2014 Fall Conditions Report

Prepared by:

Hydrologic Forecast Centre

Date:

December 14, 2014

Manitoba

Table of Contents

Table of Figures

EXECUTIVE SUMMARY

One of the major factors that affect spring runoff potential is the soil moisture before freeze up. The soil moisture before freeze up is greatly affected by the accumulated summer and fall precipitation. Almost all of the major River Basins in Manitoba (The Assiniboine River, The Red River, The Saskatchewan River, The Souris River, and The Qu'Appelle River) have received precipitation normal to well above normal between April 01 and October 31, 2014. Record rainfall has been observed on the Assiniboine and the Qu'Appelle River watersheds in Saskatchewan during this period, which led to the 2014 flood. The Red River basin in general has been receiving normal to below normal precipitation since August 1, 2014. Because of this fall and summer precipitation patterns, the soil moisture before freeze up is above normal for the Assiniboine River, the Qu'Appelle River, and the upper watersheds of the Souris River. Above normal soil moisture indicates the potential for higher risk of spring flooding on those river basins if winter precipitation is normal to above normal. The Qu'Appelle River basin and southern parts of the Assiniboine River basin have relatively similar soil moisture as the fall of 2010, which led to the 2011 flood. All other river basins and all other areas across the province are relatively dry or drier compared to the fall of 2010. The soil moisture at freeze up is below normal for the Red River and the Pembina river basins. For all other river basins and for the rest of the province, the soil moisture at freeze up is normal. The soil moisture in comparison with the fall of 2013 is relatively wet for the Assiniboine River and the Qu'Appelle River and relatively dry for the Red River basin.

Other major factors that affect spring runoff potential are the amount of snow fall (winter precipitation), snow melting rate, spring rainfall on top of snow melt, frozen ground index and base flow and base lake level conditions. Winter precipitation records for November and first 10 days of December indicate precipitation records are normal to well below normal in most watersheds. Also, Environment Canada's latest long term precipitation forecast indicates precipitation will be below normal for the Assiniboine River and the Qu'Appelle River basins and will be normal for the rest of the province, which is in a favourable condition. Base flow and level conditions indicate most major rivers and lakes are above the normal flow or level for this time of the year. The Assiniboine River, the Qu'Appelle River and the Souris River in most locations are at record high flows for this time of the year surpassing the previous high record flows observed in the fall of 2010. Above normal flows and levels would mean a higher risk of

potential spring flooding. Most of the major lakes, including Lake Manitoba and Dauphin Lake, are above the normal operating range.

It is not very practical and feasible to provide a long term flood forecast as conditions could change significantly during the coming months. However, due to above normal soil moisture conditions and record high base flow conditions, the Assiniboine River, the Qu'Appelle River and the Souris River will be closely monitored. Even with a normal winter precipitation, these watersheds could lead to major flooding if 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 bring major flooding on Manitoba basins.

BACKGROUND

Runoff potential that leads 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 Condition

Historically, all of the above factors have effectively contributed to either a major flood or drought. The combination of these factors, which leads to a flood or drought, is generally unique for each and specific year and for each and specific basin across the province. Generally, the soil moisture before freeze up, winter precipitation, and base flow conditions are well known before end of March 31st and would give a very strong indication of flood or drought.

SUMMER AND FALL PRECIPITATION

Almost all of the major Manitoba River Basins (The Assiniboine River, The Red River, The Saskatchewan River, The Souris River, The Qu'Appelle River and The Saskatchewan River) have received precipitation normal to well above normal between April 01 and October 31, 2014

(Figure 1). Record rainfall has been observed on the Assiniboine and the Qu'Appelle River watersheds in Saskatchewan during this period, which led to the 2014 flood (Figure 2).

The Red River basin in general has recorded below normal to well below normal precipitation for August, September and October. Precipitation records for August, September and October indicate that central Manitoba, south-west Manitoba and the Assiniboine River, the Qu'Appelle River and the Souris River watersheds in Saskatchewan had received normal to above normal precipitation

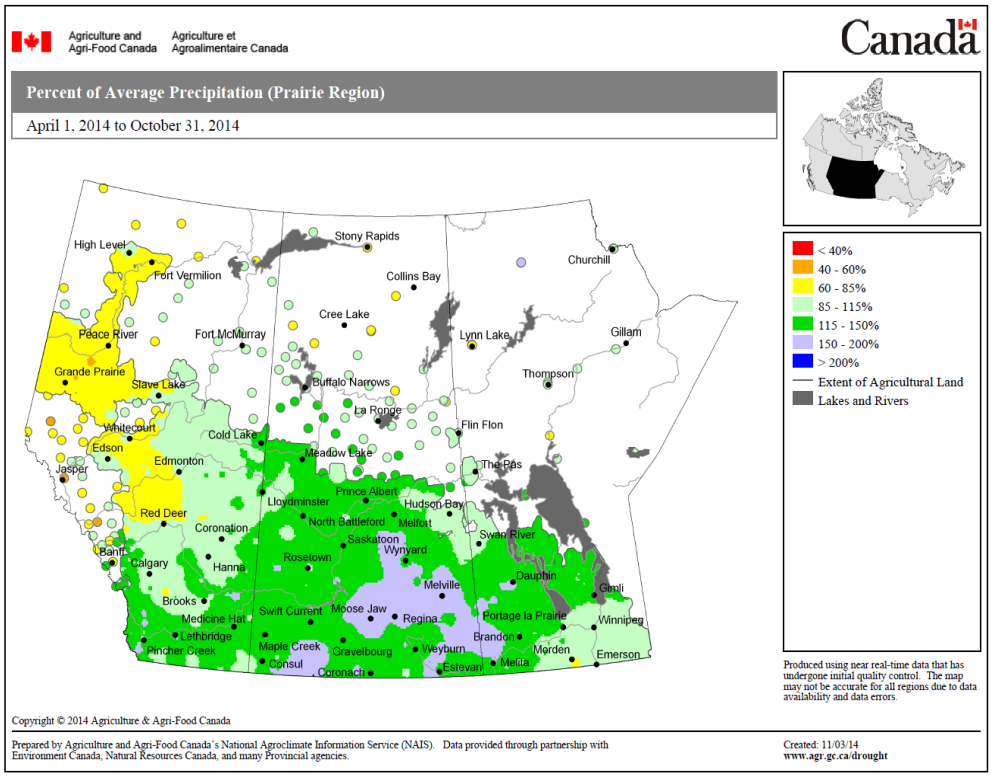


Figure 1. Percent average precipitation April 1, 2014 to October 31, 2014.

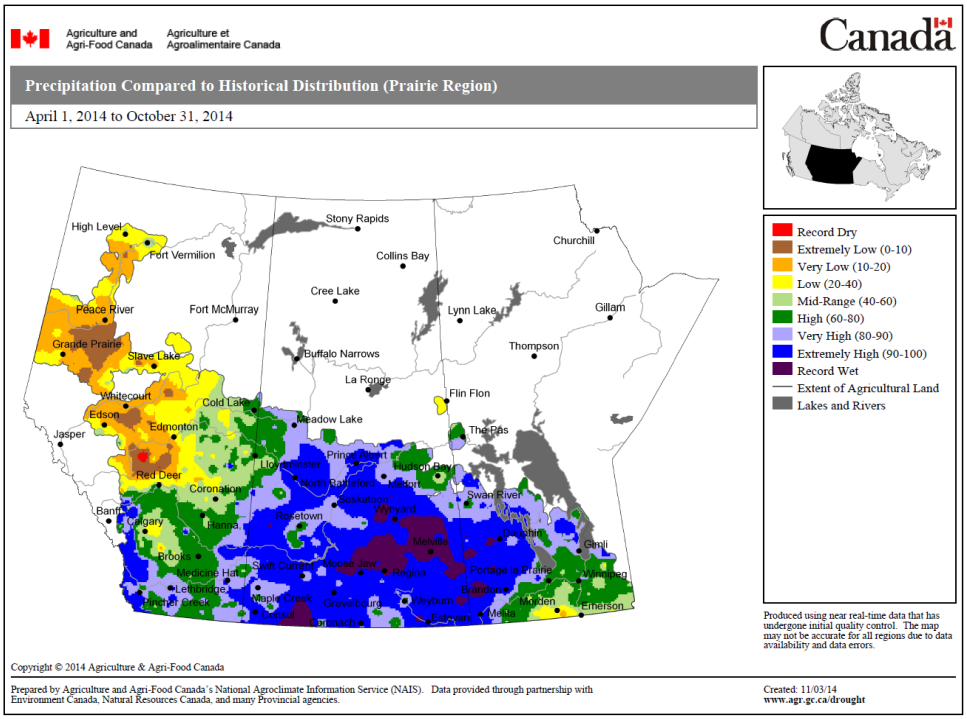


Figure 2. Precipitation compared to historical distribution April 1, 2014 to October 31, 2014

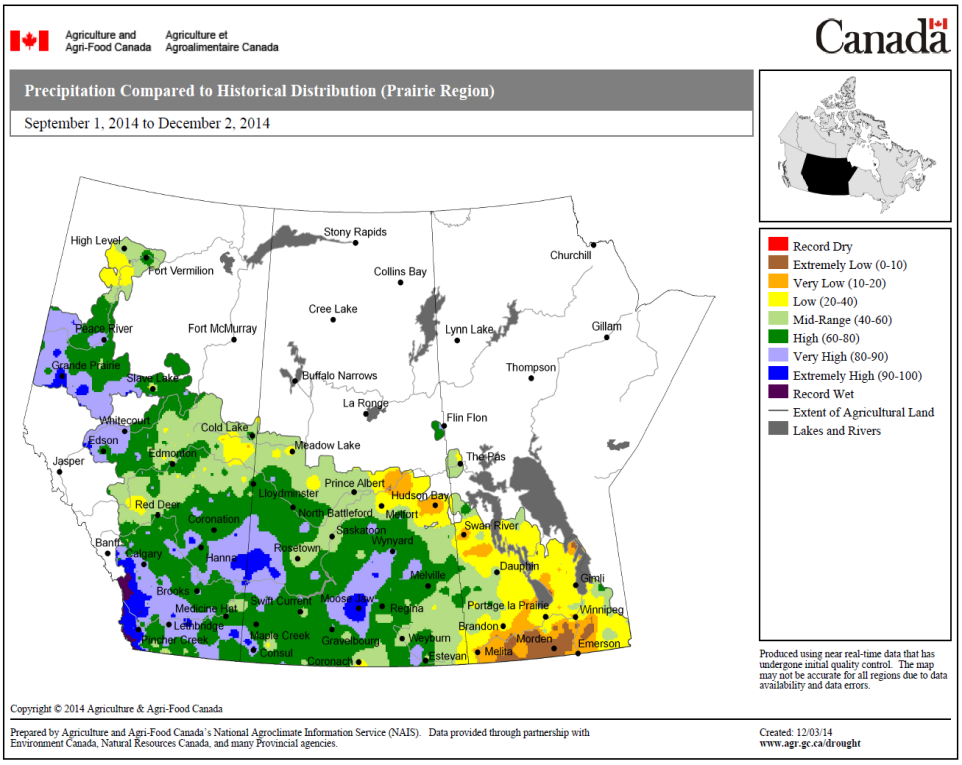


Figure 3. Precipitation compared to historical distribution September 1, 2014 to December 2, 2014

