2019 Status of Surface Water Quantity Lower Athabasca Region

Reporting on the Lower Athabasca Surface Water Quantity Management Framework for January 2019 - December 2019

Alberta

2019 Status of Surface Water Quantity, Lower Athabasca Region, Alberta

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The authors thank reviewers for their technical reviews and feedback, which have enhanced this work.

Reviewer 1 holds a Ph.D. in Civil Engineering, is a registered Professional Engineer in Alberta (P.Eng.), and has over 20 years of combined experience in water resources engineering practice (hydrology, hydraulics, and municipal engineering studies), management, research, and instrument set-up.

Reviewer 2 holds a MSc. in environmental engineering and is a registered Professional Engineer in Alberta (P.Eng). The reviewer has 10 years of working in cumulative effects management with the Government of Alberta and is currently in a leadership and coordination role in the development and implementation of environmental management frameworks.

Reviewer 3 holds a M.A. in geography and has more than 10 years of experience working in water resources and environmental policy, planning, and management. The reviewer is currently in a leadership role in the development and implementation of environmental management frameworks.

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Acronyms and Abbreviations

AEP	Alberta Environment and Parks
AER	Alberta Energy Regulator
ANI	Preliminary Aboriginal Navigation Index
LARP	Lower Athabasca Regional Plan
RSD	Resource Stewardship Division
The Framework	Lower Athabasca Region Surface Water Quantity Management Framework for the Lower Athabasca River
TDL	Temporary Diversion Licence
WSC	Water Survey of Canada
WURS	Alberta's Water Use Reporting System

Executive Summary

Background

The Lower Athabasca Region Surface Water Quantity Management Framework for the Lower Athabasca River (the Framework) came into effect on October 29, 2015. The Framework establishes weekly management triggers and water withdrawal limits to enable proactive management of mineable oil sands water use from the Lower Athabasca River. The Framework also includes a series of adaptive management triggers that will signal when river flow and water use conditions are close to, or outside of, the range of predicted future conditions used in modelling and development of the weekly management triggers and water withdrawal limits.

This report presents a summary of 2019 streamflow on the Lower Athabasca River and water use by the mineable oil sands sector and other licenced users, relative to weekly management limits, and provides analyses of six of the seven adaptive management triggers. This evaluation fulfills commitments for public reporting outlined in the Framework.

2019 Results Summary

- No water withdrawal limits were exceeded;
- No adaptive management triggers were exceeded;

Introduction

The Lower Athabasca Region Surface Water Quantity Management Framework for the Lower Athabasca River (the Framework) came into effect on October 29, 2015, after the Government of Alberta committed to completing the Framework in the Lower Athabasca Regional Plan. The objective is to manage cumulative water withdrawals to support both human and ecosystem needs, while balancing social, environmental, and economic interests. The Framework updated and replaced the *Water Management Framework: Instream Flows Needs and Water Management System for the Lower Athabasca River* (Alberta Environment and Fisheries and Oceans Canada 2007). The Framework augments and complements existing policies and legislation and is consistent with other provincial policies, strategies, and frameworks, and with the stated desired outcomes for the region.

The Framework relies on two types of tools in establishing the need for and nature of a management response – weekly management triggers and water withdrawal limits, and indicators with associated adaptive management triggers. Weekly management triggers and water withdrawal limits only pertain to the mineable oil sands sector. They are implemented by the Alberta Energy Regulator (AER) to enable proactive management of mineable oil sands water use from the Athabasca River. Withdrawal limits generally decrease as streamflow decreases and regulatory responses are triggered when thresholds are exceeded. Indicators and adaptive management triggers pertain to all licenced water users. Indicators provide information and track changes over time and do not prompt management responses. Adaptive management triggers indicate when streamflow and/or water use conditions are outside of the range of predicted future conditions, which were derived from modelling and used in the development of the weekly management triggers and water withdrawal limits. Crossing adaptive management triggers results in a management response process, which could result in changes to weekly management triggers and withdrawal limits.

Evaluation of the management triggers and water withdrawal limits is completed for every calendar year. This report presents flow conditions in the Athabasca River and water use by the mineable oil sands sector, relative to weekly water withdrawal limits, and analyses of six of the Framework's seven adaptive management triggers. The seventh adaptive management trigger, which aims to relate ecological function to surface water quantity, is under development, and work on the ecological knowledge gaps is ongoing.

The evaluation covers January 1 to December 31, 2019 and fulfills commitments for public reporting made in the Framework.

Lower Athabasca Region

The Lower Athabasca Regional Plan (LARP) was developed by the Government of Alberta in 2012, under the Land Use Framework (Government of Alberta, 2008). The Lower Athabasca Region covers approximately 93,212 km^2 in northeastern Alberta (Figure 1). The LARP identifies strategic directions aligned with a long-term vision for the region that includes economic, environmental, and social goals, and establishes monitoring, evaluation, and reporting commitments. The plan is given legislative authority under the *Alberta Land Stewardship Act* (Government of Alberta, 2009), aligns with key pieces of provincial legislation and strategies.

The Resource Stewardship Division (RSD) of Alberta Environment and Parks (AEP) is responsible for the monitoring, evaluation and reporting on the condition of the environment, and developing a management action plan in the Lower Athabasca Region, while other divisions of the Government of Alberta and regulators are responsible for management of activities and resources in response to environmental conditions.

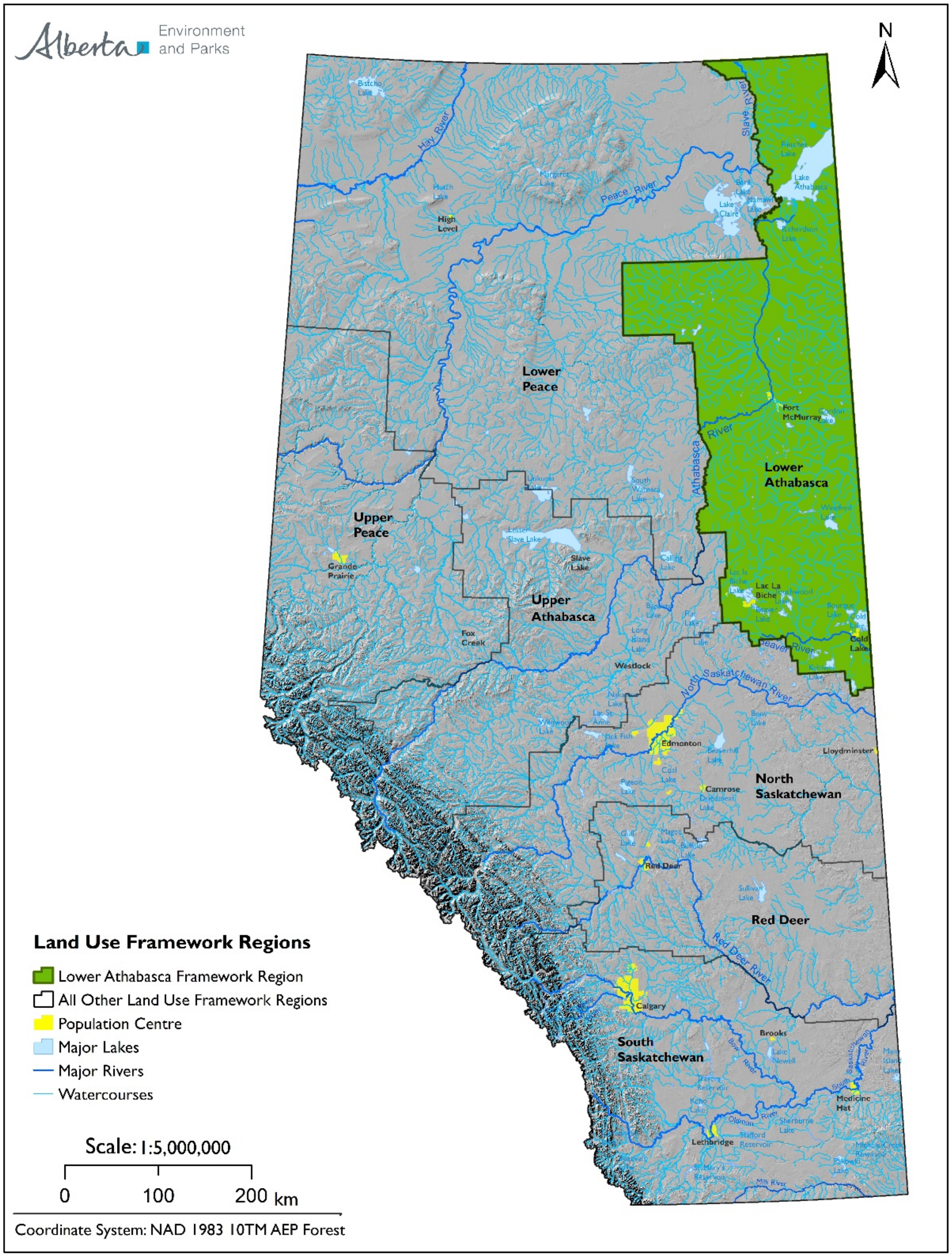

Figure 1: Location of the seven Land Use Framework Regions in Alberta. The Lower Athabasca Region is the area shaded green on the map

Data Sources

Implementation of and reporting on the Framework requires a variety of data, including both measured and modelled streamflow, water allocation and use data from the mineable oil sands sector and other licenced users.

