

# **2017 Alberta-NWT Transboundary Water Quantity Technical Report**

*for the*

***Slave and Hay Transboundary Rivers***

*a companion report to the*

## **Alberta-Northwest Territories Bilateral Management Committee Annual Report to Ministers, 2017-18**

### **Prepared by:**

Ryan Connon, Hydrologist  
Water Management and Monitoring Division  
(Previously Water Resources Division)  
Department of Environment and Natural Resources  
Government of the Northwest Territories

-and-

Carmen delaChevrotiere, Transboundary Water Quantity Specialist  
Watershed Resilience and Transboundary Waters  
Environmental Knowledge and Prediction Branch  
(Previously Transboundary Waters Secretariat)  
Environment and Parks  
Government of Alberta

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# Executive Summary

The 2017 Alberta-NWT Transboundary Water Quantity Technical Report provides an overview of 2017 water quantity data in the Hay and Slave River basins. Total annual streamflow in the Slave River in 2017 was slightly above average (105% of normal) while total annual flow in the Hay River was lower than average (46% of normal). On the Slave River annual consumptive use was well below 2 billion m<sup>3</sup>, at 1.03 billion m<sup>3</sup>. The pre-defined threshold of 2 billion m<sup>3</sup> remained at 1.9% of the long term mean annual streamflow. On the Hay River, the total volume of groundwater and surface water licences exceeded 2.5% of the natural flows at the border in November, December, February, and March. This exceeded Trigger 1 and prompted analysis of Trigger 2. Actual water use was less than 1% of the natural flow at the border in all months, which was lower than the Trigger 2 threshold of 4% and also lower than the interim objective of 5%.

## Introduction

In 2015, the Government of Alberta and the Government of the Northwest Territories signed a Bilateral Water Management Agreement to cooperatively manage shared transboundary waters. As part of the Alberta (AB)-Northwest Territories (NWT) Bilateral Water Management Agreement (the Agreement), a Bilateral Management Committee (Committee) was established with the responsibility of implementing and reporting on the Agreement.

This Water Quantity Technical Report is a companion report to the Committee's third annual report to Ministers, "Working Together to Manage Our Shared Waters, 2017-18". The technical report describes analysis of the 2017 water quantity data and activities that occurred from April 1, 2017 to March 31, 2018. For a summary of the information in this technical report, refer to the Surface Water Quantity section of the Committee's third annual report.

## Water quantity monitoring and derived datasets

Setting and tracking the interim transboundary objectives and triggers of the Agreement is based on long-term monitoring of streamflow, water allocations for use, as well as reporting data for actual water use in Alberta.

The Water Survey of Canada (WSC), a section of Environment and Climate Change Canada (ECCC), is the agency responsible for hydrometric measurements and associated data in Canada. The WSC partners with each of the provinces and territories to cost-share hydrometric monitoring.

Water use is tracked through water permitting systems in AB and NWT. For the analysis in this report, key data on upstream uses in Alberta, licensed under the *Water Act*, (e.g. total annual allocation, return flow, type of use, location of use) were obtained from Alberta's Environmental Management System for the Slave River basin. For the Hay River basin, more detailed information on the water use and conditions for water use (e.g. minimum flow and reporting requirements) were obtained from licence documents. The Alberta Energy Regulator (AER) regulates uses under the *Water Act* for the upstream oil and gas sector, and Alberta Environment and Parks (AEP) regulates uses for all other sectors.

Almost all water licences require the licensee to report actual water use. Many licences have been updated to require online reporting to Alberta's Water Use Reporting System. Monthly, and in some cases daily, reporting data are provided by the licensees to Alberta by deadlines specified in their licence documents. This electronic database was queried for the water uses in the Hay River basin in Alberta. Paper files of water use reporting may be available, but were not gathered for the analysis.

Streamflow and allocation data were combined to produce estimated natural flows for Trigger 1 for the Hay River. For Trigger 2, streamflow and actual water use data were combined. Table 1 lists the locations of monitoring and derived flow datasets.

