Canada in conjunction with the Faculty of Environment at UW to broaden understandings of environmental health matters through Canada.
- Munkittrick, K. 2018. Environmental effects monitoring: choosing the right indicators. Invited presentation at Workshop: Towards Selecting biological monitoring indicators
- Munkittrick. K, Nov 20, 2017; Yellowknife NT. A course delivered for Environment and Natural Resources personnel, Design of Monitoring programs (4 hr) and Designing Adaptive monitoring programs (4 hr)
- Special introductory stable isotope ecology workshop over March break. March 8-9, 2018.
 University of New Brunswick, Fredericton, NB. Instructor: Dr. B. Hayden. Laurier MSc Participant: Ari Yamaguchi.

Developing 'Omic' and Chemical Fingerprinting Methodologies using Ultrahigh-Resolution Mass Spectrometry for Geochemistry and Healthy Waters (Jones)

Thermo Scientific, manufacturer of the OrbiTrap instruments, provided a total of 9 days
of detailed hands-on training on the analytical equipment for Investigators PDFs and
students.

Southern Forest Water Futures (Arain)

• Turkey Point Observatory Tour, The participants of this trip visited the St. Williams Interpretive Centre to learn about the history of logging in Norfolk County and about agricultural landscapes of Southern Ontario. Participants will visit the Turkey Point Observatory of the Global Water Futures Program, which comprises four flux towers in an age-sequence (78-, 43-, 15-yr old) of coniferous and deciduous (>80-yr old) forests. Participants will learn about the history of land use changes in the region and how human activities have shaped the mixed forest-oak savannah landscape in the region. Participants will visit and learn about forest management research and activities taking place in the White and Red Pine Plantation forests in the St. Williams Conservation Reserve for ecosystem restoration, enhanced carbon sequestration and sustainable water resources in the face of climate change. A lunch stop (at participant's expense) will be made for world-famous Lake Erie Perch.

Storms and Precipitation Across the Continental Divide Experiment (SPADE) (Theriault)

- John Pomeroy, Hydrological modelling instruction on the Cold Regions Hydrological Model (CRHM), Canmore, February 2018.
- John Pomeroy, Kananaskis Short Course on Principles of Hydrology (Jan 10-21, 2018).

Wilfrid Laurier University Technical Team (Munkittrick)

- Principles of Hydrologic Modelling, University of Waterloo, June 4-9, 2018; Waterloo, ON.
 A week-long professional short course about the development of computational hydrological models.
- Resistivity Imaging Seminar, Nov 8-10, 2017; Austin Texas. A short course designed for people utilizing electrical resistivity tomography equipment, a geophysical method for mapping the subsurface. Attended by Ashley Rudy.

Cross-institutional and user training opportunities

- Research Associate at UNBC supported in part by MWF, is running the VIC-GL model in close collaboration with hydrologists at PCIC/University of Victoria
- M. Kompanizare attended training for CRHM modelling at the University of Saskatchewan, September, 2017.
- de Lannoy: PhD and Master's students received advanced training at the BI (Bio-Interfaces Institute)

- de Lannoy: PhD and Master's students received advanced training at the CCEM (Canadian Center for Electron Microscopy)
- de Lannoy: PhD and Master's students received advanced training at the McMaster Regional Center for Mass Spectrometry
- HQP under Petrone: CRHM Training Course, Canmore Alberta, February 21-22, 2018
- Graduate course, Wilfrid Laurier University, GG675W. Intro to experimental design, reproducibility, and statistics in R. 5 HQP from Waterloo and Laurier.
- NWF Northern Student Training Session: Research Communication April 13, 2018 (25 HQP from Laurier, Waterloo, Guelph and McMaster)
- NWF Training Session #1 (2018, M. Salman)
- Participation in ATRAPP Annual meeting
- R+GitHub Recurring Workshop on data management and visualization, Fall 2017. Hosted by ML Larsen and KR Salk. 5 HQP from Waterloo and Laurier.
- S. Courtenay was a Visiting Research Fellow in the Australian Rivers Institute, Griffith University Nathan Campus in Brisbane Australia January 22 April 13, 2018
- Session with Government of Saskatchewan for AIS monitoring
- Workshop with Orano to boost the cooperation with industrial end users and knowledge mobilization, Dr. Hecker, Dr. Xie and Ms. DeBofsky visited Orano Canada Inc.

Special Seminars

- Forecasting Tools and Mitigation Options for Diverse Bloom-Affected Lakes (FORMBLOOM) (Baulch)
 - Salk, KR. "Biogeochemical drivers of harmful algal blooms across lake systems"
 Laurier Biology Seminar Series 2017-2018. 24 Oct 2017.
- Mountain Water Futures (Carey)
 - Hayashi. 2018 National Groundwater Association Henry Darcy Distinguished Lecture titled "Alpine hydrogeology: The critical role of groundwater in sourcing the headwaters of the world". The lecture was given at the following universities and institutions.
 - Jan. 16 University of Calgary, Calgary, Alberta
 - Jan. 19 University of Saskatchewan, Saskatoon, Saskatchewan
 - Jan. 25 University of British Columbia, Vancouver, BC
 - Jan. 26 Simon Fraser University, Burnaby, BC
 - Feb. 1 Stanford University, Stanford, California
 - Feb. 2 Lawrence Berkeley National Laboratory, Berkeley, California
 - Feb. 6 University of Alberta, Edmonton, Alberta
 - Feb. 13 University at Buffalo, Buffalo, New York
 - Feb. 15 University of Delaware, Newark, Delaware
 - Feb. 16 U.S. Geological Survey, Reston, Virginia

- Feb. 20 University of Florida, Gainsville, Florida
- Feb. 22 Appalachian State University, Boone, North Carolina
- Feb. 23 Michigan State University, East Lansing, Michigan
- Mar. 13 Universidade de São Paulo, São Paulo, Brazil
- Mar. 15 Universidad de Chile, Santiago, Chile
- Mar. 21 McMaster University, Hamilton, Ontario
- Mar. 22 University of Guelph, Guelph, Ontario
- Mar. 23 University of Waterloo, Waterloo, Ontario

Wilfrid Laurier Technical Team (Munkittrick)

Munkittrick, K. 2018. Environmental effects monitoring: choosing the right indicators.
 Invited presentation at Workshop: Towards Selecting biological monitoring indicators under the AB_NWT Bilateral Water Management Agreement, Jan 24-25, 2018, Edmonton, AB

Integrated Modelling Program for Canada (IMPC) (Razavi)

• Hayley Carlson, Social Network Analysis Discussion Group Seminars, January 31, February 28th, March 14th, 2018, University of Saskatchewan.

Storms and Precipitation Across the Continental Divide Experiment (SPADE) (Theriault)

• Thériault, J. M. (2018) Weather conditions and precipitation characteristics on the eastern slopes of the Rocky Mountains, Webinar series on Climate change, extremes and variability Part I: Newest ways of using climate models in water resource applications. Canadian Water Resources Association.

Boreal Water Futures (Waddington)

• Waddington: Wetland BMP Knowledge Exchange webinar with Ducks Unlimited (April 5, 2018).

Prairie Water Futures (Whitfield/Spence)

 PW/GWF student engagement and young professional's opportunities in KM in collaboration with GWF KM Core are developing opportunities with students/HQP within Prairie Water to advance skills in knowledge mobilization and science communication. As envisioned, this will eventually contribute to workshop opportunities and seminars within Prairie Water and GWF that are co-produced with students/HQP.

Workshops

Northern Water Futures (Baltzer)

- Anna Coles and Carolyn Gibson participated in Landscape Change Workshop, hosted by the Sahtu Renewable Resources Board, Tulita, 12-14 February 2018.
- Brittney Glass: Farvolden Day 3 Minute Thesis Competition, October, 2017

- Danielle Brandow: Climate Change and the Health of Canadians Faculty of Environment (University of Waterloo). Workshop held by Health Canada in conjunction with the Faculty of Environment at UW to broaden understandings of environmental health matters through Canada.
- Danielle Brandow: International Webinar of Experts on Climate change and Health System. This meeting brought together government representatives from over 40 of the most vulnerable countries and territories in the world, with WHO, other UN partners and technical experts to advance global action on climate change and health. Link: (http://www.who.int/globalchange/mediacentre/events/climate-healthconference/en/)
- Maxime Salman: Canadian Exploration Geophysical Society Mini Symposium, December, 2017
- Munkittrick, K. 2018. Environmental effects monitoring: choosing the right indicators. Invited presentation at Workshop: Towards Selecting biological monitoring indicators under the AB_NWT Bilateral Water Management Agreement, Jan 24-25, 2018, Edmonton, AB
- Munkittrick, K. 2018. Monitoring cumulative effects its critical role in Cumulative effects assessment. Invited presenter and participant at ENR Cumulative effects framework meeting, Yellowknife, NT, Feb 7-9, 2018
- Special introductory stable isotope ecology workshop over March break. March 8-9, 2018. University of New Brunswick, Fredericton, NB. Instructor: Dr. B. Hayden. Laurier MSc Participant: Ari Yamaguchi.
- Wynona Klemt: Resource Extraction & Northern Societies workshop/ short-course (funded through NSERC's TERRE-CREATE program) at the University of Alberta, June 2017. This workshop examined different social, political, and economic aspects related to the exploration and development of resources in the circumpolar north.

Lake Futures (Basu)

- Barclay, J. Zimmer, M. and Van Meter, KJ, co-chair of session Terrestrial-Aquatic Linkages in the Context of Land Use/Land Cover Change: Contemporary and Legacy Effects on Physical and Biogeochemical River Processes I, AGU Fall Meeting 2017, San Francisco, CA.
- Chris Parsons, Maria Dittrich, Kimberly Van Meter, and Agnes Richards: co-chairing session organizing at the International Association of Great Lakes Research (IAGLR 2018) meeting in Toronto, Canada on June 18-22-2018 Nutrient Sources, Transport & Retention in Great Lakes Watersheds: Field Measurements, Modeling and Management implications.
- Fereidoun Rezanezhad, Colin McCarter, Tobias Weber, Merrin Macrae, Nandita Basu, and Philippe Van Cappellen: co-chairing session on "Coupled Hydrological and Biogeochemical Functions, Part II: Terrestrial Ecosystems" at the Canadian Geophysical Union (CGU 2018) in Niagara Falls Canada (June 2018).

