Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada

2013 Annual Review of Agroclimate Conditions Across Canada

This report is produced by Agriculture and Agri-Food Canada's National Agroclimate Information Service and summarizes the agroclimate conditions and impacts experienced across Canada during the 2013 agricultural year.

Canada

Annual Review of Agroclimate Conditions Across Canada, 2013

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Overview

This report was compiled and written over the period December 2013 to January 2014 to summarize the variable weather conditions and resultant agroclimate impacts across Canada over the course of the 2013 growing season up to the end of December 2013. It also provides a short term forecast from February to April, 2014. Overall, 2013 turned out to be a very good agricultural year despite less-than-ideal conditions heading into the start of the growing season. Precipitation and heat came when needed, and although there were several significant weather events—like the highly publicized floods in Calgary and Toronto—these events did not significantly impact agriculture. Ultimately, the 2013 agricultural season resulted in above-average to record yields in the Prairie region, average to above-average yields in the Pacific region, and average yields in the Central and Atlantic regions. Also reflecting the positive year, on the livestock side, conditions did not warrant tax deferral designations anywhere in Canada for either droughts or excess moisture. This is a rare occurrence, and in the 25-year history of the Livestock Tax Deferral provision, the situation where no designations are made anywhere in Canada has occurred only a couple of times.

More specifically, the Pacific region (British Columbia) was hot, dry, and mostly free of significant agroclimate issues. The region experienced an above-average number of wildfires in agricultural areas throughout spring and summer, but impacts on production were minimal. The effective use of irrigation in the region resulted in average crop development and subsequent harvest despite the abnormally hot and dry conditions. The Prairie region (Alberta, Saskatchewan, and Manitoba) received well above-average winter precipitation and experienced an abnormally cold spring. This caused seeding delays and flooding once the snow finally melted, although the impacts were much less severe than initially expected. Favourable conditions in late spring and throughout the summer allowed the ground to dry and crop development to catch up, eventually resulting in record yields. The most significant weather event of the agricultural year was the June flooding in Alberta, but despite evacuations and substantial damage to infrastructure, agricultural impacts were minimal. Other notable events included the hail that damaged crops and infrastructure in Alberta throughout July and August and the minor flooding that occurred in Manitoba. As summer changed to fall, conditions dried out across the Prairie region, resulting in low moisture heading into the winter.

The Central and Atlantic regions received below-average winter precipitation, causing drought concerns until spring precipitation recharged many of the dry areas. The moisture kept coming and the Central region (Ontario and Quebec) experienced a cold and wet growing season that resulted in excessive moisture, which slowed crop development and limited yields. In Ontario, the Holland Marsh and Toronto areas were both impacted by significant flooding, but agricultural impacts were relatively small. Quebec experienced significant winter kill of alfalfa fields due to low snow cover and cold winter temperatures and was then impacted by localized flooding throughout the spring and summer. The Atlantic region was mostly free of significant agroclimate impacts throughout the year. In Nova Scotia, a hybrid virus affected strawberry crops and a few orchards were quarantined because of Apple Proliferation Phytoplasma, but yields were still above-average for most crops in the region.

According to Environment Canada, much of the country could be in for a colder than normal winter. The three-month temperature forecast for February to April 2014 is for below-normal temperatures across the Prairie, Central, and Atlantic regions, and normal temperatures in other regions. No significant impact is expected if the temperature forecast is realized. The three-month precipitation forecast is for above-normal precipitation in south and central Alberta as well as in southern Nova Scotia. If the precipitation forecast is realized, the additional snowmelt in south and central Alberta could help to mitigate the abnormally dry fall conditions. Note however that there is a low confidence level in the winter forecast as the signals from ocean temperature models upon which they are based are weak.

Conditions leading into the 2013 Growing Season

By the end of the 2012 fall season, dryness and drought were the most significant issues facing Canadian agricultural producers. As per Agriculture and Agri-Food Canada's (AAFC) Canadian Drought Monitor, the Peace River area of British Columbia and Alberta experienced a moderate drought rating of D1 (see Appendix B for an explanation of drought ratings) (Figure 1). Across the Prairie region, dry conditions prevailed throughout much of southern Saskatchewan and Manitoba until winter snowfall began in October. An area of moderate drought (D1) stretched from Regina, Saskatchewan all the way to Thunder Bay, Ontario, and a small portion of southeast Saskatchewan experienced severe drought (D2) (Figure 1). Fall precipitation ranged from very low to extremely low across agricultural areas in central Alberta, east-central Saskatchewan, and western Manitoba, contributing to these dry conditions. This resulted in low soil moisture that impacted fall seeding and caused concern for winter water supplies and spring pasture development. In Central Canada, there were patches of moderate drought in the Lake Huron and Ottawa areas of Ontario as well as northeast of Montreal, Quebec. However, rainfall from post-tropical storm Sandy on October 31 alleviated much of this dryness, resulting in a more positive winter outlook.

The 2012-2013 winter brought high to record precipitation to much of the Pacific and Prairie regions, reversing the dry fall conditions (Figure 2). British Columbia received just enough precipitation to stabilize agricultural conditions heading into the growing season, while the southern Prairie region received well above-average to record snowfall that began as early as mid-October and remained on the ground until May in some areas. Eastern Saskatchewan and southwestern Manitoba in particular received more than twice their normal winter precipitation, with a record amount falling in the Regina, Saskatchewan area (Figure 2). This created a significant risk of above-normal to very-high spring runoff in nearly all agricultural areas in the province, with the Saskatchewan, Qu'Appelle, Souris, and Assiniboine River systems most in danger of flooding. The risk increased further in March when the majority of the Prairie region received between 100 and 200 percent of normal precipitation (Figure 3).

