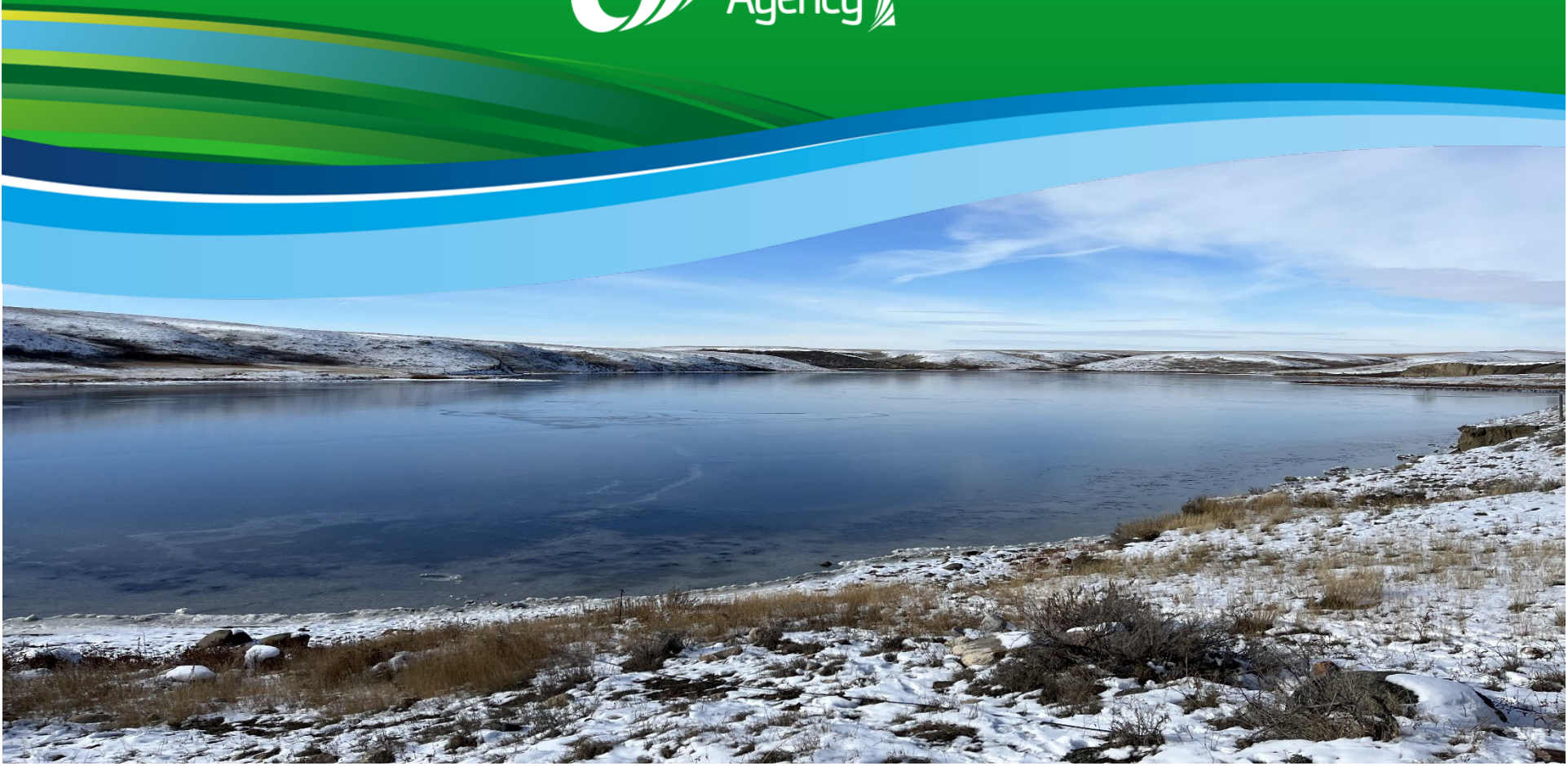


S A S K A T C H E W A N



2023 Conditions at Freeze-up Report

Based on Conditions as of November 1, 2023

Prepared by: Flow Forecasting & Operations Planning - Water Security Agency

Executive Summary

The Water Security Agency (WSA) issues the *Conditions at Freeze-up Report* to summarize conditions during the late fall/early winter period. Current conditions, in combination with the winter snowpack, become the initial conditions for the spring snowmelt runoff. This report gives an early indication of areas that are more vulnerable to potentially above or below normal runoff during the spring period. It is not a spring runoff forecast, as winter snow accumulation is an integral component in the runoff yield during the melt and is impossible to predict at this juncture.

Across most of the province, precipitation accumulations in 2023 were well below normal. This has resulted in generally dry conditions at freeze-up. Conditions are driest in the west, encompassing an area extending from the Leader area north to Lloydminster and west to Saskatoon. In this area, extreme agricultural drought conditions exist.

In the southwest and southeast corners of the province, heavier rainfall in the fall resulted in near normal soil moisture conditions going into freeze-up. Across the remainder of the province, topsoil moisture conditions are generally below to well below normal.

Apart from Lake Diefenbaker, which has been impacted by dry conditions in the headwater areas in Alberta, most larger water supply reservoirs across southern and central Saskatchewan are at near normal elevations for this time of year. At this time, there are no areas where WSA believes that there is a heightened risk of above normal spring runoff in 2024. There is, however, concern of surface water supply issues in the southwest if winter snowfall is below average. In some cases, an above normal snowpack would be required to stave off extremely dry conditions.

An early snowfall event occurred across much of southern and east central Saskatchewan. This snowfall was followed by below normal

temperatures, leaving a lot of these areas snow covered. The early snowfall could result in two outcomes: 1) there is the potential in areas where the early snowfall melted, could result in reduced infiltration capacity come spring because the topsoil will be frozen and sealed off, or 2) the early, heavy snow received could insulate the soil and reduce frost penetration, which would result in more infiltration in the spring and therefore reduce the runoff in spring 2024. Snow surveys in February will help ascertain which scenario is likely to develop.

At this time, there are no areas where WSA believes that there is a heightened risk of above normal spring runoff in 2024. There is, however, concern of surface water supply issues in the west if winter snowfall is below average.

Current long-range forecasts and climate indices suggest near normal precipitation and above normal temperatures through the winter months over much of the province. A long term El Niño pattern has developed, which typically means a drier and warmer winter for Saskatchewan.

The preliminary Spring Runoff Outlook for 2024 will be issued in early February.

Cover Photo: Admiral Reservoir near Admiral, Oct. 31, 2023
Credit: Jenna Coates, Water Security Agency

Precipitation and Conditions leading into Freeze-Up

Summary:

- As a result of the higher runoff in spring 2023, even with the below normal precipitation throughout the growing season, most large water supply reservoirs are at near normal levels.
- Seasonal precipitation across the province was generally well below normal.
- An early snowfall occurred across much of southern and west central Saskatchewan that could increase soil moisture or spring runoff potential.

2023 Spring Runoff Summary

The spring runoff in 2023 experienced a rapid snowmelt resulting in peak flows exceeding expectations over much of south-central Saskatchewan. Observed runoff peaks generally ranged from 1 in 5 to over 1 in 50 year events. Sandy and Rush Lake creeks observed their highest peak flows within their observed records. Across the remainder of the south, the runoff response was generally near normal, except the far southwest and the far southeast corners, where there was more snow and, as was expected, above normal runoff peaks were observed.

Farther north, runoff progressed as expected with the North and South Saskatchewan River basins generally seeing a near to below normal runoff response, with a few exceptions. As forecast, the Churchill River Basin and basins farther north saw a well below normal runoff response in spring 2023.