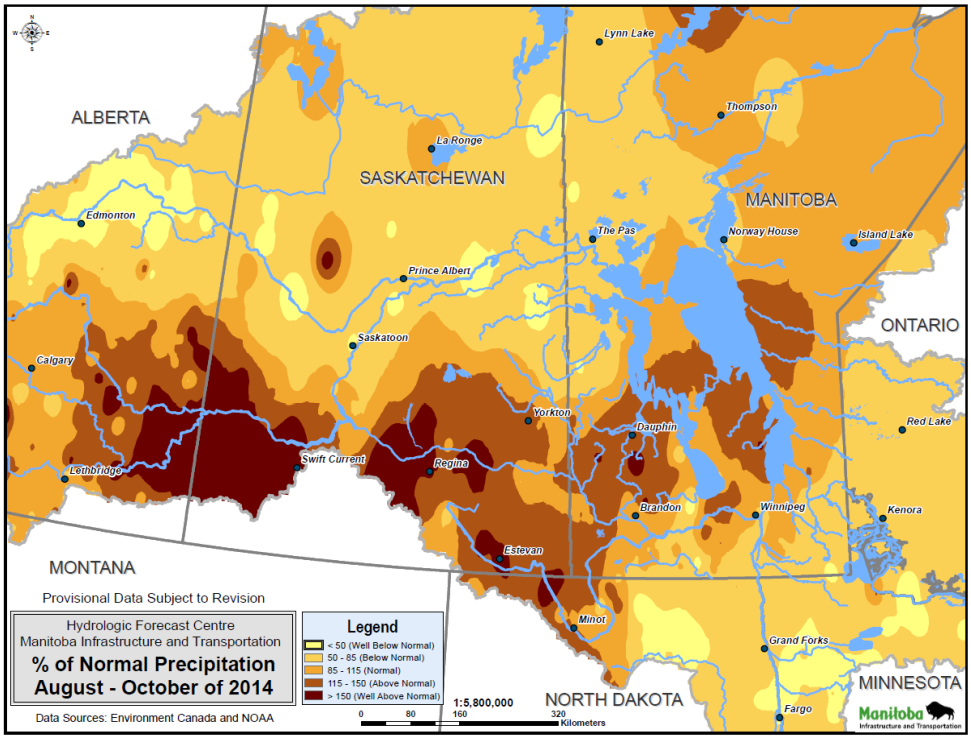


Figure 4. Percent normal precipitation August 2014 to October 2014

SOIL MOISTURE CONDITION

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 2014 is shown in Figure 5. The other common method is the Airborne Gamma Survey, which uses radiation technology from low-flying aircraft to determine the soil moisture on the top 20 cm of soil. The Gamma Survey has been conducted on southern and south western Manitoba basins and the result is shown in Figure 6. Manitoba Agriculture (MAFRI) also conducts routine survey of physical measurement of soil moisture in root zone across the province. The results are presented in either percent water holding capacity of the soil (Figure 7) or millimetres of water available in the root zone (Figure 8). A recent advancement in satellite image technology has also enabled for the estimation of soil moisture on the top 5 cm of soil from Satellite imagery. Satellite soil moisture mapping was conducted by Agriculture and Agri Food Canada and the result is presented in Figure 9.

The soil moisture analysis generally indicates similar soil moisture patterns in all our watersheds. Soil moisture is normal to above normal for western and south western Manitoba and above normal in South and South east Saskatchewan. The soil moisture is below normal for the Red River basin and near normal for the rest of the province. Root zone water holding capacities (field capacities) are above 60% for most of the province, except the western and south western Manitoba which has recorded above 80% field capacity.

The soil moisture condition is relatively dry or drier compared to the soil moisture observed in the fall of 2010, except for the Assiniboine River, the Qu'Appelle River and the Souris River basins that have observed similar soil moisture amounts compared to the fall of 2010. The soil moisture is relatively wet for the Assiniboine River and the Qu'Appelle river and relatively dry for the Red River basin. Soil moisture conditions in the fall of 2010 and winter accumulated precipitation in 2010/2011 are presented in Appendix. Soil moisture in the top root zone (0-30 cm) for the fall of 2014 are also presented in Appendix.

