

2015 Fall Conditions Report

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Date:

December 21st, 2015



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EXECUTIVE SUMMARY

The fall conditions report describes the state of various factors affecting spring runoff. One major factor that affects spring runoff potential is the soil moisture at the time of freeze-up. The soil moisture before freeze-up is greatly influenced by the accumulated summer and fall precipitation. Due to the late freeze-up this year and to capture the effect of late fall precipitation, November rainfall was included in the analyses performed by the Hydrologic Forecast Centre.

Most river basins in Manitoba have received normal to above normal precipitation between April and November. The Red, Assiniboine, Qu'Appelle and Souris River watersheds have all received normal to above normal precipitation. The upstream watershed of the Saskatchewan River has received normal precipitation between April and November while the downstream portion received above normal precipitation during the same period. In particular, precipitation in September, October and November is above normal to well above normal throughout the watersheds of the Saskatchewan, Assiniboine, Qu'Appelle and the Souris River Basins.

Due to the fall and summer precipitation patterns, the soil moisture before freeze-up is above normal for the Saskatchewan, Assiniboine and Qu'Appelle Rivers, as well as the upper watersheds of the Souris River. Above normal soil moisture indicates the potential for higher risk of spring flooding within these river basins if future precipitation is normal to above normal and fast snow melt occurs. Soil moisture in these basins is slightly greater than the soil moisture observed in the fall of 2014, which led to above average runoff in the spring of 2015.

The Red River basin has a mixed soil moisture pattern. The Manitoba portion of the basin has above normal soil moisture; whereas the United States portion of the basin has normal to below normal soil moisture. The Whiteshell Lakes area, including the Lake of the Woods area, has near normal soil moisture conditions.

Current lake levels indicate that most lakes, including Lake Manitoba, are at a desirable level for this time of the year. The Saskatchewan, Assiniboine, Qu'Appelle and Souris Rivers currently have base flows that are considered well above normal; and the Red River base flow is also above normal for this time of year. Above normal base flows and levels represent a higher potential for spring flooding.

Environment Canada's latest long term precipitation forecast indicates precipitation will be above normal for parts of the Souris River basin and northern Manitoba and will be near normal for the rest of the province. The Souris River basin has already indicated above normal soil moisture. If the forecasted above normal precipitation within this basin occurs, it could lead to above normal spring runoff. Even with normal precipitation, the basins with high soil moisture could see above normal spring runoff. The Hydrologic Forecast Center will regularly monitor the winter precipitation patterns throughout these basins.

It is not very practical or feasible to provide a long term 2016 flood forecast as conditions could change significantly during the coming months. However, due to above normal soil moisture conditions and high base flow conditions, the Saskatchewan, Assiniboine, Qu'Appelle and Souris Rivers will be closely monitored. Even with normal winter precipitation, these watersheds could see major flooding if a fast melt rate or heavy spring rainfall were to occur in early spring. A single major weather storm, similar to the one observed in the summer of 2014, could cause major flooding in Manitoba.

BACKGROUND

Runoff potential leading to a possible flood or drought is generally dependent on six major factors: These are listed in the order of significance as:

1. Winter precipitation;
2. Soil moisture at freeze-up;
3. Effective spring rain (April rainfall);
4. Melt rate;
5. Frost index and;
6. Base-flow conditions.

Historically, all of the above factors have effectively contributed to either a major flood or drought. The combination of these factors is generally unique for each specific year and for each specific basin across the province. Generally, the soil moisture at freeze-up, winter precipitation, and base flow conditions are well known before spring melt and give a very strong indication of flood or drought potential.

SUMMER AND FALL PRECIPITATION

Almost all of the major Manitoba River Basins (The Assiniboine River, The Red River, The Saskatchewan River, The Souris River and The Qu'Appelle River) have received normal to above normal precipitation between April and November. Figures 1 - 3 show how the precipitation received during this period compares to normal conditions and Figure 4 shows the total accumulated precipitation from May 1st – November 15th.

The Red River basin has received different precipitation amounts for September, October and November. The upstream portion of the basin in the US has received below normal precipitation while the downstream portion of the basin in Manitoba has received above normal precipitation for the same period. The records for September, October and November indicate that Saskatchewan, including the upstream basins of the Saskatchewan River, Assiniboine River, Qu'Appelle River and Souris River watersheds have received above normal precipitation. Northern Manitoba has also received above normal precipitation for that time period and the rest of the province received near normal precipitation amounts. Figures 5 and 6 show the fall precipitation amounts compared to normal conditions.

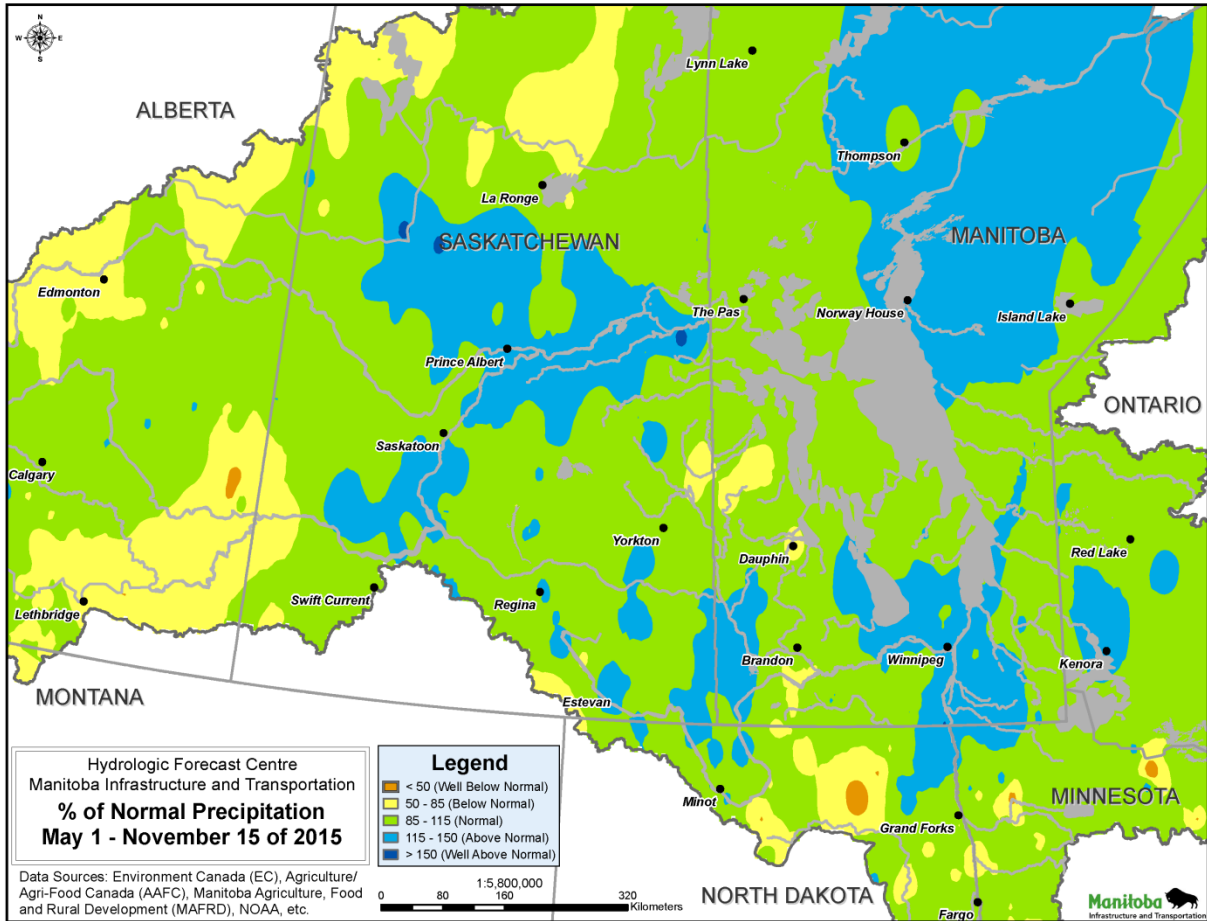


Figure 1: Percent Normal Precipitation (%) from May 1 to Nov 15, 2015.

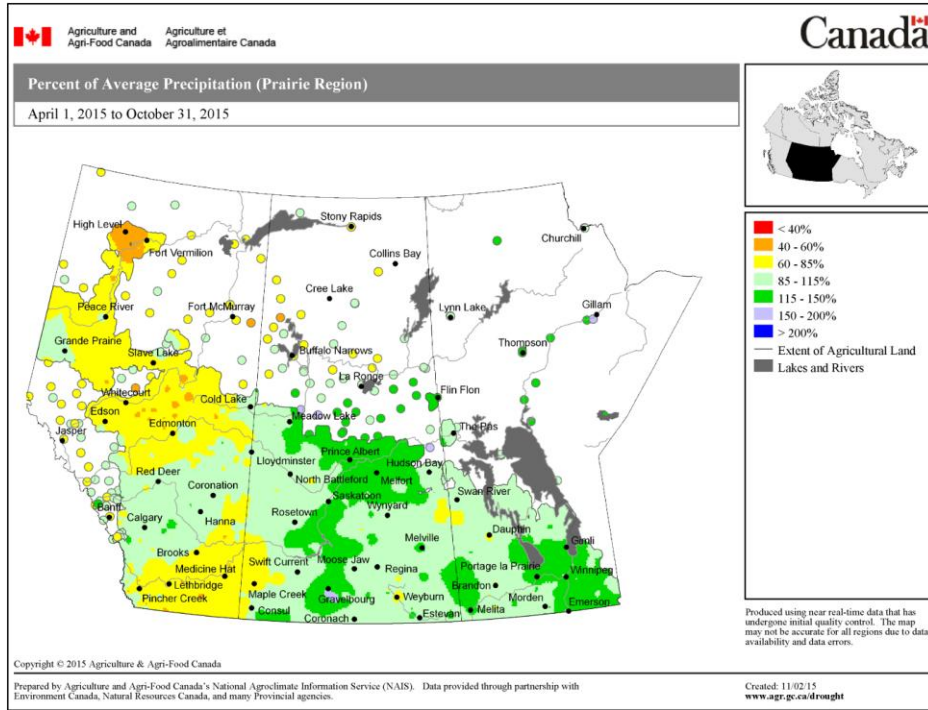


Figure 2: Percent Average Precipitation (%) from Apr 1 to Oct 31, 2015. (AAFC)

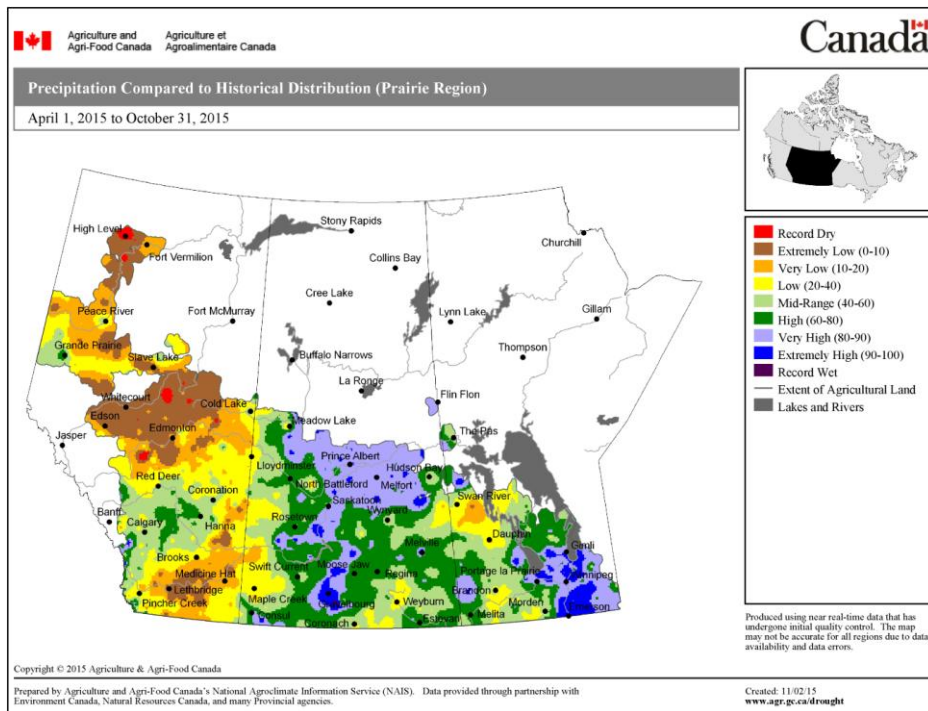


Figure 3: Precipitation Compared to Historical Distribution from Apr 1 to Oct 31, 2015. (AAFC)