2023 Summer Precipitation Summary

As shown in Figure 1 and Figure 2, precipitation received throughout the summer over most of southern and central Saskatchewan was

near to slightly below normal. Conditions were particularly dry in the Leader, Maple Creek, Consul and Moose Jaw areas where precipitation accumulation percentiles were classified as very to extremely low. There were some pockets in west central Saskatchewan that received above normal precipitation due to early summer rainfall events. In the north, the conditions varied from near normal in southern areas to below normal in the far north.

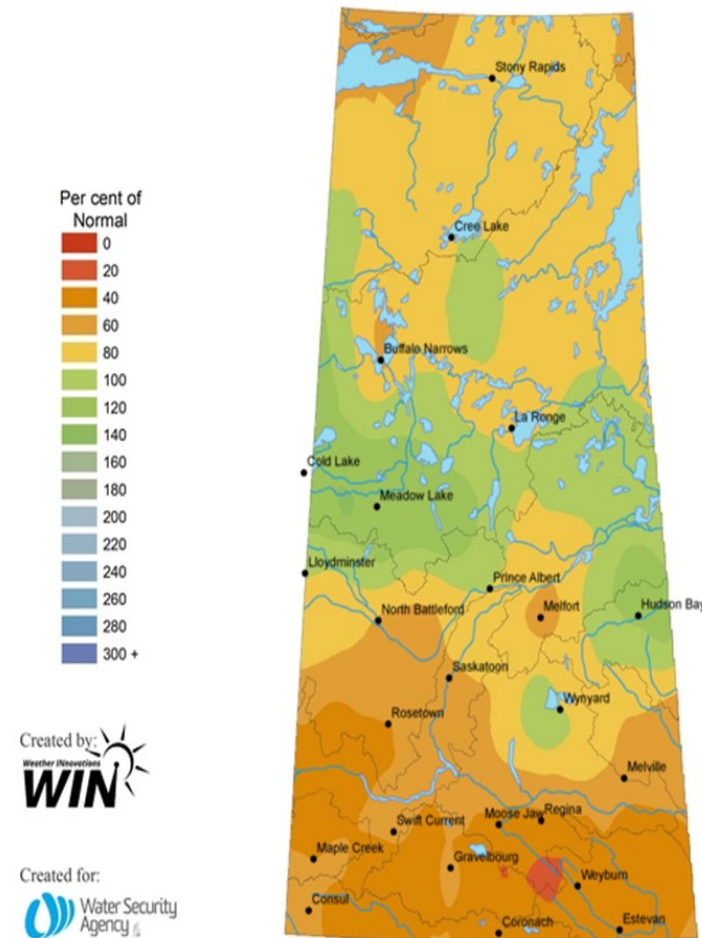
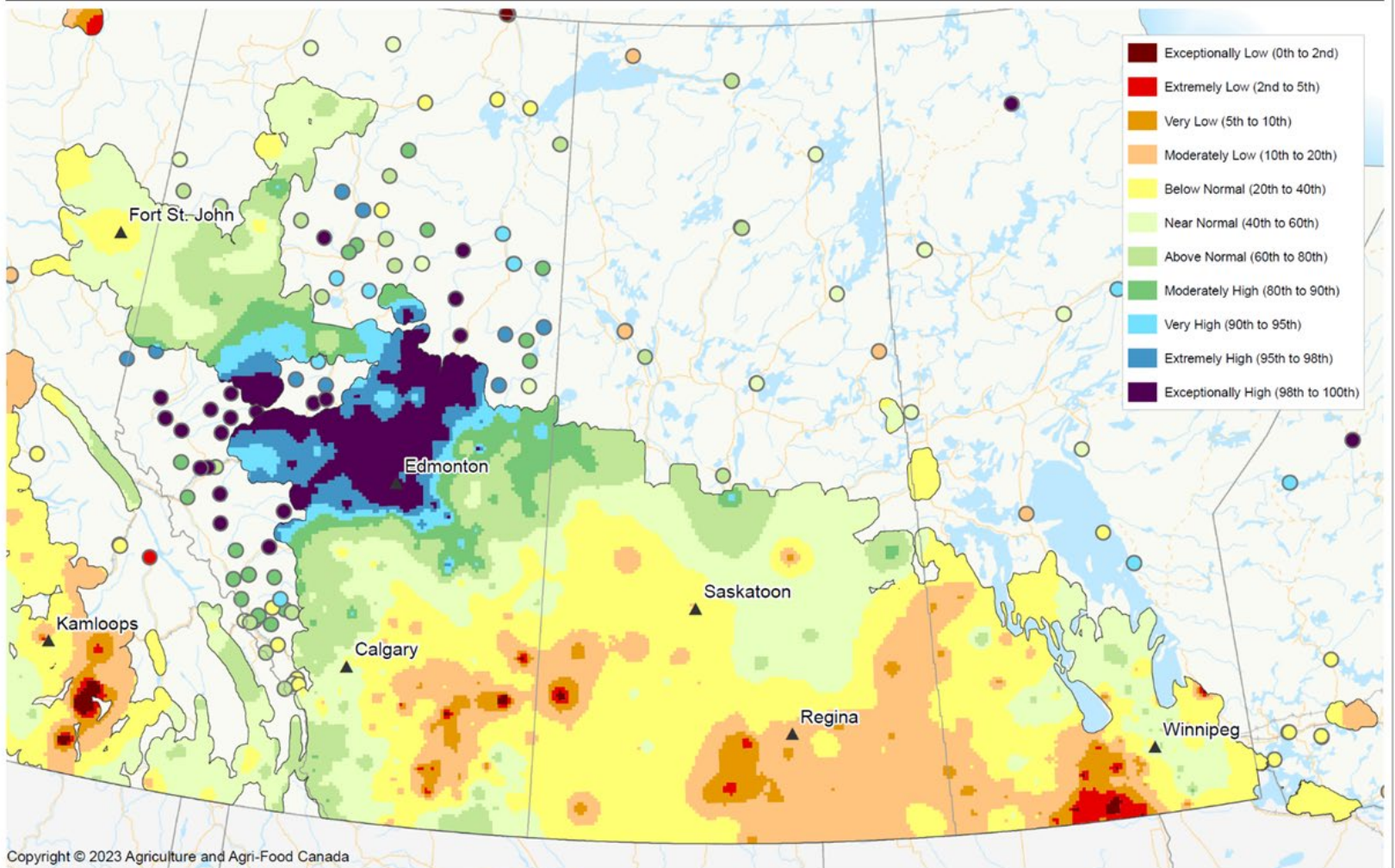


Figure 1: 90-day Per Cent Normal Rainfall Accumulations June 3 to August 31, 2023



Precipitation Percentiles in past 90 days, as of August 31, 2023



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Prepared by Agriculture and Agri-Food Canada's Science and Technology Branch. Data provided through partnership with Environment Canada, Natural Resources Canada, Provincial and private agencies. Produced using near real-time data that has undergone some quality control. The accuracy of this map varies due to data availability and potential data errors.

Created: 2023-09-01
www.agr.gc.ca/drought

Figure 2: June 3 to August 31, 2023 Precipitation Compared to Historic (Map Courtesy of Agriculture and Agri-Food Canada)

2023 Fall Precipitation Summary

Figure 3 shows rainfall percentages compared to normal across the province from September 3 to November 1, 2023 (note that this figure does not adequately represent snowfall as the bulk of the gauges used only collect liquid precipitation). Generally, rainfall across the province was below normal in the fall. There were a couple areas in the far southwest and far southeast corners of the province where near normal precipitation accumulation were observed.