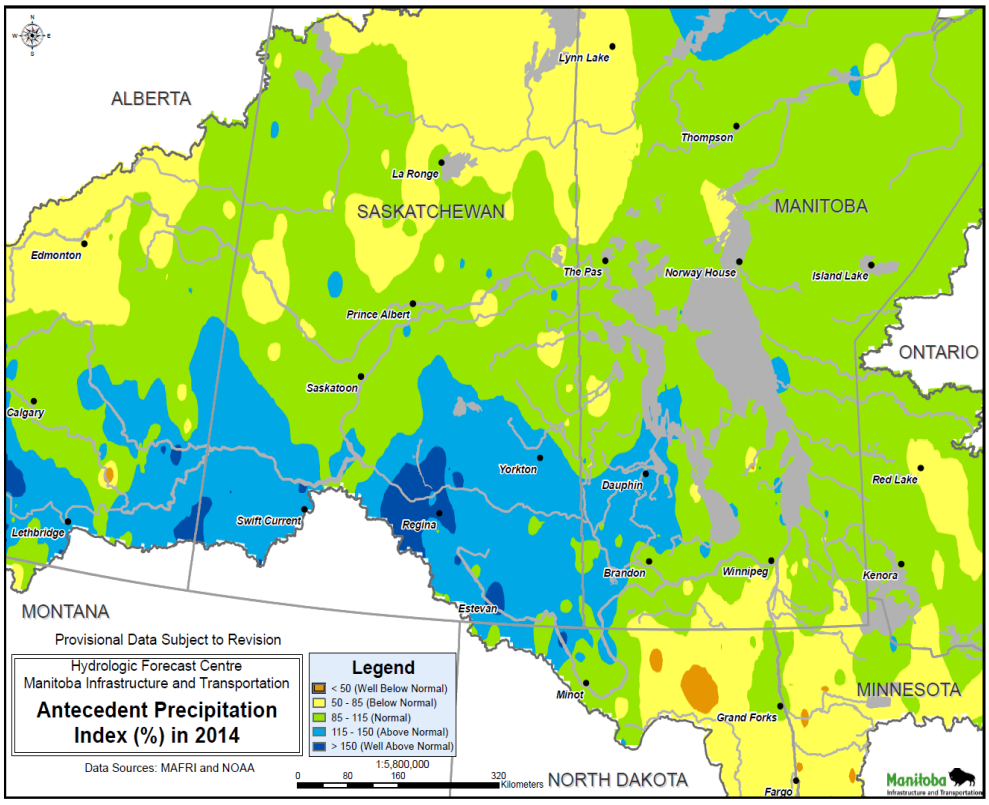


Figure 5. Antecedent Precipitation Index (API) 2014

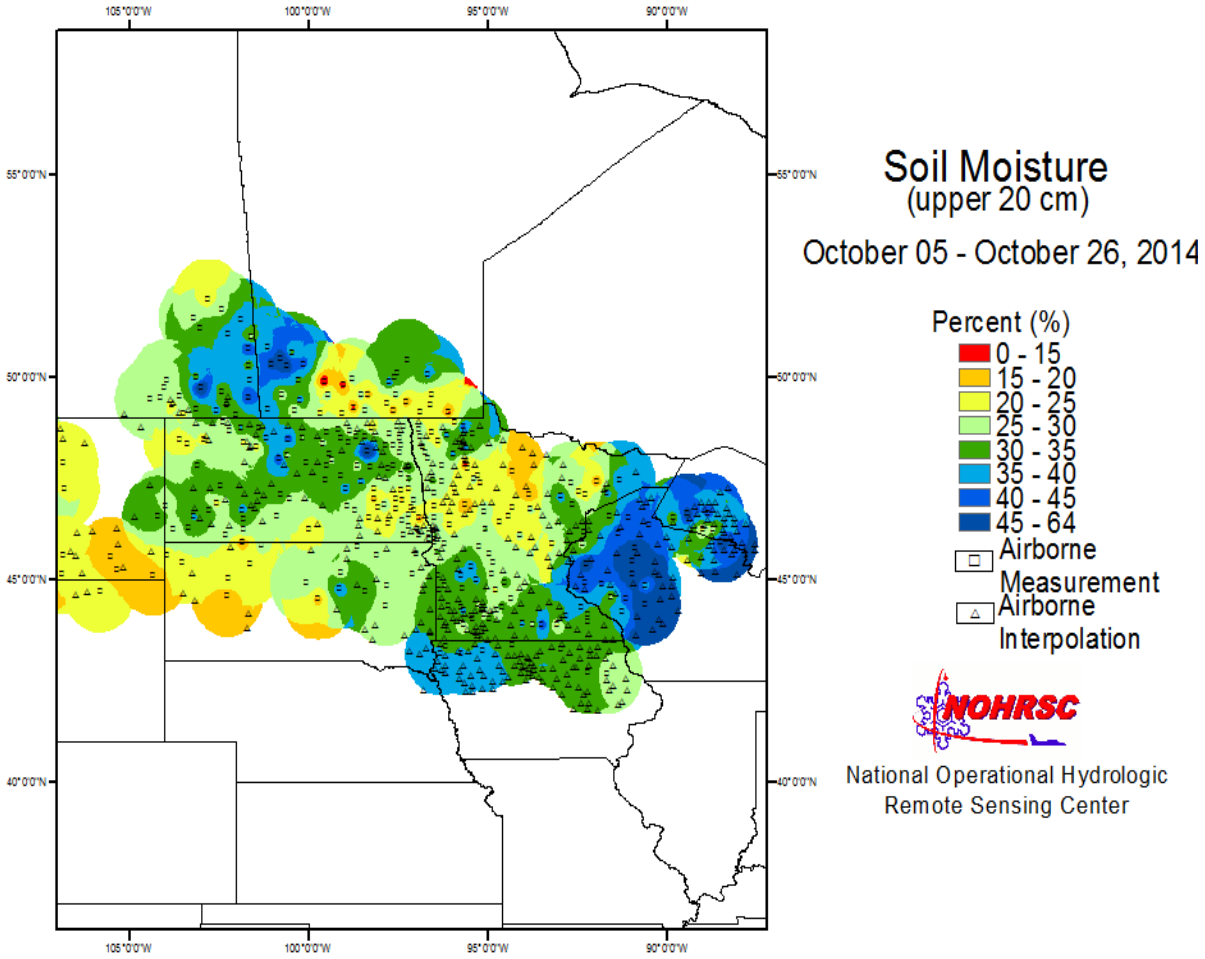


Figure 6. Soil moisture from Gamma Survey

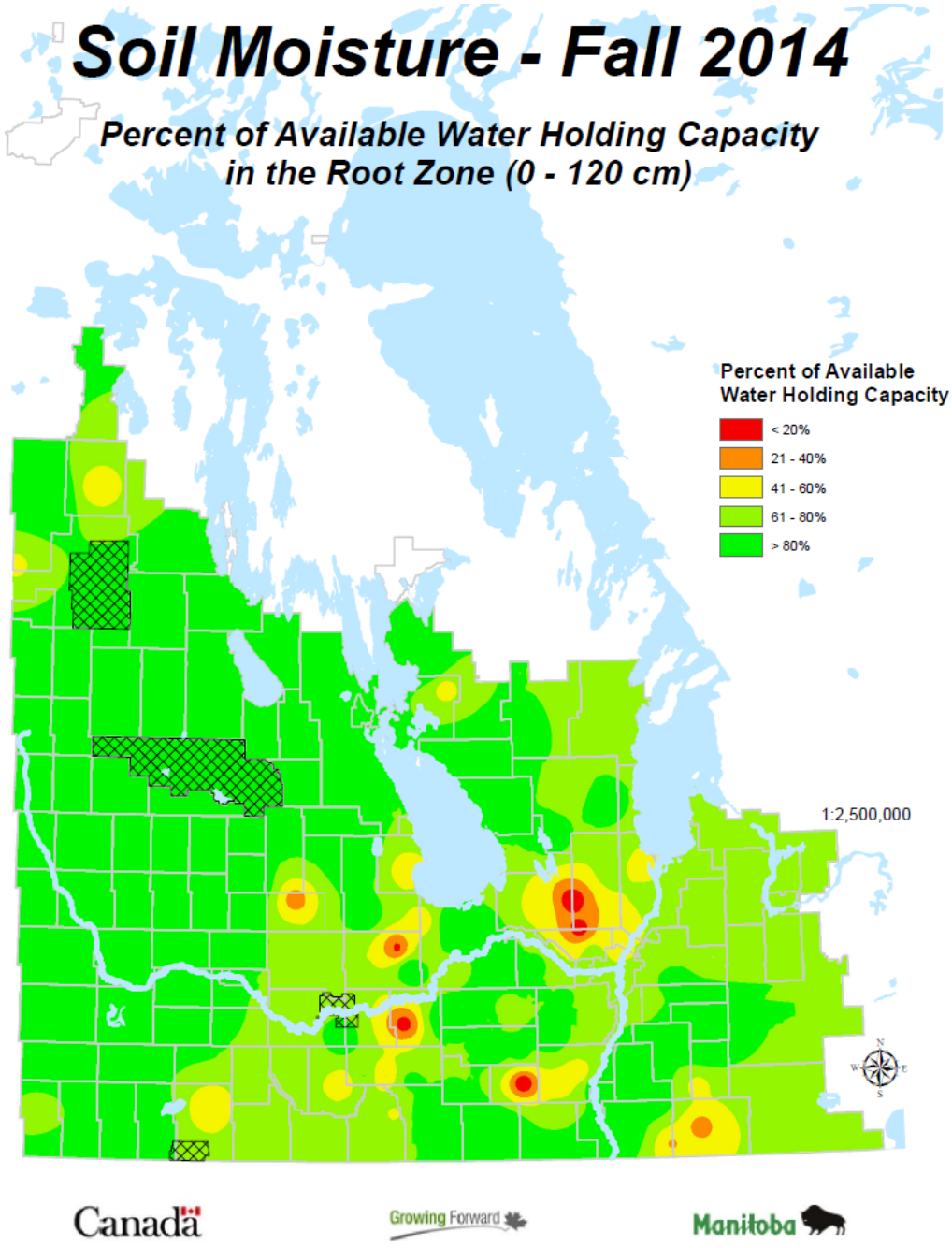


Figure 7. Soil moisture from field measurements by MAFRI (% Holding Capacity)

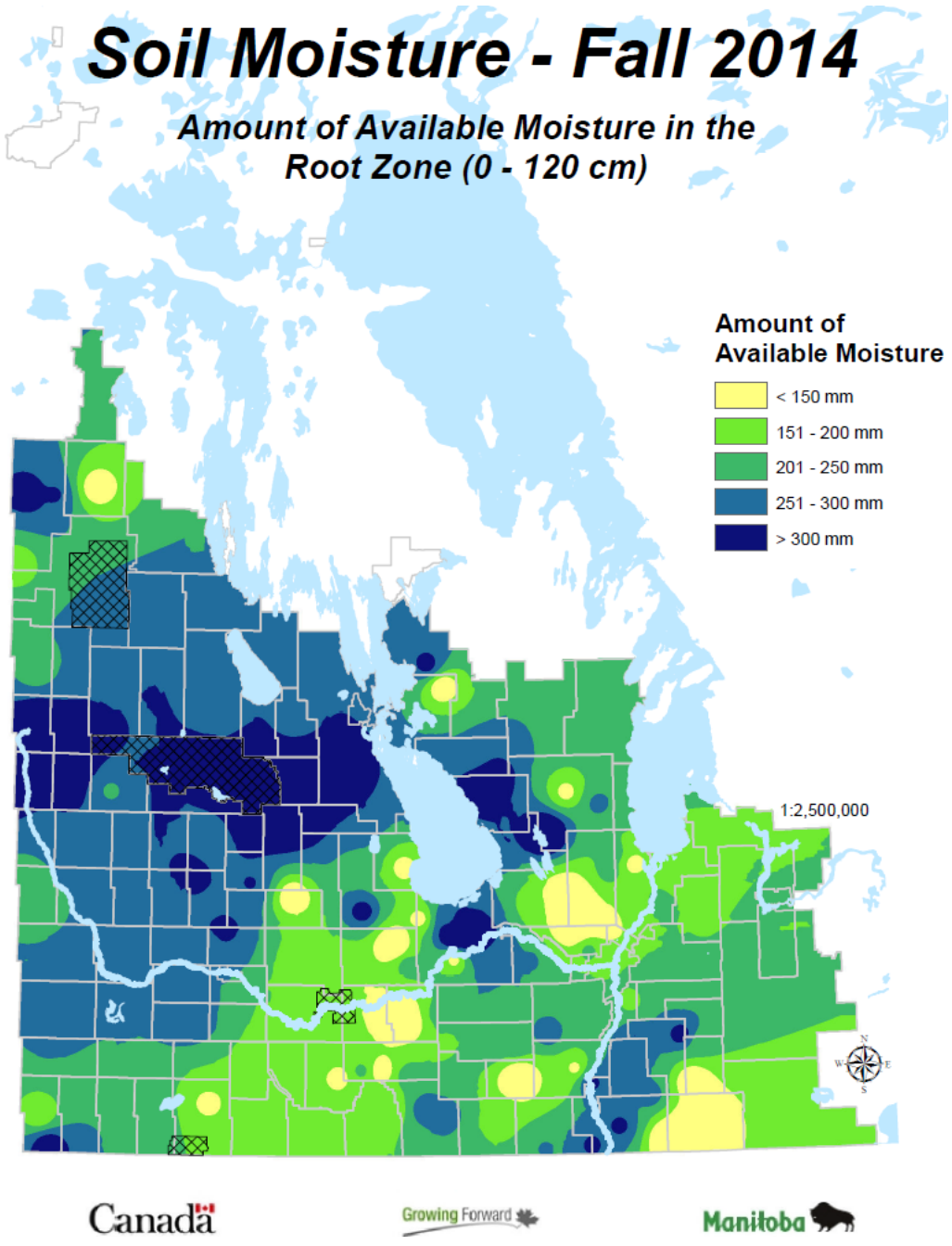


Figure 8. Soil moisture from field measurements by MAFRI (mm water in root zone)

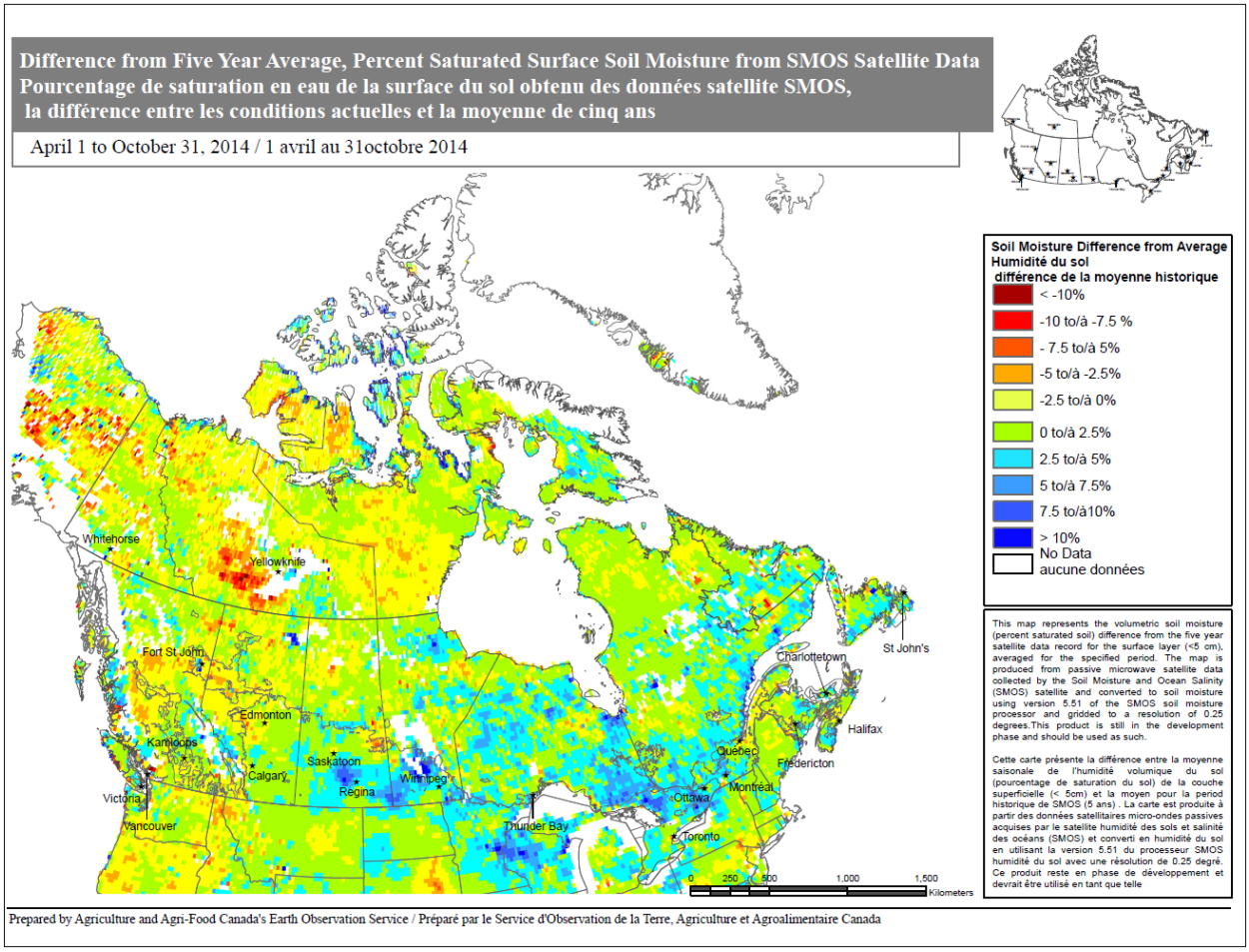


Figure 9. Soil moisture from satellite image (From Agriculture and Agri Food Canada).

BASE CONDITION

Rivers

Most of the major rivers are above or near the upper quartile (75%) flow values. Upper quartile values indicate that for 75% of the time, the recorded flows are equal or less than that value. The Red River flows at James Avenue (Figure 10) and St. Agathe (Figure 11) indicate that flows are at upper quartile level for this time of the year. The Assiniboine River, Qu'Appelle River and Souris River at most gauging stations indicate flows are at record high values for this time of the year surpassing the previous high record observed in the fall of 2010 (Figure 12 to 17). It is expected flows will continue to drop during the winter periods. High base flows and levels during

the spring runoff could increase the potential for major spring flooding. Current flows for main rivers at selected locations are given on Table 1.

Table 1. Flows for main rivers at selected locations.

Rivers	Location	Flow (cfs)
Red River	Emerson	3,180
	Ste Agathe	3,500
Assiniboine River	Russell	880
	Miniota	2,650
	Brandon	3,188
	Holland	4,600
	Headingly	4,600
Shellmouth Dam Release	Shellmouth	760
Souris River	Wawanesa	1,412
	Melita	284
	Souris	756
Qu'Appelle River	Welby	952
Fairford River	Near Fairford	10,240
Dauphin River	Near Dauphin	8,475
Waterhen River	Near Waterhen	8,120
Lake St Martin Emrg. Out. Channel	Lake St Martin	3,300

Lakes

All major lakes (Lake Manitoba, Lake Winnipegosis, Dauphin Lake, Whitewater Lake, and Lake Winnipeg) are above the upper quartile range for this time of the year (Figure 18 to 21). Lake of the Prairies (Shellmouth Reservoir) is at median condition for this time of the year (Figure 22) and is expected to drop 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 lakes level, this could induce major flooding. The current lake levels and the expected level by March 30, 2015 (before the 2015 spring runoff) is given on Table 2.

