Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

2015 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 2015 agricultural year.

Canada

Annual Review of Agroclimate Conditions Across Canada, 2015

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Table of Contents

Table of Figures

Overview

This report summarizes the variable weather conditions and agroclimate impacts across Canada during the 2015 growing season. It also provides a seasonal forecast from February to April 2016.

Globally, 2015 was the hottest year on record, replacing 2014 as the previous record-holder[1]. Climate phenomenon such as El Niño and a mass of warm water called "The Blob" in the Pacific Ocean interacted to push warm air inland and deflect low pressure systems north. In Canada, this resulted in a challenging growing season. Damage from spring frosts, a severe drought, and rain during harvest reduced crop yields and quality, and caused significant livestock feed and agricultural water shortages. Yields of 2015 field crops were, however, near or above the 10-year averages.[2]

Specifically by region, the Pacific Region (British Columbia) experienced an abnormally hot and dry growing season with a drought that peaked in mid-August. These conditions contributed to reduced stream flows and availability of water for irrigation and feed supplies in many areas of the province. Irrigation helped mitigate drought impacts, and final crop yields and quality were better than expected although grain, forage, oilseed and livestock producers experienced a below-average production year.

In the Prairie region (Alberta, Saskatchewan, Manitoba), an increasingly warm spring led to mild drought conditions which continued to deteriorate to severe drought conditions by mid-summer. Just enough precipitation arrived just in time - in spring for Manitoba and south-west Saskatchewan and starting in mid-summer in Alberta - to prevent crop failure, but yield reductions were observed in earlier-seeded crops. By late summer, Alberta had declared a state of agricultural disaster. Precipitation in the fall alleviated significant moisture deficits but made harvest challenging and degraded quality in later-seeded crops. Heat advanced crop maturity over the summer, and periods of dry conditions over the fall allowed for a timely harvest. Overall, yields were below-average in Alberta, and near-average in Saskatchewan and Manitoba.

The Central region (Ontario and Quebec) experienced an average growing season in spite of weather-related delays. Drought did not materialize as feared in the spring. Instead, cool temperatures and above-normal precipitation caused seeding delays in spring and early summer. Heat waves in the summer progressed crop development and a long, warm fall compensated for spring delays in crop maturity. Harvest progressed in a timely manner and was complete by the end of November. Overall yields were near to above-average.

The Atlantic region (Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland) received significant winter snowfall and a cold, wet spring that delayed seeding and crop development. Winterkill was the most significant impact to producers across the growing season. Like the Central region, hot and dry conditions later in summer made up for springs delays. Fall weather was mild and, other than some precipitation in early October, harvest progressed normally. Overall yields and the quality of most crops was near to above-average.

Drought was the most significant climate-related risk in 2015 and caused severe livestock feed shortages in the Pacific and Prairie regions. These conditions prompted an early announcement of the federal livestock tax deferral provision available to producers who were forced to reduce herd sizes due to drought or excess moisture conditions. On July 24th, 351 regions were announced in southern and coastal British Columbia, and in Alberta, south-west Saskatchewan and northern Manitoba.

Early global forecasts indicate 2016 may be even warmer than 2015[3]. El Niño continues and the forecast is for it to last at least into spring. The Environment Canada forecast for February through April is for above-average temperatures, particularly in the Pacific and Atlantic regions. If the forecast proves accurate, over-wintering crops and pastures will benefit from the mild conditions, but there is a risk from some lingering soil moisture deficits in western Canada.

[1] NOAA National Centers for Environmental Information. "State of the Climate: Global Analysis for December 2015." Available online from http://www.ncdc.noaa.gov/sotc/global/201512
[2] Statistics Canada. "Canada: outlook for principal field crops, December 18, 2015." Available online at http://www.agr.gc.ca
[3] UK Met Office. "2016 global mean temperature forecast." Available online at http://www.metoffice.gov.uk/news/releases/archive/2015/global-temperature

Conditions leading into the 2015 Growing Season

The 2014 growing season was cool and wet, and was followed by a warm fall with precipitation and unseasonal frost events that degraded crop quality and disrupted harvest. Flooding through the spring and summer resulted in lost acreage and re-seeding, and by the end of October, approximately 72 per cent of Canada's agricultural land had received high to record high levels of precipitation. Details on these events can be found in the 2014 Annual Review of Agroclimate Conditions Across Canada, available on the Government of Canada publications website (www.publications.gc.ca).

In the 2014 fall season, the southern regions across the country received average to above-average precipitation, resulting in adequate soil moisture heading into winter. Northern Alberta and southern Manitoba received below-average fall precipitation and had poor soil moisture at the start of winter. At the end of November, the Canadian Drought Monitor showed moderate drought in northern and north-central British Columbia and Alberta, and southern Manitoba (Figure 1).

The fall featured warm temperatures in western Canada and the Atlantic region and below-seasonal to near-seasonal temperatures in the Central region. Early frost events in September damaged crops in all regions of Canada, particularly in the Atlantic and Central regions. Alberta had a widespread record snowfall event in early September that damaged crops and downgraded quality. Precipitation, excess moisture and frost delayed harvest into December in the Central and Atlantic regions, particularly for corn and soybeans.

Winter precipitation throughout much of British Columbia and northern parts of the Prairie region was above-normal, with the southern Prairie provinces receiving near-normal amounts. Manitoba received very low precipitation compared to normal, with much of the agricultural region receiving very low to record low winter amounts (Figure 2). In the late winter and early spring months, precipitation was below-average across much of the Prairie region. Winter temperatures 1 to 4 degrees above-normal meant that most precipitation fell as rain rather than snow in British Columbia, reducing the snow pack and spring runoff potential (Figure 3). At the end of March, early signs of the potential for drought were evident. While the snowpack was variable across the west, south-west British Columbia, southern Alberta, the Rocky Mountains, the northern Peace region and eastern Manitoba had below-normal accumulations that contributed to below-normal spring runoff in many basins. Provincial authorities in British Columbia and Alberta reported a below-average mountain snowpack. Soil moisture deficits were present in western and south-west Saskatchewan. Growing conditions were approximately a month ahead in British Columbia.