This fall, there were intermittent and sporadic instances of early snowfall in several parts of the province during the second half of October. Figure 4 highlights the estimated accumulations between October 17 and 31. Throughout this time, most of southern and east central Saskatchewan received 20 to 100 mm of snow. The heaviest snow occurred in the southeast corner, along the US border, where approximately 250 mm of snow fell. A good portion of northern Saskatchewan also received snow during October, with most of the far north receiving 20 to 100 mm. The heaviest snowfall occurred south of Lake Athabasca where up to 200 mm was recorded.

Cooler temperature following the snowfall events resulted in most of the areas that received the snow still remaining snow covered. The early snowfall could have two different effects on soil moisture conditions. Firstly, it may insulate the soil and reduce frost penetration, typically leading to increased infiltration in the spring, thus reducing the runoff potential and possibly improving soil moisture. Alternatively, in areas where snow melted due to temperature and/or precipitation, it may create a frozen, less penetrable soil layer, potentially resulting in reduced infiltration in the spring (i.e., higher runoff to replenish reservoirs).

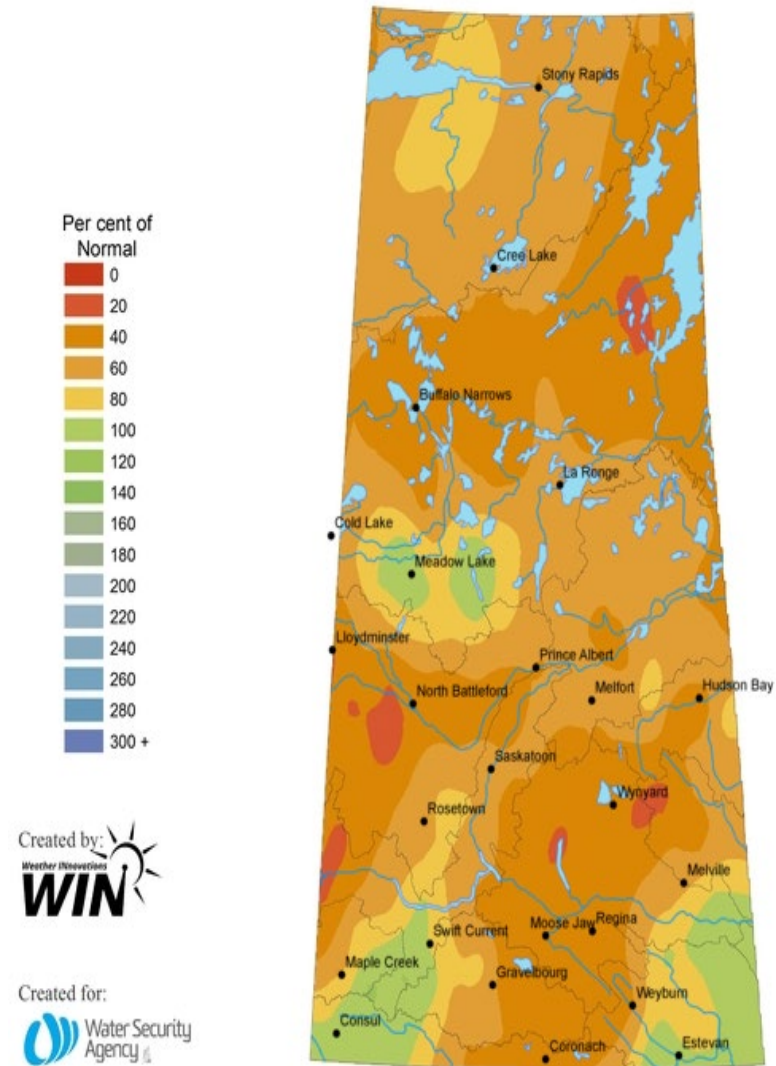


Figure 3: Per Cent Normal Precipitation September 1 to November 1, 2023

Snowfall: 15 dys, 20231017-20231031
Chutes de neige: 15 jrs, 20231017-20231031



Gouvernement du Canada / Government of Canada

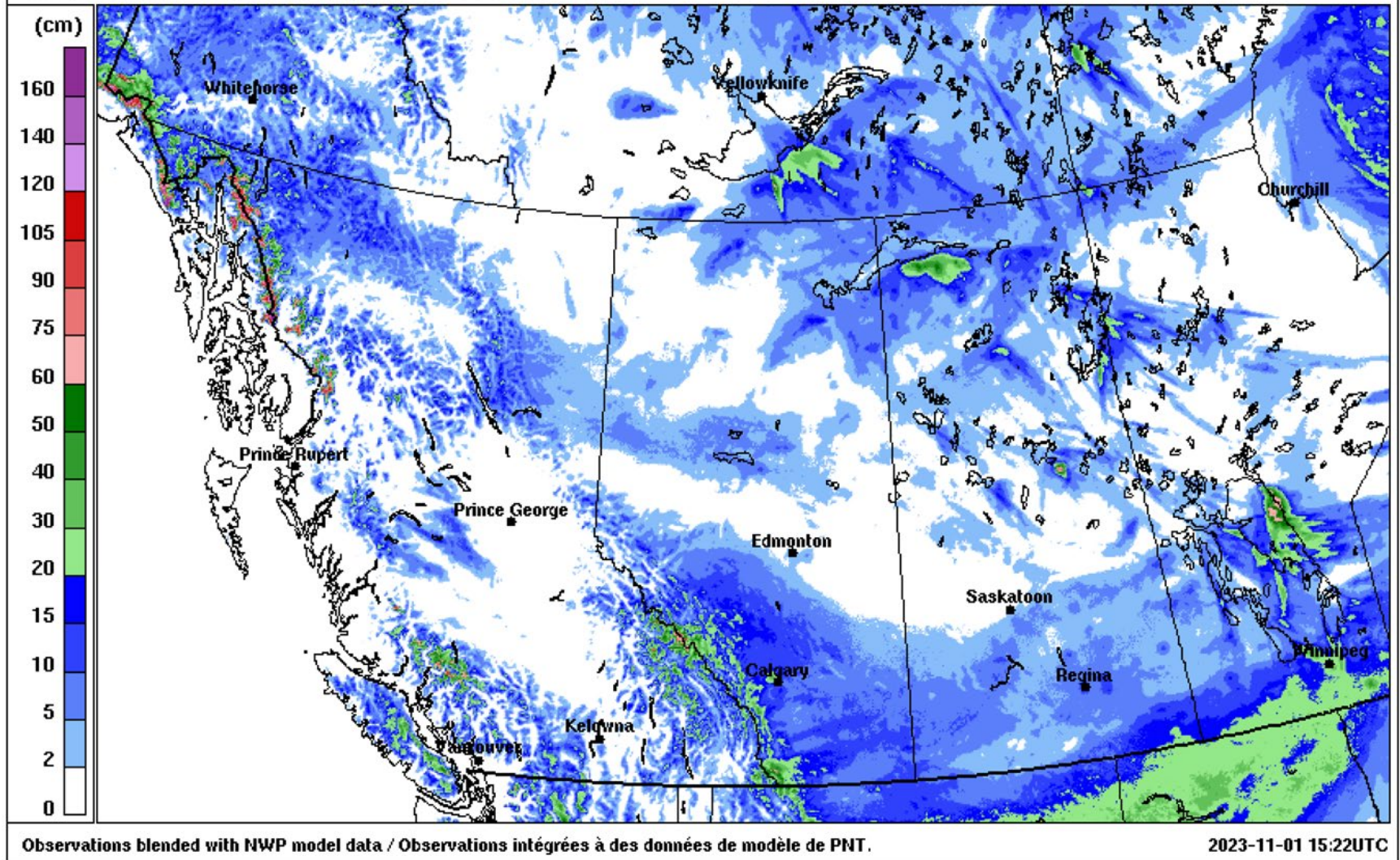


Figure 4: Snowfall Received from October 17 to 23, 2023
(Map Courtesy of Environment and Climate Change Canada)

Soil Moisture Conditions

Summary:

- Late fall precipitation in the southwest resulted in near normal topsoil moisture; however, dugout and wetland storage capacity remains high meaning that they could hold more water in the spring (i.e., not contributing to a higher runoff).
- The remainder of the province saw drier than normal soil moisture prior to freeze-up.
- Conditions are driest in western areas of the province, particularly in the area extending from Leader north to Lloydminster and west to Saskatoon.

