

2017 February Flood Outlook

Manitoba Hydrologic Forecast Center

Manitoba Infrastructure

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**Hydrologic Forecast Centre
Manitoba Infrastructure
Winnipeg, Manitoba**

**FEBRUARY OUTLOOK REPORT FOR MANITOBA
February 27, 2017**

Overview

The February Outlook Report prepared by the Hydrologic Forecast Centre of Manitoba Infrastructure reports normal to above normal runoff potential across the province. The risk of overland flooding is generally moderate to major across the province. This could change depending on weather conditions between now and the spring melt.

Due to the above normal soil moisture and above normal winter precipitation to the end of February, the Red River, the Souris River, the Pembina River, the Roseau River, the lower Assiniboine River and the Whiteshell lakes area are at major risk of overland flooding. The risk of overland flooding is moderate in other areas of the province including the Saskatchewan River, Interlake region and the Upper Assiniboine River.

Most of the major lakes are above normal levels for this time of the year, and the risk for lake high water flooding is moderate to major depending on future weather conditions. Flows and levels in most rivers are above normal to well above normal for this time of the year.

Soil Frost Depth:

Frost depth is near normal to below normal throughout most of Manitoba. Generally, below normal frost depth means that the soil can absorb more melting surface water and potentially decrease the amount of overland flooding whereas above normal frost depth can contribute to increased runoff.

Soil Moisture Conditions at Freeze up:

Soil moisture is generally normal to well above normal on all Manitoba basins.

- Southern Manitoba including the Red River Valley: normal to above normal
- Western Manitoba: above normal to well above normal
- Saskatchewan: above normal to well above normal
- Northern Manitoba, including The Pas Region: above normal to well above normal
- Interlake: normal to above normal

- Eastern Manitoba: near normal

Winter Precipitation:

Winter precipitation is normal to above normal throughout southern and southeastern Manitoba, including the Red River, the Souris River, the Pembina River, the Roseau River, the Winnipeg River and the Whiteshell area. The Interlake has received near normal winter precipitation.

The winter precipitation in the Red River basin in the U.S, the Souris River basin in the U.S, and the Winnipeg River basin in Ontario is above normal to well above normal.

Winter precipitation has been normal to below normal for western Manitoba and below normal in northern Manitoba and Saskatchewan. Below normal winter precipitation is recorded in the Qu'Appelle River, the upper Assiniboine River and the Saskatchewan River watersheds including the Lake Winnipegosis basin.

Future Weather:

Environment Canada's latest long term forecast shows equal chance of below normal, near normal and above normal precipitation for the next three months. It also shows there is a slightly higher chance of above normal temperatures throughout northern Manitoba with near normal temperatures for the rest of the province.

National Weather Service's long term forecast shows an increased chance of below normal temperatures across the Souris River basin and western portion of the Red River basin in the U.S. The forecast also shows a higher probability of above normal precipitation on the U.S. portion of the Souris River and the Red River basins.

Runoff:

The potential for spring runoff is above normal to well above normal in the Red River, the Souris River, the lower Assiniboine River, the Pembina River and the Roseau River basins. The potential for spring runoff is near normal in the upper Assiniboine River, the Saskatchewan River, the Qu'Appelle River and the Interlake region. The runoff potential is normal to above normal throughout the rest of the province, including the Winnipeg River basins, the Lake Winnipegosis region and the Whiteshell area. .

The early melt which occurred in mid February in the southern portion of the Red River basin has diminished most of the snowpack south of Grand Forks. This has slightly reduced the potential for flood flows on the Red River in Manitoba, but it has also left the soil saturated and prone to high runoff volumes from future precipitation.

Flood Outlook:

The magnitude of spring flood potential is still very dependent on weather conditions until the spring melt. Flood potential is significantly affected by:

- the amount of additional snow and spring rain;
- frost depth at the time of runoff;
- the timing and rate of the spring thaw; and
- the timing of peak flows in Manitoba, in the U.S. and in Saskatchewan and Ontario.

Delayed thaw and spring rainstorms could result in rapid snow melt aggravating overland flooding and increasing tributary flows. A single precipitation event similar to the rainstorm that occurred in the summer of 2014 could change the flood outlook significantly.

The province's practice is to plan and prepare for the unfavourable weather condition scenario (the upper decile or a 1 in 10 chance that Manitoba will experience an extreme weather scenario resulting in a high flood risk). The preliminary outlook shows the risk of overland flooding for the unfavourable weather scenario in the following watersheds:

- Red River: major risk;
- Pembina River: major risk;
- Roseau River: major risk;
- Assiniboine River: moderate to major risk;
- South Western Region: major risk;
- Interlake Region and the Fisher River: moderate risk;
- Eastern Region and the Winnipeg River: moderate to major risk; and,
- Northern Manitoba/The Pas Regions and the Saskatchewan, Carrot and Swan rivers: moderate risk.

Preparations:

As a matter of standard annual practice leading in to the spring flood season, the Manitoba government reviews existing emergency response plans, confirms communications networks, coordinates the sharing of information and plans with municipalities and First Nations, and prepares personnel and resources used in flood response.

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Soil Moisture Conditions

As previously outlined in the 2016 Fall Conditions Report, the soil moisture analysis based on weighted summer and fall precipitation indicates normal to well above normal soil moisture for most of Manitoba, and above normal to well above normal throughout most of Saskatchewan and the Saskatchewan River basin. The Assiniboine River, Qu'Appelle River and Souris River basins have above normal to well above normal soil moisture (Figure 1 and Figure 2). Due to the February melt followed by freezing temperatures, the soil moisture in the southern portion of the Red River basin is assumed to be completely saturated.