Official verified daily flow rates for the Athabasca River measured at the Water Survey of Canada (WSC) Fort McMurray station (historic hydrometric data for 07DA001 "Athabasca River below Fort McMurray") are used to evaluate adaptive management triggers. This hydrometric station has been monitored since 1957 and is located below Fort McMurray, downstream of the confluence with the Clearwater River and upstream of all water withdrawals by the mineable oil sands sector (Figure 2). Streamflow on the Athabasca River at Fort McMurray represents the integration of upstream hydroclimatic conditions, including rainfall, snowmelt, and glacier melt, as well as groundwater fluxes (Marshall *et al.* 2011; Peters *et al.* 2013; Bawden *et al.* 2014; Gibson *et al*. 2016), and upstream withdrawals and returns.

Official verified flows at the Fort McMurray station are not available in real time to determine water withdrawal limits. Therefore, weekly management triggers and cumulative withdrawal limits are evaluated using weekly flow estimates calculated by AEP. Weekly flow estimates are provided by AEP to mineable oil sands operators, the AER, and the public, through the Athabasca River Conditions and Use website at the start of each week. These weekly flow estimates are based on the best information available at the time and are used to determine the applicable cumulative water withdrawal limit for a given week. They do not necessarily represent a weekly average flow estimate for the week or flow forecast for the following week, i.e. the flow estimate available as close as possible to the beginning of the week is used as the weekly flow.

Surface water allocations from the Athabasca River Basin are specified in *Water Act* licences, which are required by all water users. This data is contained in the Alberta Environment and Parks Environmental Management System (EMS). Actual water use data is reported by oil sands operators and other major water users (e.g. forestry, water management) to Alberta's Water Use Reporting System (WURS) according to the condition specified in their licences. Annual water use for all reporting licences upstream of the Fort McMurray station is extracted from WURS and used to calculate the upstream water use adaptive management trigger. Daily water use by mineable oil sands operators is extracted from WURS and used to calculate weekly average values, and the range of minimum and maximum daily withdrawal rates each week, and evaluate weekly management triggers and cumulative withdrawal limits.

Under the *Water Act* multiyear term licences and Temporary Diversion Licences (TDLs) can be issued. TDLs provide authority for diverting and using water for a maximum of one year. Typically TDLs are issued when there is a need for a short-term water diversion and use for emergency water supply, dust control and bridge washing, drilling oil and gas wells, and possibly other short term uses. Efforts are currently being made to consider the contributions of TDLs for annual reporting, and estimations of TDL water use for oil sands water use related metrics (for 2017, 2018, and 2019 are provided in Appendix B: Inclusion of Temporary Diversion Licences.

It should be noted that at the time the Framework was developed, term licences represented the vast majority of water withdrawals compared to TDLs. Estimation of usage by TDLs was challenging due differences in reporting intervals, and the presence of non-reporting for TDLs.

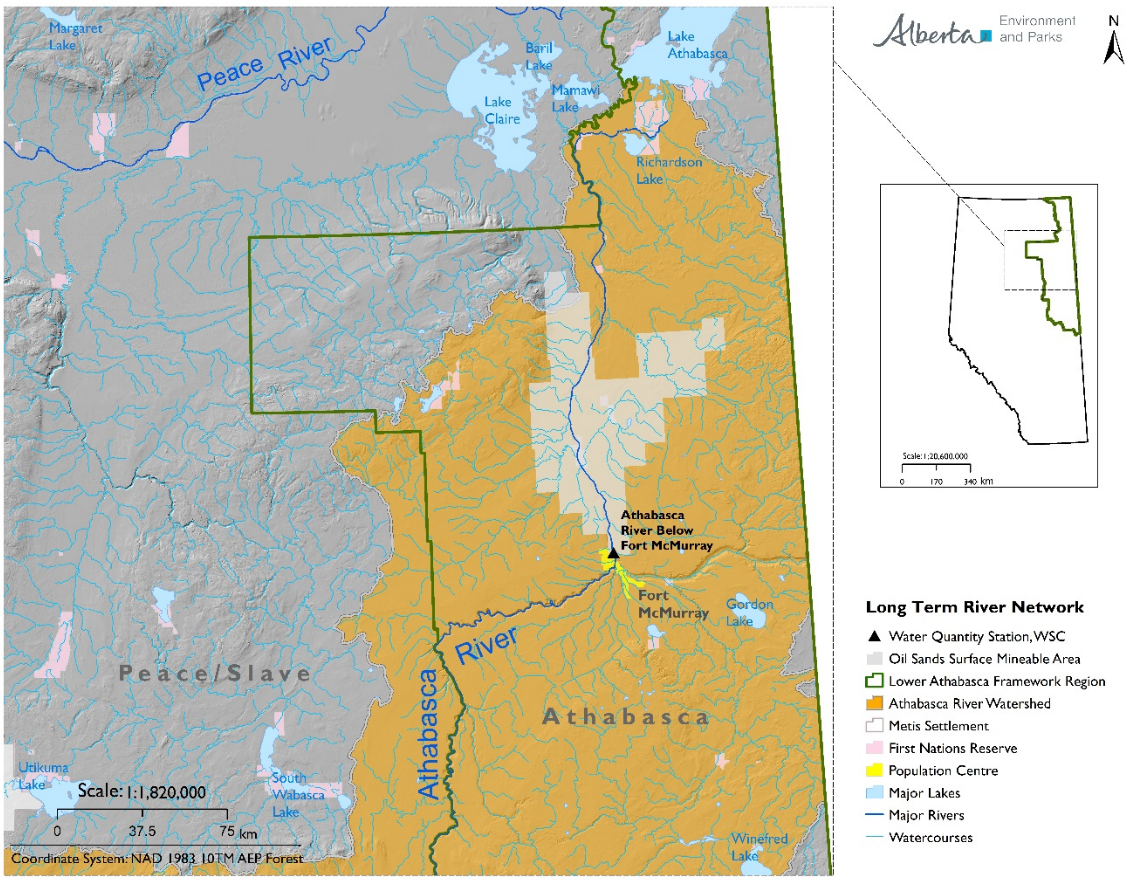

Figure 2: Location of Water Survey of Canada Fort McMurray station (WSC gauge 07DA001 "Athabasca River below Fort McMurray") in the Lower Athabasca Region of Alberta.

Weekly and Adaptive Management Triggers Overview

The weekly management triggers and withdrawal limits established in the Framework set the maximum cumulative water withdrawals permitted by mineable oil sands operators from the Athabasca River. The weekly management triggers and water withdrawal limits are divided into five seasons: Mid-Winter, Early Spring, Late Spring, Summer/Fall, and Early Winter. Each of these seasons has distinct weekly flow triggers and corresponding cumulative water withdrawal limits. The weekly triggers and limits are implemented and tracked by the AER.

Adaptive management triggers signal when river flow and water use conditions are close to the bounds of, or outside of, the range of predicted future conditions derived from modelling and used in the development of the weekly management triggers and water withdrawal limits used in modelling.

