Lower Athabasca Region
Status of Surface Water Quantity

October 29 2015 – December 31 2016

Reporting on the Surface Water Quantity Management Framework

Alberta Environment and Parks
Policy and Planning Division

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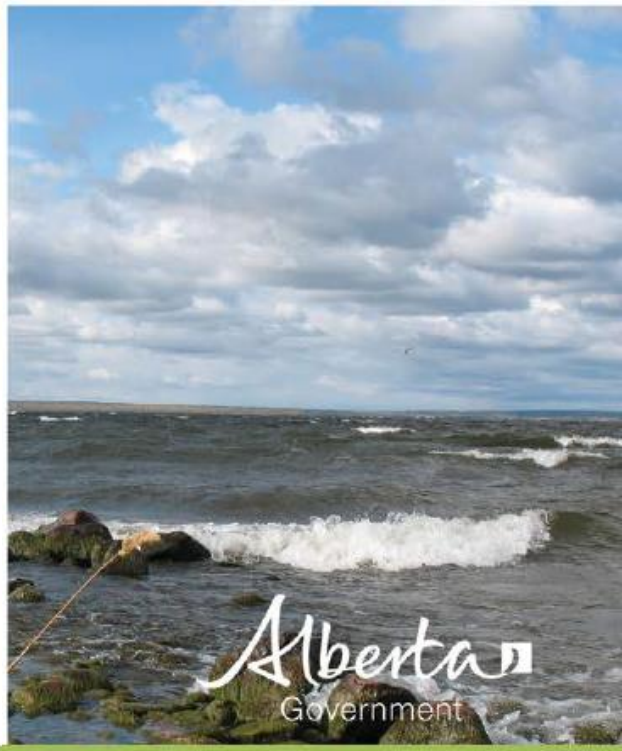

2015 and 2016 Status of Surface Water Quantity, Lower Athabasca Region, Alberta

Zahidul Islam and Chantelle Leidl

This publication is part of the Status of Ambient Environmental Condition series.

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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 flow conditions in the river and water use by the mineable oil sands sector, relative to weekly management limits, and analysis of the adaptive management triggers. The evaluation covers the time period from October 29, 2015 through to the end of 2016 and fulfills commitments for public reporting made in the Framework.

2015/16 Results Summary

From the date of framework implementation until the end of 2016

- No water withdrawal limits were exceeded (AER 2017);
- No adaptive management triggers were exceeded;
- Development of ecosystem status indicators continued considering alignment with the Lower Athabasca Region Biodiversity Management Framework. Work on the ecological knowledge gaps to support ecological indicator and trigger development continued.

Introduction

The Lower Athabasca Region Surface Water Quantity Management Framework for the Lower Athabasca River[1] (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[2] . The objective of the Framework 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* which was implemented by Alberta Environment and Fisheries and Oceans Canada in 2007.

The Framework establishes weekly management triggers and water withdrawal limits, implemented by the Alberta Energy Regulator (AER), to enable proactive management of mineable oil sands water use from the 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 flow conditions in the river and water use by the mineable oil sands sector, relative to weekly water withdrawal limits, and analysis of six of the Framework's seven adaptive management triggers. A seventh adaptive management trigger is under development to consider ecological function as related to surface water quantity. This report also provides an update on ecosystem status monitoring and studies that are being undertaken to fill knowledge gaps.

The evaluation covers the time period from October 29, 2015 through to the end of 2016 and fulfills commitments for public reporting made in the Framework.

[1] Available at https://open.alberta.ca/publications/9781460121733
[2] Available at https://www.landuse.alberta.ca/RegionalPlans/LowerAthabascaRegion/Pages/default.aspx

Lower Athabasca Regional Plan

The Lower Athabasca Regional Plan (LARP) is a management plan developed by the Government of Alberta under the Land Use Framework. The plan sets outcomes that describe what the Government of Alberta wants to accomplish at a regional level, and is given legislative authority under the *Alberta Land Stewardship Act*.

The Lower Athabasca Regional Plan applies to the Lower Athabasca Region, an area approximately 93,212 square kilometers in size located in the northeast corner of Alberta (Figure 1).

For more information on the Lower Athabasca Region, see the Lower Athabasca Regional Plan.

The Environmental Monitoring and Science division of Alberta Environment and Parks is responsible for the monitoring, assessing and reporting on the condition of the environment in the Lower Athabasca Region. Other sections of the Government of Alberta, as well as the Alberta Energy Regulator, are responsible for management of activities and resources in response to environmental conditions.

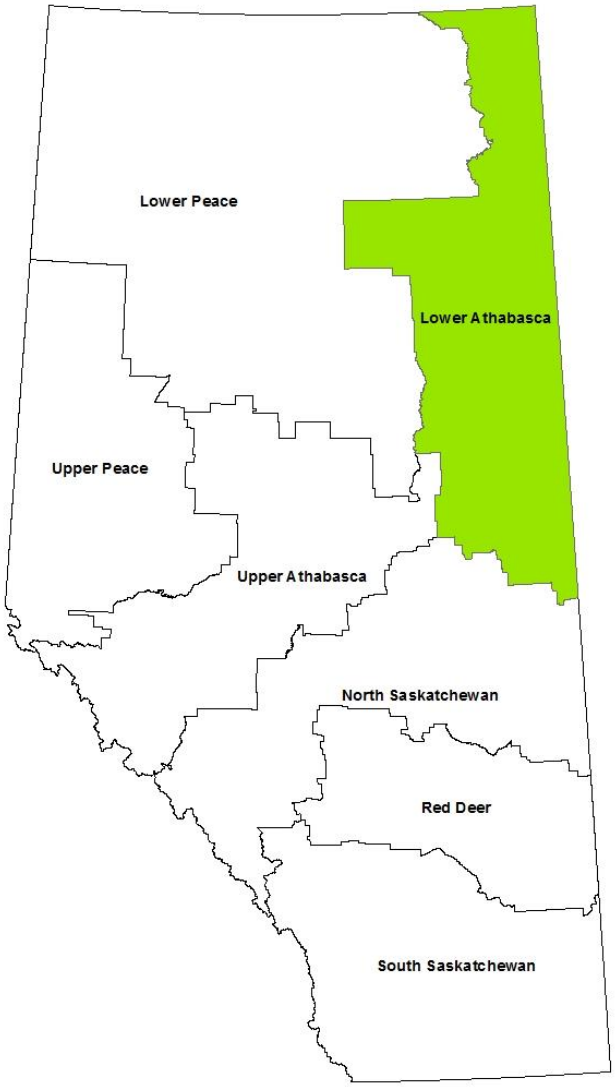


Figure 1. Land-use Framework Regions of Alberta

Data Sources

Implementation of and reporting on the Framework uses a variety of data, including both measured and modelled flow, as well as water allocation and use data from the mineable oil sands sector and other users. Evaluation of the framework is based on the calendar year.

For the purposes of the Framework, flow rates for the Athabasca River measured at the Water Survey of Canada (WSC) Fort McMurray station (WSC gauge 07DA001 “Athabasca River below Fort McMurray”) are used. This 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).

Weekly flow estimates are provided by Alberta Environment and Parks through the Athabasca River Conditions and Use website[3] to mineable oil sands operators, the Alberta Energy Regulator, and the public. These estimates are used to determine the applicable cumulative water withdrawal limit for a given week. The annual analysis of adaptive management triggers uses finalized daily streamflow data from WSC Fort McMurray station.

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 Alberta Environment and Park’s Environmental Management System (EMS). Actual water use data is reported by oil sands operators and other major water users to Alberta’s Water Use Reporting System (WURS) according to the condition specified in their licences. For the purpose of this reporting, water use upstream of the Fort McMurray station was extracted from WURS on an annual basis; while water use data from the Lower Athabasca River for the mineable oil sands operators were extracted on a daily/monthly basis.

