· 2018-2020 ·

Working Together

TO MANAGE OUR SHARED WATERS

Alberta-Northwest Territories Bilateral Management Committee Annual Report to Ministers

Preface

This report provides a summary of the work done between April 1, 2018 and March 31, 2020 to meet the commitments of the Alberta-Northwest Territories Bilateral Water Management Agreement. The report is based on technical reports. Links to the full text of the original reports, where available, are provided in Appendix A.

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Executive Summary

The Alberta-NWT Bilateral Water Management Agreement provides for the protection of transboundary waters, including the Slave, Hay, Buffalo, Little Buffalo, Whitesand, Yates, Kakisa, Petitot, Salt, and Tethul rivers, their tributaries and groundwater. A joint Bilateral Management Committee oversees the collective efforts of Alberta and the Northwest Territories to implement the Agreement.

Collaborating in a Changing Environment

Information sharing plays a fundamental role in our efforts. Research findings, regulatory activities, monitoring results, and technical methods are shared between the NWT and Alberta team members, as well as with government, educational, community, and land and water management organizations.

A Traditional Knowledge Working Group was established and engaged consultants to conduct a comprehensive review of existing frameworks and best practices regarding traditional knowledge in decision making. We will continue developing a traditional knowledge framework that honours knowledge holders and offers respectful pathways of braiding knowledge systems for the implementation of the Agreement.

Climate change and the resulting thaw of permafrost often has a significant impact on water and the aquatic environment. With Northern Canada warming at about three times the world's average rate, we need to understand whether changes in water quality, quantity or biological indicators are caused by climate change or by activities in Alberta or the NWT.

Over the past two years, we have reviewed available research studies and found that there are relatively few studies related to climate impacts on the main stems of the Peace and Slave rivers or in the Hay River basin. Our work on understanding the impact of climate change continues, and will include a full state-of-knowledge report on permafrost presence and thaw rates in the transboundary basins and how further thaw might impact water quantity and quality. This information will be shared once completed.

Monitoring Programs

Biological monitoring has been an important area of work since signing the Agreement. The benthic macroinvertebrate (e.g. aquatic insects and worms) monitoring program started in 2017 to gather information that will be used as an indicator of change in the aquatic environment. So far, differences in the amount and diversity of benthic macroinvertebrates have been noted between the Slave and Hay rivers as well as between high water and lower water years. Due to this variability, additional years of sampling are required to establish the baseline condition under different flow conditions.

Another program to assess change is the monitoring of large and small-bodied fish in the Slave and Hay rivers. The Slave River fish monitoring program is designed for comparison to results from the upstream Oil Sands Monitoring Program on the Athabasca

River. The program also uses data from historical fish research and monitoring programs completed for the Slave River. Fish monitoring on the Slave River took place in 2019 and will continue in 2020. Fish monitoring will also expand and include preliminary sampling on the Hay River in 2020 for both small and large-bodied fish.

A review of the data from historical and ongoing studies and monitoring programs was completed to determine to what extent metals, nutrients, and polycyclic aromatic hydrocarbons (PAHs) may be moving in the aquatic ecosystem of the Slave River. Further studies are needed to be able to assess movement of metals, nutrients, and PAHs from water and sediment to plants and animals in the Slave River.

Water quantity and quality monitoring programs continued through 2018 and 2019.

When the Agreement was signed in 2015, insufficient data were available to develop water quality triggers for mercury. Because mercury is toxic and can accumulate in organisms, the collection and analysis of mercury samples on the Slave and Hay rivers became a priority. Additional sampling has led to the development of interim open water triggers for total and dissolved mercury for the Slave River. These triggers were used to assess mercury levels in 2018 and 2019. Triggers for the Hay River are now being developed and will be applied to the data in 2022.

Learning More About Groundwater

The work of groundwater scientists with the Governments of Alberta and the NWT continues, and we are learning more about the location, quality, and quantity of our shared groundwater. Since the information on groundwater is limited in the Hay River basin near the Alberta-NWT border,

and there are some potential and existing developments in the basin, the Bilateral Management Committee agreed to increase the classification for the Hay River groundwater area from Class 1 to Class 2 to allow for more learning to take place.

The inventory of existing groundwater monitoring data is an ongoing project. A preliminary review of groundwater quality data from the provincial groundwater monitoring network in Alberta indicated no obvious trend in groundwater quantity or quality. Overall, the quality of groundwater appears to be safe for consumption at monitoring locations, with most measured parameters below the Guidelines for Canadian Drinking Water Quality. Water samples collected prior to 2014 from monitoring wells installed in the Upper and Lower Hay river basin show higher concentration of total dissolved solids (TDS), sodium, iron and sulphate. Water samples collected between 2015-2018 in the Lower Hay sub-basin show traces of lead marginally exceeding the "Guidelines for Canadian Drinking Water Quality". These parameters (except lead) are Aesthetic Objectives that tend to occur naturally higher in Alberta. Further monitoring may be required to determine if there are any persistent trends over time.

Based on Alberta's process for developing Groundwater Management Frameworks, we are working towards a joint groundwater management framework that would be consistent with the ones being developed in the other jurisdictions of the Mackenzie River Basin. The framework will help to determine groundwater quality baseline and to establish management action triggers, which will improve land-use decision-making.

Slave River

Water Quantity

In 2018 and 2019, total annual streamflow on the Slave River was slightly lower than average. Human use in both years was well below the Agreement's two billion cubic metre (m^3) threshold and this threshold remains at 1.9% of the long-term average streamflow. There were no changes to water transfers for use outside of the Peace or Athabasca River basins in Alberta.

Water Quality

Trend analysis revealed statistically significant trends for alkalinity, dissolved magnesium and dissolved sulphate. These trends suggest that the levels of these parameters are higher today than when consistent monitoring began in the Slave River in 1972.

To explore these parameters further, we looked for trends in the latter half of the dataset, 2000-2019. Increasing trends were found for alkalinity and dissolved magnesium, but not for dissolved sulphate. This analysis suggests that, while sulphate levels are higher today compared to the early days of monitoring, dissolved sulphate levels in the Slave River have been stable for the last two decades.

To further understand changes in Slave River alkalinity and dissolved magnesium levels, we looked at data from upstream water quality sites. Reviewing the water quality data from the Athabasca and Peace rivers can help explain water quality conditions in the Slave River.

Similar to the Slave River, increasing trends were found in the Peace River for alkalinity and dissolved magnesium. No other trends were found from two upstream sites at Peace River at Peace Point and Athabasca River at Baseline 27. Given that the Peace River contributes almost 80% of the water to the Slave River, it is likely that changes in Peace River alkalinity and dissolved magnesium levels are influencing the levels of these two parameters in the Slave River.

A statistically significant increasing trend was also found for nitrate/nitrite. No trends for nitrate/nitrite were found in either the Athabasca or Peace Rivers although a similar trend was found in the Hay River. Given the same pattern for nitrate/nitrite in both the Slave and Hay Rivers, the reported trend could be part of a broader regional pattern in the southern part of the territory.

Some human made, toxic, bioaccumulative, and persistent substances were detected in the Slave River. However, concentrations were very low and below levels that could be harmful to aquatic life.

Hay River

Water Quantity

On the Hay River, the total annual streamflow in 2018 was lower than average at 59% of normal, and in 2019 was much lower than average at 39% of normal. Human use, however, was lower than 2% of the monthly natural flow at the border.

Water Quality

Trend analysis revealed a statistically significant increasing trend for nitrate/nitrite. Given that nitrate/nitrite levels appear to be increasing in both the Slave and Hay Rivers as described earlier, the reported trends could be part of a broader regional pattern.

Some human made, toxic, bioaccumulative, and persistent substances were detected in the Hay River. However, concentrations were very low and were below levels that could be harmful to aquatic life.

Sommaire

L'Entente sur les eaux transfrontalières entre l'Alberta et les Territoires du Nord-Ouest prévoit la protection des eaux transfrontalières, y compris les rivières des Esclaves, au Foin, Buffalo, Little Buffalo, Whitesand, Yates, Kakisa, Petitot, Salt et Tethul, leurs affluents et les eaux souterraines. Un comité de gestion bilatéral conjoint supervise les efforts collectifs de l'Alberta et des TNO pour mettre en œuvre l'Entente.

Collaboration dans un environnement en mutation

La mise en commun des renseignements joue un rôle fondamental dans nos efforts. Les résultats de la recherche, les activités réglementaires, les résultats de la surveillance et les méthodes techniques sont mis en commun entre les membres des équipes des TNO et de l'Alberta, ainsi qu'avec les organisations gouvernementales, éducatives, communautaires et de gestion des terres et des eaux.

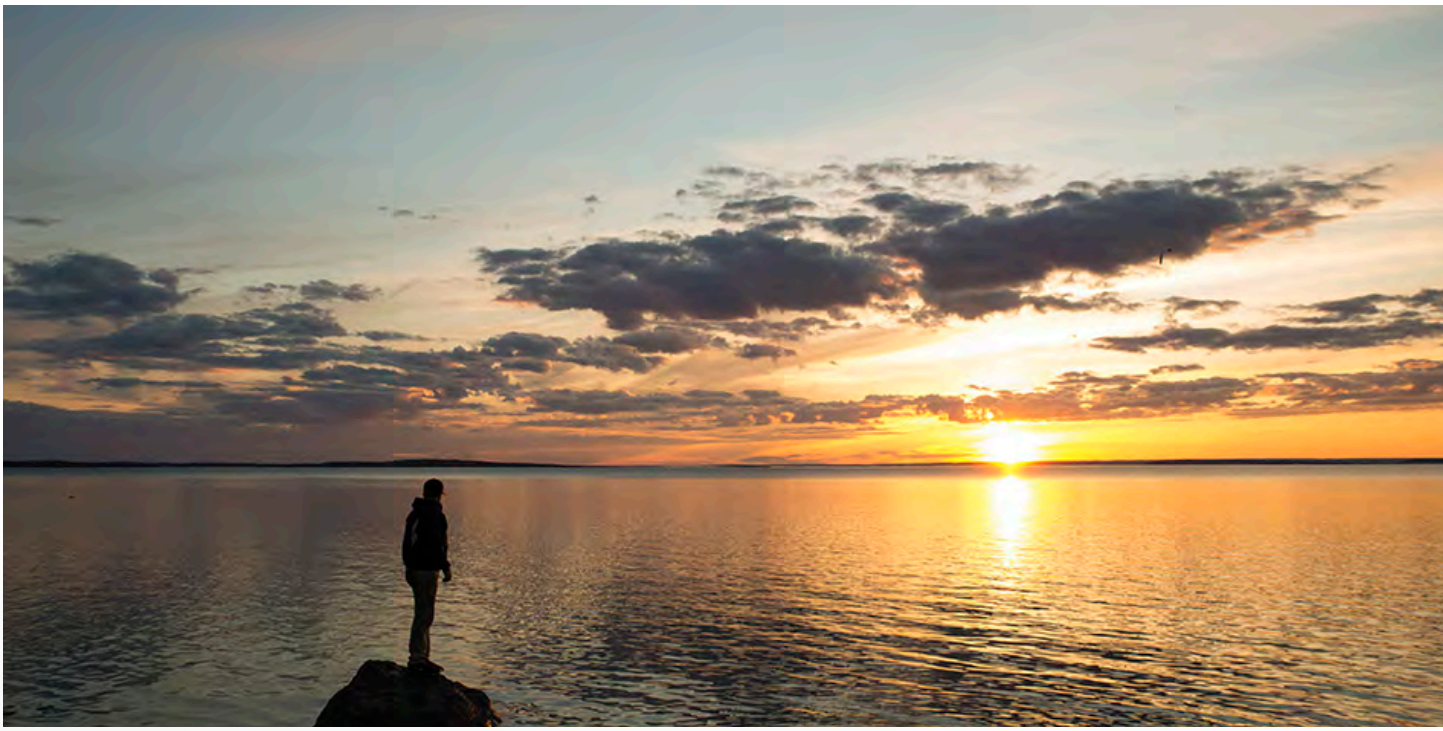
Un groupe de travail sur le savoir traditionnel a été créé et a engagé des consultants pour effectuer un examen complet des cadres existants et des pratiques exemplaires concernant le savoir traditionnel dans la prise de décision. Nous continuerons à concevoir un cadre du savoir traditionnel qui honore les détenteurs du savoir et offre des voies respectueuses d'intégration des systèmes de connaissances pour la mise en œuvre de l'Entente.

Le changement climatique et le dégel du pergélisol qui en résulte peuvent avoir des répercussions importantes sur l'eau et l'environnement aquatique. Le Nord canadien se réchauffant environ trois fois plus vite que la moyenne mondiale, nous devons comprendre si les changements sont causés par le changement climatique ou par les activités en Alberta ou aux TNO.

Au cours des deux dernières années, nous avons examiné les études disponibles et avons constaté qu'il y a relativement peu d'études liées aux répercussions climatiques sur les affluents principaux des rivières de la Paix et des Esclaves ou dans le bassin de la rivière au Foin. Nos travaux visant à comprendre les répercussions du changement climatique se poursuivent et comprendront un rapport complet sur l'état des connaissances sur la présence de pergélisol et les taux de dégel dans les bassins transfrontaliers, ainsi que la manière dont la poursuite du dégel pourrait avoir des répercussions sur la quantité et la qualité de l'eau. Ces informations seront diffusées une fois ces travaux achevés.

Programmes de surveillance Monitoring Programs

La surveillance biologique a été un domaine de travail important depuis la signature de l'Entente. Le programme de surveillance des macroinvertébrés benthiques (par exemple, les insectes et les vers aquatiques) a débuté en 2017 pour recueillir des informations qui seront utilisées comme indicateur de changement dans l'environnement aquatique. Jusqu'à présent, on a relevé des différences dans la quantité et la diversité des macroinvertébrés benthiques entre les rivières au Foin et des Esclaves, ainsi qu'entre les années de hautes eaux et de basses eaux. En raison de cette variabilité, des années supplémentaires



d'échantillonnage sont nécessaires pour établir les conditions de base suivant différents débits.