Seven adaptive management triggers are included in the Framework, the first six of which are included in this report:

1. Upstream water use
2. Changes to long-term seasonal flow in the Athabasca River
3. Changes to oil sands water use
4. Cumulative oil sands water use, relative to weekly flow
5. High oil sands water use during low summer/fall flows
6. Preliminary Aboriginal Navigation Index (ANI)
7. Ecological indicators and triggers (under development)

Weekly Management Triggers and Cumulative Withdrawal Limits

The AER tracks and reports annually on the performance of mineable oil sands operators relative to the weekly water withdrawal limits identified in the Framework. These limits are cumulative in that they represent the total permitted withdrawal by oil sands operators, combined, each week, based on flow estimates provided by AEP (Table 1). Water withdrawals remained below these limits for the reporting period, January 1 to December 31, 2019, and have not exceeded weekly withdrawal limits since the implementation of the management framework in October 2015.

Weekly flows and associated water withdrawal limits are given in Figure 3. Streamflow and withdrawal limits are lowest during the winter period when precipitation is falling as snow and the river is ice-covered, and are highest during the spring and summer. Weekly withdrawal limits compared to actual water use are shown in Figure 4 and provided in tabular form in Appendix A. Actual water withdrawals are calculated as the average weekly combined withdrawals by oil sands operators, expressed as cubic meters per second (m^3/s). The range between maximum and minimum combined daily withdrawals within each week are also shown in Figure 4. While streamflow and withdrawal limits fluctuate seasonally, actual water withdrawals remain within a limited range of variability throughout the year. Figures from two previous reporting periods, 2018 and 2017 have been updated to show the range of maximum and minimum daily withdrawals, and are presented in Appendix A. The range of maximum and minimum withdrawals remained below the weekly limits in the 2018 and 2017 reporting periods.

Oil sands operators using water from the Lower Athabasca River develop and submit annual Oil Sands Mining Water Management Agreements by November 1st of each year as identified in the Framework. Two water management agreements covering 2019 were delivered by the mineable oil sands operators (agreements for the 2018-2019 and 2019-2020 periods). These agreements specify the share of the available water for each of the individual mine operators during different seasons and under different streamflow conditions to ensure that the weekly cumulative water withdrawal limits under the Framework are not exceeded.

Inclusion of TDLs has been considered and reported in Appendix B: Inclusion of Temporary Diversion Licences.

Table 1. Weekly flow triggers and cumulative water use limits on the Lower Athabasca River for mineable oil sands operations

Mid Winter (January 1 to April 15) Weeks 1-15	
Weekly Flow Triggers (m^3/s)	Cumulative Water Withdrawal Limits
more than 270 m^3/s	16 m^3/s
150 to 270 m^3/s	6% of Weekly Flow
91.6 to 150 m^3/s	9 m^3/s
87 to 91.6 m^3/s	Weekly Flow minus 82.6 m^3/s
less than 87 m^3/s	4.4. m^3/s

Early Spring (April 16 to May 6) Weeks 16-18	
Weekly Flow Triggers (m^3/s)	Cumulative Water Withdrawal Limits
more than 98.6 m^3/s	16 m^3/s
87 to 98.6 m^3/s	Weekly Flow minus 82.6 m^3/s
less than 87 m^3/s	4.4. m^3/s

Late Spring (May 7 to June 10) Weeks 19-23	
Weekly Flow Triggers (m^3/s)	Cumulative Water Withdrawal Limits
more than 102.6 m^3/s	20 m^3/s
87 to 102.6 m^3/s	Weekly Flow minus 82.6 m^3/s
less than 87 m^3/s	4.4. m^3/s

Summer/Fall (June 11 to October 28) Weeks 24-43	
Weekly Flow Triggers (m^3/s)	Cumulative Water Withdrawal Limits
more than 111.6 m^3/s	29 m^3/s
87 to 111.6 m^3/s	Weekly Flow minus 82.6 m^3/s
less than 87 m^3/s	4.4. m^3/s

Early Winter (October 29 to December 31) Weeks 44-52	
Weekly Flow Triggers (m^3/s)	Cumulative Water Withdrawal Limits
more than 200 m^3/s	16 m^3/s
150 to 200 m^3/s	8% of Weekly Flow
94.6 to 150 m^3/s	12 m^3/s
87 to 94.6 m^3/s	Weekly Flow minus 82.6 m^3/s
less than 87 m^3/s	4.4. m^3/s

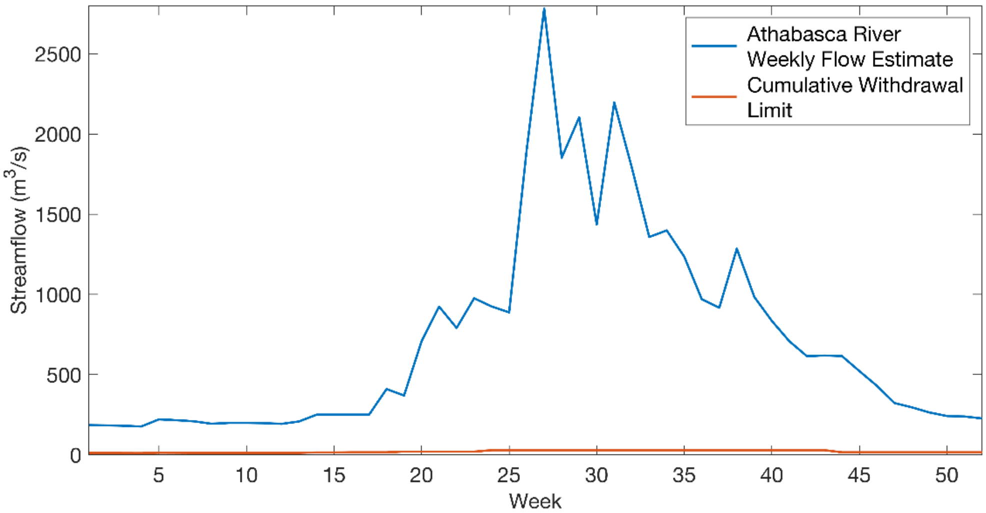

Figure 3. Weekly measured average streamflow compared to withdrawal limits from January 1 to December 31, 2019. Cumulative withdrawal limits represent the combined total permitted water withdrawal by oil sands operators each week, and are determined by weekly streamflow estimates provided by AEP.

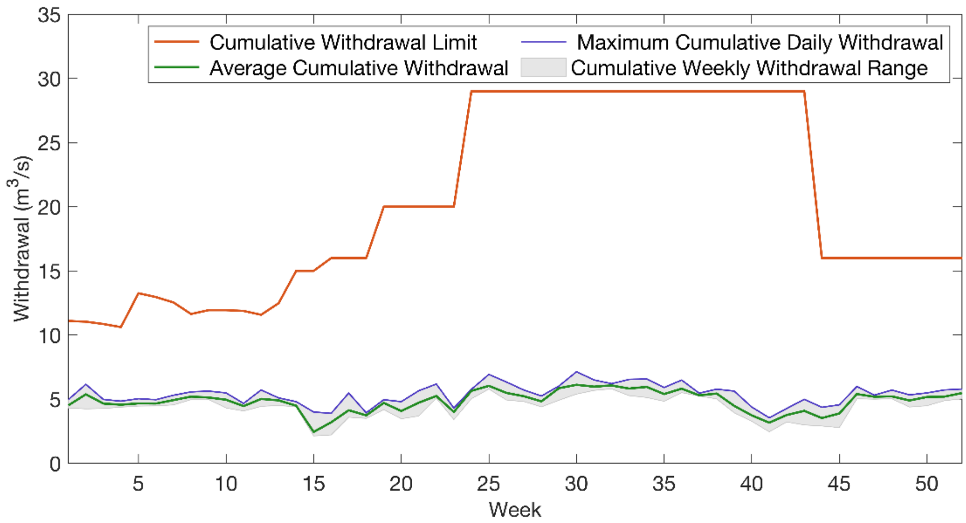

Figure 4. Cumulative withdrawal limits compared to withdrawal rates from January 1 to December 31, 2019. The green line represents the average cumulative withdrawal for the week, the grey shaded region represents the range between the lowest and highest daily withdrawals for that week, and the blue line indicates the maximum daily withdrawal within that week.

