

2017
2018

WORKING TOGETHER TO MANAGE OUR SHARED WATERS

Alberta-Northwest Territories
Bilateral Management Committee
Annual Report to Minister



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PREFACE

This report provides an overall summary of the work done between April 1, 2017 and March 31, 2018 to meet the commitments of the Alberta-Northwest Territories (NWT) Bilateral Water Management Agreement. The report is based on scientific and technical reports. Links to the full text of the original reports, where available, are provided in Appendix A.



EXECUTIVE SUMMARY

In 2015, Alberta and the NWT signed an agreement to cooperatively manage shared transboundary waters. As part of the Alberta-NWT Bilateral Water Management Agreement, a Bilateral Management Committee was established with the responsibility of implementing and reporting on the Agreement. This is the Committee's third annual report.

Considerable collaboration took place between the governments of Alberta and the NWT in 2017-18 to implement the Bilateral Water Management Agreement. This annual report, for the fiscal year of 2017-18, details activities undertaken from April 2017 to March 2018 and includes results of analysis of 2017 water quality and quantity monitoring data from the Slave and Hay rivers.

While the goal of the Agreement is clear – to protect our shared waters for the living things that depend upon it – determining the best methods to do this is complex.

Much of our work is focused on obtaining and analyzing data, using methods that provide an early warning of changes in aquatic ecosystem health, understanding the causes of changes to aquatic ecosystem health and identifying what information is needed for future monitoring. Examples of this work, completed between April 1, 2017 and March 31, 2018, include:

- The completion of two reports summarizing existing information about biological monitoring in the Slave and Hay rivers;
- The start of a pilot program to monitor benthic macroinvertebrates in the Slave and Hay rivers;
- A workshop with biological monitoring experts from governments, non-government organizations and universities;
- The completion of a report summarizing documented traditional knowledge about biological indicators for the Slave and Hay rivers;
- A first meeting to establish the Alberta-NWT Traditional Knowledge Working Group;
- The collection of water samples from the Slave and Hay rivers for the analysis of mercury for future trigger development;
- The analysis of samples from the Slave and Hay rivers for 14 substances that are primarily of human origin and toxic, bioaccumulative and persistent;
- The development of a water quality report summarizing the 2017 water quality data generated from the Slave and Hay rivers;
- The development of a report providing information about what is and is not known about groundwater in the North; and
- The analysis of 2017 streamflow data from the Slave and Hay rivers in conjunction with analysis of water-use data from Alberta.



While we seek the best methods for long-term implementation of the Agreement, we continue to monitor water quantity and quality in the Slave and Hay rivers. Using the agreed-to measures, significant 2017 results include:

Water quantity

Alberta's annual use of water from the Slave River basin remained below the threshold of 2 billion cubic metres, which is 1.9% of the long-term annual flow.

For the Hay River, Trigger 1, which assesses the total volume of water licensed in the Hay River basin, was exceeded in February, March, November and December, prompting the analysis of Trigger 2. Trigger 2, which assesses the volume of water used in the Hay River basin, was not exceeded in any month.

Water quality

Slave River water quality results revealed levels of alkalinity, dissolved magnesium, nitrate/nitrite, and dissolved sulphate appear to be higher in recent years (2015-2017) than in the past. The amount of total dissolved solids and dissolved magnesium were above their historical seasonal maximum value on one occasion in 2017. All other parameters were within acceptable ranges.

The water quality of the Hay River appears unchanged as no statistically significant changes were found.

Under Trigger 2, particulate organic carbon (POC) was above both its historical seasonal and overall maximum values on one occasion in 2017. The elevated POC levels seem to be due to the high levels of sediment associated with high flows at the time of sampling. High flow events tend to carry more particulate matter to which many metals and other substances are attached. All other parameters were within the range of what has been observed in the past.

Basin

An area of land where all surface water flows to the same body of water.

In the case of tributaries of a larger basin, each tributary will have a sub-basin.

For example, the Hay River basin is a sub-basin of the Mackenzie River basin.

Moving forward

To further pursue commitments in the Agreement, the BMC is following a multi-year work plan. Work planned for the next few years include:

- Continuing to collect data on benthic macroinvertebrates from the Slave and Hay rivers to be able to detect changes in the future.
- Exploring how metals and organic compounds move through the food web of the Slave River aquatic ecosystem.
- Developing monitoring plans for small and large-bodied fish in the Slave and Hay rivers.
- Continuing to review traditional knowledge sources, including the Government of Northwest Territories (GNWT) Traditional Knowledge Framework, the work of the Environmental Monitoring and Science Division of Alberta Environment and Parks, and the work of the Mackenzie River Basin Board Traditional Knowledge and Strengthening Partnerships Committee.
- Continuing to track and report use, annual flow and movement of water outside of the Slave River basin, and refining the methods for calculating annual use and mean annual flow when needed.
- Continuing to assess water quality and quantity triggers for the Slave and Hay rivers.
- Continuing mercury water quality sampling programs in the Slave and Hay rivers.
- Continuing to learn more about the location, quality and quantity of our shared groundwater.

In addition, over the longer term, work will include:

- Continuing to monitor and assess water quality and quantity in the Slave and Hay Rivers;
- Starting a pilot program to sample small and large-bodied fish in the Slave River;
- Developing a terms of reference and work plan for the Alberta-NWT Traditional Knowledge Working Group;
- Organizing a basin-wide water quality subcommittee to discuss other methods to assess change;
- Developing a plan and finding partners to learn more about permafrost and effects on groundwater in the Slave and Hay River basins; and
- Approving a common methodology for assessing groundwater quality baselines (i.e., the range that is normal) and determine when further investigation is needed.

The BMC looks forward to continued cooperation and collaboration, and continues to take all reasonable actions to meet the commitments of the Agreement and sustain the spirit under which it was signed.

COOPERATING AND COLLABORATING TO PROTECT OUR WATER

Canada, and its provinces and territories, each have responsibilities to manage water under their respective jurisdictions. In 1997, British Columbia, Alberta, Saskatchewan, the NWT, Yukon, and Canada signed an agreement to cooperatively manage the preservation and sustainable use of water throughout the Mackenzie River basin, which spans these jurisdictions. The *Mackenzie River Basin Transboundary Waters Master Agreement* committed these provinces and territories to develop bilateral water management agreements.

In 2015, Alberta and the NWT signed an agreement to cooperatively manage shared transboundary waters. These waters include the Slave, Hay, Buffalo, Little Buffalo, Whitesand, Yates, Kakisa, Petitot, Salt and Tethul rivers, and their tributaries and groundwater.

As part of the Alberta-NWT Bilateral Water Management Agreement, a joint Bilateral Management Committee was established to be responsible for implementing and reporting on all aspects of the Agreement.

Each year, the Bilateral Management Committee publishes an annual report to keep citizens and elected officials up to date on its progress. The 2017-18 members of the Committee are listed in Appendix B.

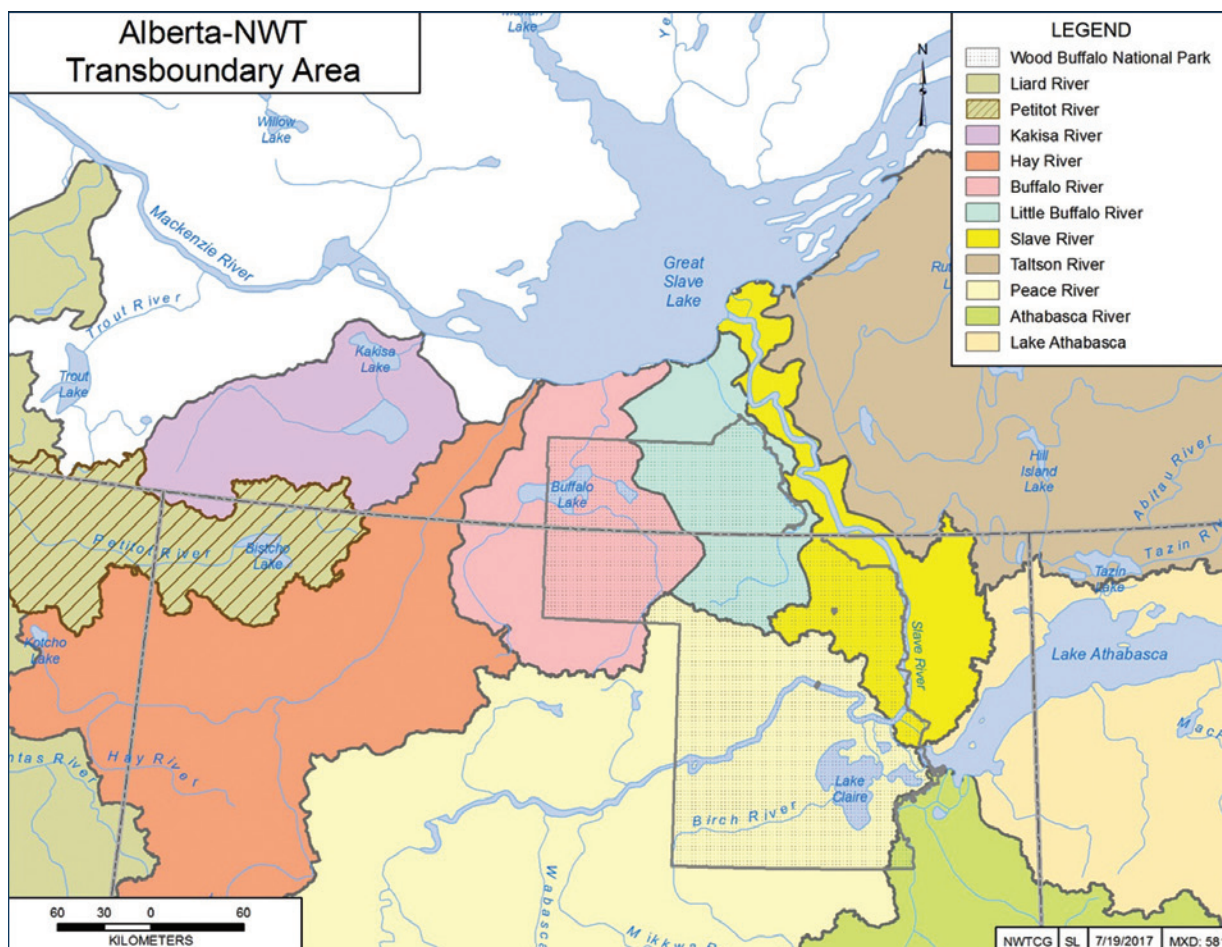


Figure 1. Map of the AB-NWT Transboundary Area

ACTIVITIES AND PROGRESS

Ongoing information sharing

Relevant information is shared between the Alberta and NWT teams working to manage and protect our shared waters. This includes research findings, regulatory activities, monitoring results and technical methods. Discussions are frequent, as we work together to find the best ways to meet the commitments of the Agreement.