[3] Athabasca River Conditions and Use website: http://www.environment.alberta.ca/apps/OSEM/

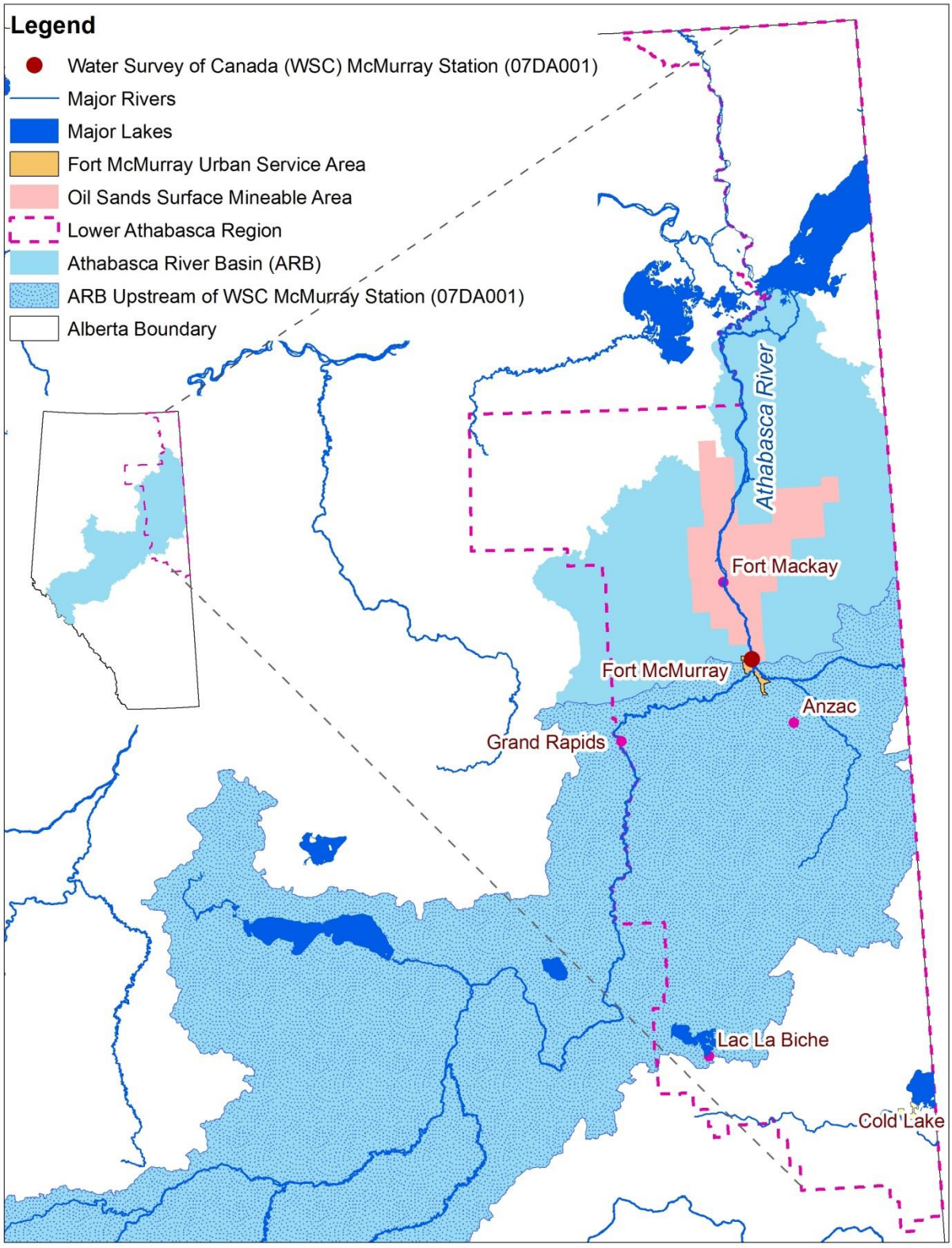


Figure 2. Location of Water Survey of Canada Fort McMurray station (WSC gauge 07DA001 "Athabasca River below Fort McMurray") in the Lower Athabasca Region of Alberta.

Indicators and Triggers

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 Alberta Energy Regulator.

Adaptive management triggers 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.

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 Alberta Energy Regulator 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 and represent the total permitted withdrawal by oil sands operators (combined) each week, based on flow. From the time the Framework took effect in October 2015, until the end of 2016, water use remained below these limits. A summary of the weekly flows and associated water withdrawal limits compared to actual water use is shown below (Figures 3 and 4) and provided in tabular form in Appendix A.

Oil sands operators using water from the Lower Athabasca River also develop and submit annual Oil Sands Mining Water Management Agreements as identified in the Framework (AER 2017). A water management agreement for the 2016-2017 period was delivered by the mineable oil sands operators. This agreement specifies the share of the available water for each of the individual mine operators during different seasons and under different stream flow conditions to ensure that the weekly cumulative water withdrawal limits under the Framework are not exceeded.

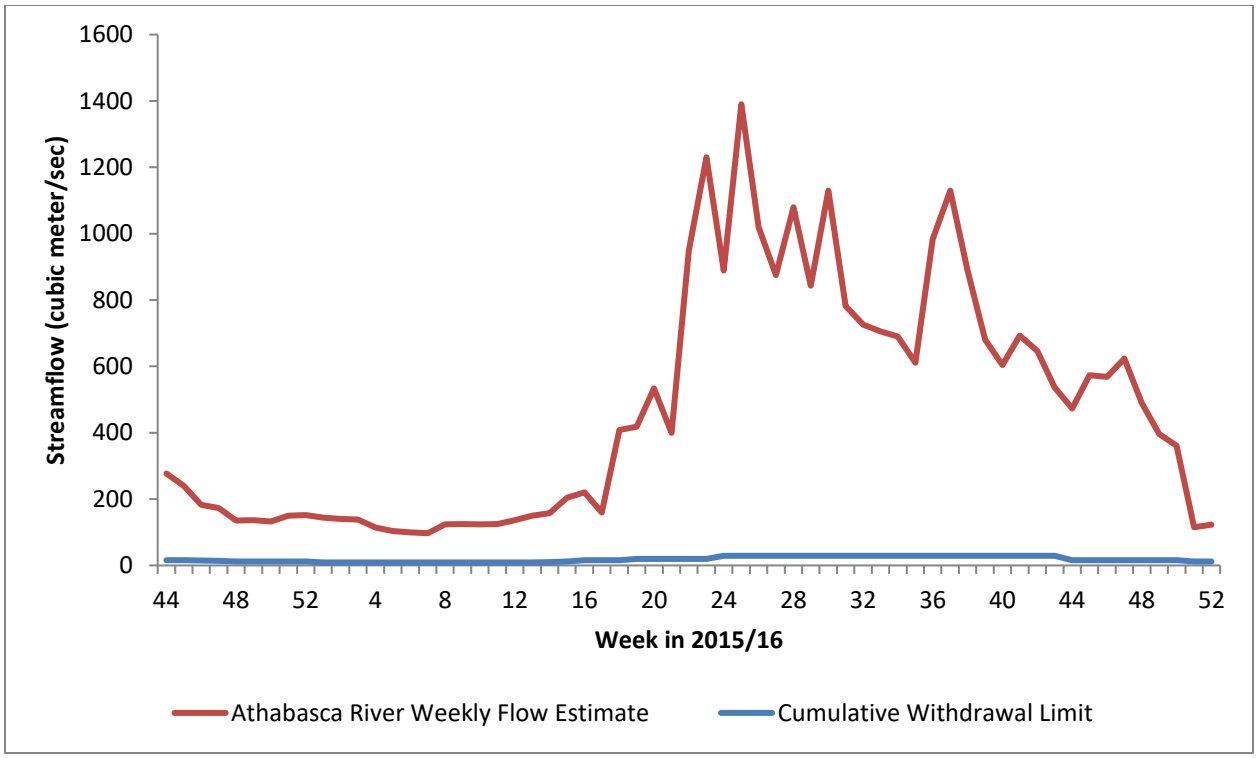


Figure 3. Stream flow compared to cumulative withdrawal limits from October 29, 2015 to December 31, 2016. Cumulative withdrawal limits represent the total permitted withdrawal by oil sands operators (combined) each week, based on flow.