Un autre programme d'évaluation des changements est la surveillance des poissons de grande et de petite tailles dans les rivières au Foin et des Esclaves. Le programme de surveillance des poissons de la rivière des Esclaves est conçu pour permettre des comparaisons avec les résultats du programme de surveillance des sables bitumineux en amont, dans la rivière Athabasca. Le programme permet également de faire des comparaisons avec la surveillance qui a été effectuée précédemment sur la rivière des Esclaves. La surveillance des poissons de la rivière des Esclaves a eu lieu en 2019 et se poursuivra en 2020. La surveillance des poissons sera également élargie et comprendra un échantillonnage préliminaire sur la rivière Hay en 2020 pour les poissons de petite et de grande tailles.

Un examen des données provenant d'études et de programmes de surveillance antérieurs et actuels a été effectué afin de déterminer dans quelle mesure les métaux, les nutriments et les hydrocarbures aromatiques polycycliques (HAP) peuvent s'accumuler dans le écosystème aquatique de la rivière des Esclaves. D'autres études sont nécessaires pour établir la présence d'un transfert des métaux, des nutriments et des HAP contenus dans l'eau et les sédiments vers les plantes et les animaux de la rivière des Esclaves.

Les programmes de surveillance de la quantité et de la qualité de l'eau se sont poursuivis en 2018 et 2019.

Lorsque l'Entente a été signée en 2015, les données disponibles étaient insuffisantes pour définir des déclencheurs de qualité de l'eau pour le mercure. Le mercure étant toxique et pouvant s'accumuler dans les organismes, la collecte et l'analyse d'échantillons

de mercure sont devenues une priorité. La campagne d'échantillonnage a conduit à la définition de déclencheurs provisoires en eau libre pour le mercure total et dissous dans la rivière des Esclaves. Ces déclencheurs ont été utilisés pour évaluer les niveaux de mercure en 2018 et 2019. Les déclencheurs pour la rivière Hay sont en cours d'élaboration.

En savoir plus sur les eaux souterraines

Le travail des scientifiques spécialistes des eaux souterraines avec les gouvernements de l'Alberta et des TNO se poursuit, et nous en apprenons davantage sur l'emplacement, la qualité et la quantité des eaux souterraines que nous avons en commun. Étant donné que l'information sur les eaux souterraines est limitée dans le bassin de la rivière Hay, près de la frontière entre l'Alberta et les TNO, et qu'il y a quelques développements potentiels et existants dans le bassin, le Comité bilatéral de gestion a convenu d'augmenter la classification de la zone des eaux souterraines de la rivière Hay de la classe 1 à la classe 2 afin de permettre un apprentissage plus approfondi.

L'inventaire des données existantes sur la surveillance des eaux souterraines est un projet en cours. Un examen préliminaire des données sur la qualité des eaux souterraines provenant du réseau provincial de surveillance des eaux souterraines en Alberta n'a révélé aucune tendance évidente dans la quantité ou la qualité des eaux souterraines. Dans l'ensemble, la qualité de l'eau souterraine semble être sécuritaire pour la consommation aux sites de surveillance, la plupart des paramètres mesurés étant inférieurs aux Recommandations pour la qualité de l'eau potable au Canada.

Nous travaillons à l'élaboration d'un cadre mixte de gestion des eaux souterraines inspiré du processus de l'Alberta pour l'élaboration de cadres de gestion des eaux souterraines. Ce cadre serait conforme à ceux qui sont en cours d'élaboration dans les autres juridictions du bassin du fleuve Mackenzie. Le cadre aidera à déterminer les seuils de référence sur la qualité des eaux souterraines et à établir les déclencheurs d'intervention, ce qui améliorera la prise de décisions sur l'utilisation des terres.

Rivière des Esclaves

Quantité d'eau

En 2018 et 2019, le débit annuel total de la rivière des Esclaves a été légèrement inférieur à la moyenne. L'utilisation humaine au cours de ces deux années était bien inférieure au seuil de deux milliards de mètres cubes (m3) fixé par l'Entente, et ce seuil reste fixé à 1,9 % du débit moyen à long terme. Aucun changement n'a été apporté aux transferts d'eau destinés à être utilisés à l'extérieur des bassins des rivières de la Paix ou Athabasca en Alberta.

Qualité de l'eau

L'analyse des tendances a révélé des tendances statistiquement significatives pour l'alcalinité, le magnésium dissous et le sulfate dissous. Ces tendances suggèrent que les niveaux de ces paramètres sont plus élevés aujourd'hui que lorsque la surveillance régulière a commencé dans la rivière des Esclaves.

Pour explorer davantage ces paramètres, nous avons examiné les tendances dans la seconde moitié de l'ensemble de données, soit de 2000 à 2019. Des tendances à la hausse ont été constatées pour l'alcalinité et le magnésium dissous, mais pas pour le sulfate dissous. Cette analyse suggère que, bien que les niveaux de sulfate soient plus élevés aujourd'hui qu'aux premiers jours de la surveillance, les niveaux de sulfate dissous dans la rivière des Esclaves sont stables depuis les deux dernières décennies.

Pour mieux comprendre les changements dans les niveaux d'alcalinité et de magnésium dissous de la rivière des Esclaves, nous avons examiné les données des sites d'évaluation de la qualité de l'eau en amont. L'examen des données sur la qualité de l'eau des rivières Athabasca et de la Paix peut aider à expliquer les conditions de qualité de l'eau de la rivière des Esclaves.

Comme dans la rivière des Esclaves, des tendances à la hausse ont été observées dans la rivière de la Paix pour l'alcalinité et le magnésium dissous. Aucune autre tendance n'a été relevée dans deux sites en amont, soit la rivière de la Paix à Peace Point et la rivière Athabasca à Baseline 27. Étant donné que la rivière de la Paix fournit près de 80 % de l'eau de la rivière des Esclaves, il est probable que les changements dans les niveaux d'alcalinité et de magnésium dissous de la rivière de la Paix influencent les niveaux de ces deux paramètres dans la rivière des Esclaves.

Une tendance à la hausse statistiquement significative a également été constatée pour les nitrates et les nitrites. Cependant, étant donné que les niveaux de nitrates et de nitrites semblent également augmenter dans la rivière au Foin, la tendance signalée pourrait faire partie d'un modèle régional plus large.

Certaines substances toxiques, bioaccumulatives et persistantes d'origine humaine ont été détectées dans la rivière des Esclaves. Toutefois, les concentrations étaient très faibles et se situaient en dessous des niveaux susceptibles de nuire à la vie aquatique.

Rivière au Foin

Quantité d'eau

Dans la rivière au Foin, le débit annuel total a été inférieur à la moyenne en 2018, à 59 % de la normale, et en 2019, il a été beaucoup plus faible que la moyenne, à 39 % de la normale. L'utilisation humaine, cependant, était inférieure à 4 % du débit naturel mensuel à la frontière.

Qualité de l'eau

L'analyse des tendances a révélé une tendance à la hausse statistiquement significative pour les nitrates et les nitrites. Étant donné que les niveaux de nitrates et de nitrites semblent augmenter dans les rivières au Foin et des Esclaves, la tendance signalée pourrait faire partie d'un modèle régional plus large.

Certaines substances toxiques, bioaccumulatives et persistantes d'origine humaine ont été détectées dans la rivière au Foin. Toutefois, les concentrations étaient très faibles et se situaient en dessous des niveaux susceptibles de nuire à la vie aquatique.

Safeguarding a Precious Resource

The Mackenzie River basin provides the majority of water in the Northwest Territories (NWT), and encompasses significant portions of Northern British Columbia, Alberta, and Saskatchewan, and eastern portions of Yukon. In 1997, these jurisdictions, along with the Government of Canada, signed an agreement to cooperatively manage the preservation and sustainable use of the basin's water. The *Mackenzie River Basin Transboundary Waters Master Agreement* also committed these provinces and territories to develop bilateral water management agreements.

The Alberta-NWT Bilateral Water Management Agreement (the Agreement), signed in 2015, is one of these. This Agreement provides for the protection of the Slave, Hay, Buffalo, Little Buffalo, Whitesand, Yates, Kakisa, Petitot, Salt, and Tethul rivers, and their tributaries and groundwater.

A joint Bilateral Management Committee oversees the collaborative efforts of Alberta and the NWT to implement the Agreement.

The Bilateral Management Committee usually reports on its progress annually. Due to the COVID-19 pandemic in 2020 and the need to catch up on reporting, the previous year's report was delayed. This report therefore covers two fiscal years – April 1, 2018 to March 31, 2019, and April 1, 2019 to March 31, 2020.

Activities and Progress

Ongoing Information Sharing

Relevant information was shared between the Alberta and NWT teams working to protect our shared waters. This includes research findings, regulatory activities, monitoring results, and technical methods. Frequent discussions were held, as we worked together to find the best ways to meet the commitments of the Agreement.

The Government of the Northwest Territories (GNWT) and the Government of Alberta (GOA) regularly share information related to environmental assessment processes relevant to shared waters. For example, in April 2018, the GNWT was notified that Canadian Natural Resources Limited applied for approval to extend the northeast mine pit at its Horizon oil sands processing plant and mine.

In March 2020, the GNWT was notified that regular water quality monitoring was temporarily suspended by both Alberta Environment and Parks and Environment and Climate Change Canada (ECCC), due to public health and safety restrictions in response to the COVID-19 pandemic. The GNWT reached out to the GOA and, in cooperation with ECCC, managed to ensure minimal disruption for at least the three sites that are within the transboundary reach of the Slave River and the one site that is within the transboundary reach of the Hay River.[1]

In April 2018, the GNWT was notified that a Paramount Resources Ltd. pipeline released an estimated 100,000 litres of crude oil and 190,000 litres of produced water nine kilometers east of Zama City, Alberta. It was a land-based spill and did not reach a water body. The spill was contained and recovery and remediation efforts took place. There was no sign of spill migration into the downstream waters.

The GNWT and GOA are working to improve prior notification processes for energy-related projects and working with ECCC to improve prior notification for decisions about suspending water quality monitoring at important sites identified in our Agreement.

Joint Work Plan

The Bilateral Management Committee approves an annual work plan to guide the Alberta and NWT teams' work for the upcoming fiscal year. The plan is based on continued work to address previously identified priorities, as well as any new developments important to the implementation of the Agreement.

Classification of Waters

The classification of water bodies is based on risk that considers:

- the level of upstream development such as, industry, agriculture and drinking water for upstream communities;
- the extent of traditional use;
- drinking water use in downstream communities;
- observed changes in conditions; and,
- the sensitivity of the related ecosystem.

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

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[1] *The next report to the Ministers will list any temporary interruptions and suspensions to monitoring and describe the communications and collaboration between GNWT, GOA and ECCC in 2020 and 2021.*

Class 2 water bodies are at moderate risk. Class 2 waters require Learning Plans to better understand the history, current and potential future of water quality, quantity and health of the overall aquatic ecosystem.

Class 3 water bodies are considered 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 surface bodies of water managed under the Agreement are currently Class 1.

The Hay River groundwater area, which has been mapped out based on the surface water sub-basin, was re-classified from a Class 1 to a Class 2 in 2019-2020 to allow for more learning to take place.

The Slave River groundwater area remains a Class 1.

Learning Plans

A Learning Plan is very much what it seems – a plan to learn more. Learning Plans are in development for the Slave and Hay rivers. All of the work associated with the Agreement contributes to a better understanding of our shared waters.

Public Engagement

Sharing information and engaging with the public about water management and the Agreement foster public understanding and allow public input to be considered in bilateral water management.

There are several 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. The email address for the GNWT is nwtwaterstrategy@gov.nt.ca, and for the GOA, aep.tws@gov.ab.ca.

GNWT staff meet regularly with the NWT Water Strategy Indigenous Steering Committee (formerly the Aboriginal Steering Committee) for guidance on the implementation of the NWT Water Stewardship Strategy and the Agreement.

In Alberta, the general public, stakeholders, government partners, and Indigenous communities are engaged through land use and water planning processes. Indigenous working groups are engaged throughout the development, implementation, ongoing review, and potential amendment of regional land use plans.

Alberta and NWT representatives provide updates to the Mackenzie River Basin Board twice per year.

In addition to these ongoing methods of communication, representatives from Alberta and the NWT attend a number of meetings each year to share information and obtain input on water management issues.

April 1, 2018 to March 31, 2019

In May 2018, the Government of Alberta board member on the Mighty Peace Watershed Alliance (MPWA) provided an update to the MPWA on the implementation of the Agreement and ongoing project work. The MPWA is the planning and advisory council for the Peace/Slave River Basin.

At the Alberta Watershed Planning and Advisory Council Summit in Peace River, Alberta in June 2018, the NWT gave a presentation on the downstream perspective of the Agreement.

In July 2018, at a training workshop for Project Wet, the NWT provided an overview of the Agreement and the opportunities it offers. Project Wet is an international program designed to give teachers and other educators the tools to include water and environmental education in classrooms and other programs. Participants included educators from the NWT, Yukon, Nunavut, Alberta and Saskatchewan.

The NWT attended the annual Water Stewardship Strategy Implementation Workshop in Dettah, NWT, in October 2018, to discuss the importance of traditional knowledge for informing NWT's transboundary water management agreements.

The NWT met with the Slave River and Delta Partnership in March 2019 in Fort Smith, NWT, to discuss development of a fish monitoring plan for the Slave River. The Partnership includes Indigenous and local governments and community members from the Slave River area. The workshop discussed what concerns the communities have about fish, how they know when fish are healthy or unhealthy, the best species to monitor, and the best places to monitor. Background on the Agreement and related water monitoring programs and initiatives in the region were also discussed.

April 1, 2019 to March 31, 2020

Following a request by the groups that attended the Slave River and Delta Partnership meeting, the NWT participated in follow up meetings with individual organizations in May 2019 to further discuss the fish monitoring program design.

NWT also participated in the Great Slave Lake Advisory Committee meeting in Hay River on May 7, 2019, to provide an overview and obtain feedback on the transboundary fish monitoring plan.

In October 2019, the NWT gave a presentation on the Alberta-NWT benthic macroinvertebrate monitoring program at the National Canadian Aquatic Biomonitoring Network Forum. The focus of the presentation was to share information on how benthic macroinvertebrate monitoring is being applied to protect the aquatic ecosystem in large transboundary rivers.

At the October 2019 annual Water Stewardship Strategy Implementation Workshop in Dettah, NWT, GNWT staff shared how the transboundary agreements account for climate change.