- H. Kheyrollah Pour, S. Bocaniov, P. Van Cappellen: co-chairing session organizing at the International Association of Great Lakes Research (IAGLR 2018) meeting in Toronto, Canada on June 18-22-2018 (Harmful Algal Blooms (HABs) and their Toxicity: Remote Sensing and Modeling Approaches).
- H. Kheyrollah Pour, T. Milojevic, P. Van Cappellen, Gail Krantzberg, Nicola Crawhall: organizing panel session at the 10th Canadian Science Policy Conference (CSPC 2018) meeting in Ottawa, Canada on November 7-9, 2018 (Managing Receiving Water: Can Canadian Water Policies and Regulations Address Current and Emerging Challenges?)
- H. Kheyrollah Pour: Co-Chair session of International Union of Geodesy and Geophysics (IUGG 2019): Climate Change Impacts on Arctic Snow, Permafrost, Lake and River Ice. Montreal, Canada, July 9-18, 2019.
- Merrin Macrae, Jane Elliott, Henry Wilson and Nandita Basu: co-chairing session on "Agricultural Management and Water Quality in Current and Future Climates" at the Canadian Geophysical Union (CGU 2018) in Niagara Falls Canada (June 2018).
- Wilusz, D., Aloysius, N., Basu, NB, AGU Fall Meeting 2017, Co-convener of "Advances in Coupled Human-Natural Systems Modeling for Water and Land Resources Management II, San Francisco, CA

FORMBLOOM (Baulch)

- FeSPG / Formbloom Workshops, University of Waterloo 20 Nov 2017
- FORMBLOOM Field Planning workshop 12 April 2018
- Graduate course, Wilfrid Laurier University, GG675W. Intro to experimental design, reproducibility, and statistics in R. 5 HQP from Waterloo and Laurier
- Puru Shah attended and presented at The 2nd Interdisciplinary Freshwater Harmful Algal Blooms Workshop, bringing together leading experts from across North America on April 16-18, 2018 Toronto, Ontario
- Venkiteswaran JJ. FORMBLOOM goals, Fe Isotope STPGP synergy for 2018 and update on 303 & 304 fertilization 9 April 2018

Transformative Sensor Technologies and Smart Watersheds for Canadian Water Futures (Duguay)

Canadian Exploration Geophysical Society Mini Symposium (2017, M. Salman)

Winter Soil Processes in Transition (Fereidoun)

- Conference session organizer and convener, 2017 AGU Fall meeting, 12-16 December 2017, New Orleans, Louisiana. Session 26151: Integrative approaches to advance understanding of soil and sediment biogeochemical functioning.
 - Conveners: Geertje J. Pronk, Fereidoun Rezanezhad, Kai U. Totsche, Philippe Van Cappellen

- Conference session organizer and convener, 2018 CGU Joint Meeting, 10-14 June 2018,
 Niagara Falls, Ontario, Canada, "Coupled Hydrological and Biogeochemical Functions, Part I: Wetland Ecosystems". Biogeoscience and Hydrology, Session CGU-H-08.
 - CGU_H_08: Coupled Hydrological and Biogeochemical Functions, Part I: Wetland Ecosystems
 - Conveners: Colin McCarter, Fereidoun Rezanezhad, Maria Strack, Jonathan Price, Carl Mitchell
- Conference session organizer and convener, 2018 CGU Joint Meeting, 10-14 June 2018, Niagara Falls, Ontario, Canada, "Coupled Hydrological and Biogeochemical Functions, Part II: Terrestrial Ecosystems". Biogeoscience and Hydrology, Session CGU-H-09.
 - CGU_H_09: Coupled Hydrological and Biogeochemical Functions, Part II: Terrestrial Ecosystems
 - Conveners: Fereidoun Rezanezhad, Colin McCarter, Tobias Weber, Merrin Macrae, Nandita Basu, Philippe Van Cappellen
- A session proposal has been submitted to 2018 AGU Fall Meeting on: Hydrobiogeochemical dynamics of snow-dominated terrestrial systems during the winter and shoulder seasons

Adaptation Governance and Policy Changes in Relation to a Changing Moisture Regime Across the Southern Boreal Forest (Laroque)

- Sheri Andrews-Key worked with Mistik Management Ltd. at their November 2017 Public Advisory Group Workshop to aid in informing and incorporating science and traditional knowledge with communities, stakeholders and community representatives from across the Mistik Forest Management Area on climate change and adaptation.
- Sheri Andrews-Key worked with representatives from provincial and the federal Canadian governments in Ottawa in September 2017, to aid in providing direction and helping form Natural Resources Canada, strategic 10-year direction for Sustainable Forest Management and Climate Change.

Wilfrid Laurier Technical Team (Munkittrick)

- Munkittrick, K. 2018. Monitoring cumulative effects its critical role in Cumulative effects assessment. Invited presenter and participant at ENR Cumulative effects framework meeting, Yellowknife, NT, Feb 7-9, 2018
- Rudy, A. 2017. Towards a Canadian Permafrost Network, Yellowknife, NT, Nov 16, 2017

Boreal Water Futures (Waddington)

 Black (BWF project manager) and Nicholls (PhD student under Carey) participated in an interactive workshop on knowledge mobilization on Friday, April 13th hosted by Northern Water Futures and WLU.

Prairie Water Futures (Whitfield/ Spence)

- Mora, M.G. (2017) Prince Albert Model Forest meeting. Mistawasis, SK. November 6, 2017
- Shook, K. (2017) Instructor, Hydrological modelling instruction on the Cold Regions Hydrological Model (CRHM), Saskatoon, October 2017.
- Strickert, G.E.H., Hassazedha, E., Carr, M., and Carlson, H., (2017) Participatory Water Quality Modelling in the Qu'Appelle Valley, December 10th, Lumsden.
- Strickert, G.E.H., Hassazedha, E., Carr, M., and Carlson, H., (2017) Participatory Water Quality Modelling in the Qu'Appelle Valley, December 6th Moose Jaw.

Appendix J – Funding Agencies/ External Collaborators/ Partners/ Users and Stakeholders

11.9 No	Leveraged	Contribution
Unit Name	Cash (\$)	In-kind (\$)
Academic Institutions		<u> </u>
Alberta Biodiversity Monitoring Institute		
Chinese Academy of Science		
Forêt Montmorency, Université Laval		200000
Global Institute for Water Security		
IISD-Experimental Lakes Area (ELA)	0	22000
Laurier		343696
Norwegian Institute for water Research (NIVA)		
Ohio State University		
Southern Ontario Water Consortium (analytical and ecotox nodes)	0	1000
Université de Montréal	10000	20000
Université du Québec à Montréal		66000
University of Calgary		15000
University of Manitoba		140000
University of Northern British Columbia	132000	33000
University of Osnabruck		
University of Saskatchewan		202000
University of Victoria		54000
University of Waterloo	181279	690000
Washington State University		1000
Western Partnership for Wildland Fire Science, University of		50000
Alberta		
Western University		10000
Wilfrid Laurier University		846000
York University, adjunct Wilfrid Laurier, adjunct University of	8000	30000
Waterloo		
International Institutions		
Bay-Delta Office, Department of Water Resources		
Bowling Green State University		
EAWAG (Swiss Federal Institute of Aquatic Science and		
Technology) EAWAG is both Academic and International so		
this entry is repeated below		
Gorgan University of Agricultural Sciences and Natural		
Resources		
Helmholtz Centre for Environmental Research		

Hydromotographications (HAD) NCAD USA	5 7 7 7 10	
Hydrometeorological Applications (HAP), NCAR, USA		ed C
Indian Institute of Science	2013	
Indian Institute of Technology (IIT) Delhi	1 1	111111111111111111111111111111111111111
International Copper Association		
International Lead Association		
International Zinc Association		
Joint Research Center, European Commission		
Lawrence Berkeley National Laboratory		
Nanjing University, Nanjing, China	0	3000
NASA ABoVe		
NASA JPL		
National Center for Atmospheric Research		86000
NOAA-GLERL (Great Lakes Environmental Research		
Laboratory)		
Norwegian Institute for Water Research		60000
Red River Basin Commission		
Spanish National Research Council		
Swedish Meteorologic and Hydrologic Institute (SMHI)		5000
Swedish University of Agricultural Sciences		
Tai Lake riverine pollution prevention and management	0	1000
office, Chinese Ministry of Science and Technology, China		
Tai Lake riverine pollution prevention and management		
office, Chinese Ministry of Science Nanjing University,		
Nanjing, China		
United Nations University	0	
United Nations University - Institute for Water Environment		
and Health (UNU-INWEH)		
United States Department of Agriculture: Agricultural		
Research Service (USDA-ARS)		
University of New South Wales		
University of Arizona		
University of Michigan, Water Centre		12500
US Forest Service		1000
US NCAR		
USACE (U.S. Army Corps of Engineers)		
Yale University		
Provincial Governments		
		30000
	30000	33333
	550000	1
Nanjing, China United Nations University United Nations University - Institute for Water Environment and Health (UNU-INWEH) United States Department of Agriculture: Agricultural Research Service (USDA-ARS) University of New South Wales University of Arizona University of Michigan, Water Centre US Forest Service US NCAR USACE (U.S. Army Corps of Engineers) Yale University	30000	1000

Alberta Innovates-Water Innovation Program and Wildlife		
Branch	and a series	31
Alberta Land Use	1 2	
BC Hydro		3
BC Ministry of Forests, Lands, and Natural Resource		
Operations		
BC Parks		
City of Calgary	100000	200000
Climate Change Unit, ENR, GNWT		
Credit River Conservation		
Emergency Management & Fire Services		
Environment and Natural resources, Government of		
Northwest Territories		
Environmental Science Research Fund		
Friends of Mill Creek		
Geomatics Centre, GNWT		
GNWT	295000	2200000
GNWT Cumulative Impacts Monitoring Program	360000	
Grand River Conservation Authority		
Grand River Fisheries Management Plan Implementation		
Committee		
Hydro-Québec		60000
Long Point Region Conservation Authority (LPRCA)		
Manitoba Agriculture	0	0
Manitoba Hydro		45000
Manitoba Infrastructure		5000
Manitoba Sustainable Development		
Ministry of the Environment and Climate Change		9750
NB Power		15000
Northern Contaminants Program	58405	
Nova Scotia Department of Agriculture		
NWT Environmental Studies Research Fund	500000	
Ontario Climate Consortium (OCC) & Toronto Region		
Conservation Authority (TRCA)		
Ontario Ministry of Agriculture, Food and Rural Affairs		25500
(OMAFRA)		
Ontario Ministry of Environment and Climate Change		3000
(OMECC)		
Ontario Ministry of Natural Resources and Forestry - LEMU		4500
Ontario Ministry of Natural Resources and Forestry (OMNRF)		
– Alymer District		
Ontario Ministry of Natural Resources and Forestry (OMNRF)		
– Ontario Forest Research Institute (OFRI)		