**Table 1.** Hay and Slave River monitoring sites and flow datasets for assessment of interim objectives and triggers

Monitoring Station/Assessment Point	Site Status and/or description of data	Purpose
Hay River near Town of Hay River (flow monitoring, 1963-present; level monitoring, 2002-present)	Continuous monitoring since July 1963, one incomplete month (July 2010)  Drainage Area: 51,700 km <sup>2</sup> ; coordinates of hydrometric station: 60.743 N, 115.8596 W	To derive estimated flow at the border.
Hay River near AB-NWT Border (level monitoring, 1986-2016)	Intermittent monitoring between 1986 and 1998, and continuous measurements from 2004 to present.  Drainage area: 48,800 km <sup>2</sup> ; coordinates of hydrometric station: 60.0039 N, 116.9721 W	To obtain drainage area for estimating flow at the border.
Hay River at the AB-NWT Border (calculated/derived flow)	This value is calculated by reducing the flow to the smaller drainage area at the border, which is 94 percent of the flow near the town of Hay River	To derive naturalized flow at the border.
Hay River at the AB-NWT Border (estimated natural flow)	This value is calculated by adding the upstream monthly surface water and groundwater allocation total for locations in the basin, or estimated consumption, to the 'Hay River at the AB-NWT Border (calculated flow estimate)' above.	To assess the triggers for the Hay River basin
Slave River at Fitzgerald (flow monitoring, 1960-present)	Intermittent monitoring 1921-1922, 1930-1931, and 1953-1958  Continuous daily monitoring since May 1959, nine incomplete months (2011-2014)	To assess whether the two billion cubic metres (m <sup>3</sup> ) consumptive use threshold becomes significantly different from 1.9 percent of the long-term average annual flow.

## *Next steps*

AB and NWT will continue to share information about ongoing or new hydrometric monitoring occurring in their respective jurisdictions where relevant to the Agreement. The Bilateral Management Committee will update Appendix I (monitoring list) as deemed necessary.

The methodology behind WSC and AEP's 'near-real-time' flow estimation for the ice-covered season will be further explored. It is difficult to estimate under-ice flow based on water level measurements, and it is therefore important to understand how often flow is actually measured, and the methodology behind the flow estimates in between measurements.

The Parties will 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 hydrological trends and water management in the Peace-Athabasca Delta system as part of the Wood Buffalo National Park Action Plan.

## Water quantity triggers and objectives, and daily flow conditions

The Agreement commits Alberta and the NWT to establish and implement transboundary water quantity objectives and monitoring according to the Risk Informed Management approach. Classification of water bodies considers the level of upstream development and other factors including the extent of traditional use and drinking water use in downstream communities, observed changes in conditions, and the sensitivity of the related ecosystem. Both the Hay and Slave Rivers are designated as 'Class 3' water bodies, which require the development and monitoring of site-specific objectives.

A transboundary water quantity objective refers to the minimum amount of water calculated at the border that the upstream Party must pass to the downstream Party. This minimum amount of water must satisfy ecological integrity needs the aquatic ecosystem. After these needs are met, at least 50 percent of the remaining water must also be passed to the downstream Party. The methodology for calculating these flows is based on a "modified desktop method" and can be found in Appendix D of the Agreement.

### *Slave River*

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 consumptive use in Alberta reaches two billion cubic metres;
- two billion cubic metres (m<sup>3</sup>) becomes significantly different from 1.9% of the long-term average annual streamflow; or,

- 50% of the consumptive use in Alberta is for use outside of the Mackenzie River basin.

Alberta's current annual allocation, of both surface and groundwater in the Slave River basin, is used as an estimate for annual consumptive use. Based on assessment of water use as part of Alberta's water management program under the Alberta *Water Act*, the actual use of water in a given year is often 50 percent or less.

The allocation is the maximum volume allowed, assuming no low flow restrictions. The maximum volume for a licence includes consideration of emergency water demands in addition to typical annual needs for the long-term operation of the diversion. Low flow restrictions are specific to each licence, and are not included in the maximum annual diversion volume. For more details on an individual licensee's conditions for water use, licence documents can be accessed online through Alberta's 'Authorization Viewer'.