Joint work plan

The Bilateral Management Committee continues to maintain its five-year rolling work plan to set priorities and guide the Alberta and NWT teams' ongoing work. The Committee reviews and approves the plan each year and updates it as needed.

Classification of waters and current status

The Alberta-NWT Agreement is based on a risk-informed management approach. The classification of water bodies considers the level of upstream development and other factors, including the extent of traditional use, drinking water use in downstream communities, observed changes in conditions and the sensitivity of the related ecosystem. Upstream developments include industry, agriculture and drinking water for upstream communities.

Class 1 waters are at low risk and only require the level of monitoring already being undertaken by Alberta and the NWT.

Class 2 water bodies are at a moderate level of risk and therefore require Learning Plans to be developed to better understand the past, current and potential future of water quality, quantity and health of the overall **aquatic ecosystem** (more information about Learning Plans is provided in the next section).

Class 3 water bodies are at a higher risk. In addition to Learning Plans, Class 3 waters require the development and monitoring of site-specific objectives.

Class 4 is only assigned if objectives for a body of water are not being met, and corrective action is needed.

Current status

The Slave and Hay rivers are currently Class 3 because upstream development is present, there is significant traditional use, there have been changes in water quantity and quality over time, and they supply drinking water for downstream communities in the NWT.

All other bodies of water managed under the Agreement, including groundwater beneath the surface, are currently Class 1.

Learning plans

As Class 3 waters, the Slave River and Hay River require Learning Plans. A Learning Plan is very much what it seems – a plan to learn more. Learning Plans are being developed for the Slave and Hay rivers. All of the work associated with the Agreement, including state of the knowledge reports completed for the Slave and Hay watersheds, contributes to the Learning Plans and helps us better understand our shared waters.

Public engagement

Ongoing

There are several ongoing ways that information is shared with the public. Reports completed as part of the implementation of the Agreement are published online. Both jurisdictions have general email addresses that the public may use to share information or ask questions:

GNWT: nwtwaterstrategy@gov.nt.ca

Government of Alberta: aep.tws@gov.ab.ca

GNWT staff meet regularly with the NWT Water Strategy Aboriginal Steering Committee for guidance on the NWT Water Stewardship Strategy and Bilateral Water Management Agreement implementation.

Alberta engages with the general public, stakeholders, government partners and Indigenous communities during its land use and water planning processes. Through Indigenous working groups, First Nations and Métis are engaged throughout the development, implementation, ongoing review, and potential amendments of regional land use plans.

2017-18

NWT and Alberta staff shared an update of progress on work under the Agreement at the June 2017 Canadian Water Resources Association conference in Lethbridge, which included:

- An overview of the key components of the Alberta-NWT Bilateral Management Agreement and the challenges of implementing such a comprehensive water management agreement;
- A presentation on hydrocarbon monitoring results in the Slave and Hay rivers. It provided an overview of the concentration levels for several polycyclic aromatic hydrocarbons in water and sediment and explored their potential origins; and,
- An overview of the Mackenzie River Basin Hydraulic Model platform that has been developed in two major stages over the past 10 years. In 2016, significant work was completed to extend the historical flow database and update the hydrological modeling component. Existing capabilities of the model were highlighted with results from the most recent update.

In November 2017, NWT staff shared updates about its transboundary agreements at the NWT Water Stewardship Strategy Implementation workshop: <https://www.nwtwaterstewardship.ca/en/november-22-23-2017-nwt-water-stewardship-strategy-implementation-workshop-final-summary-report>

Several presentations were made to provide more in-depth learning opportunities about **biological indicators** being monitored under the Agreement. Dr. Jennifer Lento from the University of New Brunswick and Dr. Lorne Doig from the University of Saskatchewan met with students in Fort Smith and at Kát'odeeche First Nation (Hay River), as well as the public in Fort Smith and Hay River. Dr. Lento gave presentations to the public about the use of **benthic macroinvertebrates** in assessing river and lake health. Dr. Doig led hands-on activities with students teaching about data collection and analysis. Benthic macroinvertebrate samples were brought to the presentations so that people could learn more about different identification techniques and benthic macroinvertebrate life cycles and how they live, breathe, and eat.

GNWT staff gave a presentation about the benthic macroinvertebrate monitoring in November 2017 at a regional wildlife workshop in Fort Smith. The workshop was attended by local Indigenous government, municipal, GNWT, and Parks Canada (Wood Buffalo National Park) representatives. The presentation focused on the goals of the monitoring plan and described the sampling that happened in 2017.

Aquatic ecosystem

An aquatic ecosystem is a community of living organisms, including humans, interacting with each other and their physical environment, including water, land and air.

Biological indicators

A biological indicator is a species, community, or biological process used to provide information that tells us about changes in their environment.

For example, some benthic invertebrates will die if the water has been polluted with certain chemicals; and there are changes in the livers of fish living in polluted water.

By studying biological indicators repeatedly over time, and in different areas of a river or lake, we know if the water has changed, and can then investigate the cause of these changes.

Benthic macroinvertebrates

Benthic invertebrates are tiny, spineless creatures that live on the bottom of rivers, lakes, and other bodies of water. If these tiny organisms are large enough to be seen without a microscope, they are called benthic macroinvertebrates. Examples of benthic macroinvertebrates include worms, snails, beetles, and dragonfly larvae.

There are many different kinds of these organisms in Alberta and the NWT. Monitoring them over time is one way to learn about changes in the water.



MONITORING METHODS AND RESULTS

Monitoring includes directly measuring things, such as water levels, water quality and biology, and identifying changes over time. To implement the Agreement, a number of different types of measures are used.

Biological indicators

One of the intentions of the Agreement is to protect the aquatic ecosystem, including water, fish, plants and people, and their relationships with one another. One of the ways this is done is by identifying and monitoring biological indicators.

Biological indicators for the Slave and Hay rivers were identified in the Agreement and include small and large-bodied fish, benthic macroinvertebrates and aquatic mammals.

Selecting the best biological indicators for long-term monitoring takes time and extensive research. Different methods of sampling and assessment also need to be tested. Over time, indicators and methods may change as we learn more about the aquatic ecosystem.

Between April 1, 2017 and March 31, 2018, biology-related work included:

- The development of two reports summarizing existing information about biological monitoring in the Slave and Hay rivers;
- The start of a pilot sampling program to collect benthic macroinvertebrates; and
- A workshop with biological monitoring experts from governments, non-government organizations and universities.

Traditional knowledge synthesis report: biological indicators in the Slave and Hay rivers

A report summarizing documented traditional knowledge about biological indicators for the Slave and Hay rivers was completed. The summary is based on documents provided by the GNWT and includes workshop reports, research reports, and information collected about the Hay River watershed. The summary will inform work going forward and it highlighted that traditional knowledge:

- Has recognized changes and trends over decades;
- Tends to focus on changes in certain species, rather than on environmental changes themselves;
- Includes a broad range of insects and birds that might be useful as indicators;
- Tends to focus on the life cycles of species and what would interfere with life cycles; and
- Includes identification of new and possibly invasive (i.e., non-native and potentially harmful) species.

Synthesis and recommendations report: biological monitoring and biological indicators in the Slave and Hay rivers

A summary of past and current biological research and monitoring was completed last year. Based on this information and discussions with several experts, recommendations for future biological monitoring and biological indicators were developed. The recommendations are informing work going forward.



Workshops on biological indicators

In January 2018, the Governments of Alberta and NWT co-hosted a workshop to discuss biological indicators and monitoring. The purpose was to choose organisms that would best indicate the health of the Slave and Hay rivers, and to discuss how to set up an overall monitoring program. The workshop was attended by representatives and experts from the Governments of Alberta, NWT and Canada; Indigenous governments and organizations; research and educational organizations; and external experts knowledgeable about biological monitoring of large river systems, and the use of Indigenous traditional knowledge in biological monitoring.

Participants recommended sampling both large-bodied fish (such as whitefish, sucker and northern pike) and benthic macroinvertebrates. Frequent sampling over three to five years would establish a starting point to compare against conditions in the future. From then on, sampling could occur on a three-to-five year rotation among the sample locations. Small semi-aquatic mammals, such as beaver and muskrat, could also be tested for contaminants, and to check on how safe they are to eat. Participants recommended designing a monitoring program similar to others in Canada to be able to compare results in different locations.

Participants agreed that traditional knowledge should be taken into account in designing the program, and that indicators that are valuable to both scientific and community-based ways of understanding should be used.