Dravings of Cackatchowan Forestry Branch	30000	7
Province of Saskatchewan-Forestry Branch	30000	6-1
Saskatchewan Ministry of Agriculture	200	15000
Saskatchewan Ministry of the Environment: Fish	1 2 8	15000
Saskatchewan Research Council		10000
Saskatchewan Water Security Agency		2000
Toronto and Region Conservation Authority		180000
Water Standards Section, Ontario Ministry of Environment	63250	0
and Climate Change		
Yukon Environment		90000
Federal Government		
Agriculture and Agri-Food Canada (AAFC)	0	116000
Canada Centre for Remote Sensing (CCRS), Natural		
Resources Canada (NRCan)		
Canadian Forest Service		50000
Canadian Forest Service-Northern		
Canadian Ice Service		
Canadian Space Agency		100000
CFI - John R. Evans Leaders Fund		200000
CFI (CryoSAR)		1737102
Diversification Canada (WED)		
Environment and Climate Change Canada (ECCC)	17850	949200
Environment and Climate Change Canada- Atmospheric		150000
Science and Technology		
Environment and Climate Change Canada- Water Science		370000
and Technology Directorate		
Environment and Climate Change Canada, Centre for Inland		
Waters (CCIW)		
Environment and Climate Change Canada	18000	11250000
Geological Survey of Canada		
Government of Canada-Natural Resources Canada		
Health Canada		
Indigenous and Northern Affairs Canada		
International Joint Commission		
Natural Resources Canada (NRCan)		40000
Natural Resources Canada- Geological Survey of Canada		1200000
NISAR		120000
Northern Scientific Training Program	5400	
NSERC Create for Water Security	3-00	
,	1765000	
NSERC Discovery Grants NSERC Promoscience	1/03000	108000
Parks Canada Pales Continental Chalf Program (Finalish)	20500	50000
Polar Continental Shelf Program (English)	38500	

Science and Technology Branch, Environment and Climate Change Canada Social Science and Humanities Research Council of Canada (SSHRC) FLEDGE Statistics Canada Ottawa Water Survey of Canada Western Economic Industry Partners Agriculture Producers Association of Saskatchewan Aquanty Inc. BC Hydro BGC Consulting Buffalo Pound Water Treatment Plant (BPWTP) Campbell Scientific Canadian Natural Resources Limited Canadian Oil Sands Innovation Alliance Canadian Sphagnum Peat Moss Association CatlQ CFI industry match De Beers Canada DraganFly Doud Ducks Unlimited Canada Ecology North Sa0000 Sa0000 Sa0000 Sa0000 Savetiment and Climate Canadian Sphagnum Peat Moss Association Canadian Sphagnum Peat Moss Association DraganFly Savetiment Plant Climate Savetiment Plant Climate Canadian Sphagnum Peat Moss Association CatlQ Savetiment Plant Climate Savetiment Plant Climate Canadian Sphagnum Peat Moss Association CatlQ Savetiment Plant Climate S	Prairie Provinces Water Board	- 77	
Change Canada Social Science and Humanities Research Council of Canada (SSHRC) FLEDGE Statistics Canada Ottawa Water Survey of Canada Western Economic Industry Partners Agriculture Producers Association of Saskatchewan Aquanty Inc. BC Hydro BGC Consulting Buffalo Pound Water Treatment Plant (BPWTP) Campbell Scientific Canadian Natural Resources Limited Canadian Oil Sands Innovation Alliance Canadian Rural Revitalization Foundation CatlQ CFI industry match De Beers Canada Ducks Unlimited Canada Ecology North Sandon 30000 137000 1374576 1374576 1374576 1374576 1374576 1374576 1374576 1374576 1374576 1374576 1374576 1374576 1374576 1374576 1374576 1374576 137500 14800 25000 Canadian Sphagnum Peat Moss Association 14800 CatlQ 25000 CFI industry match 348000		0	0
Social Science and Humanities Research Council of Canada (SSHRC) FLEDGE Statistics Canada Ottawa Water Survey of Canada Western Economic 1374576 Industry Partners Agriculture Producers Association of Saskatchewan 13500 BC Hydro 335000 BC Hydro 335000 BGC Consulting Buffalo Pound Water Treatment Plant (BPWTP) 0 Campbell Scientific 1109600 Canadian Natural Resources Limited 2 Canadian Oil Sands Innovation Alliance 1637600 Canadian Sphagnum Peat Moss Association 14800 CatlQ 25000 CFI industry match 642000 De Beers Canada 1900000 DraganFly 20000 Ducks Unlimited Canada 960000 Ecology North 348000		1 2	1
Statistics Canada Ottawa Water Survey of Canada Western Economic 1374576 Industry Partners Agriculture Producers Association of Saskatchewan Aquanty Inc. 13500 BC Hydro 335000 BGC Consulting Buffalo Pound Water Treatment Plant (BPWTP) 0 Campbell Scientific 1109600 Canadian Natural Resources Limited Canadian Oil Sands Innovation Alliance 1637600 Canadian Rural Revitalization Foundation 25000 Canadian Sphagnum Peat Moss Association 14800 CatlQ 25000 CFI industry match 642000 De Beers Canada 1900000 DraganFly 20000 Ducks Unlimited Canada 960000 Ecology North 348000	<u> </u>		30000
Water Survey of Canada1374576Western Economic1374576Industry Partners13500Agriculture Producers Association of Saskatchewan13500Aquanty Inc.13500BC Hydro335000BGC Consulting0Buffalo Pound Water Treatment Plant (BPWTP)0Campbell Scientific1109600Canadian Natural Resources Limited1637600Canadian Oil Sands Innovation Alliance1637600Canadian Rural Revitalization Foundation25000Canadian Sphagnum Peat Moss Association14800CatlQ25000CFI industry match642000De Beers Canada1900000DraganFly20000Ducks Unlimited Canada960000Ecology North348000	(SSHRC) FLEDGE		
Western Economic1374576Industry PartnersAgriculture Producers Association of Saskatchewan13500Aquanty Inc.13500BC Hydro335000BGC Consulting0Buffalo Pound Water Treatment Plant (BPWTP)0Campbell Scientific1109600Canadian Natural Resources Limited1637600Canadian Oil Sands Innovation Alliance1637600Canadian Rural Revitalization Foundation25000Canadian Sphagnum Peat Moss Association14800CatlQ25000CFI industry match642000De Beers Canada1900000DraganFly20000Ducks Unlimited Canada960000Ecology North348000	Statistics Canada Ottawa		
Industry Partners Agriculture Producers Association of Saskatchewan Aquanty Inc. BC Hydro BGC Consulting Buffalo Pound Water Treatment Plant (BPWTP) Campbell Scientific Canadian Natural Resources Limited Canadian Oil Sands Innovation Alliance Canadian Rural Revitalization Foundation Canadian Sphagnum Peat Moss Association CatlQ CFI industry match De Beers Canada DraganFly Ducks Unlimited Canada Ecology North 13500 13500 1400 15000 1637600 1637600 250000 250000 250000 250000 250000 250000	Water Survey of Canada		
Agriculture Producers Association of Saskatchewan Aquanty Inc. 13500 BC Hydro 335000 BGC Consulting Buffalo Pound Water Treatment Plant (BPWTP) 0 Campbell Scientific 1109600 Canadian Natural Resources Limited Canadian Oil Sands Innovation Alliance 1637600 Canadian Rural Revitalization Foundation 25000 Canadian Sphagnum Peat Moss Association 14800 CatlQ 25000 CFI industry match 642000 De Beers Canada 1900000 DraganFly 20000 Ducks Unlimited Canada 960000 Ecology North 348000	Western Economic		1374576
Aquanty Inc. 13500 BC Hydro 335000 BGC Consulting Buffalo Pound Water Treatment Plant (BPWTP) 0 Campbell Scientific 1109600 Canadian Natural Resources Limited Canadian Oil Sands Innovation Alliance 1637600 Canadian Rural Revitalization Foundation 25000 Canadian Sphagnum Peat Moss Association 14800 CatlQ 25000 CFI industry match 642000 De Beers Canada 1900000 DraganFly 20000 Ducks Unlimited Canada 960000 Ecology North 348000	Industry Partners		
BC Hydro BGC Consulting Buffalo Pound Water Treatment Plant (BPWTP) Campbell Scientific Canadian Natural Resources Limited Canadian Oil Sands Innovation Alliance Canadian Rural Revitalization Foundation Canadian Sphagnum Peat Moss Association CatlQ CFI industry match De Beers Canada DraganFly Ducks Unlimited Canada Ecology North 335000 1109600 110	Agriculture Producers Association of Saskatchewan		
BGC Consulting Buffalo Pound Water Treatment Plant (BPWTP) Campbell Scientific Canadian Natural Resources Limited Canadian Oil Sands Innovation Alliance Canadian Rural Revitalization Foundation Canadian Sphagnum Peat Moss Association CatlQ CFI industry match De Beers Canada DraganFly Ducks Unlimited Canada Ecology North 0 1109600 1109600 1607600 1	Aquanty Inc.		13500
Buffalo Pound Water Treatment Plant (BPWTP) Campbell Scientific Canadian Natural Resources Limited Canadian Oil Sands Innovation Alliance Canadian Rural Revitalization Foundation Canadian Sphagnum Peat Moss Association CatlQ CFI industry match De Beers Canada DraganFly Ducks Unlimited Canada Ecology North 1109600 1109600 1637600 25000 25000 48000 1900000 1900000 1900000 100000 1000000 100000000	BC Hydro	335000	
Campbell Scientific1109600Canadian Natural Resources Limited1637600Canadian Oil Sands Innovation Alliance1637600Canadian Rural Revitalization Foundation25000Canadian Sphagnum Peat Moss Association14800CatlQ25000CFI industry match642000De Beers Canada1900000DraganFly20000Ducks Unlimited Canada960000Ecology North348000	BGC Consulting		
Canadian Natural Resources Limited1637600Canadian Oil Sands Innovation Alliance1637600Canadian Rural Revitalization Foundation25000Canadian Sphagnum Peat Moss Association14800CatlQ25000CFI industry match642000De Beers Canada1900000DraganFly20000Ducks Unlimited Canada960000Ecology North348000	Buffalo Pound Water Treatment Plant (BPWTP)	0	
Canadian Oil Sands Innovation Alliance1637600Canadian Rural Revitalization Foundation25000Canadian Sphagnum Peat Moss Association14800CatIQ25000CFI industry match642000De Beers Canada1900000DraganFly20000Ducks Unlimited Canada960000Ecology North348000	Campbell Scientific		1109600
Canadian Rural Revitalization Foundation25000Canadian Sphagnum Peat Moss Association14800CatIQ25000CFI industry match642000De Beers Canada1900000DraganFly20000Ducks Unlimited Canada960000Ecology North348000	Canadian Natural Resources Limited		
Canadian Sphagnum Peat Moss Association 14800 CatIQ 25000 CFI industry match 642000 De Beers Canada 1900000 DraganFly 20000 Ducks Unlimited Canada 960000 Ecology North 348000	Canadian Oil Sands Innovation Alliance	1637600	
CatIQ 25000 CFI industry match 642000 De Beers Canada 1900000 DraganFly 20000 Ducks Unlimited Canada 960000 Ecology North 348000	Canadian Rural Revitalization Foundation		25000
CFI industry match 642000 De Beers Canada 1900000 DraganFly 20000 Ducks Unlimited Canada 960000 Ecology North 348000	Canadian Sphagnum Peat Moss Association		14800
De Beers Canada 1900000 DraganFly 20000 Ducks Unlimited Canada 960000 Ecology North 348000	CatIQ		25000
DraganFly 20000 Ducks Unlimited Canada 960000 Ecology North 348000	CFI industry match		642000
Ducks Unlimited Canada 960000 Ecology North 348000	De Beers Canada		1900000
Ecology North 348000	DraganFly		20000
	Ducks Unlimited Canada		960000
EPCOR	Ecology North		348000
	EPCOR		
ESRI Canada 97500	ESRI Canada		97500
exactEarth 1500000	exactEarth		1500000
FireSmart Canada	FireSmart Canada		
Forsee Instruments	Forsee Instruments		
Giant Mine Oversight Board	Giant Mine Oversight Board		
Gordon Foundation 530000	Gordon Foundation		530000
Grain Farmers of Ontario 0 11700	Grain Farmers of Ontario	0	11700
Honeywell/COM DEV 625000	Honeywell/COM DEV		625000
Hoskin Scientific	Hoskin Scientific		
Husky Oil Operations	Husky Oil Operations		
ICLR 45000	ICLR		45000
International Copper Association	International Copper Association		
International Mineral Innovative Initiative			
International Plant Nutrition Institute (IPNI)	International Plant Nutrition Institute (IPNI)		
International Zinc Association			
Livestock Research Innovation Corporation	Livestock Research Innovation Corporation		