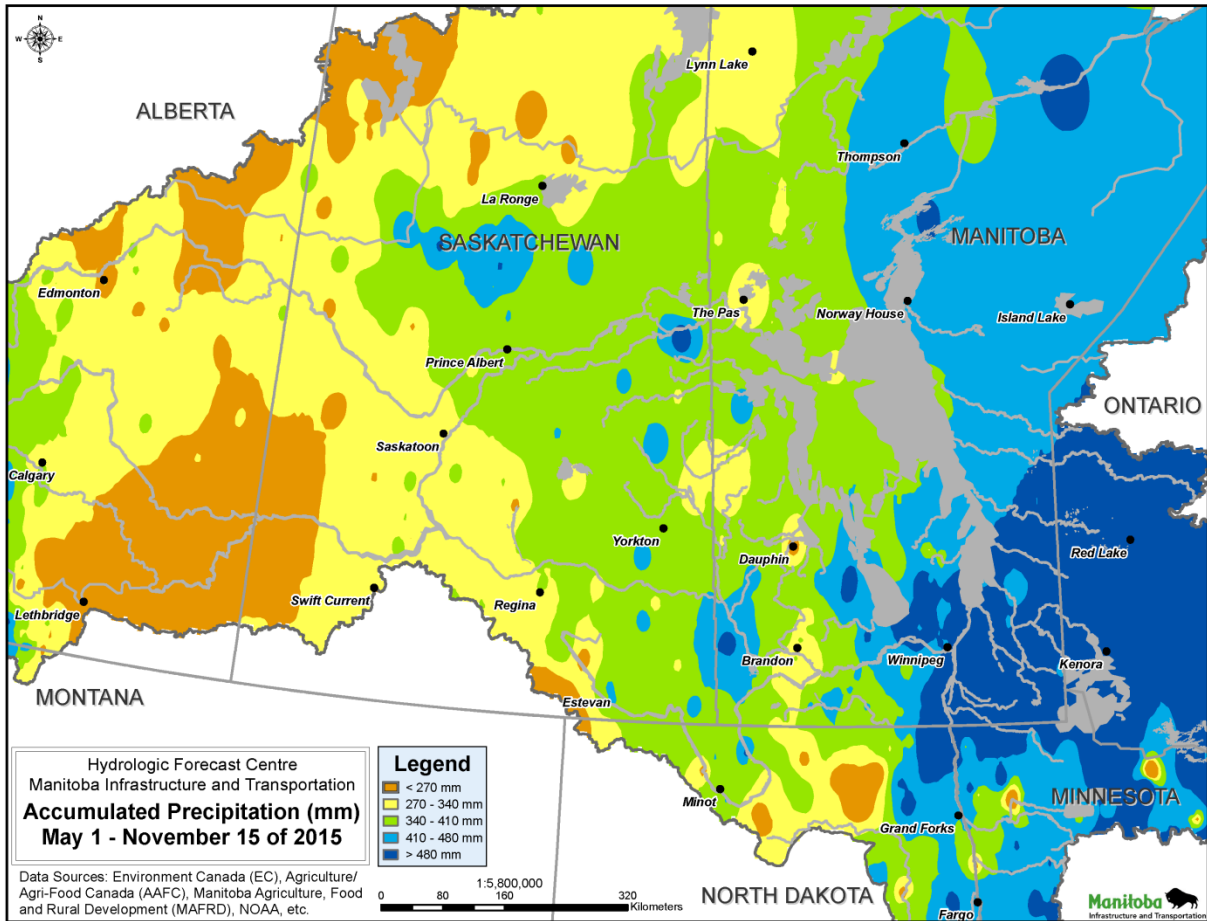


Figure 4: Total Accumulated Precipitation (mm) from May 1 to Nov 15, 2015.

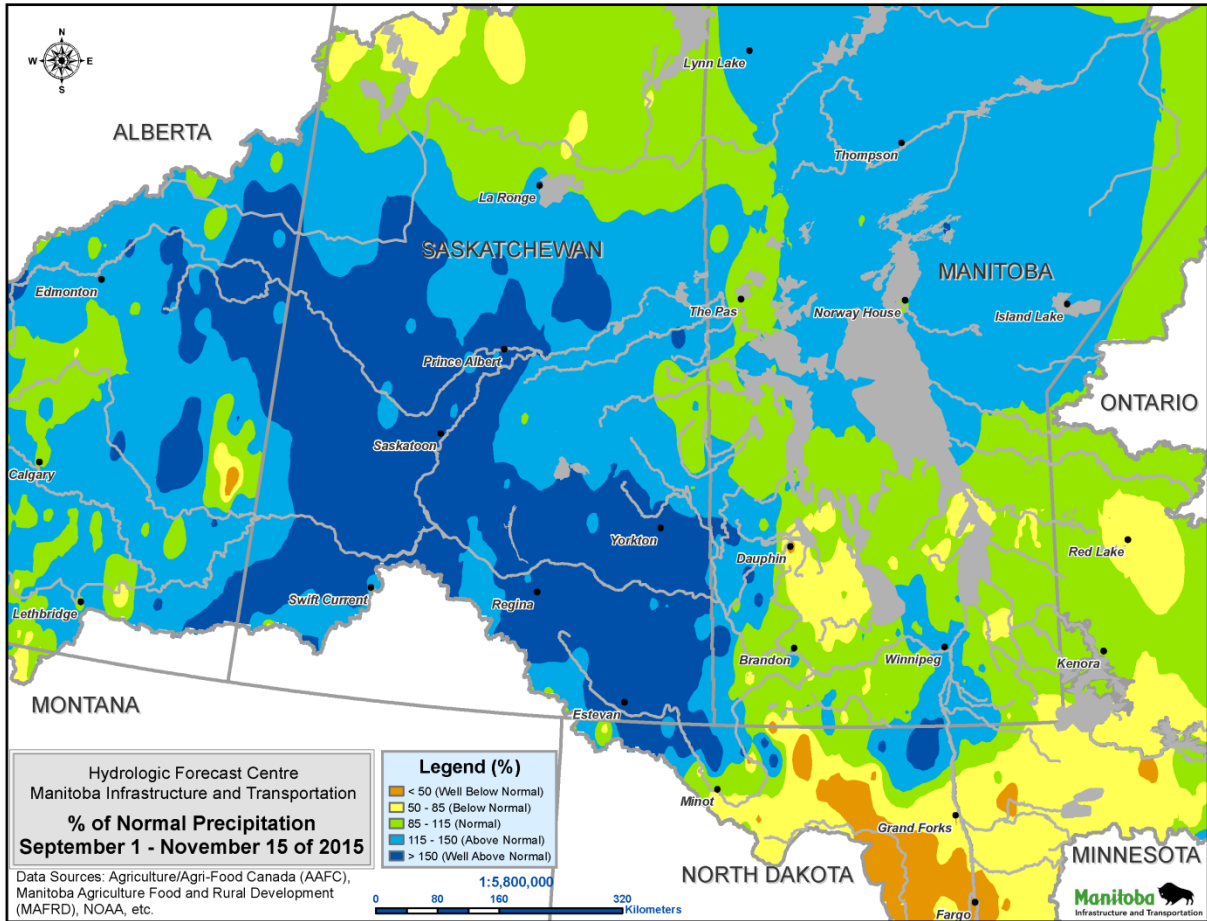


Figure 5: Percent Normal Precipitation (%) from Sept 1 to Nov 15, 2015.

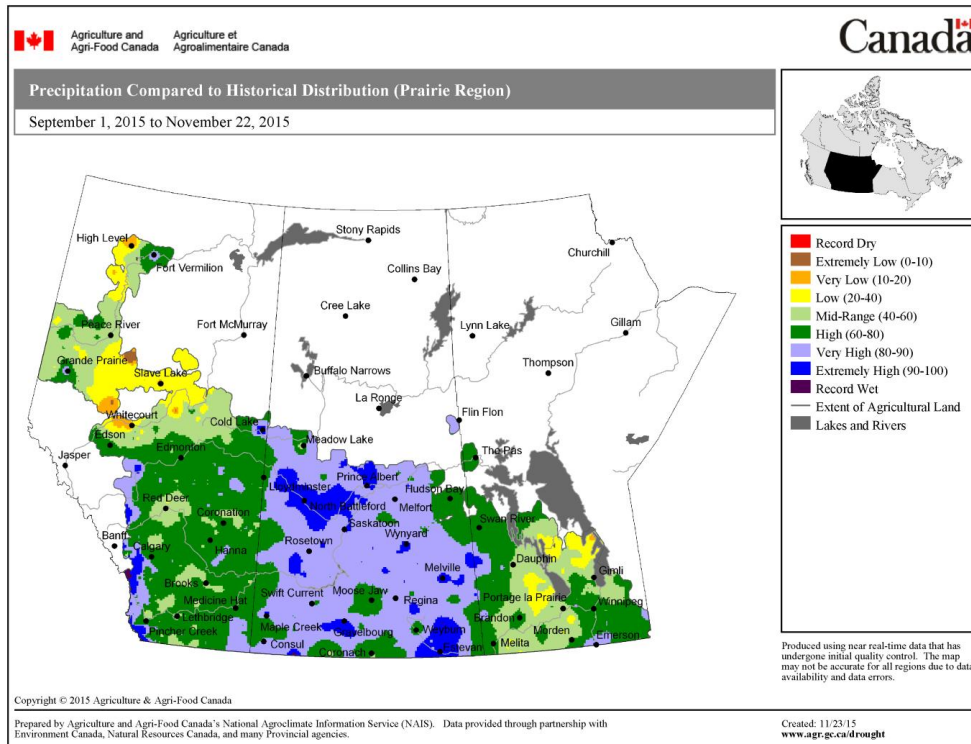


Figure 6: Precipitation Compared to Historical Distribution from Sept 1 to Nov 22, 2015. (AAFC)

SOIL MOISTURE CONDITIONS

A number of different tools have been used to determine the soil moisture before freeze-up. The most common method, which has been used for years, is Manitoba's MANAPI model which is the API (Antecedent Precipitation Index) method. The API index map for the fall of 2015 is shown in Figure 7. The other common method is the Airborne Gamma Survey, which uses radiation technology from low-flying aircraft to determine the soil moisture within the top 20 cm of soil. The Gamma Survey has been conducted in the southern and south western Manitoba basins and the results are shown on Figure 8. Manitoba Agriculture Food and Rural Development (MAFRD) also conducts routine surveys physically measuring soil moisture in root zone across the province. These results, which are usually presented in either percent water holding capacity of the soil or millimetres of water available in the root zone, are expected to be available in January 2016. A recent advancement in satellite image technology has also enabled the estimation of soil moisture in the top 5 cm of soil from satellite imagery. Satellite soil moisture mapping is conducted by AAFC and the results are presented in Figure 9.