Adaptive Management Triggers

Adaptive management triggers are designed to indicate when river flow or water use conditions are close to the bounds of or outside of the modelled predictions used to develop the Framework. Results of six of the seven adaptive management triggers for 2019 are summarized below. The seventh trigger, relating ecological function to surface water quantity, is under development.

Upstream Water Use

Trigger exceedance occurs when:

- Net water allocation[1] upstream of Fort McMurray reaches or exceeds 160 million m^3/year (approximately 5 m^3/s).
- Actual reported net water use upstream of Fort McMurray reaches or exceeds 60 million m^3/year (approximately 2 m^3/s).

The upstream water use trigger is intended to indicate if upstream water use begins to affect the degree to which flow measurements in the Athabasca River below Fort McMurray approximate natural flows. Water licences in the region exist for a variety of purposes, including recreation (e.g. parks and golf courses), agriculture, forestry, urban or municipal, and water or environmental management (e.g. flood control, lake stabilization, and wetlands). At present, all water allocation users are considered in the calculation of the upstream water use trigger.

In 2019, the gross water allocation upstream of Fort McMurray was 258 million m^3, with 162 million m^3 of this volume required to be returned to the river after use. The net water allocation of 96 million m^3 is therefore less than the 160 million m^3 allocation trigger.

Licence holders representing approximately 86% of the total allocated volume upstream of Fort McMurray in 2019 are required to report water use under the terms of their licences. Actual water use information is not available for the remaining 14% of the total allocation volume. The non-reporting users represent a significant water allocation volume and it is critical to account for this water use to best estimate actual net water use. The calculation of actual reported net water use, and consequently, the evaluation of this trigger exceedance, relies on estimations regarding the non-reporting users. The most consistent approach (as used in the 2015-16, 2017, and 2018

[1] Water allocations do not directly reflect actual water use. Rather, an allocation volume represents the maximum amount of water granted for use on an annual basis. Licences consists of three components: consumption, losses, and return flow.

reporting periods) bases actual reported net water use calculations on the assumption that non-reporting users utilized and returned water at the same ratio as the reporting users.

In 2019, licence holders reporting water use utilized 51% of their total allocated diversion volume and returned 62% of their allocated return volume. Applying these utilization and return ratios to the non-reporting licence holders results in an estimated gross upstream diversion of 133 million m^3, an estimated actual return flow of 101 million m^3, and the estimated net upstream water use is 31 million m^3, which is below the 60 million m^3 water use trigger. There is uncertainty associated with non-reporting users, and as such, the net upstream water use may be higher or lower than the calculated estimate. As an example, a range of 25% higher or lower than the ratio reporting users utilized and returned water was calculated. This estimates a net upstream water use range of 24 to 39 million m^3 which remains below the 60 million m^3 trigger threshold. It is recognized that the methodology used to calculate net water use of non-reporting licence holders requires refinement and a scientific review of calculation methods is ongoing.

Based on the above calculations, the Upstream Water Use trigger was not exceeded in 2019.

Changes to Long-term Seasonal Low Flow in the Athabasca River

Trigger exceedance occurs when:

- Median seasonal flow for a given season drops below the specified Long-Term Seasonal Low Flow Threshold values (Table 2) three or more times within any 10 consecutive year period.

From 2010 to 2019, median seasonal flow remained above the respective Low Flow Threshold each year (Figure 5). In 2015, flow was very close to, but remained slightly above the Low Flow Threshold in the Summer season. There was no exceedance of the Long-term Seasonal Flow trigger in the 10 year period from 2010 to 2019.

Table 2. Long-Term Seasonal Low Flow Adaptive Management Thresholds and 2019 Seasonal Flows.

Weeks	Season	Low Flow Threshold (m^3/s)	2019 Seasonal Flow (m^3/s)
1 to 15 (January 1 – April 15)	Mid-Winter	91.3	214
16 to 18 (April 16 – May 6)	Early Spring	173	838
19 to 23 (May 7 – June 10)	Late Spring	442	881
24 to 33 (June 11 – August 19)	Summer	636	1701
34 to 43 (August 20 – October 28)	Fall	298	957
44 to 52 (October 29 – December 31)	Early Winter	105	360

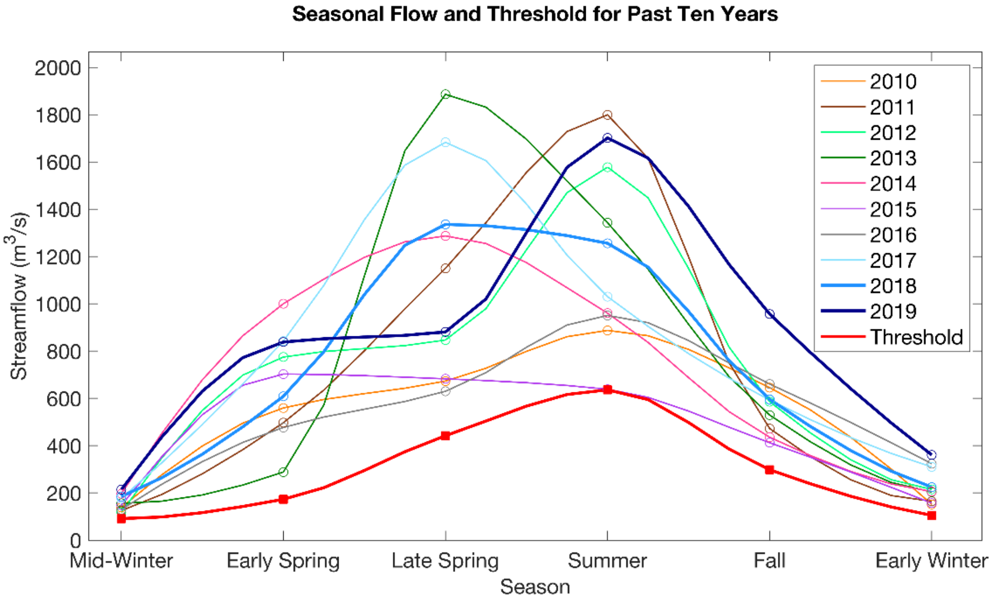

Figure 5. Comparison of seasonal low flow threshold and median flow for 2010-2019.

Long-Term Seasonal Flow Exceedance Indicator (supporting indicators)

The Framework identifies Long-Term Seasonal Flow Exceedance Indicators (Table 3), derived by determining the number of times over ten consecutive years that modelled weekly average flows would drop below a series of key flows, given a moderate climate change scenario. Weeks are divided into the winter (ice covered) and open water seasons. These indicators were designed to identify changes to river flows that might be occurring over a wider range of flows than just the very low flows utilized in the 'Changes to Long-term Seasonal Low Flows in the Athabasca River' adaptive management trigger. However, given the ten-year period of analysis, flow variability may be influenced by periods of natural variability and low-frequency and/or persistent modes of climate variability, such as the Pacific Decadal Oscillation (PDO) or El Niño-Southern Oscillation (ENSO).

The PDO oscillates between positive and negative phases with periodicities of multiple decades (Mantua and Hare 2002). Positive (La Niña) and negative (El Niño) phases of ENSO persist for approximately 9-12 months and occur every 3-5 years. Negative phases of the PDO and positive phases of ENSO are associated with higher than average streamflow, where positive PDO and negative ENSO phases are associated with lower than average streamflow in Alberta (St, Jacques *et al.* 2014; Rood *et al.* 2015). The most recent El Niño phase occurred between the last half of 2018 and first half of 2019, while the most recent La Niña phase occurred over the winter of 2017-18 (NOAA 2020). Given the duration of the PDO and ENSO phases, ten-year flow may be anomalously high or low and may not be indicative of longer-term changes.

The Long-Term Seasonal Flow Exceedance Indicators are not intended to initiate a management response, but rather, to inform an understanding of potential changes to river flow and support investigation and development of management actions when there are exceedances of adaptive management triggers.

Between 2010 and 2019, the number of winter weeks when the flow was below the thresholds was lower than the number predicted by the climate change scenarios (Table 3) for key flow rates below 1000 m^3/s, and equal to the predicted frequency for 1000 m^3/s and 1600 m^3/s (Figure 6). During the open water period the number of weeks when the flow was below the given thresholds (Table 3) was lower than the frequency predicted in the Framework (Figure 7). Based on the results of this indicator, there is no indication of significant change in the flow regime over this ten-year time period.