Figure 1: Canadian Drought Conditions at the End of October 2012

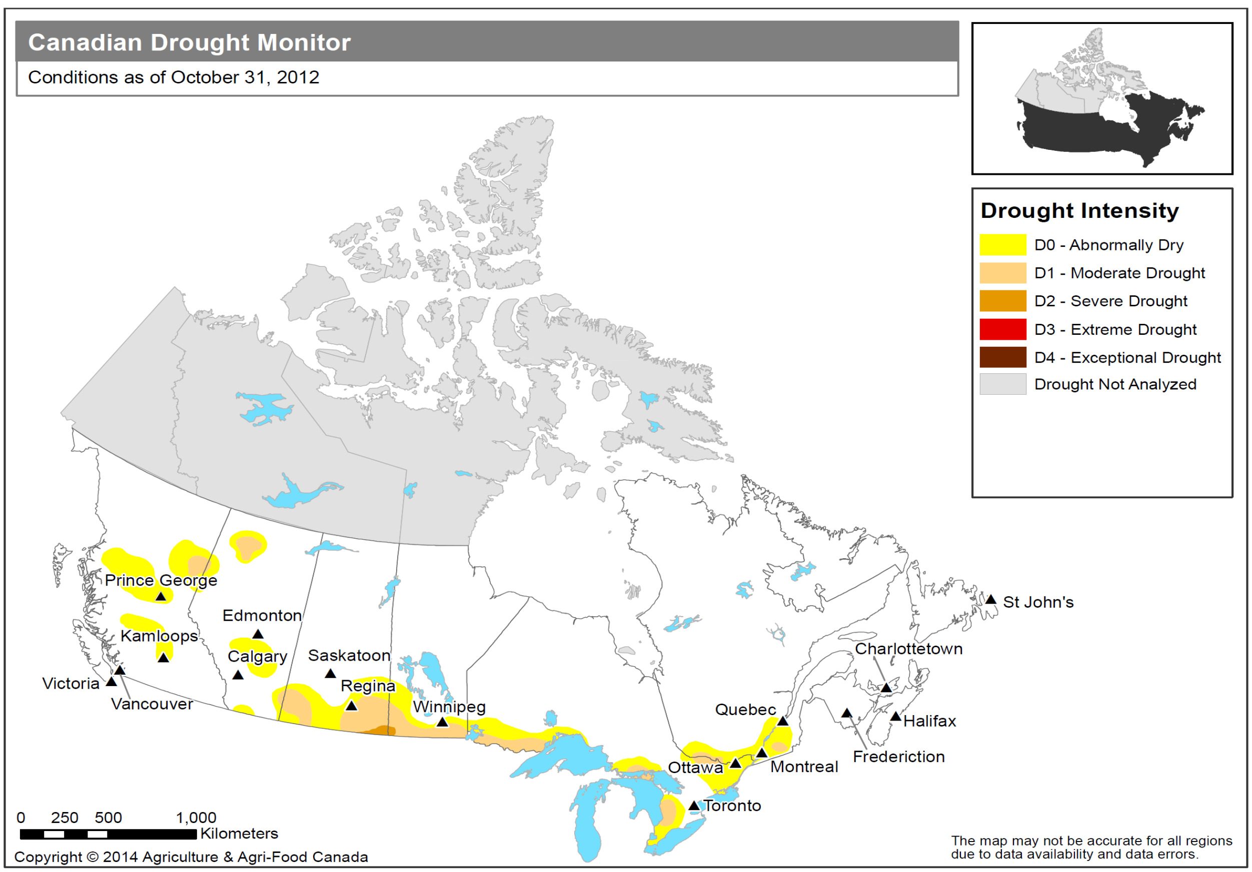


Figure 2: Winter 2012-2013 Precipitation Compared to Historical Distribution

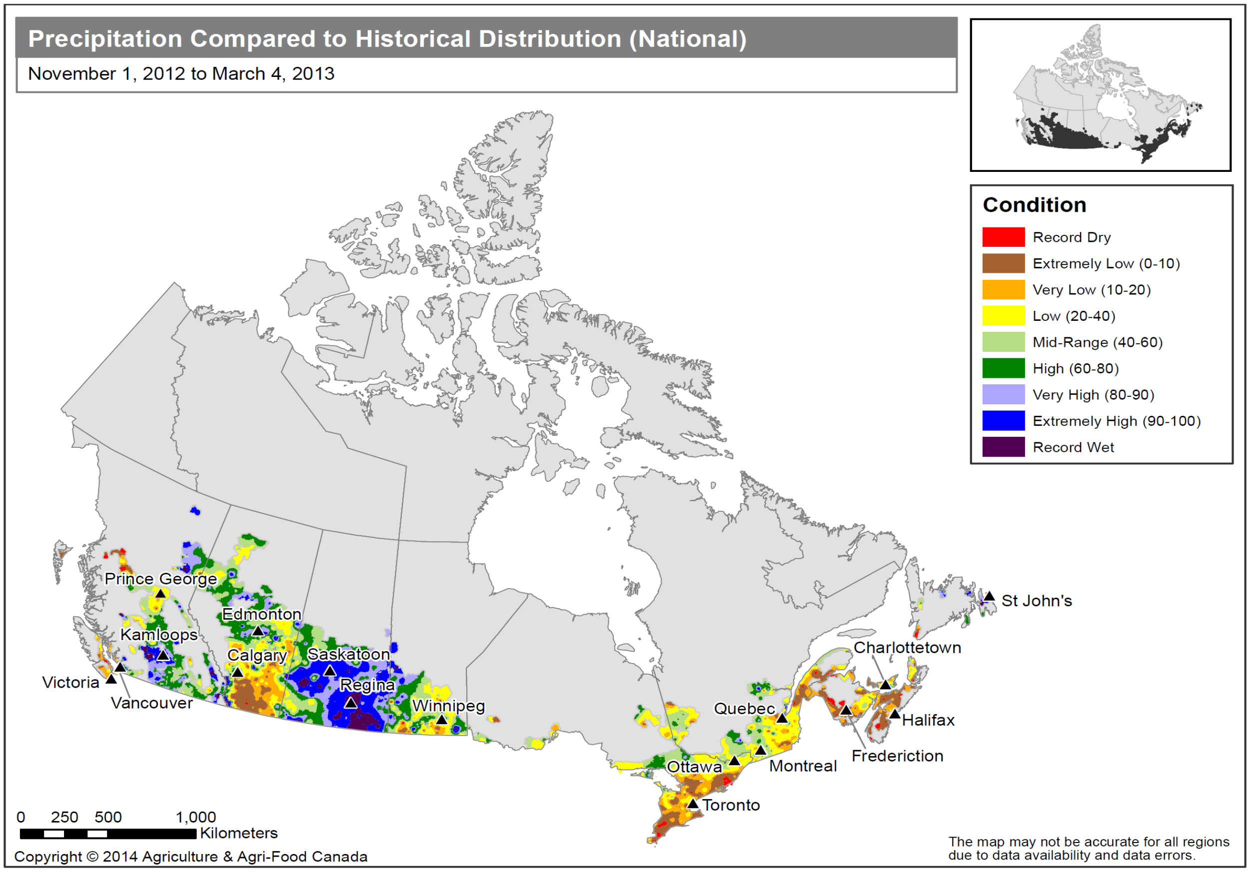


Figure 3: Percent of Average Precipitation, March 2013

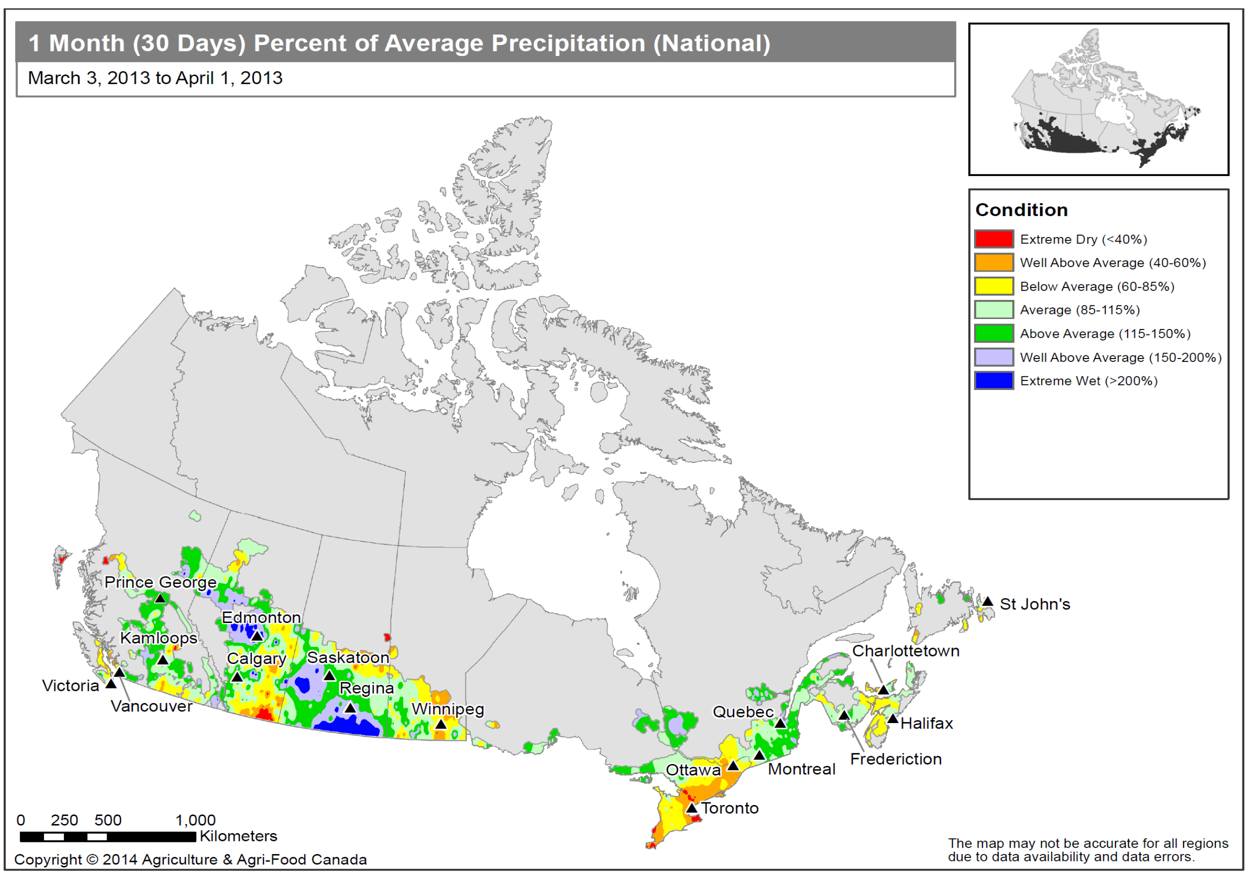
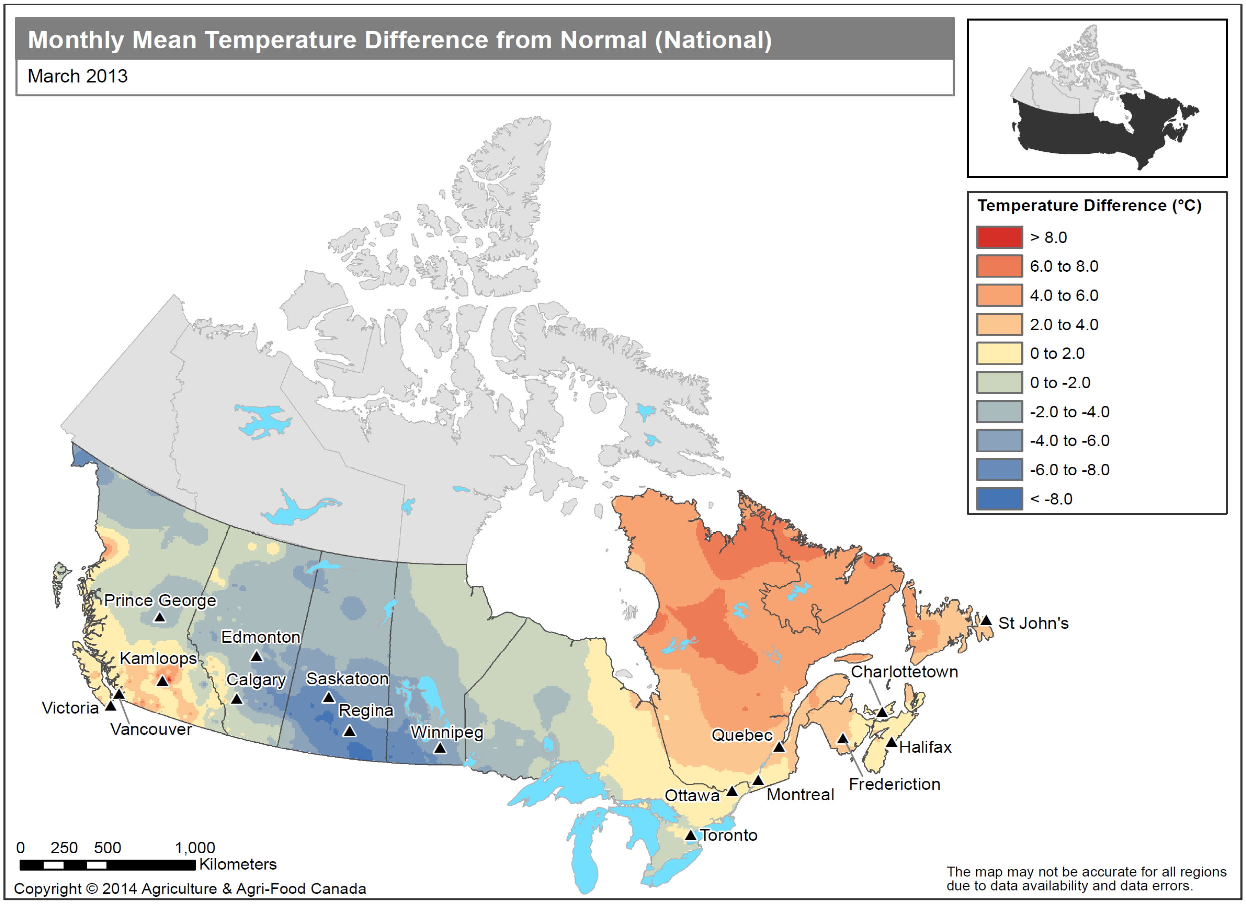


Figure 4: Monthly Mean Temperature Difference from Normal, March 2013



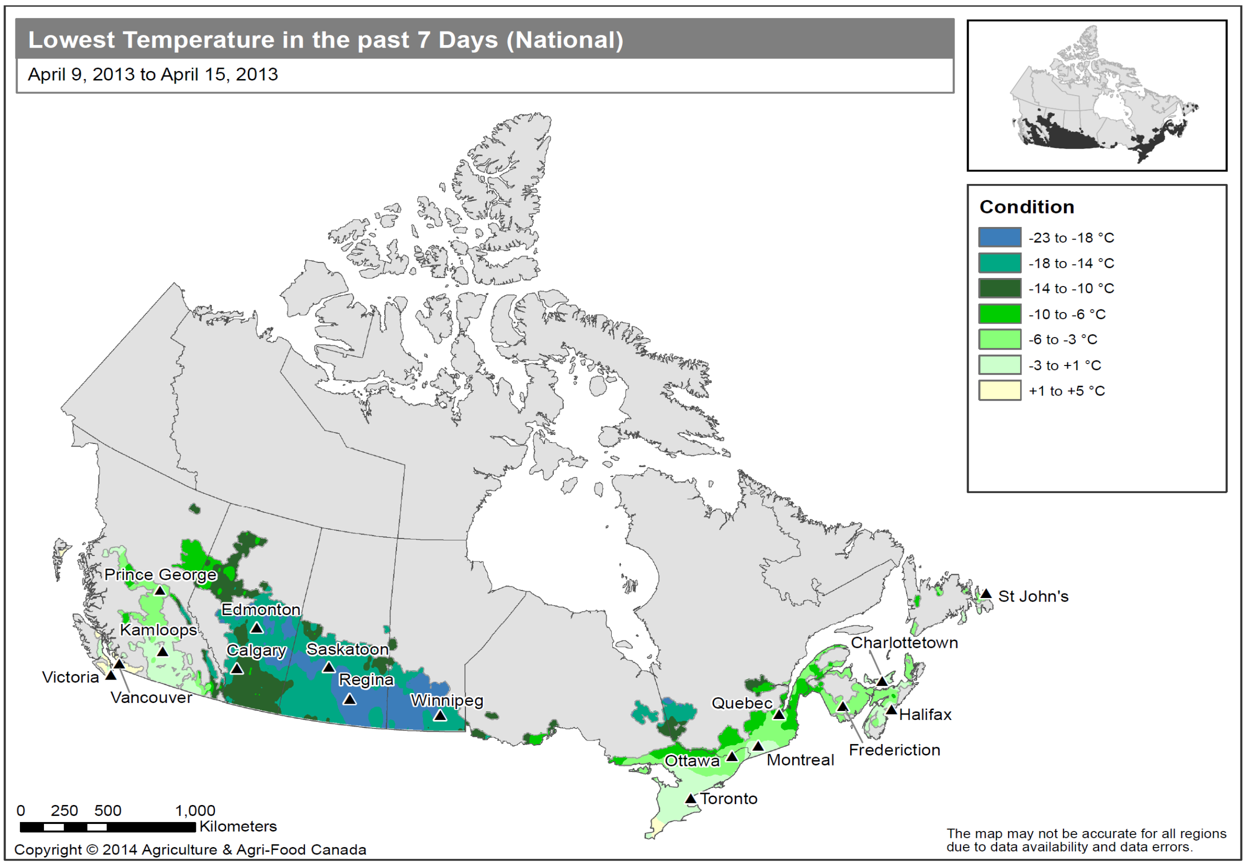
Winter temperatures fluctuated throughout Western Canada. British Columbia recorded above-average temperatures; the northern and Peace River areas were especially warm in February. Conversely, most of the Prairie region experienced below-average temperatures, with a large portion of north-central Alberta reporting six degrees Celsius below normal in December. Throughout January and February, the Prairie region—especially Alberta—warmed up, but conditions reversed again in late winter. An abnormally cold March (more than six degrees Celsius below normal) across the Prairie region (Figure 4) delayed snowmelt, thus increasing the potential for significant flooding once snowmelt began. Below-normal temperatures also increased feed requirements for livestock and negatively impacted calving.