Figure 5 show topsoil moisture conditions across the agricultural region of the province at the time of the final crop report issued on October 16, 2023. These figures show that conditions in the eastern portion of the grain belt generally ranged from near adequate to short (i.e., less than optimal for crop growth). In the west, conditions are generally drier with short to very short conditions being reported.

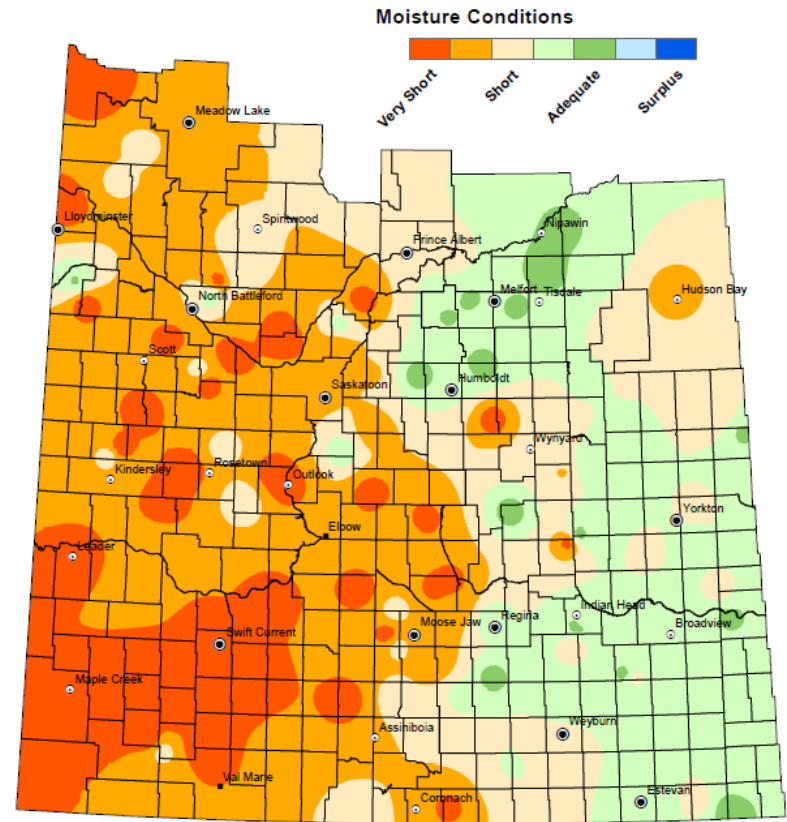


Figure 5: October 17, 2022 Cropland Topsoil Moisture Conditions (Map Courtesy of the Saskatchewan Ministry of Agriculture)

The United States National Aeronautics and Space Administration (NASA) produces soil moisture products using data from the Gravity Recovery and Climate Experiment (GRACE) satellite mission (Figure 6). This data indicates that topsoil moisture is generally much drier than normal across most of Saskatchewan. The early October rain followed by the snowfall event helped alleviate dry soil conditions in the southeast corner, where topsoil conditions now range from near to slightly below normal. The only area in the province where topsoil moisture conditions are slightly wetter than normal is in the far southwest corner.

The three-month SPEI (Standardized Precipitation-Evapotranspiration Index) map is shown in Figure 7. SPEI is a normalized drought index that uses climate data to identify areas where drought conditions exist. The SPEI values are a relative measure of surface water surplus (positive values) or deficit (negative values) in an area. The values take the current precipitation minus the potential evapotranspiration and compare it to the mean value at a location. The result is normalized, so the higher the negative number, the drier the conditions are. This map shows that in the three months prior to freeze-up, conditions had been hot and dry across the province.

The Canadian Drought Monitor assessment for October 31 is shown in Figure 8. This figure indicates that exceptional agricultural drought is persisting over southern Alberta. Conditions have remained relatively unchanged across Saskatchewan with most of the province seeing moderate to extreme drought conditions. Extreme drought conditions are prevalent in the west, encompassing an area extending from the Leader north to Lloydminster and west to Saskatoon.

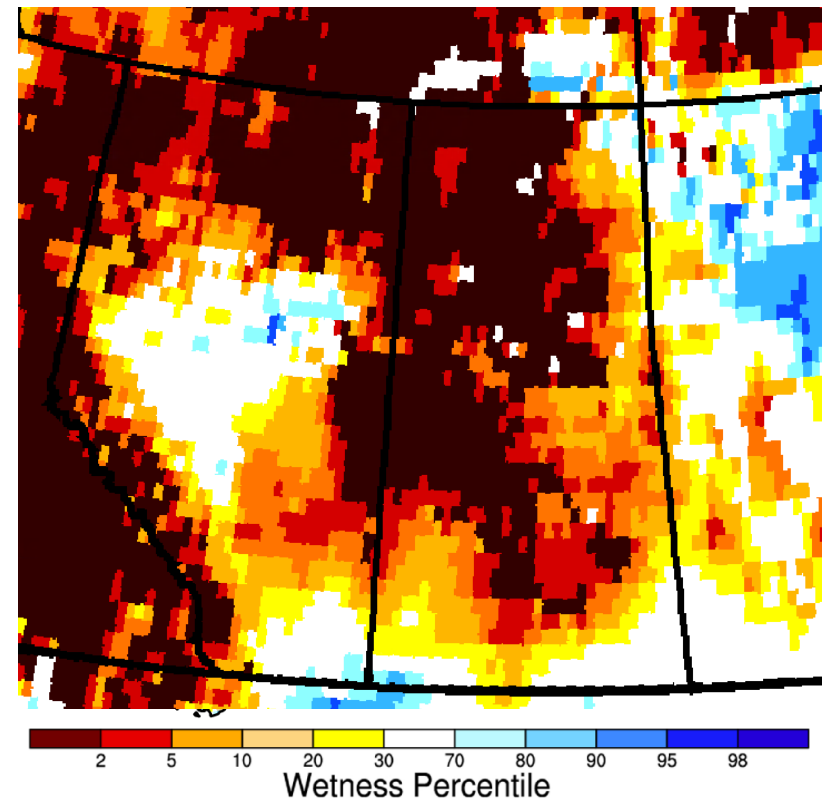
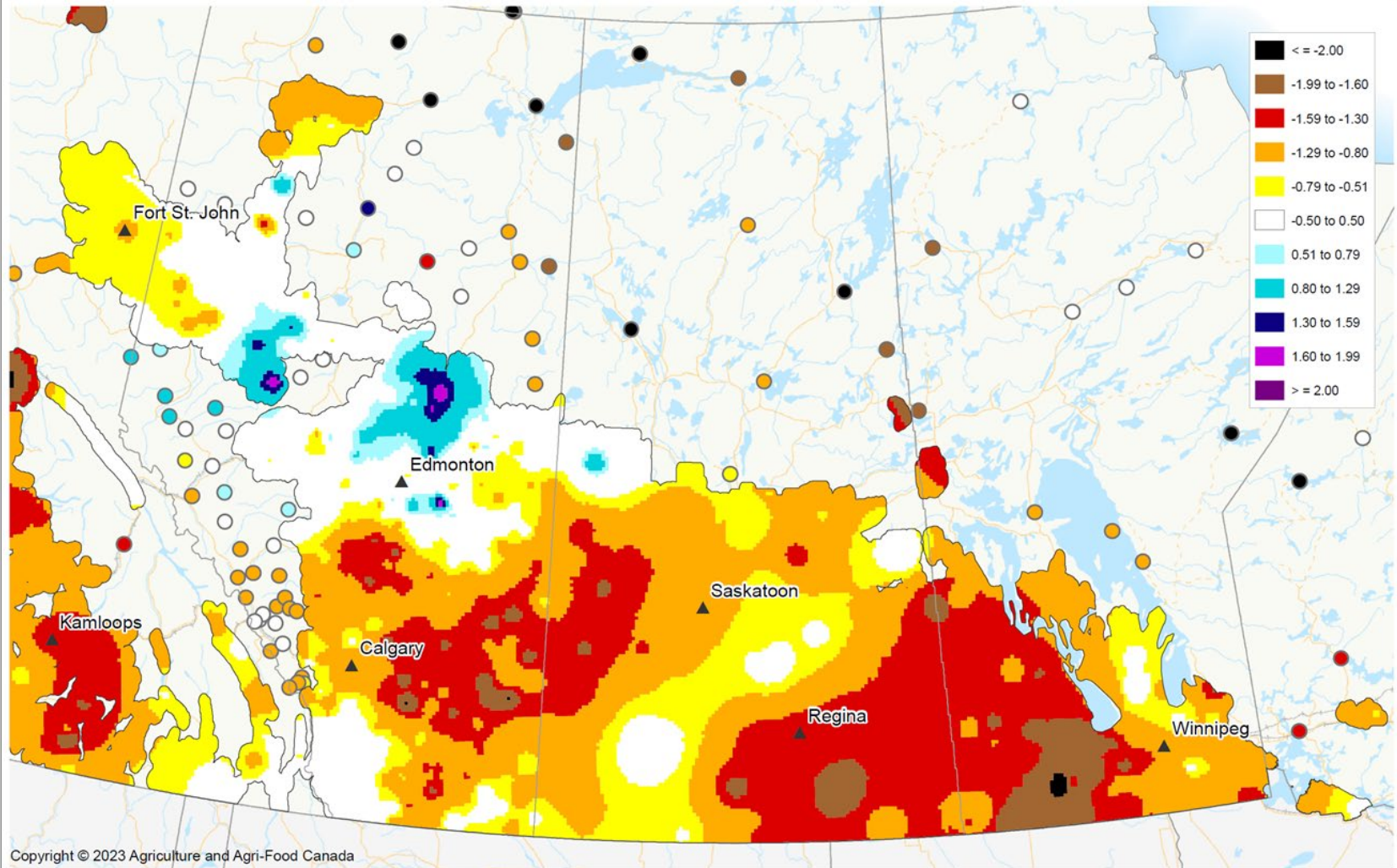