Table 3. Long-Term Seasonal Flow Exceedance indicators. The predicted number of weeks (over a consecutive 10-year period) below key flows, based on a moderate climate change scenario, as compared to the actual number of weeks below key flows from 2010 to 2019.

Weekly Mean Flow Rate (m^3/s)	# of Weeks Below Flow, Over 10-Year Period (2009-1028)			
	Winter (weeks 44-15)		Open Water (weeks 16-43)	
	Threshold	2019 Reporting	Threshold	2019 Reporting
87	9	0	0	0
100	37	0	1	0
125	96	25	1	0
150	131	73	1	0
200	184	154	4	0
270	221	198	13	3
400	237	225	60	13
600	240	236	133	78
1000	240	239	241	182
1600	240	240	275	247

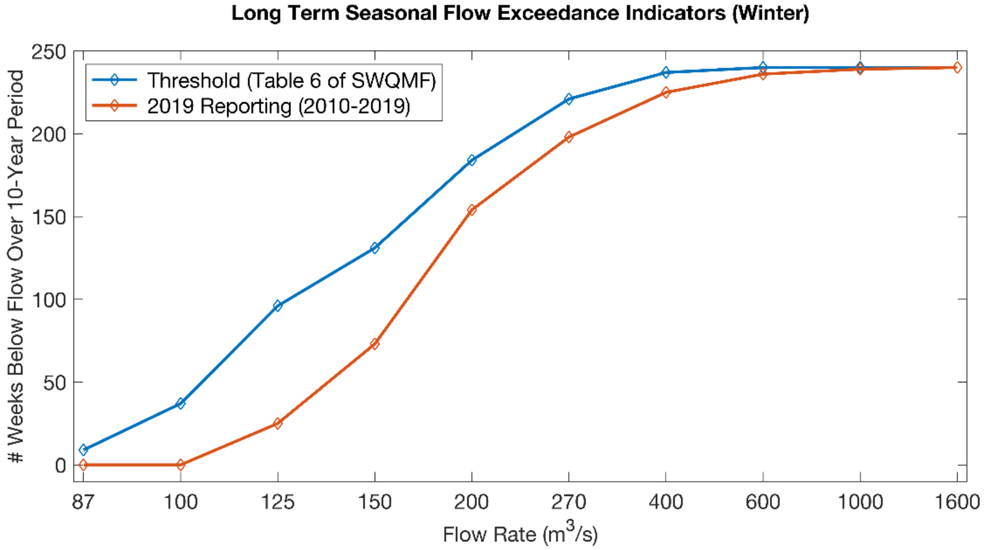

Figure 6. Evaluation of Long-Term Seasonal Flow Exceedance indicators from 2010 to 2019, for the winter season. Actual number of weeks below key flows is lower than or equal to the predicted number of weeks for all key flows.

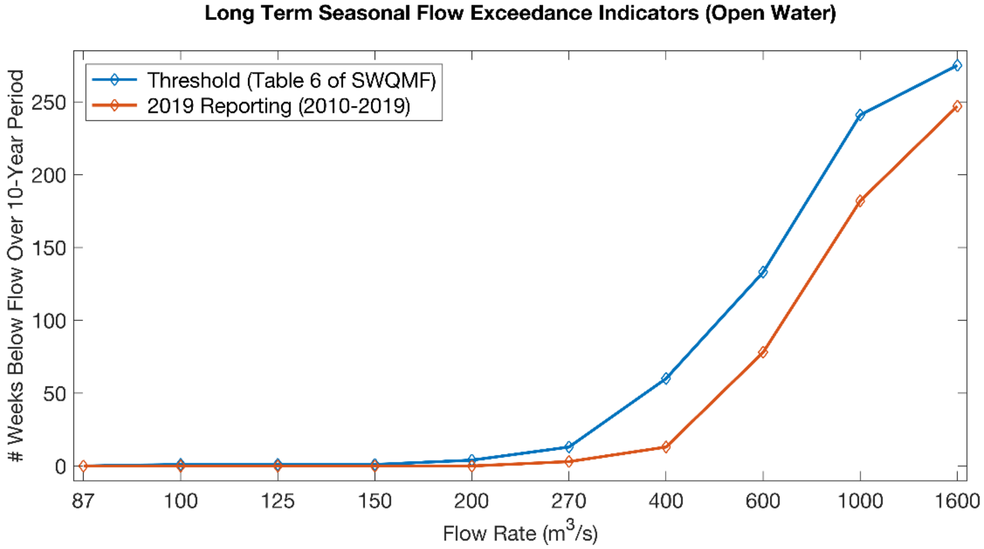

Figure 7. Evaluation of Long-Term Seasonal Flow Exceedance indicators from 2010 to 2019, for the open water season. Actual number of weeks below key flows is lower than the predicted number of weeks for all key flows.

Changes to Oil Sands Water Use

Trigger exceedance occurs when:

- Cumulative annual water withdrawals by the oil sands sector exceed 441 million m^3/year (14 m^3/s).

In 2019, the cumulative water withdrawal (gross) by the oil sands mining sector was 153 million m^3/year (4.9 m^3/s); therefore, the Oil Sands Water Use trigger was not exceeded.

Cumulative Oil Sands Water Use, Relative to Weekly Flow

Trigger exceedance occurs when:

- Cumulative (mineable and in situ) oil sands water use is equal to or greater than 10 per cent of the flow measured at the Fort McMurray station for six or more weeks during the winter period of any given year (weeks 1 to 15 and 44 to 52); or
- Cumulative (mineable and in situ) oil sands water use is equal to or greater than 6 per cent of the flow measured at the Fort McMurray station for six or more weeks during the open water period of any given year (weeks 16 to 43); or
- Cumulative (mineable and in situ) oil sands water use is equal to or greater than 15 per cent of the flow measured at the Fort McMurray station for a single week at any time of the year.

There are two winter (ice covered) periods in the 2019 calendar year - the winter beginning on week 44 of 2018 and extending to week 15 of 2019, and beginning on week 44 of 2019 (Figure 8). For the purposes of trigger exceedance calculation, this report is concerned with the cumulative number of weeks over the two winter periods in 2019 (weeks 1-15 and 44-52); however, for illustrative purposes only, the winter period beginning on week 44 of 2018 is included in Figure 8. In 2019, weekly water withdrawal by mineable and in situ oil sands producers from the Athabasca River ranged from 0.20% to 2.73% of the measured flow during the early 2019 winter period (weeks 1-15) and from 0.66% to 1.71% of the reported flow during the late 2019 winter period (weeks 44-52). During the open water period (weeks 16-43), weekly water withdrawals ranged from 0.21% to 0.80% of measured flow. Therefore, the Cumulative Oil Sands Water Use, Relative to Weekly Flow trigger was not exceeded.

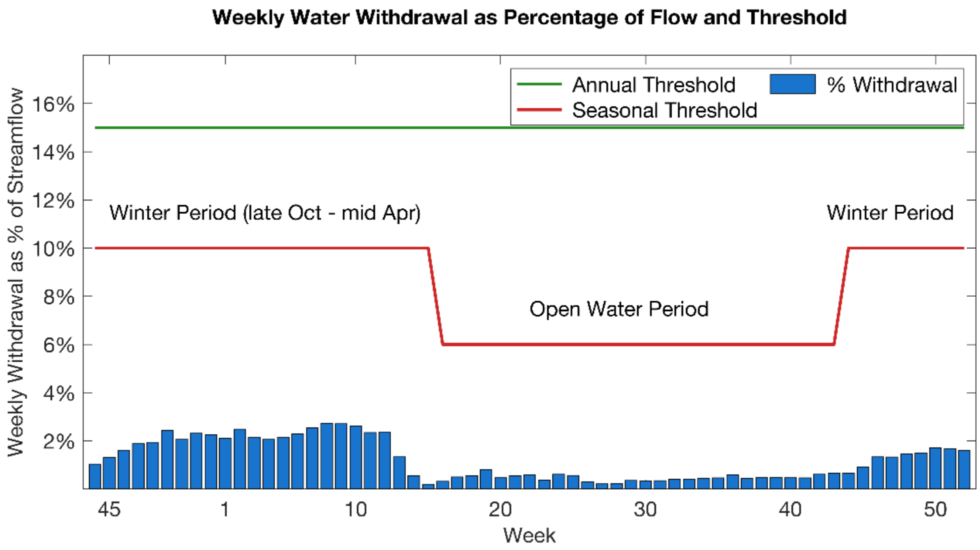

Figure 8. Weekly water withdrawal during early winter (late October 2018 – mid-April 2019), open water (mid-April – late October 2019), and late winter (late October – end December 2019) as percentage of flow, compared to annual and seasonal thresholds.

