A Brief Presented to
The House of Commons Standing Committee on Environment and Sustainable Development
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Questions for stakeholders in preparation for the House of Commons Standing Committee on Environment and Sustainable Development's study on freshwater

1. Introductory information

a) Which issues related to protecting and managing freshwater does your organization work on?

McGill University is one of Canada's leading institutions of research, teaching and higher learning. It has expertise and academic programs in several of its Faculties covering all aspects of freshwater protection and management. Professors and students in the Departments of Chemical Engineering, Civil Engineering, and Bioresource Engineering are developing technologies to provide clean water to municipalities, urban areas, rural areas and for industries which require ultra-refined water in their clean and green manufacturing processes. The reduction of point and non-point sources of pollution in freshwater is a priority area. Professors and students in the Departments of Biology and Chemistry are investigating fundamental mechanisms that lead to water contamination by emerging chemicals, pathogens and nano-particles. All of the above departments have expertise in terrestrial and aquatic ecosystem functions and how these can be protected through better stewardship of freshwater. Experts in the Department of Economics are studying financial incentives to protect freshwater and investment scenarios for renewing water infrastructure, all with the aim of ensuring highest quality water to the environment and rural and urban water users. Professors and students in the Faculty of Law are studying water policies and legislation that can best protect Canada's freshwater. There is considerable expertise in the Faculty of Medicine and the Institute of Parasitology on water for human health and prevention of waterborne diseases. Working collaboratively across departments and units and research centers, there is a great deal of synergy in finding best practices which can improve Canada's freshwater quality, improve ecosystem and human health, and understanding microbial/cellular mechanisms that can be used as natural biosensors of evaluating the health of freshwater species. Through this approach, species at

risk have been identified, and protection measures are being investigated.

McGill University takes an integrated approach to freshwater protection and management. It recognizes the inter-disciplinarity of the resource. The watershed is regarded as a unit of management incorporating all water users who each have unique roles to play in ensuring that Canada's freshwater is protected and properly managed. Each watershed has unique land and water characteristics that must be understood and respected. In this regard, the landholders of the watershed must be brought together in institutional and governance arrangements that respect the country's First Nations. This is a focus of the University's governance approach to freshwater management. University researchers are exploring the use of traditional and indigenous knowledge to watershed management. Multi-stakeholder watershed authorities or river basin councils are critical to the best management of Canada's freshwater, and various governance principles of this socio-political framework are being investigated.

McGill University is investigating the drivers that are leading to stress in rivers and watersheds. Certainly climate change is one of the major drivers, and with the aid of computer models, new and more sustainable water management scenarios are being evaluated. This is particularly evident in the work being conducted by my colleagues and I in the Department of Bioresource Engineering. Changing precipitation patterns and the more frequent occurrence of extreme flood and drought events will necessitate the design of new drainage and flood control measures, and methods of water conservation and precision irrigation during droughts. Management of freshwater during these two climatic extremes is essential to the productivity of Canada's agri-food sector. According to Agriculture and Agri-Food Canada, the Canadian agriculture and agri-food system is a key driver of Canada's economy. The system generates close to $150 billion, accounts for 7.4% of GDP, and provided one in eight jobs in Canada in 2020.

2. Interaction and collaboration with federal departments and agencies

a) Does your organization interact with federal departments and/or agencies on freshwater issues? If so, on which issues and with which departments and/or agencies?

Yes we do. The main departments with which we work are Environment and Climate Change Canada, Agriculture and Agri-Food Canada, Natural Resources Canada, Global Affairs Canada, International Joint Commission, Canadian Food Inspection Agency.

b) Do the specific freshwater issues targeted by your organization fit within the mandate of a given federal department and/or agency or do they relate to more than one department and/or agency? If more than one, have you been able to identify a lead department and/or agency with which to engage?