In the Central and Atlantic regions, temperatures 1 to 3 degrees Celsius below-normal through the winter (Figure 3) damaged crops including tender fruit trees, grapevines and winter wheat. The Central region received record low precipitation (40 to 85 per cent of normal) between November and March while Atlantic Canada received record highs (115 and 150 per cent of normal) in the same time period (Figure 2). Many areas across the Atlantic region received accumulated precipitation above 500 mm and a number of snowfall records were broken in New Brunswick and Nova Scotia. Cool temperatures and excessive snow resulted in above-average winterkill, significantly decreased maple syrup production and caused millions of dollars in damage to greenhouses.

As spring approached, the two main risks to agricultural production across Canada were the potential for drought in the west, and flooding in the east. After a cold and wet winter, producers in the Atlantic region faced a spring with a high risk of flooding, limited field access and delayed planting; above-normal temperatures in the west increased the potential for drought, particularly in the Pacific and Prairie regions.

Figure1: Canadian drought conditions at the end of November 2014

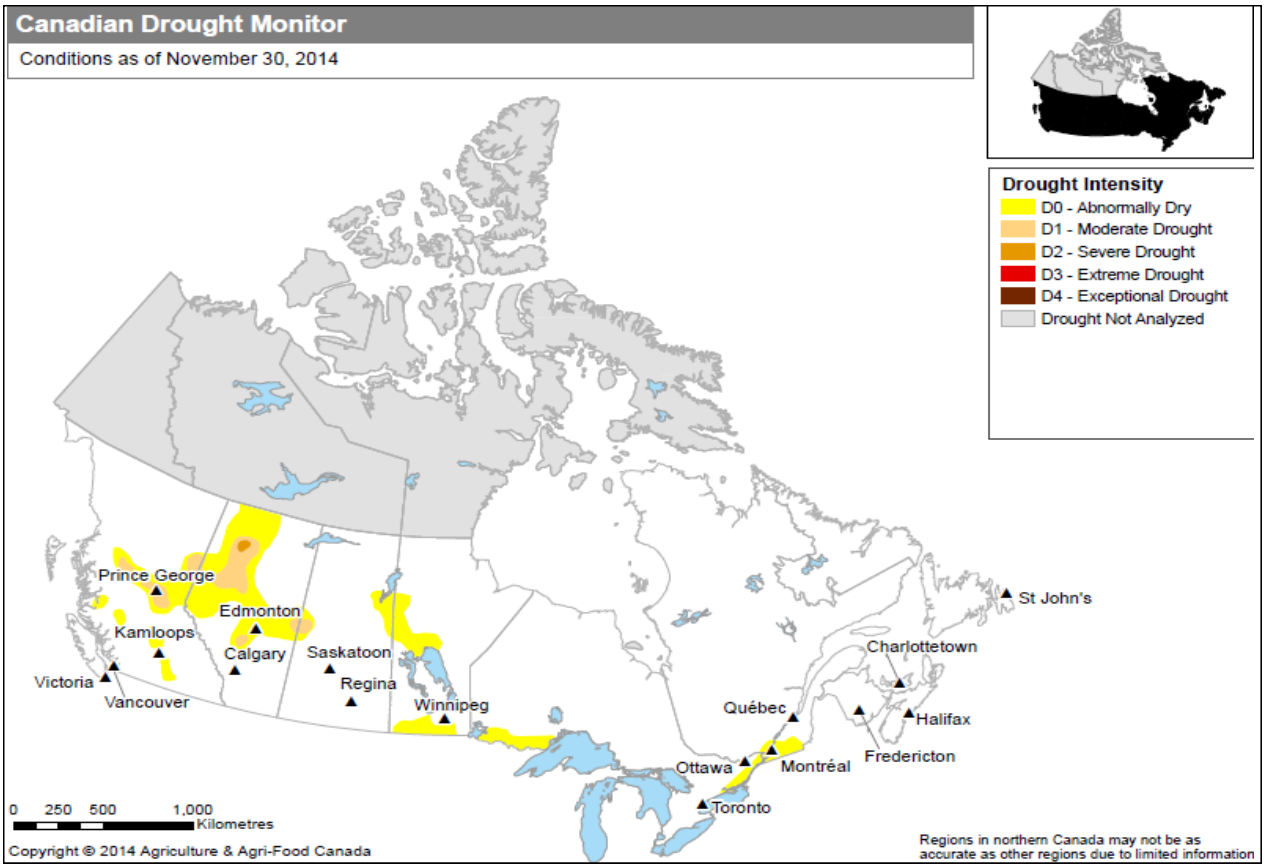


Figure 2: Winter 2014-2015 precipitation compared to historical distribution

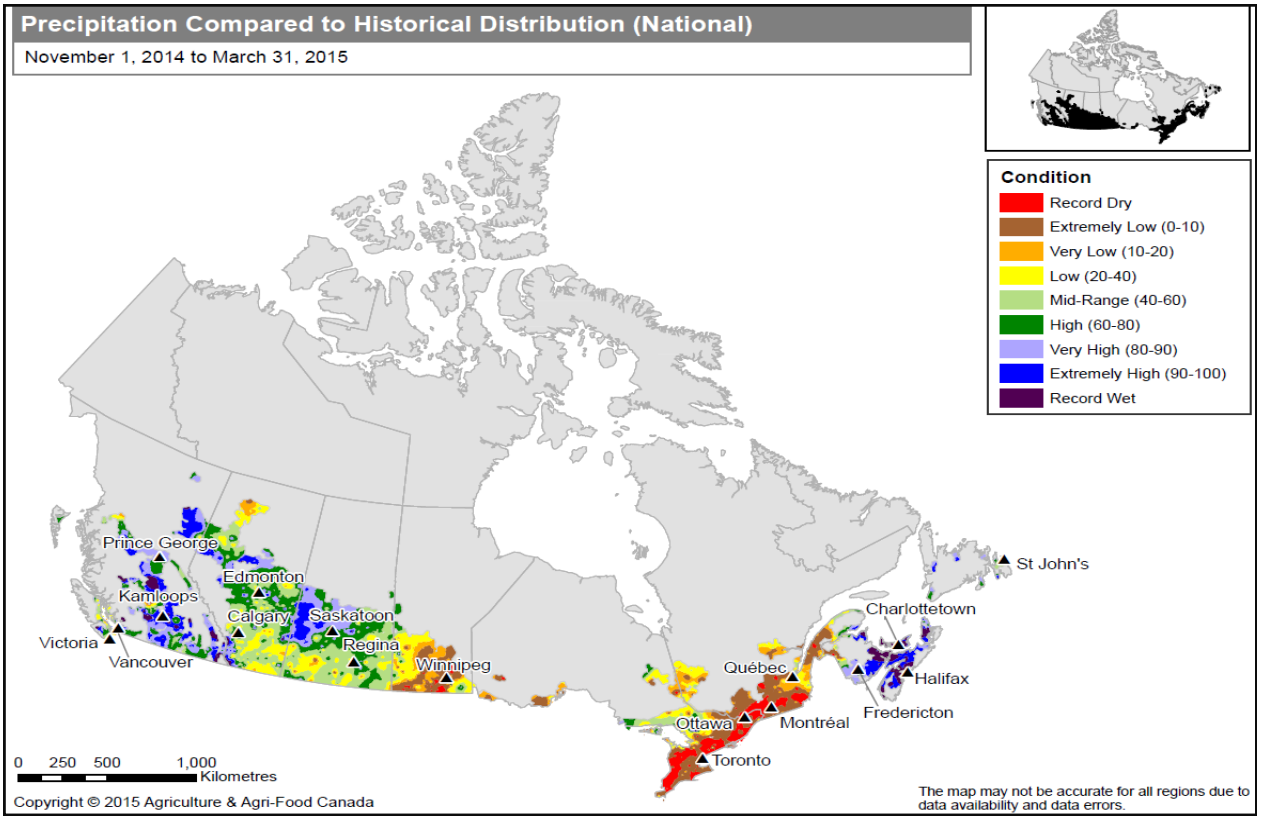
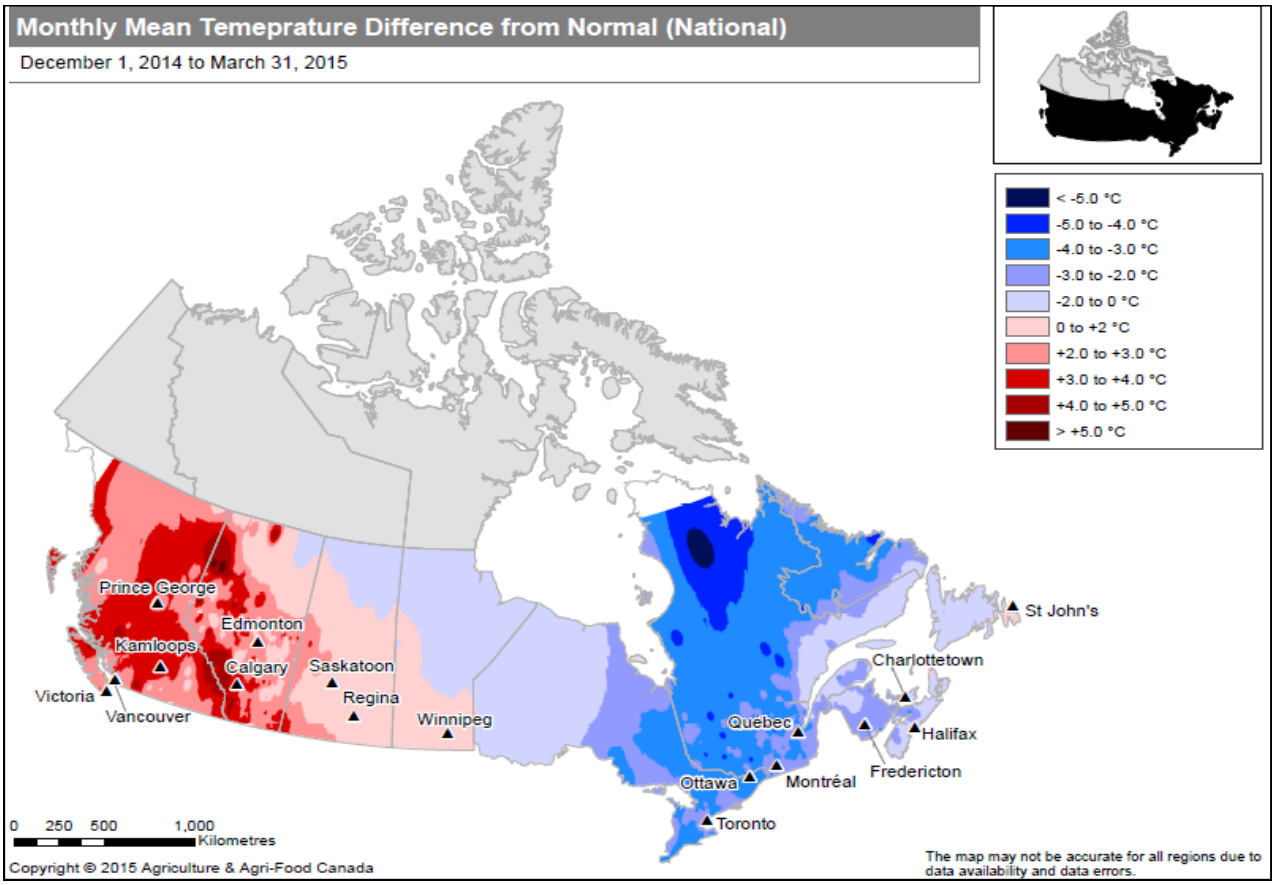