In stark contrast to the west, a large portion of Central and Atlantic Canada received well below-normal precipitation in winter 2012-2013 (Figure 2), resulting in concerns about low soil moisture and drought. The lack of precipitation was compounded by above-average temperatures throughout southern Ontario, Quebec, and most of the Atlantic region. By spring, Ontario had accumulated very little snow and began to develop drought conditions, becoming the northern extension of the large drought in the US. Fortunately, increased precipitation in March began to improve the dry conditions in Ontario. In the Atlantic region, there was potential for spring dryness, but a few late snowstorms in March stabilized conditions leading into the growing season.

Spring 2013 (April - June)

The Prairie region experienced a winter that seemingly went on forever, as cold weather, accompanied by significant snow across the region, continued well into April. The snow was very deep and persistent—on April 19, the snowpack across Saskatchewan was still 30 to 60 cm deep, a record for that late in the year. The snow was accompanied by frigid temperatures; between April 9 and 15, temperatures as low as –23 degrees Celsius occurred across the region, with record lows in Alberta and Saskatchewan (Figure 5). Throughout April, many areas reported a mean temperature difference of 8 degrees Celsius below normal (Figure 6), which was unusual and very significant. For example, residents of Saskatoon, Saskatchewan did not experience temperatures above 10 degrees Celsius for a record 189 consecutive days between October 18, 2012 and April 25, 2013. These below-normal temperatures delayed snowmelt, increased the risk of rapid flooding when snowmelt finally occurred, caused winter feed supplies to run short, and delayed seeding by two weeks throughout much of the region (and by over four weeks in certain areas) (Figure 7).

Figure 5: Record Low Temperatures in the Prairie Region, April 9 to 15, 2013



In Central Canada, increased spring precipitation was much welcomed as it provided relief from the dry and drought conditions that had developed over the winter. Southern Ontario received 50 to 90 mm of rain and snow (over 200 percent of average) between April 9 and 15, which significantly reduced the previous risk of drought and recharged many areas of concern. Although the precipitation caused flooding later in the month, there was little agricultural impact. In central Nova Scotia, the strawberry crop was infected with a hybrid virus (a combination of the mottled and yellow edge viruses). This had a significant impact on yields, as the area affected typically produced 40 percent of the berries in Nova Scotia. The province applied for federal funding to cover the losses, as producers removed up to 70 percent of their plants in an attempt to stop the virus from spreading. Despite these efforts, the virus was still active into mid-June and was later also confirmed on Prince Edward Island.

Figure 6: Monthly Mean Temperature Difference from Normal, April 2013

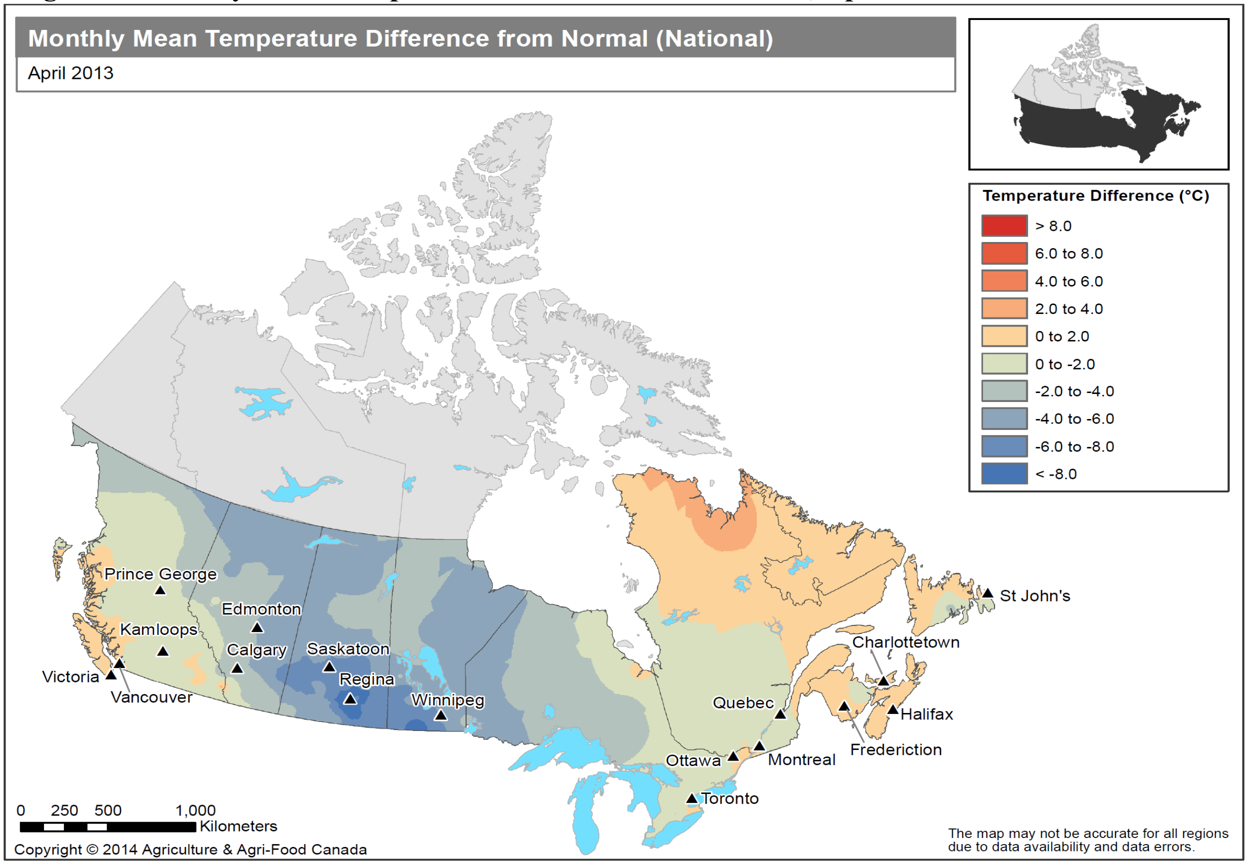
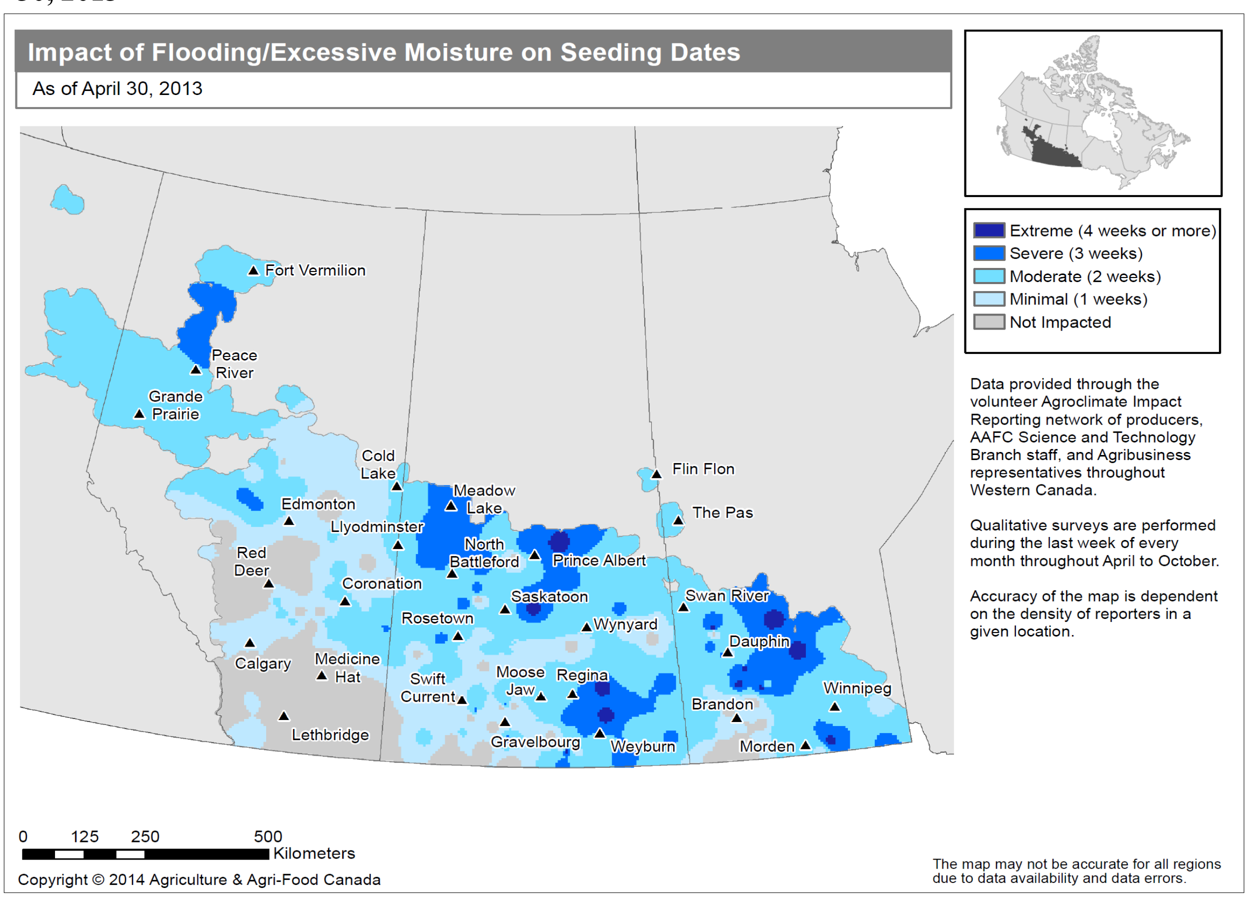


Figure 7: Impact of Flooding/Excess Moisture on Seeding Dates in the Prairie Region as of April 30, 2013