Our principal engagement is with Agriculture and Agri-Food Canada, and Environment and Climate Change Canada. However, there is also frequent interaction with all of the abovementioned agencies on an on-going basis. These efforts are highly time consuming

and sometimes repetitive. This is a reason to implement the Canada Water Agency. It can provide one-stop shopping and reduce institutional overlap.

c) Have you encountered notable successes in engaging with the federal government on freshwater issues? If so, please specify. If you have not had success in doing so, what in your opinion is the reason (e.g., no program available tailored to your needs, no identifiable service or unit within a department and/or agency with which to engage)?

We have historically had excellent relations engaging with the former Prairie Farm Rehabilitation Administration (PFRA) on irrigation expansion projects across Canada and on international water projects financed by the former Canadian International Development Agency (CIDA). Agriculture Canada provided financial support for water projects in Ontario, in conjunction with the Ontario Government. Such cost-shared projects worked well. More recently we have two significant greenhouse gas projects with Agriculture Canada, which have had strong industry participation.

We have had collaborative studies with Environment and Climate Change Canada on greenhouse gases and they have provided meteorological data through their web platforms. We have also worked with ECCC on reports dealing with transboundary water management and climate mitigation and adaptation.

d) Do you foresee engaging with the new Canada Water Agency? If so, in what way? What are your organization's expectations with respect to the Agency?

Yes we envisage a strong partnership and working relationship with the Canada Water Agency. It will provide one stop shopping for funding and programmatic requests, as well as assisting with data sharing. We wish to expand our research in areas of irrigation, drainage and flood control, and reducing greenhouse gas emissions in rural areas. We hope the CWA will actively support data sharing, and knowledge in areas of climate change, hydromet data, and expanded work on the water – food – energy nexus.

We actively participated in the Freshwater and Agriculture panel of the CWA consultations. We hope to give guidance to the Government on defining the Agriculture activities of the CWA work program. We see a very strong role for collaboration in climate adaptation in irrigated agriculture, drought proofing, water conservation in irrigated agriculture, integrated water resources management, and freshwater water management aimed at protecting wetlands and sloughs in the irrigation districts.

3. Federal water legislation, policies and regulations

a) Does your organization interact with federal departments and/or agencies on policies, legislation, regulations, or funding programs related to freshwater? If so, please specify.

We have interacted with Agriculture and Agri-Food Canada and Environment and Climate Change Canada on funding programs related to water quality improvement in

irrigated and drained lands, reduction of cyanobacteria in lakes and rivers of eastern Canada, irrigation expansion in Canada, and on reduction of greenhouse gas emissions in irrigated and drained lands.

b) Can you identify any current gaps in federal water legislation, policies, regulations, and/or initiatives, or in general across jurisdictions? If so, please specify.

Of course on the topic of freshwater there are several initiatives and gaps which can be considered. However, I will limit this to three key areas in my work. One is the development of new policies that support the reduction of non-point source pollution in agricultural watersheds. There has been much work in the US on the use of Total Maximum Daily Loads (TMDLs) technology to achieve reductions in nitrogen and phosphorus concentrations in watersheds. These, or similar tools ought to be investigated for watersheds in Canada. Secondly, updated incentives for water conservation need to be created. A suite of financial, legal and economic incentives and instruments ought to be developed for different water users. It can't be a one size fits all program across the board. Various scenarios appropriate for different water use in the different regions of Canada need to be established. Thirdly, is the vast area of respectful collaboration with our First Nations on all aspects of freshwater management, ranging from jurisdiction, legislation, and policies. Canada has an opportunity through the Canada Water Agency to show international leadership in this area of water management with the indigenous people.

c) Do you feel the federal government could play a more effective role in protecting watersheds in Canada? If so, which watersheds and how?

This is a very sensitive area given our Constitution and the jurisdictional powers enshrined to the provinces. However, there is an opportunity to show leadership in federal-provincial relations when it comes to freshwater management and protection. One area for collaboration is in the collection, sharing and interpretation of hydrologic, water use and water quality data at the watershed level, where the watersheds are inter-provincial and international.