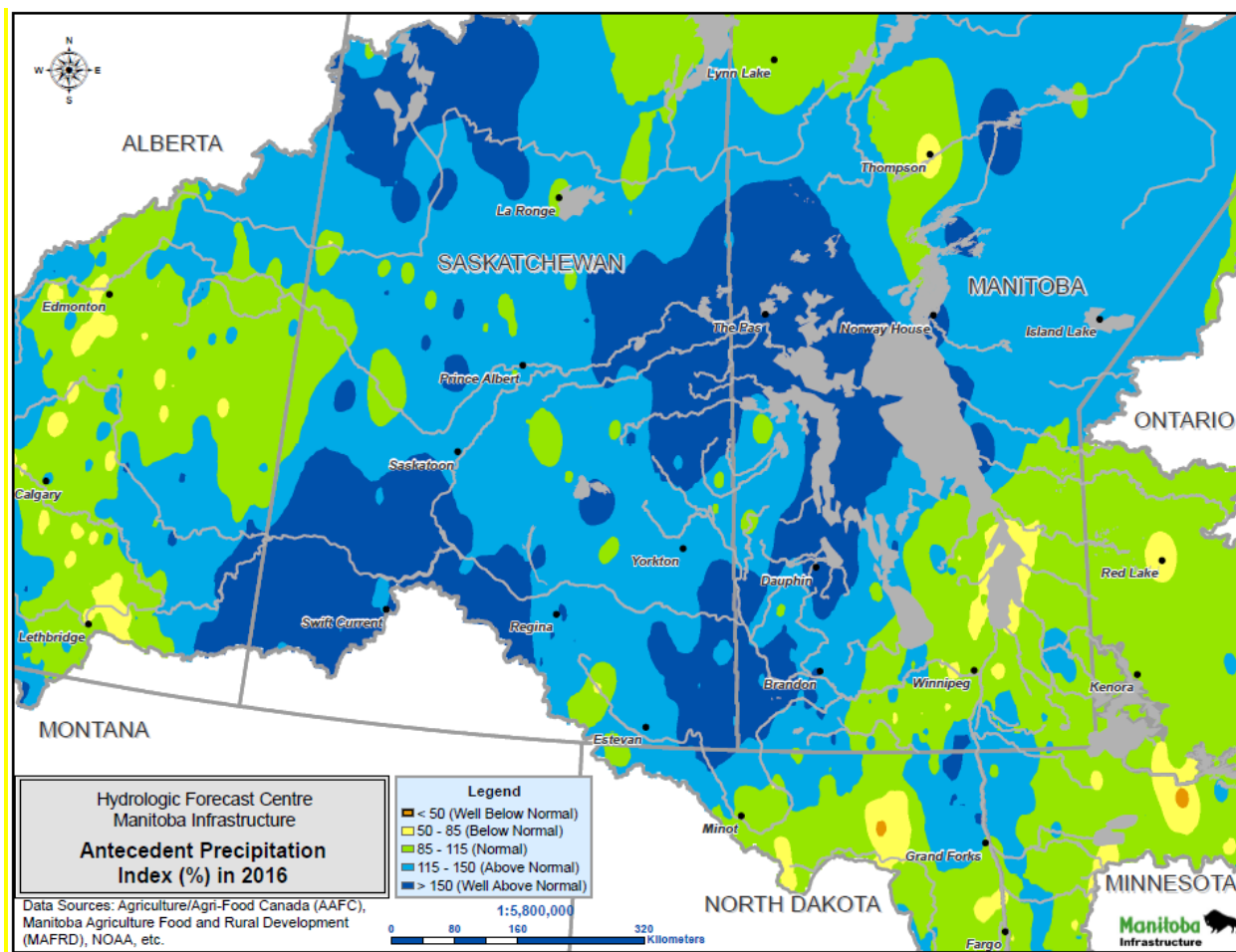


Figure 1 - Antecedent Precipitation Index (API) for the Fall of 2016.

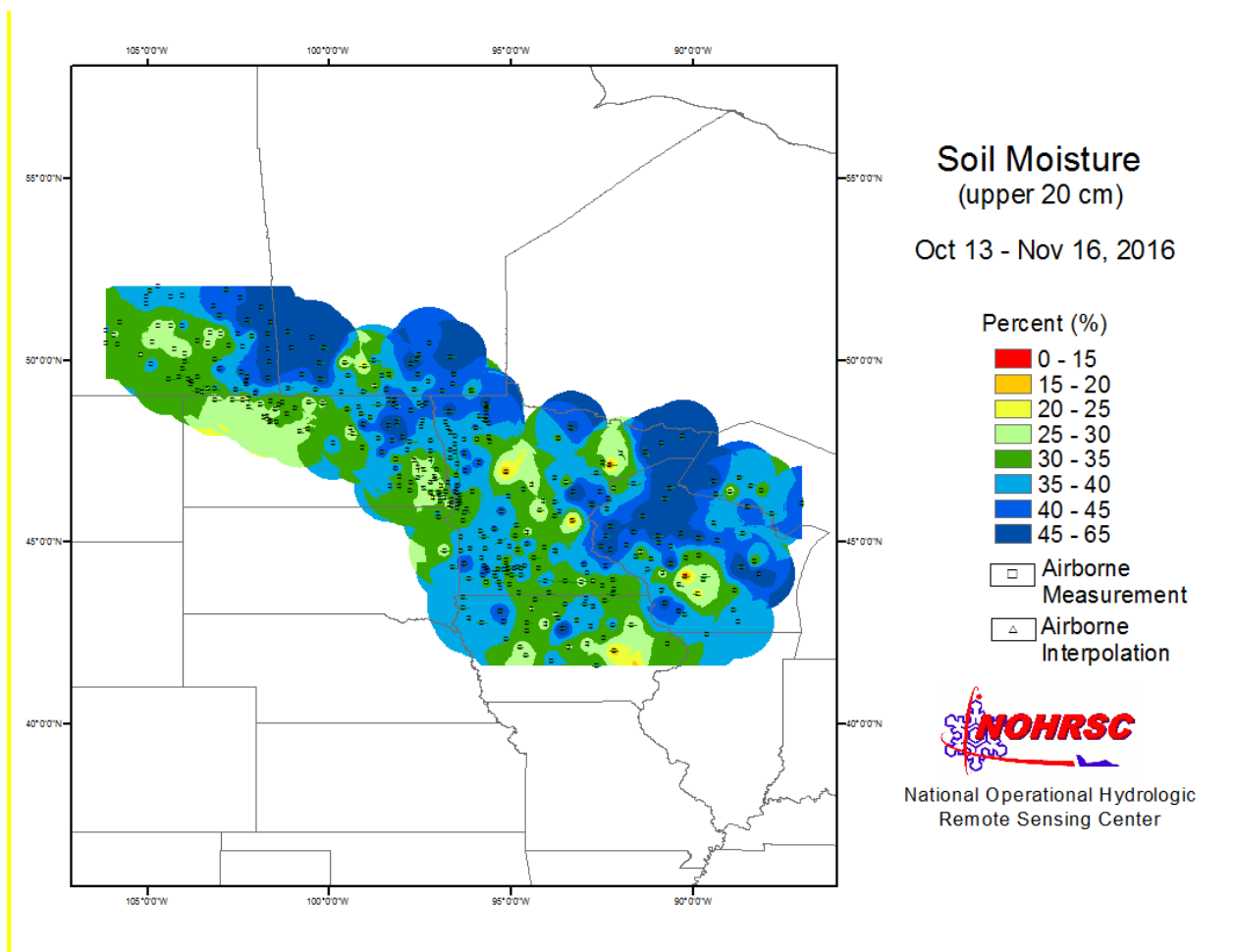


Figure 2 - Gamma Survey derived soil moisture (in the upper 20 cm of soil) from October 13 - November 16, 2016.

Frost Depth

Frost depth information is sparse and variable across watersheds based on winter temperatures and amount of snow cover insulation. Frost depth is considered to be normal to below normal throughout most of the province. The areas with above average snowpack will have a lower frost depth than areas that have received normal snowpack.

Winter Precipitation & Snow Water Content

November to February precipitation has been normal to above normal in most of southern, central and eastern Manitoba and well above normal on the U.S. portion of the Red River and Souris River basins. In western Manitoba, northern Manitoba, Saskatchewan and most of Alberta winter precipitation has been below normal (Figure 3). Since January 25th there has been a similar trend in the U.S. with above average

precipitation occurring in much of the Souris and Red River basins, but in the southern portion of the Red River basin and most of Manitoba there has been below normal precipitation (Figure 4).

Over 120 mm (4.7 inches) of precipitation has been observed in most parts of the Souris River and the Red River basins in the U.S. and in the southeast corner (Whiteshell area) of Manitoba between November 1, 2016 and February 20, 2017. Generally, southern, central, and southwestern portions of Manitoba received between 45 to 120 mm (1.8 to 4.7 inches) of precipitation during the same time period (Figure 5). Since January 25th the most precipitation occurred in southeast Manitoba and northwest Minnesota with precipitation in excess of 20 mm (0.8 inches). The Souris River basin in the U.S. and Saskatchewan received 15 to 20 mm (0.6 to 0.8 inches) of precipitation and much of southern Manitoba received 10 to 20 mm (0.4 to 0.8 inches). The rest of Manitoba received 10 mm (0.4 inches) or less in the last month (Figure 6)

Based on mid-February field observations (Figure 7), the average water content in the snowpack in different areas is as follows:

- the upper Assiniboine River basin: 45 mm (1.8 inches) (observations range between 18 mm to 55 mm (0.7 to 2.2 inches))
- lower Assiniboine River basin: 60 mm (2.4 inches) (observations range from 38 mm to 143 mm (1.5 to 5.6 inches)),
- Souris River basin: 80 mm (3.1 inches) (observations range between 58 mm to 98 mm (2.3 to 3.9 inches))
- Pembina River basin: 80 mm (3.1 inches) (observations range from 38 mm to 143 mm (1.5 to 5.6 inches))
- Red River basin: 80 mm (3.1 inches) (observations range from 58 mm to 112 mm (2.3 to 4.3 inches))
- Carrot and Saskatchewan River basins: 40 mm (1.6 inches) (observations range from 27 mm to 55 mm (1.1 to 2.2 inches))
- Parkland region: 75 mm (3 inches) (observations range from 37 mm to 119 mm (1.5 to 4.7 inches))
- Interlake: 50 mm (2 inches) (observations range from 37 mm to 75 mm (1.5 to 3.0 inches)).