The NWT presented at the Climate Change Adaptation Community Meeting in Kakisa in February 2020. Staff shared how permafrost thaw-induced land cover change has impacted water flows and levels in transboundary basins. Staff discussed these changes with community members and elders who shared how their experiences on the land are changing, as well as possible ways to adapt to these changes.

The Government of Alberta staff liaison to the Mighty Peace Watershed Alliance provided an update on the implementation of the Agreement and ongoing project work at the MPWA May 2019 Annual General Meeting.

Alberta Environment and Parks Transboundary Waters staff presented at the Alberta Watershed Planning and Advisory Council Priorities Workshop on March 3, 2020. The presentation included an overview of transboundary agreements, inter-jurisdictional work, and discussions around the importance of understanding transboundary agreements in watershed planning.

Monitoring and Results

Monitoring includes measuring things, such as water levels, water quality and biology, as well as identifying changes over time. Monitoring different parts of the aquatic ecosystem and reviewing the results are an important part of implementing the Agreement.

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.

With the exception of aquatic mammals, between April 1, 2018 and March 31, 2020, monitoring of those indicators and other biology-related work, took place to improve our knowledge of the aquatic ecosystem in our shared transboundary waters. This included:

- The second and third year of benthic macroinvertebrate monitoring on the Hay and Slave rivers;
- Small and large-bodied fish sampling on the Slave River near Fort Smith and Fort Resolution; and
- The review of data from past studies to better understand food web interactions of various compounds in the Slave River.

What's a food web?

A food web is the feeding relationship that exists between plants and animals. It is based on a food chain of what eats what. An example of a short food web for a water body is plants are eaten by bugs, then bugs are eaten by fish, which are later eaten by humans.

Benthic Macroinvertebrate Monitoring

A benthic macroinvertebrate program started in 2017 on the Slave and Hay rivers near the Alberta-NWT border. The objective of the project is to establish baseline measures for benthic macroinvertebrates to track their status and condition over time. This is one way to assess ecosystem health and provide an early warning of change or stress in the environment.

The main sampling method used for collecting macroinvertebrates is a modified version of the Canadian Aquatic Biomonitoring Network (CABIN) method, adapted for large rivers. The method consists of kicking and disturbing the riverbed while moving upstream and holding a sampling net downstream to capture disturbed organisms. Other supporting variables are also collected. For example, water quality samples are analyzed for major ions, nutrients, and metals. Physical measures are taken, such as water temperature, pH, and clarity. Other variables are sediment quality, the depth of the water, the sizes of rocks and sand on the river bottom, and the types of plants growing near the river banks.

April 1, 2018 to March 31, 2019

Benthic macroinvertebrates were sampled from the Slave and Hay rivers near the Alberta-NWT border for a second year in the summer of 2018. In the Hay River, a decline in overall number was observed in 2018 at several sites compared to the 2017 samples. The 2018 Hay River samples had a larger proportion of molluscs and worms and fewer mayflies than the 2017 samples. While 2017 was closer to a normal year in terms of water level and flow on the Hay River, the water levels in 2018 were at or below the recorded minimum. The differences observed between the two years were partially attributed to the differences in flow between years.

Figure 1. Annie Levasseur, Chris Cunada, and Brianna Levenstein (University of New Brunswick) are disassembling and sieving invertebrate samples from Hester-Dendy samplers.

Figure 2. ENR and Smith's Landing First Nation's staff are collecting and processing benthic macroinvertebrate samples through a kick sampling technique in the Slave River.

At many of the Slave River sampling sites in 2017 and 2018, there were differences in the total number and the different types of benthic macroinvertebrates. There was not a consistent increase or decrease, though. In general, there was a lower number of invertebrates in 2018 than in 2017, particularly in true flies.[2] The variability likely is related to the differences in water flow between the two years. More data are required to understand the relationships between flow and benthic macroinvertebrate community structure.

A passive sampling method using Hester-Dendy samplers was also tested for a second year in 2018 (Figure 1). Hester-Dendy samplers are devices that remain in the water in one location for an extended period of time and collect organisms as they flow through.

Hester-Dendy sample results were more similar across the two rivers than were the kick samples, indicating that kick sampling can better distinguish between the two rivers and suggesting that Hester-Dendy samples are biased towards collecting mayflies, stoneflies, and caddisflies. Although the Hester-Dendy samplers successfully collected a variety of benthic macroinvertebrates, the CABIN method captured a broader range of benthic macroinvertebrates (Figures 2 and 3). These included mayflies, stoneflies, caddisflies, true flies, and non-insects such as worms and molluscs. ECCC Environmental Effects Monitoring guidance recommends that passive sampling should only be used in situations where methods such as kick sampling cannot be used because passive samplers are less effective at capturing representative samples (ECCC 2010). Since kick sampling was effective in the rivers and collected more species than Hester-Dendy samplers, the comparison between the two sampling methods suggests that kick sampling is a technique better suited to detecting change over time.

[2] *True flies are insects with one pair of wings. They include mosquitos, black flies, crane flies, and horse flies. The larvae of true flies are very abundant in our lakes and rivers.*

April 1, 2019 to March 31, 2020

Benthic macroinvertebrates were sampled from the Slave and Hay rivers near the Alberta-NWT border for a third year in the summer of 2019.

In the Hay River, sampling took place following a surge in flow, which led to very high water levels and caused some of the sampling sites to be flooded. Some aspects of sampling could not be completed at some sites where water levels were too high.

In general, the number of macroinvertebrates collected in the Hay River was significantly lower in 2019 than in 2017 or 2018. The fewer bugs at the sites in 2019 may be the result of sampling at locations that had only been recently submerged a few weeks prior to sampling. The proportion of true flies was higher than previous years and the proportion of molluscs was greatly reduced. This was likely due to the high water level at the time of sampling (Figure 3).

In the Slave River, the total number of benthic macroinvertebrates was lower in 2019. There was a clear relationship between number and water flow, with numbers higher at sites that had a higher flow. There was a very low proportion of true flies in 2019 and a higher proportion of species that like fast-flowing water, such as mayflies, caddisflies, and especially stoneflies (Figure 3). The number of different species found was lower than in 2017, but similar to 2018.

Over the three years, 2017 to 2019, the differences in water levels and flows appeared to be the main reason for changes in benthic macroinvertebrates. The result was more variation in total number and species between years for both the Hay and Slave rivers.

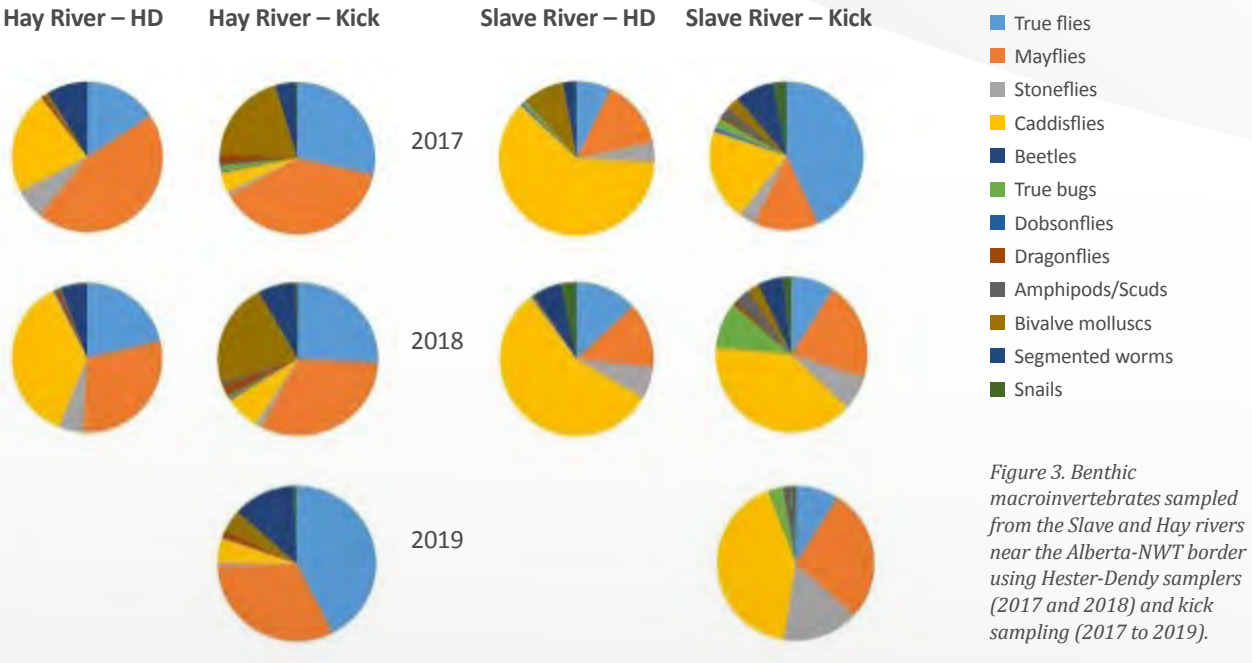

Figure 3. Benthic macroinvertebrates sampled from the Slave and Hay rivers near the Alberta-NWT border using Hester-Dendy samplers (2017 and 2018) and kick sampling (2017 to 2019).

Fish Monitoring

The development of monitoring plans for large and small-bodied fish in the Slave and Hay rivers is a priority. The intent of the monitoring plans is to collect additional baseline information and track the status and conditions of fish health over time. This will help to assess ecosystem health and get an early warning of change or stress in the environment.

April 1, 2018 to March 31, 2019

Development of a transboundary fish monitoring program on the Slave River began with a review of existing and historical fish monitoring studies. In addition, meetings were held with traditional knowledge holders, community members, and scientific experts to discuss program design.

A workshop was held in March 2019 in Fort Smith, to discuss the design of the program with the Slave River and Delta Partnership (SRDP). The SRDP includes Indigenous and municipal governments, federal and territorial government agencies, non-government organizations, and academic institutions.

April 1, 2019 to March 31, 2020

Engagement about the development of a pilot monitoring program for large and small-bodied fish continued in spring 2019. This included a meeting with the Great Slave Lake Advisory Committee, and discussions with traditional knowledge holders, community members, and scientific experts. Input gathered from the workshops and meetings helped shape the design of the pilot fish monitoring program.

Fish sampling in the Slave River near Fort Smith and Fort Resolution was conducted between September 16 and 22, 2019. Sampling was done by NWT community members, the University of Saskatchewan, Wilfrid Laurier University, and GNWT employees. Large-bodied fish species collected included lake whitefish, walleye, and jackfish (Table 1). Small-bodied fish species included trout-perch and young-of-the-year slimy sculpin. Burbot sampling was scheduled for December 2019 but was postponed due to unsafe ice conditions.

Indicators selected as part of the pilot monitoring program for large-bodied fish consist of condition factor, irregularities, levels of metals, presence of polycyclic aromatic hydrocarbons (PAHs) and other chemicals, and the number of different species.

Tissue chemistry samples were collected to indicate if there were changes to exposure to metals, PAHs, polychlorinated biphenyls, dioxins, and furans in fillets, and PAHs in bile. Liver tissue was also collected for enzyme analysis to indicate exposure to PAHs.

Location	Species	Male	Female
Fort Smith	Lake whitefish	17	11
	Walleye	15	18
	Jackfish	4	18
Fort Resolution	Lake whitefish	20	11
	Walleye	23	7
	Jackfish	8	18

Table 1. Fish collected during the 2019 fall sampling.

Figure 4. Seine fishing.

The Slave River fish monitoring program is designed to allow comparisons with results from the upstream Oil Sands Monitoring Program on the Athabasca River. The Slave River fish program also allows comparisons with monitoring that has been conducted previously on the Slave River. This includes collections under the Slave Watershed Environmental Effects Program from 2010 to 2014, the Slave River Environment Quality Monitoring Program in the early 1990s, and the Mackenzie River Basin studies in the late 1970s. Small-bodied fish collection of trout-perch[3] also provides comparisons with collection under the upstream Oil Sands Monitoring Program on the Athabasca River and its tributaries.

Condition factor (100 x weight/length^3) is a body mass index and is one of the indicators used to monitor fish health. In Figure 4, the shaded area represents the historical "normal range," calculated as two standard deviations from the baseline data.

Initial analyses show that, in 2019, female walleye weighed less, and the liver sizes in female whitefish were smaller, compared with historical data. All other indicators were within normal range.

Levels of mercury and other metals were within consumption guidelines. Analyses for organic compounds typically take longer for analysis and have been delayed because of laboratory closures due to the COVID-19 pandemic.

Members from Smith's Landing First Nation attended the Fort Chipewyan whitefish camp in the fall of 2019. Whitefish in the Peace-Athabasca Delta were sampled for various health indicators. Through participation in the Fort Chipewyan fish camp, Smith's Landing representatives experienced both the science and the traditional knowledge aspects of fish monitoring. They later used the experience to design a similar fish camp for the Slave River near the Alberta-NWT border in fall 2020.