Soil moisture is normal to above normal for most of Manitoba and above normal throughout lower and central Saskatchewan. The soil moisture is below normal for the US portion of the Red River basin.

Although soil moisture is relatively high throughout Manitoba and Saskatchewan, it is drier than the soil moisture observed in the fall of 2010. For comparison purposes, soil moisture conditions in the fall of 2010 and November precipitation in 2010 are presented in the Appendix. Also included is the winter accumulated precipitation from November 2010 to March 2011.

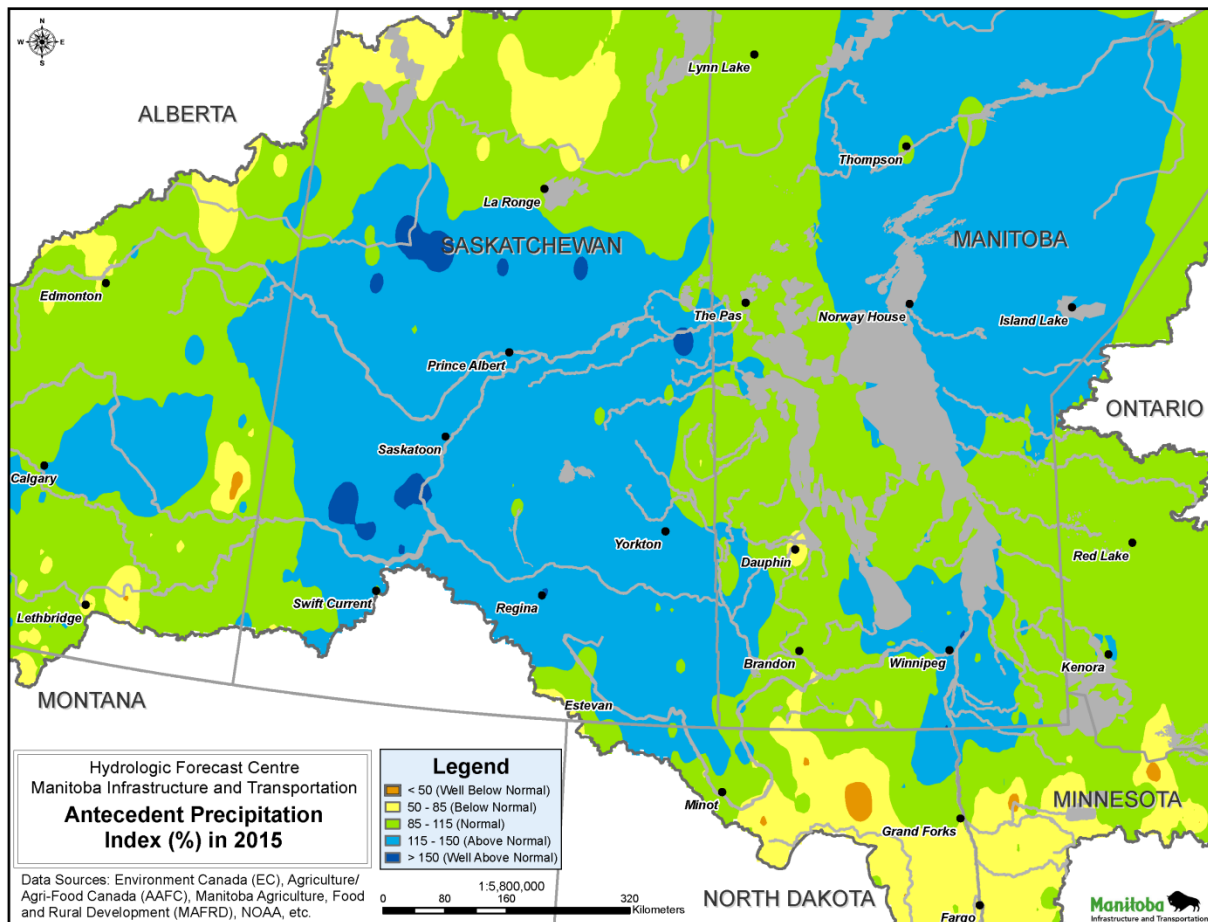


Figure 7: Antecedent Precipitation Index for 2015.

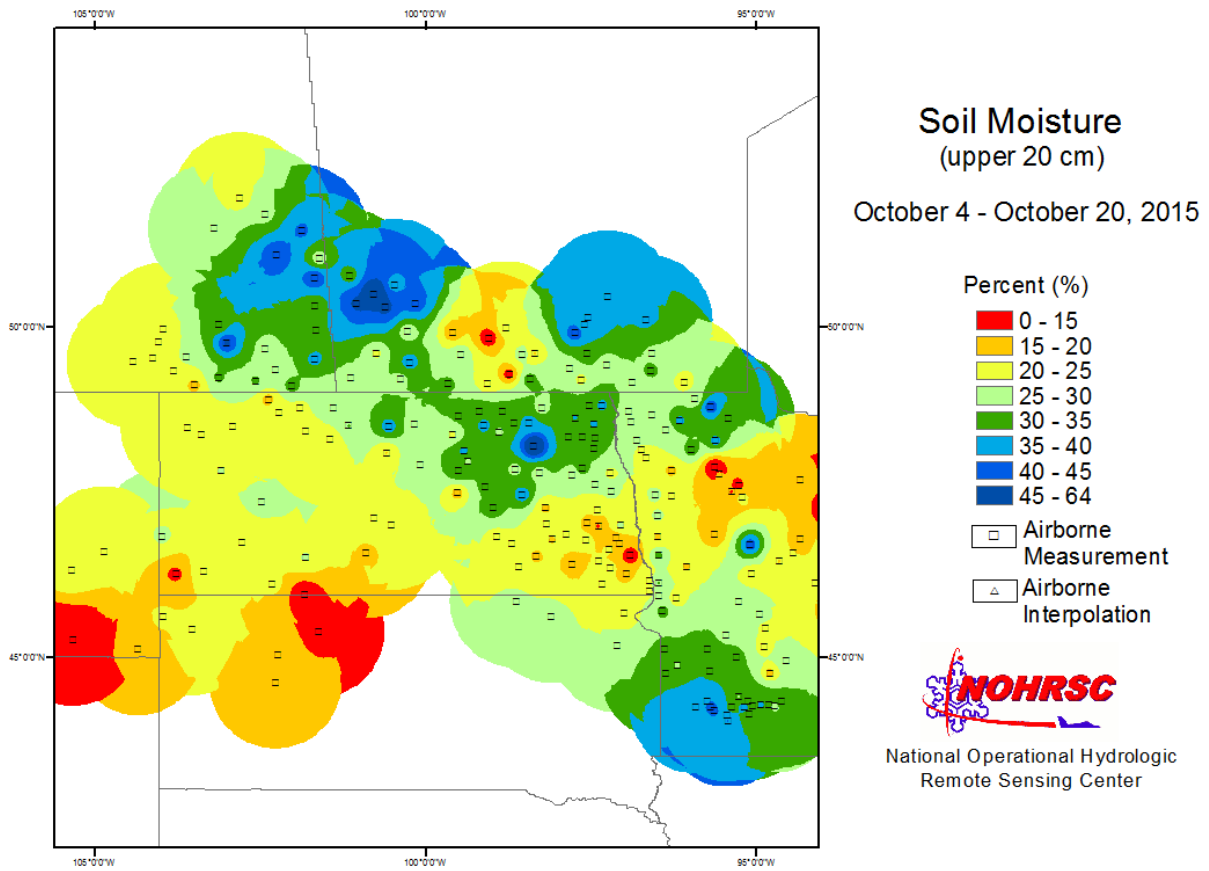


Figure 8: Soil Moisture from Gamma Survey

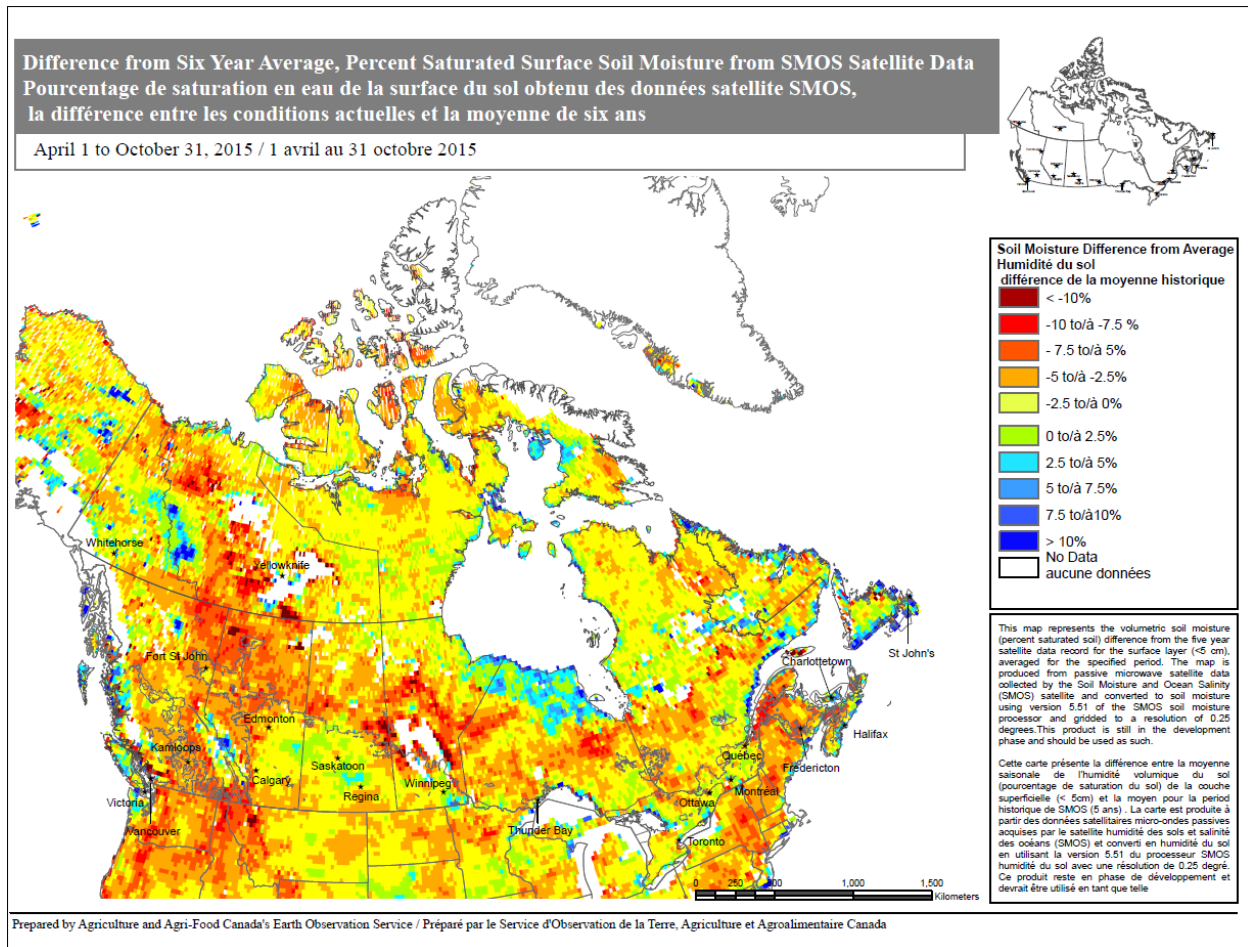


Figure 9: Soil Moisture from SMOS Satellite Data (AAFC)

BASE CONDITIONS

Rivers

Most of the major rivers are above normal for this time of year. Flows on the Saskatchewan River, Assiniboine River, Qu'Appelle River and Souris River at most gauging stations are at or above the upper decile. The upper decile indicates that flows are above this level at this time in just 10% of years. The Red River is also above normal for this time of year. Hydrographs for the major rivers are shown in Figures 12 to 20. These figures represent the flows on the rivers just prior to freeze-up before gauge readings were affected by ice. High base flows and levels during the spring runoff could increase the potential for spring flooding. Current flows for main rivers at selected locations are listed in Table 1.