Fish tissue analysis and fish health indicators reports

University of Saskatchewan scientists prepared a report, titled “Long-term changes in fish health endpoints and contaminant concentrations in the Slave River, NWT, and recommendations for future monitoring”, on the health and contaminant levels in fish collected from the Athabasca, Peace and Slave rivers. The report compares data from 2011-2015 to that from 1990-1995 in four species of fish – burbot, whitefish, jackfish and walleye. It describes the seasonal distribution of organic chemicals, heavy metals, and a variety of contaminants associated with pulp and paper mills, and oil sands extraction.

Key findings suggest that fish body condition and general health have improved, and fish tissues are still low in compounds used in pulp and paper mills, and oil sands activities. The report provides recommendations for future fish monitoring initiatives to confirm these results.

Monitoring for benthic macroinvertebrate communities on the Slave and Hay rivers (Year 1)

Benthic macroinvertebrates were sampled from the Slave and Hay rivers near the Alberta-NWT border in the fall of 2017. This was part of a pilot project to test the effectiveness of a proposed biological monitoring plan for large transboundary rivers. The first year of the project was to find potential monitoring sites and to evaluate two methods of sampling.



Figure 2. Hester-Dendy artificial substrate sampler

The CABIN method (short for Canadian Aquatic Biomonitoring Network) is a travelling kick-net sampling method to actively collect organisms, and has been adapted for large rivers. The Hester-Dendy method uses a device that remains in one location and collects organisms as they flow through.

Both methods successfully collected a variety of macroinvertebrates including mayflies, stoneflies and caddisflies, which are the most sensitive to environmental stressors such as pollution.

However, results show that the CABIN method (see Figure 3) captured a broader range of benthic macroinvertebrates and produced larger sample sizes than the Hester-Dendy method (see Figure 4). In total, 159 unique taxa (species, families or classes) of benthic macroinvertebrates were identified in the Slave and Hay rivers.

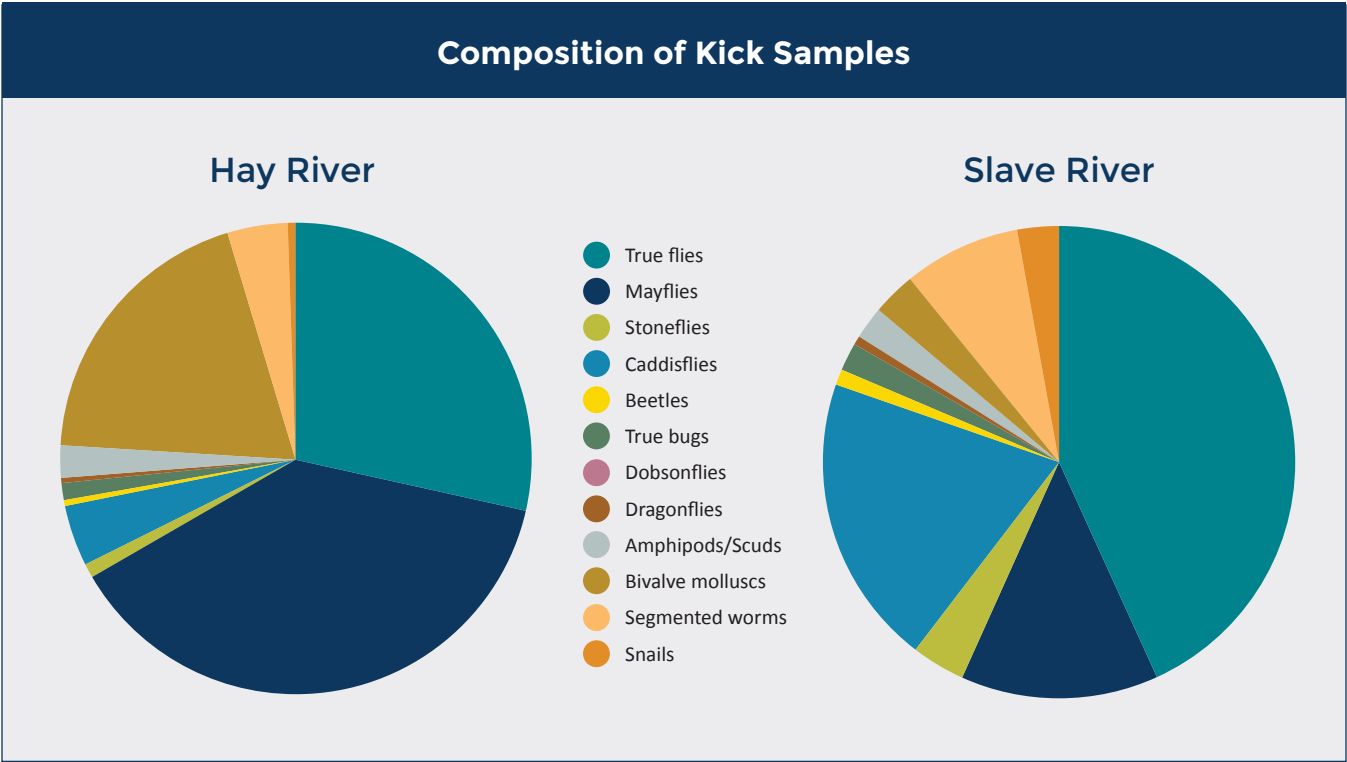


Figure 3. Composition of Kick Samples in 2017 for the Slave and Hay rivers.

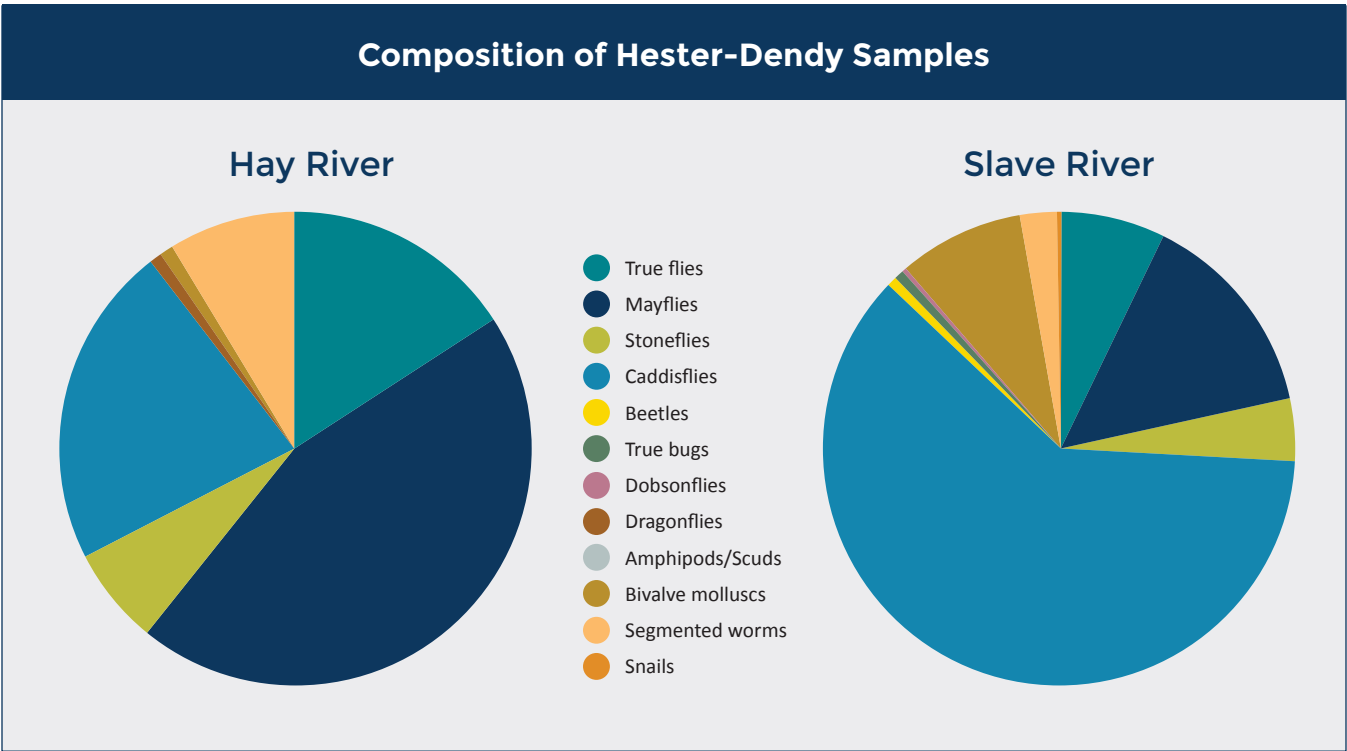


Figure 4. Composition of Hester-Dendy samples in 2017 for the Slave and Hay rivers.

As seen in Figure 3, the kick sampling showed that both rivers have a large proportion of true flies (Diptera - mostly chironomids, midges). The Hay River was more dominated by mayflies (Ephemeroptera) and had higher proportions of taxa that thrive in slow-flowing waters, including dragonflies (Odonata) and bivalve molluscs (Bivalvia), than did the Slave River. The Slave River was dominated by true flies (Diptera) and had higher proportions of some taxa that thrive in fast-flowing water, including caddisflies (Trichoptera) and stoneflies (Plecoptera). The higher proportions of true flies (Diptera) and worms (Clitellata) in the Slave River reflect soft sediments and slower flow in some reaches.

As seen in Figure 4, the Hester-Dendy samplers collected a lower proportion of true flies (Diptera) than the kick samples for both rivers. On the Hay River, mayflies dominated the Hester-Dendy samplers similar to the kick samples; but the proportion of caddisflies was much higher in the Hester-Dendy samples than in the kick samples. On the Slave River, caddisflies were the majority of organisms collected by the Hester-Dendy samplers, unlike the kick samples, followed by mayflies.