[3] *Trout-perch is a small-bodied fish that is used as an indicator species in the Athabasca for the Oil Sands Monitoring Program.*

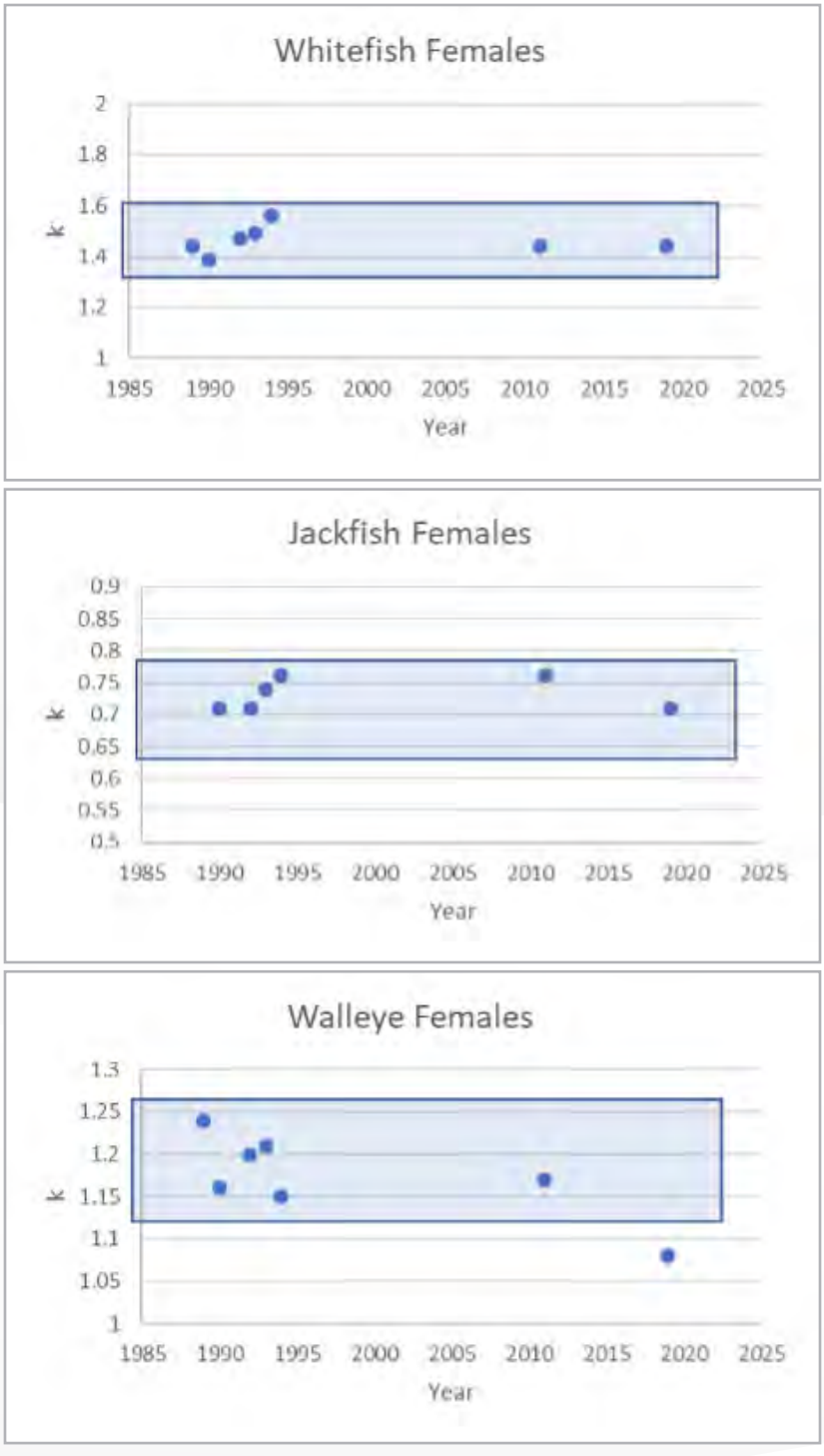

Figure 5. Condition factor of female large-bodied fish species from the Slave River historical collections during the early fall, compared to 2019 sampling.

Data Review: Water, Sediment, and Food-web Interactions of Metals, Nutrients, and PAHs in the Slave River

A review of the data from historical and ongoing studies and monitoring programs was completed. The purpose was to determine to what extent metals, nutrients, and PAHs may be accumulating in the aquatic system of the Slave River.

The review found that even though levels from those substances have been assessed in different parts of the aquatic ecosystem, including water, sediment, fish, benthic invertebrates and aquatic mammals, there are not enough data available to determine if there are changes in the way these substances enter, stay within, leave or move between those different parts of the aquatic ecosystem.

April 1, 2018 to March 31, 2019

In 2018, a project began to review previous and ongoing monitoring programs and studies to determine if the data collected from the different components of the aquatic ecosystem can be compared. During the initial phase of the project, datasets available from different studies since the 1980s were gathered and assessed for compatibility.

Datasets and studies were compatible if they took place during the same time period (e.g., day, month, season, or year), at or near the same location, and if they used the same sampling and lab analysis methods.

April 1, 2019 to March 31, 2020

As part of the second phase of the project, the data review was completed. The conclusion was that there are many knowledge and data gaps, and further studies are needed to be able to assess movement of metals, nutrients, and PAHs from water and sediment to plants and animals in the Slave River.

Although historical studies provided valuable information, the studies were conducted by different groups, trying to answer different questions, at different places and different times, using different methods. Key data gaps were identified, especially the limited data on metals and PAHs in organisms that are at the bottom of the food web. These include algae and aquatic plants, as well as in the organisms that eat them, including benthic invertebrates and fish that feed on plants.

The review also identified monitoring strategies to evaluate the distribution and movement of metals and PAHs, and their storage between water, sediment, and the food web.

Next Steps

Monitoring for benthic macroinvertebrate communities on the Slave and Hay rivers (Year 4)

Due to the variability in the benthic macroinvertebrate communities collected during the first three years of sampling (2017-19), additional years of sampling will be required to understand the baseline condition of benthic macroinvertebrates in the rivers. Sampling is scheduled to take place in fall 2020 on both the Slave and Hay rivers. Building a strong baseline is essential to compare future sampling results and be able to detect change over time.

Monitoring for large and small-bodied fish on the Slave and Hay rivers (Year 2)

Fish monitoring on the Slave River will continue in 2020 and will align with the work being conducted further upstream on the Peace and Athabasca rivers under the Oil Sands Monitoring Program. Additional small-bodied fish will be collected on the Slave River in the fall of 2020 using a vertical net called the seining method. Smith's Landing First Nation is planning to host a fish camp on the Slave River near the Alberta-NWT border in the fall of 2020.

What is statistical significance?

When we analyze data, we want to be sure that the findings are real and can't be explained by chance alone. When samples are used to analyze something, there is a possibility that the results include a sampling error or a sample that contains something that occurred simply by chance.

To make sure that the results mean what they imply, the data are mathematically tested for statistical significance. When results are statistically significant, there is greater certainty that the results are meaningful and represent the overall situation.

Another large-bodied fish, white suckers, are being considered for the Slave River fish monitoring program. White suckers could be used as an indicator species since they are one of the key monitoring species in the Oil Sands Monitoring program. They have also been successfully used as an indicator species in other monitoring programs across Canada. Work, with Smith's Landing First Nation to catch white suckers in the Salt River, a tributary to the Slave River, is planned for the spawning run in spring 2020.

Fish monitoring work will also expand to include some preliminary sampling on the Hay River in fall 2020 for both small and large-bodied fish. In addition, discussions with communities will assist in developing a future fish monitoring program for the Hay River.

Traditional Knowledge

The implementation of the Agreement is intended to have meaningful and respectful inclusion of traditional and local knowledge for decision making (Alberta-NWT Bilateral Management Agreement Appendix C – Use of Traditional and Local Knowledge).

April 1, 2018 to March 31, 2019

A Traditional Knowledge Working Group was established with membership from NWT, Alberta, and Indigenous governments and organizations within the geographic scope of the Agreement. Terms of reference were developed to guide the work of the group. The working group met regularly during the year.

April 1, 2019 to March 31, 2020

The Traditional Knowledge Working Group engaged consultants to conduct a comprehensive review of existing frameworks, best practices, or guidelines regarding traditional knowledge in decision making. The report offered seven recommendations for the development of a framework for the inclusion of traditional knowledge in the implementation of the Agreement.

The report, A Review of Traditional Knowledge Frameworks for Bilateral Water Agreement Decision Making, is publicly available online at https://www.enr.gov.nt.ca/sites/enr/files/resources/review_of_tk_frameworks_for_bwma_decision_making_barnaby_consulting_march_2020.pdf.

Next Steps

- Co-develop and implement learning plan activities with the Traditional Knowledge Working Group and interested Indigenous communities, exploring processes and tools that support meaningful inclusion and application of traditional knowledge in the implementation of the Agreement.
- Prepare a draft traditional knowledge framework that honours knowledge holders and offers respectful pathways of braiding knowledge systems for the implementation of the Agreement.

Surface Water Quantity

Alberta and the NWT have committed to developing site-specific objectives that ensure that the needs of the aquatic ecosystem are met before any water is taken for human use. The amount remaining for human use is referred to as "available water" and is shared equally between Alberta and the NWT.

Objectives and Triggers

At present, the amount of water used by Alberta and the NWT in the Slave River basin is very small compared to the total amount flowing across the border. It was therefore agreed that Alberta and NWT would consider developing objectives and triggers for the Slave River when a significant increase in human use and/or decrease in flow occurred.

Specifically:

- Annual volume licensed for use in Alberta reaches two billion cubic metres (m^3);
- Two billion cubic metres becomes significantly different from 1.9% of the long-term average annual streamflow; or
- 50% of the volume licensed for use in Alberta is for use outside of the Mackenzie River basin.[4]

For the Hay River, an interim objective and two interim triggers were set. The interim objective is for 95% of the natural flow to pass from Alberta to the NWT each month. Natural flow is the amount of water if no water is removed or diverted.

Trigger 1 is exceeded if the volume of water licensed for use by Alberta in the Hay River watershed is greater than 2.5% of the natural flow at the border (i.e., 50% of Alberta's share of water) in at least one month. If Trigger 1 is exceeded, Trigger 2 is checked. Trigger 2 is exceeded if the water actually used is greater than 4% of the monthly natural flow (i.e., 80% of Alberta's share of water).

Quantity Monitoring and Assessment

Streamflow is the amount of water that moves past a specific location over a certain period of time. It has been measured continuously on the Slave River near the Alberta-NWT border since 1959[5] and on the Hay River at the Town of Hay River since 1963.

January 1 to December 31, 2018

Total annual streamflow in the Slave River was lower than average (93% of normal). The annual volume of water licensed for use was 1.2 billion m^3, well below the 2.0 billion m^3 threshold (Figure 6). The threshold remained at 1.9% of the long term average annual streamflow.

Total annual streamflow in the Hay River was lower than average (59% of normal). Trigger 1 was exceeded in January, February, March, April, November, and December. Trigger 2 was not exceeded in any month (Figure 5).

[4] *The Alberta-NWT Bilateral Water Management Agreement specifies that a licence to transfer water into or out of the Mackenzie River Basin will not be issued in Alberta, unless the licence is specifically authorized by a special act of the legislature. Even then, flow requirements at the Alberta-NWT border and the information, notification and consultation requirements still must be met.*

January 1 to December 31, 2019

Total annual streamflow in the Slave River was slightly lower than average (88% of normal). Annual volume licensed for use was 1.3 billion m^3, well below the 2.0 billion m^3 threshold (Figure 7). Two billion m^3 remained at 1.9% of the long-term annual average streamflow.

Total annual streamflow in the Hay River was much lower than average (39% of normal). Trigger 1 was exceeded in January, February, and March. Trigger 2 was not exceeded in any month (Figure 8).

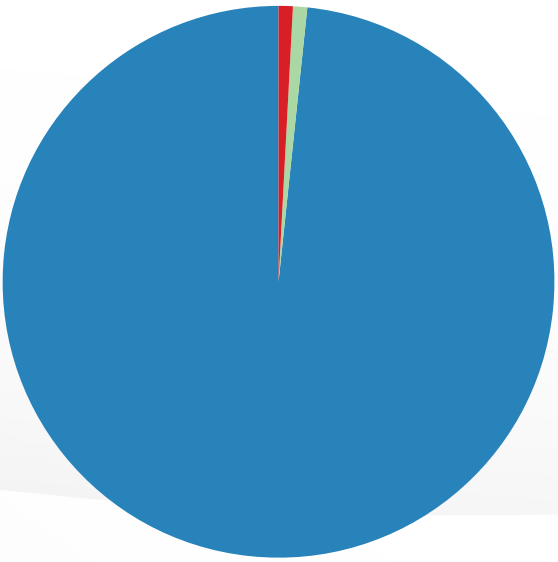

Figure 6. Alberta's 2018 volume licensed for use as a percentage of Slave River average annual flow.

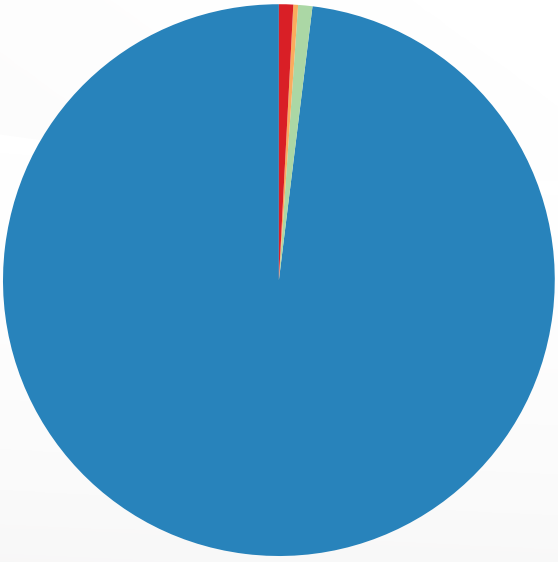

Figure 7. Alberta's 2019 volume licensed for use as a percentage of Slave River average annual flow.