Manitoba Hydro		2000
Matrix Solutions	22500	250000
McKenna Geotechnical	4 4	
Mike Wiegele Helicopter Skiing		,
Mistik Management		20000
Nestle Waters Canada		
Nickel Producers Environmental		
Nipika Mountain Resort		
O'Kane Consultants		
Orano Canada Inc. (Former name: AREVA Resources Canada		33333
Inc.)		
Partners FOR the Saskatchewan River Basin (PFSRB)		
Red River Basin Council		15000
Research Association		
Rural Policy Learning Commons	3000	12000
Saskatchewan Association of Watersheds		
Saskatchewan Irrigation Projects Association	0	3000
Solinst Canada		40000
Sorcerer Lodge		
Syncrude Canada Ltd.	924375	150000
The Saskatchewan River Delta Stewardship		12000
Thermo Fisher Scientific		
Wastewater, City of Guelph	0	0
Water Services, Region of Waterloo	0	0
Non-governmental Organizations	·	
Alberta NAWMP		
Assiniboine River Basin Initiative		
Avalanche Canada		
Bow River Basin Council		20000
Center for Excellence in Mining Innovation		
City of Calgary		
City of Saskatoon	0	3000
Columbia Basin Trust	140000	
Council of the Great Lakes Region		
Ducks Unlimited Canada (SK, AB, IWWR)		21000000
Elbow River Watershed Partnership		
Essex Region Conservation Authority		
Fraser Basin Council		
Friends of the Grand River	0	1000
Ghost Watershed Alliance Society		
Grand River Conservation Authority (GRCA)	0	20000
Hakai Institute	476000	

International Institute for Sustainable Development (IISD),		A Contraction
Experimental Lakes Area		43
Middle Grand Chapter of Trout Unlimited Canada	0	3000
Moose Jaw River Basin Stewards	U	11000
National Center for Atmospheric Research		11000
Nickel Producers Environmental Research Association		
North Saskatchewan River Basin Council		
Ontario Commercial Fisheries Association		
Ontario Federation of Anglers and Hunters	0	1000
Ontario Rivers Alliance		
	0	1000
Pacific Climate Impacts Consortium		306000
Prince Alberta Model Forest Association Inc.		200000
Red Deer River Watershed Association		200000
Redberry Lake Biosphere Reserve		20020000
Region of Waterloo, Water Services		20620000
Saskatchewan Association of Watersheds		
Spray Lakes Sawmills	297000	
St. Williams Conservation Reserve Community Council		
(SWCRCC)		2000
Trout Unlimited National	0	3000
Upper Thames River Conservation Authority	0	12000
WUQWATR (Wascana Upper Qu'Appelle Watershed		
Association Taking Responsibility)		
Indigenous Communities	T	T
6 Nations		
Beardy's and Okemasis First Nation		
Big Island Lake Cree Nation		
Canoe Lake Traditional Resource User Board		
Chiefs of Ontario		
Dehcho AAROM		20000
Dehcho First Nations		
Delta N90 Trappers	0	2000
DeneSuline Co-Management Board (Dillion)		
Divide Forest Advisory Corporation		
Haudenosaunee Resource Centre		
Indigenous Elders & Youth Council (IEYC)		
Inuvialuit FJMC		20000
James Smith Cree Nation		
Ka'a'gee Tu First Nation		80000
Knowledge Guardian		
Lubicon		
Metis Local 42		

Mistawasis Nêhiyawak		
North Slave Métis Alliance	و صوب الحر	
Northern Village of Buffalo Narrows	- %	
Northern Village of Cumberland House		17000
Sahtu Renewable Resource Board		80000
Sakitawak Resource Management Inc.		
Six Nations of the Grand River Wildlife Management Office	0	1000
Six Nations Polytechnic		
The Cree Lubicon of Little Buffalo, AB		
Tłįcho Government		
Wek'èezhìi Land and Water Board		
Yellow Quill First Nation		
Yellowknives Dene First Nation		

Appendix K - Science and Public Outreach

Citizen Science

Co-Creation of Indigenous Water Quality Tools (Martin-Hill)

 World water day community engagement event. March 22, 2018. Community Hall, Six Nations of the Grand River Territory. This was a community engagement event that was organized in celebration of the World Water Day. The team presented the project to the community and engaged in round table discussions to ascertain community priorities.

Northern Waters Futures (Baltzer)

- Supporting the Ka'a'gee Tu Atlas (Blay-Palmer/Spring). The Ka'a'gee Tu Atlas is a monitoring project that will enable community members to gain more knowledge of the impacts of environmental change and developments are having on the land and the community. The project was created through the desire to help monitor and protect the land which the community depends on for their food, health and livelihood. One priority of this project is to engage youth in mapping skills and knowledge about the land. In partnership with the NWT Centre for Geomatics an innovative EduKit was piloted with the youth in Kakisa. https://kaageetuatlas.wordpress.com
- Baltzer and Spring met with Mackenzie Datastream in January with Global Water Citizenship PI Colin Robertson to discuss collaborative opportunities. Co-Is Gray and Swanson provided input to Datastream's new data platform. Rudolph is providing input on groundwater data management for Datastream.
- We are collaborating with the Sahtu Renewable Resources Board to develop school programming that would support environmental monitoring by the students.
- Marian Watershed Stewardship Program 2017 Planning Team. Baltzer and Telford were involved in planning of the annual MWSP trip to the Marian Watershed as part of outreach for Northern Water Futures. This is an Indigenous Community-based watershed monitoring program. NWF HQP Ana Sniderhan and James Telford participated in the onthe-land event and a video featuring Tlicho partners, Sniderhan and Telford can be found here: https://vimeo.com/240199405
- Ne K'a Dene Ts'į lį Forum (Living on the Land Forum) Members. Spring (KM team) helps to coordinate and NWF investigators Baltzer, Rudolph, Turetsky, Gray, and Laird and HQP Kershaw are involved in regular calls with this Sahtu Renewable Resources Board-led group that discusses ongoing research and research priorities in the Sahtu region and development of community-led research.

Agricultural Water Futures (Macrae)

• Macrae is working with the Bruce Peninsula Biosphere Association on water quality (phosphorus) and land management strategies. This includes aspects of citizen science where volunteers collect water samples and assess stream health.

Boreal Water Futures (Waddington)

iWetland. Boreal wetland water level crowd sourcing.