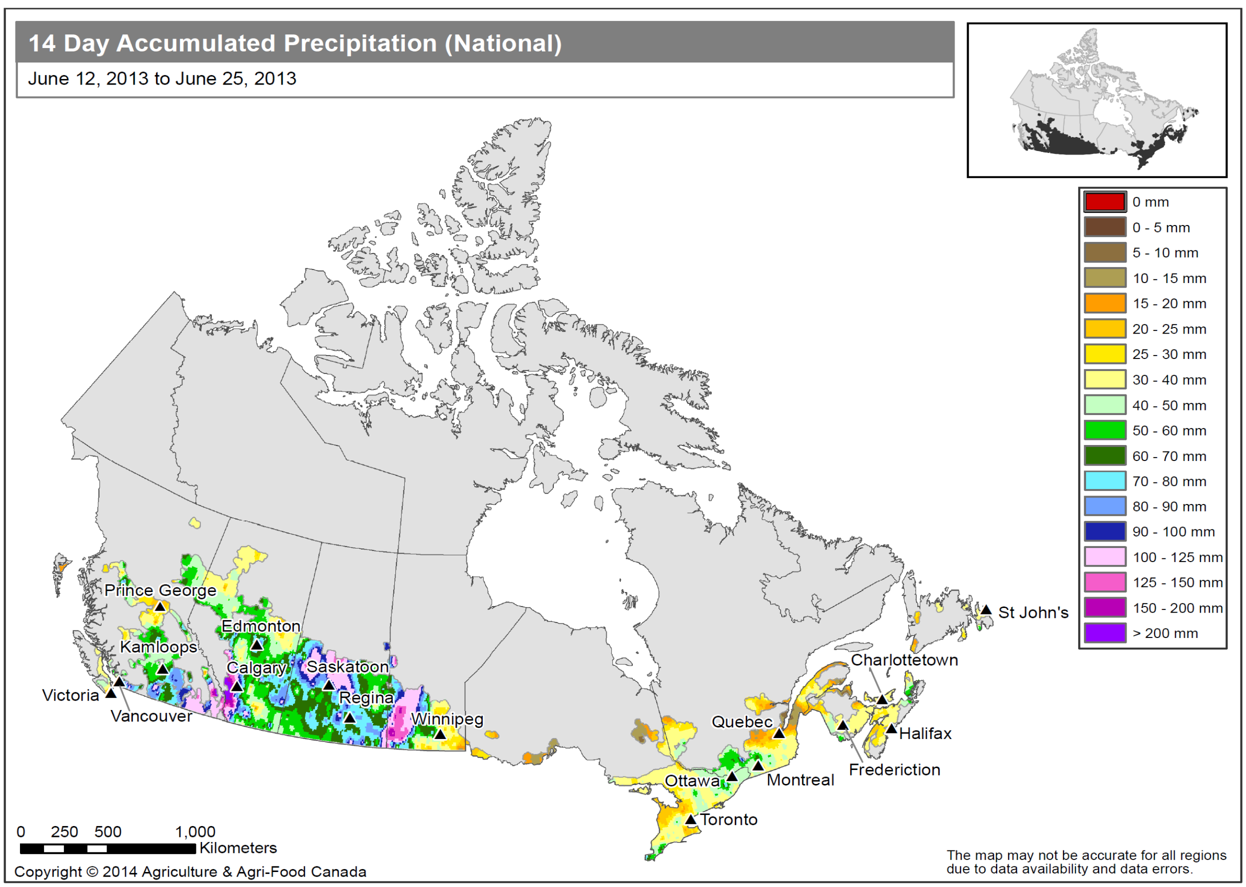


As the month of May approached, warm, dry weather swept across Western Canada. Above-average to record temperatures in the Pacific region resulted in a higher-than-usual number of wildfires in agricultural areas. These wildfires had minimal impact on agricultural production. Later in the month, heavy rain in the interior, combined with the melting of high-elevation snowpack, caused localized flooding that reduced access to fields and damaged some pastures. Overall, there were no significant disruptions to agricultural production.

In the Prairie region, the severe flooding that had been predicted did not occur. The unusually cold spring allowed a gradual melt, and the dry conditions leading into winter meant that the soil could absorb more moisture than usual. Additionally, below-normal precipitation, above-normal temperatures, and warm winds created excellent drying conditions at the end of April, further minimizing the impact of flooding and significantly improving conditions in the region. Some flooding did occur, but it was largely limited to flood plains. The flooding would have been much worse, but the weather mitigated and extended the spring snowmelt. Despite the reason for optimism, there were still a number of concerns across the region. With pasture conditions a few weeks behind, producers indicated having significant feed shortages in a large area stretching from southeast Manitoba to the Peace River area in northern Alberta. As a result, seeding began but was delayed one to four weeks throughout much of the region (Figure 7). The areas most impacted by flooding were southeastern Saskatchewan and the areas around Lake Manitoba, which had been impacted by flooding and excess moisture for six years in a row. A dry summer in the Interlake area of Manitoba allowed conditions there to dry up moderately heading into fall.

The highest-profile weather event of the spring was the Alberta flood. Between June 11 and 25 (but predominantly on June 19 and 20), record precipitation of more than 350 mm fell in the Alberta foothills west of Calgary (Figure 8). Flash flooding hit Calgary, High River, and many other urban and rural centers along the Red Deer, Bow, and Elbow River systems, causing extensive damage to homes, infrastructure, and transportation networks. Approximately 120,000 people were evacuated, 32 states of

Figure 8: June Precipitation leading to Flooding in the Prairie Region



local emergency were declared across the province, and four people died. The disaster caused more than five billion dollars in damages, making it the most costly natural disaster in Canadian history. Despite the severity of the flooding, agricultural impacts were limited and included localized damage to crops, livestock fatalities, and the disruption of processing facilities and transportation networks. Canada's largest beef processing plant, located in High River, was forced to shut down operations due to a lack of potable water. It was slow to resume full capacity work as officials concentrated on restoring drinking water to citizens before supplying the plant. Additionally, the Canadian Pacific railways between Crowsnest Pass and Rodgers Pass were washed out, resulting in delayed grain transportation.

The same precipitation event that caused flash flooding in southern Alberta also affected Saskatchewan and Manitoba. More than 100 mm of precipitation fell in north-central Saskatchewan and southwestern Manitoba, with the Pipestone, Manitoba area receiving 200 mm. Three rural municipalities, two in the southwest region and one in the Interlake region, declared states of emergency due to flood impacts. The flooding further delayed crop development, negatively impacted hay and forage supply, damaged infrastructure, and created the potential for diseases such as foot rot in cattle.

In Eastern Canada, significant winter kill of alfalfa fields, stemming from low snow cover and cold winter temperatures, occurred in the Saguenay-Lac-St-Jean region of Quebec. Also, Quebec and New Brunswick received heavy mid-May precipitation (100 to 150 mm) that caused localized flooding, delayed fieldwork, and damaged forage, fruit, and vegetable crops. These heavy rains continued in June in both Quebec and Ontario, resulting in such poor conditions that the crop insurance boards extended seeding deadlines for many crops by four to ten days in each province. A combination of high water levels, wind, and heavy rain caused dikes to break (May 25) and flooding to occur (June 16) in part of the Holland Marsh region of Ontario. Three farms were flooded and nearly 200 acres of farmland were destroyed. Farmers estimated the damage to be around one million dollars. Finally, in the Annapolis Valley in Nova Scotia, an apple orchard was quarantined in May after detection of Apple Proliferation Phytoplasma, a bacteria-like plant pest considered one of the most devastating apple tree diseases.

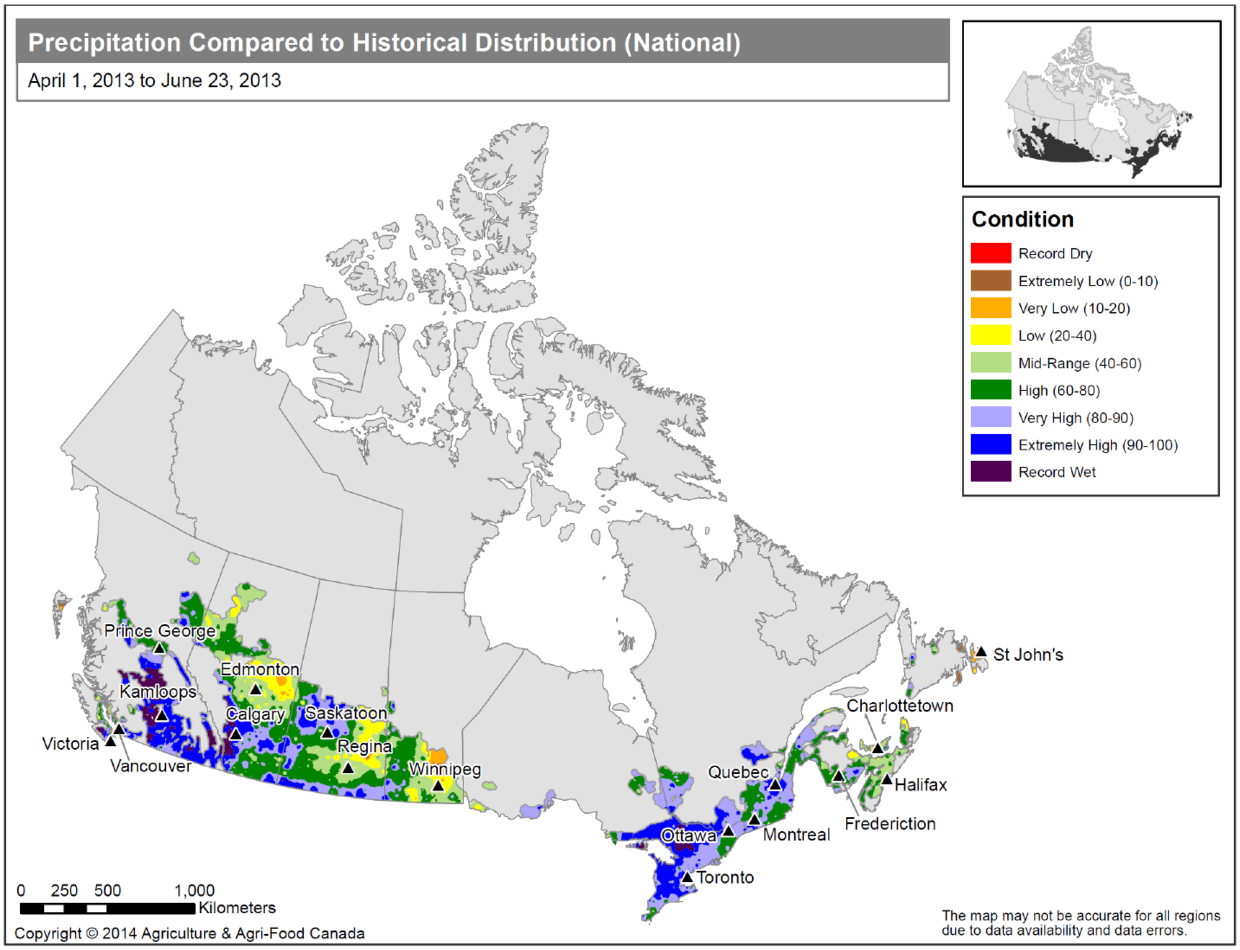
During what was a very wet spring nationwide, nearly 45 percent of Canada's agricultural areas received very high to record precipitation between April 7 and June 23 as compared to historical distribution (Figure 9). These areas included approximately 40,000 farms and 6.2 million cattle. While there were many agroclimate issues reported across the country, the impacts were not as severe as predicted in April when considering the extensive snowpack and late spring in the Prairie region. As spring transitioned into summer, crop development was one week behind due to delayed seeding, but overall, conditions were stable.

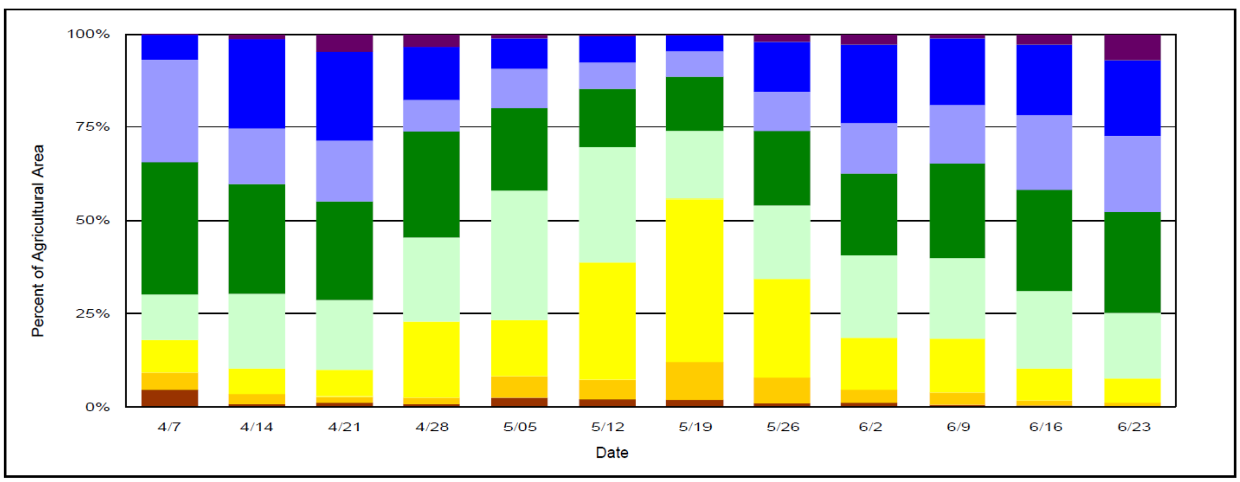
Summer 2013 (July - August)

Across Canada, severe weather was responsible for the majority of agroclimate impacts in July and August of 2013. In the Pacific region, record-breaking heat, humidity, and a lack of precipitation in the south led to drought concerns and a high to extreme risk of fire. In mid-July, the drought risk assigned by British Columbia's River Forecast Centre was increased to level 2 (dry) throughout much of the province. By August, after a continued stretch of little to no rainfall, drought risk increased again to level 3 (very dry) on Vancouver Island and was upgraded to level 2 (dry) along the west coast. Despite these dry conditions, irrigation kept crops healthy and there were no reported water shortages or irrigation restrictions.