[5] *Continuous monitoring on the Slave River began in May 1959. The first full year of data was 1960.*

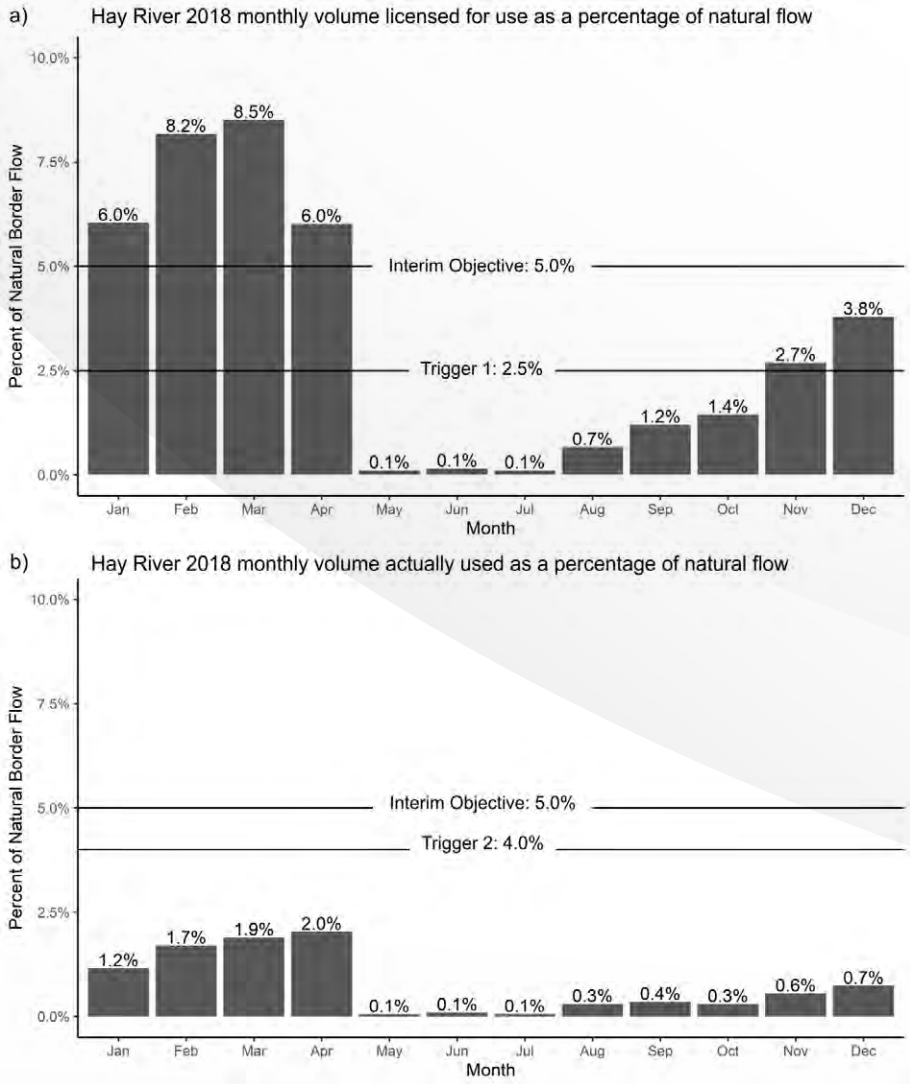

Figure 8. Hay River 2018 analysis of Trigger 1 and Trigger 2.

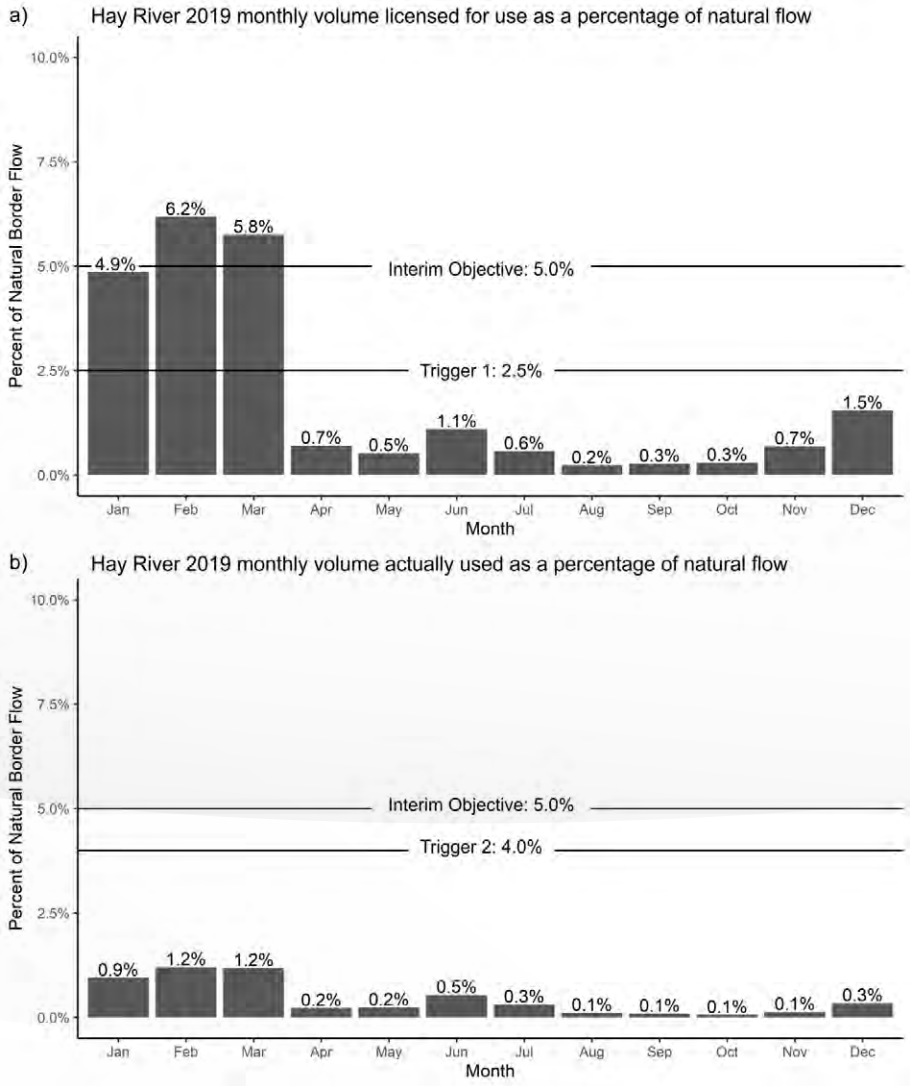

Figure 9. Hay River 2019 analysis of Trigger 1 and Trigger 2.

Ongoing Work and Next Steps

Alberta and the NWT will:

- Continue to track and report daily flow conditions for the Slave and Hay rivers compared to historical flows.
- Continue to compare flow and water use data to the interim triggers for the Hay River.
- Continue to track and report on the licensed use threshold (annual amount licensed for use and recorded flow) for the Slave River.
- Continue to track and report transfers of water for use outside of the Mackenzie River basin.
- Refine the methods for calculating use and natural flow when needed.
- Participate in work led by the Government of Canada, along with Indigenous partners, the Government of British Columbia, and BC Hydro, to support implementation of the Wood Buffalo National Park Action Plan.

Surface Water Quality

Water quality can be affected by both human activities and natural processes. Surface water quality is assessed by testing for the presence and amount of certain substances. Some of these, such as pesticides associated with agricultural activities, are human-made pollutants. Others, such as chloride, are found in small amounts naturally but can have negative effects at high levels.

Water Quality Objectives

A water quality objective is a value that Alberta and the NWT agree to meet for water quality parameters in the Slave and Hay rivers. A parameter is a specific substance that we measure in water, such as calcium. While water quality objectives are being developed, triggers based on historical data are being used to determine if the water quality is changing.

Water Quality Triggers

Water quality triggers are values calculated using historical data for a particular parameter. The Slave and Hay river seasonal, site-specific, water quality triggers, which are based on percentiles, are set to identify early changes in water quality conditions.

Two kinds of triggers are used to evaluate water quality. Trigger 1 (50th percentile) is used to assess changes over time. Trigger 2 (90th percentile) is used to highlight new values that are higher than what is expected. When a value is above a trigger, an action is prompted, such as confirmation of change and exploring what the cause may be.

Work Completed

Between April 1, 2018 and March 31, 2020, the following tasks were completed:

- Assessment of the 2018 and 2019 surface water quality data for the Slave and Hay rivers;
- Collection of samples from the Hay River for future trigger development for mercury in 2022;
- Development of an interim site-specific trigger for mercury for the Slave River; and
- Establishment of a water quality task team to discuss various methods to assess water quality in transboundary rivers throughout the Mackenzie River Basin.

Data Analysis Results

Slave River – January 1 to December 31, 2018

In 2018, samples were collected by Environment and Climate Change Canada (ECCC) from the Slave River at Fitzgerald on nine occasions. Sixty-six parameters were analyzed in each sample.

Under Trigger 1, 46 of the 66 parameters were flagged for further assessment. Of the 46 parameters flagged, alkalinity, specific conductance, dissolved calcium,

What is a percentile?

A percentile is a value below which a certain proportion of observations fall. For example, if the 90th percentile for dissolved sodium is 15.9mg/L, then 90% of the observations have a sodium concentration of 15.9mg/L or less. Since percentiles are based on observations that have been measured in the past, triggers are very conservative values. Not all observations above a trigger signal a concern, but rather can highlight those parameters that should be examined further to determine whether or not change is occurring.

dissolved magnesium, dissolved sulphate, nitrate/nitrite, and dissolved strontium were also flagged in 2015, 2016 and 2017.

Under Trigger 2, 32 of the 66 parameters were flagged for further assessment. Of the 32 parameters flagged, dissolved magnesium and dissolved sulphate were above their historical seasonal maximum values and nitrate/nitrite, dissolved sodium, dissolved cobalt, and dissolved lithium were above their historical overall maximum values.

Slave River – January 1 to December 31, 2019

In 2019, samples were collected by ECCC from the Slave River at Fitzgerald on nine occasions. Sixty-eight parameters were analyzed in each sample.

Under Trigger 1, 25 of the 66 parameters were flagged for further assessment. Of the 25 parameters flagged, alkalinity, specific conductance, dissolved calcium, dissolved magnesium, dissolved sulphate, nitrate/nitrite, and dissolved strontium were also flagged in 2015, 2016, 2017 and 2018.

Under Trigger 2, 17 of the 66 parameters were flagged for further assessment. Of the 17 parameters flagged, alkalinity and dissolved magnesium were above their historical seasonal maximum values and nitrate/nitrite was above its historical overall maximum value.

Hay River – January 1 to December 31, 2018

In 2018, samples were collected by ECCC from the Hay River near the Alberta/NWT border on three occasions. Forty parameters were analyzed in each sample.

Under Trigger 1, three of the 40 parameters were flagged for further assessment. Of the three parameters flagged, nitrate/nitrite was also flagged in 2016 and 2017. Total antimony and total selenium were flagged for the first time.

Under Trigger 2, 29 of the 40 parameters were flagged for further assessment. However, none of these were above their historical seasonal maximum values.

Hay River – January 1 to December 31, 2019

In 2019, samples were collected by ECCC from the Hay River near the Alberta/NWT Border site on four occasions. Forty parameters were analyzed in each sample.

Under Trigger 1, two of the 40 parameters were flagged for further assessment. Of the two parameters flagged, nitrate/nitrite was also flagged in 2016, 2017 and 2018. Total molybdenum was flagged for the first time.

Under Trigger 2, one of the 40 parameters was flagged for further assessment. That parameter, nitrate/nitrite, was not over its historical seasonal maximum value.

Surface Water Quality Assessment

To enhance the water quality assessment for the Slave and Hay rivers, the 2018 and 2019 water quality data for each river were presented together. This provided an opportunity to explore the data slightly differently than in previous years. Using more robust statistics resulted in useful information about the status and trends of water quality in each river.

Slave River 2018 and 2019 ▶ Trigger 1

Statistically significant increasing trends were revealed for alkalinity, dissolved magnesium, dissolved sulphate and nitrate/nitrite. This suggests that the levels of these four parameters are higher today than when consistent monitoring began in the Slave River. Figures 9-12 show the levels of alkalinity, dissolved magnesium, dissolved sulphate, and nitrate/nitrite in the Slave River over time.

To explore these parameters further, we looked for trends in the latter half of the dataset, 2000-2019. Increasing trends were found for alkalinity and dissolved magnesium, but not for dissolved sulphate. This suggests that, while sulphate levels are higher today compared to the early days of monitoring, dissolved sulphate levels in the Slave River seem to be stable for the last two decades.

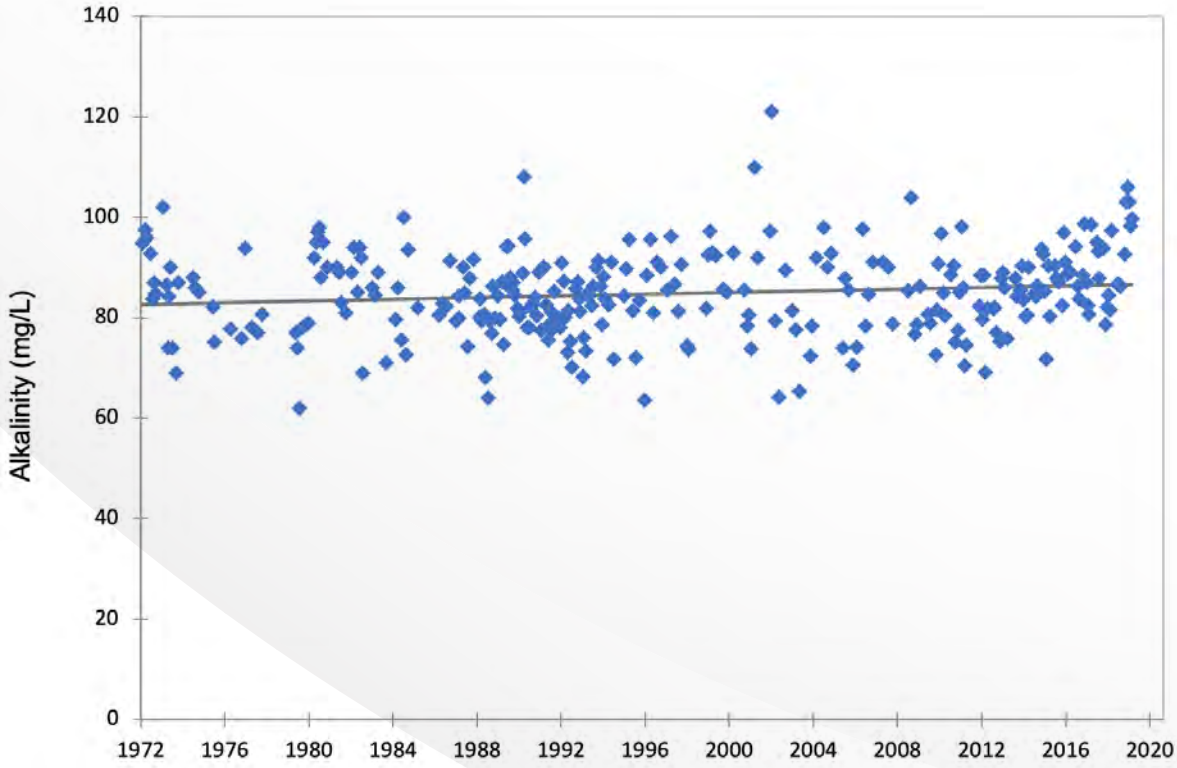

Figure 10. Levels of alkalinity in the Slave River at Fitzgerald between 1972 and 2019.