Public Outreach

Arain, Altaf

 Telling the future of water in southern forests" in McMaster BRIGHT WORLD on 12 February 2018. https://brighterworld.mcmaster.ca/articles/telling-the-future-of-water-in-southern-forests/

Baltzer, Jennifer

- December 6, 2017: Toronto Star. The great global species shake-up: http://projects.thestar.com/climate-change-global-species-shakeup/
- https://www.myyellowknifenow.com/26060/wlu-home-yk/ https://thecord.ca/laurieropens-new-official-research-office-in-yellowknife/ https://www.academica.ca/topten/wlu-opening-new-research-office-yellowknife
- https://www.waterloochronicle.ca/news-story/7563455-laurier-opens-yellowkniferesearch-office/
- November 6, 2017 Toronto Star interview about carbon emissions from the boreal forest: https://www.thestar.com/news/canada/2017/11/06/us-environmental-group-raises-alarm-on-clear-cutting-in-boreal-forest.html
- Various press about Laurier Yellowknife office opening: https://www.wlu.ca/news/news-releases/2017/sept/laurier-opening-new-research-office-in-yellowknife.html
- Winter 2017. Laurier Campus Magazine. Laurier in the North: Researchers aim to answer important questions about a changing northern climate. Accessed from http://www.campusmagazine.wlu.ca/2017/fall-winter/features/laurier-in-thenorth.html

Basu, Nandita

- PhysOrg, "Gulf of Mexico dead zone not expected to shrink anytime soon," https://goo.gl/dZUKTt
- ABC News, "Gulf of Mexico 'dead zone' will persist for decades," http://goo.gl/1NUeD3
- American Association for the Advancement of Science, "Marine Dead Zones in Gulf of Mexico are Expected to Last Decades," http://goo.gl/CMxJdF
- Basu, NB and Van Meter KJ, University of Waterloo Water Institute Newsletter, "Efforts
 to reduce pollution from agriculture paying off slowly," https://uwaterloo.ca/waterinstitute/news/efforts-reduce-pollution-agriculture-paying-slowly-0
- Blacklock's Reporter, "Study boosts pollution filters" http://bit.ly/2utCgJo
- Boston Herald, "Study: 'Legacy' nitrogen also feeds Gulf of Mexico dead zone," https://goo.gl/a6pvKA
- Canadian Freshwater Alliance, "Wetlands: From science to Action" http://bit.ly/2gEMgcA

- CBC Radio-Canada, "La destruction des petits marais: un danger pour la santé des Grands Lacs" http://bit.ly/2v0cCiL
- CBC, "Pollution reduction work can take decades to see results," https://tinyurl.com/y8jkuc8e
- Cheng, F., and Basu, N. 2017. Biogeochemical hotspots: Role of small water bodies in landscape nutrient processing. Water Resources Research. doi: 10.1002/2016WR020102.
- Chicago Tribune, "Study: 'Legacy' nitrogen also feeds Gulf of Mexico dead zone," https://goo.gl/cLRWEA
- Eos Research Spotlight (Newsletter of the American Geophysical Union), "Small wetlands retain lion's share of nutrients" http://bit.ly/2vY5RLm
- Jim Daley Writes, "Loss of wetlands linked to Great Lakes algal blooms" http://bit.ly/2uNFcDO
- MetroNews, "Wetland loss a cause of algal blooms in Great Lakes, study finds" http://bit.ly/2uDAsQG
- National Post, "Destruction of small wetlands leads to more algal blooms, Ontario study finds" http://bit.ly/2tDVS0x
- New York Times, "Study: 'Legacy' nitrogen also feeds Gulf of Mexico dead zone," https://goo.gl/r4eJdH
- Science Daily, "Destruction of wetlands linked to algal blooms in Great Lakes" http://bit.ly/2uerczZ
- The Guardian, "'Dead zone' in Gulf of Mexico will take decades to recover from farm pollution," https://goo.gl/CGoCnX
- Toronto Star, "Smaller wetlands better at filtering out pollutants than larger ones, Ontario study finds" http://bit.ly/2tDIPvX
- University of Waterloo Water Institute Newsletter, "Efforts to reduce pollution from agriculture paying off slowly," https://uwaterloo.ca/water-institute/news/efforts-reduce-pollution-agriculture-paying-slowly-0
- University of Waterloo Water Institute, "Destruction of wetlands linked to algal blooms in Great Lakes" http://bit.ly/2viPsRg
- Van Meter, K.J., Basu N.B., (2017) Time Lags in Watershed-Scale Nutrient Transport: An Exploration of Dominant Controls, Environmental Research Letters
- Van Meter, K.J., Van Cappellen, Basu N.B., (2018) Legacy nitrogen may prevent achievement of water quality goals in the Gulf of Mexico, Science
- Water Canada, "New research suggests smaller wetlands capture more nutrients" http://bit.ly/2gOa4xW
- Water Canada, "Top 5 Water Science Stories in 2017" http://bit.ly/2m3j4PV
- Waterloo Record, "A Grand Challenge: As population in the watershed booms, it is more important than ever to keep the river clear and clean," https://www.therecord.com/news-story/7975783-a-grand-challenge/
- Waterlution, "Andrew Reeves' spotlight on Great Lakes: Wetlands" http://bit.ly/2vRu1qN

- Western Producer, "Watershed cleanup could take decades," http://www.producer.com/2017/08/watershed-cleanup-could-take-decades/
- WOSU Radio, "Research shows connection between wetlands and algae blooms" http://bit.ly/2haFluP
- Basu, N.B. CBC News, "Losing small wetlands linked to algal blooms in lakes, research says" http://bit.ly/2eLaAMm
- Basu, N.B. CBC, "Pollution reduction work can take decades to see results," https://tinyurl.com/y8jkuc8e

Flanningan, Mike

- Flannigan featured in AlbertaFarmer Express article published on December 18th, 2017: https://www.albertafarmexpress.ca/2017/12/18/climate-change-equals-more-grass-fires-says-expert/
- Flannigan featured in Calgary Herald article published on October 22nd, 2017: http://calgaryherald.com/news/local-news/makes-it-more-extreme-prof-says-climate-change-made-historic-fire-season-worse
- Flannigan featured in CBC News Edmonton article published on October 24th, 2017: http://www.cbc.ca/news/canada/edmonton/wildfires-alberta-winds-1.4370192
- Flannigan featured in CTV News article published on August 11th, 2017: https://www.ctvnews.ca/sci-tech/artificial-intelligence-can-better-predict-forest-fires-says-alberta-researcher-1.3542249
- Flannigan M, and Wotton M. How will Canada manage its wildfires in the future? Online article published by The Conversation (November 26, 2017): https://theconversation.com/how-will-canada-manage-its-wildfires-in-the-future-86383#republish
- Flannigan M, and Wotton M. Wildfires will only get more devastating if we don't make big changes. Online article published by the HuffPost (July 28th, 2017): https://www.huffingtonpost.ca/mike-flannigan/wildfire-management a 23054613/

Laird, Brian

• February 2018. CBC News. Researchers see very reassuring early results in N.W.T. contaminants study. Accessed from: http://www.cbc.ca/news/canada/north/university-of-waterloo-contaminants-study-1.4530092

Macrae, Merrin

 Researchers defining phosphorus movement in Ontario soils by John Greig. Country Guide. August 25, 2017. https://www.country-guide.ca/2017/08/25/researchersdefining-phosphorus-movement-in-ontario-soils/51627/ [Macrae and Plach research featured].

Marsh, Philip

 September 2017. Article by Leica-Geosystems about "Understanding Snow Melt". Philip Marsh and the Trail Valley Research group were featured: http://leica-geosystems.com/about-us/news-room/customer-magazine/reporter-80/understanding-the-snowmelt

Martin-Hill, Dawn

- "Indigenous communities and McMaster lab partner in water quality research" by Flora Pan, CBC (Nov 4, 2017) http://www.cbc.ca/news/canada/hamilton/mcmaster-university-indigenous-community-water-quality-1.4386447)
- "McMaster research team tackles water issues in First Nations communities" by Lori Dillon https://brighterworld.mcmaster.ca/articles/co-creating-indigenous-water-qualitytools/
- "Research will probe dangerous water quality in First Nations communities" by Nicole O'Reilly, Hamilton Spectator (Nov 1, 2017) https://www.thespec.com/newsstory/7765451-research-will-probe-dangerous-water-quality-in-first-nationscommunities/
- Six Nations newspaper "Turtle Island News"
- Six Nations newspaper "Two-row times"

Petrone, Richard

• Conducted an interview with Elbow River Water Program Newsletter, March 2018.

Pomeroy, John

- Pomeroy, J. Canada isn't as water-rich as you might think. Broadcast Interview, CTV News.
 March 28, 2018
- Pomeroy, J. Feb 15, 2018. As a water crisis looms in Cape Town, could it happen in Canada? (Online Resource). In The Conversation and Maclean's.
- Pomeroy, J. Mar 21, 2018. Snowpack levels high but flooding concerns depend on rain forecast (Newspaper Article). In Calgary Herald.
- Pomeroy, J. Mar 6, 2018. Researchers say they can better predict storms caused by rising temperatures (Newspaper Article). In Saskatoon StarPhoenix
- Pomeroy, J. Mar 7, 2018 Expect more rain, floods as part of climate change: experts (Newspaper Article). In Winnipeg Free Press.
- Pomeroy, J. Mar 7, 2018. Canadian researchers find way to better predict severe storms (Online Resource). In Canadian Underwriter
- Pomeroy, J. Mar 7, 2018. New science is forecasting the future in the changing climate of Western Canada (Online Resource). In University of Saskatchewan News.
- Pomeroy, J. Mar 7, 2018. River flooding is not a risk at the moment, according to experts (Newspaper Article). In Metro Calgary.

- Pomeroy, J. Nov 16, 2017. Boosting Canada's Global Expertise in Water Security and Precision Agriculture Research (Online Resource). In Canadian Insider.
- Pomeroy, J. Nov 16, 2017. Global Institute for Water Security Receives \$1.3m to Develop Sensors (Newspaper Article). In Water Canada.
- Pomeroy, J. Sep 26, 2017. In Saskatchewan, high water washes farm profits away (Newspaper Article). In The Globe and Mail.
- Pomeroy, J. 'It's not impossible': Western Canada's risk of water shortages rising, Broadcast Interview. CBC Calgary, March 14, 2018
- Pomeroy, J. Day Zero for Cape Town water, what about Canada, and elsewhere?,
 Broadcast Interview. CBC/Radio-Canada, March 9, 2018
- Pomeroy, J. Even with its massive water resources, Canada is not immune to dramatic droughts, Broadcast Interview. Radio Canada International, March 16, 2018
- Pomeroy, J. Global Water Futures, Broadcast Interview. CBC Saskatchewan, December 12, 2017
- Pomeroy, J. Here are the places in Canada yes, Canada vulnerable to drought, Broadcast Interview. CBC/Radio-Canada, March 22, 2018
- Pomeroy, J. Is Canada's West Coast immune from a water crisis?, Broadcast Interview.
 CBC News The National, March 13, 2018
- Pomeroy, J. Study shows shocking reality of climate change in Saskatchewan and around the world, Broadcast Interview. 620 CKRM - The Source, March 6, 2018
- Pomeroy, J. U of S researchers say they can better predict storms caused by rising temps, Broadcast Interview. Global Saskatoon, March 7, 2018
- Pomeroy, J. Un nouveau modèle climatique permettra de mieux prédire les inondations dans l'Ouest canadien, Broadcast Interview. CBC/Radio-Canada, March 9, 2018
- Pomeroy, J. Yukon's Wolf Creek 'research basin' helps track and plan for climate change, Broadcast Interview. CBC North, October 2, 2017.