Figure 3: Mean temperature difference from normal, December 1, 2014 to March 31, 2015



Spring 2015 (April - June)

The Pacific and Prairie regions benefitted from a relatively mild start to the growing season with low incidence of spring flooding. Spring in the Central and Atlantic regions began with significant risks to production from cool and wet conditions, and a severe risk of flooding. In the west, agroclimate conditions worsened through the spring, as frosts led to re-seeding and persistent warm and dry conditions increased the risk for drought. The opposite was true in eastern Canada, and the significant risks to production from cool, and wet conditions and flooding declined as the season progressed.

The growing season began early in western Canada, and spring seeding operations were mostly completed one to two weeks ahead of the long-term average. Generally, above-normal temperatures facilitated earlier-than-normal seeding across the Prairie region, particularly in the south, although there were minor delays due to insufficient moisture in southern Alberta and south-west Saskatchewan. In May however, Manitoba and eastern parts of Saskatchewan experienced some weeks of below-normal temperatures and frosts that damaged early-seeded crops and led to re-seeding, particularly of canola. Despite this, the majority of cropland (68 to 89 per cent) was planted by the end of the month in the Prairie region, a large improvement from the previous year (22 to 60 per cent). Seeding and crop development in the Pacific region remained a week to several weeks ahead of normal through the spring.

In contrast, record winter precipitation and a wet and cool spring delayed seeding by a month in the Central and Atlantic regions. Temperatures were below-normal across April (Figure 4), and rainfall and snowmelt caused flooding and excess soil moisture (Figure 5). Maple syrup producers experienced field access issues through the winter and into spring, apple producers were unable to access orchards for pruning, and the ground was too wet to plant potatoes. While planting was largely still delayed at the beginning of May, warm temperatures in central and western Nova Scotia allowed some field operations to progress.

The Central region also experienced a wet spring season that delayed planting. Although the region was dry in the fall and winter, near-normal precipitation with monthly accumulations around 50 mm replenished soil moisture deficits and left soils too wet to plant. Combined with cool temperatures, operations were approximately two weeks behind in Ontario and a week behind in Quebec by the end of April. A surge of warm temperatures in early May greatly expedited seeding operations which enhanced crop development.

By the end of May, the risk to agricultural production from excess moisture had declined in the east, while drought concerns had increased in the west. Due to record temperatures, the potential for drought emerged earliest in the Pacific Region. A below-normal snowpack, particularly in the mountains and south-west, and rapid snow melt reduced the availability of water supplies for irrigation later in the season. Temperatures were above-normal in April and increased to much-above normal (2 to 5 degrees Celsius) in May and June. Compounding this, precipitation was much below-normal (40 to 85 per cent of normal) across most regions.

Comparatively, the Prairie region was drier and cooler than the Pacific region. These conditions allowed early seeding but slowed hay and pasture growth and set the stage for more severe drought as the growing season progressed. Although the snowpack and spring soil moisture were variable across the region, some areas were particularly dry, including the northern Peace region, central and southern Alberta, southern Saskatchewan and southern Manitoba. Incidences of flooding were low, with the exception of the Quill Lakes area and central Saskatchewan where flooding resulted in unseeded cropland and the evacuation of some livestock. At the end of May, the Canadian Drought Monitor was showing abnormally dry conditions across much of western Canada, with a large area of 'moderate' (D1) and 'severe' (D0) drought in southern British Columbia, on either side of the Alberta-Saskatchewan border, northern Alberta and southern Manitoba (Figure 6).