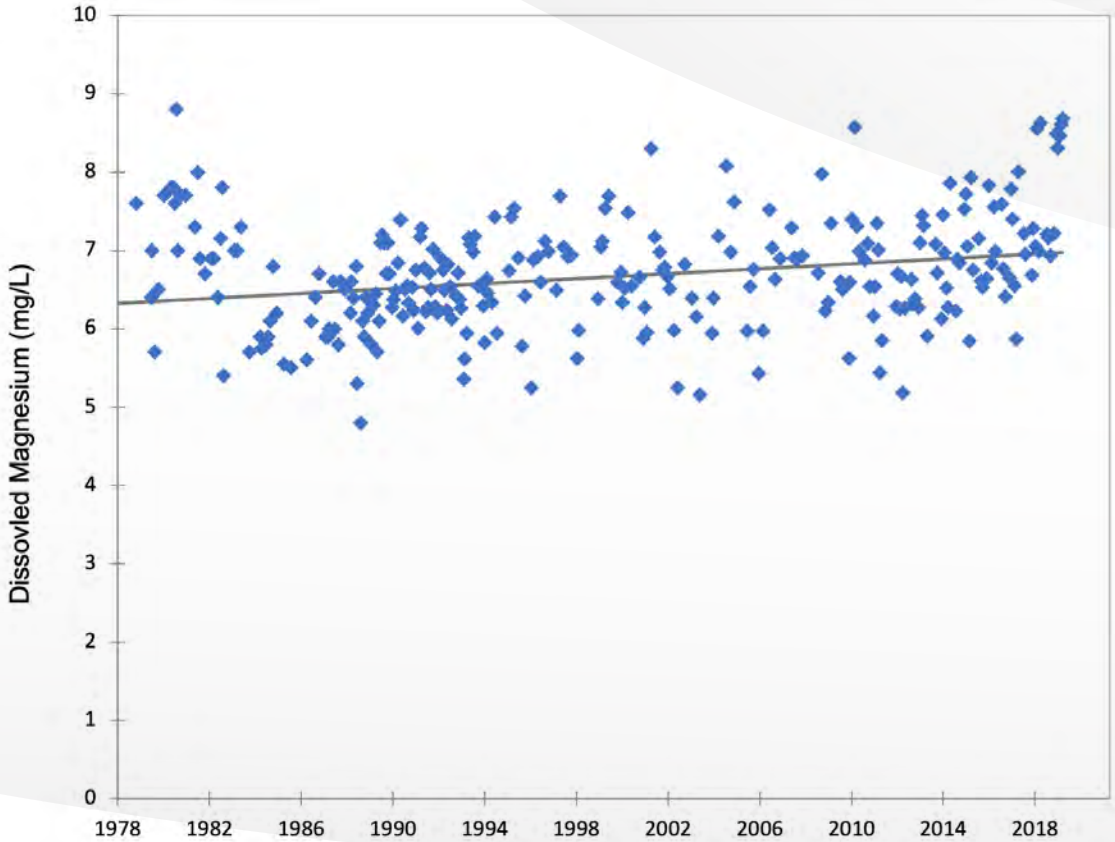

Figure 11. Levels of dissolved magnesium in the Slave River at Fitzgerald between 1978 and 2019.

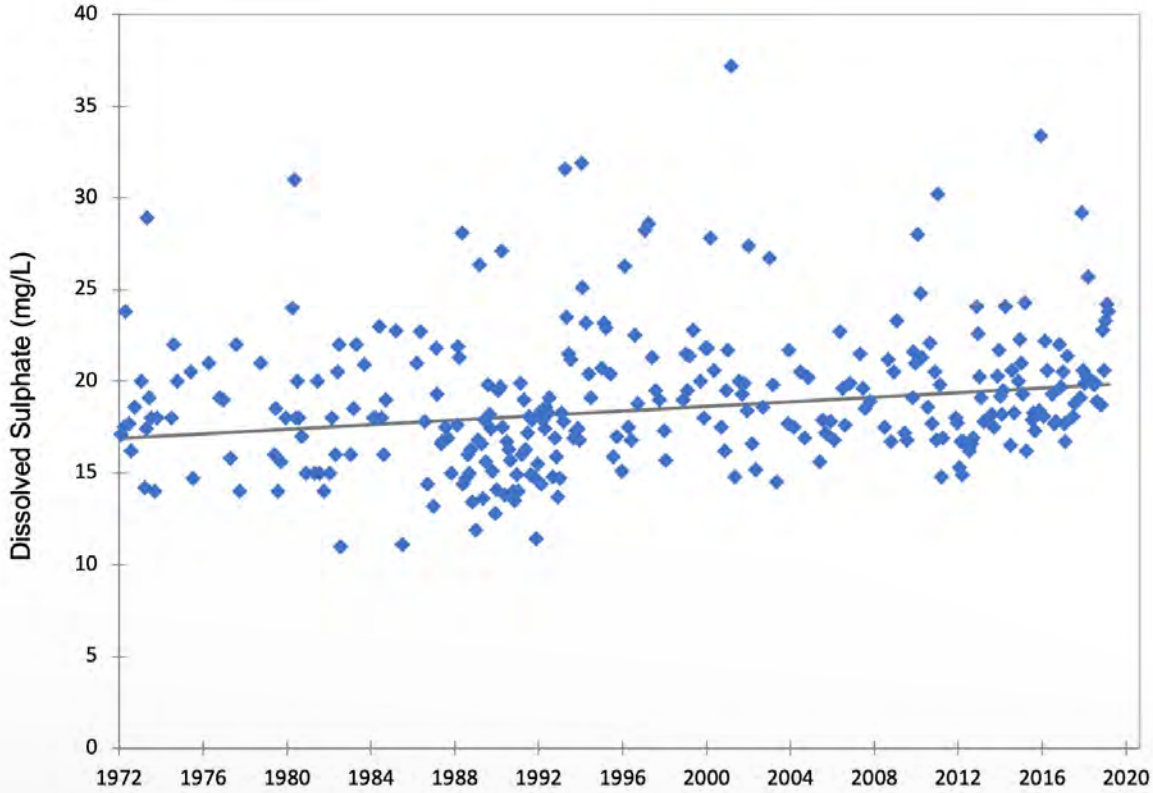

Figure 12. Levels of dissovled sulphate in the Slave River at Fitzgerald between 1972 and 2019.

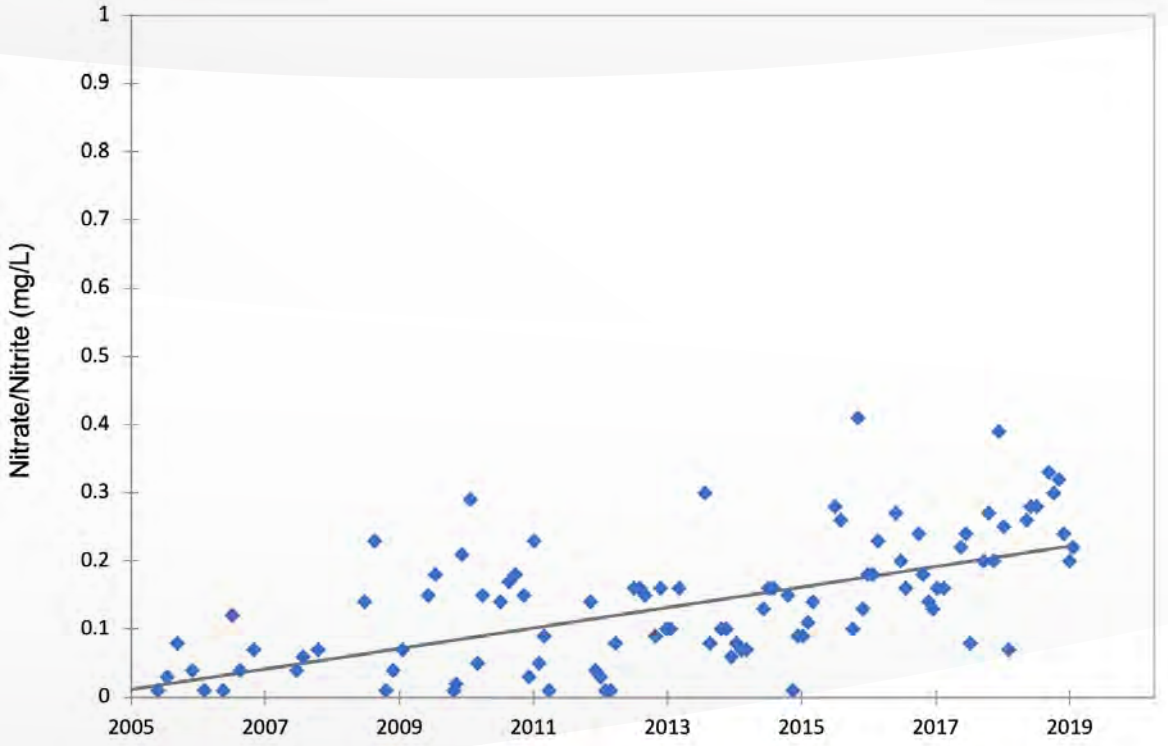

Figure 13. Levels of nitrate/nitrite in the Slave River at Fitzgerald between 2005 and 2019.

To understand changes in Slave River alkalinity, dissolved magnesium, and nitrate/nitrite levels, we looked at data from upstream water quality sites. Reviewing the water quality data from the Athabasca and Peace Rivers can help explain water quality conditions in the Slave River.

Similar to the Slave River, increasing trends were found in the Peace River for alkalinity and dissolved magnesium. No other trends were found from two upstream sites at Peace River at Peace Point and Athabasca River at Baseline 27. Given that the Peace River contributes almost 80% of the water to the Slave River, it is likely that changes in Peace River alkalinity and dissolved magnesium levels are influencing the levels of these two parameters in the Slave River. The Bilateral Management Committee will continue to work to better understand these changes and ensure that monitoring of these parameters continues and is uninterrupted.

Trigger 2

Four parameters – alkalinity, dissolved magnesium, dissolved sulphate, and nitrate/nitrite – were above their historical open water maximum values in 2018 and 2019. These parameters are among those that have repeatedly exceeded Trigger 1 each year since 2015. These parameters will continue to be monitored as noted previously and the Bilateral Management Committee will discuss methods to assess what the cause of these increases may be.

Two parameters, dissolved cobalt and dissolved lithium, were above their overall historical maximum values in 2018. When the Agreement was signed in 2015, there were too few historical data to calculate

triggers for dissolved metals. However, in order to have some kind of benchmark for the dissolved metal results, preliminary interim triggers were calculated. In the future, as more data become available, the triggers will be recalculated for all dissolved metals resulting in more meaningful values in which to compare future results. This highlights the need for a minimum number of data points prior to calculating site-specific guidelines to assess change in water quality.

Lastly, a dissolved sodium value in August 2018 was above its overall historical maximum value. Dissolved sodium data were reviewed from two other Slave River monitoring programs conducted by the GNWT in August of 2018 and the values were within the range of normal.

Hay River 2018 and 2019 ▶ **Trigger 1**

Statistically significant increasing trends were revealed for nitrate/nitrite, suggesting that levels are higher today than when consistent monitoring began in the Hay River in 2005. Figure 13 shows the levels of nitrate/nitrite in the Hay River between 2005 and 2019.

At this time, there is no water quality monitoring upstream of the Hay River transboundary sampling site. As a result, we could not review upstream data to help explain downstream water quality conditions. However, since nitrate/nitrite levels appear to be increasing in both the Slave and Hay Rivers, the reported trends are possibly part of a broader regional pattern. Monitoring and further analyses will occur in the upcoming years.

▶ **Trigger 2**

All flagged parameters were within the historical seasonal range of water quality.

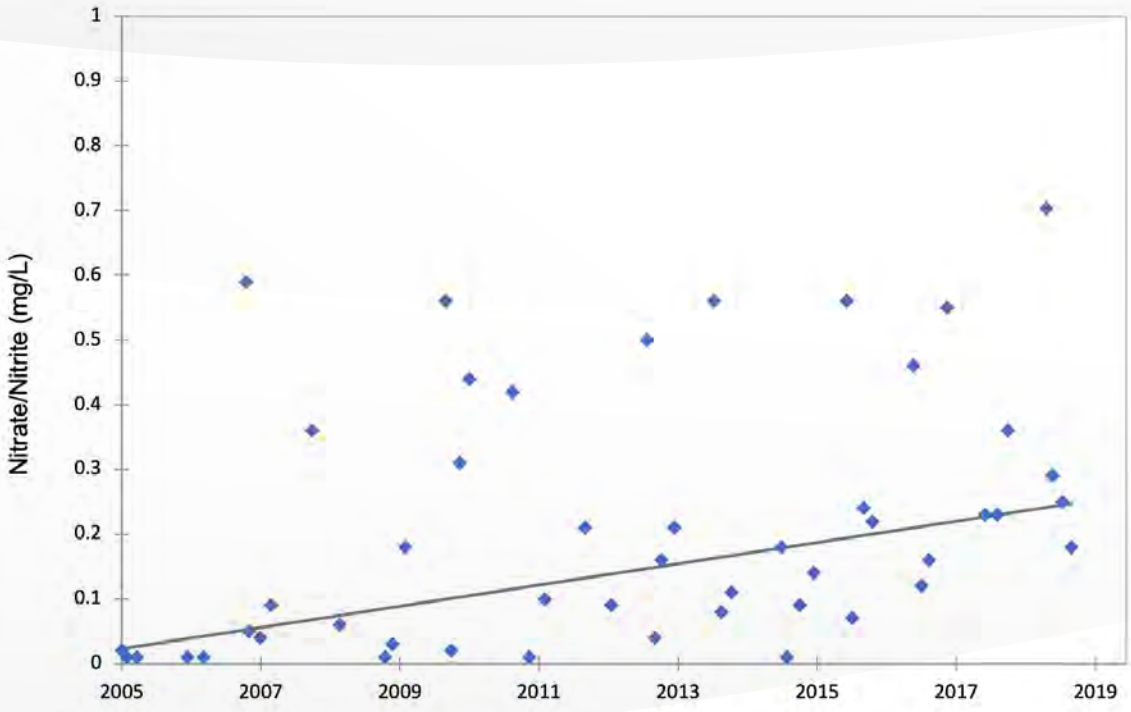

Figure 14. Levels of nitrate/nitrite in the Hay River near the Border between 2005 and 2019.