Table 1. Flows for main rivers at selected locations.

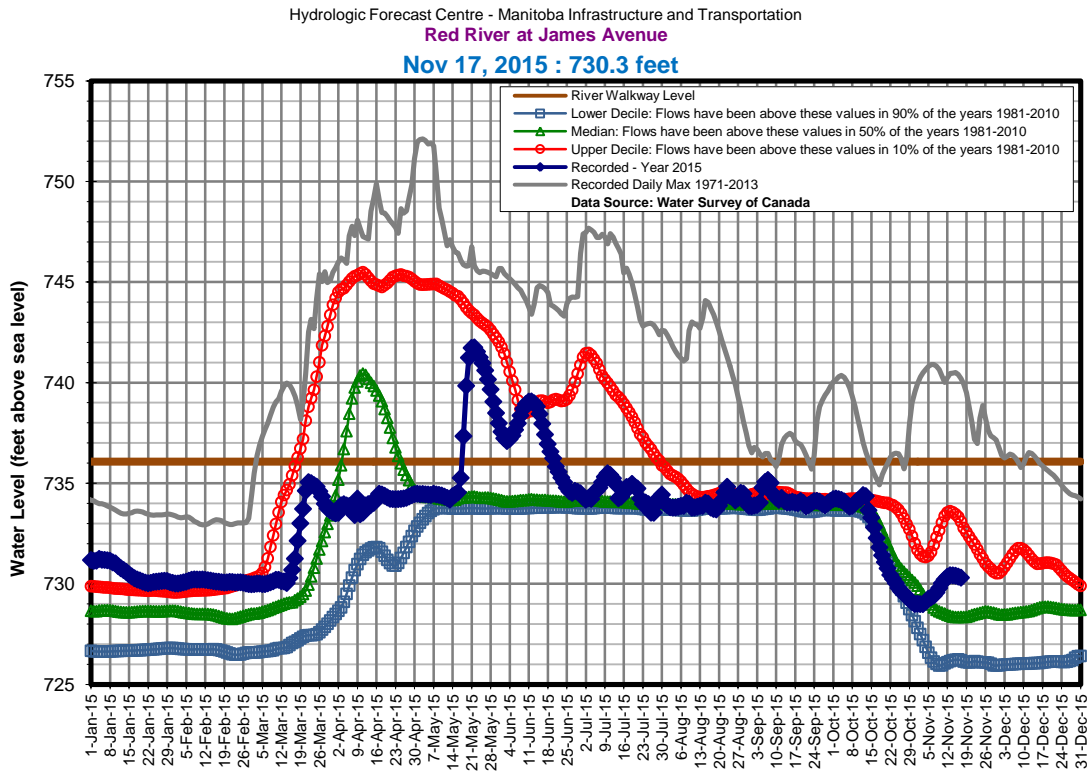
River	Location	Flow (cfs)
Red River	Emerson	2650
	St. Agathe	3580
Assiniboine River	Russell	1060
	Miniota	1625
	Brandon	1840
	Holland	2300
	Headingly	2500
Shellmouth Dam Release	Shellmouth	1050
Souris River	Wawanesa	180
	Melita	140
	Souris	160
Qu'Appelle River	Welby	570
Fairford River	Near Fairford	5650
Dauphin River	Near Dauphin River	6357
Waterhen River	Near Waterhen	4950

Lakes

All major lakes (Lake Winnipeg, Lake Manitoba, Lake Winnipegosis, Dauphin Lake, and Lake St. Martin) are above normal for this time of the year. Water level hydrographs for these lakes are shown on Figures 21 to 25. Lake of the Prairies (Shellmouth Reservoir) is at the median condition for this time of the year (Figure 26) and is expected to be drawn down further before the spring runoff. This will also reduce the flow in the Assiniboine River downstream. However, it is expected that most of the lakes will remain at or near the upper operating range before the spring runoff. If significant spring runoff occurs on top of the already high lake levels, this could induce major flooding. The current lake levels and the expected level by March 31, 2016 (before the 2015 spring runoff) are given in Table 2.

Table 2. Current lake levels and the expected level by March 30, 2015 (before the 2015 spring runoff)

Lakes	Current level as of Dec 1 st (ft)	Operating Range or long term avg (ft)	Expected Level (ft) by March 31 st
Lake Manitoba	811.87	810.5-812.5	811.5-811.8
Lake Winnipeg	713.81	711-715	
Lake St. Martin	800.82		800.2-800.6
Lake Winnipegosis	831.43	830.5	831.3-831.5
DauphinLake	854.58	854.8-855.4	854.0-854.7
Whitewater Lake	1631.9	1628	1631.8-1631.9
Shellmouth	1399.31		1386-1388