Next steps

Monitoring for benthic macroinvertebrate communities on the Slave and Hay rivers (Year 2)

Based on the 2017 results, we will be collecting data on benthic macroinvertebrate communities for at least three years to understand the current condition of benthic macroinvertebrates in the rivers.

We also want to make sure that the proposed sampling methods are appropriate for the Slave and Hay rivers, and to determine if one method is suitable for both rivers, or if river-specific methods are needed. The selected sampling locations will also be assessed to ensure they are appropriate, and sufficient to collect and evaluate baseline data.

Hester-Dendy samplers will also be deployed in the summer of 2018 to confirm the findings from the first year.

After we have collected and analyzed three years of data, we will re-evaluate the monitoring plan. The goal is to be able to compare future sampling results to our understanding of the current condition of benthic macroinvertebrates in the rivers and to see if there is change over time.

¹ Components of the aquatic ecosystem include water, sediment, fish, benthic macroinvertebrates, aquatic mammals and so on.

Data review: water, sediment, and food web interactions of various compounds in the Slave River

Historical and ongoing studies have focused on metals or organic compounds in one or two components of the aquatic ecosystem.¹ This means that little is known about the way these pollutants enter, leave, or stay within and move between different components.

We are currently studying the presence, and transfer of metals and organic compounds among many more components of the Slave River aquatic ecosystem, including sediment, water, benthic macroinvertebrates, large-bodied fish and aquatic mammals.

The goal of this project is to review, and assess data from previous and ongoing programs, and studies to determine if the data can be compared. If so, we could then investigate if pollutant levels may be changing. This information will help in the development of triggers and biological objectives to better assess the health of the aquatic system, and whether it is changing. It will also point to where we need more information.

Development of a large-bodied fish monitoring plan

The development of a monitoring plan for large-bodied fish, such as northern pike, lake whitefish, burbot and walleye, in the Slave and Hay rivers is a current priority. The intent of the monitoring plan is to combine existing baseline information on large-bodied fish, track their status/conditions over time to assess ecosystem health, and assess them to get an early warning of change or stress in the environment. Meetings with traditional knowledge holders and scientific experts will be held to discuss details for the monitoring plan.

A pilot program to sample large-bodied fish in the Slave River will begin in September 2019.



Traditional knowledge

Indigenous people of the Mackenzie River basin have a long history with the basin's natural environment. Traditional knowledge comes from generations of insight into the relationships between different types of living things, their dependence on each other and sustainable co-existence.

This knowledge is a vital source of information about the aquatic ecosystem. Documenting and sharing this knowledge with others who strive to maintain the health of the ecosystem is an important part of meeting this shared goal.

In January 2018, the first meeting to establish the joint Alberta-NWT Traditional Knowledge Working Group took place.

Next steps

Alberta and the NWT will:

- Develop a terms of reference and work plan for the Traditional Knowledge Working Group; and
- Continue to work toward culturally sensitive ways of incorporating traditional knowledge in bilateral implementation, including the GNWT Traditional Knowledge policy, the work of the Environmental Monitoring and Science Division of Alberta Environment and Parks, and the work of the Mackenzie River Basin Board Traditional Knowledge and Strengthening Partnerships Steering Committee.

Surface water quantity

One of the purposes of the Agreement is to ensure that the volume of water used by communities or industry does not have a negative effect on the aquatic ecosystem. When volumes are higher than those required to meet aquatic ecosystem needs, the excess amount (or “available water”) is then shared equally between Alberta and the NWT for use by communities, industry and other users.

Between April 1, 2017 and March 31, 2018, work on water quantity included:

- Comparing the volume of water licensed or used in the Slave and Hay river basins to the interim objectives and triggers in the Agreement;
- Analysis of submitted water-use data by category (e.g., energy industry, municipal drinking water), including the submission rate and the volume of use; and
- Discussion of additional monitoring priorities for the Hay River basin, and coordinating water quantity monitoring with water-quality monitoring needs.

Traditional and local knowledge research online

Literature reviews of traditional and local knowledge research for the Hay, Slave, Athabasca and Peace watersheds are now available online:

www.trackingchange.ca/river-basins/literature-review/

These reports were completed by University of Alberta researchers who are part of the Tracking Change project. Tracking Change is a research project led by University of Alberta, in partnership with the GNWT and the Mackenzie River Basin Board, along with many Indigenous governments and organizations throughout the Mackenzie River basin, as well as academic partners from across Canada.

The project also has international community and academic partners.



Streamflow

Streamflow, or flow, is the amount of water that moves past a specific location over a given amount of time.

The amount of water flowing through rivers and lakes varies from season to season and year to year. It is normal for a river to have above-average streamflow and below-average streamflow at different times within the same year.

Reasons include: the amount of precipitation that falls; the amount of water stored in the basin; and temperature variation.

Climate change is resulting in shifts that will likely result in floods and droughts happening more often in the future.

Natural flow

Natural flow is the river flow if no water is removed or diverted.

Water quantity objectives and triggers

All waters managed under the Agreement are currently designated as Class 1 or 2, with the exception of the Slave and Hay rivers. The Agreement requires objectives and triggers to be set for only Class 3 waters.

Although it is designated as Class 3, water quantity objectives for the Slave River have not yet been set. This is because the volume of water used by communities and industry is very low compared to the total volume of **streamflow** each year. Further discussions will be held if any of the following occur:

- Annual use in Alberta reaches 2 billion cubic metres;
- Two billion cubic metres becomes significantly different from 1.9% of the long-term average annual streamflow; or
- 50% of the use in Alberta is for use outside of the Mackenzie River basin.

For the Hay River, an objective and triggers have been set on an interim basis. The interim objective is for 95% of the **natural flow** to pass from Alberta to the NWT each month. Two triggers have been defined. Triggers are specific conditions that will require a response, such as further discussion on flow objectives, refinements to calculations, or more detailed work on determining ecosystem needs. The two interim water quantity triggers are:

- **Trigger 1:** If the volume of water licensed is greater than 2.5% of the natural flow at the border, or half of Alberta's share of water, in at least one month, further work is done to evaluate Trigger 2.
- **Trigger 2:** If the water used is greater than 4% of the monthly natural flow, or 80% of Alberta's share of the water, further data and research on ecosystem needs will be discussed.

Quantity monitoring and assessment

Streamflow has been measured on the Slave River near the Alberta-NWT border since 1960 and on the Hay River at the Town of Hay River since 1963, providing more than 50 years of data. In funding partnerships with each of Alberta and the NWT, the Water Survey of Canada measures the streamflow and provides the data.



2017 Slave River status

Figure 5a) shows the daily flows in the Slave River in 2017 compared to past flows in other years, going back to 1972. The light grey shading shows the historical highs and lows. The darker grey shading shows the average historical flows. Figure 5b) shows Alberta's surface water licensed volume (light green); groundwater licensed volume (dark blue); and the remainder of the threshold not used (orange). The remainder of flow in the river is teal.

Alberta and NWT are tracking the total licence volume as a conservative indication of water use in the Slave River basin. Alberta's annual licensed volume of water from the Slave River remains below the threshold of 2 billion cubic metres. The threshold of 2 billion cubic metres continues to be 1.9% of the long-term annual flow.

No new special acts were passed in Alberta to allow for transfer of water out of the Mackenzie River Basin. Therefore, because no new interbasin transfers were approved in 2017, the total licenced volume for use outside of the Mackenzie River basin remains at 0.02% of the licensed volume in the Slave River basin.

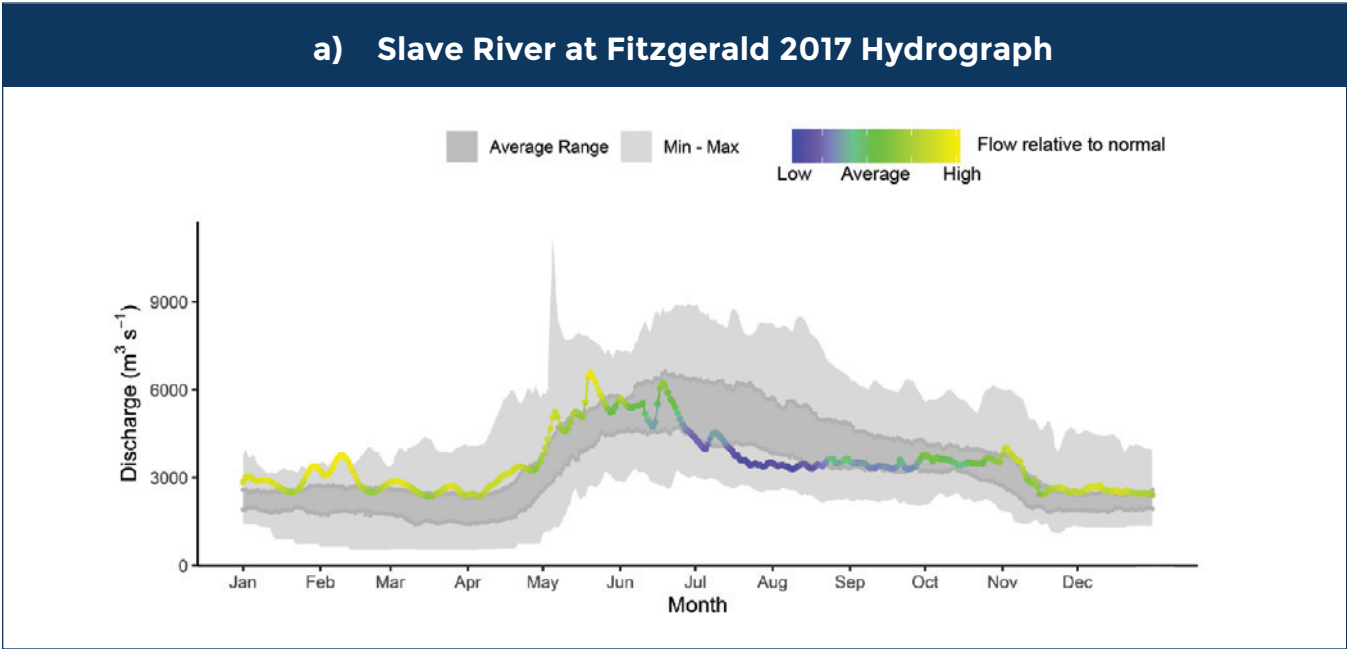


Figure 5a). Slave River at Fitzgerald 2017 daily flow values. Flow was higher than average in winter, and lower than average in summer, but did not exceed all-time minimum or maximum values. See the 2017 AB-NWT Transboundary Water Quantity Technical Report for further details on the fluctuation of daily flows in 2017 as compared to the historical record.