Mercury

When the Agreement was signed in 2015, insufficient data were available to develop water quality triggers for mercury. Because mercury is toxic and can accumulate in organisms, the collection and analysis of mercury samples became a priority. The sampling campaign has led to the development of interim open water triggers for total and dissolved mercury for the Slave River. These triggers were used to assess mercury levels in 2018 and 2019. Triggers for the Hay River are now being developed and will be applied to the data in 2022..

Water samples are analyzed for both total mercury (THg), which includes all forms of mercury in a sample, and dissolved mercury (DHg), which includes methylmercury (MeHg), the toxic form of mercury that can bioaccumulate and biomagnify in food webs. This means that it can transfer between and build up in plants and organisms.

Figures 14 and 15 include a red line showing the amount of mercury in water considered safe for fish and aquatic life, according to the Canadian Environmental Quality Guidelines. The yellow lines show the interim trigger values.

Figures 14 and 15 show mercury levels in the samples collected throughout 2018 and 2019 from the Slave River. To date, all total mercury values are below the guideline (26 ng/L) and Trigger 2 (23 ng/L) except for one sample collected in July 2019 (30 ng/L).

The Health Canada drinking water quality guideline for total mercury is 1,000 ng/L. All total and dissolved values in the Slave and Hay Rivers are well below this level.

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. 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 continuing risk to the environment.

In 2018 and 2019, under the GNWT's sampling program, two samples were collected from the Slave River and two from the Hay Rivers. The samples were analyzed for 15 of these kinds of substances. Although some were detected in each river, concentrations were very low and below levels that could be harmful to aquatic life.

Next Steps

Alberta and the NWT will:

- Review and assess the 2020 water quality data for the Slave and Hay rivers;
- Continue the mercury water quality sampling programs in the Slave and Hay rivers;
- Work with the Mackenzie River Basin Board Water Quality Task Team to review other methods to assess the water quality of the transboundary rivers throughout the Mackenzie River Basin; and
- Prepare a report that characterizes the different kinds of hydrocarbons that are present in the major transboundary rivers of the Mackenzie River Basin.

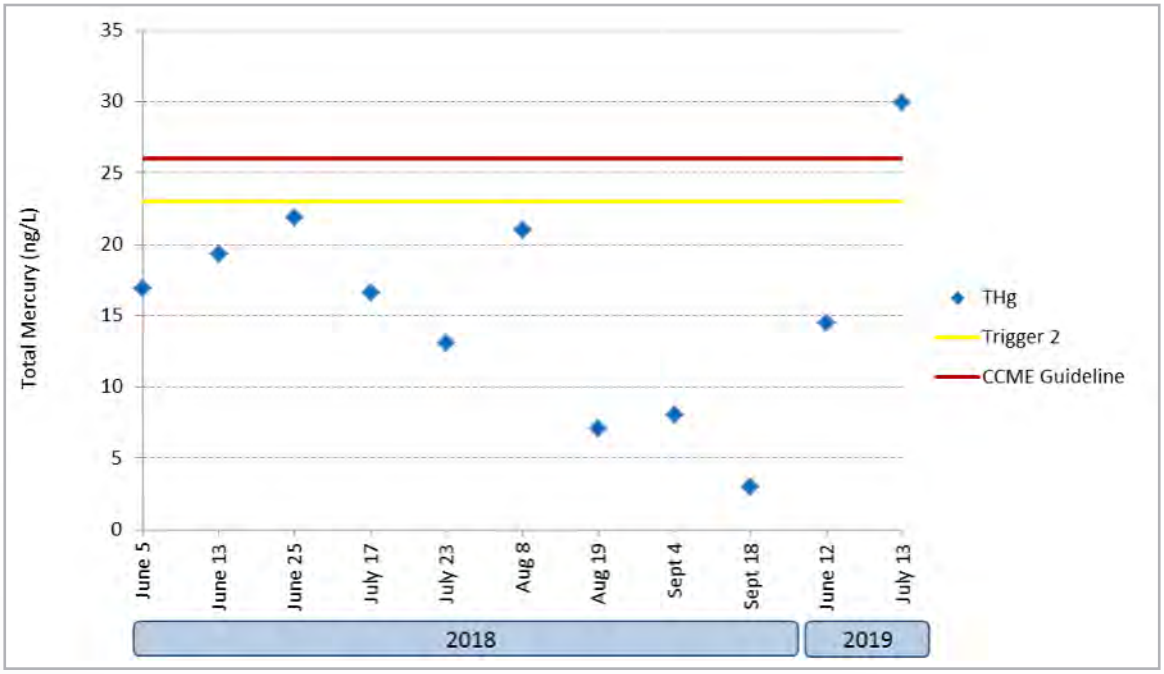

Figure 15. Levels of total mercury in the Slave River at Fort Smith in 2018 and 2019.

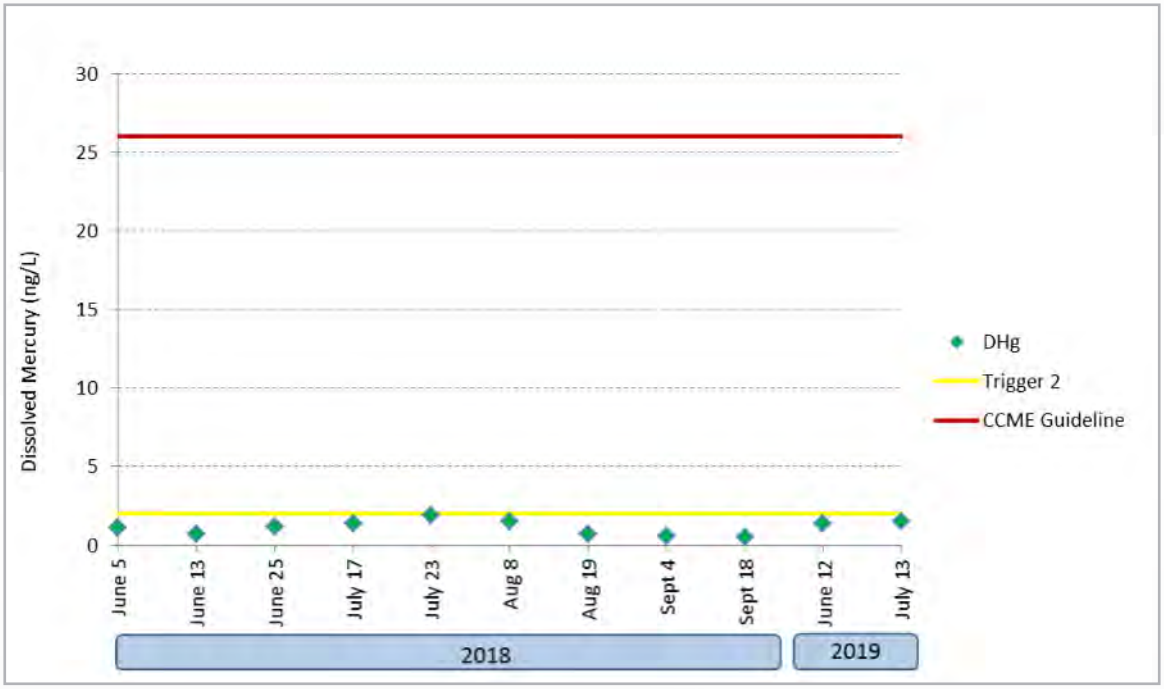

Figure 16. Levels of dissolved mercury in the Slave River at Fort Smith in 2018 and 2019.

Groundwater

Since groundwater is below the surface, it is difficult to identify and assess. The work of groundwater scientists with the Governments of Alberta and the NWT continues, and we are learning more about the location, quality, and quantity of our shared groundwater.

The locations and boundaries of most of the shared aquifers have not been mapped. Until the mapping and delineation of aquifers is complete, the surface water sub-basins of the Mackenzie River are being used as a substitute. A preliminary version of the shared groundwater areas, based on this method, is shown in Figure 16.

Since the information on groundwater is limited in the Hay River basin near the Alberta-NWT border, and there are some potential and existing developments in the basin, the Bilateral Management Committee agreed to increase the classification for the Hay River groundwater area from Class 1 to Class 2 to allow for more learning to take place.

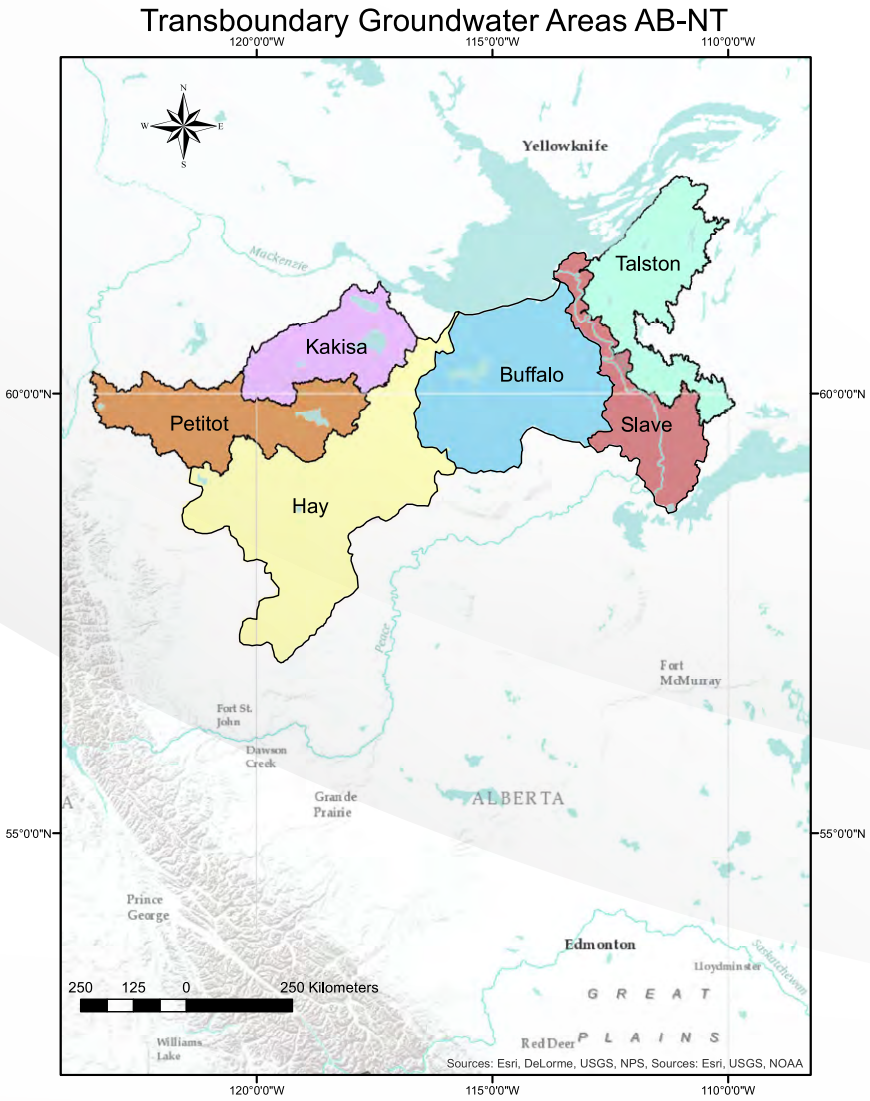

Figure 17. Alberta-NWT Transboundary Groundwater Areas.

Finding and Mapping Groundwater Aquifiers

April 1, 2018 to March 31, 2019

Sub-watersheds of the Kakisa, Petitot, Lower Hay, Buffalo and Little Buffalo rivers were used as the basis of the ongoing initiative to inventory and map aquifers.

A project began to assess the value of existing information about water, rock, and sediment below the surface for identifying aquifers. The objectives were to:

1. Describe existing groundwater-related information, including the information type, the data quality and usability, and the source and ownership of the information;
2. Evaluate existing groundwater-related information as a way of identifying the location and nature of aquifers in the Hay River and adjacent basins;
3. If existing information was suitable, complete a preliminary map of the boundaries of aquifers and their characteristics, flow directions and rates, and where groundwater and surface water interact in the Hay River and adjacent basins;
4. If existing information was deemed unsuitable to complete activities identified in Objective three, document the limitation of existing information and identify the required needs to complete the objective; and
5. Identify and prioritize efforts required for future aquifer mapping and research.

April 1, 2019 to March 31,2020

The project described above to assess the value of existing information for identifying aquifers was completed by the Alberta Geological Survey, in collaboration with Alberta Environment and Parks, and the Department of Environment and Natural Resources of the GNWT. One of the main findings of the project is that information, knowledge, and data availability on the subsurface conditions to support aquifer mapping across the Alberta-NWT border is variable. The Kakisa-Cameron Hills area (120°W to 117°30′W) has oil and gas well data available. The Hay River corridor (117°30′W to 116°W) has mainly water well and geophysical data (Figure 17). There is very little data of any type for the Wood Buffalo area (116°W to 112°30′W).

The greatest potential for aquifers is within the sediment that have settled in bedrock valley systems (Figure 18). The report highlights some gaps in data availability, as well as some differences in interpretation of sediment thickness data, that require further investigation.

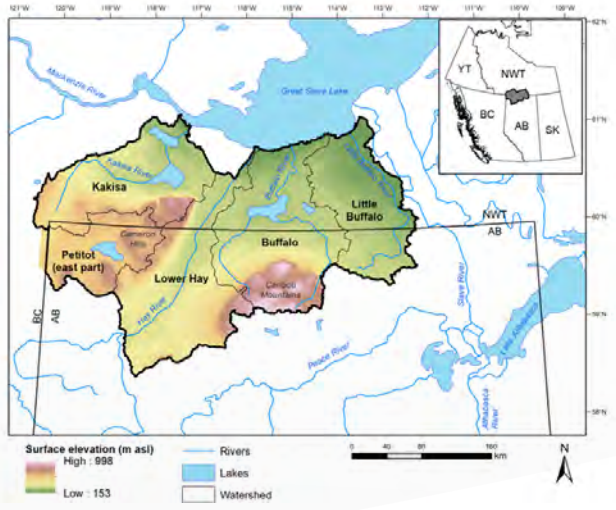

Figure 18. Location of the study area defined by watershed boundaries, shown with ground surface elevation. Inset map depicts the study area spanning Alberta and the Northwest Territories within western Canada.