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

Lakes	Current Level (f	Operating Range or long term average (ft)	Expected level by March 30, 2015 (ft)
Lake Manitoba	813.5	810.5 - 812.5	812.5-812.8
Lake Winnipeg	714.67	711-715	
Lake St Martin	801.9		802.3-802.5
Lake Winnipegosis	833	830.5	832.3-832.6
Dauphin Lake	856.4	854.8-855.4	855.3-855.6
Whitewater Lake	1632.7	1628	1632.7
Sehllmouth	1398.6		1389 - 1390

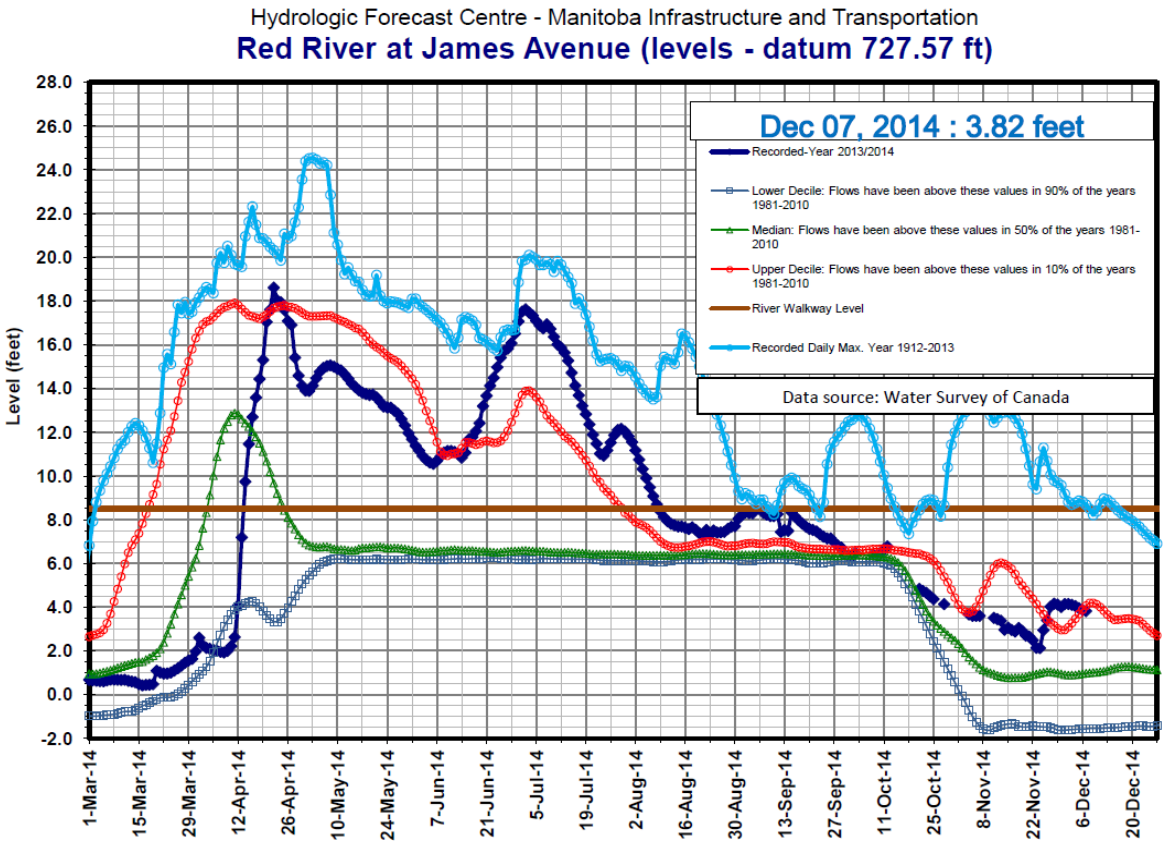


Figure 10. Red River flows at James Avenue (level readings are possibly ice affected).