Snow water content obtained from the Snow Water Equivalent (SWE) analysis conducted through the gamma airborne survey on February 8 - 18 indicates similar findings with a maximum of 145 mm (5.7 inches) on the Souris River basin (Figure 8). Calculated SWE's based on observed precipitation and

climatological data, as of February 20, 2017 (Figure 9), is generally in agreement with the field measurements and the gamma survey. It also captures the depleted snowpack in the southern portion of the Red River basin resulting from the recent warm spell.

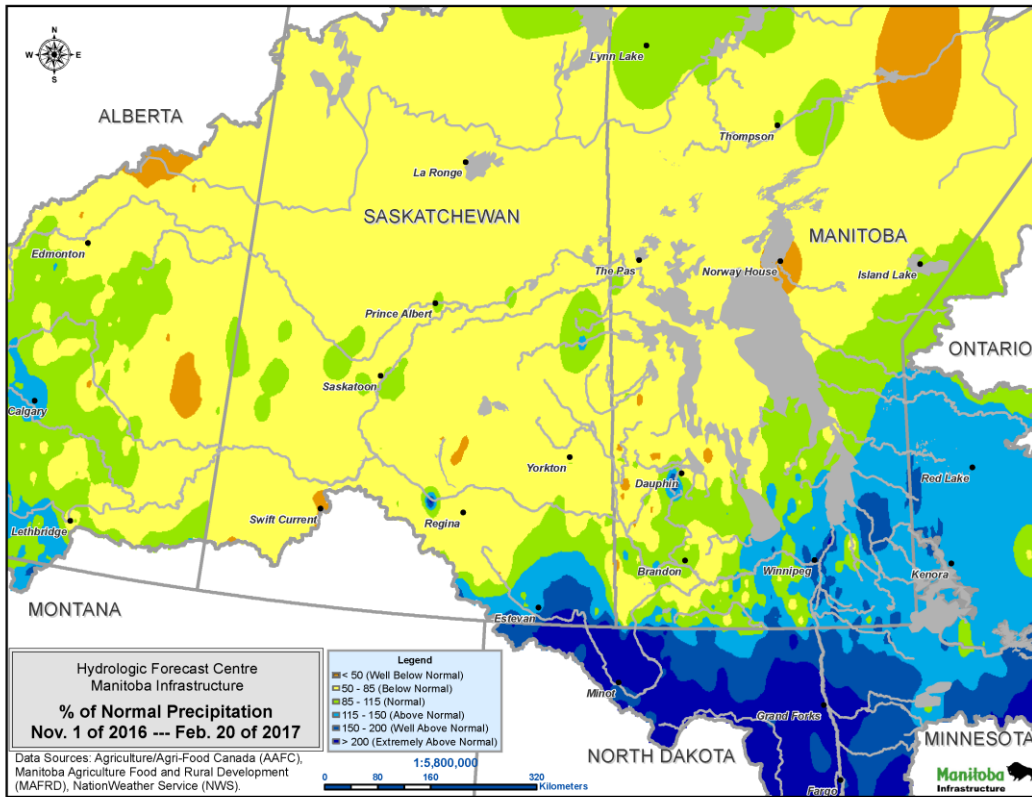


Figure 3 - Percent of Normal Precipitation from November 1, 2016 to February 20, 2017.

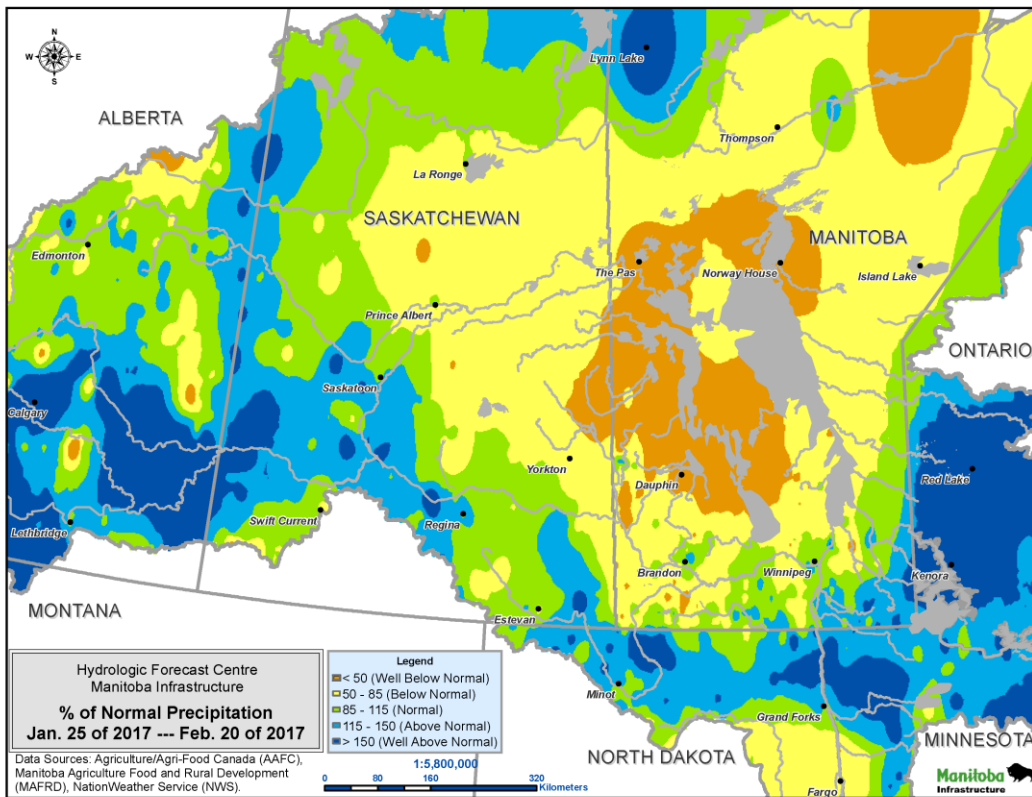


Figure 4 - Percent of Normal Precipitation from January 25, 2017 to February, 2017.