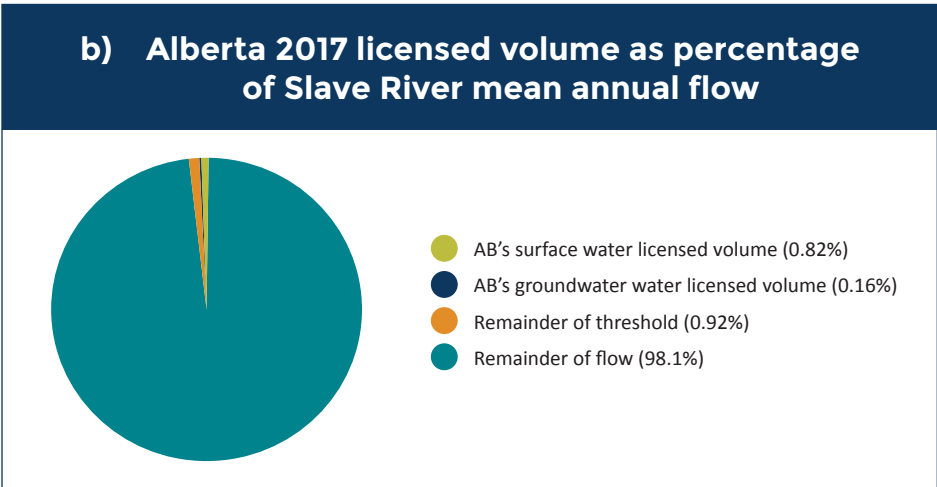


Figure 5b). Alberta 2017 licensed volume as a percentage of the Slave River long-term annual average flow. Alberta's consumptive use threshold of 2 billion cubic metres is the sum of: Alberta's surface water licensed volume (light green); groundwater licensed volume (dark blue); and the remainder of the threshold not used (orange). The remainder of flow in the river is teal.

2017 Hay River status

Figures 6a), b) and c) show the daily flows in the Hay River in 2017, along with the results for Trigger 1 and Trigger 2.

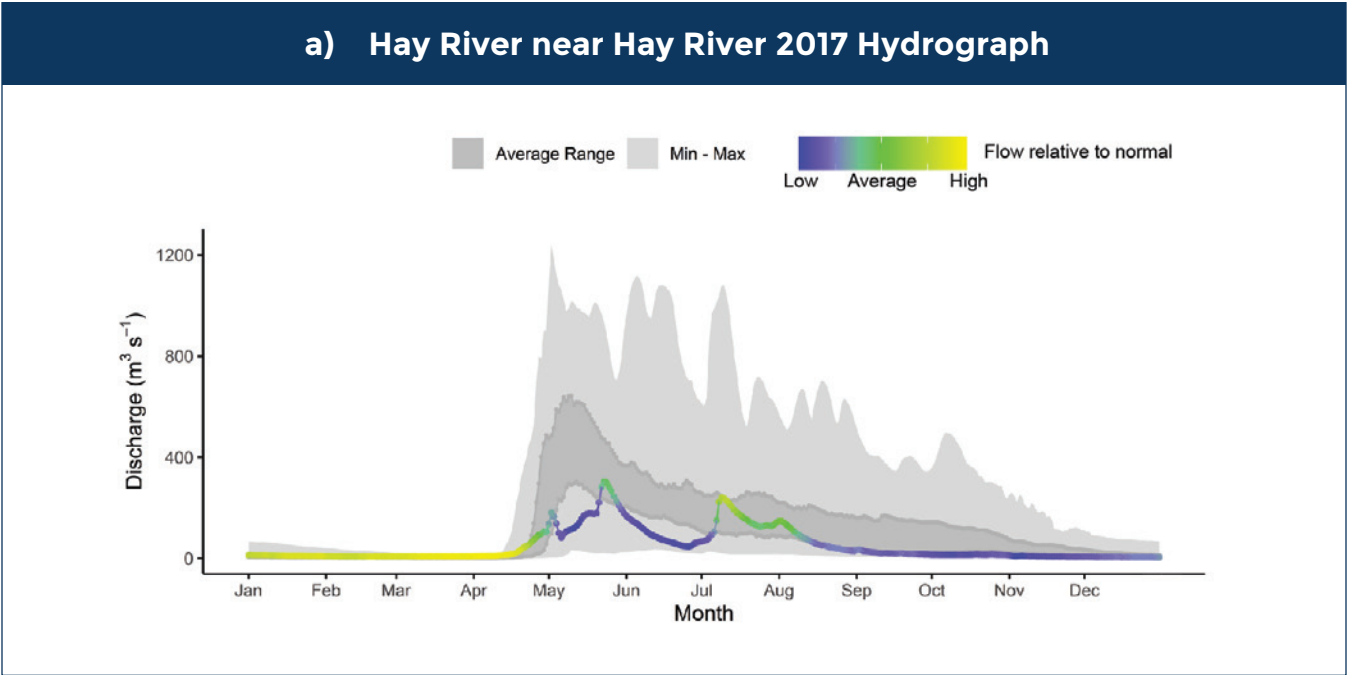


Figure 6a). Hay River near the Town of Hay River 2017 daily flow values. Flow volumes were higher than average from January to April, and lower than average in summer and fall. (See the 2017 AB-NWT Transboundary Water Quantity Technical Report for further details on the fluctuation of daily flows in 2017 as compared to the historical record.)

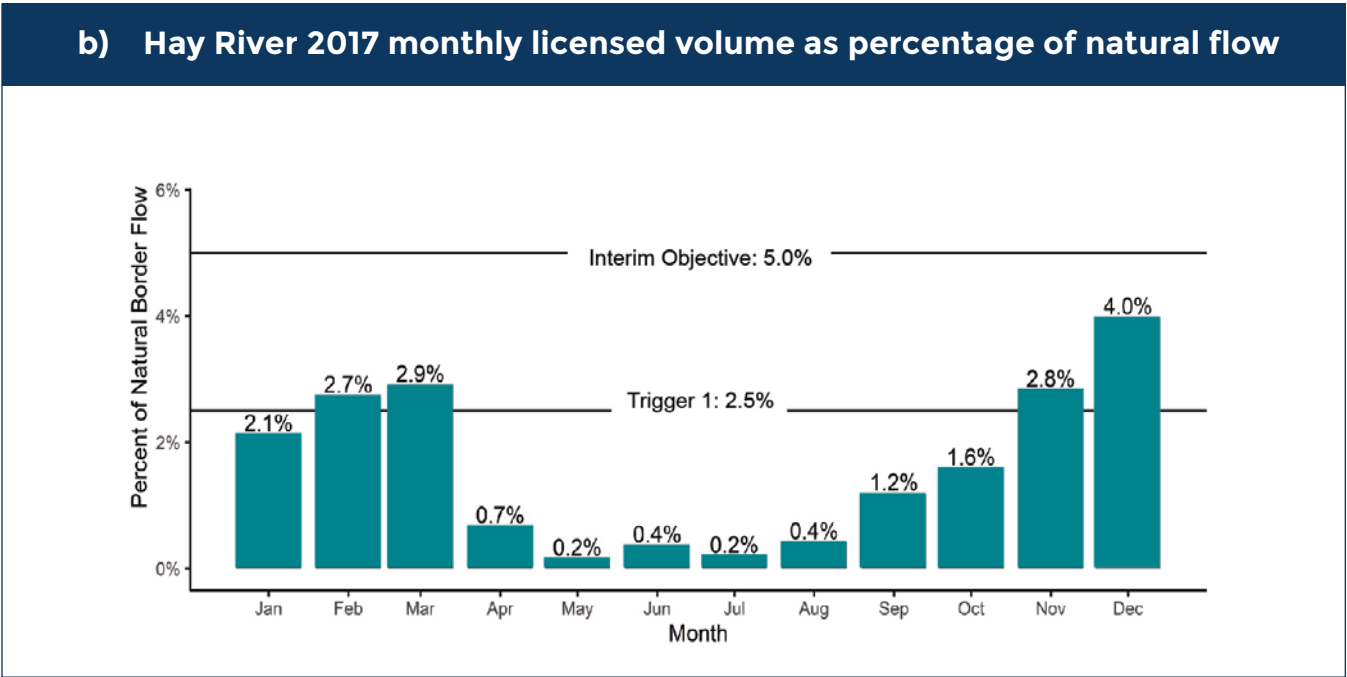


Figure 6b). Hay River 2017 monthly licensed volume estimate as percentage of natural flow at the Alberta-NWT border.