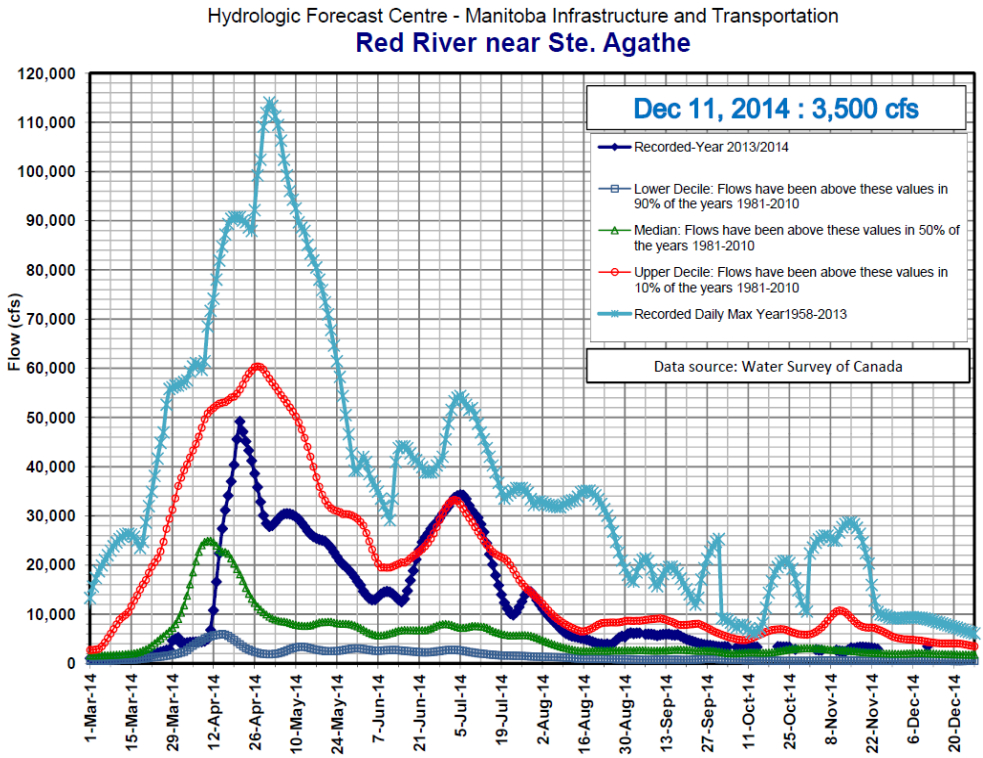


Figure 11. Red River Flows at St Agathe

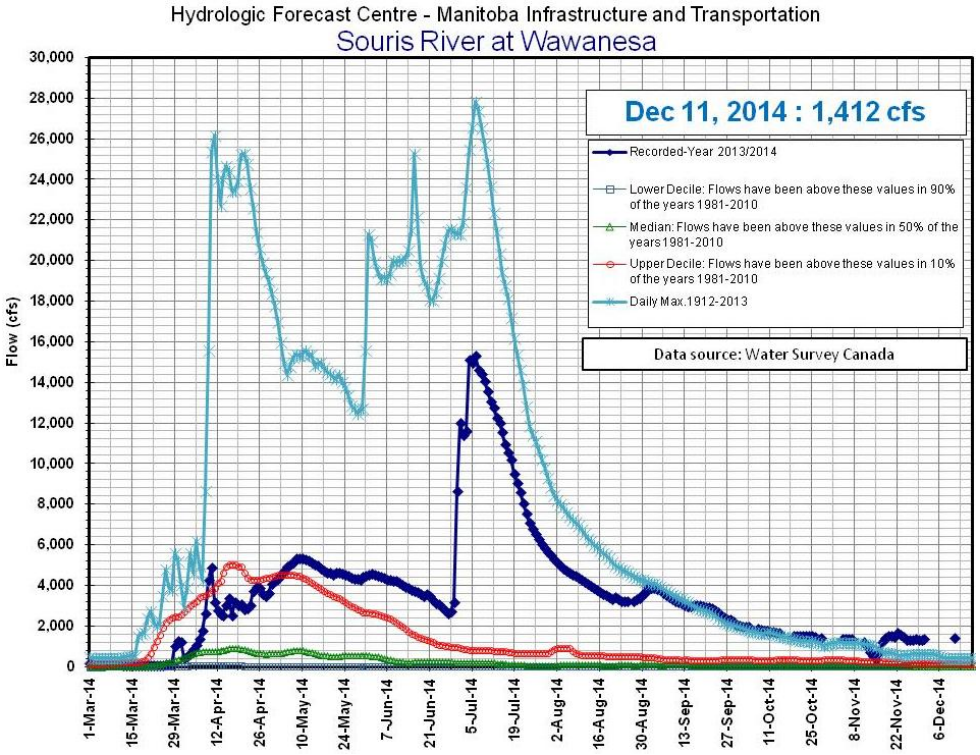


Figure 12. Souris River Flows at Wawanesa

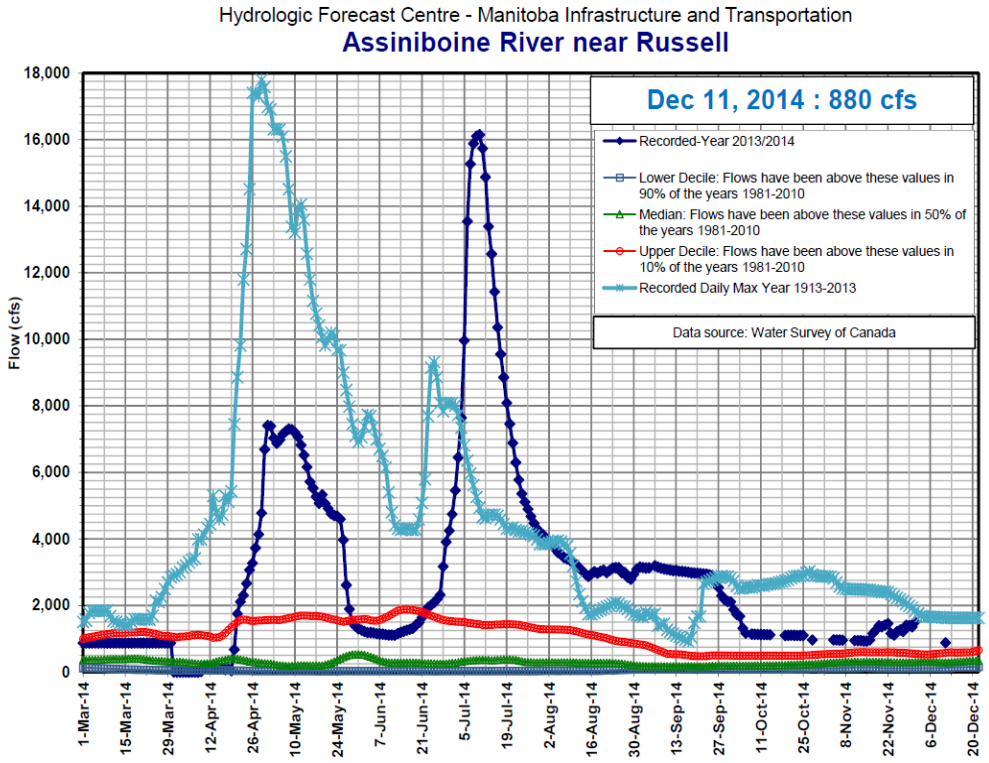


Figure 13. Assiniboine River flows near Russell

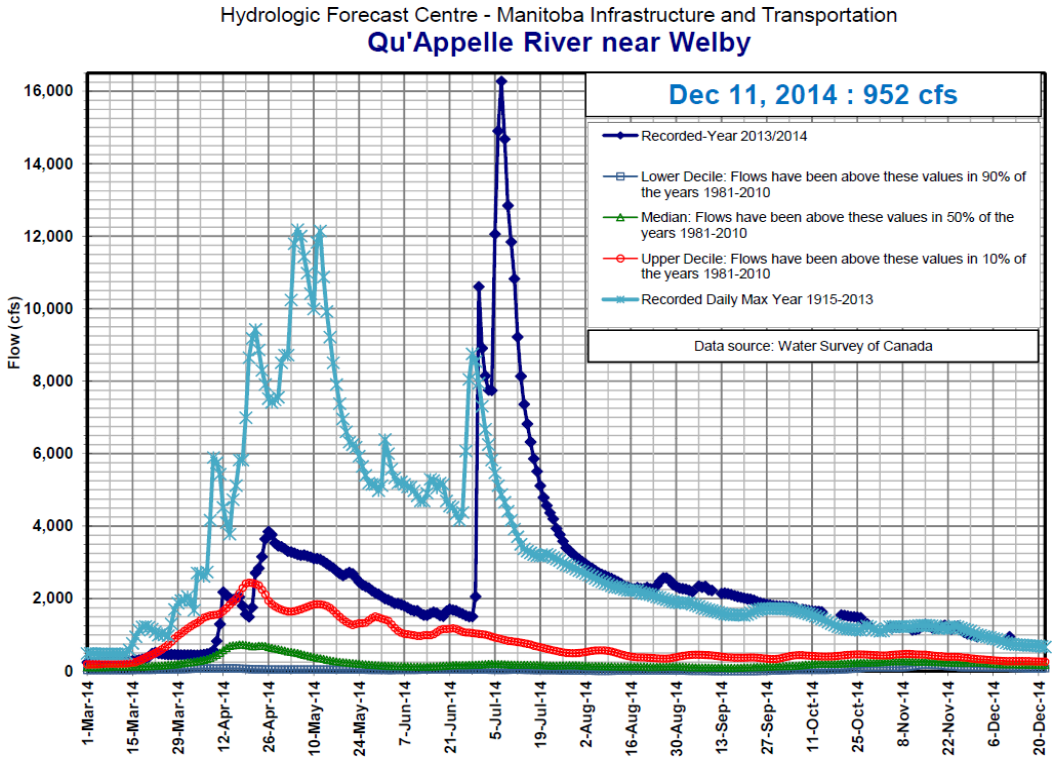


Figure 14. Qu'Appelle River flows near Welby

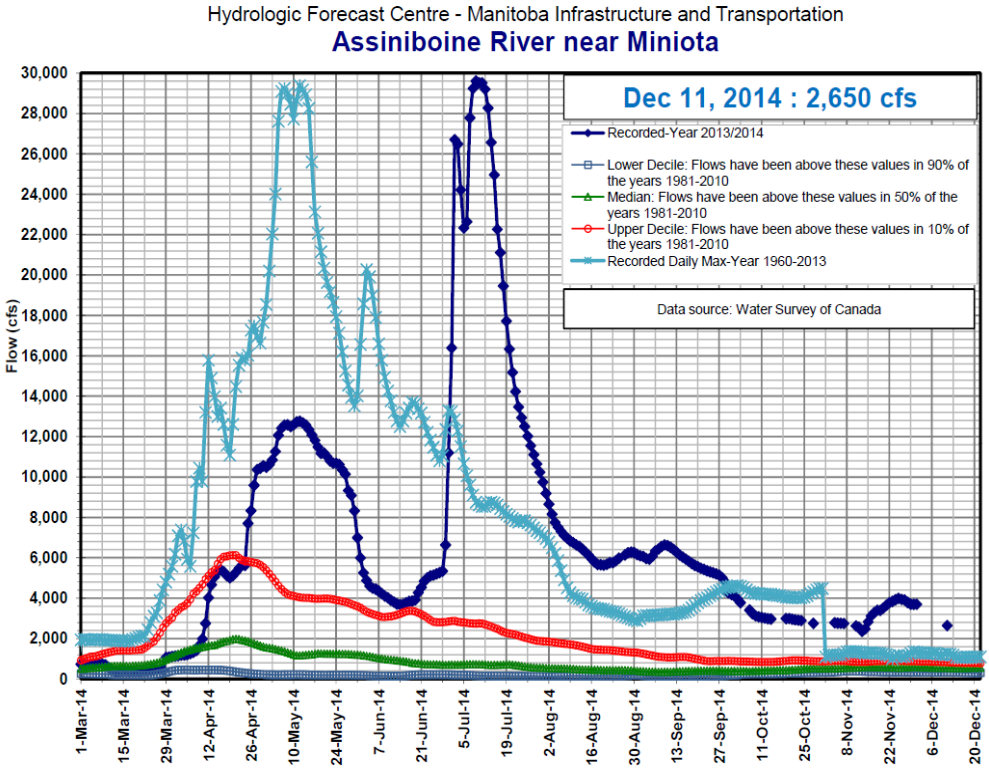


Figure 15. Assiniboine River flows near Miniota

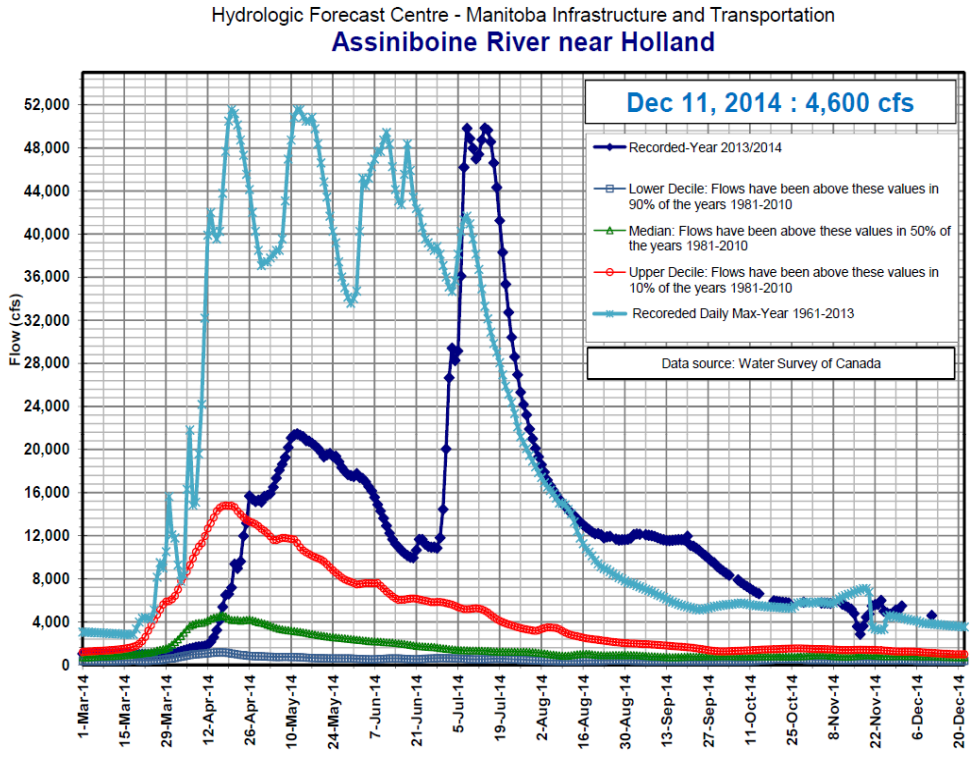


Figure 16. Assiniboine River flows near Holland

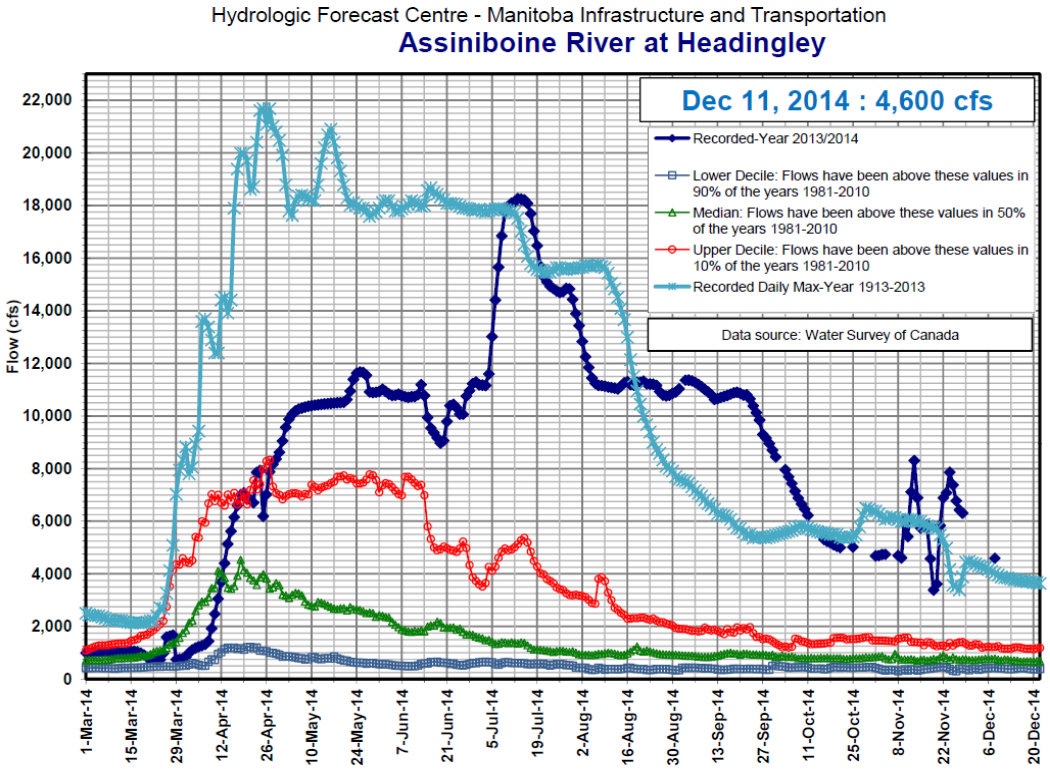