In the Prairie region, rain and hail were the cause of most summer agroclimate impacts. On July 5, an unusually large and intense hail storm tracked across southern Alberta and left a long trail of hail from Airdrie to Irricana, southeast of Drumheller, depositing approximately 30 cm of hail in an hour.

Figure 9: Precipitation Compared to Historical Distribution to June 23, 2013 and Corresponding Statistics





Date	Record Dry Area (%)	Record Dry Farms (000)	Record Dry Cattle (000)	Extremely Low (0-10) Area (%)	Extremely Low (0-10) Farms (000)	Extremely Low (0-10) Cattle (000)	Very Low (10-20) Area (%)	Very Low (10-20) Farms (000)	Very Low (10-20) Cattle (000)	Low (20-40) Area (%)	Low (20-40) Farms (000)	Low (20-40) Cattle (000)
2013-06-16	0.00	0.00	0.00	0.44	0.35	51.03	1.27	1.15	180.64	8.49	7.94	1290.17
2013-06-23	**0.00**	**0.00**	**0.00**	**0.20**	**0.06**	**5.47**	**0.96**	**0.73**	**110.61**	**6.27**	**4.44**	**659.26**

Date	High (60-80) Area (%)	High (60-80) Farms (000)	High (60-80) Cattle (000)	Very High (80-90) Area (%)	Very High (80-90) Farms (000)	Very High (80-90) Cattle (000)	Extremely High (90-100) Area (%)	Extremely High (90-100) Farms (000)	Extremely High (90-100) Cattle (000)	Record Wet Area (%)	Record Wet Farms (000)	Record Wet Cattle (000)
2013-06-16	26.90	21.73	3676.23	20.28	15.66	1968.78	18.89	21.00	2212.44	2.78	1.50	161.60
2013-06-23	**27.25**	**23.28**	**3892.03**	**20.25**	**20.78**	**2997.51**	**20.27**	**20.95**	**2777.13**	**7.08**	**2.51**	**408.08**

These statistics were generated by comparing the Statistics Canada's 2006 Census of Agriculture dataset with AAFC's Precipitation Compared to Historical Distribution map. The climate data are provided through a partnership between Environment Canada, Natural Resources Canada, and many Provincial agencies.

Figure 10: Aftermath of July 5, 2013 Hail Event in Southern Alberta

Source: Daryl Frank

The hail strip was approximately 120 km long and 1 km wide, so large that it was visible on satellite imagery. Figure 10 is a photograph that shows a small segment of the storm's path. Significant crop damage to 4000 acres of potatoes—approximately 10 percent of Alberta's potato crop—occurred.

Another hail storm nearly two weeks later on July 17 damaged some high-value irrigation crops in the Lethbridge, Taber, and Coaldale areas, adding to the above-average hail damage in Alberta. Throughout the summer season, more than 100 irrigation pivots in Alberta were destroyed during severe weather events, which impacted the ability of some producers to provide crops with late season moisture. According to the Canadian Crop Hail Association, Alberta famers' hail insurance claims in 2013 were about 25 percent above normal.

Saskatchewan and Manitoba also experienced damaging storms throughout July. Multiple high precipitation, high wind, hail, and tornado events which caused localized crop and infrastructure damage were reported. Between July 6 and 8, 70 to 120 mm of rain fell in the Dauphin, Manitoba and Prince Albert, Saskatchewan areas. One rural municipality in each province declared a state of emergency. Agricultural impacts included saturated soils and localized flooding of cropland, which caused concern about the quantity and quality of hay crops across the Prairie region. Despite the stormy weather, crop development was still good overall because the severe weather was confined to relatively small areas in each province, leaving much of the Prairie region untouched.

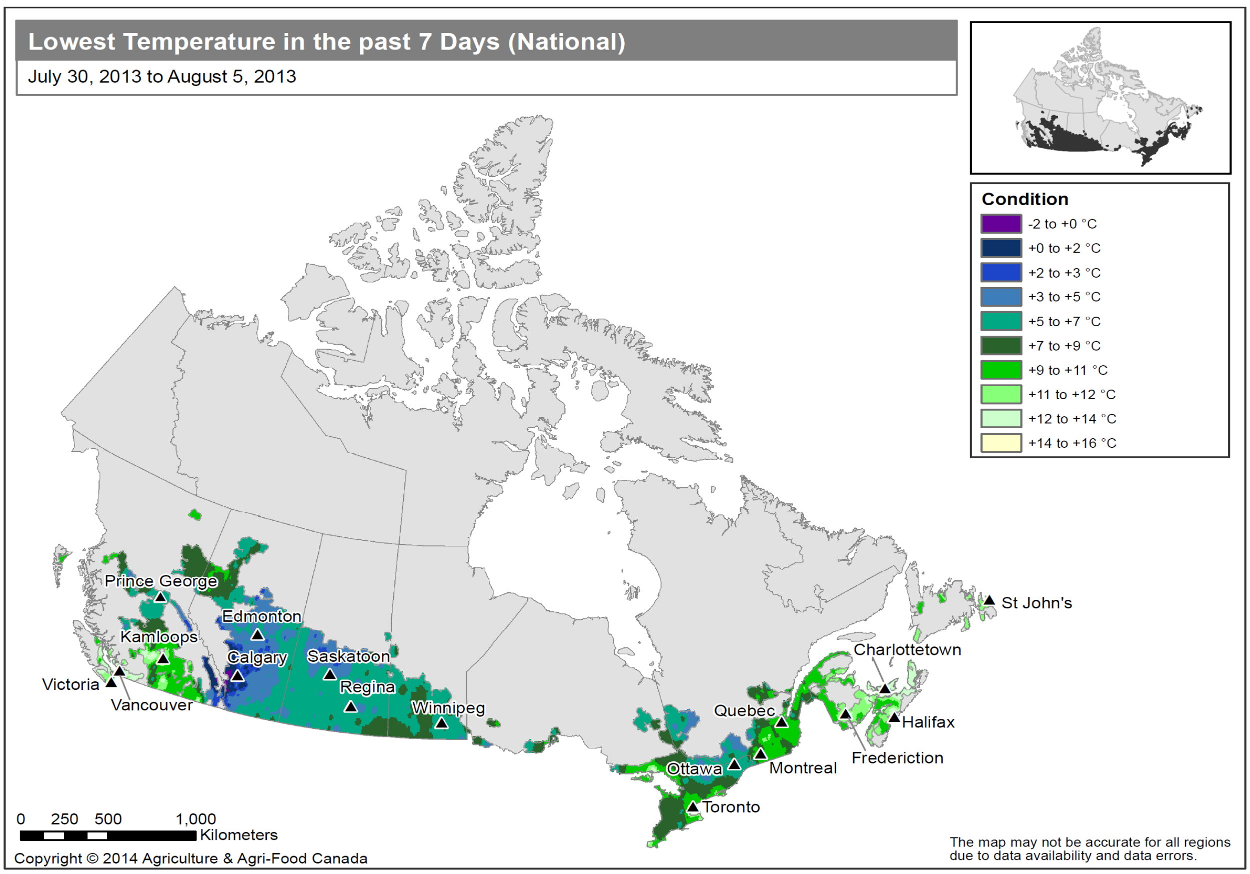
Precipitation was also a concern in Canada's Central region. On July 8, the Toronto area was hit with a large thunderstorm that deposited record precipitation, in excess of 120 mm, causing significant flooding and blackouts. Record precipitation over the preceding two weeks had already created excess moisture in the region, contributing to the storm's impact. The Insurance Bureau of Canada estimated nearly one billion dollars in damages, making it the most expensive natural disaster in the history of Ontario. While the storm was centred on metropolitan Toronto, there were agricultural impacts as well. Some Chatham-Kent farmers estimated crop damage in the tens of millions of dollars, while crops in Huron, Middlesex, Elgin, and Lambton counties were also affected. Fortunately, a mid-July heat wave brought record-high temperatures to the Central region, which helped to dry out the wet soils and advance crop development. Problems with lingering excess moisture still hindered agriculture in some areas, with Quebec remaining one week behind normal, but for the most part, the heat kept crop development in the region near-normal.

Meanwhile, the Prairie region experienced well below-normal overnight temperatures beginning in late July and into the first week of August, with the Alberta foothills dipping below freezing (Figure 11). The cool temperatures caused increased concern for frost. Producers in Saskatchewan and Manitoba were also worried that there would not be enough heat and growing days in the season for crops to fully develop. Although these concerns were valid at the time, they were alleviated by favourable weather in the fall. There were also reports of crop diseases and pests throughout the Prairie region, but no significant impacts occurred.

Towards the end of summer, British Columbia experienced its first agriculturally-significant storm of the year. A major hail storm on August 12 east of Kelowna severely damaged at least 700 acres of orchard and vineyard production. According to the B.C. Fruit Growers' Association, 10 to 15 percent of the valley's apple crop was affected, with an estimated four to six million dollars in damages. The fruit trees themselves were also affected, which could negatively impact production in 2014.

Between dryness, hail, and cold weather concerns in the west, and record-breaking rain in the east, Canadian agricultural producers had a variety of problems to deal with in the summer. However, while this severe weather resulted in high insurance claims and garnered significant media attention, the agricultural impacts were relatively minimal as the weather events were infrequent and localized. In late August, warm and dry conditions in the Prairie region advanced crop development to near normal. Warm weather in the Atlantic region also reduced excess moisture and improved crop quality and development. Ontario and Quebec, however, experienced cool and wet conditions that slowed crop development by about one week leading into fall.

Figure 11: Below-Average Temperatures in the Prairie Region, July 30 to August 5, 2013



Fall 2013 (September - October)

As September arrived, conditions across the country were good overall and there were minimal agroclimate impacts. Many agricultural areas in the Pacific and Prairie regions were classified as abnormally dry, but there were only isolated pockets officially designated as drought (Figure 12). Crop development (based on growing degree days) was rated as ahead of schedule throughout Western Canada and due to the warm, dry weather, harvest advanced dramatically across the region. This was a significant improvement, as crops were up to four weeks behind after the late start in spring. In the Central and Atlantic regions, crop development remained behind-normal by only two to four days. There was some concern in the Atlantic region when post-tropical storm Gabrielle hit on September 13, but it brought much less rain than was initially forecast, leaving agriculture unaffected.

October saw a continuation of good crop development and nearly ideal harvest conditions in the Pacific and Prairie regions, although dryness remained a concern. For many dairy farmers on the south coast of British Columbia, a span of three weeks with abnormally warm and dry weather resulted in an extra cut of forage and good establishment of cover crops on harvested corn fields. Further east, a large portion of east-central Alberta and west-central Saskatchewan experienced moderate drought (Figure 13). Dry conditions meant that soil moisture continued to decrease throughout central Alberta and Saskatchewan (Figure 14). The west-central and north-west regions of Saskatchewan were the driest areas. Provincial crop reports indicated that cropland topsoil moisture was more than 30 percent short and very short, and hayland and pasture topsoil moisture was at nearly 40 percent. This reduced the potential for hay and pasture production and caused concerns heading into winter. Soil moisture was generally good in both Ontario and Quebec.