Razavi, Saman

- Odume N and Slaughter A (February 12, 2018), Africa needs to invest more in its water professionals. In TheConversation.com.
- Slaughter A and Mantel S (February 4, 2018), What southern Africa can learn from other countries about adapting to drought. In TheConversation.com.

Servos, Mark

- A Grand Challenge. As population in the watershed booms, it is more important than ever to keep the river clear and clean. The Waterloo Region Record, Catharine Thompson, Dec. 2, 2017. https://www.therecord.com/news-story/7975783-a-grand-challenge/
- Front page of The Record features Water Institute members commenting on the importance of keeping the Grand River healthy. Water Institute. University of Waterloo,

- https://uwaterloo.ca/water-institute/news/front-page-record-features-water-institute-members
- The importance of keeping the Grand River healthy, Department of Biology, University of Waterloo, Dec. 18, 2017. https://uwaterloo.ca/biology/news/importance-keeping-grand-river-healthy
- Top Projects: The ten biggest water investments in Canada. Water Canada, March/April 2018, p 28-29. Mark Servos was interviewed and discussed the impacts of wastewater and the treatment upgrades on the environment. www.watercanada.net

Strickert, Graham

- Irland, B. (2018) What the River Knows: Saskatchewan River at Cumberland House https://voices.nationalgeographic.com/2017/07/01/what-the-river-knows-saskatchewan-delta-at-cumberland-house-canada/
- Strickert, G.E.H. (2018) Missinippi Radio. Climate Change in the Central Interior of Canada. March 8th, 2018

Spring, Andrew

 April 2017: Andrew Spring contributes to an article for Northern Public Affairs on Northern Food (in)Security: http://www.northernpublicaffairs.ca/index/coming-soonnpas-new-issue-on-food-security-in-the-north/

Turetsky, Merritt

- April 17, 2018: The Star Vancouver. Global wildfire emissions declined over past 90 years, but not in Canada. Accessed from: https://www.thestar.com/vancouver/2018/04/17/global-wildfire-emissions-declinedover-past-90-years-but-not-in-canada.html
- August 2017: Gizmodo. There's a Freakishly Large Fire Blazing Across Western Greenland.
 Accessed from: https://gizmodo.com/theres-a-freakishly-large-fire-blazing-across-western-g-1797631160
- December 12, 2017: CBC. Some forests aren't growing back after wildfires, research finds. Accessed from http://www.cbc.ca/news/technology/forests-wildfires-1.4444998
- January 2017: The Conversation. How wildfires could radically change forests-and your life. Accessed from: https://theconversation.com/how-wildfires-could-radically-changeforests-and-your-life-81158
- March 6, 2018: Science New. When bogs burn, the environment takes a hit. Accessed from https://www.sciencenews.org/article/bogs-peatlands-fire-climate-change
- Turetsky, M. January 8, 2018. CTV's Your Morning Show. Drier, warmer climate impeding forest regeneration, research shows. Accessed from https://www.ctvnews.ca/scitech/drier-warmer-climate-impeding-forest-regeneration-research-shows-1.3750520

Van Cappellen, Philippe

Ecohydrology Across Scales (SCITECH EUROPA)
 https://www.scitecheuropa.eu/ecohydrology-across-scales/85054/

Waddington, Mike

- Waddington and PhD student (Wilkinson) featured in Phys Org article published on January 17th, 2018: https://phys.org/news/2018-01-simple-key-severe-peat.html
- Waddington and PhD student (Wilkinson) featured in ScienceDaily article published on January 17th, 2018:

https://www.sciencedaily.com/releases/2018/01/180117164013.html

Wolfe, Brent

 Merrill, S. and Wolfe, J.D. (2018) In defence of potholes. March 20th. http://worldwaterday.org/in-defence-of-potholes/

Policy Briefs and Meetings with Governments

Adaption Governance (Laroque)

 Meetings with Saskatchewan Ministry of Environment, Forest Services Branch – October 2017, January 2018, March 2018, April 2018 – Working on developing strategic direction for industry and government for climate change adaptation policy in sustainable forest management planning and practices.

Agricultural Water Futures (Macrae)

- InterAction Council, High-Level Expert Group (HLEG), Canadian international policy on water, peace and security, November 28, 2017 (J. Pomeroy)
- Blue Ribbon Panel Review of Environment and Climate Change Canada's National Hydrological Service Workshop, National Hydrological Service, October 2017 to November 2017 (J. Pomeroy
- External Review Panel Member (J. Pomeroy) for the Integrated Network Design Project conducted by the Meteorological Service of Canada (MSC), November 2017 to January 2018.
- Grand River Conservation Authority (Brouwer, Robinson and HQP) [4 meetings]
- OMAFRA (Merrin Macrae)
- OMAFRA (Rob de Loë)
- Saskatchewan Water Security Agency and Ministry of Agriculture (Baulch) [2 meetings]
- Upper Thames Region Conservation Authority (Brouwer, Deadman, Robinson, Wandel and HQP) [3 Meetings]

Co-Creation of Indigenous Water Quality Tools (Martin-Hill)

- Elected Council of Six Nations provided a Band Council Resolution in support of the research over three-year period. Ethics was approved by the community.
- Meeting the Indigenous Government: we met with the Confederacy Chiefs and Clanmothers of the Six Nations of the Grand River on March 3, 2018. The team presented the project and asked for permission and support of the project by the Chiefs. The Chiefs were gracious enough to allow the project to proceed and requested interim briefings.

Crowdsourcing Water Science (Stickert)

• Prairie Provinces Water Board, NHRC, March 15th, 2018.

FORMBLOOM (Baulch)

- Annual meeting of GWF and GIWS researchers with Saskatchewan Water Security Agency.
- Frequent meetings with Dan Conrad (Buffalo Pound Water Treatment), Sandra Cooke (GRCA), Scott Higgins (IISD-ELA).

Lake Futures (Basu)

- Basu, N.B. (2017). Biogeochemical Hotspots: Role of Small Water Bodies in Watershed Nutrient Processing. Credit Valley Corporation (CVC), Toronto, November 23rd, 2017.
- Basu, N.B. (2017). Biogeochemical Hotspots: Role of Small Water Bodies in Watershed Nutrient Processing. Toronto Region Corporation Authority (TRCA), January 2018.
- Basu, N.B. (2017). Nutrient Legacies and Time Lags: Implications for Water Quality,
 Canada
- Center for Inland Waters, Environment and Climate Change Canada, Burlington, May 2018
- H. Kheyrollah Pour, T. Milojevic, P. Van Cappellen, Gail Krantzberg, Nicola Crawhall: organizing panel session at the 10th Canadian Science Policy Conference (CSPC 2018) meeting in Ottawa, Canada on November 7-9, 2018 (Managing Receiving Water: Can Canadian Water Policies and Regulations Address Current and Emerging Challenges?)
- R. Brouwer, presentation for the Lake Erie Conservation Authorities, Upper Thames Conservation Authority, London, Ontario, December, 15, 2017 (title presentation: Design & evaluation incentive-compatible economic policy instruments and BMP's to facilitate transition to sustainable agriculture).

Linking Multiple Stressors (Servos)

Mavinic, D., S. Arora, C. Brooks, Y. Comeau, M. Darbyshire, K. Kidd, T. McClenaghan, M. Servos. 2018. Canada's Challenges and Opportunities to Address Contaminants in Wastewater. National Expert Advisory Panel Report, Canadian Water Network, Waterloo, Ontario. 71 p., plus 4 Appendices. http://www.cwn-rce.ca/focus-areas/blue-cities/national-project-on-contaminants-in-wastewater/national-expert-advisory-panel-

on-canadas-needs-and-opportunities-to-address-contaminants-in-wastewater/ Prof. Mark servos was a member of the Expert Advisory Panel.

Northern Water Futures (Baltzer)

- Regular in person/phone meetings with a range of GNWT departments/divisions: Forest
 Resources Division (July, November, February, April; Baltzer, Spring); Industry Tourism
 and Innovation (Northwest Territories Geologic Survey and Agriculture Divisions) monthly
 (Turetsky, Baltzer, Spring); Water Resource Division (HQP Coles, Connon and Hicks) at
 least monthly; Climate Change Division (July and October; Spring); Department of Health
 and Social Services of the Government of the Northwest Territories to discuss project
 progress and implications for contaminant advisories/consumption notices (October
 2017; November 2017) (Laird/Skinner).
- Anna Coles* Participated in Canadian Centre for Climate Services GNWT Climate Services meeting, Explorer Hotel, Yellowknife, 28 February 2018.

Prairie Waters (Spence/Whitfield)

- Hayashi serves on the technical advisory panel for the Government of Alberta on the development of a new Groundwater Management Framework, which will use the results of the Prairie Water project as the foundation for groundwater recharge estimate. The panel had an inaugural meeting in Edmonton on August 18, 2017.
- Lindenschmidt, K. Morales, L., and Strickert, G.E.H. (2018) Towards Participatory Water Quality Modelling with Water Security Agency and Saskatchewan Agricultural Ministry, National Hydrology Research Centre. January 8, 2018.
- Strickert, G.E.H. (2018) Connecting with Communities. Prairie Provinces Water Board, NHRC, March 15th, 2018.
- Wolfe, J.D. (2018) SK MoE Prairie Resilience Framework for Climate Change Strategies— NGO consultations. February 27th, Saskatoon, SK.

SAMMS (Sub-Arctic Metal Mobility Study) (Wolfe)

• English M. February 2018. Meeting with GNWT staff (Environment and Natural Resources, Health and Social Services) and members of the Giant Mine Oversight Board to relay the rationale, objectives, and research plan for SAMMS.

SPADE (J. Thériault)

• External Review Panel Member for the Integrated Network Design Project conducted by the Meteorological Service of Canada (MSC), November 2017 to January 2018.

Transformative Sensor Technologies and Smart Watersheds (TTSW) (Duguay)

• Meetings with NWF and with the Sahtu Environmental Science and Research Board to establish observatory near Norman Wells (2018, D. Rudolph).