Figure 4: Mean temperature difference from normal, April 2015

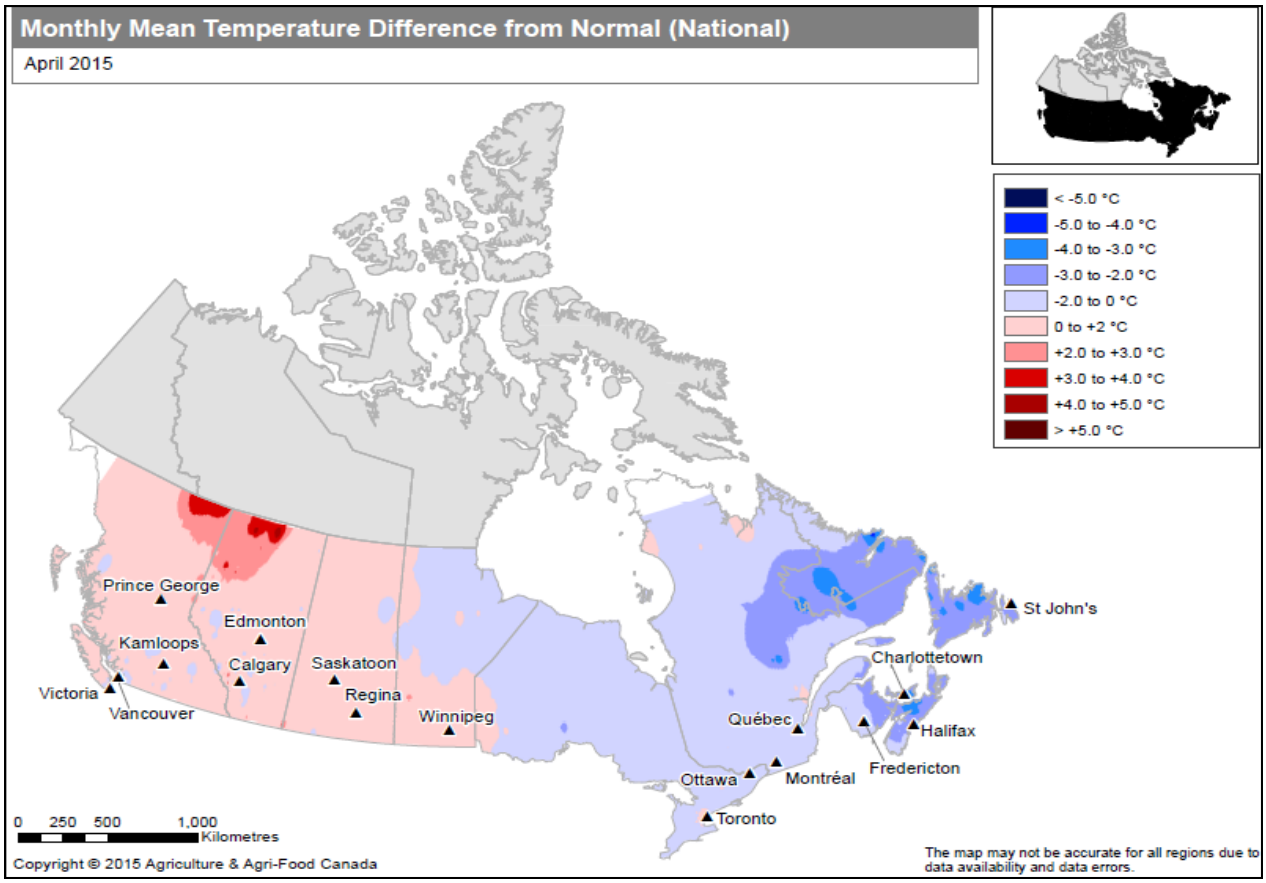


Figure 5: Difference from normal