c) Hay River 2017 monthly use estimate as percentage of natural flow

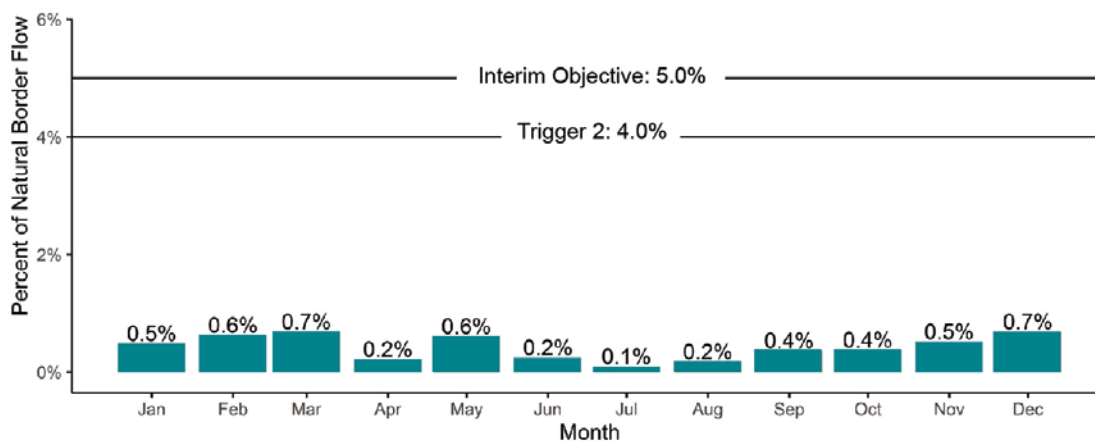


Figure 6c). Hay River 2017 monthly use as percentage of natural flow at the Alberta-NWT border.

The licensed volume of water in Alberta was greater than 2.5% of the natural flow (Trigger 1) in some months (February, March, November and December). The resulting action was to evaluate actual water use (Trigger 2). The actual water use was less than 1% of the natural flow in all months, so Trigger 2 was not exceeded in any month.

Next steps

Alberta and NWT will:

- Continue reporting daily flow data for both the Slave and Hay rivers, and compare them to historical flows;
- Continue to share **water-use data**;
- Continue to discuss priority areas for additional water-use or flow monitoring in the Hay River basin;
- Discuss coordination with other monitoring priorities for water quality and biology;
- Share information on procedures for flow measurement;
- Participate in work led by the Government of Canada, along with Indigenous partners, the Government of British Columbia and BC Hydro, to support improved understanding of the Peace-Athabasca Delta system, as part of the Wood Buffalo National Park Action Plan;
- Continue to track and report licensed volume, including volume for use outside the Mackenzie River Basin, and annual flow for the Slave River; and
- Continue to assess the interim triggers for the Hay River.

Surface water quality

Between April 1, 2017 and March 31, 2018, the following tasks were completed:

- Assessment of the 2017 **surface water** quality data for the Slave and Hay rivers; and
- Collection of mercury samples from the Slave and Hay rivers for future trigger development.

Water quality objectives

A water quality objective is a value that Alberta and the NWT have agreed to meet for each parameter monitored in the Slave and Hay rivers. A parameter is a specific substance that we measure in water, such as calcium. We continue work to develop objectives for the Slave and Hay rivers. While this work is ongoing, we are using triggers to see if the water quality is changing.

Water quality triggers

A trigger is a number that is calculated using data that were collected in the past. Interim site-specific water quality triggers were developed using data from samples collected from the Slave and Hay rivers. New data are compared against the triggers to observe any water quality changes. When a trigger is reached, an action is prompted, such as confirmation of change and evaluation of the cause.

Change is measured using two kinds of triggers: Trigger 1 is used to assess change over time and Trigger 2 is used to identify parameters with measured concentrations higher than what we expect.

The triggers may be updated as we gather new data and information.

Trigger 1

Trigger 1 was set at the median value for each parameter. The median is the middle value when all historical results are ordered from lowest to highest. A parameter was flagged if more than half of its 2017 results were above Trigger 1. A parameter that was flagged in previous years was assessed further using a test for statistical significance. A statistically significant difference in concentrations between the recent and historical time periods indicates that the parameter may be changing over time.

Trigger 2

Trigger 2 was set at the 90th **percentile** for each parameter. The 90th percentile is the value at which 90% of the historical results are below and 10% are above. A parameter was flagged if more than 10% of the results were above the Trigger 2 value. These results were then compared to their historical seasonal maximum values. River flow data were also reviewed to see if the high values were due to flow conditions at the time of sampling.

Water-use data

Under Alberta's Water Act, a licence is required for water use (including removing, impeding, or diverting flow). Alberta regulatory authorities include specific requirements for monitoring and reporting water use in each licence. Alberta has used an online Water Use Reporting System for gathering water-use data since 2006; this database was used for analysis of cumulative use in this report. Further historical and current data on water uses are also available in paper format from the Government of Alberta.

Surface water

Surface water is water that is found on the earth's surface, such as lakes and rivers.

Water quality naturally varies from place to place, with the seasons, with climate, with the quantity of water, and with the different types of soils and rocks it moves through. Water quality can also be affected by human use.

What is a percentile?

A percentile is a measure in statistics. It represents the value below which a given percentage of observations fall. For example, the 90th percentile is the value below which 90% of the observations may be found.

WATER QUALITY MONITORING PROGRAMS

Transboundary water quality is monitored in the Slave River at Fitzgerald and Fort Smith, and Hay River near the Alberta-NWT Border.

Water samples are tested for parameters, such as major ions, including magnesium and sulphate; nutrients, such as nitrogen and phosphorus; and metals, like arsenic, copper, lead and mercury.

Samples are also tested for organic substances including pesticides and hydrocarbons.

Environment and Climate Change Canada has been monitoring surface water quality of the Slave River since 1960, and the Hay River since 1988. These long-term datasets are important to understanding water quality changes over time.



2017 water quality assessment results

2017 Slave River status

In 2017, samples were collected from the Slave River at Fitzgerald on nine occasions. Sixty-six parameters were analyzed in each sample.

Under Trigger 1, 22 of the 66 parameters were flagged for further assessment. Of these, seven were also flagged in 2015 and 2016: alkalinity, specific conductance, dissolved calcium, dissolved magnesium, dissolved sulphate, nitrate/nitrite, and dissolved strontium.

Further analysis showed that four of these—alkalinity, dissolved magnesium, nitrate/nitrite, and dissolved sulphate—had statistically significant differences between the recent and historical monitoring periods. This suggests that levels of these four parameters were higher in the Slave River in the last three years than in the past.

Figure 7 compares historical and recent dissolved magnesium levels in the Slave River, as an example.

Under Trigger 2, 33 of the 66 parameters were flagged. Of these, total dissolved solids and dissolved magnesium were above their open-water maximum values but below their overall historical maximum values. This indicates that the concentration of these substances was within the range of what has been observed in the past.

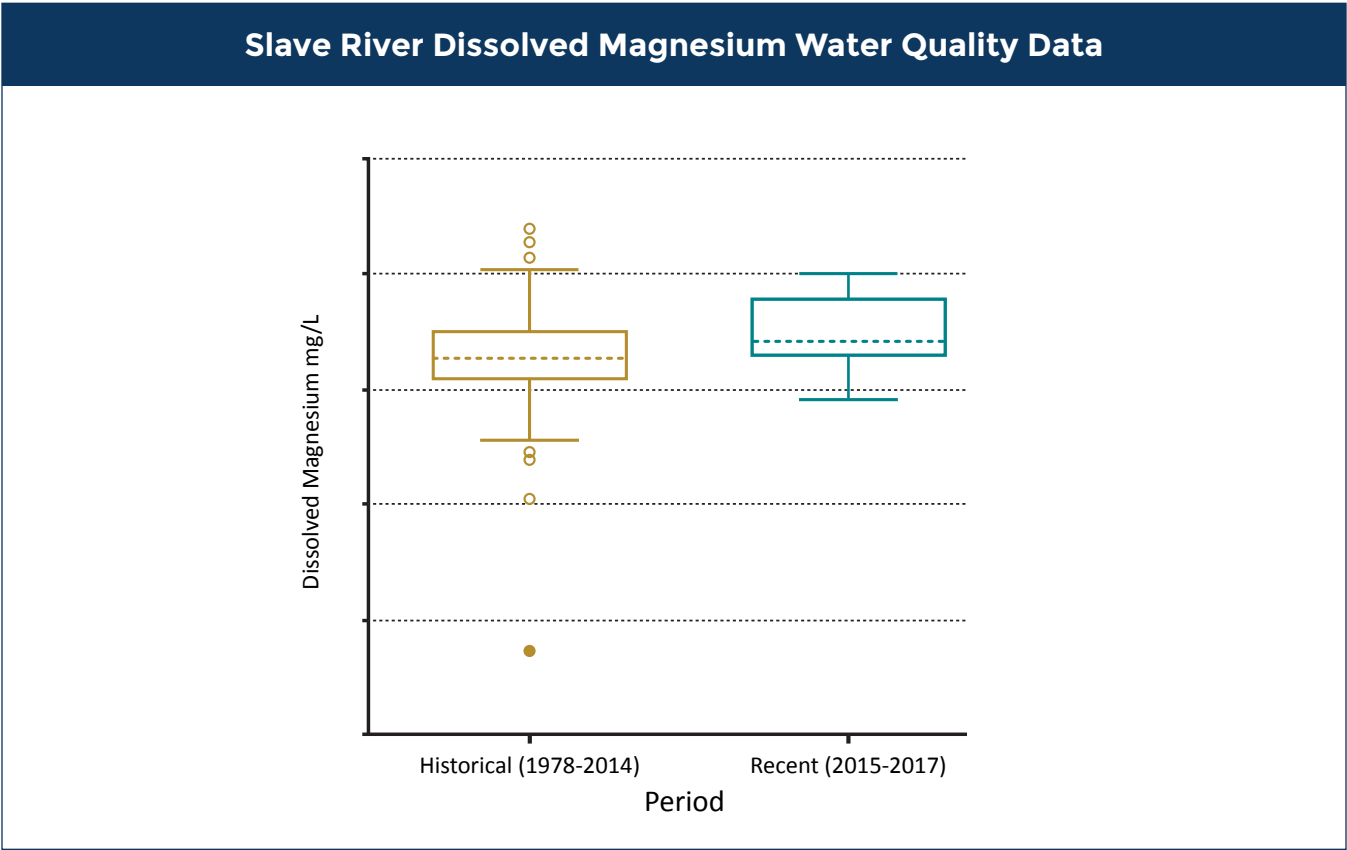


Figure 7. Box Plot comparing historical (1978-2014) and recent (2015-2017) dissolved magnesium levels in the Slave River, illustrating that recent levels are higher than historical levels. The dashed line within the box is the median, and the top and bottom of the box are the 75th and 25th percentiles, respectively. This means that 50% of the historical dissolved magnesium data fall between 6.2 and 7.0 milligrams (mg)/litre (L); whereas 50% of the recent data fall between 6.6 and 7.6 mg/L, indicating that levels are higher in recent years than in the past.