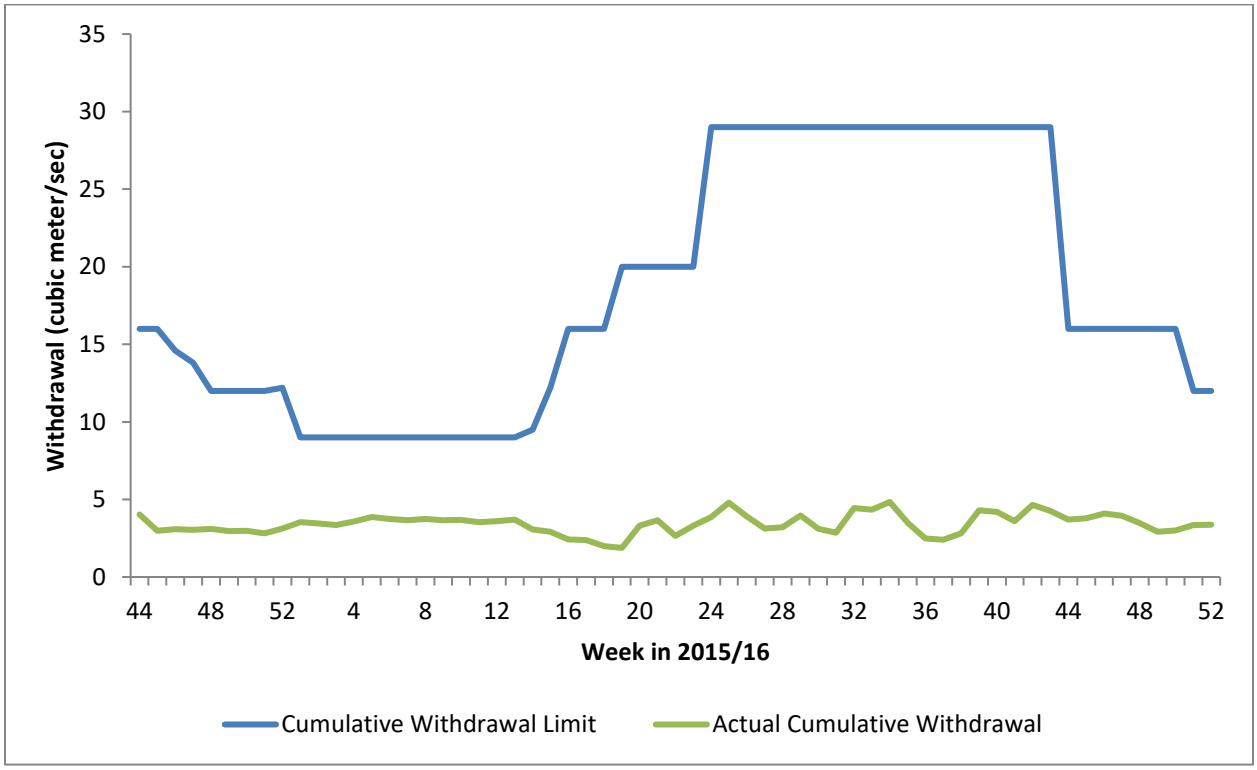


Figure 4. Cumulative withdrawal limits compared to actual withdrawal rates from October 29, 2015 to December 31, 2016 (Data provided by AER 2017). Cumulative withdrawal limits represent the total permitted withdrawal by oil sands operators (combined) each week, based on flow.

Adaptive Management Triggers

The following section provides a summary of the 2016 adaptive management trigger results. Results for the first season of Framework implementation (Early Winter, October 29 to December 31, 2015) are captured in the analysis of 2015 data. These analyses, and associated figures, are summarized in Appendix B.

Upstream Water Use

Trigger exceedance occurs when:

- Net water allocation 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).

In 2016, the gross water allocation upstream of Fort McMurray was 259 million m^3, with 164 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.

Water use information is not available for all licences upstream of Fort McMurray as many smaller licences, largely outside of the energy sector, do not have a requirement to report. Therefore, the calculation of actual reported net water use assumes that the portion of allocated volume utilized by the reported licences (those who have reported water use) is the same as that for the non-reported licences (those who have not reported water use).

In 2016, reported water use upstream of Fort McMurray accounted for approximately 85% of the total allocated volume. The licence holders reporting water use utilized approximately 51% of the total allocated diversion volume and returned 59% of their allocated return volume. Assuming the non-reporting users (accounting for 15% of the total allocated volume) also utilized 51% of their allocation diversion and returned 59% of their allocated return volume, the estimated gross upstream diversion would be 133 million m^3 and the actual return flow would be 97 million m^3. Under this assumption, the net upstream water use of 37 million m^3 is also less than the 60 million m^3 water use trigger.

Based on the above calculations, the Upstream Water Use trigger was not exceeded in 2016.

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 1) three or more times within any 10 consecutive year period.

From 2007 to 2016, median seasonal flow remained above the respective Low Flow Threshold each year (Figure 5). In 2015, flow was very close to the Low Flow Threshold in the summer season, but did not go below. Therefore, there was no exceedance of the Long-term Seasonal Flow trigger in 2016.

Table 1. Long-Term Seasonal Low Flow Adaptive Management Thresholds.

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

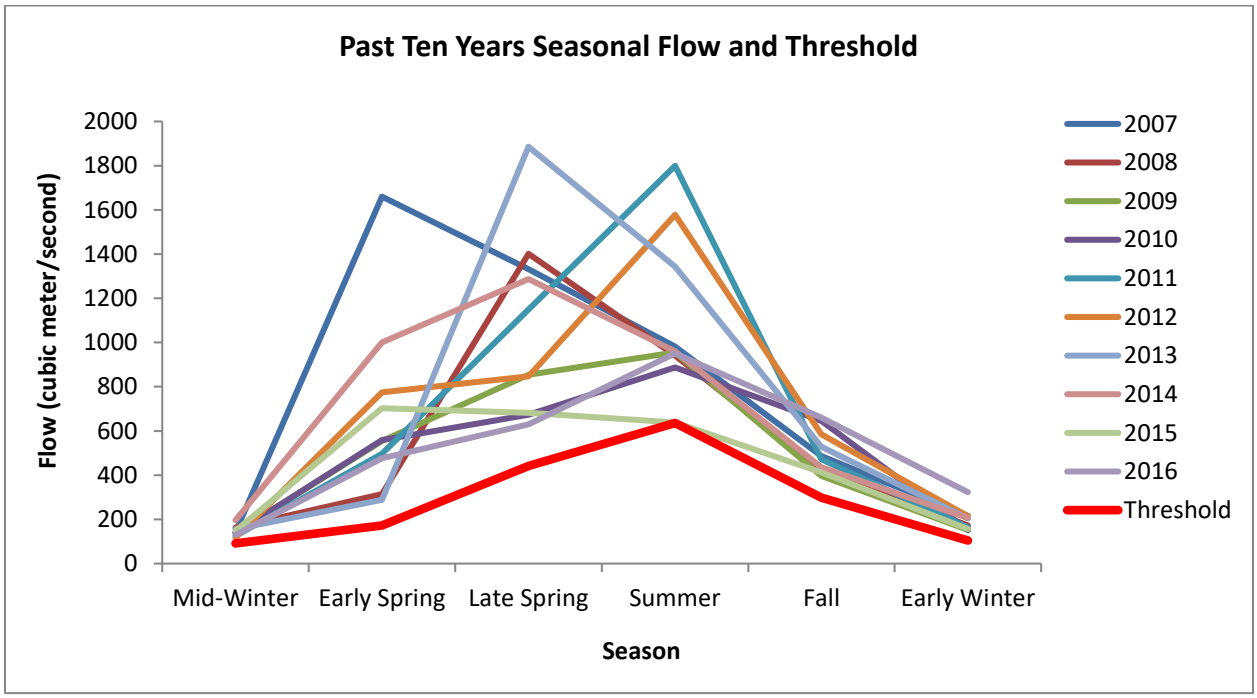


Figure 5. 2016 comparison of median seasonal flow and low flow threshold.