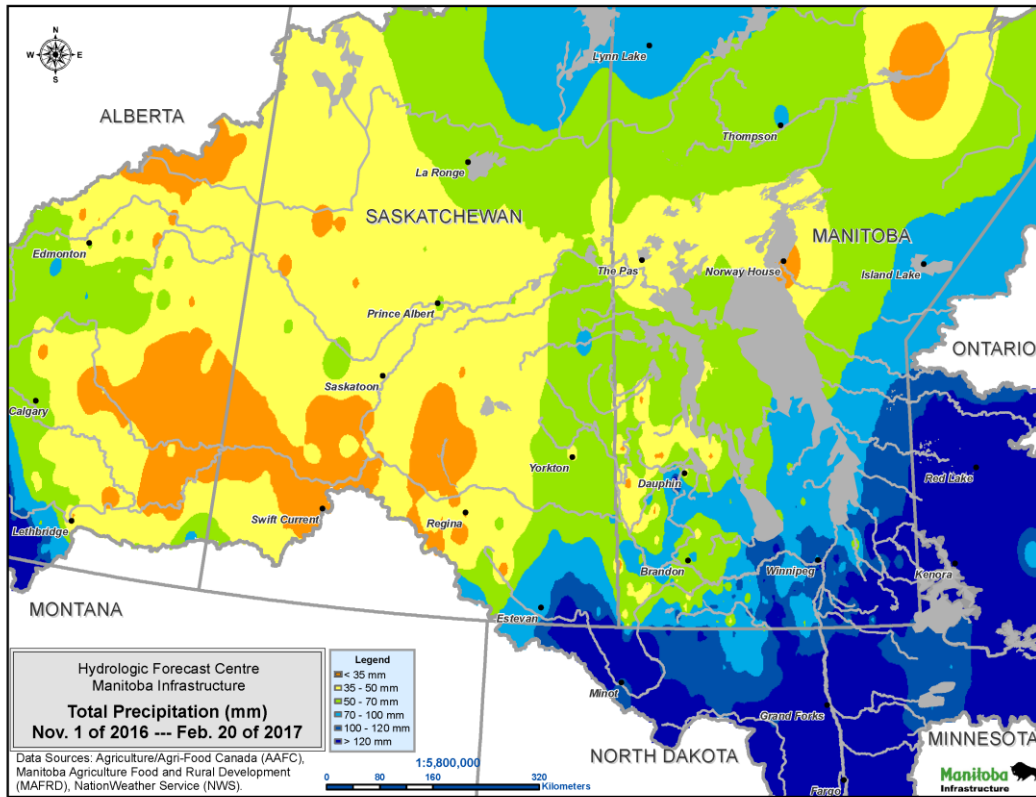


Figure 5 - Accumulated precipitation between November 1, 2016 to February 20, 2017.

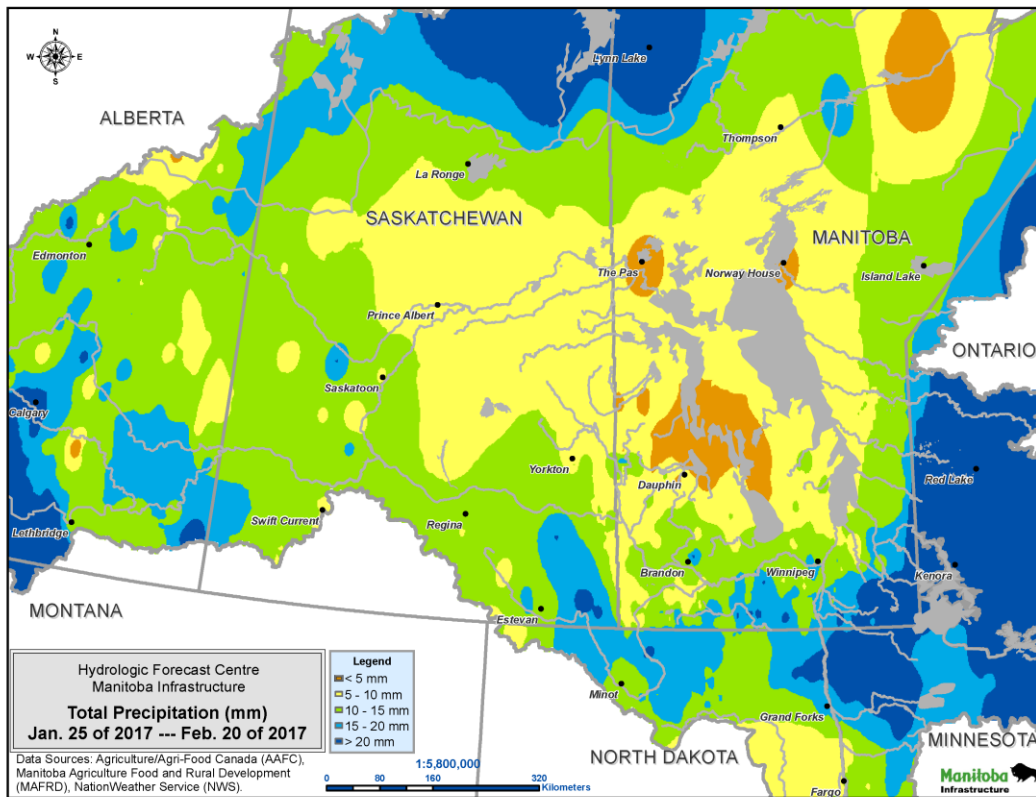


Figure 6 - Accumulated precipitation between January 25, 2017 to February 20, 2017.

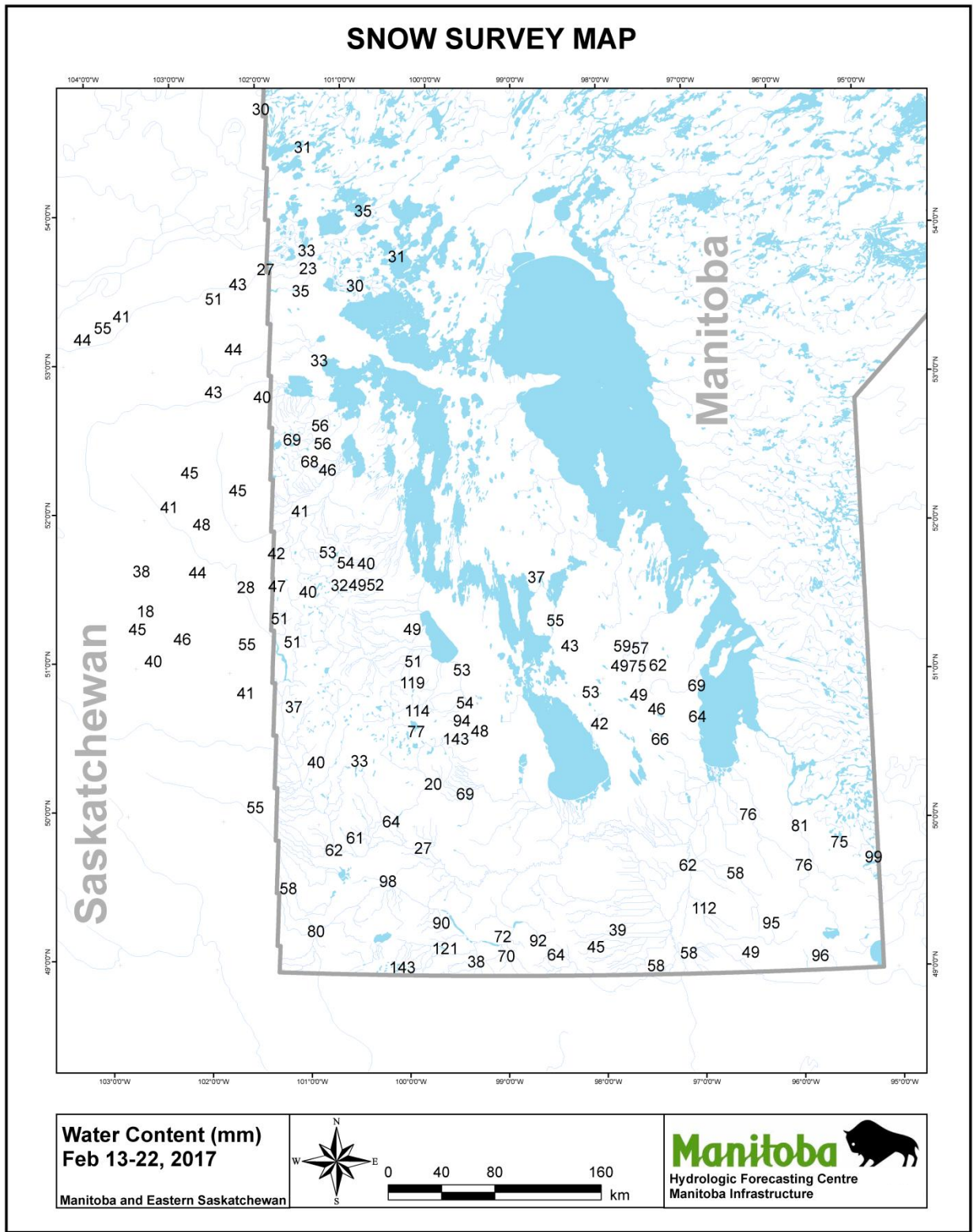


Figure 7 - February 13th – 22nd, 2017 snow survey results in millimetres of water content.