2017 Hay River status

In 2017, samples were collected from the Hay River near the Alberta-NWT border on four occasions. Forty parameters were analyzed from each sample.

Under Trigger 1, five of the 40 parameters were flagged for further assessment. Of these, nitrate/nitrite, total manganese and total uranium were also flagged in 2016. Further analysis showed no statistically significant differences between the recent and historical periods.

Under Trigger 2, 23 of the 40 parameters were flagged. Of these, only POC was above its historical seasonal and overall maximum value. Further study showed that this elevated POC value was likely due to the high suspended sediment levels associated with the high flows at the time of sampling.

These results show no significant changes in water quality in the Hay River.

Toxic, bioaccumulative and persistent substances

Alberta and the NWT are committed to preventing water pollution and working to identify any substances that are human-made, **toxic, bioaccumulative and persistent**.

In 2017, three samples were collected from both the Slave and Hay rivers and were analyzed for 14 of these kinds of substances. Some were detected on each occasion, in each river, but at very low concentrations.

The results were compared to the United States Environmental Protection Agency Chronic Aquatic Life Criteria. The levels of the substances found in the Slave and Hay rivers were considerably lower than levels that could cause concern.

Laboratory contamination is the likely cause for finding very small amounts of these substances because very small amounts of the same substances were found in the “blanks”, or the water samples that the laboratory uses to test their analytical methods.

Next steps

Alberta and the NWT will:

- Review and assess the 2018 water quality data for the Slave and Hay rivers;
- Continue the mercury water quality sampling programs in the Slave and Hay rivers; and
- Organize a basin-wide water quality subcommittee to discuss other methods to assess change.

What are toxic, bioaccumulative and persistent substances?

These are substances that do not naturally occur in water, last a very long time and build up in living things. They can pose a chronic risk to the environment.



Groundwater

The Agreement states that transboundary **groundwater** between Alberta and the NWT will be protected from pollution, and shared reasonably and equitably.

Since groundwater is below the surface, it is more difficult to identify and assess than surface water. Groundwater scientists with the Governments of Alberta and the NWT are working to learn more about the location, quality, and quantity of our shared groundwater.

Finding groundwater aquifers

The locations and borders of most of the shared aquifers have not been mapped. Until this occurs, the Governments of Alberta and the NWT have agreed to consider sub-basins of the Mackenzie River as a substitute. A preliminary version of the shared groundwater areas, based on this method, is shown in Figure 8.

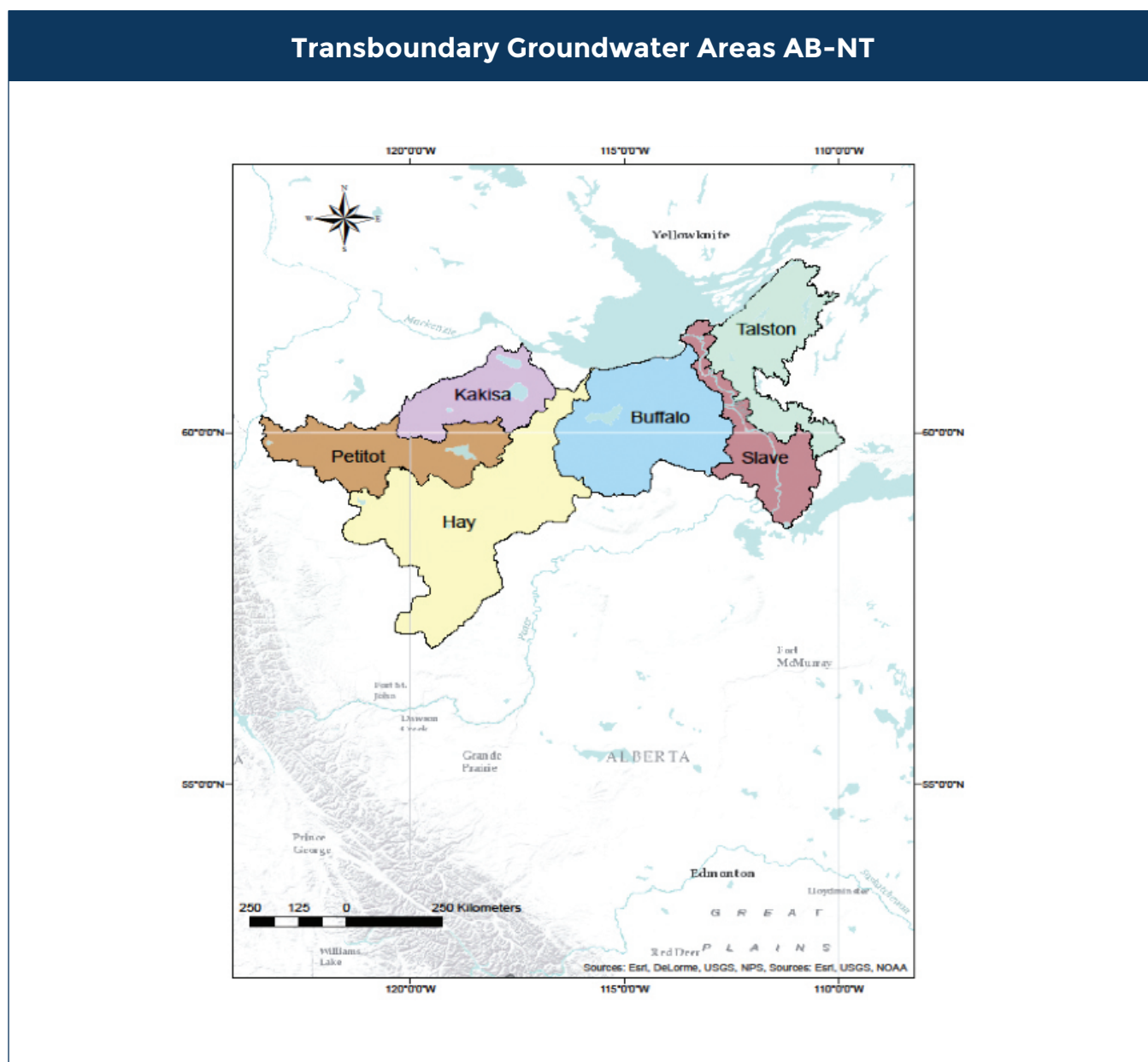


Figure 8. Sub-basins of the Mackenzie River.

About groundwater

Water below the earth's surface is called groundwater. Groundwater is found in small pockets of sediments, such as sand and in cracks in large rock formations. Some groundwater is very close to the earth's surface, while in other cases it is far below.

Groundwater and surface water are connected. Often, water above ground seeps down and water underground eventually flows to the surface.

The units of sediments and rocks where water is found are called aquifers. Figuring out where an aquifer exists and where it begins and ends is very difficult.

If land above or close to an aquifer is polluted, the pollution can seep into the aquifer, and can eventually be carried into rivers and lakes.

Water from wells drilled into an aquifer is sometimes the only source of drinking water for a community, so it is important to keep groundwater safe from pollution.

Groundwater monitoring study

The University of Montreal, in collaboration with McGill University, produced the report titled *Best Practices in Groundwater Monitoring for Northern Canada* (2018). This report provides a wealth of information about what is and is not known about groundwater in the North. A specific focus of the report was the NWT and its transboundary regions. The report includes:

- An overview of groundwater concepts specific to the northern environment, such as permafrost;
- A description of the hydrogeological regions – different types and formations of rock, groundwater units and connections with surface water bodies;
- What is known about groundwater in the Mackenzie River basin and its sub-basins;
- Legislation and guidelines about groundwater quality;
- Details about the tools and approaches available for groundwater investigation;
- Questions that remain about groundwater in the NWT;
- Recommendations about how to answer these questions; and
- Recommendations to ensure appropriate and sustainable groundwater management.

Two of the remaining questions are:

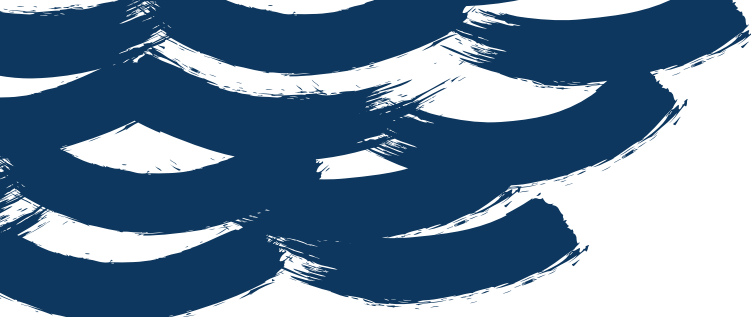
1. How is rapid warming and thawing of permafrost affecting groundwater?
2. What are the best ways to protect groundwater from pollution, over use, and climate change?