Red River near Ste. Agathe
Nov 17, 2015 : 3,688 cfs

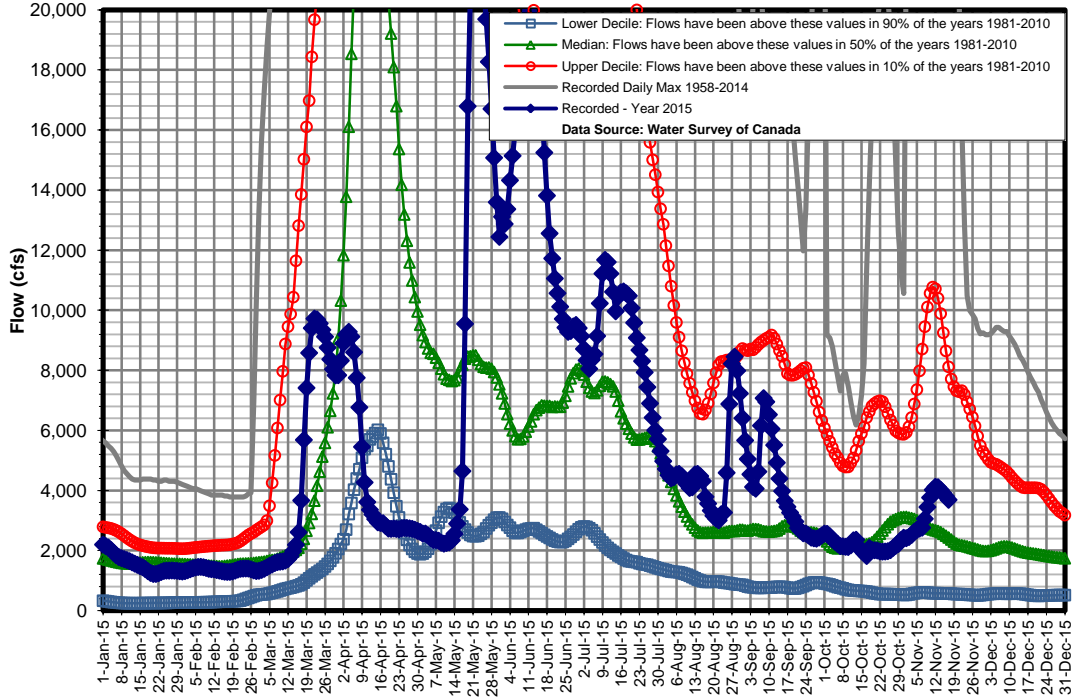


Figure 11: Red River Flows at Ste. Agathe

Souris River at Wawanesa
Nov 17, 2015 : 319 cfs

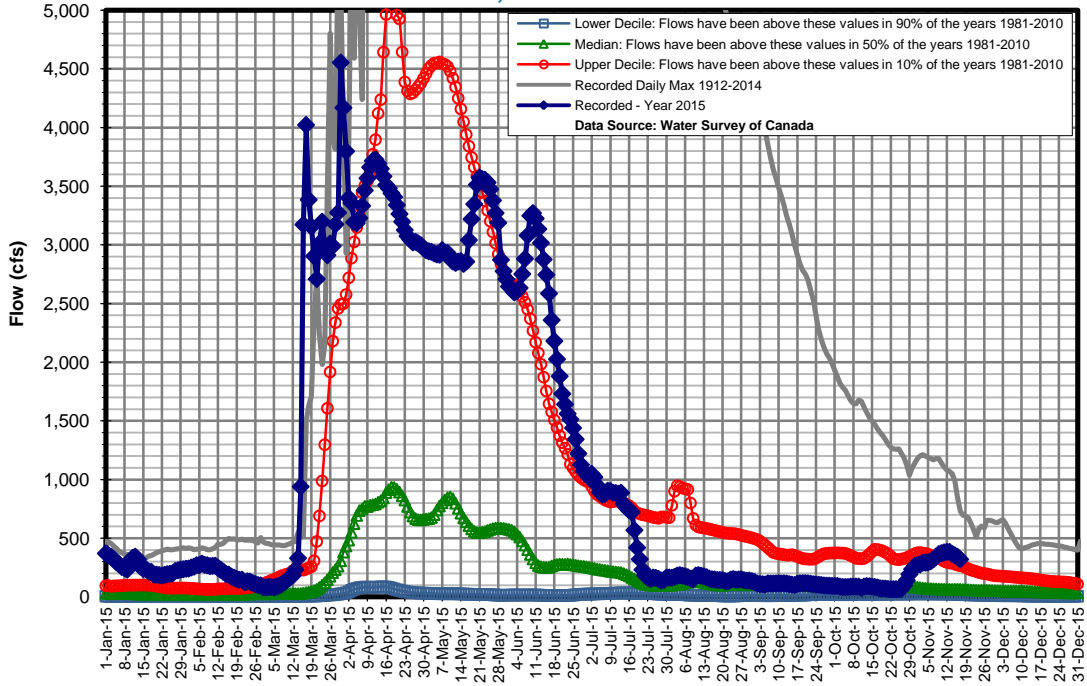


Figure 12: Souris River Flows at Wawanesa

Assiniboine River west of Russell

Nov 21, 2015 : 1,010 cfs

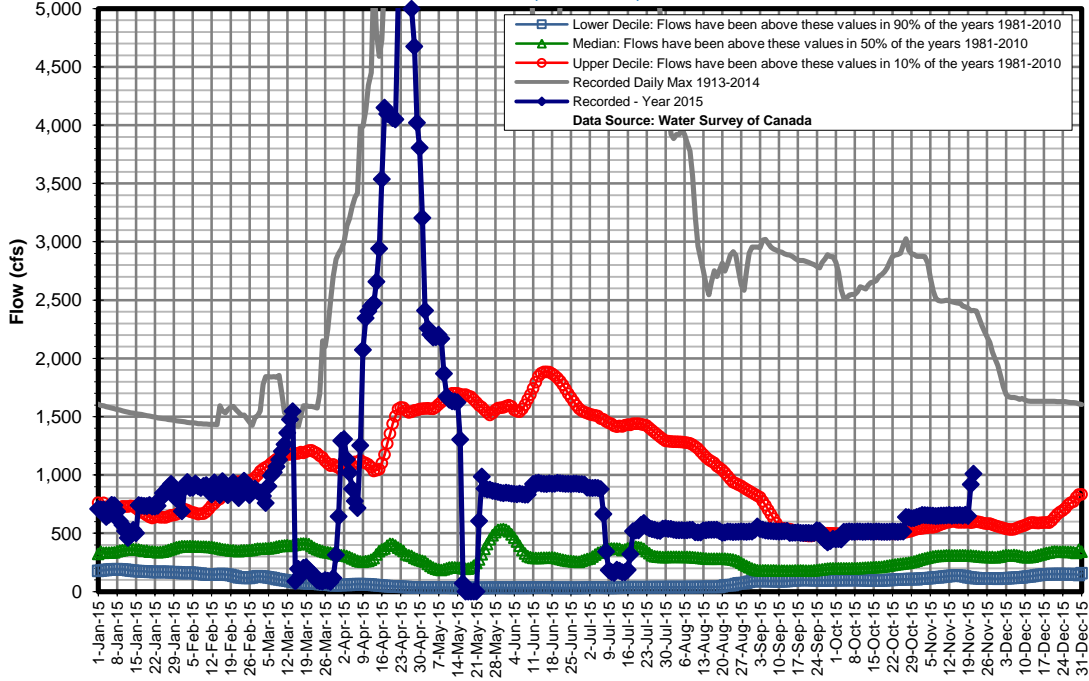


Figure 13: Assiniboine River Flows near Russell

Qu'Appelle River near Welby

Nov 18, 2015 : 601 cfs

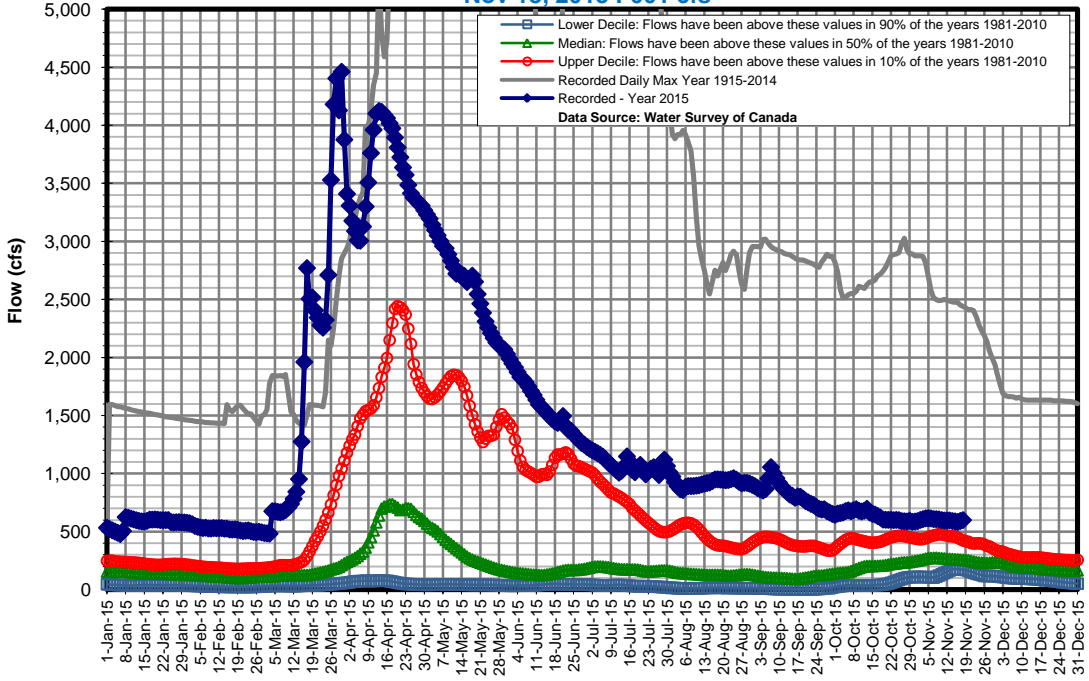


Figure 14: Qu'Appelle River Flows near Welby

Assiniboine River near Miniota

Nov 09, 2015 : 1,669 cfs

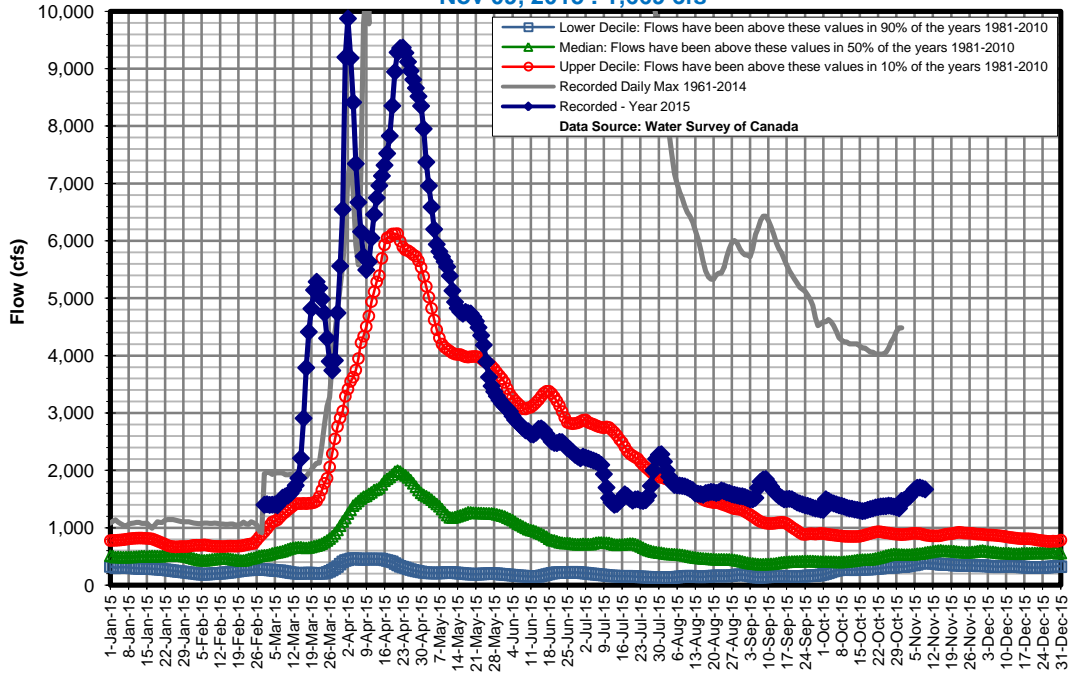


Figure 15: Assiniboine River Flows near Miniota

Assiniboine River near Holland

Nov 19, 2015 : 2,542 cfs

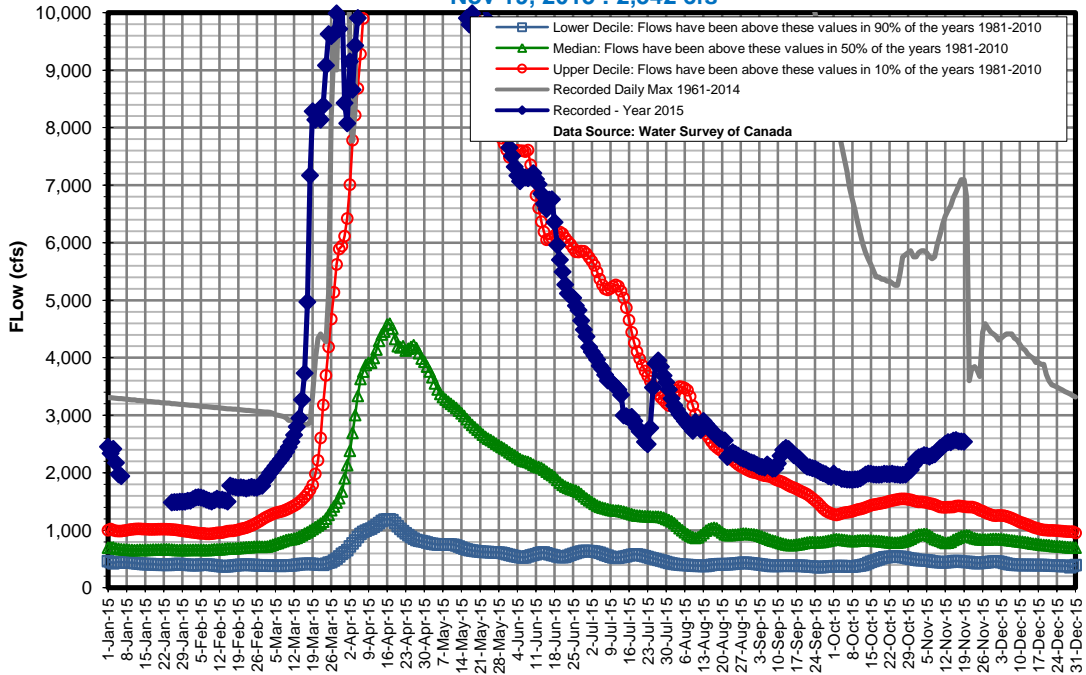


Figure 16: Assiniboine River Flows near Holland

Hydrologic Forecast Centre - Manitoba Infrastructure and Transportation
Assiniboine River at Headingley