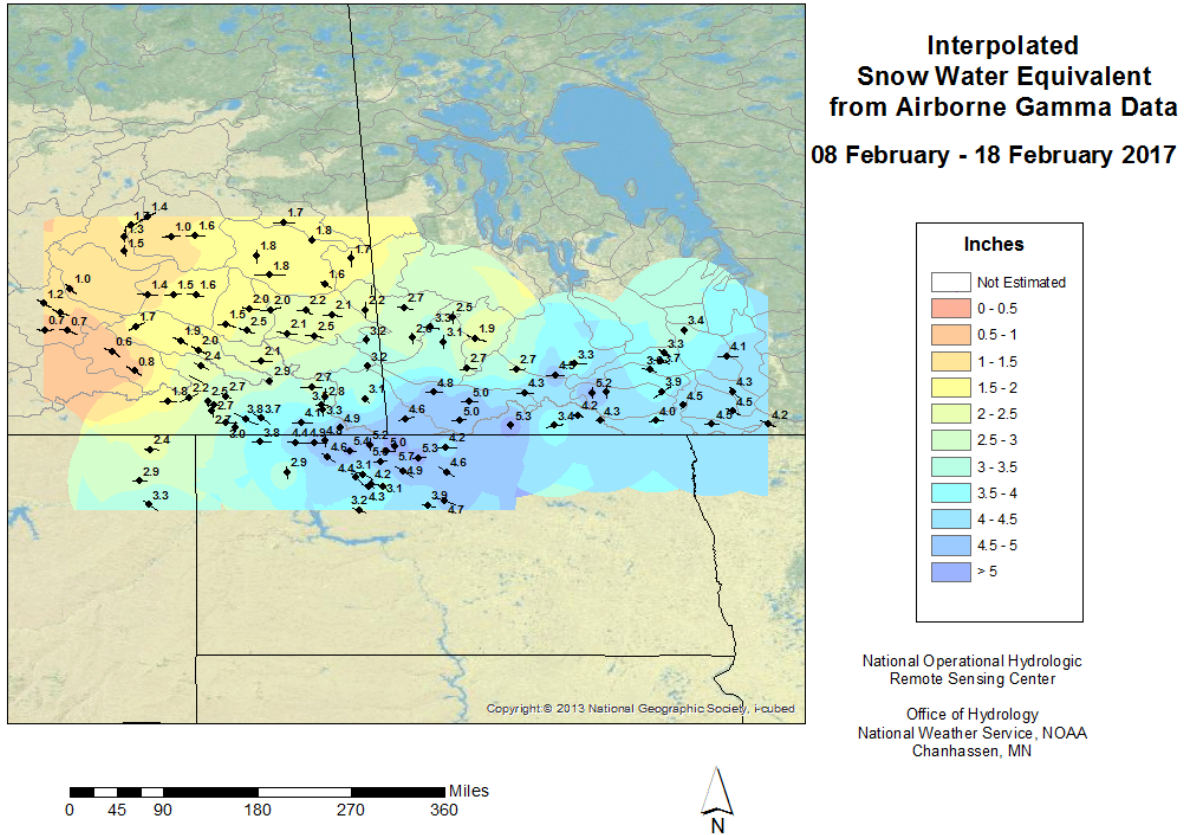


Figure 8 - February 8th – 18th, 2017 Airborne Gamma Survey results in millimetres of water content.

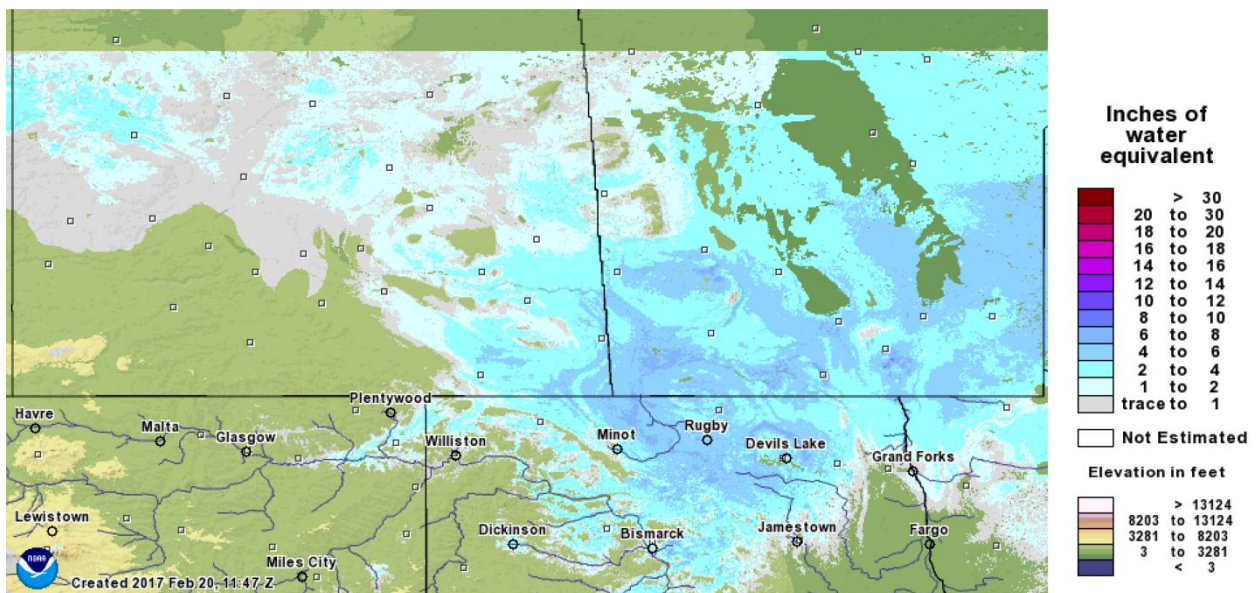


Figure 9 – Calculated SWE (inches) as of February 20, 2017.

Lake Level and River Flow Conditions

Water levels/flows at freeze-up:

- Saskatchewan, Carrot, Red Deer and Assiniboine rivers: well above normal;
- Red, Souris and Qu'Appelle rivers: above normal; and,
- Major lakes, such as Dauphin, St. Martin, Winnipegosis, Manitoba, and Winnipeg: above normal levels.

Current river flow conditions:

- Red River: early melt in the southern portion of the basin and above average soil moisture has led to well above normal flows for this time of year.
- Roseau River and Pembina River: generally flows are normal for this time of year;
- Northern rivers (including Red Deer, Saskatchewan, and Carrot rivers): flows are above normal for this time of year;
- Assiniboine River, Souris River, Qu'Appelle River: flows are above normal for this time of year; and,
- Interlake rivers (including the Waterhen, Fisher, and Fairford rivers): flows are above normal for this time of year.

Current lake levels:

- The major lakes in Manitoba are still above normal levels heading into the spring.

River Ice Conditions and Ice Jamming¹

The Red River currently has a near-normal ice thickness. Based on February measurements this year, ice thickness ranged between 56 cm (22 inches) and 61 cm (24 inches). In the vicinity of the Netley cut, the ice was thicker at 71 cm (28 inches) to 76 cm (30 inches) (Figures 10 and 11). Normal ice thickness for this time of the year varies according to the river flow velocity, and the location of the river, typically ranging between 30 cm (12 inches) and 61 cm (24 inches).