surface soil moisture, April 27 to May 10, 2015

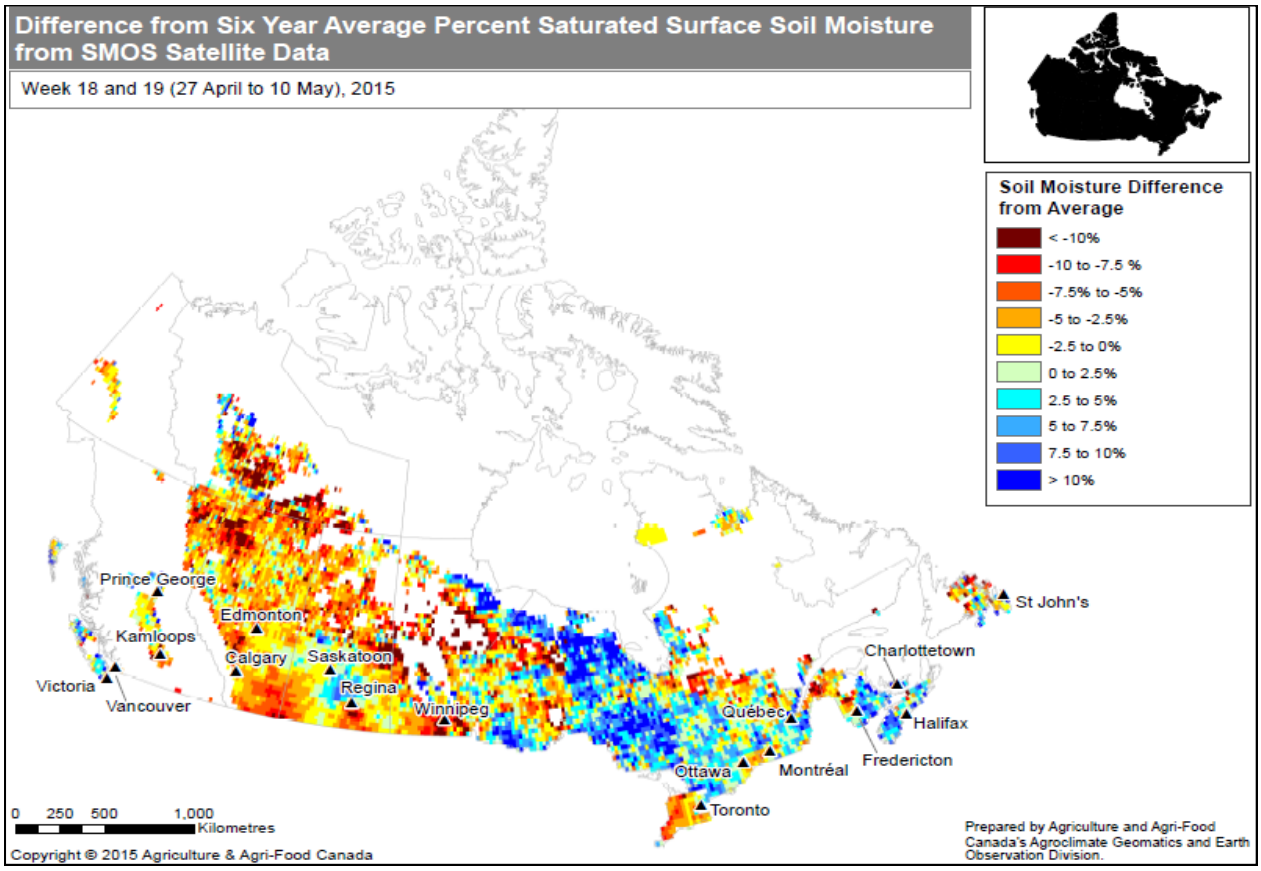
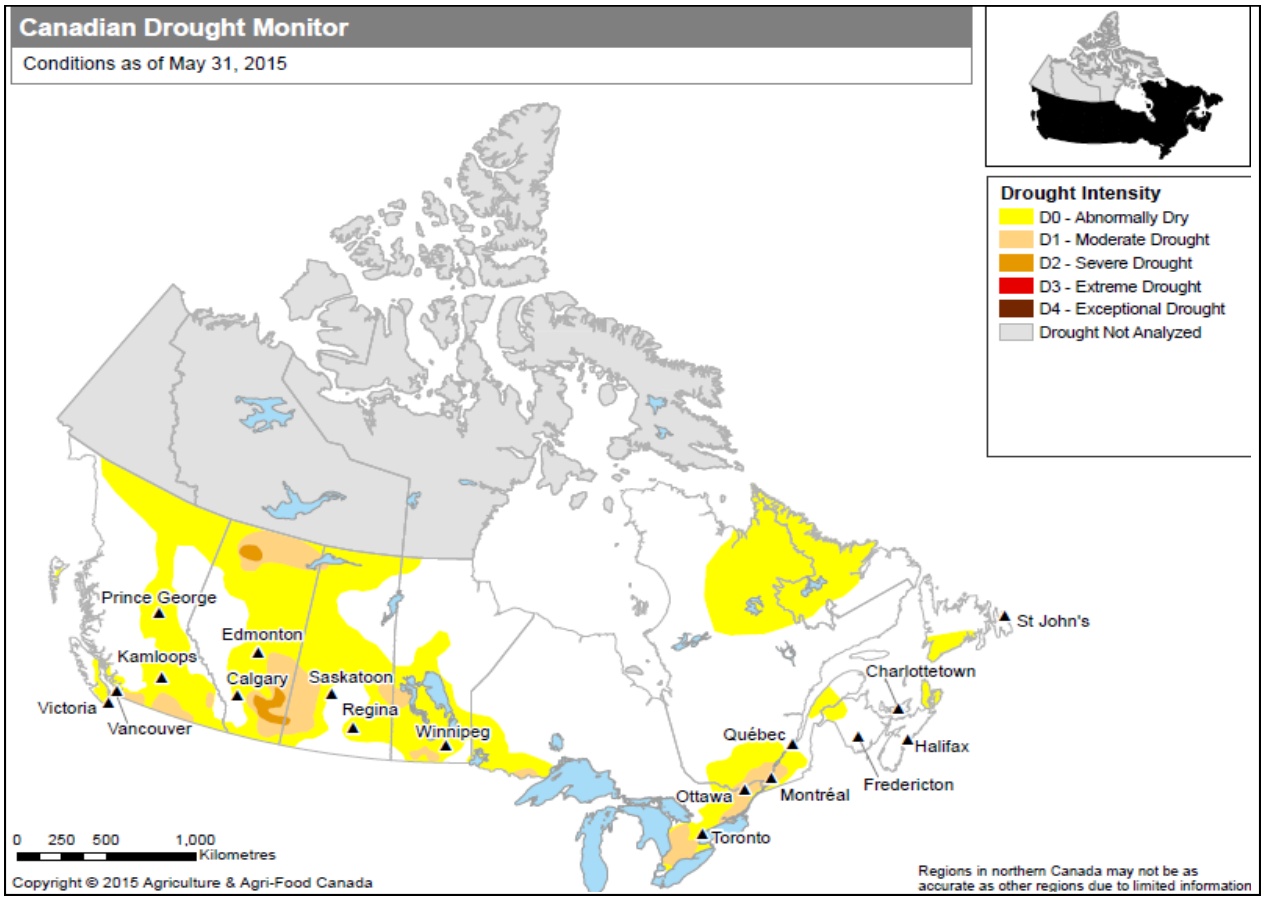