Long-Term Seasonal Flow Exceedance Indicator (supporting indicators)

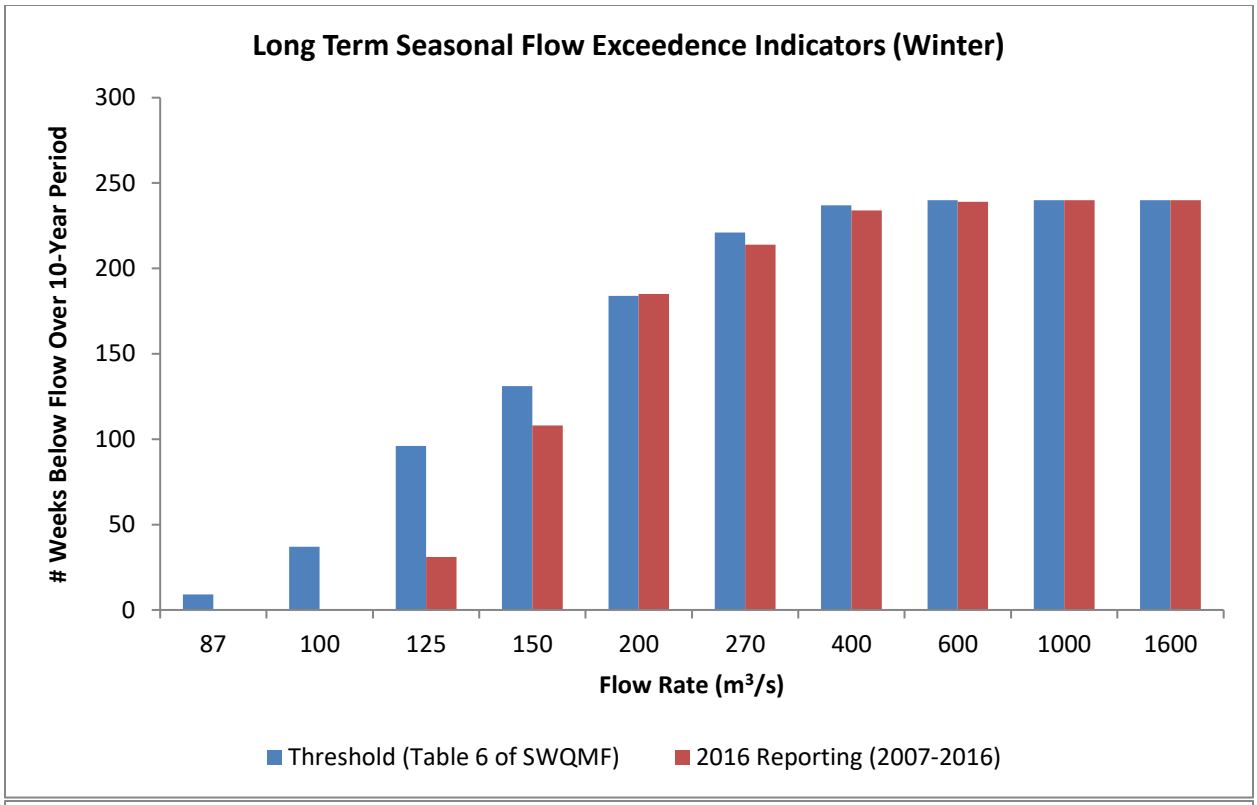
The Framework also identifies Long-Term Seasonal Flow Exceedance Indicators (Table 2), derived by determining the number of times over ten consecutive years that modelled weekly average flows would drop below a series of key flows, given a moderate climate change scenario. These indicators were designed 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.

Between 2007 and 2016, for the winter period, there was a slightly greater number of weeks where flow was less than 200m^3/s, compared to the number of weeks predicted by the climate change flow scenarios (185 weeks actual versus 184 weeks predicted) (Figure 6, top). The numbers of weeks with flow less than the lower flow rates identified in the framework (i.e. 150 m^3/s, 125 m^3/s, 100 m^3/s and 87 m^3/s) are below the numbers predicted, while the numbers of weeks with flow less than the higher flow rates identified in the framework (i.e. 270 m^3/s to 1600 m^3/s) are below or at the numbers predicted. The numbers of weeks in the open water period with flows below the key flows identified in the Framework (Table 2) were less than those predicted for all flow rates (Figure 6, bottom). Based on these overall results, there is no indication of significant change in the flow regime at this time.

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. Monitoring and reporting on these indicators will continue.

Table 2. Long-Term Seasonal Flow Exceedance indicators; predicted number of weeks (over a 10-year period) below key flows, based on moderate climate change scenario

Flow Rate (m^3/s)	# of Weeks Below Flow, Over 10-Year Period	
	Winter (week 44-15)	Open Water (week 16-43)
87	9	0
100	37	1
125	96	1
150	131	1
200	184	4
270	221	13
400	237	60
600	240	133
1000	240	241
1600	240	275



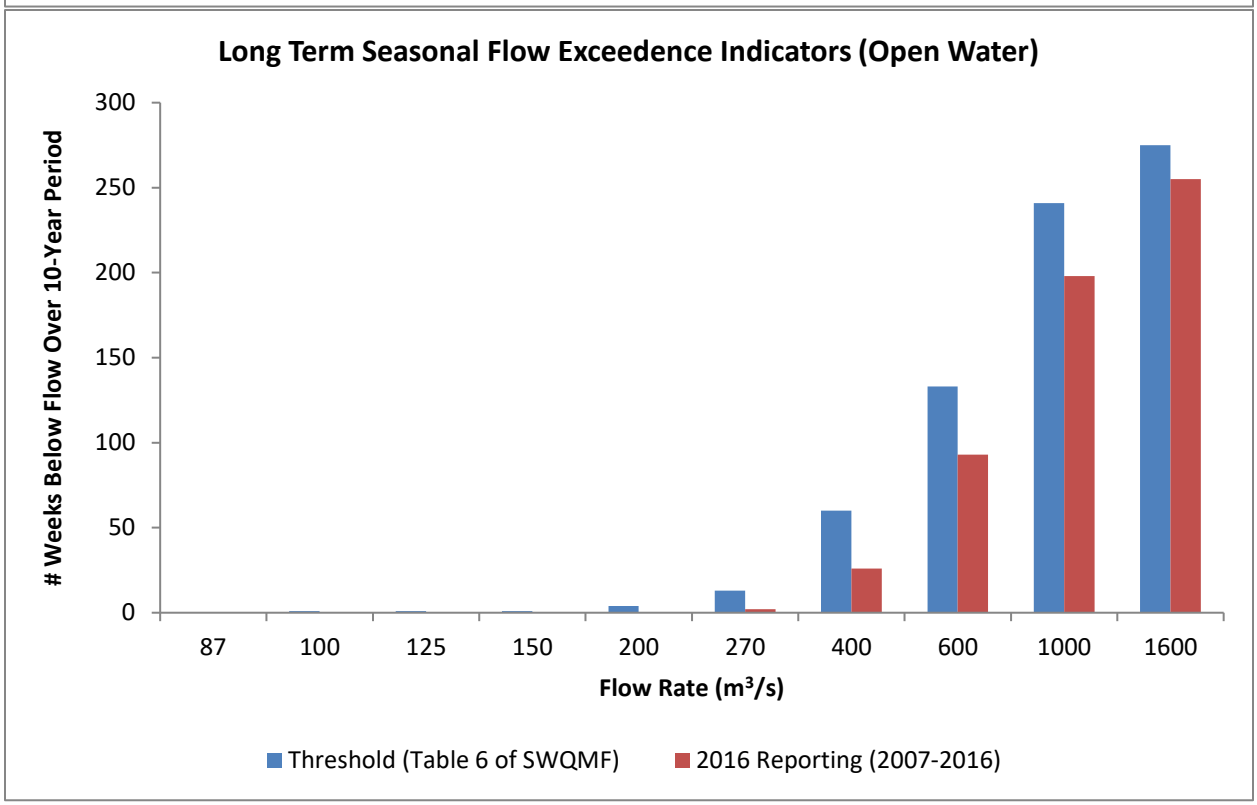


Figure 6. Evaluation of Long-Term Seasonal Flow Exceedance indicators from 2007 to 2016, for winter (top) and open water (bottom) periods. Actual number of weeks below key flow is greater than the predicted number of weeks only for flow of 200 m^3/s in winter (185 weeks actual versus 184 weeks predicted).

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 2016, the cumulative water withdrawal (gross) by the oil sands mining sector was 111.5 million m^3/year (3.53 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.

In 2016, weekly water withdrawal by mineable and in situ oil sands producers from the Athabasca River ranged from 0.63% to 3.18% of the measured flow during the winter period, and from 0.21% to 0.83% of measured flow during the open water period (Figure 7). Therefore, the Oil Sands Water Use, Relative to Weekly Flow trigger was not exceeded.