The report's recommendations include:

- Working together with communities and interested groups to learn what is most important about our shared groundwater and how best to protect it;
- Creating a groundwater and permafrost database for all data related to groundwater throughout the NWT; and
- Developing a preliminary groundwater observation network.

The final report is currently under review. Once published, it will guide future work.





Inventory of existing groundwater monitoring data

In Alberta, Environment and Parks has a large water well database that includes information about private wells and the creation of new wells. They also have a network of monitoring wells to track groundwater elevation and water quality. Approximately 48 of the monitoring wells are located within the Mackenzie River basin. Most though, are more than 100 km away from the Alberta-NWT border.

Another source of information is the Alberta Geological Survey. They recently completed a 3-D geological map of Alberta that includes a large portion of the Mackenzie River basin. Buried valleys have also been mapped up to the NWT border. This information is being reviewed to learn more about the Mackenzie River basin. Alberta Environment and Parks is currently working with industry to gather additional regulatory data. Risks from surface developments have been mapped in a surface water quality risk study for the Hay River basin.

In the NWT, information about groundwater wells is being collected from the GNWT departments of Municipal and Community Affairs, and Environment and Natural Resources, as well as from the Office of the Regulator of Oil and Gas Operations. This effort has provided data from wells at sewage lagoons and solid waste sites, from contaminated sites, and from communities that get drinking water from groundwater sources.

The current focus is information about the Hay River because of the proximity of the Hay River basin to the border and traditional use and drinking water use downstream in NWT. All of the available data will also be reviewed to look for changes in the quality and amount of groundwater over time. In addition, the inventory of data will be used to find monitoring gaps and to identify future priorities. It is anticipated lessons learned from work on the Hay River basin will be used to inform work on the Slave River basin and other basins.

Next steps

The next steps in understanding the quality, amount, and location of groundwater shared between Alberta and the NWT include:

- Proposing an approach for decision making on classifications for groundwater shared between Alberta, the NWT and British Columbia;
- Gathering and reviewing any additional groundwater data available from the Northwest Territories Geological Survey, GNWT departments of Infrastructure and Lands, as well as the Geological Survey of Canada;
- Developing a plan to map and describe Alberta-NWT transboundary aquifers in buried valleys;
- Developing a plan and finding partners to learn more about permafrost and effects on groundwater in the Slave and Hay River basins;
- Agreeing to the map of shared groundwater areas; and
- Approving a common methodology for assessing groundwater quality baselines (i.e., the range that is normal) and determining when further investigation is needed.

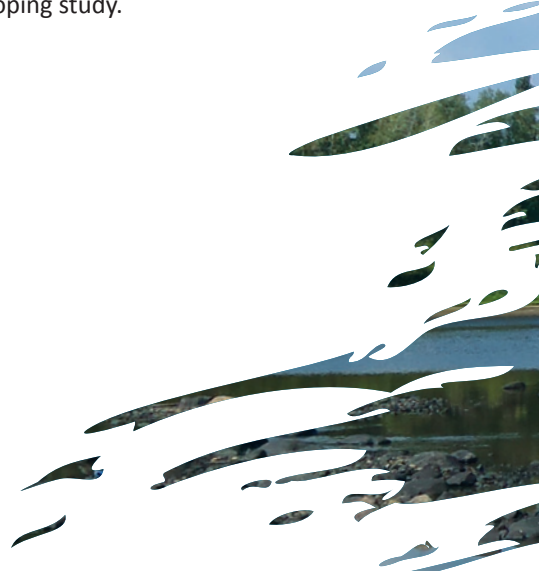
Climate change

The impact of climate change is a consideration in all of the monitoring and analysis of water quantity and quality. Alberta and NWT began discussions towards joint bilateral work on a climate change scoping study.

From 2016-18, NWT conducted jurisdiction specific work to develop a 2030 Climate Change Strategic Framework and a 2030 Energy Strategy that will provide valuable information for future bilateral work on climate change.

Next steps

Alberta and the NWT will share information regarding their jurisdictional climate change plans, and continue to discuss a climate scoping study.



CONCLUSION

The purpose of the Alberta-NWT Bilateral Water Management Agreement is to protect the waters shared by Alberta and the NWT. This includes monitoring the amount of water and the quality of water to ensure that it is sufficient to support all of the living things that depend upon it.

To achieve this goal, Alberta and the NWT are working together to:

- Report on the quality and amount of water flowing in the Slave and Hay rivers;
- Analyze historical and recent data to identify changes in the amount of water or quality of water, such as the levels of nutrients and pollutants;
- Identify changes in the aquatic ecosystem and explore their causes and impacts;
- Use additional sources of information, including agencies, experts, and traditional knowledge holders, to understand change; and
- Conduct research to develop additional indicators and triggers to identify change.

This past year's work showed that:

- There were no significant changes in water quality in the Hay River;
- Compounds used in pulp and paper mills and oil sands activities remain low in the Slave River; and
- The amount of water used was within the terms of the Agreement.

Significant changes noted that continue to be studied are:

- The levels of alkalinity, dissolved magnesium, nitrate/nitrite, and dissolved sulphate in the Slave River, which were higher in the last three years than in the past; and
- Greater variation in the highs and lows of water flow to assess if they are due to climate change.

The Bilateral Management Committee thanks all those who have contributed to the work of protecting our shared water.



ACKNOWLEDGEMENTS

A special thank you to Environment and Climate Change Canada for their continued, long-term operation of the important water quality and hydrometric sites on the Slave and Hay rivers, and throughout the Mackenzie River Basin. We would also like to thank Kátł'odeeche First Nation, Smith's Landing First Nation, and Northwest Territory Métis Nation for their assistance with the benthic macroinvertebrates and water quality sampling programs.

APPENDIX A – REPORT LINKS

Alberta-NWT Bilateral Water Management Agreement. 2015. GOA and GNWT:

https://www.enr.gov.nt.ca/sites/enr/files/ab-nwt_water_management_agreement_final_signed_2.pdf

Appendices to the Alberta-NWT Bilateral Water Management Agreement. 2015. GOA and GNWT:

https://www.enr.gov.nt.ca/sites/enr/files/bwma_ab-nt_appendices_24_february_2015.pdf

NWT Water Stewardship Strategy Implementation workshop: November 22-23, 2017. GNWT:

<https://www.nwtwaterstewardship.ca/en/november-22-23-2017-nwt-water-stewardship-strategy-implementation-workshop-final-summary-report>

Workshop Report: Towards Selecting Biological Monitoring Indicators Under the AB-NWT Bilateral Water Management Agreement. 2018. GOA and GNWT:

https://www.enr.gov.nt.ca/sites/enr/files/resources/biological_indicators_workshop_report_final.pdf

“Long-term changes in fish health endpoints and contaminant concentrations in the Slave River, NWT, and recommendations for future monitoring” (University of Saskatchewan - forthcoming)

Summary of 2017-18 Benthic Macroinvertebrate Monitoring on the Hay River and Slave River, 2020. GOA and GNWT. (forthcoming)

2017 Alberta-Northwest Territories Transboundary Water Quantity Technical Report:

https://www.enr.gov.nt.ca/sites/enr/files/resources/water_quantity_technical_report_final.pdf

2017 Alberta-Northwest Territories Water Quality Technical Report for the Slave and Hay Transboundary Rivers:

https://www.enr.gov.nt.ca/sites/enr/files/resources/2017_water_quality_technical_report_final_may_8_2020.pdf

Best Practices in Groundwater Monitoring for Northern Canada. 2018. Fortier, Daniel and McKenzie, Jeffery. Université de Montréal and McGill University. (forthcoming)

2030 NWT Climate Change Strategic Framework. 2019. GNWT:

https://www.enr.gov.nt.ca/sites/enr/files/resources/128-climate_change_strategic_framework_web.pdf

2030 Energy Strategy. 2018. GNWT:

https://www.inf.gov.nt.ca/sites/inf/files/resources/gnwt_inf_7272_energy_strategy_web-eng.pdf

APPENDIX B – BILATERAL MANAGEMENT COMMITTEE MEMBERS

*Membership for the April 1, 2017-March 31, 2018 period

BMC members

Northwest Territories



Dr. Erin Kelly

Assistant Deputy Minister,
Environment and Natural Resources,
Government of the Northwest Territories



Tim Heron

Lands and Resources Manager,
Lands and Resources,
Northwest Territory Métis Nation
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Brian Yee

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Government of Alberta

Technical team members

Northwest Territories

Meghan Beveridge, Manager, Transboundary Waters

Andrea Czarnecki, Aquatic Quality Scientist

Anna Coles, Hydrogeologist (former)

Ryan Connon, Hydrologist

Derek Faria, Hydrologist (now retired)

Isabelle de Grandpré, Hydrogeologist

Annie Levasseur, Water Stewardship Advisor

Alberta

Caroline Bampfylde,
Ecosystem and Risk Assessment Modeller

Guy Bayegnak, Senior Hydrologist,
Groundwater Policy Specialist

Jacque Browne, Transboundary Water Advisor

Carmen de la Chevrotière,

Transboundary Water Quantity Specialist

Sangeeta Guha, Hydrogeologist

Tracey Howlett, Knowledge Translation Lead,
Indigenous Services

Gongchen Li, Transboundary Water Quality Specialist

Tim Toth, Senior Transboundary Water Advisor