High Oil Sands Water Use During Low Summer and Fall Flows

Trigger exceedance occurs when:

- Cumulative oil sands water use exceeds the predicted full build-out scenario (16 m^3/s) during any week in the Summer/Fall season (weeks 24 to 43) in which the average weekly flow is less than 400 m^3/s.

In 2019, average weekly flow remained above 400 m^3/s every week in the Summer/Fall seasons (weeks 24 to 43; Figure 9). Weekly flows ranged from 620 m^3/s to 2454 m^3/s. Average weekly water withdrawals were well below 16 m^3/s, ranging from 3.16 m^3/s to 6.12 m^3/s (Figure 10). Therefore, the High Oil Sands Water Use During Low Summer/Fall Flows was not exceeded in 2019.

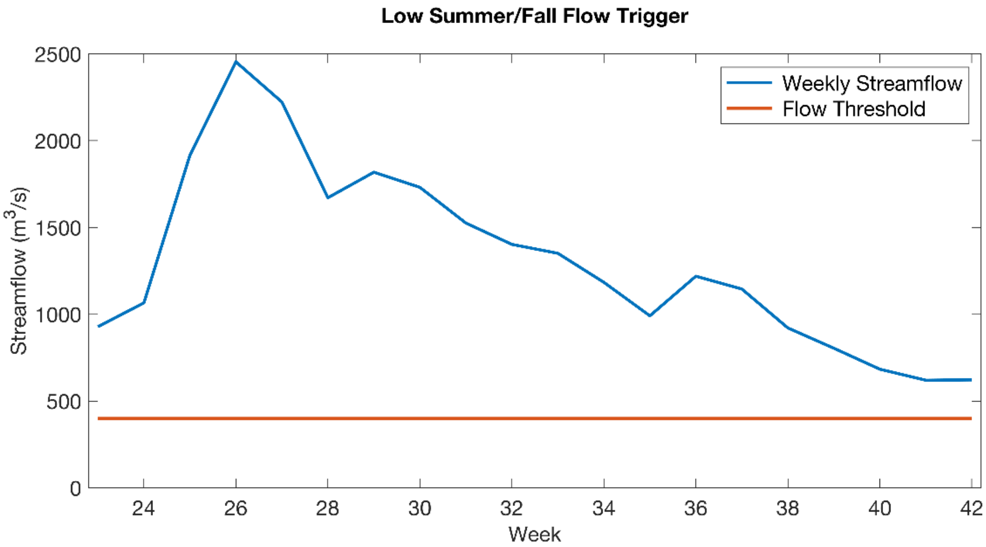

Figure 9. Streamflow for summer and fall (weeks 24-43), 2019 compared to the weekly flow threshold.

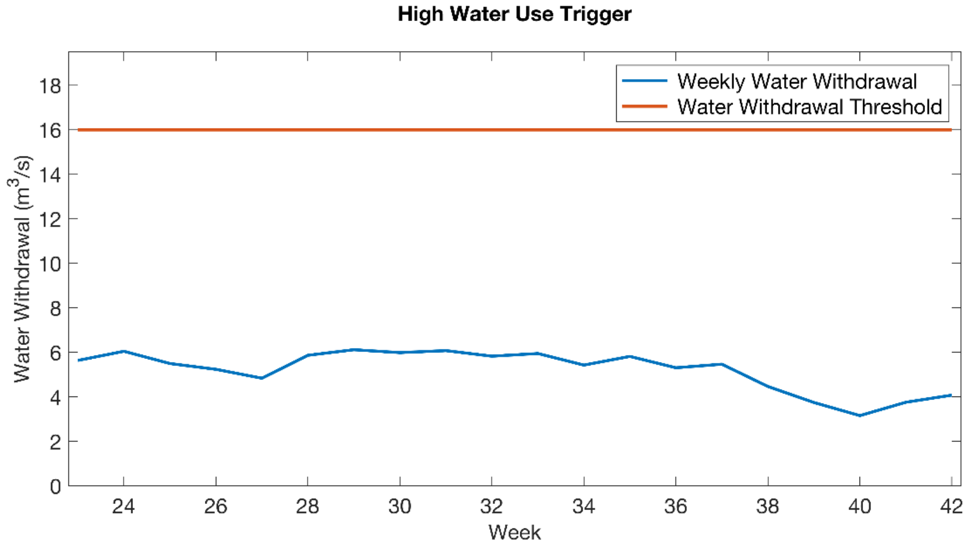

Figure 10. Weekly water withdrawal for summer and fall (weeks 24-43), 2019 compared to the threshold.

Preliminary Aboriginal Navigation Index (ANI)

Trigger exceedance occurs when:

- The fall season (weeks 34 to 43) ANI decreases by 10% after accounting for withdrawals.

The Athabasca River is an important navigational route that provides access to traditional activities for First Nations and Métis communities. Navigation can be challenging during periods of low flow, including fall when low flows can persist for weeks or months before winter freeze up. Calculation of the ANI is based on a range of stream flow navigability and is intended to provide advanced notice of potential change in river navigability. The trigger represents a change in water depth of less than 3 cm at a specific point in the river where navigation is particularly challenging and is unlikely to represent an immediate limitation to navigation or river access.

In Fall (weeks 34 to 43) 2019, the weekly decrease in ANI ranged from 0.44% to 1.10% and the average ANI decreased by 0.60% after accounting for water withdrawals for the oil sands sector from the Athabasca River (Figure 11). A summary of the weekly and seasonal ANI before and after withdrawals is provided in Figure 12. The Preliminary Aboriginal Navigation Index trigger was not exceeded in 2019.

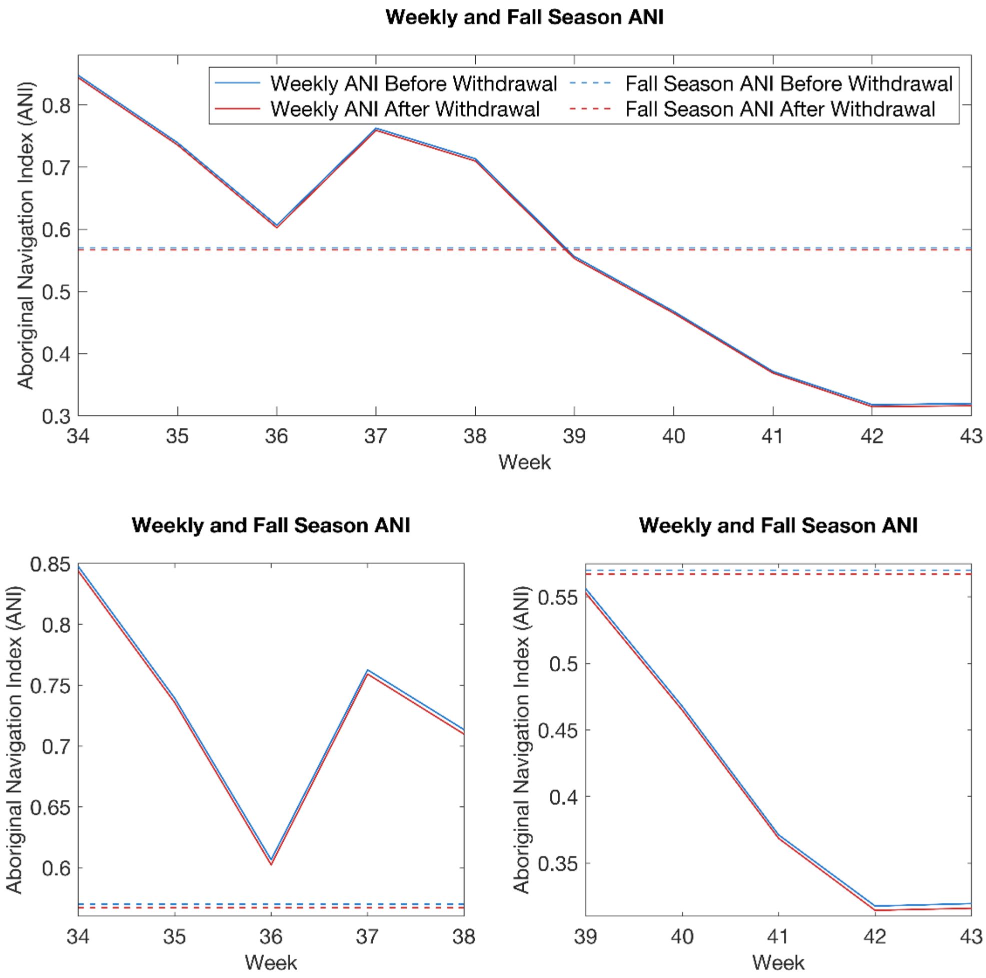

Figure 11: Fall (weeks 34 to 43) 2019 weekly and seasonal percent changes in the Aboriginal Navigation Index compared with the threshold.