Some of the watersheds in which there is on-going work, and ripe for expansion, especially with respect to water quality are:

- The Quebec-Ontario-Vermont-New York section of upper Lake Champlain
- The Great Lakes section of Eastern Ontario, Western Quebec and New York

In terms of water diversion both provincially and internationally, in light of climate change and invasive species, energy, irrigation and flood control, there are continued opportunities for the new Canada Water Agency and the IJC for data sharing analysis and jurisdictional improvements in the Red River of Manitoba, the Milk River watershed of Alberta, and the Columbia River Basin.

At the national level, there are unprecedented opportunities for the Canada Water Agency to work with the federal departments, provincial governments (Alberta,

Saskatchewan, Manitoba), First Nations, NGOs, universities, and civil society in the **Saskatchewan River watershed**. This is another example where Canada could showcase internationally, the successful management of a very large river basin for multiple water use, improved water quality, protection of waterfowl and aquatic habitats, control of invasive species, energy, ecology, land use protection, irrigated agriculture, hunting and fishing, tourism, and sharing the resource in a respectful way with our First Nations. Of course freshwater management will be best achieved by working at the sub-basin level.

A map of the basin with some essential facts is presented below.

d) Are there areas of freshwater policy, legislation and/or regulation where you feel the federal government should play a greater role?

At the moment there is a multiplicity of federal government departments and agencies (20 to be precise) involved in freshwater across Canada. This is further duplicated at the provincial level. The municipalities also have a role with respect to water supply and wastewater disposal. One area that can be thus improved is harmonization of policies and legislation across these multiple jurisdictions.

In reviewing the Canadian water framework (https://www.canada.ca/en/environment-climate-change/services/water-overview/governance-legislation/federal-policy.html), there is now a unique opportunity to modernize the Federal Water Policy, especially in light of the new stressors of climate change, water quality, water apportionment, environmental flows, and water use conflicts. This is also an opportunity to re-examine the Canada Water Act.

e) Are there areas of freshwater policy, legislation and/or regulation that you feel the federal government should vacate and leave to another level of government or to the private sector?

The answer to this question lies in the review and modernization of the Canada Water Act and the Federal Water Policy. Certainly, there are now unprecedented opportunities to take advantage of private sector technological developments in clean water technologies, water purification, wastewater treatment, remote sensing and use of new sensor technologies and data transmission of water quantity and water quality data, and processing and analysis of this large volume of datasets through artificial intelligence and machine learning.

f) Are you aware of instances where federal freshwater policy, legislation, regulations, and/or initiatives have clearly benefitted from your organization's input?

I believe that our studies on irrigation expansion potential for the former PFRA and our research on precision irrigation and Variable Rate Irrigation (VRI) in Alberta, as well as our many sustained presentations, over two decades, to federal, provincial and producers' organizations have contributed to some extent to the federal government's new funding towards irrigation expansion in Saskatchewan and Alberta.

4. Collection of information and data

a) Do you believe that there is sufficient data collected and made available publicly about freshwater in Canada?

This is one area in which Canada has lost ground over a few short decades. There has been a decline in the hydromet data being collected and the closure of various hydromet stations across the country due to budgetary pressures over the years. The country has also lost critical human resources with the skills to collect, analyze, process and disseminate data. It was certainly an area in which Canada had strength and was recognized by the WHO and UNESCO in the operation of the GEMS program globally. More data needs to be collected in the regions and made available publicly.

b) Do you believe there should be improvement in freshwater-related data-sharing?

Absolutely. This is an area ripe for collaboration between the federal government, provincial governments, universities, NGOs and the private sector. The federal government needs to play a role in quality control and standardization of databases, so that users can retrieve data in standardized formats, knowing that the data has gone through various levels of error checking. There are currently datasets in the public domain but one is never sure of the quality. Poor quality data leads to poor decision making.

c) Is there any specific type of data or information you would like the federal government to provide to freshwater stakeholders?

One area is to have more available near real time water quality data for the major rivers, lakes and watersheds. Water quality data is sparse across the county. Some organizations

who have been contracted by clients to collect water quality data are not able to release such data publicly. Ecosystem health can now be monitored using biosensors, and this technology should be researched with the aim of assessing the health of rivers, lakes and watersheds on a more timely basis, so that remedial measures can be put in place more rapidly, in response to different threat levels.