Nov 19, 2015 : 2,680 cfs

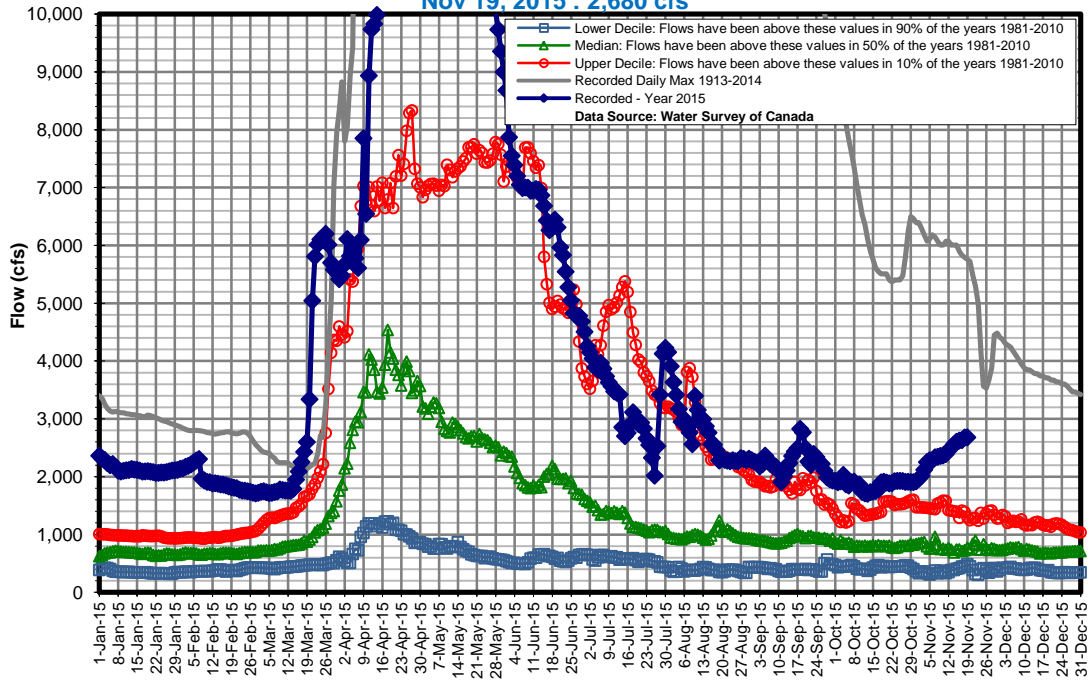


Figure 17: Assiniboine River Flows near Headingley

Hydrologic Forecast Centre - Manitoba Infrastructure and Transportation

Saskatchewan River at the Pas

Nov 18, 2015 : 17,503 cfs

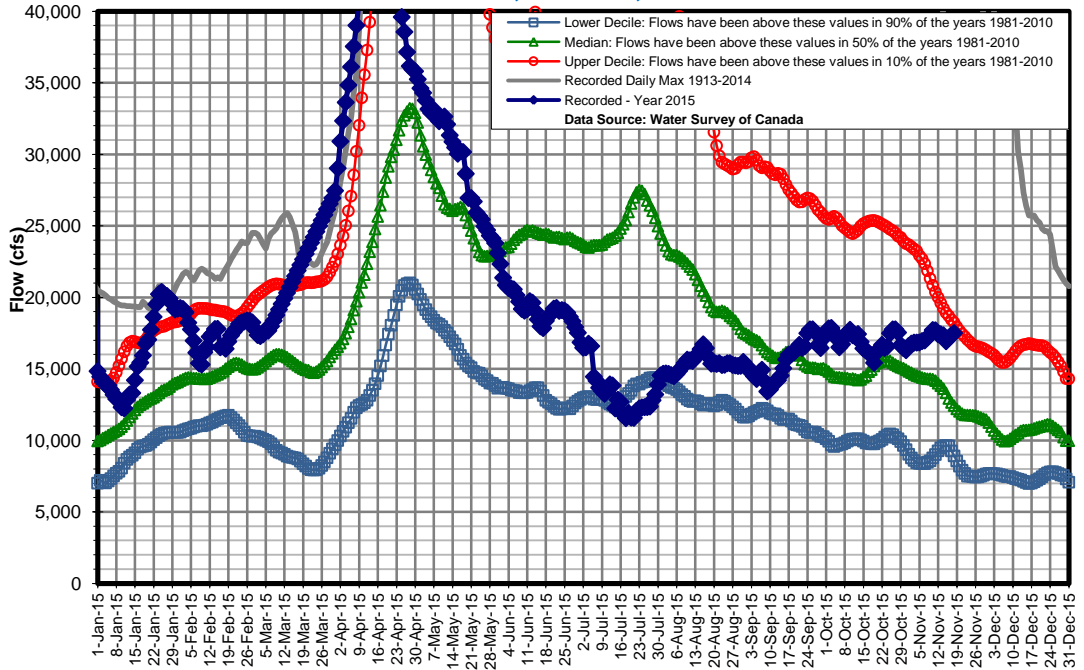


Figure 18: Saskatchewan River Flows at the Pas

Lake Winnipeg Observed Water Level
2014 -

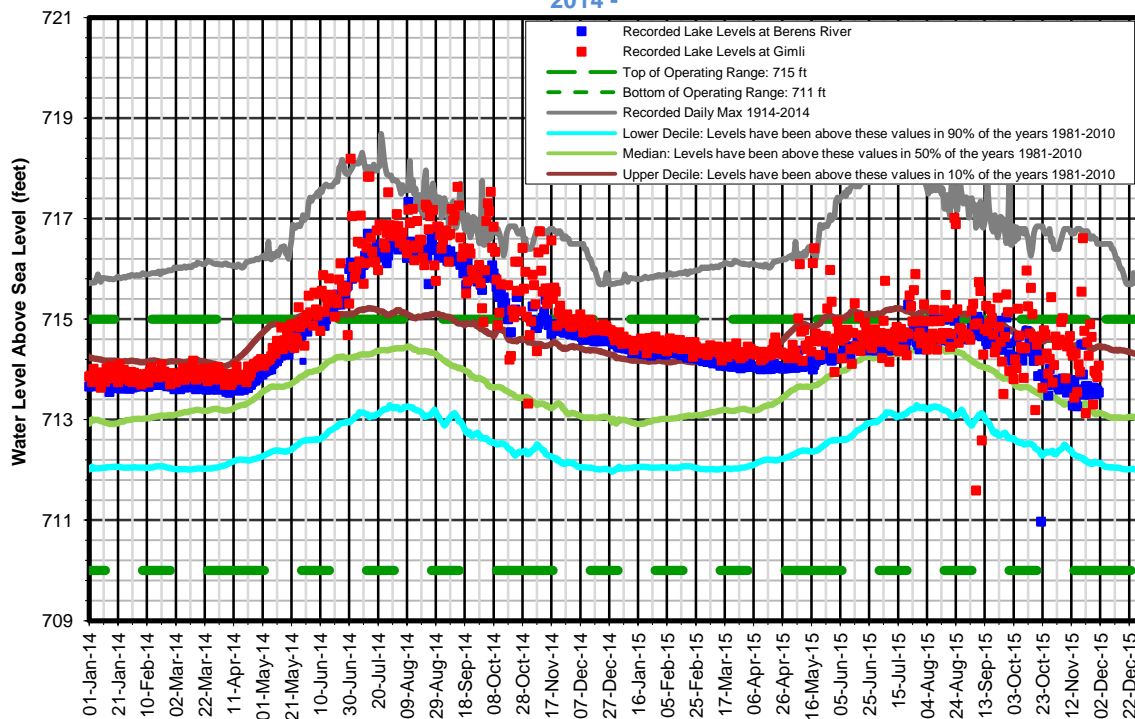


Figure 19: Lake Winnipeg Water Levels

Dauphin Lake Observed Water Level
2014 - 2015

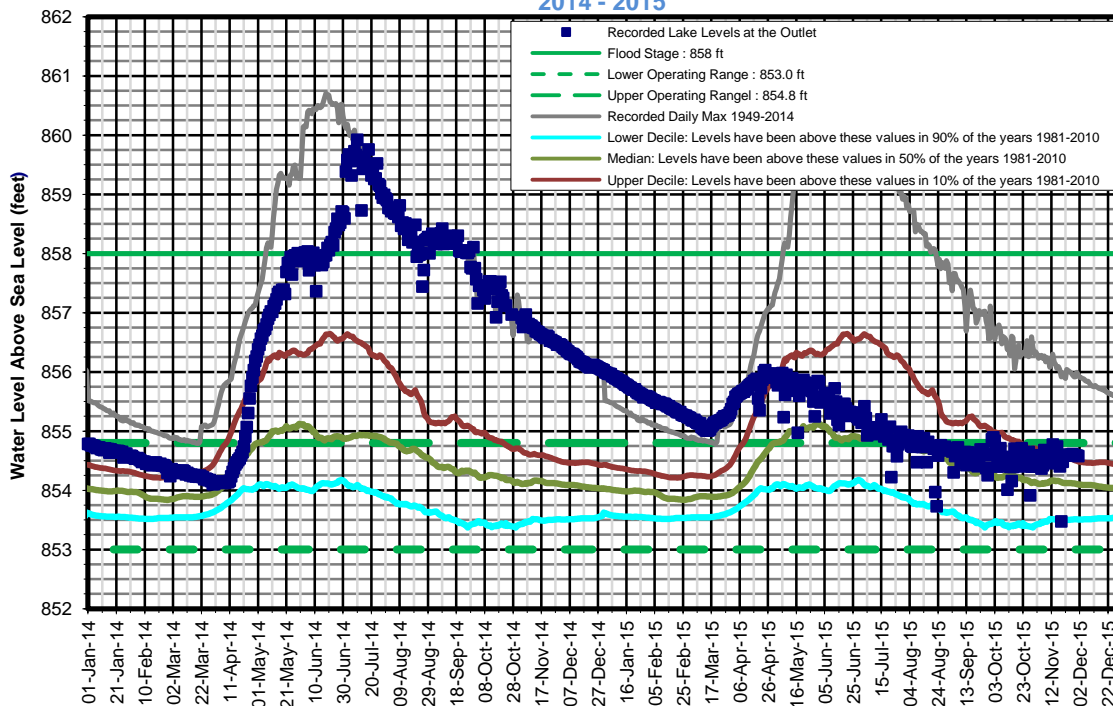


Figure 20: Dauphin Lake Water Levels

Hydrologic Forecast Centre - Manitoba Infrastructure and Transportation
Lake Manitoba Observed Water Level
 2014 - 2015

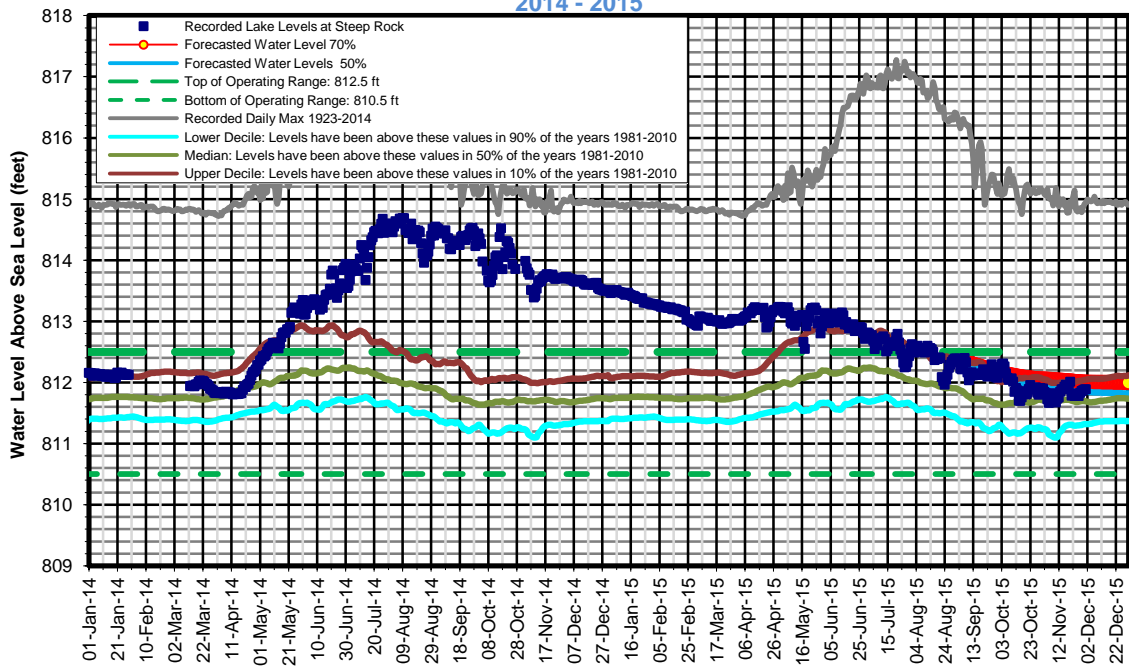


Figure 21: Lake Manitoba Water Levels

Hydrologic Forecast Centre - Manitoba Infrastructure and Transportation
Lake Winnipegosis Observed Water Level
 2014 - 2015

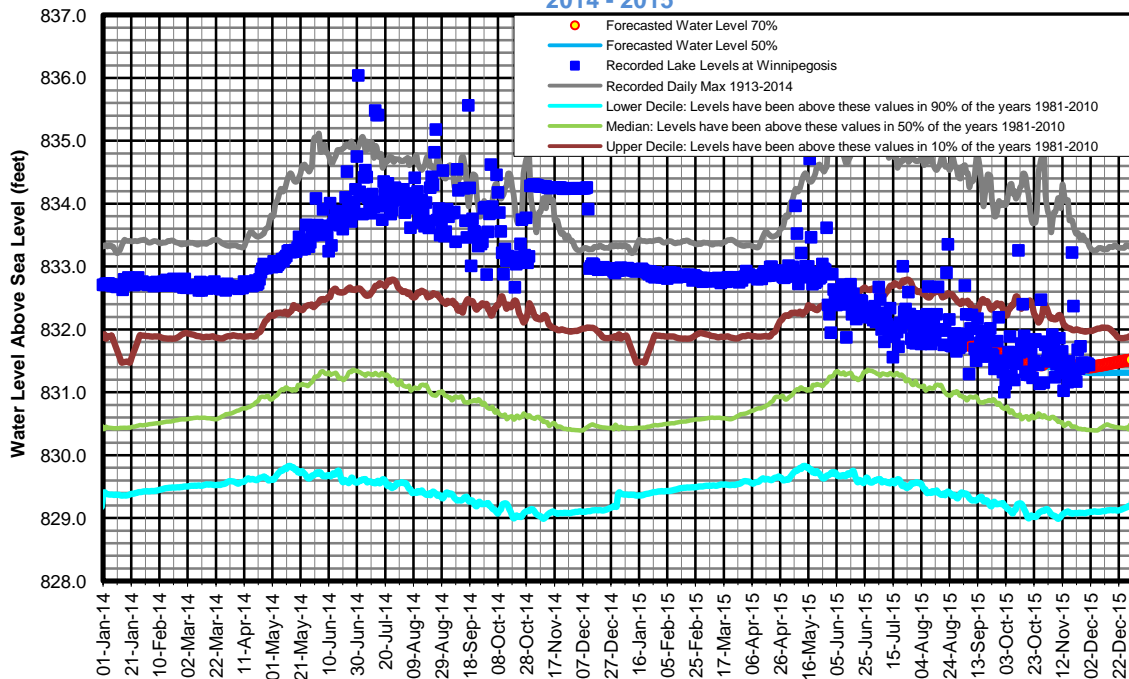


Figure 22: Lake Winnipegosis Water Levels

Hydrologic Forecast Centre - Manitoba Infrastructure and Transportation
**Lake St. Martin Observed Water Level
 2014 - 2015**