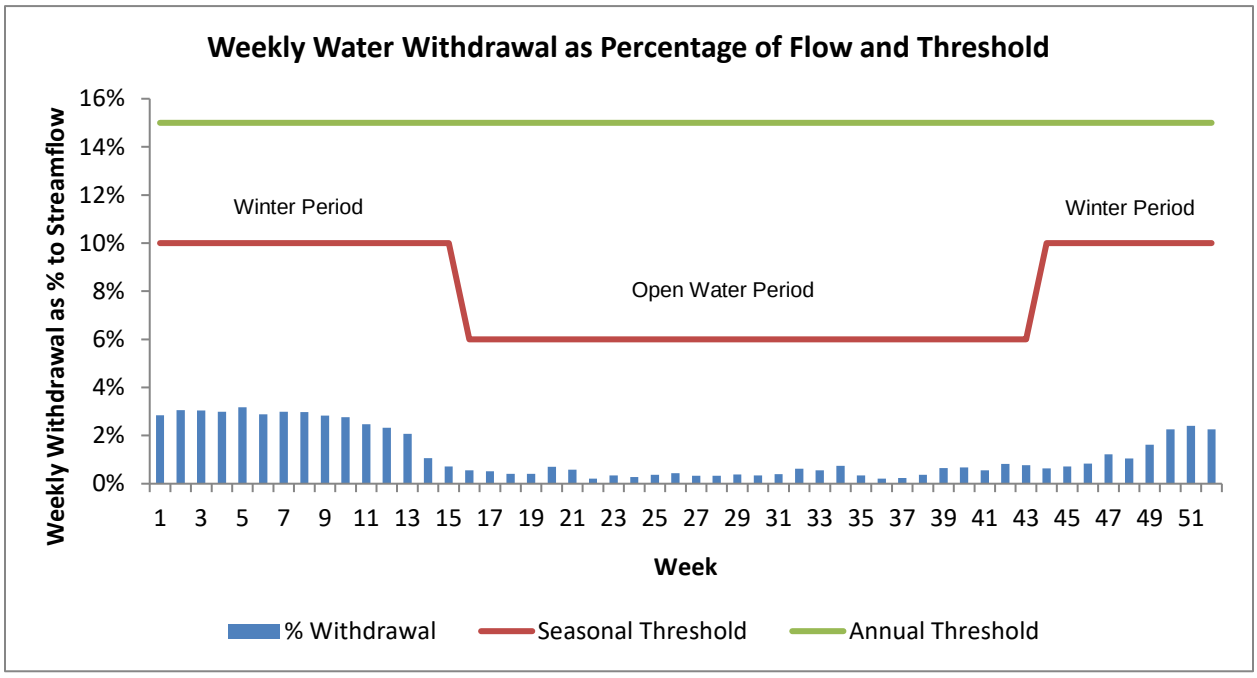


Figure 7. 2016 weekly water withdrawal as percentage of flow, as compared to thresholds.

High Oil Sands Water Use During Low Summer/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 2016, average weekly flow was above 400 m^3/s each week in the Summer/Fall season (weeks 24 to 43) (Figure 8). During this time, weekly water withdrawals were also well below 16 m^3/s, ranging from 2.5 m^3/s to 4.9 m^3/s. The High Oil Sands Water Use During Low Summer/Fall Flows was therefore not exceeded in 2016.

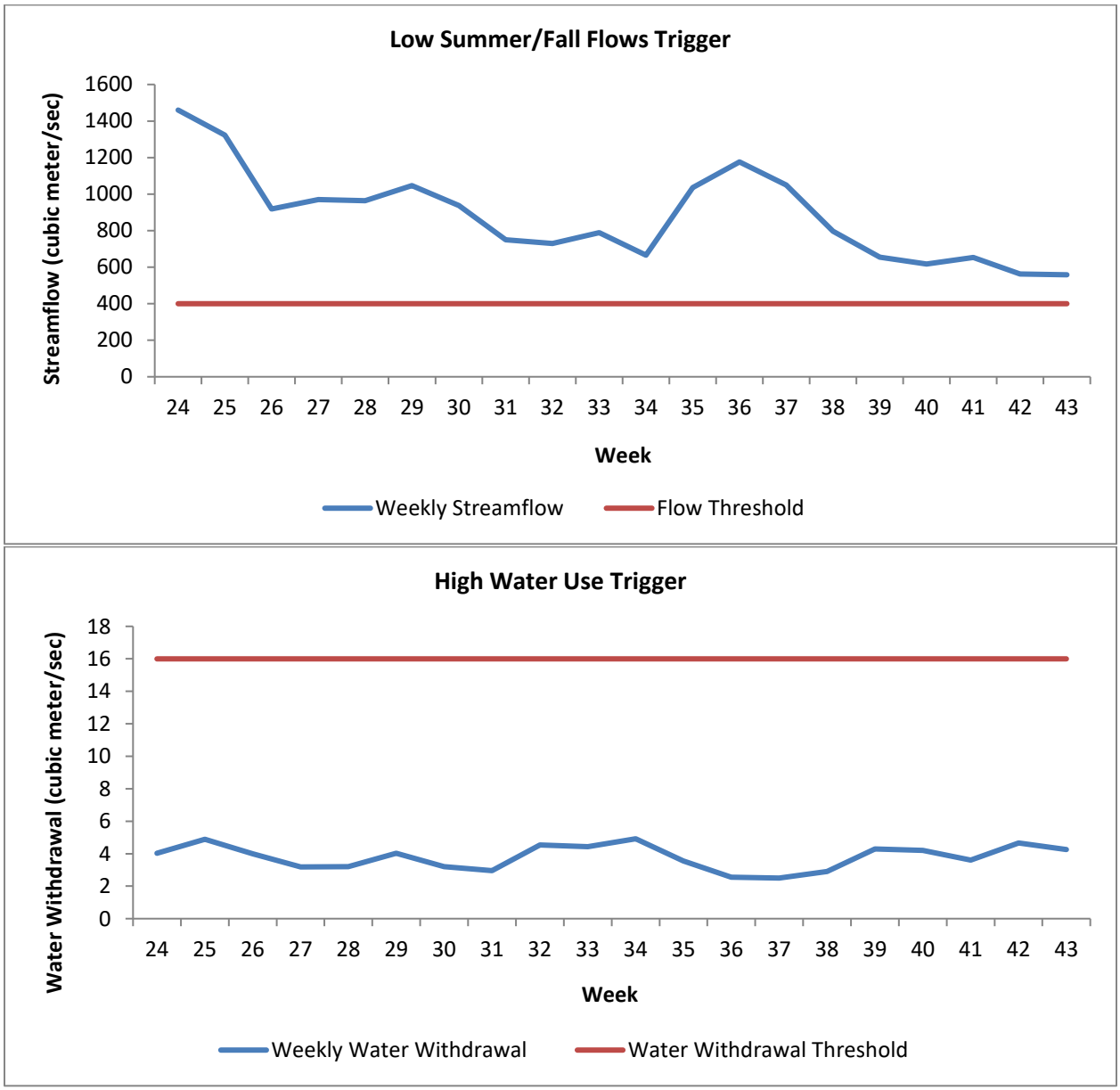


Figure 8. 2016 streamflow (top) and weekly water withdrawal (bottom) compared to thresholds.

Preliminary Aboriginal Navigation Index (ANI)

Trigger exceedance occurs when:

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

In 2016, the average fall season (weeks 34 to 43) ANI decreased by 1% after accounting for water withdrawals for oil sands from the Athabasca River (Figure 9). The Preliminary Aboriginal Navigation Index trigger therefore was not exceeded in 2016.

In support of the Aboriginal Navigation Index and ongoing data needs related to traditional use and continuous improvement under the Framework, a collaborative project with Mikisew Cree First Nation to develop an Aboriginal Peoples' Navigation Hazard Mobile Application has been initiated. Application requirements have been collected from community and government stakeholders. Development of an application that can be used on hand-held devices has been funded, received community support and is underway. The application will be available to allow river and delta users to upload their travel routes and hazards encountered. Information from the application will be used to support mitigation and travel safety as well as updates to the Framework through refinement of the Aboriginal Navigation Index and trigger.