Figure 17. Assiniboine River flows near Headingly

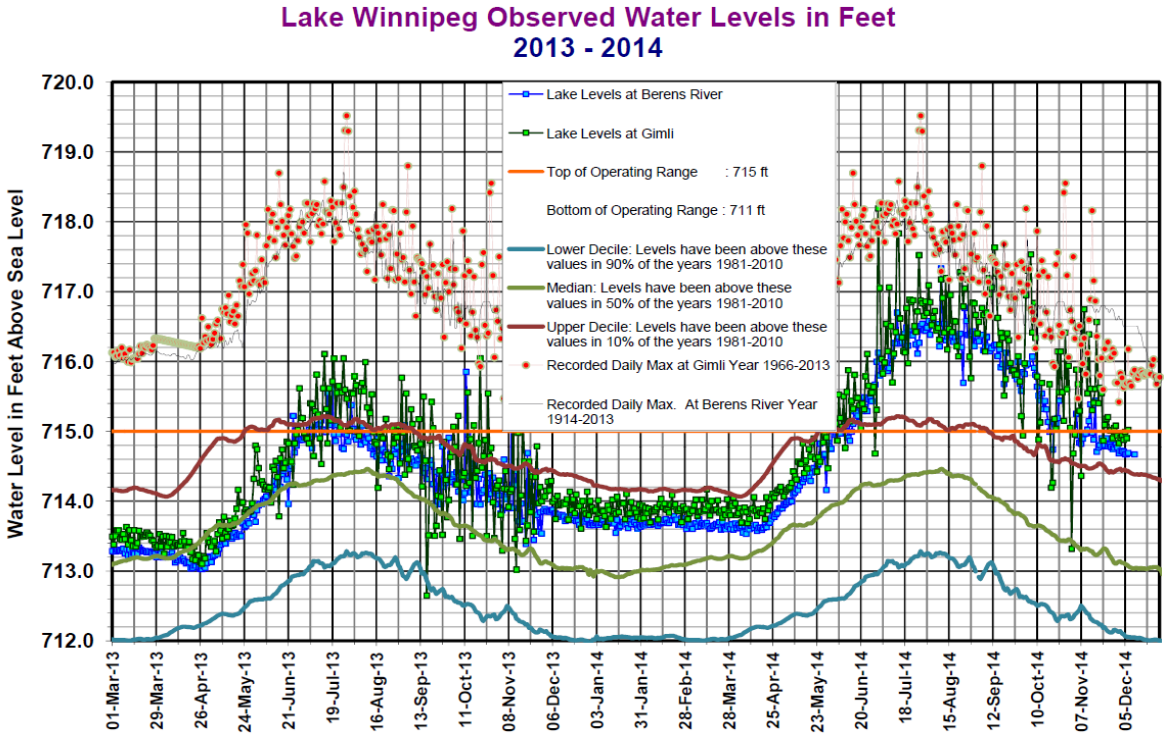


Figure 18. Lake Winnipeg water levels

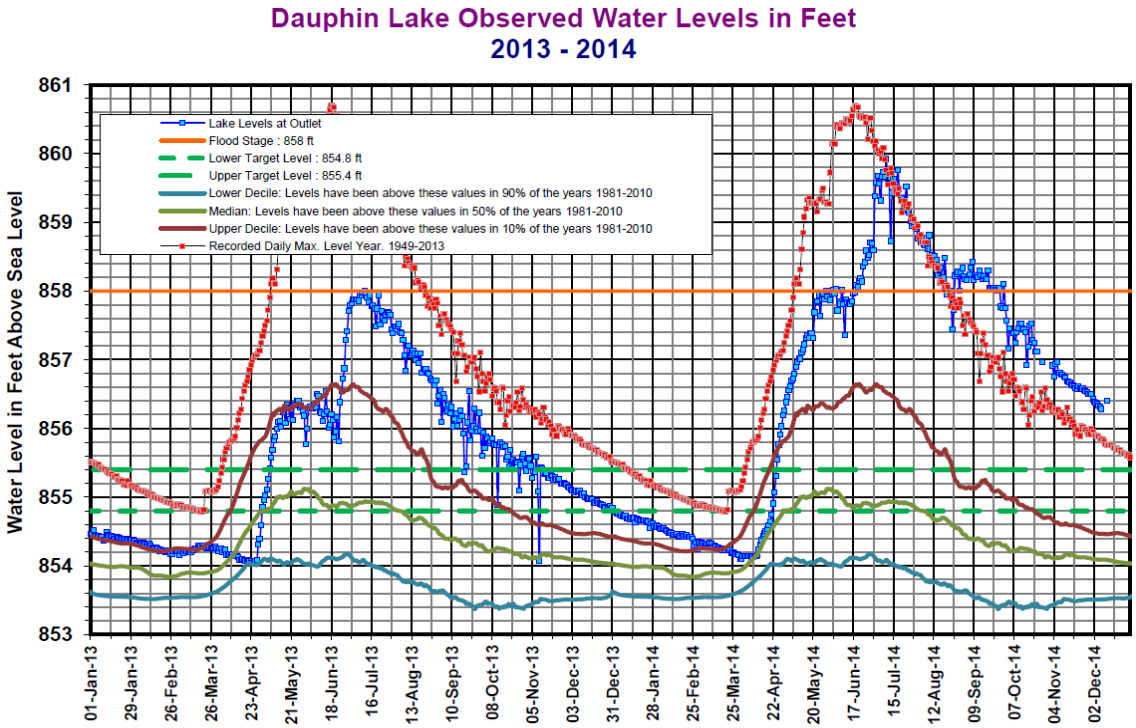


Figure 19. Dauphin Lake water levels

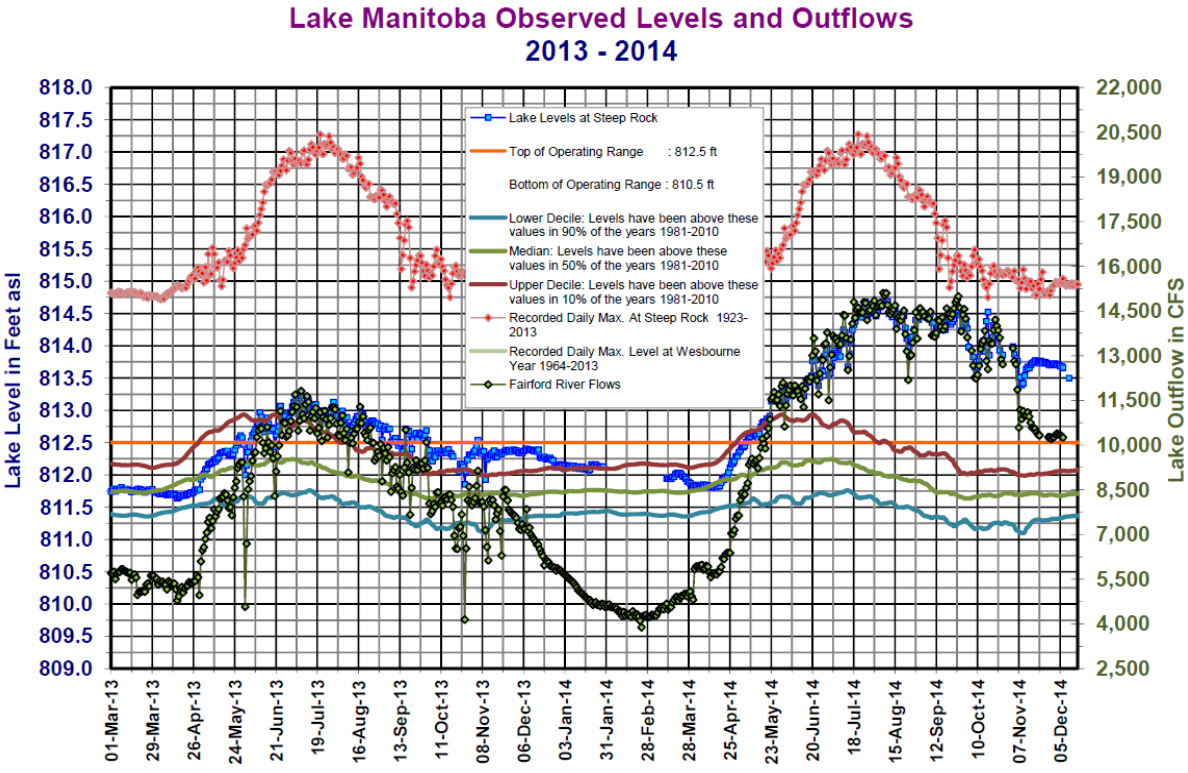


Figure 20. Lake Manitoba Water levels and Fairford River flows

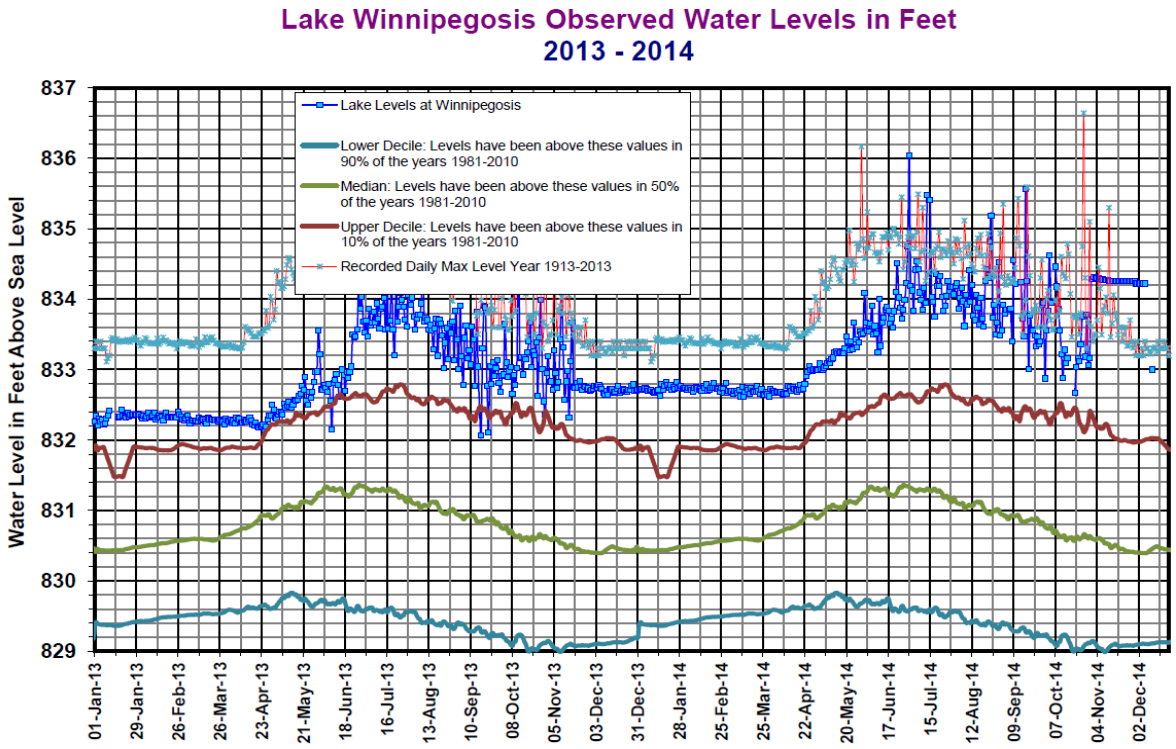


Figure 21. Lake Winnipegosis water levels

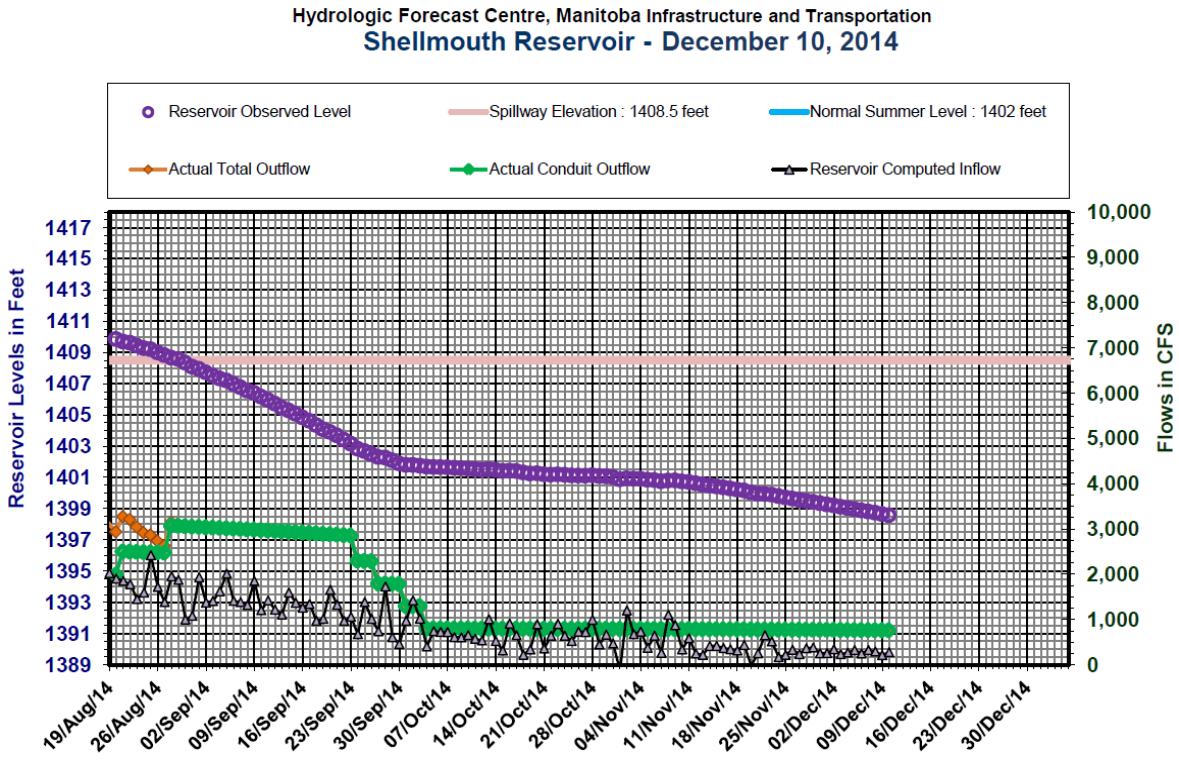


Figure 22. Lake of the Prairies (Shellmouth Reservoir) water levels

WINTER PRECIPITATION (LONG TERM PRECIPITATION FORECAST)