Figure 12: Canadian Drought Conditions at the End of August 2013

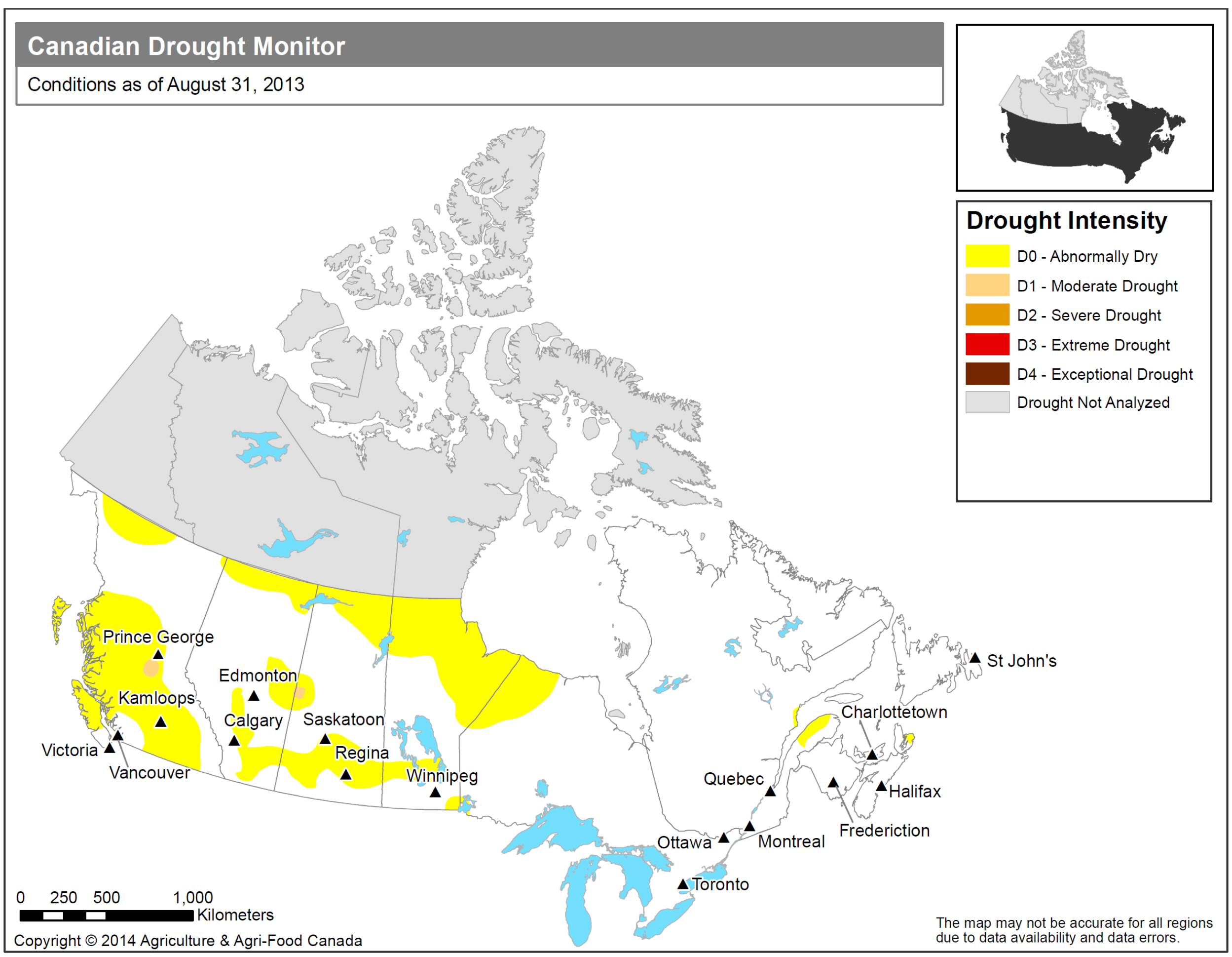


Figure 13: Canadian Drought Conditions at the End of October 2013

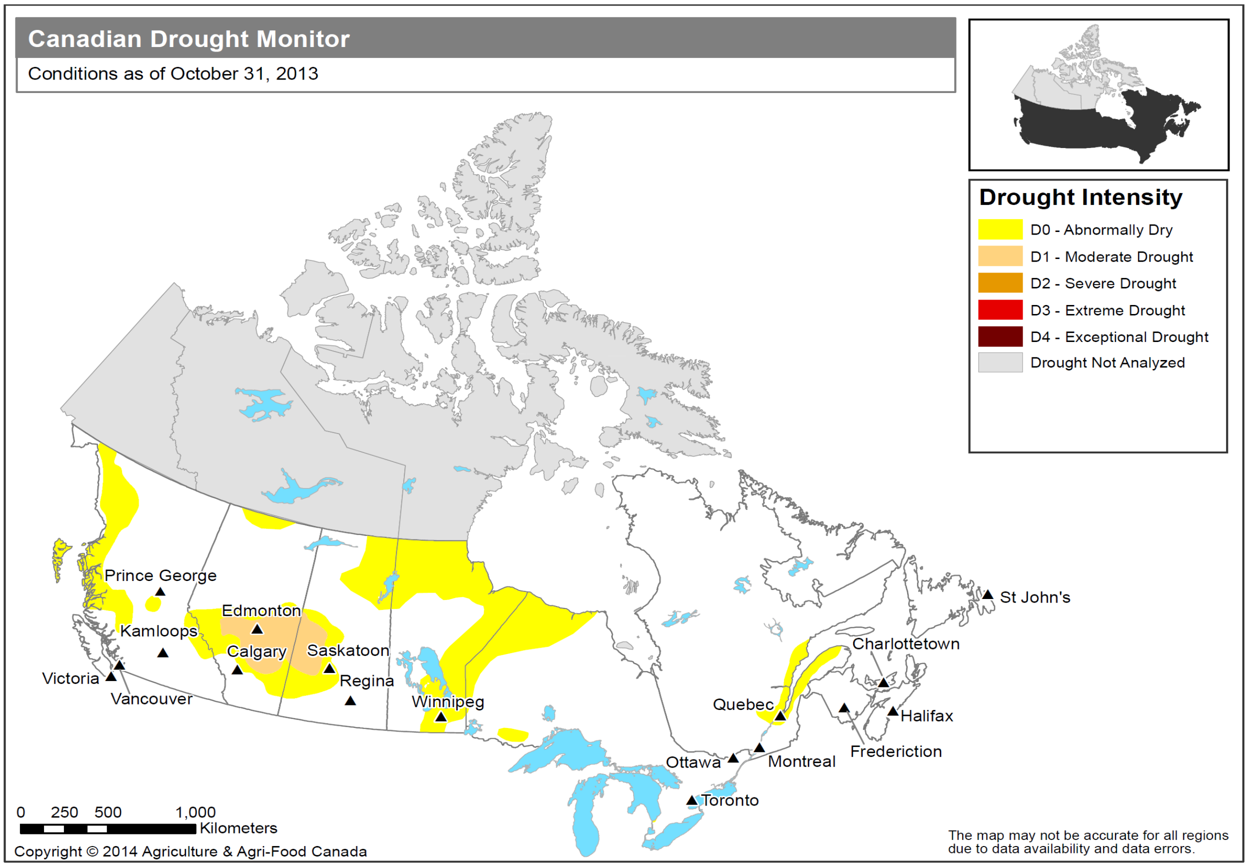
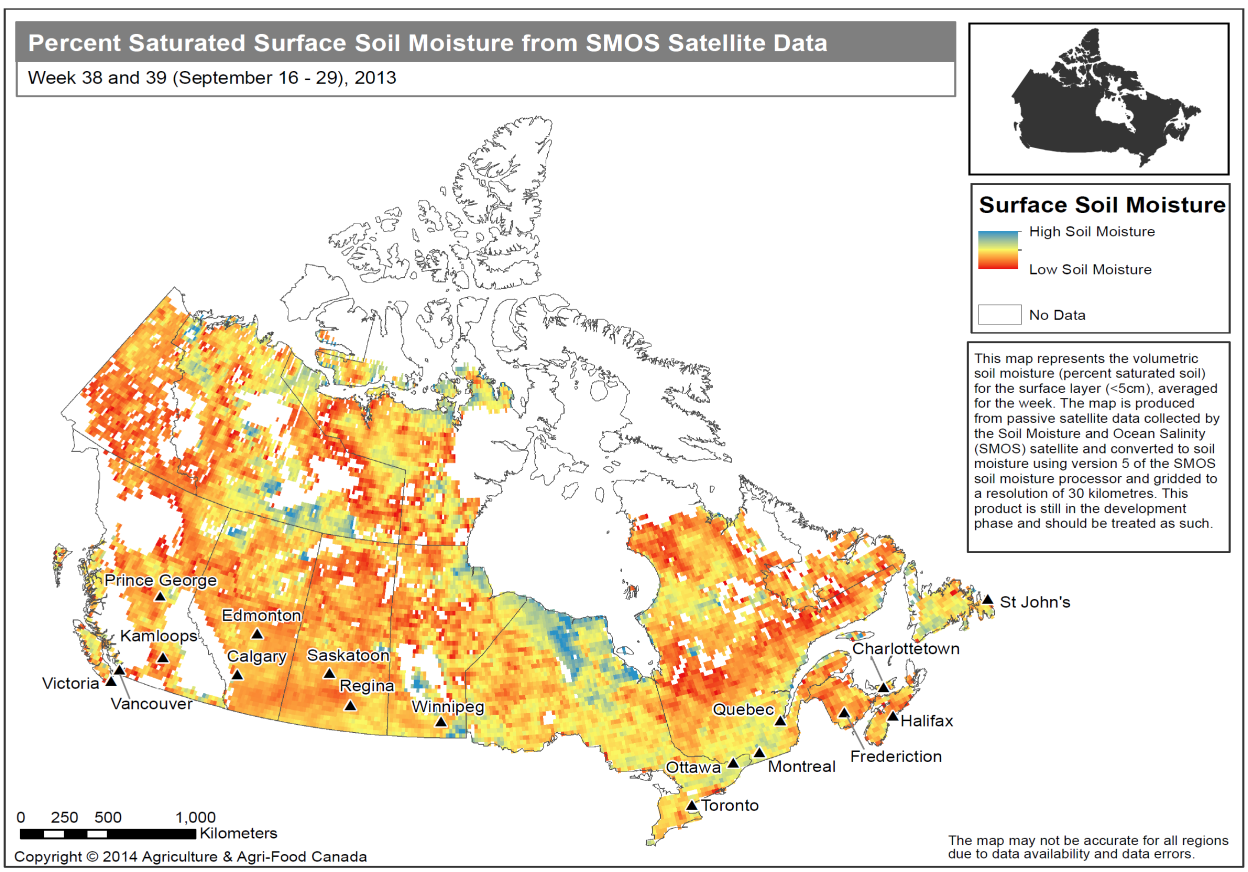


Figure 14: Surface Soil Moisture Conditions from September 16 to 29, 2013



Canadian crop production in 2013 was excellent in the Prairie region and average elsewhere in the country. In British Columbia, fruit yields were average while wheat, hay, and canola yields were all above-average, aided by the warm fall. In the Prairie region, the combination of warm summer and fall temperatures, adequate soil moisture, and minimal severe weather made up for the late start in the spring and resulted in well above-average to record crop production. Harvest was completed by Thanksgiving (October 14) and the crops were excellent, with above-average to record yields and average to above-average quality for grains and oil seeds. Statistics Canada estimated that the Prairie region produced 30.5 million tonnes of wheat in 2013, with record production reported in some areas. According to media reports, there was so much grain that supplies of grain storage bags ran out in some areas, with reports of grain being temporarily stored on the ground. The large yields also caused other issues with regional transportation networks, and contributed to commodity price declines in Canada due to large world supplies of all crops.