WLU Technical Team (Munkittrik)

 A stakeholders meeting was planned by Jennifer, Mike and Shawne Kokelj during September/October and held in November 2017. The meeting took place in Yellowknife at GNWT offices and involved WLU, GNWT ENR, GNWT Department of Infrastructure, NTPC, and researchers from Brock and Carleton universities.

Workshops and Presentations

- American Geophysical Unions special session on "Diagnosis of Hydrological Change in Cold in Cold Regions" convened by Howard Wheater, John Pomeroy, Dennis Lettenmaier, Chris Debeer and Kevin Shook https://agu.confex.com/agu/fm17/meetingapp.cgi/Session/33992
- April 2018: Two-day SAMMS science planning workshop (WLU).
- Assembly of First Nations National Water Symposium & Trade Show (February 6-8, 2018, Vancouver)
- Assiniboine River Basin Initiative, Regina, February 14th, 2018
- Babaran, D. 2018. The adoption of VEC monitoring and multivariate analyses on the Blair Creek Sub-watershed as a model for CEA. Grand River Conservation Authority Lunch and Learn. 20 April 2018, GRCA Headquarters. Invited platform presentation.
- Baltzer J, Cumming S, Day, N*, Degre-Timmons, G*, Johnstone J, Mack, M, McIntire E, Reid, K*, Schmiegelow F, Spring A*, Turetsky, M, Walker, X, and White A* (2017) Impacts of wildfire extent and severity on caribou habitat: from woodland to barren ground. Invited presentation to Government of the Northwest Territories, Environment and Natural Resources Department. Yellowknife, NT
- Baltzer was an Invited panelist for the Changing Cold Regions and Environment of Western Canada Panel Presentation. Roxy Theatre, Saskatoon. March 6, 2018
- Baltzer, Rudolph, Skinner and HQP Ratelle*, Brandow*, Gibson* and Coles* attended Nę K'ə Dene Ts'į lį (Living on the Land) Forum Workshop - Sahtú Landscape Change Monday-Wednesday, February 12-14, 2018, Cultural Centre, Tulít'a Hamlet Building
- Basu, N.B was an invited participant in the Canadian Water Network (CWN) organized workshop on "Assessing the Adequacy of Urban Nutrient Load Mesaurements" attended by multiple user and stakeholder groups including ECCC, GRCA, TRCA, MOECC, Conservation Halton, Toronto Water, City of Windsor, Region of Waterloo, and Regional Municipality of Durham.
- Baulch, H. Prairie Water Futures. Red River Basin Commission. Winnipeg, Manitoba.
 January 2018.
- Berg A. 2018. Soil Freeze thaw field experiments in support of SMAP. NASA Jet Propulsion Laboratory. Pasadena, California. Invited presentation.

- Brouwer, R. Presentation to Upper Thames River Conservation Authority, Grand River Conservation Authority and Essex Region Conservation Authority partners on AWF research. London, Ontario. December 15, 2017.
- Carey SK. Water in the Changing North. John Rae Lecture. Hamilton Association for the Advancement of Literature, Science and Art..
- CGU Session H-04: Impacts of Forest Disturbances and Climate Change on Watershed Hydrology and Biogeochemistry. Conveners: Qiang Li, M. Altaf Arain, Michael Pisaric and Fan-Rui Meng.
- Co-Chair (with M. Fuzzen, McMaster) Canadian Ecotoxicty Workshop Special Session. How clean is clean enough? Guelph, Ontario. Oct 1-4, 2017.
- Coles, A (2017) An overview of Laurier's water research in the Northwest Territories", oral presentation at the NWT Water Stewardship Strategy Workshop, Dettah, 22-23 November.
- Coles, A (2018) An overview of Laurier's research in the North Slave region, NWT", oral presentation at the North Slave Metis Alliance Public Engagement Workshop, Yellowknife.
- Coles, A (2018) Climate change impacts on the hydrology of the NWT. Invited panelist in Ecology North's Climate Change Panel Discussion, Yellowknife.
- Connon, R (2018) Wilfrid Laurier University research initiatives in the Northwest Territories. Northern Association of Professional Engineers and Geoscientists, Yellowknife, Northwest Territories.
- Co-sponsored a seminar titled "History of Bathurst Caribou and Tlicho People: Managing in a time of scarcity. JOINT PRESENTATION BY Dr. John B. Zoe (Tłįchǫ Government) and Dr. Jan Adamczewski (Government of Northwest Territories). February 5th, 2018. Waterloo, Ontario, Canada.
- CREP held its inaugural workshop in November 2017 at Manitoba Hydro
- Curry, A. 2018. Linking flows and ecology: current understanding and directions with examples from the Mactaquac aquatic ecosystems study. NSERC Connect workshop on environmental flows. January 31, Montreal, QC.
- Day, NJ (2017) Ecological Roles of Heat-Resistant Fungi in Regeneration of Forests After Fire in the Northwest Territories. Ecology North, 22 June, Yellowknife, Northwest Territories, Canada – Invited public seminar.
- de Loë, R. Agriculture in the evolving landscape of water governance. Invited presentation at "Leadership Summit", Christian Farmers Federation of Ontario, Waterloo, Ontario. March 27, 2018.
- de Loë, R. Where Does Agriculture Fit in the Water Governance Landscape? Invited presentation at "Water Stewardship Workshop", Christian Farmers Federation of Ontario, Guelph, Ontario. September 28, 2017.
- Deadman, P. and Robinson, D. Upper Thames River Conservation Authority. 3 meetings between September 22, 2017 and February 2018.

- December 2017: SAMMS inception meeting (WLU).
- Dhiyebi, H. and M. Servos. Cumulative Effects in the Mill Creek Sub-watershed. Friends of Mill Creek (FOMC), April 18, 2018. FOMC includes representatives from industry, local government, OMNRF, GRCA and public.
- Elders meeting, Little Buffalo, Alberta (February 2018)
- English M. February 2018. SAMMS presentation at Sir John Franklin High School (Yellowknife).
- Forest Products Association of Canada March 2018 for dissemination and knowledge transfer on climate change adaptation strategies, planning, and implementation within industry and governments Sustainable Forest Management Planning.
- Grand River Fisheries Management Plan: Tour of the Speed River and Eramosa River Subwatersheds. Presented fisheries research priorities and progress on the Speed River (Servos and Tetreault), October 13, 2017.
- Hall RI and BB Wolfe. (2018). Paleoenvironmental research in the Peace-Athabasca Delta (2000 onwards). Invited presentation to BC Hydro, Vancouver.
- Helen M. Baulch. Prairie Water Futures. Red River Basin Commission. Winnipeg MB, January 2018.
- Impacts of wildfire extent and severity on caribou habitat: from woodland to barren ground. Baltzer organized a public information session in Wekweeti, Northwest Territories to share research results with the community. Wekweeti Youth Centre, July 13, 2017.
- IMPC Kickoff workshop, 14-15 September 2017, National Hydrology Research Centre, Saskatoon. Nearly 70 people from 16 academic, governmental, regulatory, and industrial sectors attended the workshop.
- J. Thériault: Gave a presentation to an undergraduate student outreach activity at UQAM called les midis atmosphériques. An overview of GWF, SPADE and MWF was presented to the students.
- Jardine, T. 2017. Environmental flows for large river deltas. SK Webinar Series, Canadian Water Resources Association, December 12, Saskatoon, SK.
- Julie Theriault gave a presentation to an undergraduate student outreach activity at UQAM called les midis atmosphériques, including an overview of GWF, SPADE and MWF was presented to the students.
- Kahnekanoron (Water is Precious): Resistance and Research at the Art Gallery of Hamilton (Mar 24, 2018) This was a public event at the Art Gallery of Hamilton designed to inform and engage the urban Indigenous community in the project. Presentations were held by Dawn Martin Hill, Patricia Chow-Fraser, Constantine Samaan, and Amos Keye. The link to the event: https://www.artgalleryofhamilton.com/program/kahnekanoron-water-isprecious-resistance-and-research/
- Kahnekanoron: World Water Day Water and Health Workshop at the Six Nations Community Hall (Mar 22, 2018; free event). The poster advertising this event to the

community is shown in Appendix 1. McMaster researchers from Pillar 2 and Pillar 3 projects visited Six Nations on the Grand River to learn about environmental and health concerns related to water in the community of Six Nations. Dawn Martin Hill, Nancy Doubleday, Nidhi Nagabhatla, Patricia Chow-Fraser, Altaf Arain, Constantine Samaan, Tina Moffat, Ravi Selvaganapathy, Emil Sekerinski and Charles de Lannoy presented their GWF projects to the community.

- Kara Hearne participated in regional knowledge mobilization network workshop held in Waterloo on January 23, 2018
- Laird B, Ratelle M, Brandow D, Laird M, Skinner K, Simmons D. Contaminant Biomonitoring in the Northwest Territories Mackenzie Valley: Investigating the Links Between Contaminant Exposure, Nutritional Status, and Country Food Use: Terminology Workshop, February 11, 2017, Deline, NT.
- Laird B, Ratelle M, Brandow D, Skinner K, Simmons D. Contaminant Biomonitoring in the Northwest Territories Mackenzie Valley: Investigating the Links Between Contaminant Exposure, Nutritional Status, and Country Food Use: Terminology Workshop, February 5-6, 2018, Deline, NT
- Laird B, Ratelle M, Brandow D, Skinner K, Simmons D. Contaminant Biomonitoring in the Northwest Territories Mackenzie Valley: Investigating the Links Between Contaminant Exposure, Nutritional Status, and Country Food Use: Terminology Workshop. Tulita, NT. December 1, 2017.
- Lindenschmidt, K.E., Morales, L., Strickert, G.E.H. (2017) Meeting with Representatives from Water Security Agency and Saskatchewan Ministry of Agriculture. National Hydrology Research Center. November 23rd, 2017.
- Lindenschmidt, K.E., Morales, L., Strickert, G.E.H. Workshop with Representatives from Water Security Agency and Saskatchewan Ministry of Agriculture. National Hydrology Research Center. November 23rd, 2018.
- Liu J., Baulch H., and Elliott J. (2018) Nutrient loading and water quality. 2018 Annual Convention Pillars of Agrology: Water for All. Apr. 11-12, 2018. Prince Albert, Saskatchewan.
- Liu J., Baulch H., Roste J., and Elliott J. Agricultural water quality on the prairies: Challenges, choices and solutions. Saskatchewan Drainage Water Management Conference. Melfort, Saskatchewan. Jan. 23, 2018.
- Liu J., Baulch H., Roste J., and Elliott J. Agricultural water quality on the prairies: Challenges, choices and solutions. Saskatchewan Drainage Water Management Conference. Moose Jaw, Saskatchewan. Jan. 26, 2018.
- Macrae, M.L. and McKague, K. Managing Phosphorus! Southwestern Agricultural Conference. Ridgetown, Ontario. January 2-3, 2018.
- March 2018: SAMMS fieldwork planning workshop (WLU).