Table 2 shows Slave River surface water and groundwater allocations as well as flows for 2017, 2016 and 2015. The total allocation has decreased each year.<sup>1</sup> The 2 billion m<sup>3</sup> consumptive use threshold remains at 1.9 percent of the long-term annual flow of the Slave River.

**Table 2:** Comparison of Slave River Basin Allocations and Mean Annual Flows from 1972

	<b>2017</b>	<b>2016</b>	<b>2015</b>
	<b>(m<sup>3</sup>/year)</b>	<b>(m<sup>3</sup>/year)</b>	<b>(m<sup>3</sup>/year)</b>
<b>Surface Water Allocation</b>	862,344,066	905,699,542	904,073,517
<b>Groundwater Allocation</b>	167,249,005	169,607,408	178,146,719
<b>Total Allocation</b>	1,029,593,071	1,075,306,951	1,082,220,236
<b>Consumptive Use Threshold</b>	2,000,000,000	2,000,000,000	2,000,000,000
<b>Mean Annual Flow from 1972</b>	105,400,000,000	105,300,000,000	105,400,000,000

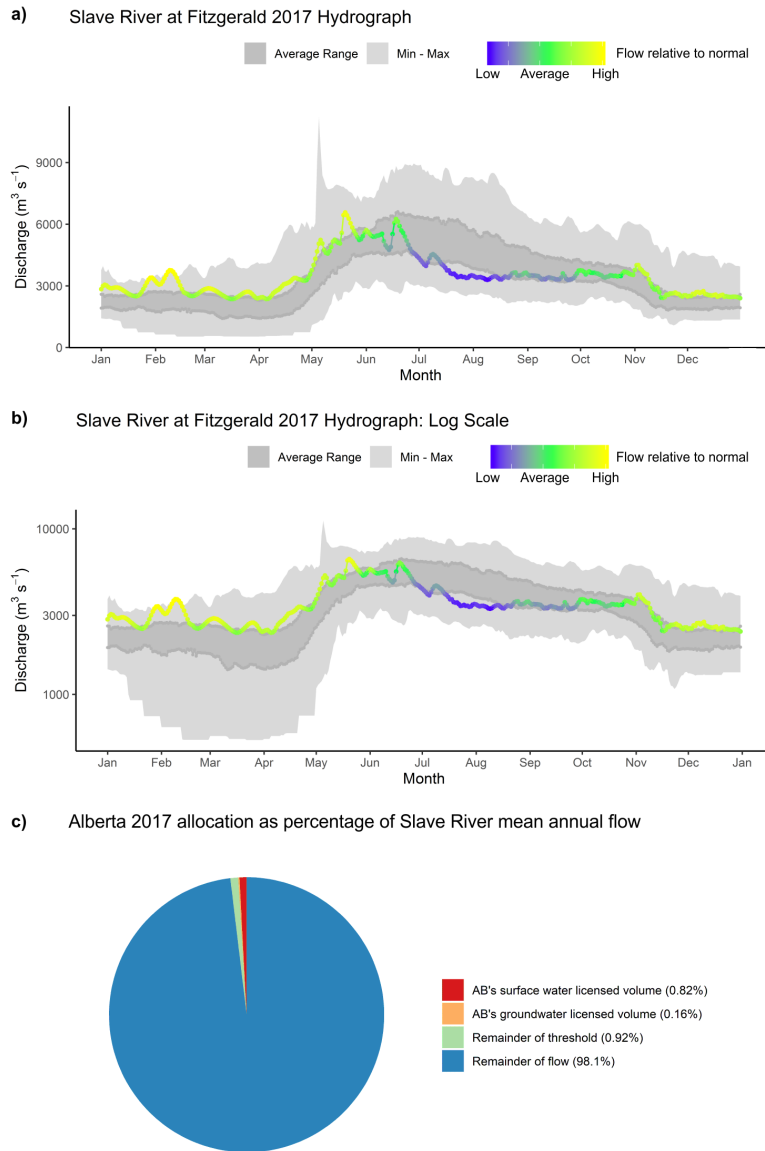
No new special acts were passed in Alberta to allow for transfer of water out of the Mackenzie River Basin. As reported in "Working Together to Manage our Shared Waters Alberta-Northwest Territories Bilateral Management Committee Annual Report to Ministers 2016-17", the total volume of allocation under special acts (209,000 m<sup>3</sup>) remains at 0.02 percent of the total allocation of water in the Slave River basin.