In Ontario and Quebec, crop production varied, reflecting impacts by excess moisture and fall frost events, so harvest was expected to be below-average. Ontario experienced wet fall conditions that damaged bean crops and impacted winter wheat seeding. Yields would have been lower but for a spell of warm, dry weather in mid-fall that allowed for a better-than-expected harvest. In Quebec, growing conditions were average in September and excellent in October, which made up for the cool, wet summer and allowed crop production to approach historic averages. The Atlantic region produced above -average yields thanks to a good fall. Warm and dry conditions in September and October were ideal for harvesting and made up for the wet summer. Nova Scotia enjoyed above-average apple harvests despite the Apple Proliferation Phytoplasma scare that resulted in the quarantine of three orchards earlier in the spring. In November, the quarantines were lifted and no further trace of the disease was discovered. Prince Edward Island experienced a particularly good weather year. Conditions were good for potatoes, leading to an average yield of particularly good quality.

The most significant agroclimate issue heading into winter 2013-2014 was low soil moisture levels in the Prairie region, especially in Saskatchewan and Alberta (Figure 14). Fall recharge was minimal, so above-normal precipitation will be needed over the winter to replenish soil moisture. Throughout the rest of Canada, conditions were near normal and relatively stable heading into freeze-up.

Winter Outlook (November 2013 - April 2014)

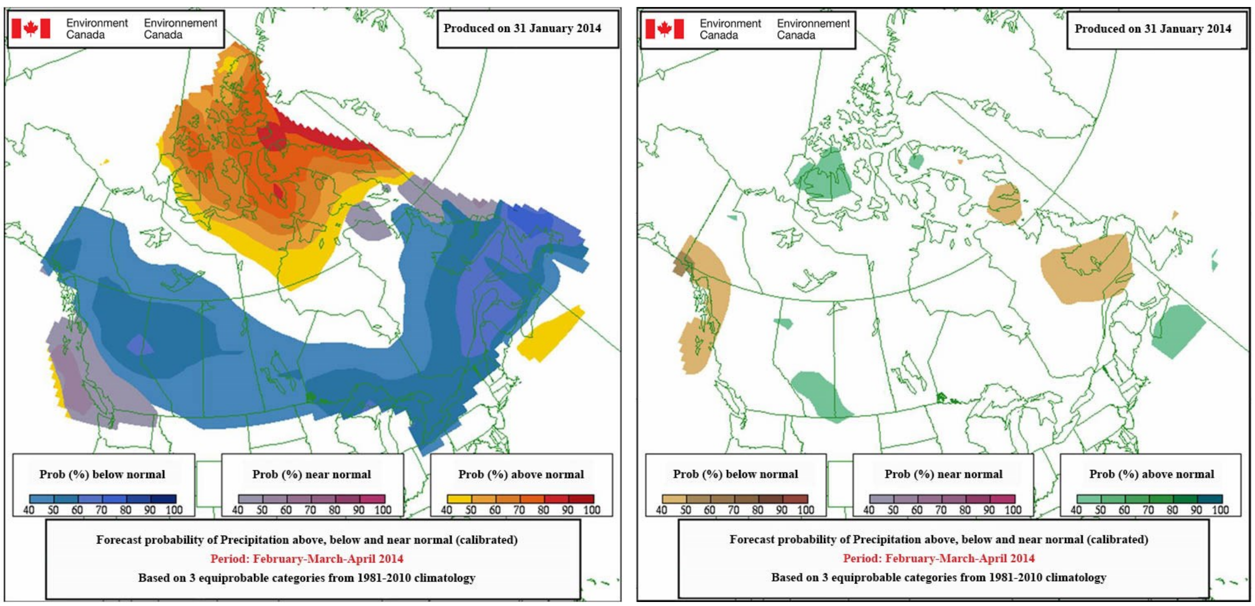
The winter of 2013-2014 got off to a cold start across Canada, with November temperatures below-normal across the majority of the country. British Columbia was the exception and experienced an average November and December. Across the Prairie region, temperatures were below-normal in November and December, with December bringing particularly cold weather. This cold front extended east across Ontario, Quebec, and the Atlantic region, with temperatures more than five degrees Celsius below normal. The January forecast was for Manitoba and Ontario to remain colder than normal but for Saskatchewan, Quebec, and the Atlantic region to experience normal temperatures.

Precipitation across Canada throughout November and December varied considerably. In British Columbia, the centre of the province received high to extremely high precipitation while the southern area was below-average. Vancouver Island received extremely low precipitation. Dryness was also experienced across the southern portion of the Prairie region, with southern Manitoba recording extremely low precipitation. The above-average to record crop, while very welcome, has also helped to deplete soil moisture. This is particularly concerning in southern Manitoba, as the area was abnormally dry heading into winter. Conversely, the area between Calgary and Edmonton in Alberta and stretching up into the Peace District of British Columbia received very high to record precipitation, and the area north of Saskatoon, Saskatchewan was also very wet. This extra snow should help to recharge the areas with currently dry soils. As usual, spring weather conditions will be a large factor determining the amount of runoff that is absorbed by the soil and the risk of flooding.

The agricultural areas in Ontario and Quebec received low to mid-range precipitation in November and December, while Atlantic Canada received above-average precipitation. On December 22, 2013, a major ice storm hit the Central and Atlantic regions, with the bulk of the damage occurring in southern Ontario. About 350,000 people in Ontario and another 120,000 in Quebec were without power. The storm caused around $106 million in damages, but agricultural impacts were minimal, damaging some sugar maple and apple trees as well as resulting in limited disruptions to dairy operations due to power outages. The January temperature forecast is for above-normal temperatures in Ontario and the Atlantic region and below-normal temperatures in Quebec.

The Environment Canada three-month winter forecast for the months of February to April predict colder than normal winter across much of Canada. Normal temperatures in British Columbia, and below-normal temperatures across the Prairie, Central, and Atlantic regions are expected (Figure 15). The three -month precipitation forecast is for above-normal precipitation in south and central Alberta as well as in southern Nova Scotia (Figure 15). If the precipitation forecast holds true, this could further recharge the abnormally dry soils in east-central Alberta. Note however that this year's forecasts have a low confidence level as the signals from ocean temperature models upon which they are based are weak.

Figure 15: EC Temperature and Precipitation 3-Month Forecasts, February to April 2014



Summary

According to Environment Canada's preliminary records, 2013 was the 16th warmest year in Canada since 1948, and the 2013 national average temperatures were recorded at 0.8 degrees Celsius above normal. The Pacific region was particularly warm with temperatures averaging 1.3 degrees Celsius above normal. Despite the flooding and excess moisture that impacted Alberta and Ontario, Canada as a whole was 6 percent drier than usual in 2013, making it the 13th driest year on record since 1948. It was particularly dry in British Columbia, especially along the Pacific coast where precipitation was 25 percent below average. Northern Alberta and southern Manitoba were also drier than average. The Great Lakes and St. Lawrence areas in the Central region were the only places that were notably wetter than usual, as precipitation was 12 percent above average.

Throughout the 2013 agricultural year, there were minimal climate related risks to agriculture (see Appendix A for a summary graphic of the year). The most significant risk in the spring was the late snowmelt and subsequent flooding in the Prairie region that delayed seeding and crop development. In the summer, the most significant climate-related risks were flooding and excess moisture in Manitoba and the Central region, and disease in the Atlantic region. The 2013 fall season was remarkably free of significant risks. However of note, by late fall, dry conditions developed in the Prairie region and lowered soil moisture heading into winter.

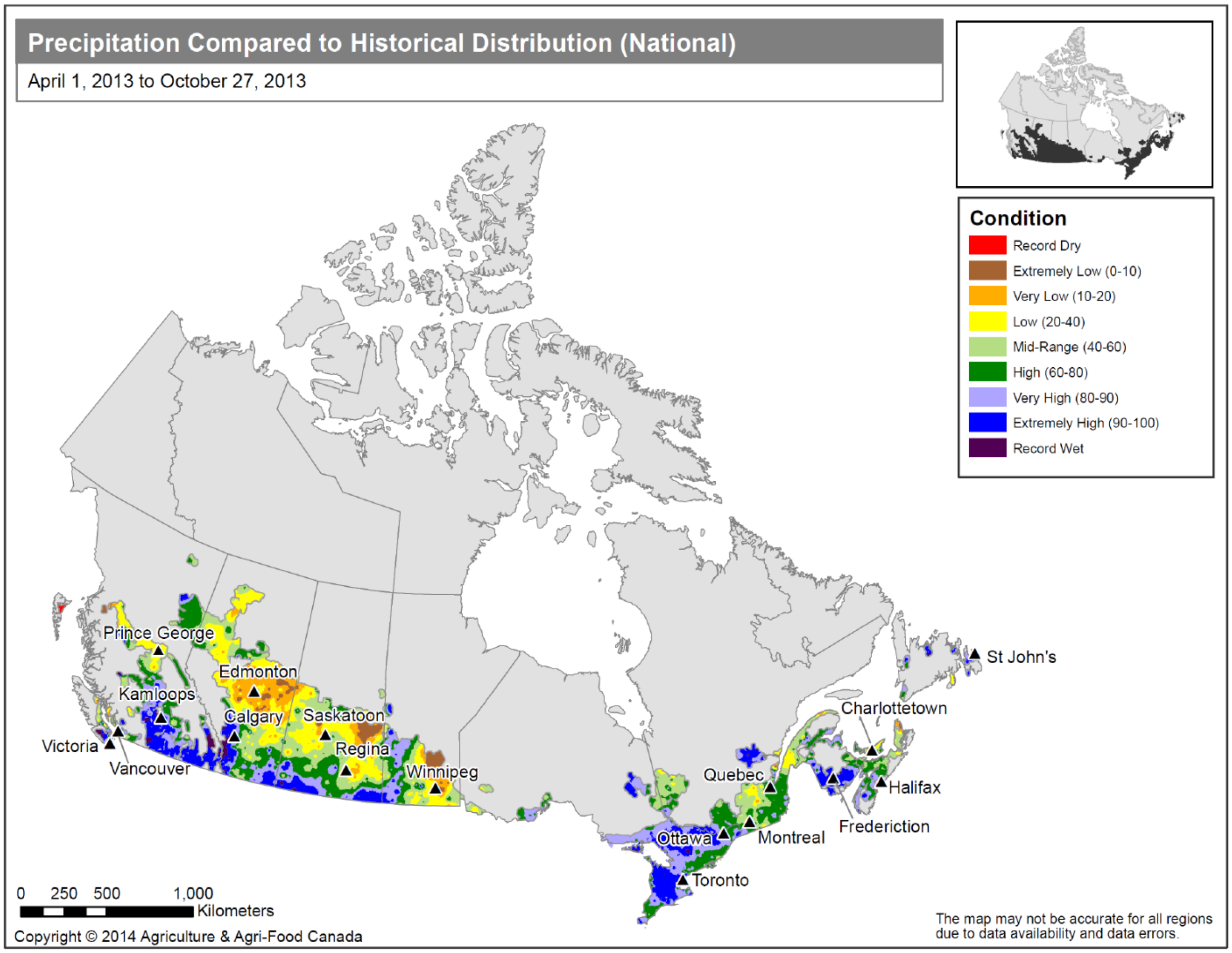
Compared to 2012, dry and drought conditions had little agroclimate impact in 2013. By the end of the 2013 growing season, 13 percent of Canadian agricultural areas were considered very dry to record dry, due to a lack of precipitation throughout the fall season (Figure 16). After a wet growing season, this dryness was beneficial for crop development and harvest. By contrast, the 2012 growing season saw drought conditions concentrated in Ontario and Quebec that peaked at three different times: late April, mid-July, and early September. This caused problems for crop development throughout the season and impacted a much larger number of producers than in 2013, when 10,040 farms (down from 22,800 in 2012) and around 1.5 million cattle (down from 2.1 million in 2012) were negatively affected (Figure 16). Fall precipitation in 2012 recharged the soil moisture in Ontario and Quebec, improving conditions heading into the 2013 growing season.