Figure 6: October 30, 2023 Root Zone Soil Moisture Drought Indicator
(Map Courtesy of NASA)



3 - Month Standardized Precipitation Evapotranspiration Index (SPEI)

as of October 31, 2023



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Prepared by Agriculture and Agri-Food Canada's Science and Technology Branch. Data provided through partnership with Environment Canada, Natural Resources Canada, Provincial and private agencies. Produced using near real-time data that has undergone some quality control. The accuracy of this map varies due to data availability and potential data errors.

Created: 2023-11-01
www.agr.gc.ca/drought

Figure 7: 3-month Standardized Precipitation-Evapotranspiration Index (SPEI) for October 31, 2023
(Map courtesy of Agriculture and Agri-Food Canada)

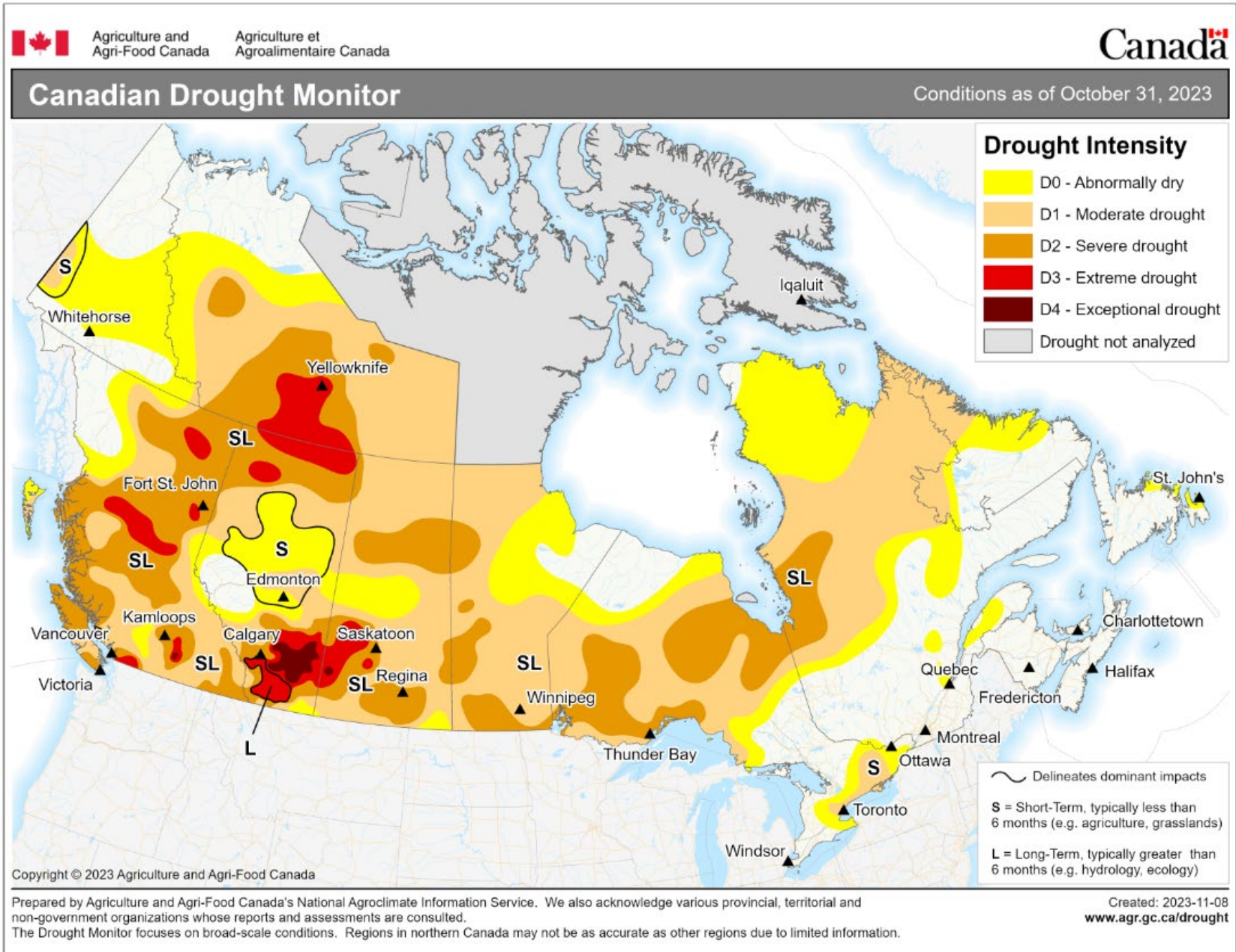


Figure 8: Canadian Drought Monitor – October 31, 2023
 (Map courtesy of Agriculture and Agri-Food Canada)

Current Water Supply Conditions

Summary:

- 2023 was a drier than normal year across the province. As such, most of the province is in the moderate to extreme risk of seeing negative impact to surface and shallow groundwater supplies in 2024. Areas in the southwest are most at risk.
- All major water supply reservoirs, with the exception of Lake Diefenbaker, are near or above normal levels for this time of year.