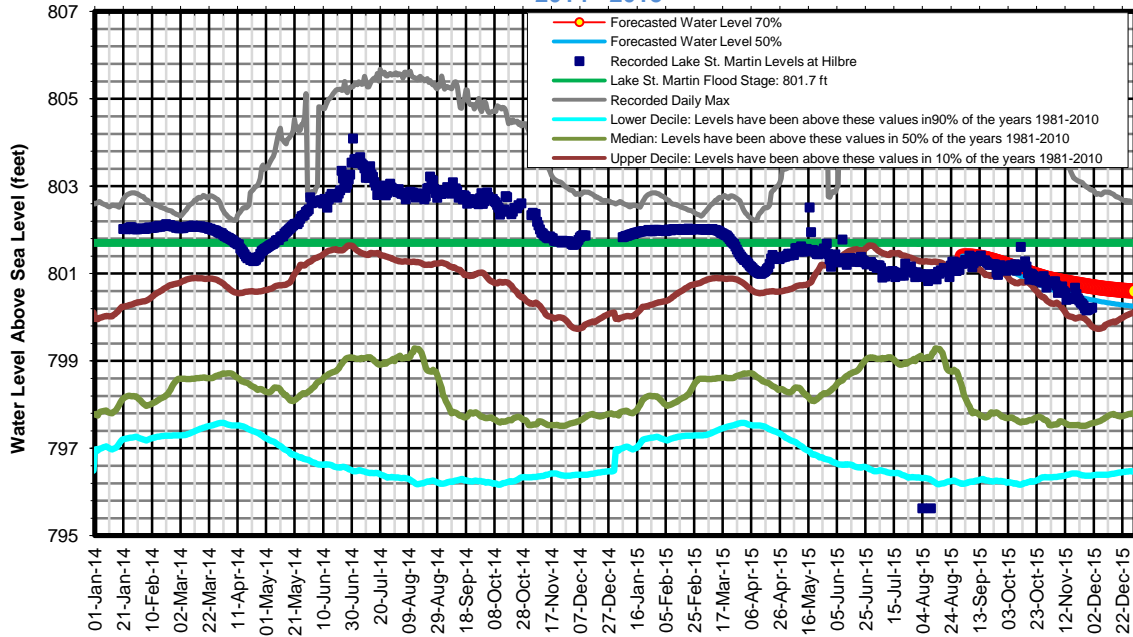


Figure 23: Lake St. Martin Water Levels

Hydrologic Forecast Centre, Manitoba Infrastructure and Transportation
Shellmouth Reservoir - December 01, 2015

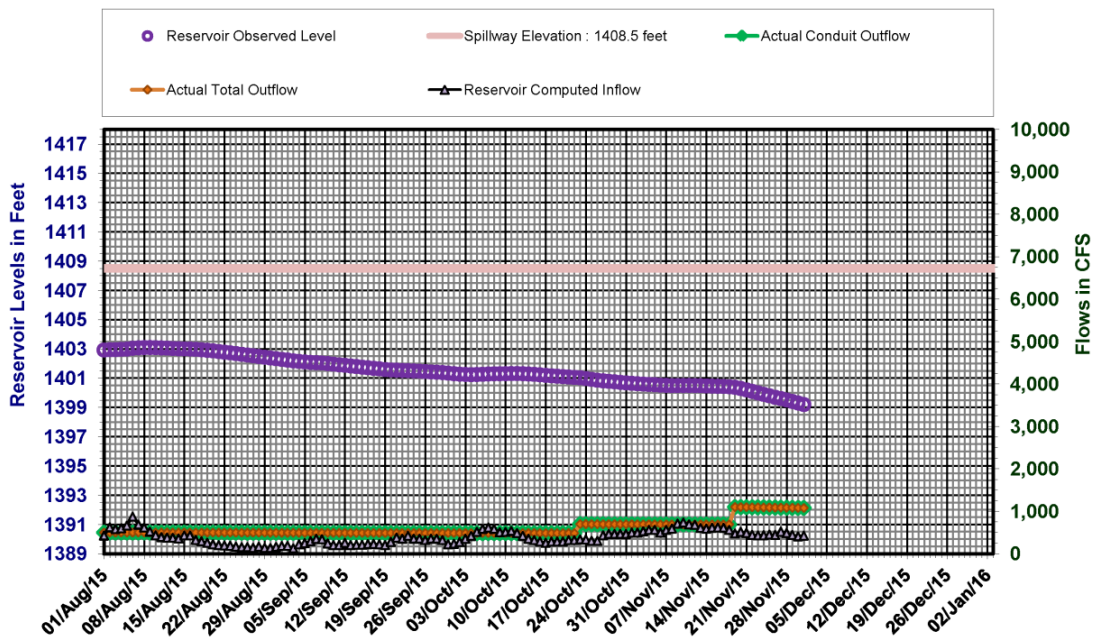


Figure 24: Lake of the Prairies (Shellmouth Reservoir) Water Levels

WINTER PRECIPITATION (LONG TERM PRECIPITATION FORECAST)

Winter precipitation records from November 15 until December 13 indicate that most watersheds in southern Manitoba have received below normal precipitation during this period (Figure 27). The Qu'Appelle, Souris and the Manitoba portion of the Red River have received below normal precipitation. The US portion of the Red River has received above normal precipitation. The Saskatchewan and upper Assiniboine basins have also received above normal precipitation during this period in addition to above normal precipitation in the fall and high soil moisture at the time of freeze-up. Although conditions are not as wet as they were in the fall of 2010, the Assiniboine basin could be at risk of flooding and will be closely monitored throughout the winter.

Environment Canada recently issued a long term precipitation forecast for the months of December, January and February (Figure 28). Based on the forecast it is expected that the majority of Manitoba will receive near normal winter precipitation. Above normal precipitation is forecasted for part of the Souris River basin and Northern Manitoba. The National Weather Service Climate Prediction Centre is forecasting near normal precipitation within the Red River Basin. Experience indicates that these long term forecasts are more accurate for the first month of the forecast and conditions start to change significantly further into the future. Generally, long term weather forecasts are not as reliable as short term forecasts.