Spring weather affects deterioration of ice and will be a significant factor in determining ice strength at break-up. It is difficult to predict the time of occurrence and extent of ice jamming. However, with the ice cutting and the Amphibex ice breaking activities currently underway will reduce ice jamming and related flooding on the lower Red River.

¹ See Appendix A for 'Ice Jam' definition

Localized flooding can occur when and where ice jams develop, even with below average river flows.

The chances of localized flooding due to snow and ice blockages in drains, ditches and small streams during the early part of the run-off period will depend on the nature of the spring breakup and rate of melt. Due to the wet fall conditions, and due to recent warming and then re-freezeing, there is a risk that some drainage culverts could be blocked with ice accumulations.



Figure 10 – Ice Thickness Measurements based on Ground Penetrating Radar, Netley North

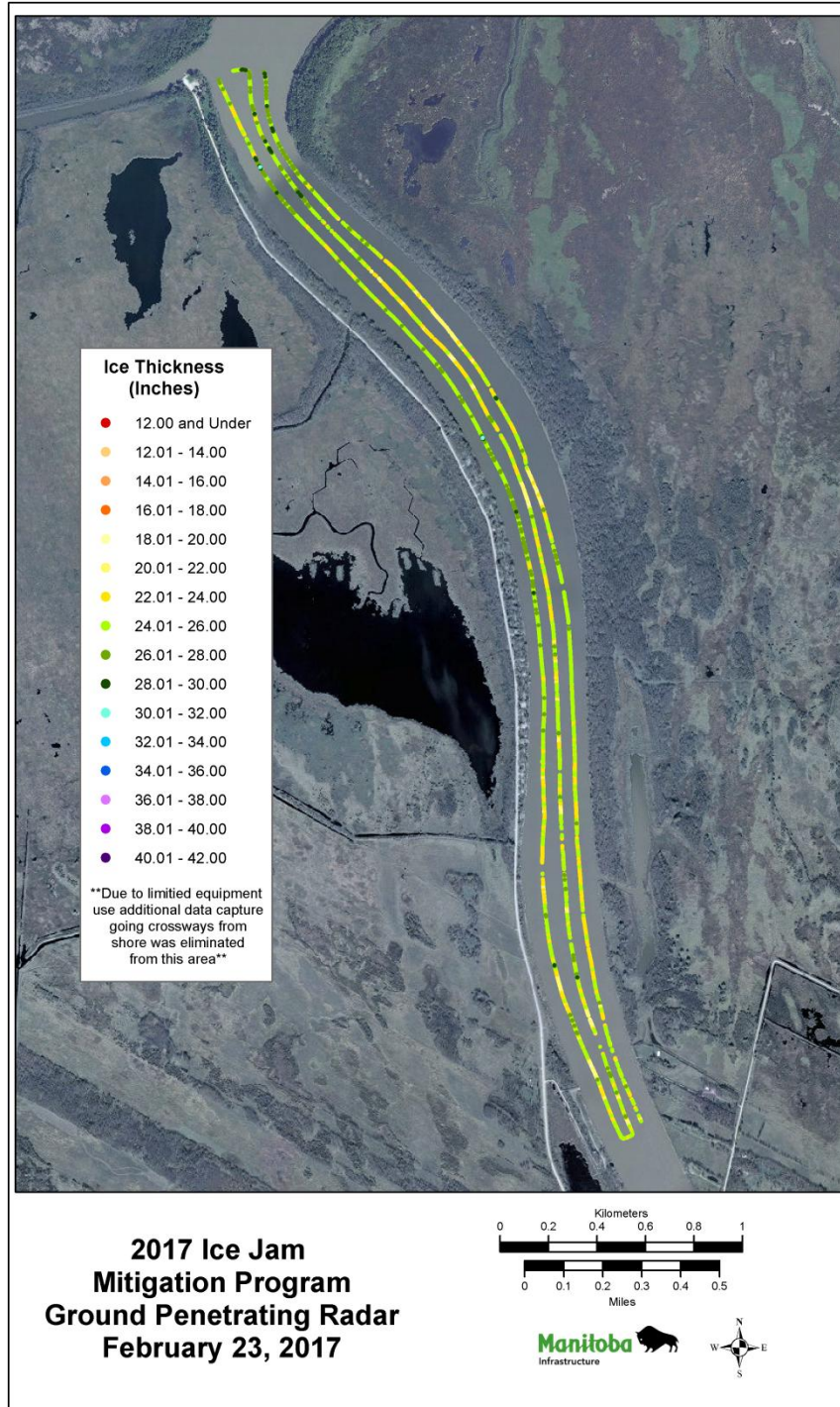


Figure 11 – Ice Thickness Measurements based on Ground Penetrating Radar, Netley South

Runoff Potential²

The expected 2017 spring runoff potential (Figure 12) is based on:

- 2016 measurements of soil moisture at freeze up;
- winter precipitation as of February 20, 2017; and
- future weather condition scenarios based on historic data.

The runoff potential ranges from normal to above normal for most of Manitoba and above normal to well above normal in the U.S., while the runoff potential in Saskatchewan is generally near normal. The runoff potential is described for the following areas:

- Red River basin in Manitoba: normal to above normal;
- Red River basin in US: above normal to well above normal;
 - An early melt in the southern portion of the basin has reduced the snowpack but the ground remains saturated, which may result in a higher proportion of runoff from future precipitation.
- Pembina River: normal to above normal;
- Southeastern Manitoba: normal to above normal;
- Upper Assiniboine River basin: near normal conditions;
- Lower Assiniboine River: normal to above normal
- Qu'Appelle River basin: normal to above normal;
- Saskatchewan River basin; near normal ;
- Souris River basin: above normal to well above normal;
- Interlake Region: near normal;
- Northern Manitoba: near normal;
- Dauphin Lake/Riding Mountain area: normal to above normal;
- Northwest Manitoba (including the northern areas of Lake Winnipegosis, and The Pas): normal to above normal; and,
- Regions to the east of Lake Winnipeg (including Berens River) and Island Lake area: near normal.