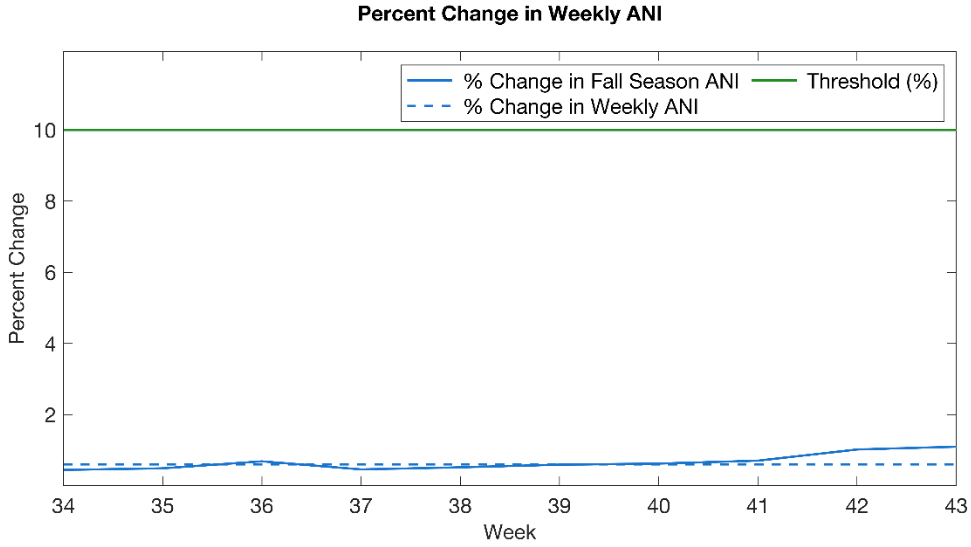

Figure 12. Fall (weeks 34 to 43) 2019 weekly and seasonal Aboriginal Navigation Index, before and after accounting for withdrawals.

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Appendix A: Summary of the weekly management triggers and cumulative withdrawal limits

2019 Reporting period

Table 4: Summary of the weekly management triggers and cumulative withdrawal limits for the 2019 reporting period

Year	Week	Weekly Flow Estimates (m3/s)	Cumulative Withdrawal Limit (m3/s)	Average Cumulative Withdrawal (m3/s)	Maximum Cumulative Withdrawal (m3/s)
2019	1	185	11.1	4.51	4.97
2019	2	184	11.04	5.37	6.16
2019	3	181	10.86	4.67	4.98
2019	4	177	10.62	4.57	4.85
2019	5	221	13.26	4.68	5.04
2019	6	216	12.96	4.66	4.96
2019	7	209	12.54	4.92	5.31
2019	8	194	11.64	5.20	5.57
2019	9	199	11.94	5.15	5.63
2019	10	199	11.94	4.97	5.49
2019	11	198	11.88	4.46	4.67
2019	12	193	11.58	5.01	5.72
2019	13	208	12.48	4.91	5.10
2019	14	250	15	4.50	4.81
2019	15	250	15	2.45	4.00
2019	16	250	16	3.21	3.90
2019	17	250	16	4.14	5.48
2019	18	410	16	3.74	3.94
2019	19	370	20	4.71	4.96
2019	20	708	20	4.09	4.81
2019	21	924	20	4.73	5.66
2019	22	791	20	5.25	6.18
2019	23	976	20	4.01	4.31

2019	24	925	29	5.64	5.77
2019	25	888	29	6.05	6.93
2019	26	1900	29	5.50	6.34
2019	27	2782	29	5.24	5.71
2019	28	1852	29	4.84	5.25
2019	29	2104	29	5.87	6.03
2019	30	1436	29	6.12	7.14
2019	31	2197	29	5.99	6.50
2019	32	1793	29	6.08	6.21
2019	33	1358	29	5.83	6.54
2019	34	1399	29	5.95	6.58
2019	35	1235	29	5.43	5.91
2019	36	970	29	5.82	6.49
2019	37	917	29	5.31	5.47
2019	38	1285	29	5.47	5.78
2019	39	984	29	4.47	5.63
2019	40	835	29	3.75	4.39
2019	41	708	29	3.16	3.55
2019	42	615	29	3.76	4.28
2019	43	619	29	4.08	4.99
2019	44	616	16	3.53	4.37
2019	45	522	16	3.88	4.56
2019	46	430	16	5.42	5.99
2019	47	323	16	5.20	5.32
2019	48	296	16	5.23	5.71
2019	49	264	16	4.91	5.34
2019	50	242	16	5.17	5.49
2019	51	239	16	5.18	5.72
2019	52	227	16	5.47	5.79

2018 Reporting period

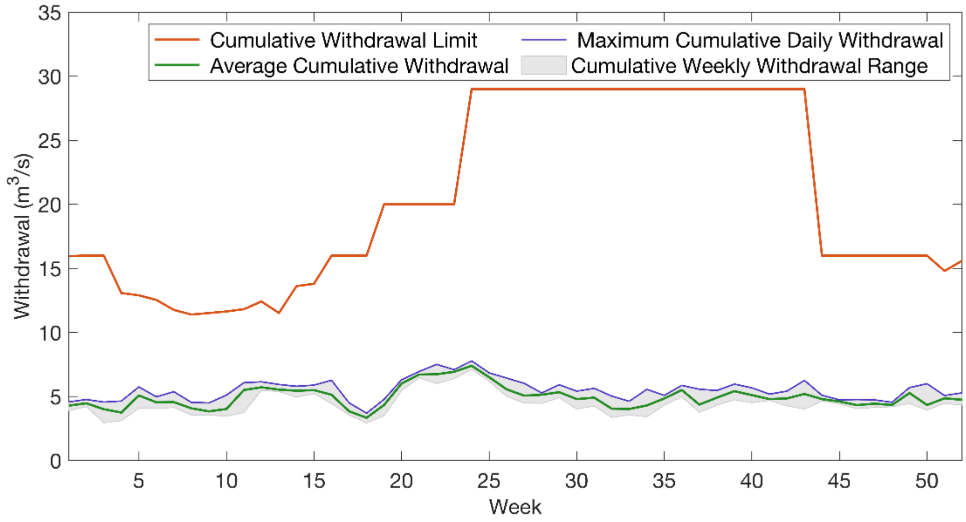

Figure 13: ***Cumulative withdrawal limits compared to withdrawal rates from January 1 to December 31, 2018. The green line represents the average cumulative withdrawal for the week, the grey shaded region represents the range between the lowest and highest daily withdrawals for that week, and the blue line indicates the maximum daily withdrawal within that week.***

Table 5: Summary of the weekly management triggers and cumulative withdrawal limits for the 2018 reporting period