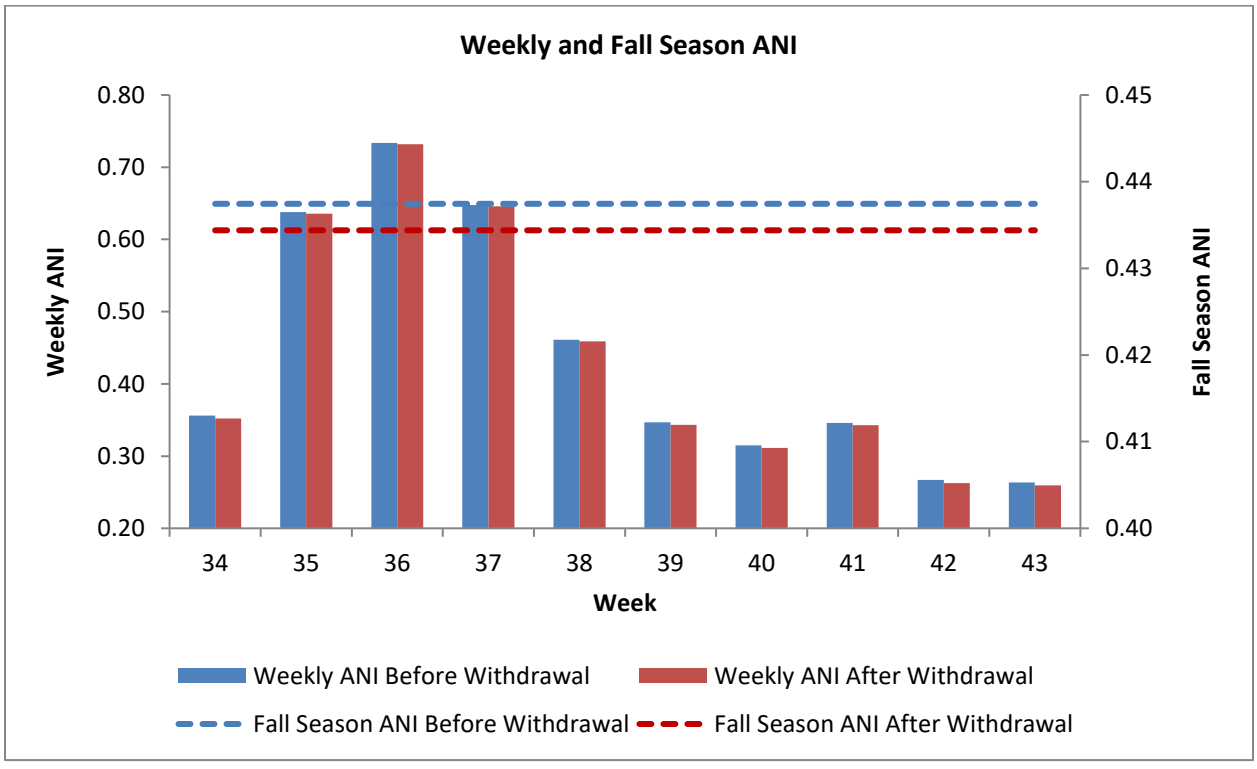


Figure 9. 2016 Aboriginal Navigation Index for the fall season, before and after accounting for withdrawal.

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

Summary of the weekly management triggers and cumulative withdrawal limits since the Makowecki Management Framework took Effect (Actual cumulative withdrawal provided by AER 2017)

Year	Week	Athabasca River Flow Rate (m3/s)	Cumulative Withdrawal Limit (m3/s)	Actual Cumulative Withdrawal (m3/s)
2015	44	277	16	4.04
2015	45	240	16	2.97
2015	46	183	14.6	3.08
2015	47	173	13.8	3.05
2015	48	135	12	3.11
2015	49	136	12	2.96
2015	50	132	12	2.97
2015	51	150	12	2.82
2015	52	152	12.2	3.12
2016	1	144	9	3.54
2016	2	140	9	3.46
2016	3	138	9	3.36
2016	4	114	9	3.58
2016	5	104	9	3.87
2016	6	100	9	3.75
2016	7	97	9	3.66
2016	8	124	9	3.75
2016	9	125	9	3.67
2016	10	124	9	3.68
2016	11	125	9	3.53
2016	12	136	9	3.59
2016	13	150	9	3.70
2016	14	158	9.5	3.06
2016	15	204	12.2	2.91
2016	16	220	16	2.43
2016	17	159	16	2.38
2016	18	408	16	1.99
2016	19	418	20	1.88
2016	20	534	20	3.30
2016	21	400	20	3.66
2016	22	949	20	2.65
2016	23	1230	20	3.30
2016	24	889	29	3.86
2016	25	1390	29	4.79
2016	26	1020	29	3.90
2016	27	875	29	3.12
2016	28	1080	29	3.21
2016	29	843	29	3.96
2016	30	1130	29	3.10
2016	31	782	29	2.86
2016	32	726	29	4.44
2016	33	705	29	4.35

Year	Week	Athabasca River Flow Rate (m3/s)	Cumulative Withdrawal Limit (m3/s)	Actual Cumulative Withdrawal (m3/s)
2016	34	690	29	4.84
2016	35	611	29	3.50
2016	36	983	29	2.49
2016	37	1130	29	2.41
2016	38	889	29	2.81
2016	39	680	29	4.29
2016	40	604	29	4.20
2016	41	693	29	3.60
2016	42	647	29	4.66
2016	43	537	29	4.26
2016	44	473	16	3.70
2016	45	573	16	3.79
2016	46	568	16	4.10
2016	47	623	16	3.95
2016	48	490	16	3.47
2016	49	396	16	2.92
2016	50	361	16	2.99
2016	51	115	12	3.35
2016	52	123	12	3.38

Appendix B: Summary of 2015 results for the adaptive management triggers

The Framework took effect on October 29, 2015 (week 44). Due to the nature of the adaptive management triggers, results for the first season of Framework implementation (Early Winter - October 29 to December 31, 2015) are difficult to isolate and are therefore captured in the below analysis of all 2015 data.

Trigger Name	Trigger Description	2015 Value	Exceedance?
Upstream water use	Net water allocation upstream of Fort McMurray ≥ 160 million m3/yr Reported net water use upstream of Fort McMurray ≥ 60 million m3/yr	93 million m^3/yr 42 million m^3/yr	No
Changes to long-term seasonal flow in the Athabasca River	Median seasonal flow for a given season < Low Flow Threshold value 3 or more times within 10 consecutive years	Median seasonal flow > threshold from 2006-15. **See Figure B1.**	No
Changes to oil sands water use	Cumulative annual oil sands water withdrawals > 441 million m^3/yr.	121 million m^3/yr	No
Cumulative oil sands water use, relative to weekly flow	Cumulative (mineable and in situ) oil sands water use is: • ≥ 10% of flow for 6 or more weeks during the winter period; or • ≥ 6% of flow for 6 or more weeks during the open water period; or • ≥ 15% of flow for a single week at any time of the year.	Winter: 0.37 to 2.7% Open water: 0.4 to 1.55% **See Figure B2.**	No
High oil sands water use during low summer/fall flows	Cumulative oil sands water use > 16 m^3/s during any week in the Summer/Fall season in which the average weekly flow is < 400 m^3/s.	Flow < 400m^3/s in weeks 41, 42, and 43; Water use < 16 m^3/s in all weeks **See Figure B3.**	No
Preliminary Aboriginal Navigation Index (ANI)	The fall season (weeks 34 to 43) ANI decreases by 10% after accounting for withdrawals.	4% decrease **See Figure B4.**	No
Ecological indicators and triggers	Under development	NA	NA