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<sup>1</sup> A correction was made to 2016 allocations reported in "Working Together to Manage our Shared Waters Alberta-Northwest Territories Bilateral Management Committee Annual Report to Ministers 2016-17", which incorrectly included allocations in the Hay River basin. A transcription error was corrected for 2015 surface water allocations.

Daily discharge rates for Slave River at Fitzgerald in 2017 are presented in Figures 1a and 1b. In Figure 1b, the hydrograph is projected on a plot with a log scale y-axis, which allows better visualisation of winter flows. The dark gray bands represent daily 'average flows' (calculated as the interquartile range), while daily maximum and minimum flows are depicted with the light grey ribbons. Daily flows for 2017 are plotted according to their daily percentile and then illustrated relative to normal. Natural variability of streamflow results in higher than average flows at some times in the year, and lower than average flows at other times. Figure 1c presents Alberta's 2017 groundwater and surface water allocations on the Slave River as a percentage of long-term annual discharge on the Slave River.





**Figure 1:** Slave River daily hydrographs present on a linear (a) and log (b) y-axis; and c) Alberta's 2017 allocations as percentage of Slave River mean annual flow

## Hay River

For the Hay River, objectives 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.

The analysis of 'water licensed' (Trigger 1) or 'water used' (Trigger 2) includes all types of Alberta *Water Act* licences (i.e. long-term licences, temporary diversions, and traditional agricultural registrations), for surface water and groundwater. It also includes a licence held by AEP for annual net water balance losses from Hutch Lake, a lake created for wildlife management.

In order to estimate the monthly naturalized flow, the total monthly allocation is added to the monthly flow at the border for Trigger 1. For Trigger 2, the monthly estimated and monthly reported use is added to the monthly flow. This assumes a direct, instantaneous effect of all diversions throughout the basin. This is a simplified and conservative estimate; it does not consider routing of each diversion, residence time or storage in lakes or wetlands, and when it would reach the border if not diverted. It also assumes that the water is diverted (surface water and groundwater) at the same rate throughout the year. The only exception was for evaporative losses at Hutch Lake, which was distributed proportional to evaporation rates throughout the year, with higher values in summer and zero values in winter months as ice cover and snow cover on the lake prevent an evaporative flux. The distribution was based on shallow lake evaporation estimates<sup>2</sup> calculated with climate data from High Level, AB.