Greenhouse gas data from rural watersheds can also be collected and made available, as this will aid in the selection of best management practices (BMPs) for improved water, air and soil quality, as well as sustainable land-use practices.

d) Has your organization experienced challenges obtaining well-organized data from the federal government on issues relating to freshwater?

Yes, we have been unable to get water quality data for some of our watershed and lake ecosystem work in Quebec and Ontario. This is particularly true for nitrogen and phosphorus data for long term longitudinal studies, as we evaluate the effectiveness of various BMPs over time.

e) Is the lack of standardized data or information across government jurisdictions a problem or challenge for your organization in accomplishing its objectives with respect to protecting and managing freshwater?

Absolutely, and this is expected to be a major role for the Canada Water Agency. The Agency should make it a priority to standardize the data collection systems across the country and provide the data to the public in a format that is easily retrievable.

This is another opportunity to show global leadership. There are now new sensor technologies on the market and access to remote sensing platforms. When these tools and technologies are coupled with cloud based data transmission systems and storage, it is now possible to use supercomputers to process and analyze the data. Therefore IT coupled with artificial intelligence (AI) and machine learning (ML) can be transformative in the area of freshwater management and protection. The Canadian private sector, universities and research institutes are poised to make this an area of international success for Canada.

5. International and business issues

a) Should Canada play a greater role internationally in helping find solutions, either through government and/or the private-sector involvement, to the challenge of global freshwater security?

Canada is well respected by both developed and developing countries for its work in the environment and water management. Many Canadian institutions involved in sectors including energy, agriculture, water treatment, wastewater treatment, environment, and transboundary river basin management have been contracted internationally to deliver policies, products, services, and technologies in many developing countries. We have lost this capacity over the years, and it is now appropriate for the Canada Water Agency and Global Affairs Canada, to work with the regional and international development agencies

and funding agencies to expose Canadian products, expertise and private sector business to rising international opportunities.

Canada can help trigger other governments and bilateral development agencies to support joint projects in support of the SDGs which are water related. In fact all 17 SDGs touch the sector both directly and indirectly.

b) Do you feel Canadian private-sector companies, including financial institutions, can and should play a role internationally?

Yes, for sure. The private sector can work with financial institutions such as FinDev Canada, the World Bank, IFC, and the regional development banks, and pension funds and green funds to build public-private partnerships in the water sector in developing countries. This is a growth sector for the Canadian economy and will lead to increased international business opportunities for Canadian companies and increased employment of Canadians.

c) What role can the federal government play in better supporting freshwater-related academic research, R&D, businesses, products, and services?

There are unlimited opportunities for the federal government, through the tri-councils (CIHR, NSERC, SSHRC), the National Research Council (NRC) and Sustainable Development Technology Canada (SDTC) to support academic research and R&D that is targeted for collaboration with industry partners and NGOs. These programs are often user driven and respond to the needs of the partners. One problem in the past is the development of only one centre of excellence or expertise to serve the entire country. This is unrealistic. The problems are regional in nature, and the solutions will have to be regional or location specific. This aspect needs to be addressed in any future programming by the federal government. The AAFC Living Labs are an example of location specific, user driven applied research and development.

There is no doubt that the demand for trained expertise in freshwater management and protection is not being fully met. Therefore the federal government can work with the universities to develop ***internships*** for both undergraduate and graduate students, so that the trainees can gain experience in government labs and research stations, industry labs, and with NGOs.

The federal government ought to support universities willing to work with First Nations on development of policies, legislation and practices which take into consideration the traditional, cultural, and spiritual values which the First Nations people attach to freshwater. This is also a unique opportunity for Canada to show leadership to train and support indigenous leaders in freshwater management and protection by having “southern” Canadians students and professors interact with and learn from indigenous leaders and students. Lasting and respectful solutions to freshwater management and protection in the North can only be developed by the people of the North. These cannot be imposed from outside.