Figure 9 shows the hydrological drought risk map developed for 2024. This map was developed based on current conditions and illustrates the risk to surface water and shallow ground water supplies in 2024. It is important to note that only local runoff is considered in the creation of this map, not the major river systems such as the Saskatchewan River System.

As this figure shows, the dry conditions across most of the province throughout the year has resulted in moderate to extreme risk across most of the province. The driest conditions persist in the southwest and west-central portions of the province where there is a higher risk to water supply in 2024. In areas where the risk is high or extreme, even a normal snowpack would likely result in further water supply shortages in 2024.

Even with the dry conditions across the province, apart from Lake Diefenbaker, all major water supply reservoirs in the south are near or above normal operating levels for this time of year. Low flows on the South Saskatchewan River, both upstream and downstream of Lake Diefenbaker, are currently resulting in challenges for some water users.

DROUGHT RISK 2024

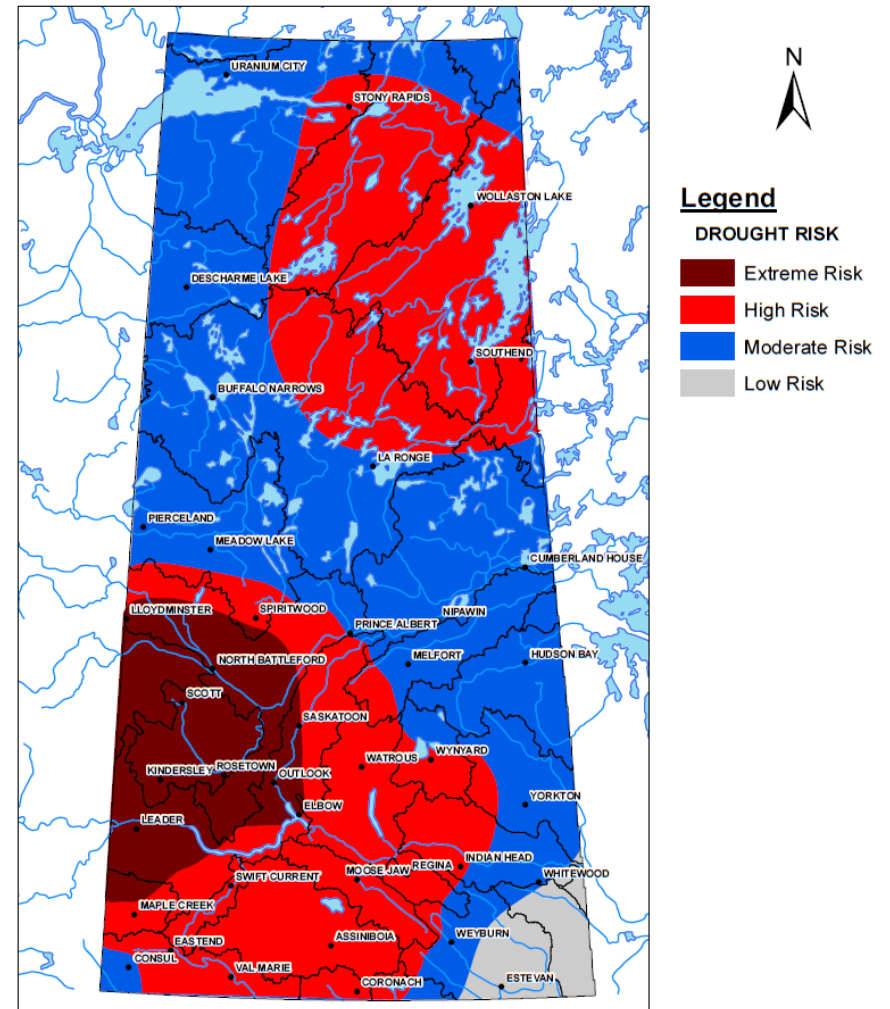


Figure 9: 2024 Drought Risk Map

Fall Streamflow

Summary:

- Below to well below normal streamflow across the province was observed.
- Moderate to extreme hydrologic drought conditions are prevalent in western, southern and far northeastern Saskatchewan.

Fall streamflow is an indication of antecedent conditions within a basin prior to freeze-up. Most creeks in southern Saskatchewan are ephemeral, typically only flowing for a short duration during the spring freshet or during periods of above normal rainfall; however, when conditions are wet, these creeks can flow at elevated rates over extended durations as water stored within the basin is slowly released.

Table 1 provides a summary of the preliminary flow, rank and historical statistics for select streamflow gauges across the province for October 31, 2023. October 31 is used for this table as many of these streamflow gauges are only operated seasonally. Table 1 shows that October 31 flows generally varied from below normal to well below normal across southern and central Saskatchewan at freeze-up. In the north, on the Churchill River, flows are generally below normal due to drier conditions over the past few months. Flows in the southeast, including Long, Moose Mountain and Pipestone creeks, had late season flows that were near normal due to late October precipitations. Moderate to extreme drought conditions in fall 2023 across most of western and southern Saskatchewan has resulted in a reduced runoff potential for the spring.

Pre-Spring Runoff Lake Level Projections

Summary:

- Lakes and reservoirs in the Qu'Appelle, Souris and Saskatchewan River basins are expected to be at near normal levels prior to the spring runoff in 2024.

Table 2 shows the current lake levels on the Qu'Appelle River, and their projected March 1, 2024 levels. All lakes on the Qu'Appelle River System are expected to be near their normal levels on March 1, 2024.

Fishing Lake and the Quill lakes are expected to see small gains over the winter due to snow loading and potential groundwater inflows.

In other closed or semi-closed basin lakes, many of which are not gauged and not included in the table below, water levels have dropped and are expected to remain relatively steady going into the 2024 spring runoff.

In the Souris River Basin, Grant Devine Lake and Rafferty Reservoir are being drawn down to meet their February 1 target elevations of 561.0 m and 549.5 m, respectively. Grant Devine currently has a 0.5 m³/s release, which is expected to continue into mid January. Rafferty Reservoir currently has a release near 2 m³/s that is expected to last until late January. Beginning on February 1, 2024, spring runoff forecasts for the Souris River Basin will be prepared in consultation with our United States partners for both reservoirs on a semi-monthly basis. The reservoirs may be drawn down further in advance of spring runoff if warranted by these forecasts, in accordance with the 1989 Canada-US Agreement on Water Supply and Flood Control in the Souris River Basin.

Winter streamflows on the North Saskatchewan River are expected to be slightly below normal through the winter. On the South Saskatchewan River, inflows to Lake Diefenbaker are expected to remain below normal through the winter. With the drier conditions in the basin, the plan is to restrict releases from Lake Diefenbaker throughout the winter. The release will be set at a rate that will leave Lake Diefenbaker at a target elevation of 551.5 to 552 m prior to the start of spring runoff (which typically occurs mid to late March). To minimize the risk of another low water year on Lake Diefenbaker like was experienced 2023, the target elevation will be adjusted up or down depending on how the snowpack materializes in the mountains and across the prairies in Alberta and Saskatchewan throughout the winter.

Cumberland Lake is currently well below normal due to dry conditions this past year, which resulted in below normal flows on the Saskatchewan River System. The lake is expected to remain at low levels throughout the winter.