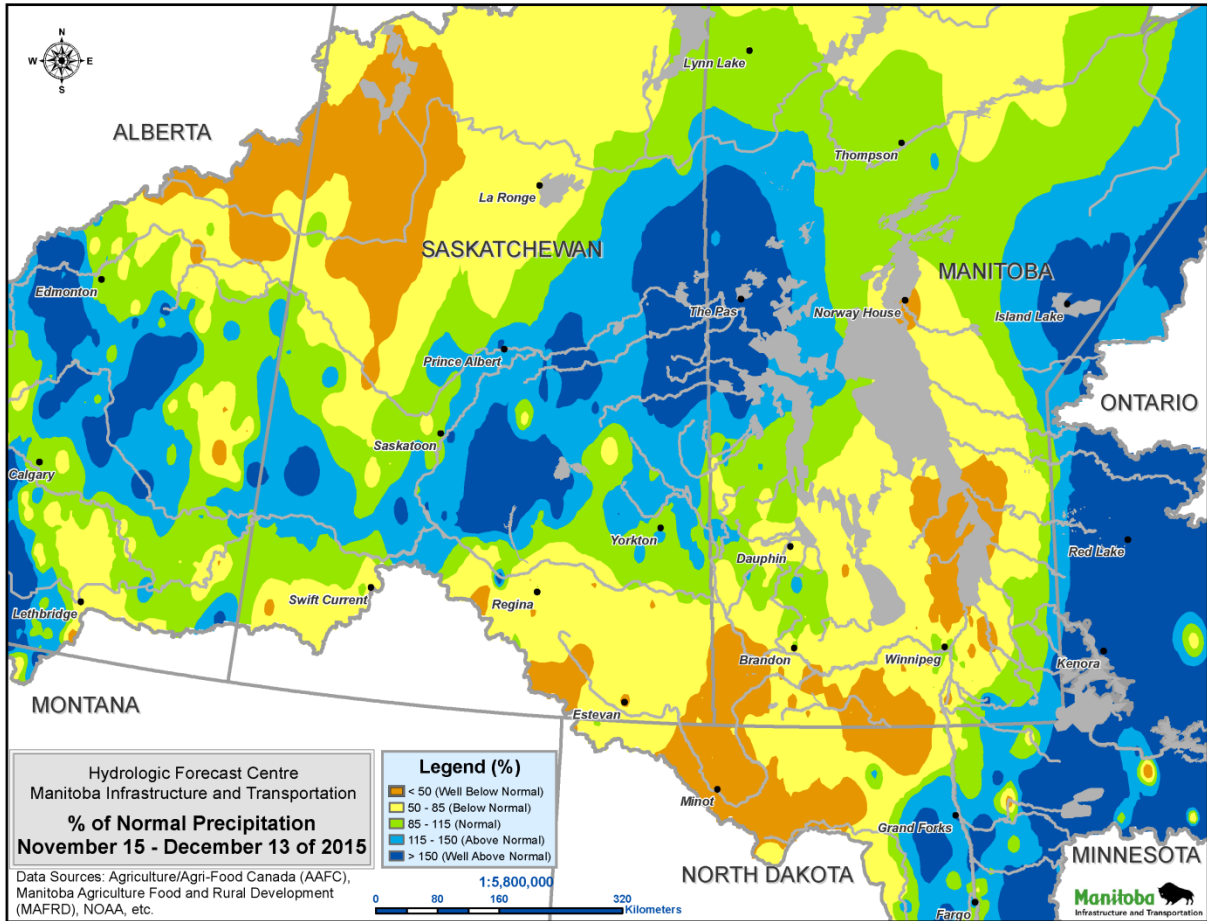


Figure 25: Percent Normal Precipitation from Nov 15 – Dec 13

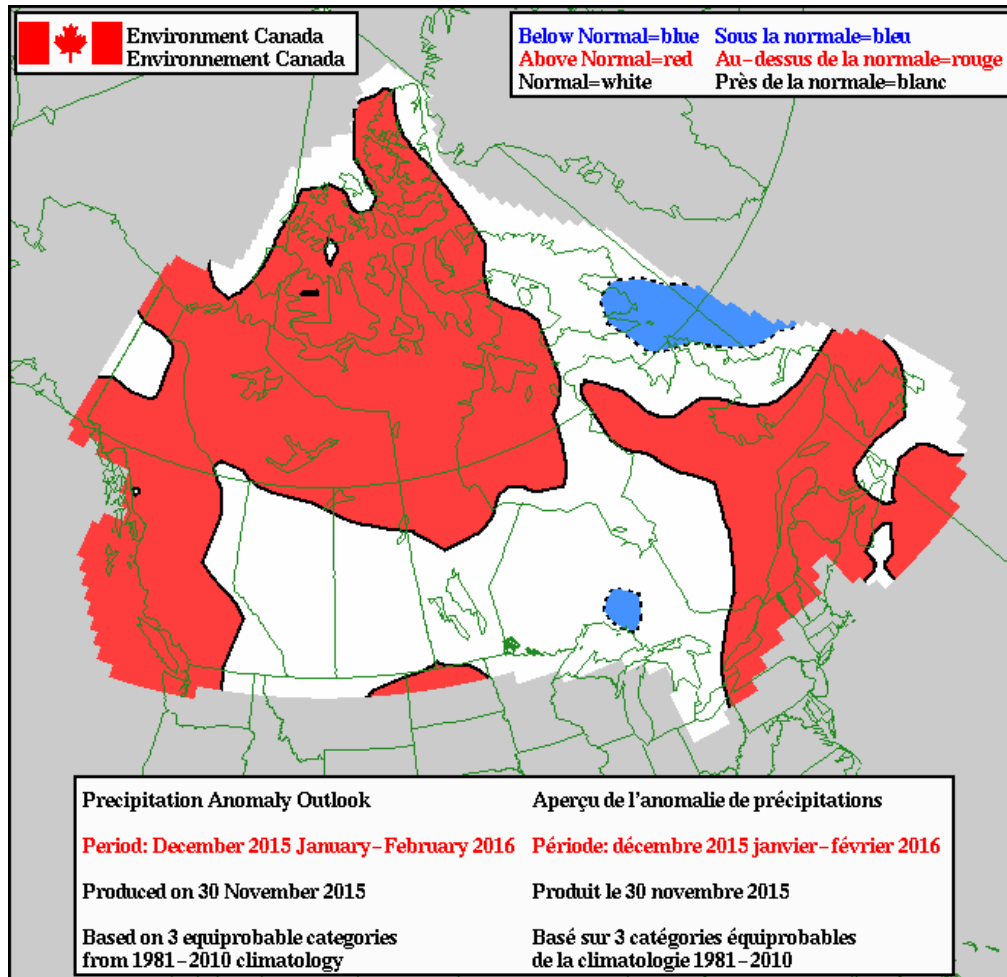
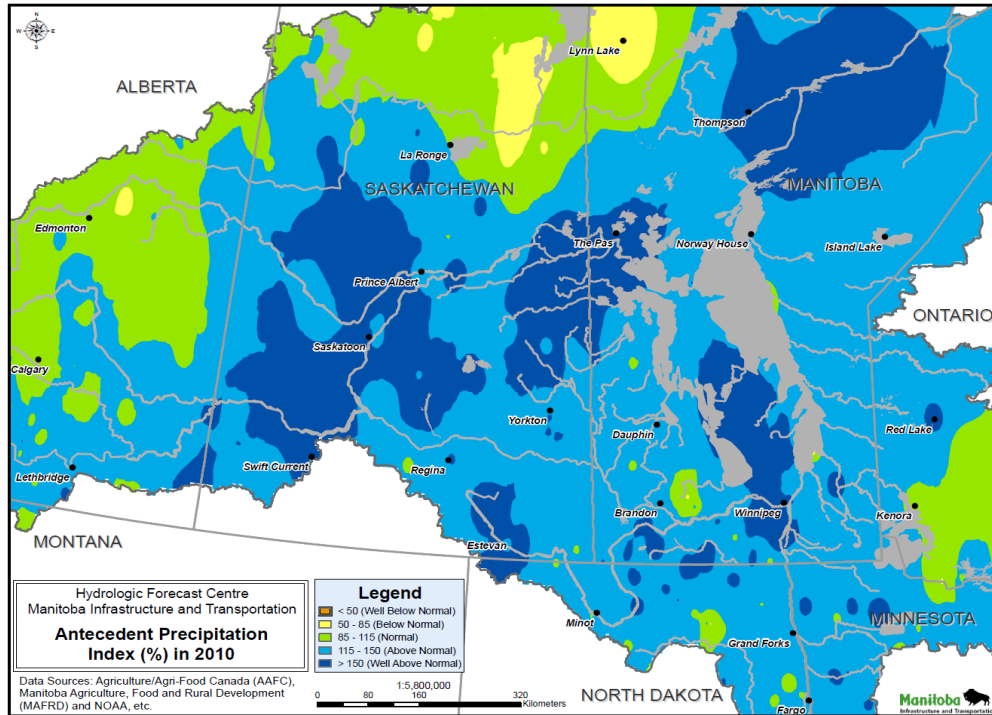
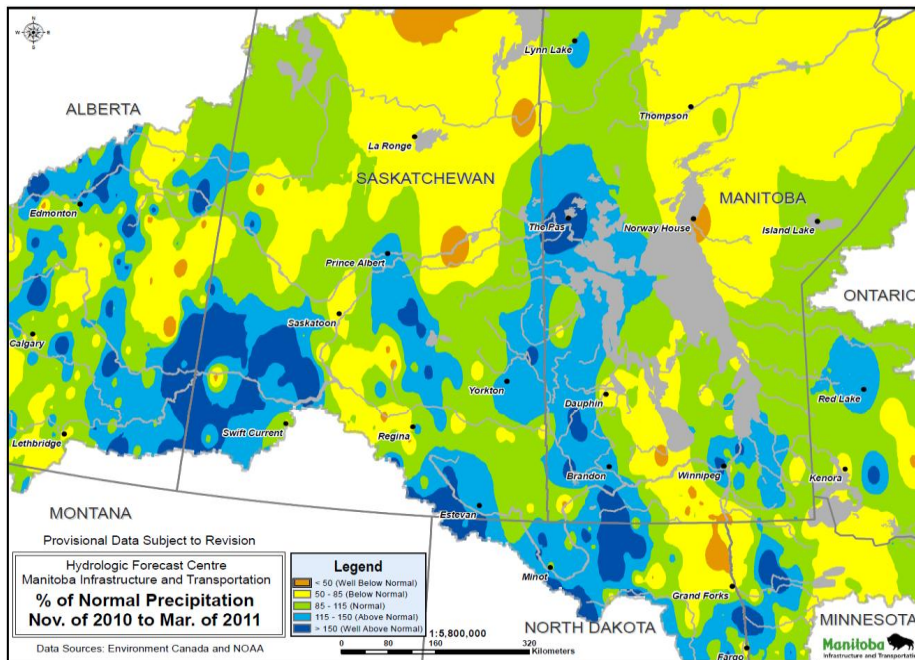


Figure 26: Environment Canada Extended Precipitation Forecast

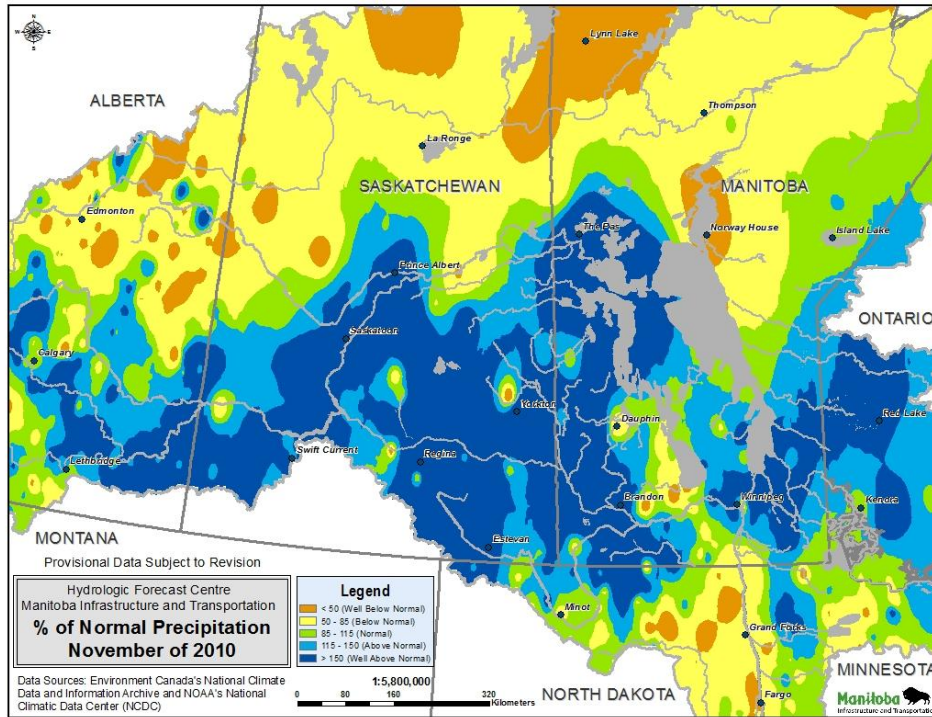
APPENDIX: CONDITIONS IN THE FALL OF 2010



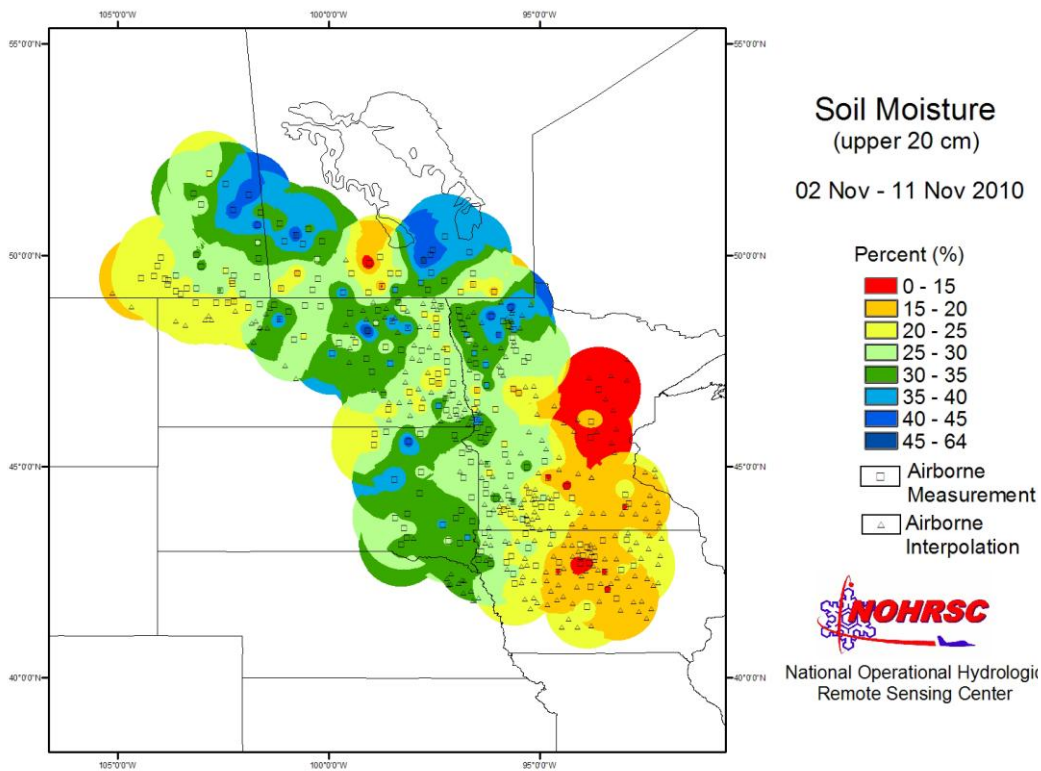
API in the fall of 2010 that led to the flood of 2011



Percent Normal Winter Precipitation in 2010/2011



Percent Normal Precipitation for November 2010



Gamma Survey in the fall of 2010