Winter precipitation records for November and first 10 days of December indicate precipitation records are normal to well below normal in most watersheds (Figure 23 and 24). This indicates a milder trend on precipitation in comparison with the fall of 2010. During the same period in the fall of 2010, precipitation records are well above normal on the Assiniboine River, the Qu'Appelle River and the Souris River basins. Percent normal precipitation for November 2010 is shown in Appendix.

Environment Canada recently issued a long term precipitation forecast for the months of December, January and February (Figure 25). Based on the forecast it is expected that the majority of Manitoba will be near normal condition except the Assiniboine River and the Qu'Appelle River watersheds, which expect below normal precipitation. Experience indicates that these long term forecasts are more accurate for the first month of the forecast and conditions start to change significantly for longer time ranges. Generally, long term weather forecasts are not as reliable as short term forecasts. The National Weather Service Climate Prediction Centre forecasts for near normal precipitation on the Red River Basin.

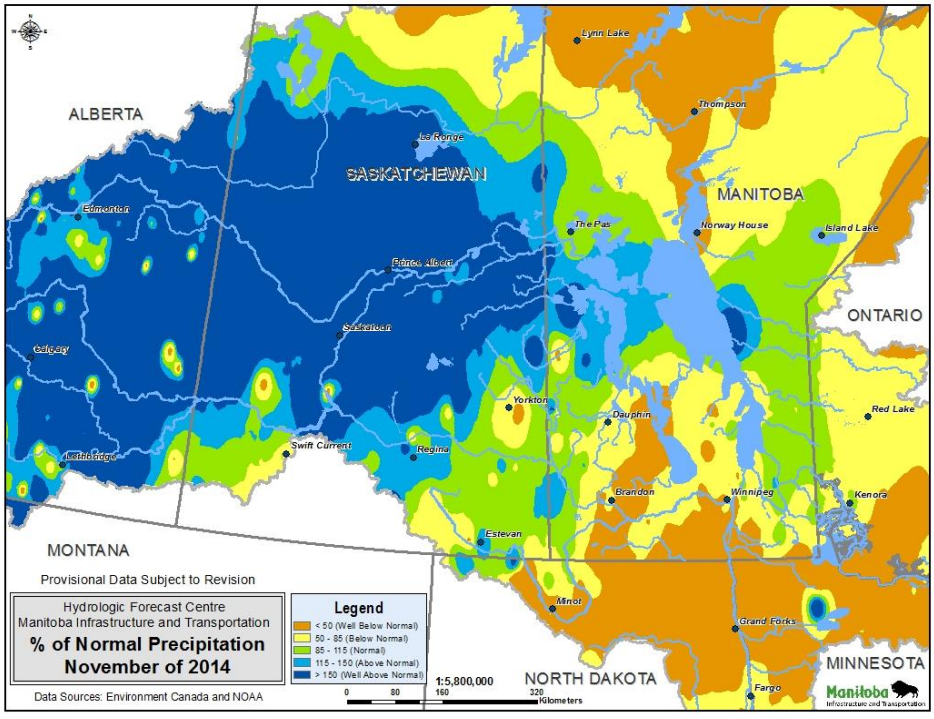


Figure 23. Percent normal precipitation for November 2014

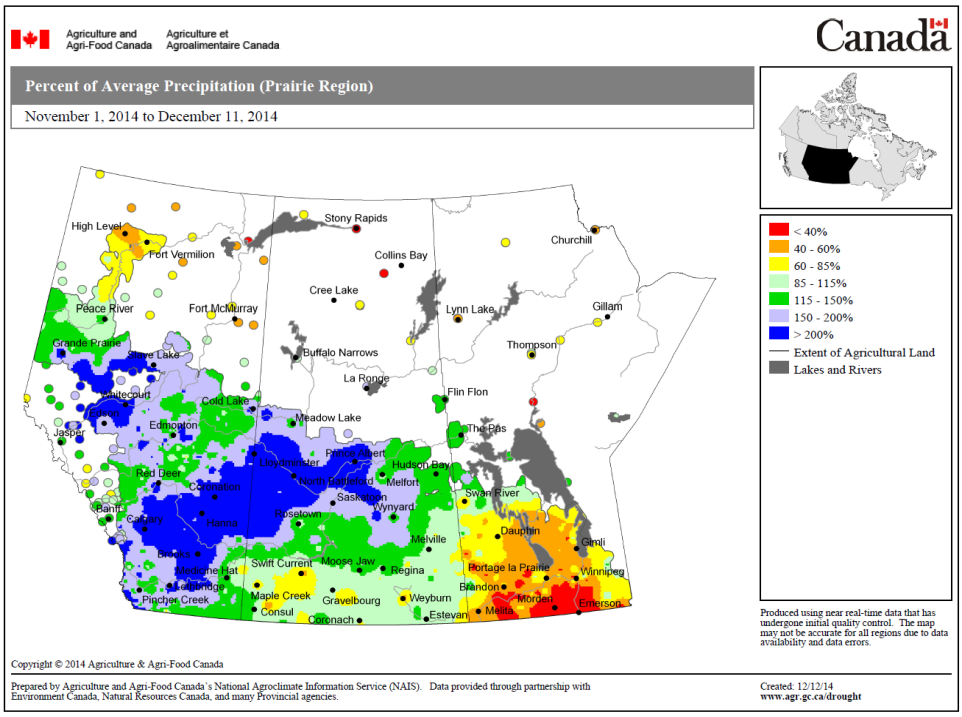


Figure 24. Percent normal precipitation for November 1 to December 11, 2014.

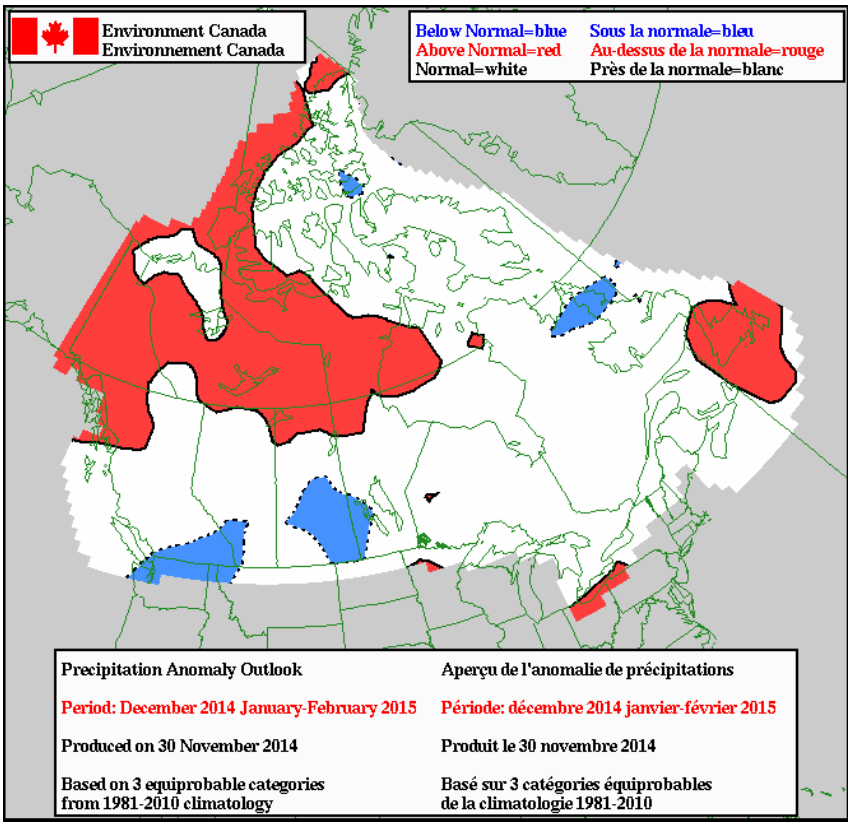
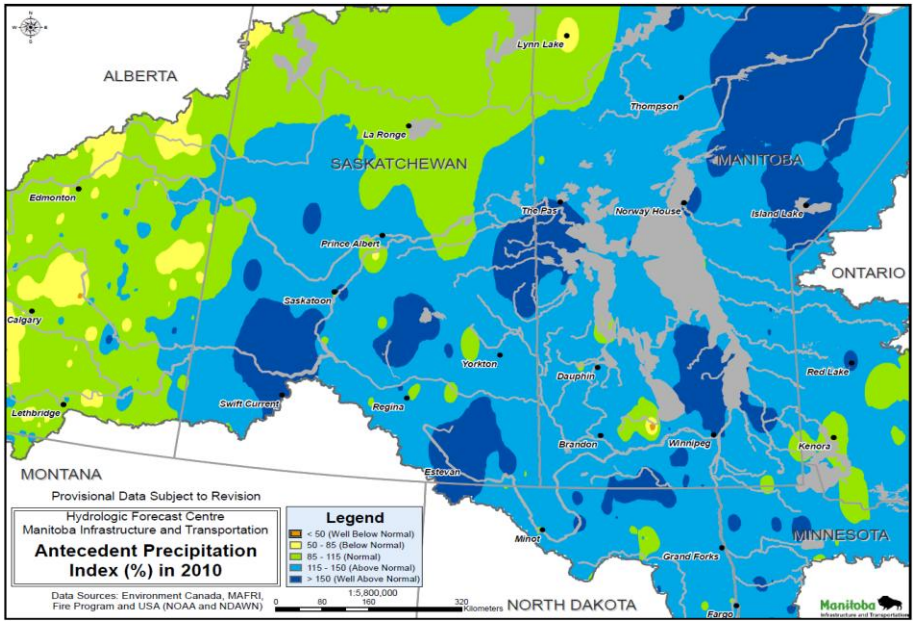