The report recommended future work priorities and also addressed some of the elements identified in the Groundwater Learning Plan (Appendix H2 of the Agreement). The full report is available at https://www.ags.aer.ca/publications/OFR_2020_04.html.

The next phase of the project will start in 2020-2021, with the following objectives:

1. Map aquifers of the Hay River Basin;
2. Sample the Hay River during a low flow period for naturally occurring isotopic tracers as indicators of the hydrogeology of the Hay River corridor;
3. Re-evaluate the identified major buried valleys and the shallow sediment thickness in Alberta and Northwest Territories;
4. Gather available geophysical information about the Kakisa and Petitot River basins; and
5. Conduct measurements and geophysical surveys in the Kakisa-Cameron Hills area.

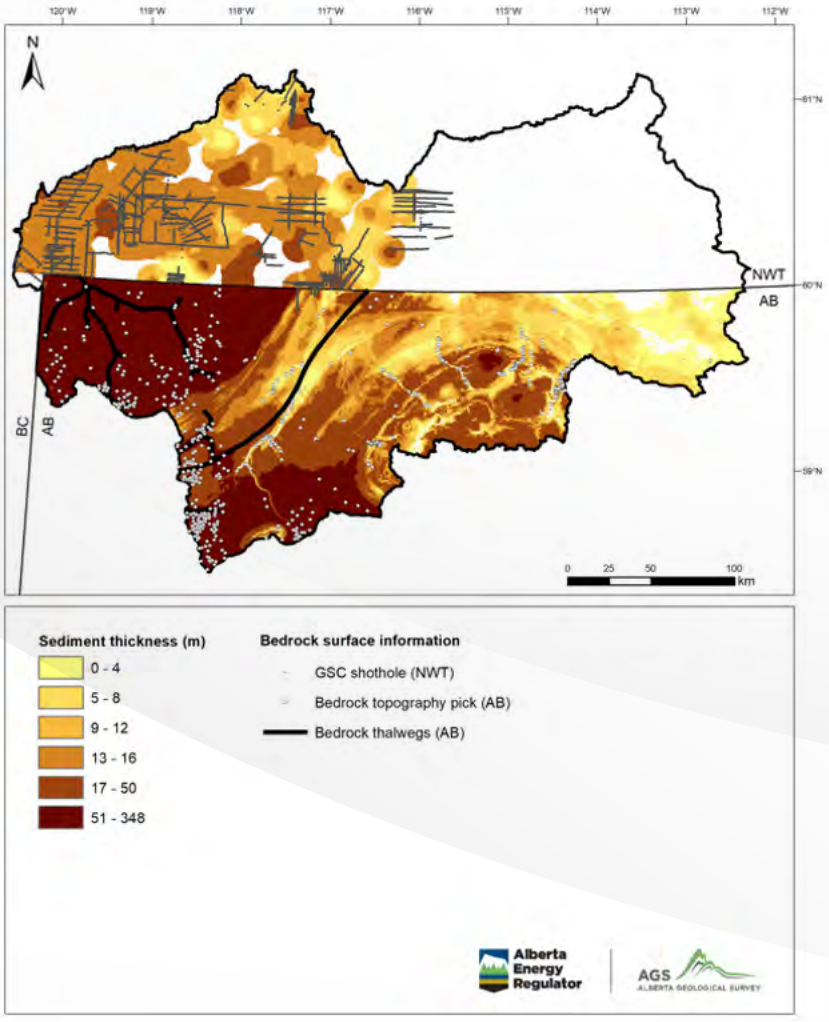

Figure 19. Modelled sediment thickness by the Alberta Geological Survey (2020) for Alberta and by Smith and Lesk-Winfield (2010) for the Northwest Territories.

Inventory of Existing Groundwater Monitoring Data

April 1, 2018 to March 31, 2019

The inventory of existing groundwater monitoring data is an ongoing project. In 2018/2019, the NWT gathered additional information from the GNWT Departments of Infrastructure and Lands, the Northwest Territories Geological Survey, and the Geological Survey of Canada.

A preliminary review of groundwater quality data from the provincial groundwater monitoring network in Alberta indicated no obvious trend in groundwater quantity or quality. Overall, the quality of groundwater appears to be safe for consumption at monitoring locations, with most measured parameters below the Guidelines for Canadian Drinking Water Quality.

Permafrost Assessment

April 1, 2018 to March 31, 2019

Permafrost in the Alberta-NWT transboundary region is sporadic and typically only found in organic soils where there can be a high volume of ice content. With ongoing climate change, the thawing of permafrost may have a considerable impact on the flow and storage of water.

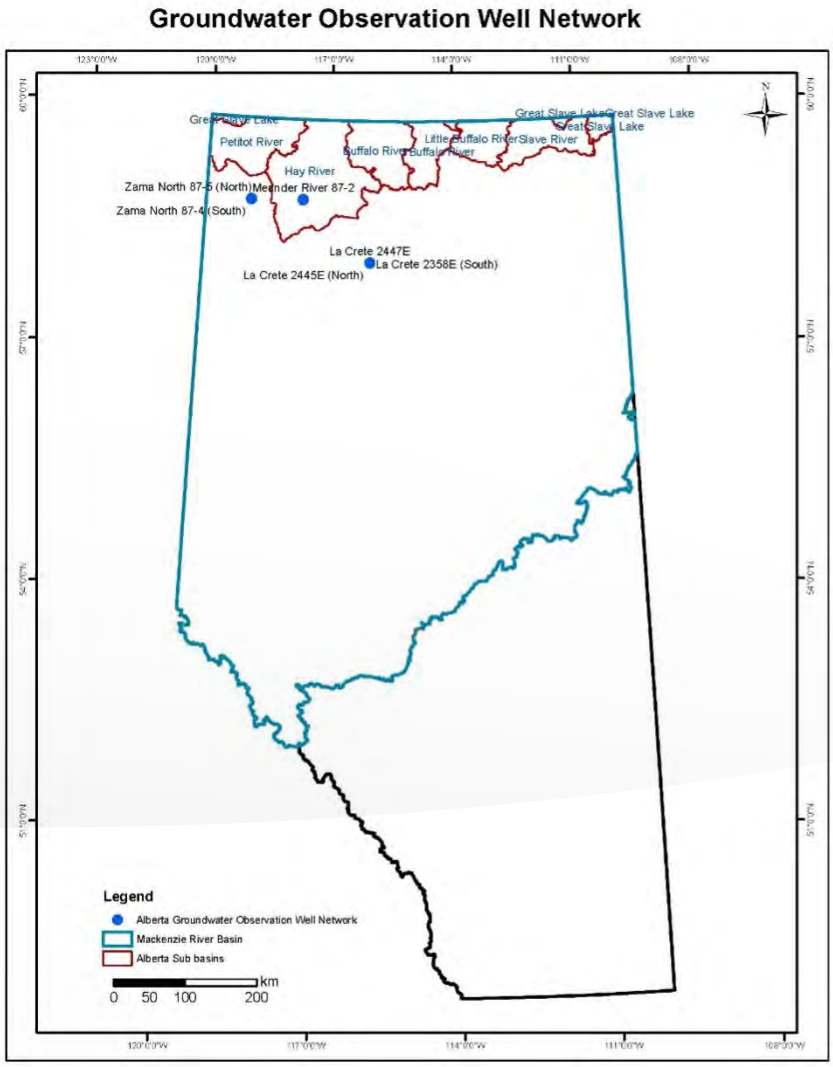

Figure 20. Alberta Groundwater Observation Network monitoring sites.

A scope of work was developed to learn more about the state of permafrost in the Liard/Petitot, Kakisa, Hay, Buffalo, Slave, and Taltson River transboundary watersheds. The purpose is to identify areas most sensitive to permafrost thaw and to identify the potential impacts of permafrost thaw on groundwater and surface water.

Results will be used to highlight knowledge gaps related to permafrost, to establish groundwater and surface water monitoring priorities related to permafrost thaw, and to better inform the Bilateral Management Committee of how flow and storage of water in the transboundary watersheds may change in response to climate change. The project will be carried out in collaboration with academic partners.

April 1, 2019 to March 31, 2020

Wilfrid Laurier University, in collaboration with the University of Alberta, conducted a desktop study to determine the current state of knowledge on the extent of permafrost in the transboundary river basins mentioned in the scope of work, as well as a description of the impact of permafrost on the basins. This desktop study had the following objectives:

1. Gather existing information on permafrost in the transboundary area;
2. Consolidate literature on the causes of permafrost thaw, and the impacts of permafrost thaw on groundwater and surface water dynamics, specific to the type of permafrost present in the area;
3. Identify impacts of permafrost thaw on water chemistry and nutrient cycling in the transboundary area;
4. Identify where permafrost thaw is likely to have the most impact on the water balance; and
5. Identify gaps in our understanding of changes in the basins resulting from permafrost thaw.

The final report is expected in March 2021.

Guideline for Groundwater Management Frameworks

April 1, 2019 to March 31, 2020

There is no universally accepted method for assessing groundwater quality. Each jurisdiction has its own method and this can lead to differing assessments of a common groundwater resource.

The Government of Alberta has developed a rigorous, transparent, repeatable, and scientifically credible process for developing and implementing Groundwater Management Frameworks across all different land-use regions in Alberta. The guideline has been shared with the NWT to develop a joint Alberta-NWT groundwater management framework that would be consistent with the ones being developed in Alberta but also with the other jurisdictions of the Mackenzie River Basin. The framework will help to determine groundwater quality baselines and to establish management action triggers, which will improve land-use decision-making.

Next Steps

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

- Continuing work to identify and map aquifers;
- Gathering and reviewing any additional groundwater data available from industry; and
- Developing a joint Alberta-NWT groundwater management framework.

Climate Change

Studies have shown that Canada's Arctic is more affected by climate change than southern areas (Vincent et al., 2015). In addition to northern Canada warming at about three times the world's average rate, there have also been increases in precipitation.

Earth systems models repeatedly predict that a warmer climate will intensify the water cycle (Box et al., 2019). This means that we are likely to see more evaporation of surface water and transpiration of water from plants, and more frequent and more extreme rain and snow fall events. This is likely to affect flood frequency, provide higher amounts of runoff, and increase movement of soil and other sediment.

Climate change is also projected to indirectly impact water quantity and quality. An increase in wildfires and the thawing of permafrost could change the surface landscape, altering where the water flows and collects (Hanes et al., 2018 and Biskaborn et al., 2019).

To implement the Agreement, we need to understand whether changes in the waters or aquatic ecosystem are caused by climate change or by activities in Alberta or the NWT.

To learn more, in 2018, Alberta and the NWT jointly worked with an academic to study the risks and potential impact of climate change in the transboundary basins. They completed a literature review of all relevant scientific publications, a statistical analysis of historical climate and hydrometric data, and a draft framework for a climate change risk assessment for the Hay and Slave River basins.

The results found that there has been a research focus on climate change impacts in the Athabasca River basin and the Peace-Athabasca Delta, but relatively few studies on the main stems of the Peace and Slave rivers or the Hay River basin.

Alberta and the NWT are continually working on developing and improving tools to monitor historic and real-time hydrometric and climate data to assess how climate change and permafrost thaw are affecting the Hay and Slave River watersheds.

Conclusion

The Bilateral Management Committee oversees implementation of the Alberta-NWT Bilateral Water Management Agreement. The efforts of team members in Alberta and the NWT over the past two years clearly demonstrate that the intent of the Agreement is being fulfilled.

Numerous measures have been established to assess the quantity and quality of our shared waters. New ways of testing and early indicators of change continue to be developed.

Biological indicators include the analysis of benthic macroinvertebrates and fish, as well as studies to learn more about the movement of nutrients, metals and PAHs between the water, plants, and animals.

Surface water quality and quantity will continue to be monitored.

We are also learning more about the location of underground aquifers, and the amount and quality of groundwater.

The impact of climate change on the aquatic environment continues to be studied, as projections indicate that global warming could alter several aspects of our waters, including its quality.

Acknowledgements

A special thank you to Kátł'odeeche First Nation, Smith's Landing First Nation, and Fort Smith Métis Council for their assistance with the benthic macroinvertebrates and transboundary water quality monitoring programs. We would also like to thank Environmental and Climate Change Canada for continuing water quality and water quantity monitoring in 2018 and 2019.

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_2015-02-24_no_watermark.pdf

Water Quality Technical Report, 2018-2019
https://www.enr.gov.nt.ca/en/alberta-nwt-transboundary-water-quality-slave-and-hay-rivers-2018-2019-qualite-des-eaux

Water Quantity Technical Report, 2018-2019
https://www.enr.gov.nt.ca/en/alberta-nwt-transboundary-water-quantity-slave-and-hay-rivers-2018-2019-quatite-des-eaux

Public Benthics Report, 2017-2019
https://www.enr.gov.nt.ca/en/benthic-macroinvertebrate-monitoring-plan-large-transboundary-rivers-alberta-nwt-region-assessment

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Biskaborn, B.K., Smith, S.L., Noetzli, J., Matthes, H., Vieira, G., Streletskiy, D.A. … Lantuit, H. (**2019**). Permafrost is warming at a global scale. *Nature Communications*, 10(264). https://doi.org/10.1038/s41467-018-08240-4.

Box, J.E., Colgan, W.T., Christensen, T.R., Schmidt, N.M, Lund, M. … Olsen, M.S. (**2019**). Key indicators of Arctic climate change: 1971-2017. *Environmental Research Letters*, 14, 045010. https://doi.org/10.1088/1748-9326/aafc1b.

Environment and Climate Change Canada (ECCC). 2010. *2010 Pulp and Paper Environmental Effects Monitoring (EEMR) Technical Guidance Document*. 449pg.

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Vincent, L. A., Zhang, X., Brown, R. D., Feng, Y., Mekis, E., Milewska, E. J., & Wang, X. L. (**2015**). Observed trends in Canada's climate and influence of low-frequency variability modes. *Journal of Climate*, 28(11), 4545-4560. https://doi.org/10.1175/JCLI-D-14-00697.1.

Smerdon, B.D. (2020). State of Subsurface Knowledge to Support Aquifer Mapping Across the Alberta–Northwest Territories Border. https://www.ags.aer.ca/publications/OFR_2020_04.html.

Appendix B – Members of the Bilateral Management Committee

April 1, 2018 to March 31, 2020

BMC Members

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Northwest Territory Métis Nation
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