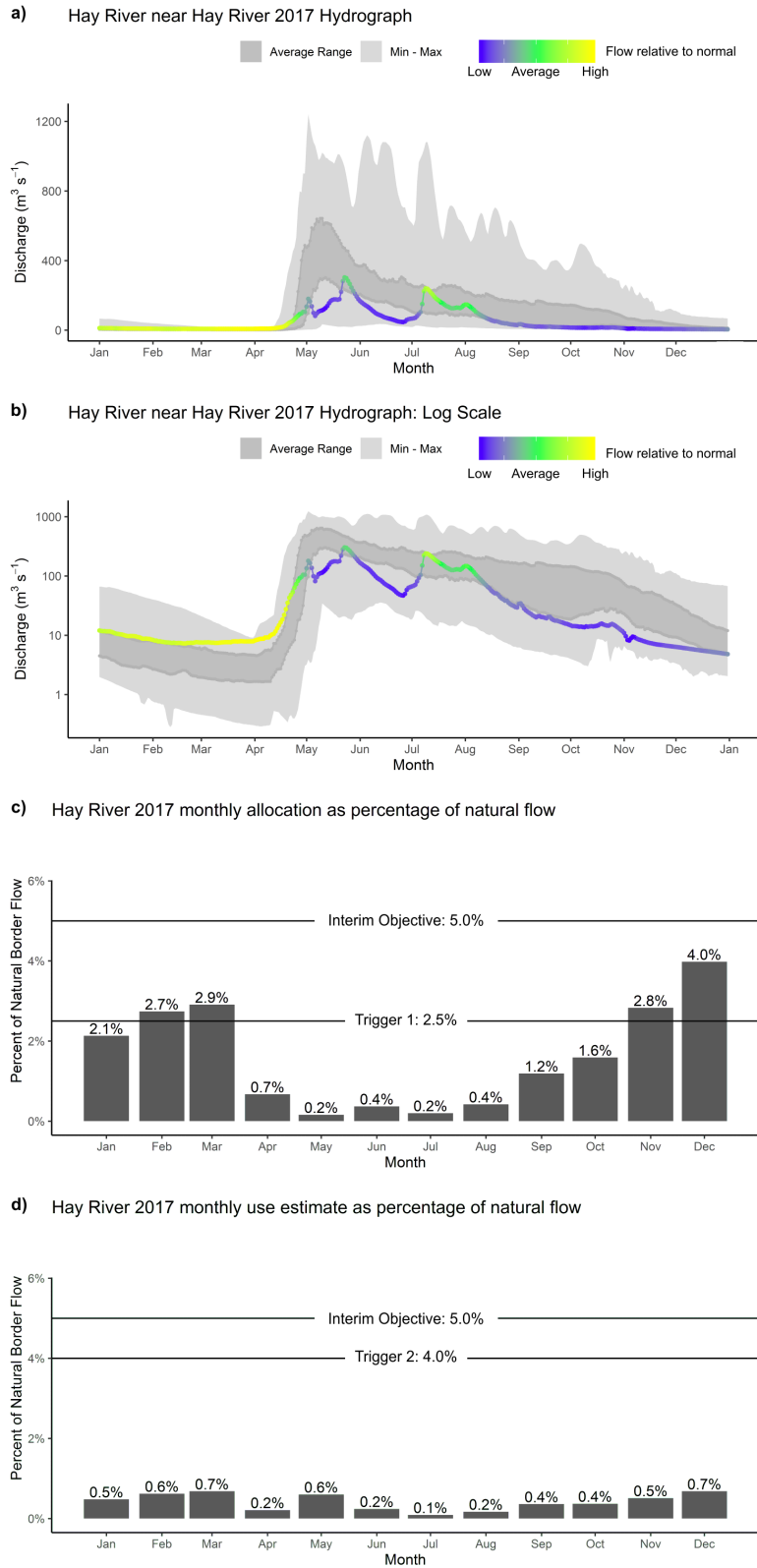
Figure 2a and b present an annual hydrograph comprised of daily flows on the Hay River in 2017. Figure 2c shows the monthly allocation as a percentage of the monthly natural border flow, in relation to Trigger 1. This value is well below Trigger 1 in most months, but exceeded Trigger 1 in February, March, November and December. The resulting action was to evaluate actual water use (Trigger 2). Figure 2d

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<sup>2</sup> Shallow lake evaporation estimates are based on average monthly Morton's model estimates from 1972-2009. The dataset can be found in 'Evaporation and Evapotranspiration in Alberta, April 2013' ISBN: 9781-4601-1121-5 (On-line). Negative evaporation estimates for the months of January, February, November and December were set to zero.

shows the results for 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.

Trigger 2 includes the same long-term allocations, temporary diversions, and traditional agricultural registrations for surface water and groundwater as in Trigger 1, but, instead of using the allocation volume, it uses actual water use data submitted by licensees to Alberta's online Water Use Reporting System (WURS). As there is no reporting for the wildlife management licence for Hutch Lake, the same monthly volumes, as used for Trigger 1, were used for Trigger 2.



**Figure 2:** Hay River daily hydrographs present on a linear (a) and log (b) y-axis; and c) Alberta's 2017 monthly licensed volume and d) Alberta's 2017 monthly use estimate as percentage of Hay River natural border flow

Not all licensees are required to submit actual water use data to WURS. For example, the Alberta Energy Regulator recently began requiring reporting for new temporary diversion licences (TDLs), but it is not required for other sectors regulated by Alberta Environment and Parks (e.g. forestry, transportation, and downstream oil and gas activities). In 2017 further details of the reporting by sector were investigated and included in this report.