² See Appendix A for 'Runoff Potential' definition

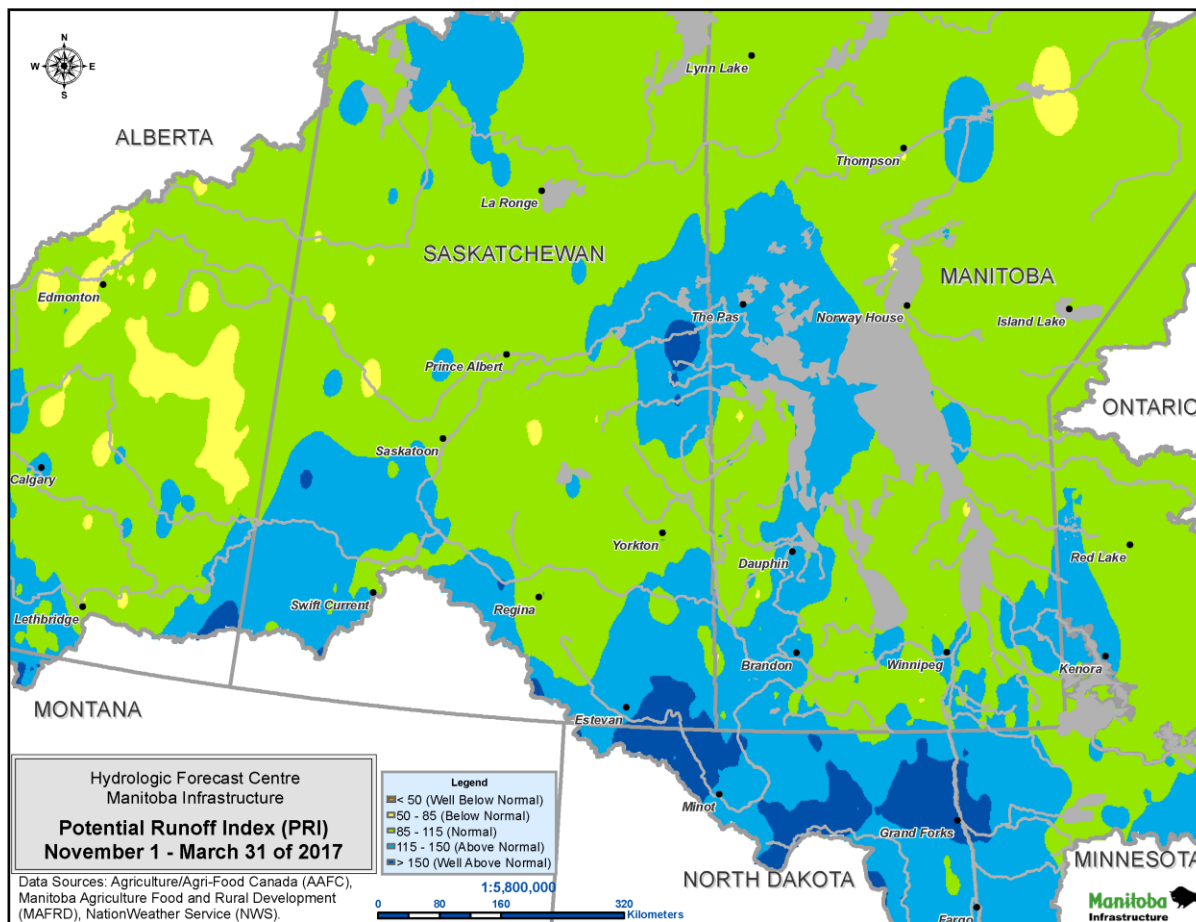


Figure 12 – Runoff Potential as of March 31, 2017. (Assuming normal weather for the remainder of winter).

Flood Outlook³

Spring flood outlooks are estimated river and lake peak water levels or flows that are based on current basin conditions, and three possible future weather scenarios. These weather scenarios are favourable, normal, and unfavourable, which correspond to three different probabilities of occurrence (lower decile, median, and upper decile). The province's practice is to plan and prepare for the upper decile (unfavourable) weather scenario conditions. For further information see Appendix A: Definitions.

The risk of potential flooding is described by four categories: minor, moderate, major and severe⁷.

³ See Appendix A for 'Flood Outlook', 'Weather Scenarios', 'Favourable Weather', 'Normal Weather', and 'Unfavourable Weather' definitions

⁷ See Appendix A for 'Minor/Moderate/Major and Severe' Flood risk definitions

A number of uncertainties exist with respect to this flood outlook. These include, but are not limited to the following:

- future weather uncertainties (snowfall and spring rainfall);
- winter snowpack, onset of melt, and melt rate (i.e. timing and speed of snow melt);
- uncertainty in meteorological and hydrometric data;
- timing of the peak flows;
- frost depth at the time of spring melt; and,
- computer model prediction uncertainty.

Red River

- There is a risk of major spring flooding on the Red River main stem. The current soil moisture condition varies from above normal on the U.S. portion of the basin to near normal on the Canadian side of the border. Winter precipitation has been above normal to well above normal this year throughout the basin.
- An early melt on the southern portion of the basin has reduced the snowpack in the area. However, in the remainder of the basin, the snow cover remains mostly in place. Due to the fact that the areas that had melting then have experienced a period of cold temperatures, the ground remains saturated and vulnerable to a high percentage of runoff from future precipitation.
- Favourable weather: moderate risk of flooding
 - Levels would be similar to spring melt levels observed in 2013 from Emerson to Ste. Agathe.
- Normal weather: moderate risk of flooding
 - Levels would be similar to spring melt levels observed in 2010 from Emerson to Ste. Agathe.
- Unfavourable weather: major risk of flooding
 - Levels on the Red River main stem would be similar to 2011 from Emerson to Ste. Agathe.
- There is a moderate flood risk for the small tributaries such as the La Salle, Rat and Morris rivers.
- There is sufficient community protection within the Red River basin as community dike elevations are higher than the predicted levels.

Red River Floodway

- The Red River Floodway has been operated for 31 out of the 48 years since it has been constructed for the purpose of providing flood protection to the City of Winnipeg. Due to above normal conditions throughout the basin, there is a very high chance that the Floodway will be operated during the 2017 spring melt.
- The ice-induced peak at James Avenue is estimated between 5.6 m (18.5 feet) to 6.7 m (22.0 feet).
- Open water estimated levels at James Avenue are:
 - Favourable weather: 5.2 m (17.0 feet)
 - Unfavourable weather: 5.9 m (19.5 feet).

Pembina River and Roseau River

- The potential for spring flooding is major on both the Pembina and Roseau rivers. Both basins have received above normal snowfall on top of above normal soil moisture.
 - Favourable weather: moderate risk of flooding.
 - Normal to unfavourable weather: major risk of flooding.

Assiniboine River

- Flood risk ranges from moderate to major due to above normal soil moisture in the watershed and near normal to below normal snow water equivalent in the snowpack.
 - Favourable weather: minor risk of flooding
 - Levels will be slightly less than 2009 or 2007 from Shellmouth downstream to Brandon.
 - Levels will be similar to 2009 levels from Brandon to Portage.
 - Normal weather: moderate risk of flooding
 - Levels will be higher than 2009 but lower than 2005 from Shellmouth downstream to Brandon.
 - Levels will be similar to 1995 levels from Brandon to Portage.
 - Unfavourable weather: major risk of flooding
 - Levels will be similar to 1995 or 1976 levels from Shellmouth downstream to Brandon. Brandon's flood protection dikes are adequate for this scenario.
 - Levels will be slightly less than levels observed in 2011 or summer 2014 from Brandon to Portage.

- With high contributions expected from the Souris River, the flood risk on the Assiniboine River increases to major downstream of the confluence with the Souris River.
- The preliminary flood outlook for the Qu'Appelle River at St. Lazare:
 - Favourable to normal weather: minor risk of flooding
 - Unfavourable weather: moderate risk of flooding
 - St. Lazare flood protection dikes are adequate.

Portage Diversion

- The Portage Diversion has been operated 34 out of the 47 years since it has been constructed for the purpose of preventing ice jamming on the Assiniboine River east of Portage and to provide flood protection to the City of Winnipeg and the areas along the Assiniboine River downstream of Portage, in accordance with the operating guidelines. Based on the runoff potential in the Assiniboine and Souris basins, the probability of operating the Portage Diversion is high.

Shellmouth Dam

- The forecasted inflow volumes into the Shellmouth reservoir for favourable, normal and unfavourable conditions are 200,000 ac-ft, 400,000 ac-ft and 600,000 ac-ft, respectively.
- The Shellmouth Dam is being operated to draw down the reservoir to provide storage capacity for reservoir inflows to reduce flooding downstream. The current reservoir level as of February 24th, 2017 is 422.95 m (1387.64 ft). The Shellmouth Liaison Committee provides regular input into the Dam operations to meet the target level of 427.33 m to 427.94 m (1402 ft to 1404 ft) after the spring runoff. The current outflow from the reservoir is 1,269 cfs (cubic feet per second).

Souris River (South Western Region)

- Both snow accumulation and soil moisture within the Souris River basin are above normal to well above normal. Estimated flooding for the Souris River and its tributaries is as follows:
 - Favourable weather: moderate risk of flooding downstream of Minot along the main stem.
 - Levels are expected to be similar to the 2013 levels at Wawanesa.
 - Normal weather: major flood risk downstream of Minot along the main stem.
 - Levels are generally expected to be similar to 2014 summer levels at Wawanesa.
 - Unfavourable weather: major to severe flood risk downstream of Minot along the main stem.