Figure 6: Canadian drought conditions at the end of May 2015

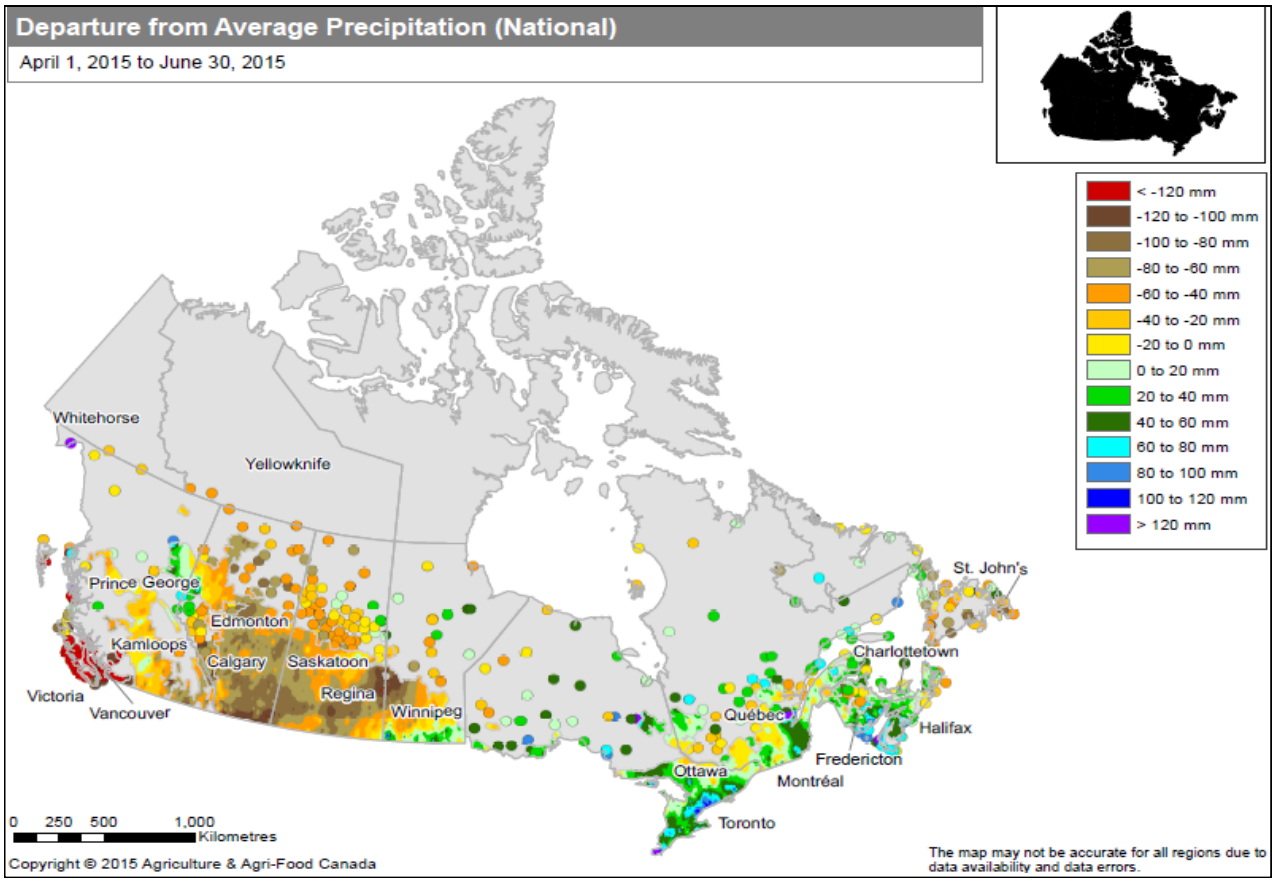


In the Central region, warmer temperatures and drier conditions in May advanced seeding progress to near-normal, but crops were slow to develop due to dry conditions. Crops in central and northern regions, including asparagus in Ontario, vineyards in the Sherbrooke region of Quebec and blueberries in Saguenay-Lac-Saint-Jean, were damaged by frost. In the Atlantic region, excess moisture problems were eased by above-normal temperatures, which reduced seeding delays to two or three weeks except in northern New Brunswick where operations were delayed by a month.

Overall, most seeding in eastern Canada was completed by mid-June. Seeding that remained, including the planting of late-season crops and field activities, was further delayed in June by wet conditions. Most of the Central and Atlantic regions received more than 115 per cent of normal precipitation over the month, and southern Ontario and Nova Scotia were particularly wet. Localized incidences of excess moisture and flooding occurred across both regions. In the Central region, 40 per cent of the corn and soybean planting was delayed by excess moisture in south-west Ontario, while flooding damaged 865 acres of crops and infrastructure (estimated $1.2 million in damages) in the Estrie region of north-west Quebec. Wet field conditions and flooding were also present in Amherst, Nova Scotia and Sackville, New Brunswick. The risk to production from excess moisture was short-lived however. Delays in field operations were reduced to a three week delay in May and were near-normal by the end of June.

In western Canada, drought was prevalent by the end of June and significant moisture deficits existed across the region. Since April 1st, most of the Prairie region and eastern British Columbia were showing deficits between 60 mm to 100 mm, with the southern coast of British Columbia showing deficits greater than 120 mm (Figure 7). At the same time, rain in June began to recharge moisture reserves in some areas; the south-west Peace region and southern Manitoba had received surplus precipitation of up to 40 mm (Figure 7).