Table 3 provides 2017 reporting data for surface water licences by sector. The reporting rate is nearly 100 percent for sectors assumed to be required to report. The actual reporting rate can only be verified by checking requirements in each licence document. The AER generally requires reporting for temporary licences, but AEP does not. Therefore, temporary licences for 'Upstream Oil and Gas' were assumed to have a requirement to report, as this sector is regulated by AER. Temporary licences for 'Downstream Oil and Gas', 'Forestry', and 'Construction and Transportation' were assumed not to have the requirement to report. Individual reporting requirements were verified by checking the long-term licence documents, but were not checked for the temporary licence documents or agricultural registrations. There were four TDLs for downstream oil and gas for a volume of 5,200 cubic metres of water that were assumed to not be required to report. There are two licences for the 'urban' sector, one of which is for the Dene Tha' First Nation, which does not require reporting to WURS. 'Agricultural Registrations', 'Water Management' licences, and the one 'Environmental' licence do not have reporting requirements. The 'Environmental' licence is for the creation of Hutch Lake for wildlife management. There is one licence for 'Recreation' that did not report as required in its licence.

**Table 3: Reporting for Surface Water Licences by Sector for 2017**

	Number of Licences and TDLs with Reports	Total Number of TDLs, Licences, Registrations	Number of Long-Term Licences & Registrations	Number of TDLs	Allocation of Licences with Reports (m <sup>3</sup> )	Total Allocation (m <sup>3</sup> )	Percentage of Allocation Volume with Reports
UPSTREAM OIL AND GAS	199	289	5	284	4,073,940	4,173,290	97.62%
DOWNSTREAM OIL AND GAS	2	6	2	4	42,600	47,800	89.12%
FORESTRY	0	223	0	223	-	481,650	0.00%
CONSTRUCTION AND TRANSPORTATION	0	27	0	27	-	18,510	0.00%
RECREATION	0	1	1	0	-	19,720	0.00%
AGRICULTURAL REGISTRATION	0	21	21	0	-	1,451	0.00%
URBAN	1	2	2	0	296,040	602,040	49.17%
WATER MANAGEMENT	0	2	2	0	-	10	0.00%
ENVIRONMENTAL	0	1	1	0	-	960,052	0.00%
<b>TOTAL</b>	<b>202</b>	<b>572</b>	<b>34</b>	<b>538</b>	<b>4,412,580</b>	<b>6,304,523</b>	<b>69.99%</b>

Table 4 provides surface water reporting data by sector for 2016. The reporting rates were similar to 2017. In 2017, 98 percent of the allocations by volume were reported for the upstream oil and gas sector, versus 93 percent in 2016. The difference in reporting for downstream oil and gas was due to the four new TDLs in 2017 that AEP does not require to report. There was also improvement in the reporting for the 'urban' sector in 2017.

**Table 4: Reporting for Surface Water Licences by Sector for 2016**

	Number of Licences and TDLs with Reports	Total Number of TDLs, Licences, Registrations	Number of Long-Term Licences & Registrations	Number of TDLs	Allocation of Licences with Reports (m³)	Total Allocation (m³)	Percentage of Allocation Volume with Reports
UPSTREAM OIL AND GAS	68	234	5	229	3,756,890	4,036,775	93.07%
DOWNSTREAM OIL AND GAS	2	2	2	0	42,600	42,600	100.00%
FORESTRY	0	265	0	265	-	624,150	0.00%
CONSTRUCTION AND TRANSPORTATION	0	13	0	13	-	1,800	0.00%
RECREATION	0	1	1	0	-	19,720	0.00%
AGRICULTURAL REGISTRATION	0	21	21	0	-	1,451	0.00%
URBAN	0	3	2	1	-	603,540	0.00%
WATER MANAGEMENT	0	2	2	0	-	10	0.00%
ENVIRONMENTAL	0	1	1	0	-	960,052	0.00%
SUBURBAN/RURAL	0	1	0	1	-	150	0.00%
<b>TOTAL</b>	<b>70</b>	<b>543</b>	<b>34</b>	<b>509</b>	<b>3,799,490</b>	<b>6,290,248</b>	<b>60.40%</b>

Table 5 provides 2017 reporting data for groundwater licences by sector. Table 6 provides the groundwater reporting data by sector for 2016. The reporting rates for 2017 and 2016 are similar.