- Marek Stastna is co-organizing a session on Physical Processes in Lakes as part of the 61st Annual Conference of the International Association for Great Lakes Research. June 18-22, 2018.
- Meeting and presentation with the Monitoring and Wastewater Groups of Environment and Climate Change Canada, to discuss research results, implications and future directions. Hull, Quebec, March 8, 2018 (Servos).
- Meetings and presentation with end users related to environmental impact of wastewater in the Grand River. This included representatives from the Water Services Region of Waterloo, Wastewater City of Guelph, Grand River Conservation Authority, Environment and Climate Change Canada. Cambridge, Ont. Feb. 14, 2018. Servos, Parker, et al. made a presentation followed by discussion on future directions.
- Microsatellite mission design workshop with Honeywell and water research community (2018)
- Mistik's Public Advisory Group Meetings November 2017 and May 2018 for dissemination and knowledge transfer on climate change adaptation within Mistik's Forest Management Area and planning process.
- Monk, W. 2018. Research needs for holistic environmental flows frameworks in a changing world. NSERC Connect workshop on environmental flows. January 31, Montreal, QC.
- Muslim and indigenous women for water 'picnic camp' workshop, in Little Buffalo, Alberta (August 2017)
- Ohero:kon and other Indigenous youth from Six Nations and surrounding territory participated in workshops to discuss water, Indigenous rights, and environmental issues. Presentations and performances also took place that included Water Protectors and Youth Leaders from the Standing Rock Camp. The poster advertising this event to the community is shown in Appendix 1.
- Outreach event. Sports and water issues science camp, Little Buffalo Public School, Lubicon Cree, (October 2017). An advertisement poster is shown in Appendix 1. Link to the article describing this event: https://www.cfl.ca/2017/10/29/former-argo-ticat-john-williams-mission-canadian-indigenous-communities/.
- Peters, D. 2018. eFlows in the north. NSERC Connect workshop on environmental flows. January 31, Montreal, QC.
- Plach, J. and Macrae, M.L. Non-growing season Phosphorus Losses in Ontario. Christian Farmers Federation of Ontario, Guelph, Ontario. September 28, 2017.
- Pomeroy J, (2018). Saskatchewan Water Futures. Canadian Federation of University Women, Saskatoon, February 5, 2018
- Pomeroy J, (2018). The Global Water Futures Programme Science, Prediction and Policy for the Canadian Prairies. PHJV Policy Committee Webinar Series, February 14, 2018

- Pomeroy J, Carey S (2017). Wolf Creek Research Basin Yukon's Own Water and Climate Science Catalyst, Global Water Futures. Yukon Water Forum, Whitehorse, September 26, 2017
- Pomeroy J, Carey S, (2017). Wolf Creek Research Basin Yukon's Own Water and Climate Science Catalyst, Global Water Futures. Yukon Water Forum, Whitehorse, September 26, 2017
- Pomeroy JW, Carey SK. Wolf Creek Research Basin, Yukon's own water and science catalyst. Presented to the Yukon Science Institute, Whitehorse, September 2017.
- Pomeroy, J. Global Water Futures and Agriculture. Plenary Talk for the Alberta Irrigation Projects Association. Lethbridge, Alberta. December, 2017.
- Pomeroy, J. Saskatchewan Water Futures. Canadian Federation of University Women, Saskatoon. February 5, 2018.
- Pomeroy, J. The Global Water Futures Programme Science, Prediction and Policy for the Canadian Prairies. PHJV Policy Committee Webinar Series. February 14, 2018.
- Slaughter A. and Carlson H., Climate Change and Water Resources, Webinar series by Partner In Research (PIR) Canada, February 22, 2018. A recording of the webinar can be seen here: https://www.youtube.com/watch?v=XFXWhVsYlXo
- Stadnyk T, CWRA WORKSHOP on "Water without Borders: Breaking Down Barriers to Achieve a More Integrated Approach to Watershed Management" January 26, 2018
- Stadnyk T, Principles of Hydrological Modeling, University of Waterloo, 19th June 2017 –
 24th June 2017
- Stadnyk T, Workshop with Manitoba Hydro, Feb 6, 2018.
- Stephen Déry presented a talk entitled "The 2017/2018 winter snowpack in Prince George
 and surrounding area" at the Winston's Thursday Breakfast Club" to a general audience
 of ~30 people on 8 March 2018. During the talk, Stephen discussed briefly the role of
 atmospheric rivers in the hydrology of western Canada and ongoing plans within the MWF
 project to conduct high-resolution VIC hydrological simulations of western Canada's main
 watersheds.
- Stories of Cultural Survival a Keynote by Wade Davis, launching GWF (October 13, 2017). An advertisement poster is shown in Appendix 1.
- Strickert, G.E.H. (2017), Participatory Water Quality Modelling in the Upper Qu'Appelle River System. Lumsden Hall, SK, November 10th, 2017.
- Strickert, G.E.H. (2018), Connecting with Communities: Presentation to the Prairie Provinces Water Board, Saskatoon, March 14th 2018, National Hydrology Research Center.
- Strickert, G.E.H. (2018), Participatory Water Quality Modelling in the Moose Jaw River System. Sportsman Centre, Moose Jaw, November 5th, 2017.
- Van Eerd, L. and Macrae, M.L. Influence of Cover Crops and Residues on Winter Nutrient Release. Presentation to Certified Crop Advisor Annual Meeting. London, Ontario. January 10, 2018.

- Van Esbroeck, C. and Macrae, M.L. Presentation on AWF Project to UTRCA, GRCA and ERCA partners (and other Conservation Authorities). London, Ontario. December 15,
- Van Esbroeck, C., Macrae, M.L., McKague, K. Agricultural Phosphorus Losses: Impact of Land Management Practices. Land Improvement Contractors of Ontario Annual General Meeting. London, Ontario. January 23, 2018.
- Water Works Art competition (round one) for Haudenosaunee youth on the theme of 'Haudenosaunee teachings about the value of water to our health' (December 2017), art work is exhibited at the Art Gallery of Hamilton. The poster advertising this event to the community is shown in Appendix 1.
- Water Works Art competition (round two) for youth within the Grand Erie District School Board (March 2018); art work to be exhibited at the Art Gallery of Hamilton, McMaster and McMaster Children's Hospital
- Wolfe, J. J. Elliott, and H. Baulch. 2018. Water quality. Saskatchewan Association of Watersheds. Swift Current. April 2018.

Promotional Videos

- Baltzer's RSC Induction video: https://www.youtube.com/watch?v=GcHy7QwYa_A
- "Becoming Water"
 http://artsandscience.usask.ca/news/articles/1340/_Becoming_Water_Art_and_Science_in_Conversation_available_fo
- A. Sniderhan interviewed in Marian Watershed Stewardship Program video, Fall 2017: https://vimeo.com/240199405
- Basu, N.B. (2018). Biogeochemical Hotspots: Role of Small Water Bodies in Watershed Nutrient Processing, Webinar on Wetlands: From Science to Action organized by Canadian Freshwater Alliance, September 25, 2018 (https://www.freshwateralliance.ca/fresh ideas wetlands)
- Laurier northern research video: https://youtu.be/P-cvxZpi_wQ
- Pomeroy, J. Changing Cold Regions Network (CCRN) short documentary film Changing Climate and Environment of Western Canada, March 6, 2018.
 https://www.youtube.com/watch?v=L8lbgckLy6k
- Strickert G and Shantz S (Producer), & Toews I (Director), (2017), Short documentary film, Becoming Water: Art and Science in Conversation [291 Film Co], Canada. https://sens.usask.ca/news-articles/2017/becoming-water-art-and-science-inconversation-available-for-online-viewing-.php
- The Life of a Grad Student: Danielle Brandow, School of Public Health and Health Systems. https://www.youtube.com/watch?v=5ldofbNMtaQ
- St. Denis National Wildlife Area: https://www.youtube.com/watch?v=1sfTyNj4ZJM
- Brightwater Creek Watershed: https://www.youtube.com/watch?v=K8DWZGVnNwQ
- Canadian Rockies Hydrological Observatory: https://www.youtube.com/watch?v=MVeVZxiiHJA

- Forecasting Extreme Weather Events: https://www.youtube.com/watch?v=Z5vOuOS5Jro
- E.B. Campbell Dam Saskatchewan River Delta: https://www.youtube.com/watch?v=wlcLB0nQw8g
- Sediment and Nutrient Transport Modelling: https://www.youtube.com/watch?v=tdBNdTQ9a6M
- Swift Current Agricultural Research Site: https://www.youtube.com/watch?v=i-GY5ImUpY0
- Rosethern Research Site Prairie Hydrology: https://www.youtube.com/watch?v=Atm9JR1fYcg
- Lake Diefenbaker Research Site: https://www.youtube.com/watch?v=cZ1xfBG Dbk
- Buffalo Pound Lake Research Site: https://www.youtube.com/watch?v=v4o9zABsne0
- Lake Diefenbaker Toxicology & Water Quality
- Swift Current Creek Urban Municipal Drainage: https://www.youtube.com/watch?v=IWH_QEttTsg
- Modelling Riverine Processes: https://www.youtube.com/watch?v=Rdf8a-lgZfc
- Boreal Forest: https://www.youtube.com/watch?v=0I9TX97GBsg
- Socio-Hydrology: https://www.youtube.com/watch?v=e8DmQLuPqvA
- Integrated Watershed Modelling: https://www.youtube.com/watch?v=6dzOSQBXOOU
- Mine Overlay Site Testing Facility: https://www.youtube.com/watch?v=AlxweoN7erQ



University of Saskatchewan National Hydrology Research Centre 11 Innovation Boulevard Saskatoon, SK S7N 3H5 Canada

Tel: (306) 966-2021 Fax: (306) 966-1193 gwf.project@usask.ca