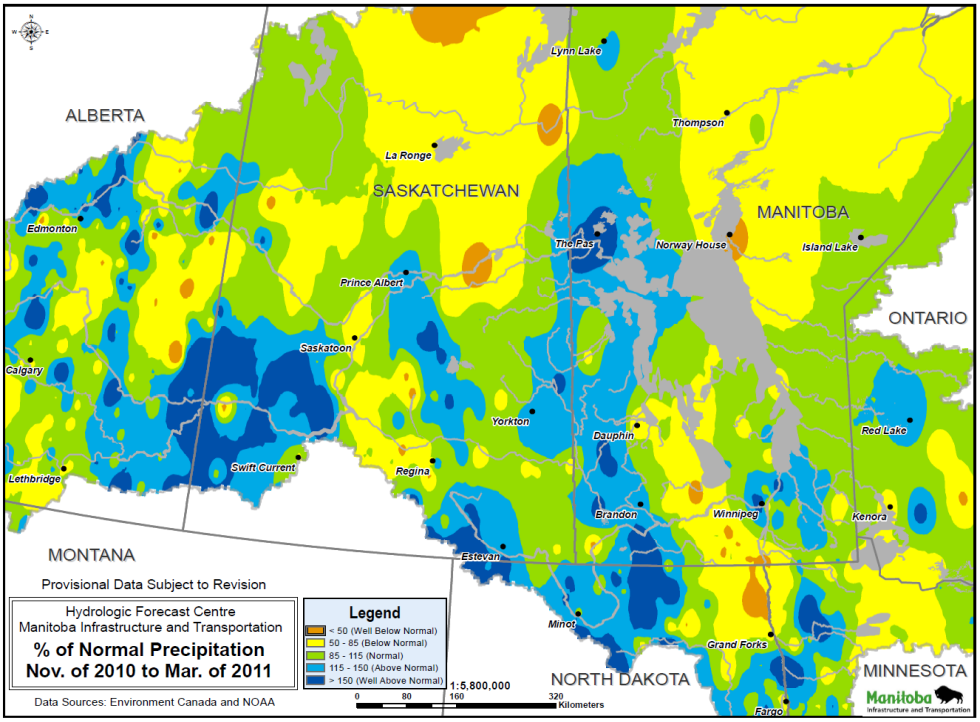
Figure 25. Environment Canada extended Precipitation forecast

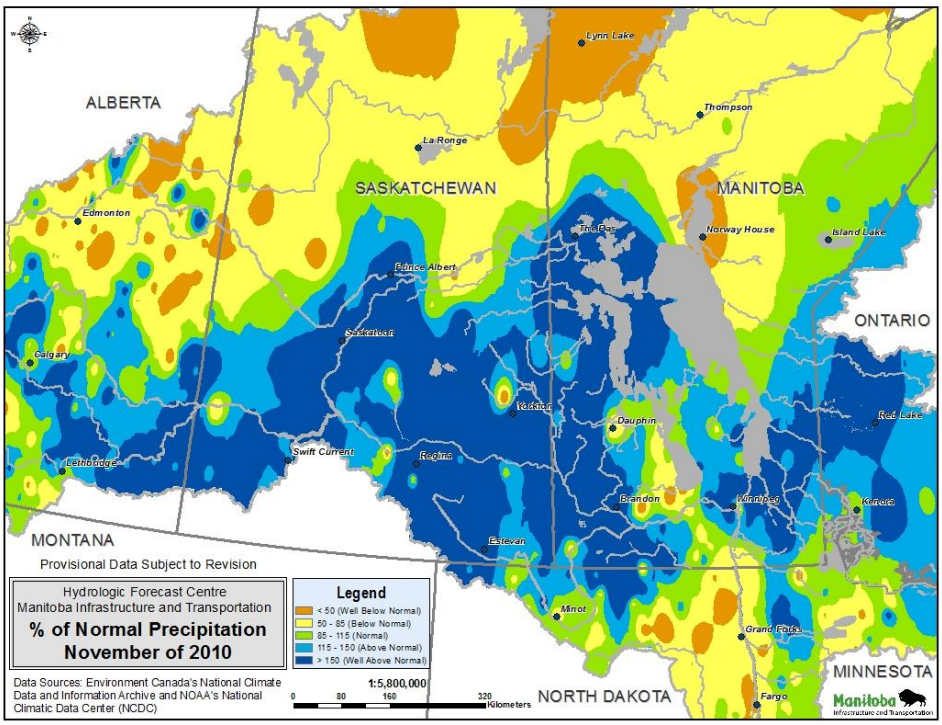
APPENDIX: CONDITIONS IN THE FALL OF 2011

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

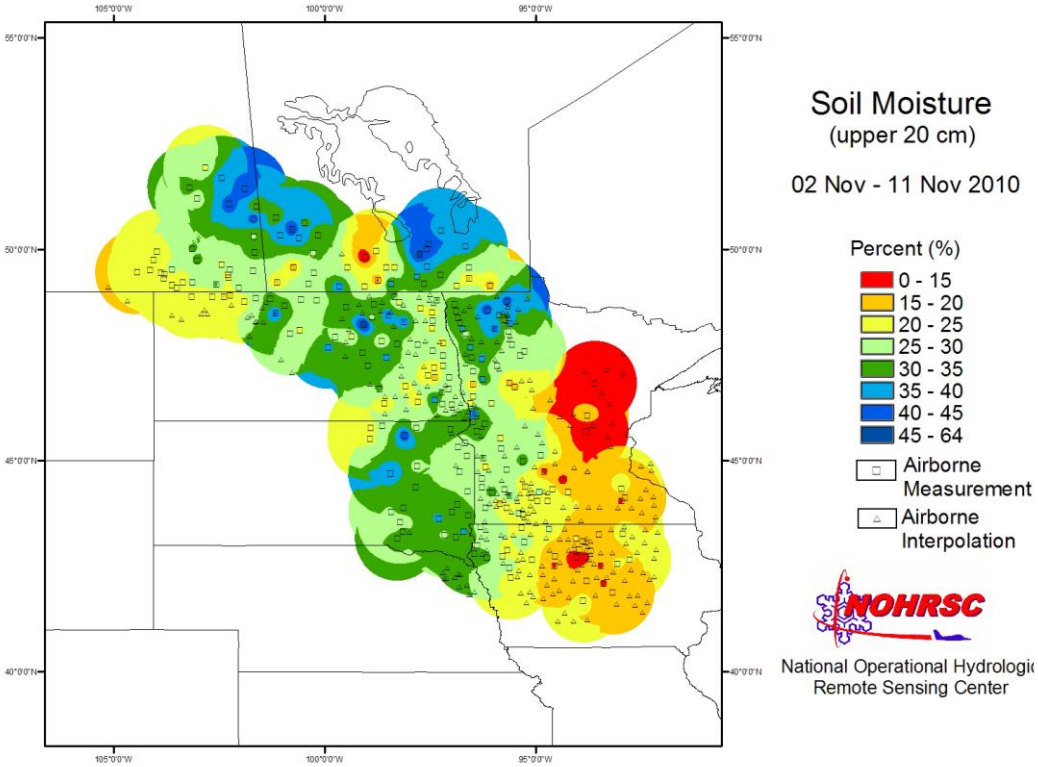


Winter Precipitation in 2010/2011



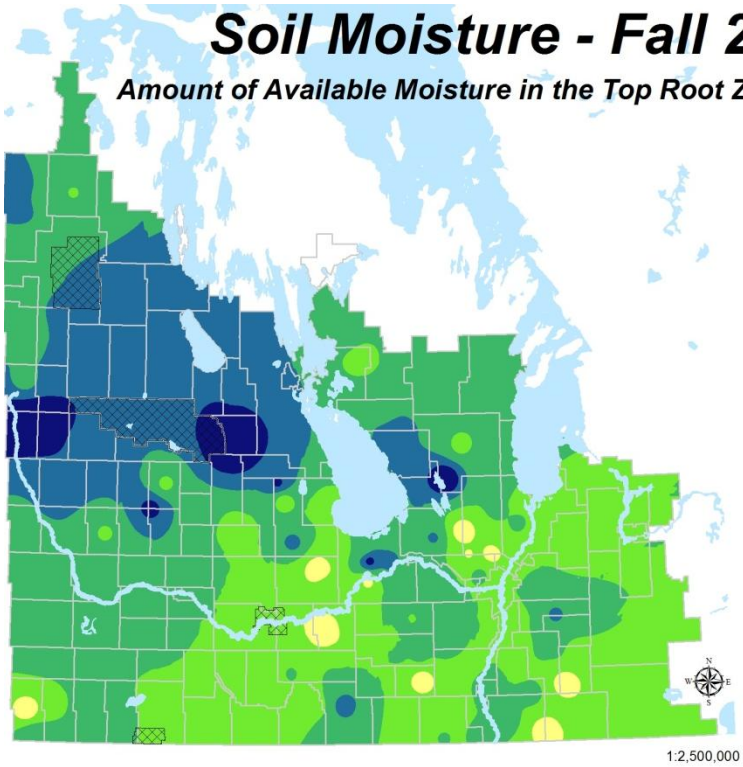


Gamma Survey in the fall of 2010



Soil Moisture - Fall 2014

Amount of Available Moisture in the Top Root Zone (0-30 cm)



Amount of Available Moisture

- < 25 mm
- 26 - 50 mm
- 51 - 75 mm
- 76 - 100 mm
- > 100 mm

The colours on this map represent measured soil moisture values from soil samples collected at 105 sites across Manitoba. The sampling sites were chosen based on locations whose soils best represent the surrounding areas. Soil properties such as bulk density, field capacity and wilting point were estimated for each soil based on their physical characteristics.

For more information, contact M. Riekman, Manitoba Agriculture, Food and Rural Development.

Email: marla.riekman@gov.mb.ca

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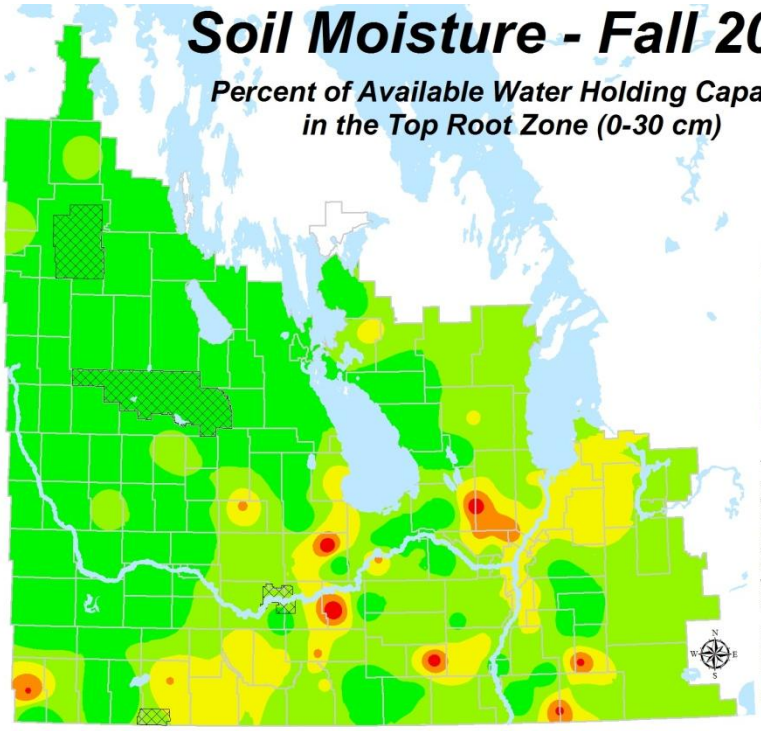
Canada Growing Forward Manitoba

Date: 2014-12-03

Soil Moisture - Fall 2014

Percent of Available Water Holding Capacity in the Top Root Zone (0-30 cm)



Percent of Available Water Holding Capacity

- < 20%
- 21 - 40%
- 41 - 60%
- 61 - 80%
- > 80%

The colours on this map represent measured soil moisture values from soil samples collected at 105 sites across Manitoba. The sampling sites were chosen based on locations whose soils best represent the surrounding areas. Soil properties such as bulk density, field capacity and wilting point were estimated for each soil based on their physical characteristics.

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Date: 2014-12-0