**Table 5: Reporting for Groundwater Licences by Sector for 2017**

	Number of Licences and TDLs with Reports	Out of Total (TDLs and Licences)	Total Licences & Registrations	Total TDLs	Allocation of Licences with Reports	Total Allocation	Percentage of Allocation Volume with Reports
UPSTREAM OIL AND GAS	7	19	18	1	201,875	236,837	85.24%
SUBURBAN/RURAL	4	5	5	0	973,074	973,074	100.00%
RECREATION	0	1	1	0	-	1,234	0.00%
oil & gas, work camp	1	1	1	0	3,650	3,650	100.00%
	<b>12</b>	<b>26</b>	<b>25</b>	<b>1</b>	<b>1,178,599</b>	<b>1,214,795</b>	<b>97.02%</b>

**Table 6: Reporting for Groundwater Licences by Sector for 2016**

	Number of Licences and TDLs with Reports	Out of Total (TDLs and Licences)	Total Licences & Registrations	Total TDLs	Allocation of Licences with Reports	Total Allocation	Percentage of Allocation Volume with Reports
UPSTREAM OIL AND GAS	9	21	14	7	204335	239205	85.42%
SUBURBAN/RURAL	0	5	1	4	956300	973074	98.28%
RECREATION	0	1	1	0	0	1234	0.00%
oil & gas, work camp	1	1	1	0	3650	3650	100.00%
	<b>10</b>	<b>28</b>	<b>17</b>	<b>11</b>	<b>1,164,285</b>	<b>1,217,163</b>	<b>95.66%</b>

Of the available actual use data from WURS, far less than the maximum allocation volume was used. In 2016, 27 percent<sup>3</sup> of the surface water allocation was used, and 5 percent of the groundwater allocation was used. This means that 21 percent of the total allocation volume of both surface water and groundwater was used in 2016. In 2017, 24 percent of the surface water allocation was used, and 6 percent of the groundwater allocation was used. This means that 20 percent of the total allocation volume of both surface and groundwater was used.

In order to estimate the monthly natural flow for Trigger 2, the actual water use was added to the monthly volume of flow at the border. When WURS data on actual use was not available, consumption was estimated at 40 percent of the allocation volume. This estimated consumption calculation followed the same procedure as in the 2016 analysis, where the estimated consumption is double the reported use for both surface water and groundwater (*i.e.* 20 percent multiplied by 2). The exception to this estimation was for the Hutch Lake environmental licence, for which consumption was assumed to be equal to allocation.

## *Next steps*

Daily flow conditions, for both the Slave and Hay rivers, will continue to be tracked and reported on relative to historical data, and aggregated for reporting on interim water quantity objectives and triggers these flows will also be used as a guide to assess interim water quality triggers. The Parties will continue to track and report on the consumptive use threshold (annual consumptive use and recorded flow) for the Slave River. Interbasin transfers will continue to be tracked and reported. The methods for calculating annual consumptive use and mean annual flow will be refined when needed.

The Parties will continue to track and report on the interim objective and triggers for the Hay River. Considerable additional analysis of licence reporting requirements and reporting rates by volume and by sector was completed and presented in this report. Refinements to estimates of monthly allocation, consumptive use, and natural flow will continue to be discussed.

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<sup>3</sup> There is a slight correction of the 2016 data, from “Working Together to Manage our Shared Waters Alberta-Northwest Territories Bilateral Management Committee Annual Report to Ministers 2016-17”. In the analysis for that report, a small amount of reported volume was missed; meaning the volume of the allocation used was 27, rather than 31% of the surface water allocation.