Year	Week	Weekly Flow Estimates (m3/s)	Cumulative Withdrawal Limit (m3/s)	Average Cumulative Withdrawal (m3/s)	Maximum Cumulative Withdrawal (m3/s)
2018	1	266	15.96	4.29	4.58
2018	2	279	16	4.47	4.77
2018	3	272	16	4.01	4.57
2018	4	218	13.08	3.75	4.65
2018	5	215	12.9	5.08	5.75
2018	6	209	12.54	4.55	4.98
2018	7	196	11.76	4.56	5.38
2018	8	190	11.4	4.08	4.54
2018	9	192	11.52	3.84	4.50
2018	10	194	11.64	4.03	5.11
2018	11	197	11.82	5.51	6.08

2018	12	207	12.42	5.72	6.15
2018	13	192	11.52	5.54	5.94
2018	14	227	13.62	5.45	5.80
2018	15	230	13.8	5.50	5.89
2018	16	230	16	5.14	6.27
2018	17	300	16	3.85	4.51
2018	18	764	16	3.34	3.70
2018	19	560	20	4.34	4.78
2018	20	1390	20	6.01	6.31
2018	21	1420	20	6.72	6.95
2018	22	1321	20	6.74	7.51
2018	23	1220	20	6.93	7.10
2018	24	988	29	7.40	7.78
2018	25	1613	29	6.51	6.85
2018	26	1120	29	5.56	6.44
2018	27	1317	29	5.07	6.03
2018	28	1990	29	5.14	5.28
2018	29	1210	29	5.34	5.92
2018	30	1160	29	4.80	5.42
2018	31	1400	29	4.91	5.64
2018	32	1130	29	4.05	5.03
2018	33	876	29	4.03	4.63
2018	34	833	29	4.30	5.56
2018	35	626	29	4.85	5.09
2018	36	635	29	5.51	5.87
2018	37	608	29	4.37	5.57
2018	38	616	29	4.91	5.47
2018	39	538	29	5.42	5.97
2018	40	569	29	5.11	5.68
2018	41	597	29	4.80	5.19
2018	42	510	29	4.85	5.42
2018	43	487	29	5.20	6.26
2018	44	470	16	4.80	5.10
2018	45	626	16	4.61	4.74
2018	46	402	16	4.33	4.77
2018	47	290	16	4.44	4.74
2018	48	258	16	4.34	4.55
2018	49	235	16	5.27	5.70
2018	50	218	16	4.34	6.00
2018	51	185	14.8	4.86	5.08
2018	52	195	15.6	4.75	5.29

2017 Reporting period

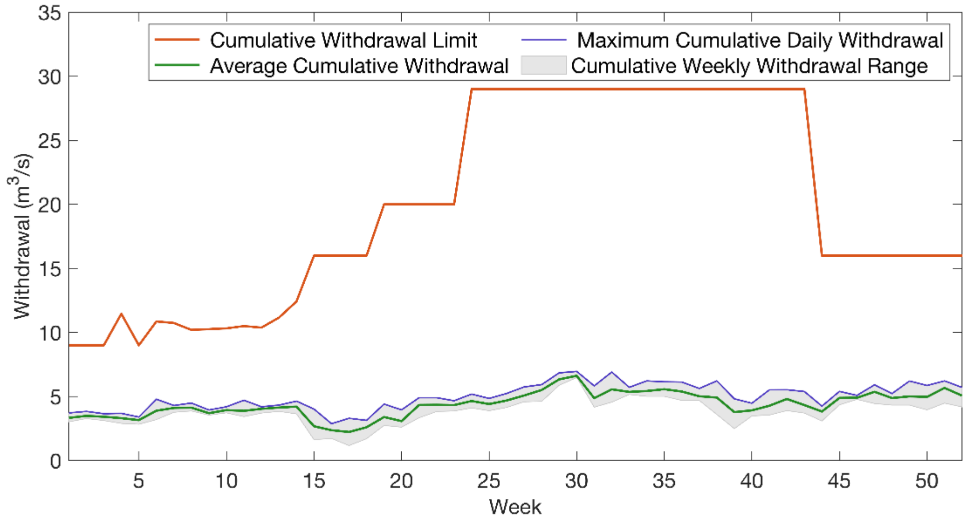

Figure 14: ***Cumulative withdrawal limits compared to withdrawal rates from January 1 to December 31, 2017. The green line represents the average cumulative withdrawal for the week, the grey shaded region represents the range between the lowest and highest daily withdrawals for that week, and the blue line indicates the maximum daily withdrawal within that week.***

Table 6: Summary of the weekly management triggers and cumulative withdrawal limits for the 2017 reporting period

Year	Week	Weekly Flow (m3/s)	Cumulative Withdrawal Limit (m3/s)	Actual Cumulative Withdrawal (m3/s)	Maximum Cumulative Withdrawal (m3/s)
2017	1	116	9	3.33	3.72
2017	2	110	9	3.49	3.84
2017	3	109	9	3.42	3.66
2017	4	191	11.46	3.31	3.69
2017	5	128	9	3.16	3.40
2017	6	181	10.86	3.89	4.79
2017	7	179	10.74	4.11	4.30
2017	8	170	10.2	4.13	4.49
2017	9	171	10.26	3.70	3.95
2017	10	172	10.32	3.94	4.20
2017	11	175	10.5	3.88	4.71
2017	12	173	10.38	4.04	4.20
2017	13	186	11.16	4.14	4.33

2017	14	207	12.42	4.21	4.64
2017	15	319	16	2.68	4.02
2017	16	321	16	2.37	2.88
2017	17	375	16	2.23	3.30
2017	18	889	16	2.60	3.14
2017	19	1185	20	3.40	4.41
2017	20	1460	20	3.08	3.96
2017	21	1820	20	4.34	4.91
2017	22	1490	20	4.35	4.91
2017	23	1740	20	4.33	4.67
2017	24	1370	29	4.65	5.19
2017	25	1836	29	4.41	4.85
2017	26	1185	29	4.69	5.24
2017	27	1160	29	5.08	5.75
2017	28	1240*	29	5.51	5.93
2017	29	973	29	6.34	6.85
2017	30	847	29	6.62	6.96
2017	31	1110*	29	4.87	5.83
2017	32	878	29	5.56	6.91
2017	33	854	29	5.36	5.72
2017	34	706	29	5.43	6.22
2017	35	583	29	5.57	6.15
2017	36	462	29	5.39	6.13
2017	37	436	29	5.02	5.63
2017	38	522	29	4.92	6.22
2017	39	506	29	3.78	4.82
2017	40	709	29	3.92	4.48
2017	41	636	29	4.28	5.52
2017	42	558	29	4.81	5.53
2017	43	627	29	4.33	5.39
2017	44	653	16	3.83	4.25
2017	45	604	16	4.89	5.40
2017	46	519	16	4.90	5.09
2017	47	361	16	5.37	5.91
2017	48	337	16	4.88	5.23
2017	49	289	16	5.01	6.21
2017	50	268	16	4.97	5.86
2017	51	308	16	5.67	6.22
2017	52	278	16	5.07	5.71

Appendix B: Inclusion of Temporary Diversion Licences

Under the province's Water Act, a licence must be obtained before diverting surface water. A Temporary Diversion Licence (TDL) provides authority for this diversion for a maximum of one year. TDLs may be regulated through either the Alberta Energy Regulator (AER) or Alberta Environment and Parks (AEP). Those regulated by AER are required to report usage, while those regulated by AEP are not. Due to this partial usage reporting, and the fact that the reporting interval for AER TDLs is normally different than term licences (i.e. monthly vs. daily), it can be difficult to calculate the exact contribution of TDLs to water withdrawals and returns. However, efforts are being made to consider their contributions for annual reporting metrics.

Oil Sands Water Usage

Oil sands water usage is reported for both the Weekly Management Trigger (Cumulative Withdrawal Limits) and Adaptive Management Triggers (Changes to Oil Sands Water Use, Cumulative Oil Sands Use Relative to Weekly Flow, and High Oil Sands Water Use During Low Summer and Fall Flows). It considers water usage directly from the main stem of the Athabasca River downstream of the Water Survey of Canada Station 07DA001. It should be noted, however, that most TDL Oil Sands users do not withdraw directly from the main stem of the Athabasca River, but from lakes and tributaries.

For 2017, 2018, and 2019 reporting shows there was no usage for AER-regulated or AEP regulated TDLs related to "Oil Sands Usage" as defined in the framework. This means that during this period Oil Sands TDL usage would not have had any effect on Oil Sands related triggers in the framework.