Table 1: Fall Stream Flow Conditions

| Station | 203 Flow (m ³ /s) | 2023 Rank | Years of Record | Lower Quartile Flow (m ³ /s) | Median Flow (m ³ /s) | Upper Quartile Flow (m ³ /s) | Historical Rankings | | | | |
|--|------------------------------|-----------|-----------------|---|---------------------------------|---|---------------------|------|------|------|------|
| | | | | | | | 1 | 2 | 3 | 4 | 5 |
| ASSINIBOINE RIVER AT KAMSACK | 0.29 | 58 | 80 | 0.3 | 0.6 | 1.7 | 2010 | 2016 | 2014 | 1954 | 1995 |
| BALLANTYNE RIVER ABOVE BALLANTYNE BAY | 1.9 | 46 | 48 | 3.4 | 6.4 | 8.5 | 2016 | 1970 | 1979 | 2012 | 1993 |
| BATTLE CREEK AT ALBERTA BOUNDARY | 0.14 | 39 | 49 | 0.1 | 0.2 | 0.3 | 2010 | 2016 | 2011 | 2012 | 1993 |
| BATTLE RIVER NEAR THE SASKATCHEWAN BOUNDARY | 0.0 | 45 | 45 | 1.1 | 1.9 | 2.7 | 1980 | 1982 | 1981 | 1986 | 2005 |
| BEAVER RIVER BELOW WATERHEN RIVER | 27 | 38 | 49 | 28 | 41 | 68 | 2005 | 1973 | 1997 | 2017 | 1974 |
| BIRCH CREEK NEAR ELFROS | 0.0 | 17 | 61 | 0.0 | 0.0 | 0.0 | 2016 | 2010 | 2006 | 1995 | 2005 |
| CANOE RIVER NEAR BEAUVAL | 7.0 | 42 | 51 | 7.7 | 12 | 17 | 1973 | 2005 | 1997 | 1995 | 2012 |
| CARROT RIVER NEAR TURNBERRY | 4 | 48 | 58 | 4.7 | 8.6 | 15 | 2016 | 2006 | 2005 | 2010 | 1978 |
| CHURCHILL RIVER ABOVE OTTER RAPIDS | 159 | 53 | 61 | 199 | 306 | 409 | 2020 | 1974 | 2005 | 1997 | 2017 |
| CHURCHILL RIVER NEAR PATUANAK | 74 | 33 | 41 | 89.8 | 140 | 177 | 1974 | 2020 | 2017 | 1975 | 2019 |
| CUTARM CREEK NEAR SPY HILL | 0.11 | 39 | 82 | 0.0 | 0.1 | 0.2 | 2016 | 2010 | 2014 | 1953 | 1954 |
| DORE RIVER NEAR THE MOUTH | 4.5 | 16 | 53 | 1.0 | 2.1 | 5.4 | 2017 | 1974 | 2007 | 1975 | 2018 |
| FRENCHMAN RIVER AT INTERNATIONAL BOUNDARY | 0.70 | 17 | 96 | 0.0 | 0.2 | 0.5 | 2016 | 2014 | 2010 | 2019 | 1983 |
| HAULTAIN RIVER ABOVE NORBERT RIVER | 9 | 50 | 55 | 11.9 | 16.9 | 23.8 | 2016 | 2012 | 1978 | 1997 | 1979 |
| IRONSRING CREEK NEAR WATSON | 0.1 | 8 | 62 | 0.0 | 0.0 | 0.0 | 2016 | 2006 | 2010 | 2005 | 2014 |
| LANIGAN CREEK ABOVE BOULDER LAKE | 0.0 | 22 | 66 | 0.0 | 0.0 | 0.0 | 2010 | 2006 | 2015 | 2016 | 2005 |
| LIGHTNING CREEK NEAR CARNDUFF | 0.2 | 3 | 51 | 0.0 | 0.0 | 0.0 | 1975 | 2014 | 2023 | 2016 | 1985 |
| LONG CREEK NEAR NOONAN | 0.1 | 14 | 95 | 0.0 | 0.0 | 0.0 | 2013 | 1911 | 2011 | 2014 | 2010 |
| MOOSE JAW RIVER NEAR BURDICK | 0.1 | 47 | 71 | 0.0 | 0.1 | 0.2 | 2016 | 1959 | 1993 | 2002 | 1954 |
| MOOSE MOUNTAIN CREEK ABOVE GRANT DEVINE LAKE | 0.3 | 18 | 87 | 0.0 | 0.0 | 0.2 | 2014 | 2010 | 2011 | 1954 | 1955 |
| NOTUKEU CREEK NEAR VANGUARD | 0.0 | 59 | 76 | 0.0 | 0.1 | 0.1 | 2016 | 2011 | 1963 | 1916 | 1965 |
| PIPESTONE CREEK ABOVE MOOSOMIN LAKE | 0.1 | 20 | 51 | 0.0 | 0.0 | 0.2 | 2014 | 2011 | 2010 | 2016 | 2001 |
| QU'APPELLE RIVER NEAR WELBY | 7.8 | 25 | 62 | 3.7 | 5.7 | 9.8 | 2014 | 2010 | 2011 | 2016 | 1954 |
| RED DEER RIVER NEAR ERWOOD | 1.4 | 61 | 70 | 1.9 | 4.0 | 7.0 | 2016 | 2010 | 1954 | 1970 | 2006 |
| REINDEER RIVER ABOVE DEVIL RAPIDS | 315 | 24 | 39 | 254 | 338 | 438 | 1997 | 2020 | 2009 | 1987 | 1992 |
| STURGEON RIVER NEAR PRINCE ALBERT | 1.3 | 16 | 47 | 0.2 | 0.5 | 1.9 | 2010 | 2016 | 2015 | 2012 | 2018 |
| STURGEON-WEIR RIVER AT LEAF RAPIDS | 19 | 41 | 46 | 30.8 | 44.8 | 53.9 | 2005 | 2020 | 1974 | 1983 | 2016 |
| SWAN RIVER NEAR NORQUAY | 0.90 | 38 | 49 | 1.0 | 2.0 | 3.3 | 2016 | 1970 | 2010 | 1993 | 2009 |
| SWIFT CURRENT CREEK BELOW ROCK CREEK | 0.41 | 31 | 69 | 0.2 | 0.3 | 0.5 | 2016 | 2015 | 2014 | 2013 | 2011 |
| TORCH RIVER NEAR LOVE | 4.6 | 36 | 67 | 3.1 | 4.7 | 7.3 | 2016 | 2005 | 1954 | 2015 | 2004 |

| Station | 203 Flow (m ³ /s) | 2023 Rank | Years of Record | Lower Quartile Flow (m ³ /s) | Median Flow (m ³ /s) | Upper Quartile Flow (m ³ /s) | Historical Rankings | | | | |
|--------------------------------------|------------------------------|-----------|-----------------|---|---------------------------------|---|---------------------|------|------|------|------|
| | | | | | | | 1 | 2 | 3 | 4 | 5 |
| WATHAMAN RIVER BELOW WATHAMAN LAKE | 13 | 53 | 53 | 41.3 | 59.5 | 83.5 | 1997 | 2005 | 1978 | 2020 | 1976 |
| WHEELER RIVER BELOW RUSSELL LAKE | 9 | 50 | 51 | 14.0 | 16.9 | 20.3 | 1976 | 1997 | 2020 | 1978 | 1979 |
| WHITESAND RIVER NEAR CANORA | 0.0 | 58 | 77 | 0.0 | 0.2 | 0.5 | 2016 | 2010 | 2014 | 1995 | 1954 |
| WOOD RIVER NEAR LAFLECHE | 0.0 | 19 | 67 | 0.0 | 0.0 | 0.0 | 2016 | 2014 | 2013 | 2019 | 2015 |
| YELLOW GRASS DITCH NEAR YELLOW GRASS | 0.0 | 11 | 67 | 0.0 | 0.0 | 0.0 | 2011 | 2010 | 2000 | 2014 | 2009 |
| YORKTON CREEK NEAR EBENEZER | 0.1 | 38 | 79 | 0.0 | 0.1 | 0.2 | 2016 | 2014 | 1954 | 2010 | 1995 |