- Levels are expected to be between 1976 and 2011 levels at Wawanesa.
- The existing dikes in the towns of Melita, Souris, and Wawanesa are at an elevation which is high enough to protect against these water levels.

Interlake Region

- Soil moisture is normal to above normal throughout the Interlake region with near normal snow accumulation. Estimated flooding potential is as follows:
 - Favourable to normal weather: minor risk of flooding.
 - Unfavourable weather: moderate risk of flooding.
- As in most years, the risk of ice jamming is high for the Icelandic, Fisher and Whitemud rivers.

Fairford Control Structure

- The Fairford Control Structure is operating at 100% of maximum capacity and will remain this way throughout the spring.

Eastern Region

- The soil moisture is normal to above normal and the accumulated snowpack is above normal for the Eastern Region, including Winnipeg River. Estimated flooding potential:
 - Favourable to normal weather: moderate risk flooding.
 - Unfavourable weather: major risk of flooding.

Manitoba Lakes

- Currently, most major lakes are above normal levels.

Lake Manitoba

- Lake Manitoba's current level is 247.63 m (812.45 ft).
- The current level is 0.19 m (0.62 ft) above normal for this time of year, and is within the operating range of 247.04 m (810.5 ft) to 247.65 m (812.5 ft).
- After spring runoff, the lake level is expected to be 247.7 – 248.1 m (812.8 – 814.1 ft) with median to upper decile inflows.

Lake St. Martin

- Lake St. Martin is currently at 244.53 m (802.26 ft).
- The current level is 1.24 m (4.06 ft) above normal for this time of year.
- After spring runoff, the lake level is expected to be 244.5 – 244.9 m (802.3 – 803.6 ft) with median to upper decile inflows.

Lake Winnipeg

- Lake Winnipeg's current level is 218.00 m (715.20 ft).
- The current level is 0.66 m (2.15 ft) above normal for this time of year and above the operating range of 216.71 m (711 ft) to 217.93 m (715 ft).

Lake Winnipegosis

- Lake Winnipegosis is currently at 254.12 m (833.73 ft).
- The current level is 0.97 m (3.18 ft) above normal for this time of year.
- After spring runoff, the lake level is expected to be 254.1 – 254.3 m (833.5 – 834.2 ft) with median to upper decile inflows.

Dauphin Lake

- Dauphin Lake's current level is 260.87 m (855.87 ft).
- The current level is 0.55 m (1.80 ft) above normal for this time of year and above the upper operating range of 260.5 m (854.8 ft).

Northern Manitoba and The Pas Regions

- Soil moisture is generally above normal throughout the Saskatchewan River basin in Manitoba and Saskatchewan. Soil moisture in the Saskatchewan River basin in Alberta is near normal. The accumulated snowpack is below normal for most of the basin with slightly higher accumulation near the Manitoba-Saskatchewan border. The peak open water level on the main stem of the Saskatchewan River at The Pas is expected to be below bank full level in the unfavourable weather scenario, although much will depend on future weather and the regulation of Saskatchewan's Tobin Lake outflows.
- Saskatchewan River potential flooding ranges from minor to moderate when considering all potential weather scenarios.
 - Favourable to normal weather: minor risk of flooding.
 - Unfavourable weather: moderate risk of flooding.
- The Carrot River near Turnberry and the Red Deer River near Erwood are both tracking above normal streamflow conditions and under unfavourable weather may have a major risk of flooding.
- Swan River estimated flows and flooding:
 - Unfavourable weather: moderate risk of flooding.

Flood Preparations

- As a matter of standard annual practice leading in to the spring flood season, the Manitoba government reviews existing emergency response plans, confirms communications networks,

coordinates the sharing of information and plans with municipalities and First Nations, and prepares personnel and resources used in flood response.

- The ice-jam mitigation program north of Winnipeg has commenced with ice cutters and Amphibex machines working along the Red River to weaken the ice.

Future Forecast Information

If the spring melt and runoff has not yet begun, a second flood outlook will be published with updated information towards the end of March when further precipitation and other weather details are available.

Appendix A: Definitions

¹ Ice Jam:

- A blockage of ice on a river/stream which restricts flow, resulting in increased water levels upstream.
- Jams may occur due to changing river channel geometry, bends in the river channel, depth of ice, rate of water level rise, or a solid section of ice downstream.

² Runoff Potential:

- Indication of how much water is expected to flow overland as opposed to being absorbed into the ground.
- Is based on soil moisture measurements at freeze up, most recent snowpack conditions, and normal future weather conditions.
- Is a contributing factor into flood outlook determinations.
- Described in comparison to normal historical conditions (i.e. normal, near normal, slightly above normal, etc.).
- Can change significantly if future precipitation and melt rates differ from the average.

³ Flood Outlook:

- Estimated spring peak water levels and flows provided before spring water flow begins.
- Estimates are based on diverse information, such as soil moisture, winter precipitation, snowpack, topography, current water level, channel capacity, and future weather condition scenarios (precipitation, temperatures, etc.).
- Estimates are provided for three weather scenarios (favourable, normal, and unfavourable) which correspond to three different probabilities of occurrence (lower decile, median and upper decile).

³ Weather Scenarios:

- Used to account for future weather such as additional snow, melt rates and spring rainfall, determined by statistical analysis of the past 30 - 40 years of climate data.
- Three scenarios used:
 - Lower decile
 - There is a 10% chance of the weather being that 'favourable' or better. 90% of the time the weather will be worse than this 'favourable' condition.
 - Median
 - There is a 50% chance of the weather being 'normal' or better.
 - Upper decile
 - There is a 10% chance of the weather being that 'unfavourable' or worse. 90% of the time the weather will be better than this 'unfavourable' condition.
- Province's practice is to plan/prepare to the upper decile condition.

³ Favourable Weather:

- Characterized by little additional precipitation and a gradual snow melt.

³ Normal Weather:

- Characterized by normal rainfall and temperature.
- Typically used to describe historic climate trends.

³ Unfavourable Weather:

- Significant wide spread precipitation with a rapid snowmelt.

⁵ Flow/Discharge [expressed in cubic feet per second (cfs) or cubic metres per second (cms)]:

- The volume of water that passes a given location within a given period of time.

⁶ FPL – Flood Protection Level:

- The greater of the flood of record or the 1-in-100-yr flood, plus a freeboard allowance for a particular waterway (typically 2 ft) or water body (site specific).
- It is provided by the Hydrologic Forecasting and Water Management (HFWM) branch of MI on a site specific and structure specific basis.
- This is formally set by the Water Resources Administration Act for the Red River designated flood areas.
- In non Designated Flood Areas, the FPL is recommended by the province, but ultimately regulated by the local planning districts and/or municipalities.

⁷ Definition for minor/moderate/major and severe flood risk:

- Minor Risk: The probability that stages in rivers and lakes exceed the flood stage is very minor (small or below average).
- Moderate Risk: The probability that stages in rivers and lakes exceed the flood stage is moderate (average).
- Major Risk: The probability that stages in rivers and lakes exceed the flood stage is high (above average).
- Severe Risk: The probability that stages in rivers and lakes exceed the flood stage is very high (well above average).

Additional terminology:

Operational Forecasts:

- Estimated future crest water level, flow and date of occurrence provided once active melt and river flow has begun.
- Estimates are modelled based on observed flow, existing conditions (including channel capacity, topography, and remaining snowpack) and normal future weather.
- Observed conditions are monitored throughout the flood and compared against the historic climate data used to generate the forecast.
- Forecasts are updated when weather conditions are outside the range of historical climate data used to generate the forecast.
- A range of forecasted values is provided further in advance of an upcoming forecasted crest because of unknowns in the basin conditions and river flows, and limitations in the modelling procedures.