Trigger: Changes to long-term seasonal flow in the Athabasca River

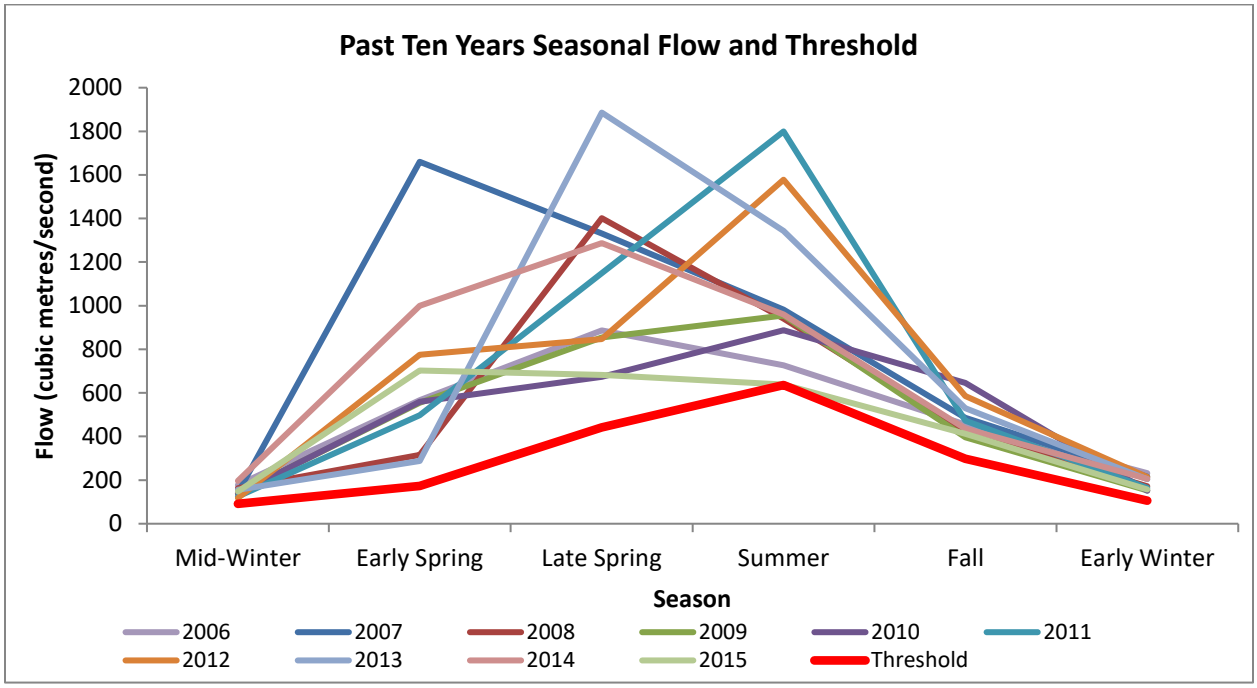

Figure B1. Comparison of 2015 seasonal flow and low flow threshold.

Trigger: Cumulative oil sands water use, relative to weekly flow

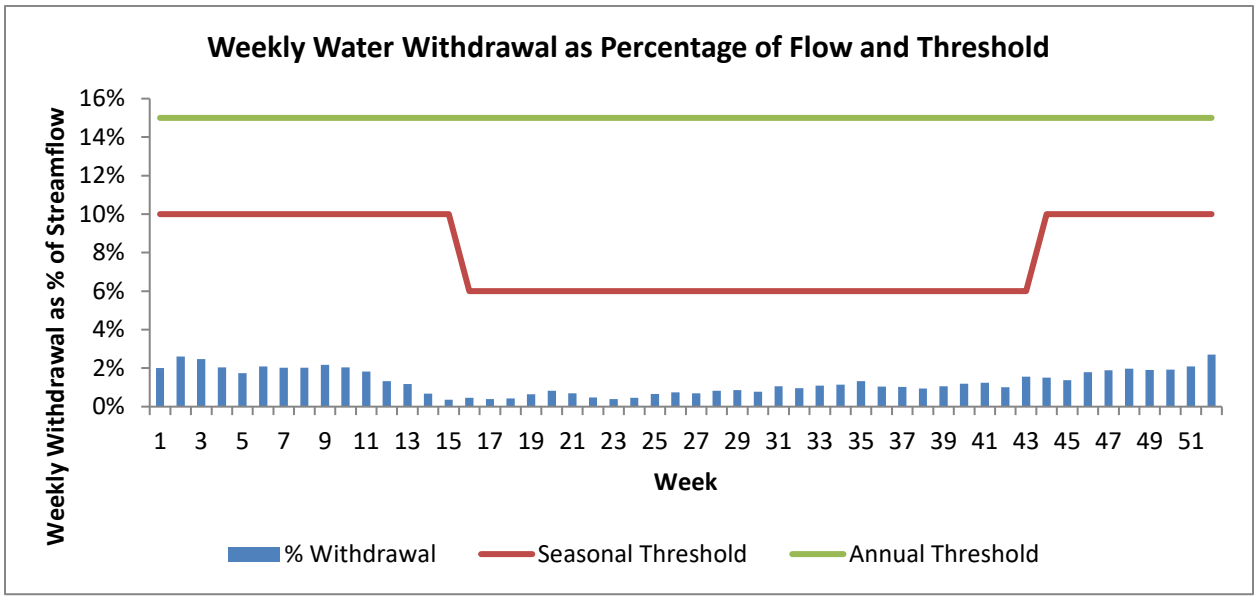

Figure B2. 2015 weekly water withdrawal as percentage of flow, as compared to thresholds.

Trigger: High oil sands water use during low summer/fall flows

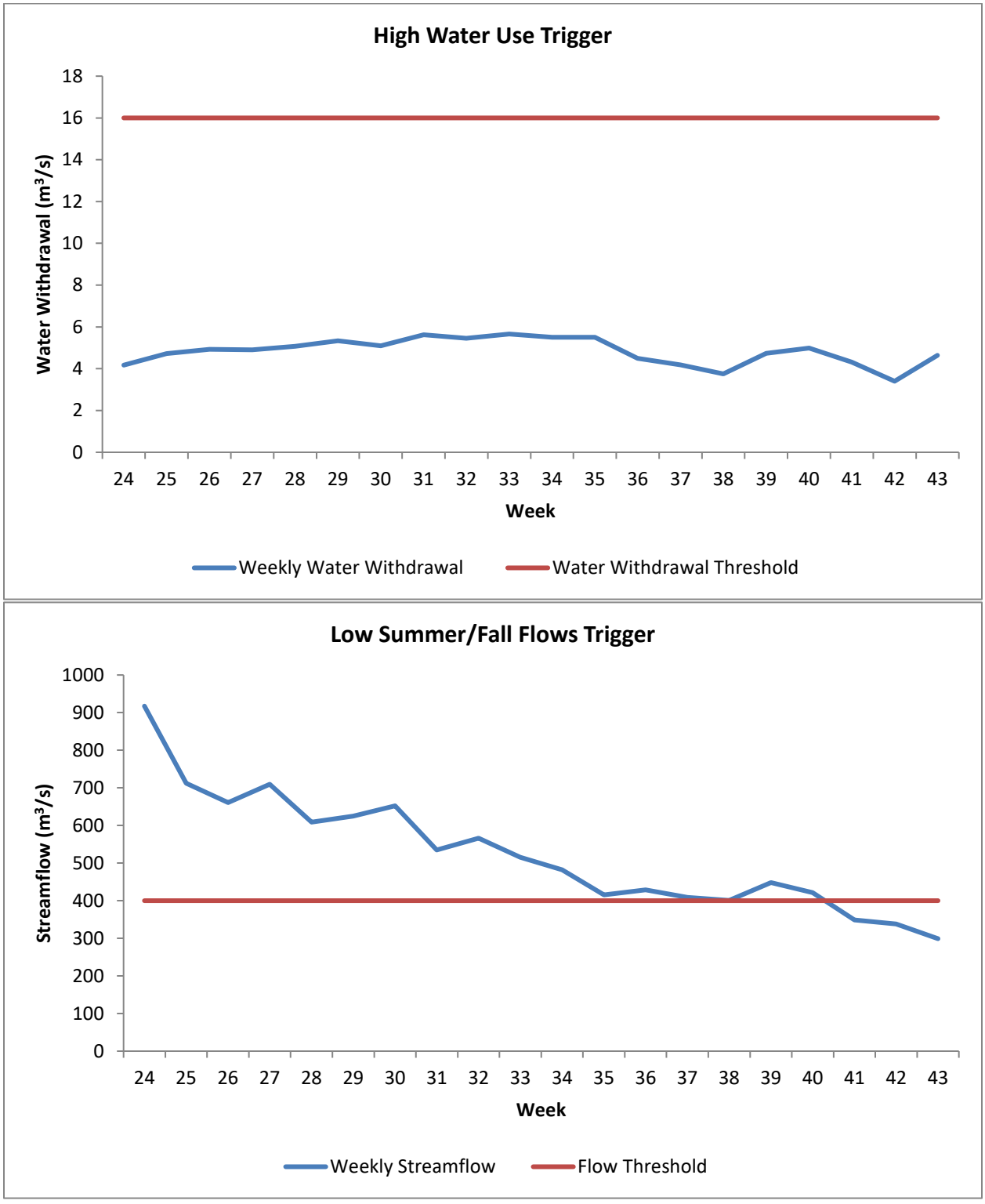

Figure B3. 2015 streamflow (top) and weekly water withdrawal (bottom) compared to thresholds.