Table 2: November 1, 2023 Observed Levels and Projections for March 1, 2024

| Lake | November 1, 2023 | | | March 1, 2024 | | |
|-----------------|----------------------|---------------|---------------------------|-----------------------|---------------|---------------------------|
| | Observed 2023 (masl) | Median (masl) | Departure from Median (m) | Projected 2024 (masl) | Median (masl) | Departure from Median (m) |
| Buffalo Pound | 509.36 | 509.38 | 0.02 | 509.36 | 509.28 | -0.08 |
| Last Mountain | 489.97 | 489.88 | 0.06 | 489.90 | 489.90 | -0.0 |
| Echo-Pasqua | 478.61 | 478.56 | -0.07 | 478.40 | 478.50 | -0.10 |
| Mission-Katepwa | 478.38 | 478.35 | -0.03 | 478.28 | 478.27 | 0.01 |
| Crooked | 451.10 | 451.07 | -0.03 | 450.70 | 450.80 | -0.10 |
| Round | 441.96 | 441.83 | 0.13 | 441.68 | 441.55 | 0.13 |
| Quill lakes | 519.53 | 515 | 4.53 | 519.59 | 515 | 4.59 |
| Fishing | 529.82 | 529 | 0.82 | 529.95 | 529 | 0.95 |

Climatic Conditions and Long-Range Weather Forecasts

Summary:

- Long-range forecasts are predicting near normal precipitation and above normal temperatures over the next couple of months.
- For the first time in seven years, El Niño conditions are prevalent. This indicates the potential for disruptive weather and climate patterns over the winter.

Large Scale Climate Influences

The hydroclimate of Saskatchewan is heavily influenced by varying, recurring large-scale climate patterns such as the Pacific Decadal Oscillation (PDO), Pacific North American mode (PNA), and the El Niño-Southern Oscillation (ENSO). These large-scale climatic influences can provide insight but should be considered within the context of past experiences rather than a forecast of upcoming conditions.

PDO

The Pacific Decadal Oscillation is an index of sea surface temperatures over the northern portion of the Pacific Ocean. This index shifts from warm (positive) to cool (negative) phases lasting about 20 to 35 years. During negative phases, Saskatchewan typically experiences above normal snowfall and consequently experiences larger spring runoff events. Conversely, we tend to see lower than normal snowfall when the PDO is in its positive phase. The PDO signal has been negative since January 2020 and was strong in October 2023 at -1.65. The PDO is expected to remain in the negative phase throughout the winter.

PNA

The Pacific North American Pattern is one of the most prominent modes of low-frequency variability in the Northern Hemisphere extratropics and is associated with fluctuations in the strength and location of the jet stream. During the positive phase, warmer and drier conditions typically persist over western North America. The PNA is difficult to forecast beyond one month. The PNA is currently in the positive phase but is expected to go into the negative phase in November.

ENSO

The El Niño-Southern Oscillation is a naturally occurring phenomenon that involves fluctuating Pacific Ocean temperatures near the equator. During El Niño (Warm Phase) years, Saskatchewan typically experiences warmer and drier winters. The opposite generally occurs during La Niña (Cool Phase) years; conditions tend to be cooler and wetter. El Niño conditions have developed in the tropical Pacific for the first time in seven years, setting the stage for a probable surge in global temperatures and disruptive weather and climate patterns. Based on model outputs, these conditions are likely to continue throughout the winter into spring 2024.

Seasonal Outlooks

The US National Weather Service hosts a webpage with seasonal forecasts from six models, including two Environment and Climate Change Canada models, and produces multi-model ensemble products. Most of these models are forecasting near normal precipitation and above normal temperatures across Saskatchewan between November 1, 2023 and January 31, 2024. Conditions are expected to vary farthest from normal in the far northeast where well above normal temperatures are expected. Three-month spatial anomalies maps for precipitation (Figure 10) and temperature (Figure 11) covering the November 1, 2023 to January 31, 2024 forecast period are provided.

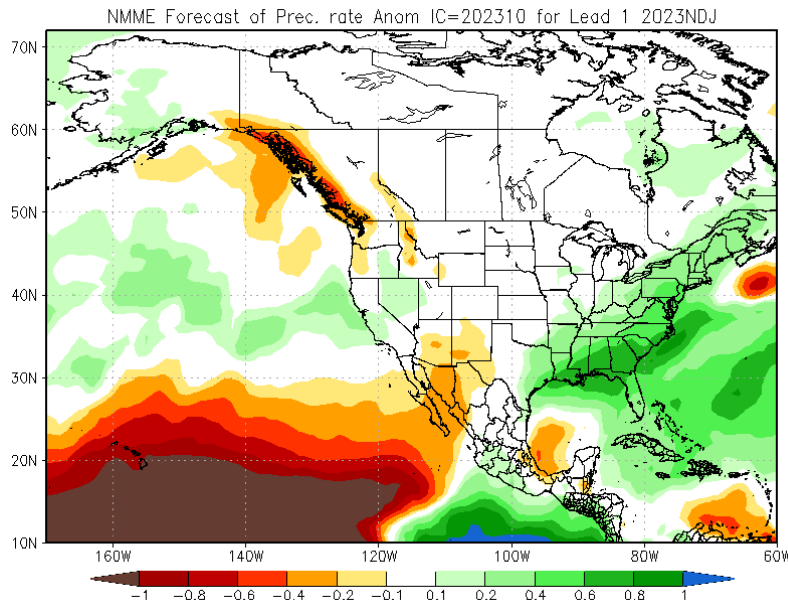


Figure 10: North American Multi-Model Ensemble Precipitation Anomaly Outlook for November 1, 2023 to January 31, 2024 (Map courtesy of the US National Weather Service)

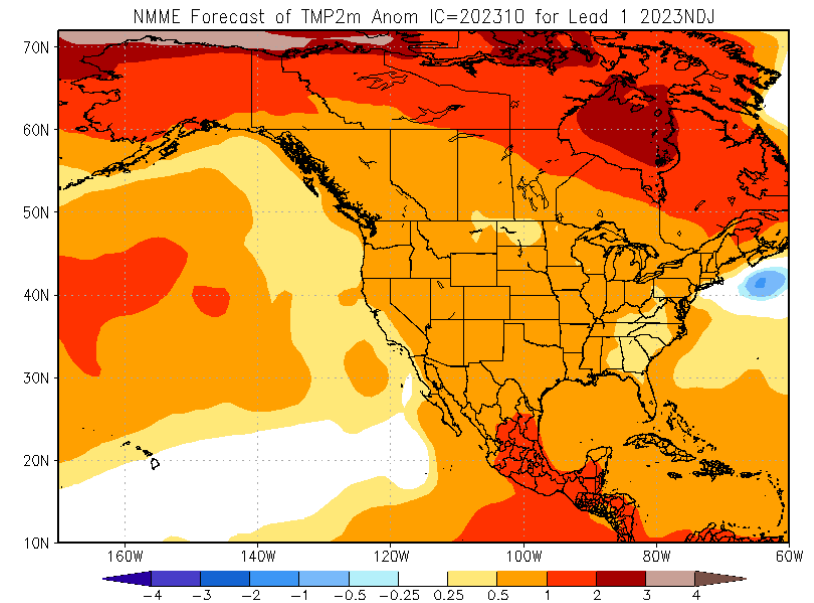


Figure 11: North American Multi-Model Ensemble Temperature Anomaly Outlook for November 1, 2023 to January 31, 2024 (Map courtesy of the US National Weather Service)

Monitoring of Runoff Conditions and Spring Runoff Forecasts

The Water Security Agency will continue to monitor conditions throughout the 2023-24 winter. Beginning in early February, Spring Runoff Outlooks will be released on www.wsask.ca.