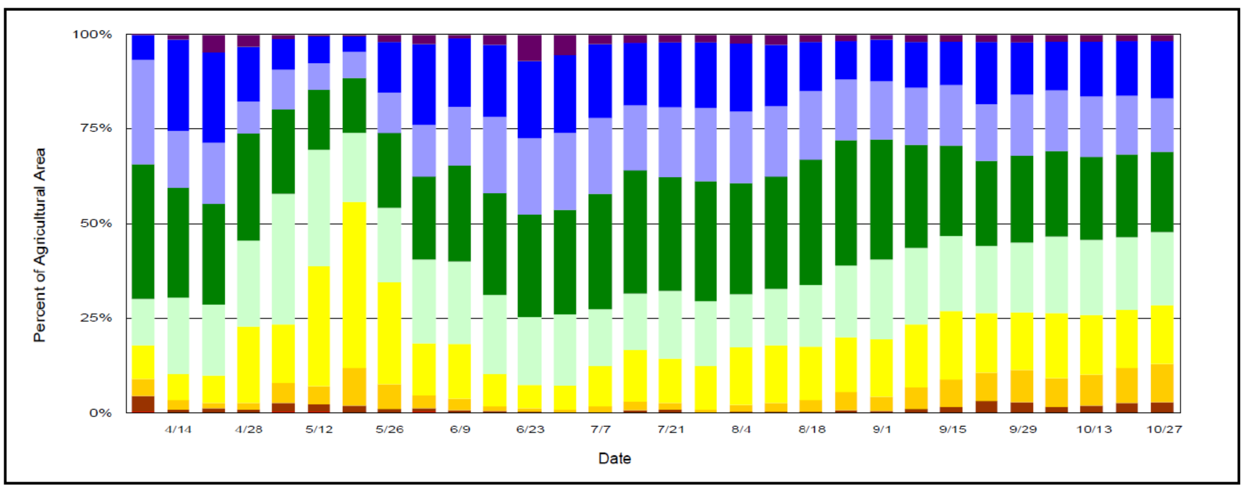
The more significant agroclimate impacts in 2013 were from flooding and excessive moisture, and approximately 31 percent of agricultural areas in Canada were considered to be very wet to record wet—up from 19 percent in 2012. This affected 27,310 farms (up from 16,100 in 2012) and more than 3.6 million cattle (up from 2.7 million in 2012) (Figure 16).

The 2013 agricultural season was noteworthy because there were no significant agroclimate impacts, despite less-than-ideal conditions heading into the start of the growing season. While there were several significant weather events—such as the highly publicized floods in Calgary and Toronto—these events did not significantly impact agriculture. Crop production was above-average to record in the Prairie region, average to above-average in the Pacific region, and average in the Central and Atlantic regions. Yields were so high in the Prairie region that storage and transportation issues arose. In Eastern Canada, Ontario and Quebec dealt with wet, cold weather but managed to achieve average crop production, while excellent fall conditions led to an above-average harvest in the Atlantic region. Also reflecting the positive year, on the livestock side, conditions did not warrant tax deferral designations anywhere in Canada for either droughts or excess moisture. This is a rare occurrence, and in the 25-year history of the Livestock Tax Deferral provision, the situation where no designations are made anywhere in Canada has occurred only a couple of times. As an interesting statistic, note that, in the 30-year period 1980 to 2010, Canada has experienced 20 years with drought and 6 years with floods on agricultural land, so years without one or the other are the exception.

Environment Canada forecasts for February to April 2014 predict normal temperatures in British Columbia and below-normal temperatures across the Prairie, Central, and Atlantic regions (Figure 15). The precipitation forecast predicts above-normal precipitation in south and central Alberta and southern Nova Scotia (Figure 15). Both the temperature and precipitation forecasts for this winter have a low confidence level associated with them as the signals from ocean temperature models upon which they are based are weak.

Figure 16: Precipitation Compared to Historical Distribution to October 27, 2013 and Corresponding Statistics





	Record Dry			Extremely Low (0-10)			Very Low (10-20)			Low (20-40)		
Date	Area (%)	Farms (000)	Cattle (000)	Area (%)	Farms (000)	Cattle (000)	Area (%)	Farms (000)	Cattle (000)	Area (%)	Farms (000)	Cattle (000)
2013-10-20	0.06	0.05	7.72	2.45	1.66	270.94	9.25	7.33	1107.47	15.56	13.09	2131.58
2013-10-27	**0.17**	**0.07**	**9.76**	**2.60**	**1.84**	**291.10**	**10.09**	**8.13**	**1203.96**	**15.62**	**14.14**	**2092.12**

	High (60-80)			Very High (80-90)			Extremely High (90-100)			Record Wet		
Date	Area (%)	Farms (000)	Cattle (000)	Area (%)	Farms (000)	Cattle (000)	Area (%)	Farms (000)	Cattle (000)	Area (%)	Farms (000)	Cattle (000)
2013-10-20	22.08	21.63	3198.91	15.32	13.07	1819.96	14.72	14.64	1854.72	1.61	0.45	70.13
2013-10-27	**21.29**	**20.06**	**3151.57**	**13.90**	**12.07**	**1616.00**	**15.34**	**14.68**	**1923.96**	**1.68**	**0.56**	**88.38**

These statistics were generated by comparing the Statistics Canada's 2006 Census of Agriculture dataset with AAFC's Precipitation Compared to Historical Distribution map. The climate data are provided through a partnership between Environment Canada, Natural Resources Canada, and many Provincial agencies.

Appendix A: Summary of 2013 Agroclimate Conditions

	BC	AB	SK	MB	ON	QC	ATL
Nov. 5, 2013	**1**	**1** low soil moisture	**1** low soil moisture	**1** (low soil moisture)	**1**	**1**	**1**
Oct.1, 2013	**1**	**1** wind	**1** wind	**1**	**1**	**1**	**1**
Sept. 17, 2013	**1**	**1** (frost)	**1** (frost)	**1** (frost)	**1** low temps, frost	**1** (frost)	**1**
Sept. 4, 2013	**1**	**1**	**1**	**1**	**1**	**1** (frost)	**1**
Aug. 20, 2013	**1** dry, hail	**1**	**1**	**1**	**1** low temps	**1**	**1**
Aug. 7, 2013	**1** dry	**1** disease, hail, frost	**1** low temps, disease	**1** low temps, disease	**1**	No Report	**1**
July 23, 2013	**1** dry	**1** storms, hail, wind, (disease)	**1** storms, hail, tornadoes, (disease)	**2** storms, hail, tornadoes	**1**	**2** excess moisture	**1**
July 9, 2013	**1** heat	**1** hail, excess moisture, (disease)	**1** excess moisture	**2** flooding	**2** flooding, (disease)	**2** excess moisture, (disease)	**1** disease
June 25, 2013	No Report	**3** flooding, (disease)	**2** excess moisture	**3** flooding, (disease)	**2** flooding	**2** excess moisture	**2** disease
June 11, 2013	No Report	**1**	**1**	**1** flooding	**1**	**2** excess moisture	**2** excess moisture, disease
May 28, 2013	**2** flooding, fire, insects	**1**	**1** flooding, delayed seeding	**1** flooding, delayed seeding	**1** frost	**2** winter kill, frost, flooding	**1** disease
May 14, 2013	**1**	**1**	**2** flooding, delayed seeding	**2** flooding, delayed seeding	**1**	**1**	**1**
Apr. 30, 2013	**1**	**1**	**3** flooding, delayed seeding	**3** flooding, delayed seeding	**1** flooding	**1**	**1**
Apr. 16, 2013	**1**	**1**	**3** (flooding, delayed seeding)	**3** (flooding, delayed seeding)	**1**	**1**	**2** disease
Apr. 3, 2013	**1**	**1**	**2** (flooding)	**2** (flooding)	**1** dry	**1**	**1**
Mar. 12, 2013	**1**	**1**	**2** (flooding)	**2** (flooding)	**1** drought	**1**	**1** dry
Nov. 6, 2012	**1**	**2** dry	**2** dry	**3** drought	**2** rain, wind	**1**	**2** rain, wind

[1]No Significant Risk; [2]Low Risk; [3]Moderate Risk; [4]High or Urgent Risk
Text not in brackets indicates the event was currently occurring at the time of the report.
Text in brackets indicates a potential risk.

Appendix B: AAFC Map Products Referred to in this Report

AAFC National Agroclimate Information Service (NAIS)

Agroclimate Impact Reporting (AIR) Maps

AIR maps are based on monthly input from a volunteer network of producers, primarily in the Prairie region. Each map represents an aspect of the impacts of various weather-related risks to agriculture for any given month throughout the growing season (April to October). NAIS compiles the data and interpolates the results using geospatial techniques. The accuracy of each map varies by region based on the number of participating producers and the density of reporters across the agricultural landscape.

To view all maps produced from monthly volunteer surveys, please visit the AIR pages on AAFC's website at: **www.agr.gc.ca/air**

Precipitation & Temperature Maps

The suite of precipitation and temperature maps cited throughout this document are produced with data from federal and provincial climate monitoring networks, consisting of more than 2000 climate stations. NAIS applies a system of automated and manual quality control to the data to ensure suitable value for agricultural products. Map accuracy varies by the number of stations in a particular region, the instrumentation used, and the quality of the data received.

To view these maps and other related products produced by the National Agroclimate Information Service, please visit the Drought Watch pages on AAFC's website at: **www.agr.gc.ca/drought**

Canadian Drought Monitor (CDM) Maps

A consolidated map of drought extent and intensity for all of Canada is produced monthly. Analysis includes a review of all available data from numerous federal and provincial agencies, and interpretation by NAIS using a draft classification system. Drought intensity categories are assigned based on analysis and weighted formulas. The resulting output provides direct input into the larger North American Drought Monitor (NADM) map. The Drought Monitor summary map identifies general drought areas, labeling droughts by intensity, with D1 being the least intense and D4 being the most intense. Areas classified as D0 are drought watch areas—either drying out and possibly heading for drought, or are recovering from drought but not yet back to normal, suffering long-term impacts such as low reservoir levels.

For more information, visit the North American Drought Monitor (NADM) website:
http://www.drought.gov/nadm/

AAFC Earth Observation

Percent Saturated Surface Soil Moisture from SMOS Satellite Data

Satellite surface soil moisture maps are created by averaging daily measurements using the Soil Moisture and Ocean Salinity (SMOS) satellite mission launched by the European Space agency in 2009. Soil moisture is calculated from the satellite signal and represents moisture conditions in the top 1-5 cm of the soil profile. The satellite depicts volumetric soil moisture, which is the fraction of the soil that is water, as opposed to solid material or air (pore) space. The soil moisture from SMOS has been found to compare well with ground truth measurements, with SMOS consistently underestimating soil moisture but capturing the general wetting and drying trends that are found. Results for areas where land cover is densely vegetated (i.e. forested) or in highly mountainous areas are less accurate than cropland/grassland and bare soil areas. Soil moisture where soils are frozen cannot be measured from a satellite sensor such as SMOS.

Acknowledgements

We acknowledge and thank the following groups and organizations whose reports and data were utilized to produce this 2013 Annual Review of Agroclimate Conditions Across Canada:

- AAFC's Agroclimate Impact Reporting network of volunteer producers and industry representatives that are consulted monthly to obtain agroclimate impact information
- Environment Canada, Natural Resources Canada, and the multiple provincial agencies that provide climate data for the maps that appear on Drought Watch

Seasonal forecast information was obtained from:

- Environment Canada
- International Research Institute for Climate and Society
- National Oceanographic and Atmospheric Administration (NOAA): National Weather Service, Climate Prediction Center