Trigger: Preliminary Aboriginal Navigation Index (ANI)

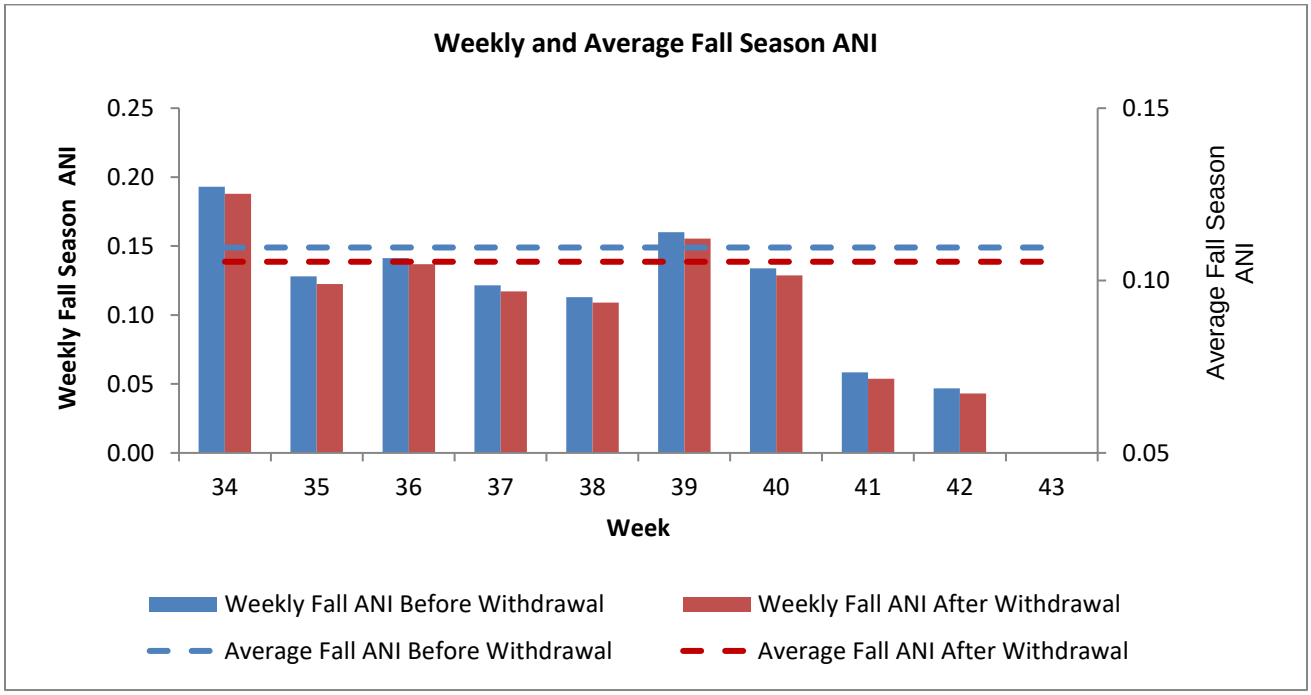

Figure B4. 2015 Aboriginal Navigation Index for the fall season.

Long-Term Seasonal Low Flow Exceedance Indicators

The supporting indicators (Long-Term Seasonal Flow Exceedance Indicators) were also evaluated for 2015, with the following results.

Indicator Name	Indicator Description	2015 Values
Long-Term Seasonal Low Flow Exceedance Indicators	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.	Between 2006 and 2015, the actual number of weeks flow was below key flows was less than the predicted number of weeks for all key flows in the open water period and for 9 of the 10 key flows in the winter period. In winter, the model predicted 237 weeks below 400 m^3/s; the actual number of weeks below 400 m^3/s was 238. **See Figure B5.**

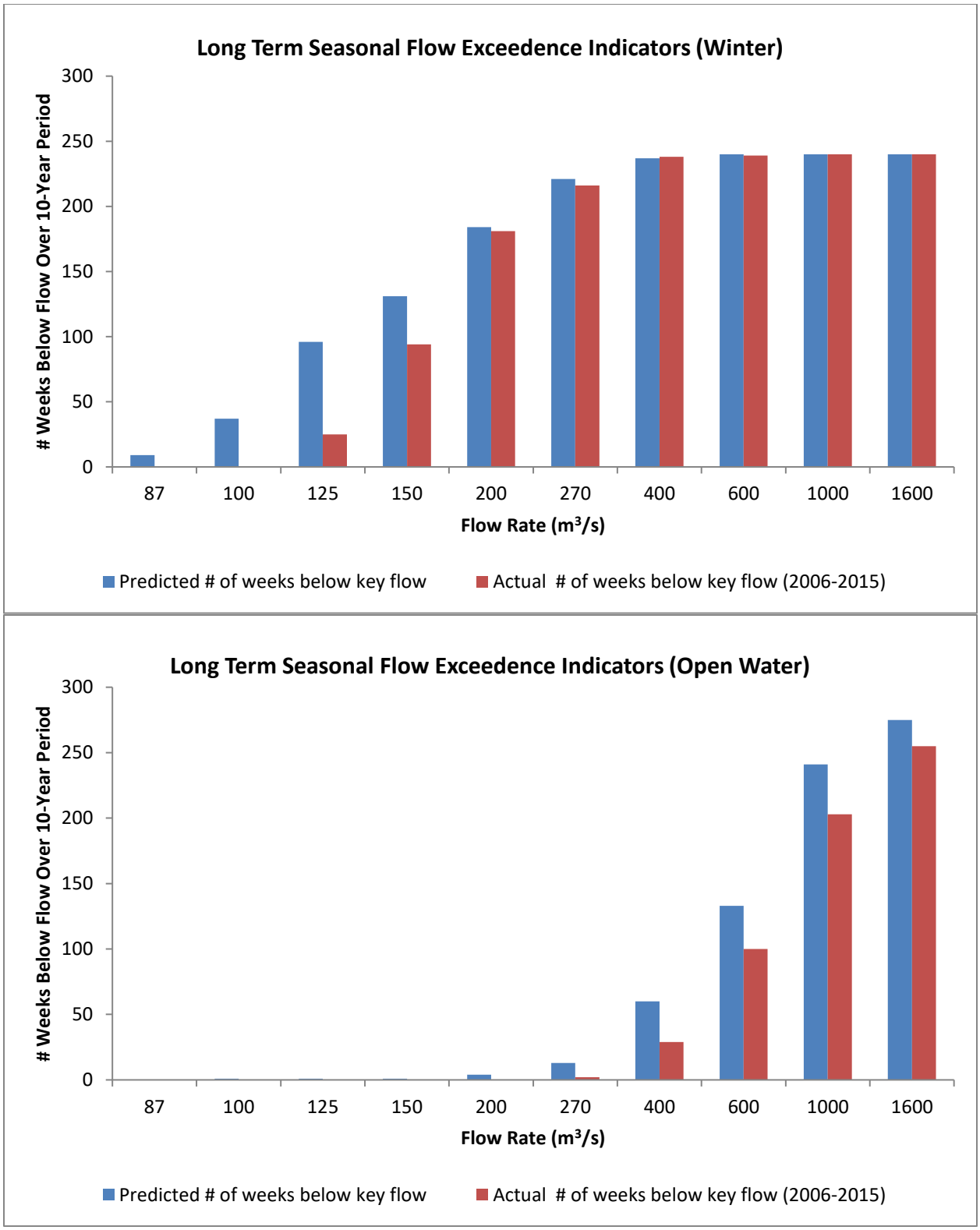

Figure B5. Evaluation of Long-Term Seasonal Flow Exceedance indicators from 2006 to 2015, for winter (top) and open water (bottom) periods. Actual number of weeks below key flow is greater than the predicted number of weeks only for flow of 400 m^3/s in winter (238 weeks actual versus 237 weeks predicted).