Figure 7: Departure from normal precipitation, April 1 to June 30, 2015

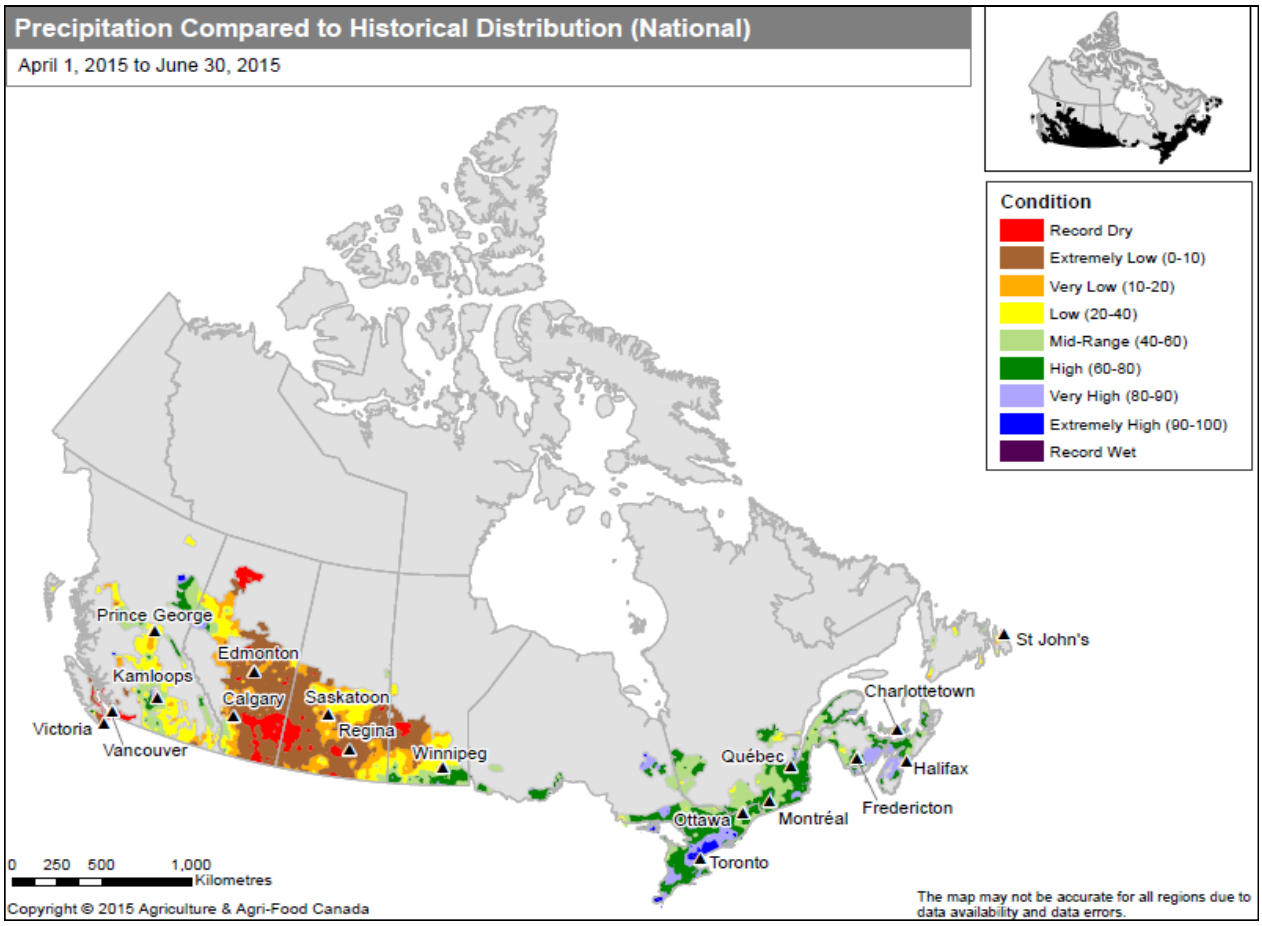


The Pacific region faced the driest June on record for the coastal and southern regions, and set 64 new temperature records. Several extreme-low streamflow advisories, extreme wildfire risk ratings and high provincial hydrological drought class ratings were in place by the end of the month. In the Prairie region, Alberta reported the most intense drought conditions. According to Provincial authorities, the northern Peace River region, located north of Edmonton, and south-central Alberta, experienced 1-in-25 year drought conditions, or worse. Soil moisture was also in very low supply in western Saskatchewan for crop and hay lands. Forages and pastures in north-west Manitoba also experienced moisture stress. There was difficulty completing seeding in some areas due to the dry conditions.

In June, crops in western Canada began to show signs of moisture and heat stress. Crop development was uneven across the region; warm weather advanced the development in some areas while in others, cool or dry conditions delayed growth. In British Columbia, dryland crops in coastal regions were beginning to show signs of heat stress. In the Prairie region, drought conditions led to poor emergence of re-seeded canola in north-west Manitoba and the majority of crops and hay in Alberta was rated significantly below the 5-year average. There was inadequate forage production in the north-west and central regions.

By the end of the spring season, the dominant risk to production was the intensifying drought in western Canada. As of June 28th, approximately 55 per cent of the agricultural area in Canada was experiencing low to record low precipitation since the beginning of the growing season (April1st). This represented approximately 8.6 million cattle and 44,000 farms (Figure 8). In eastern Canada however, conditions had improved during the spring. Agricultural operations had caught up to normal after the cool, late start to the growing season and were in stable condition heading into summer.

Figure 8: Precipitation compared to historical distribution, April 1 to June 30, 2015



Summer 2015 (July - August)

Drought worsened in the Pacific and Prairie regions during the summer season, resulting in poor pasture growth, reduced water availability for agriculture and increasing the potential for crop failure. Timely rains in mid-summer began to alleviate dry conditions, first in Manitoba and south-east Saskatchewan, then at the end of summer in Alberta, and later still in British Columbia. The Central and Atlantic regions generally received mild weather, with the lasting effects of excess moisture causing some minor operational delays and degrading crop quality.

Drought intensified in parts of Alberta and British Columbia during July and August, and vegetation was under severe moisture and heat stress (Figure 9). Risk of crop failure in some regions was high and many producers were significantly concerned for crop and forage outlooks. Severe moisture deficits existed through most of the region in July and remained well into the fall for many areas. Deficits ranged from negative 60 to negative 120 mm across most of Alberta and Saskatchewan with some areas more than negative120 mm below-normal around Edmonton, pockets in southern Alberta and Saskatchewan and throughout south-west and coastal British Columbia. Above-normal temperatures also continued causing a further deterioration in conditions, particularly in the Pacific region where heat waves occurred. Between April 1 and July 31, the south and central Prairie region experienced between 31 and 50 days above 25 degrees Celsius, while the Pacific region received above 50 which is approximately 15 more days than each of the previous two years (Figure 10).

British Columbia and Alberta were the regions most severely impacted by drought. In British Columbia, provincial hydrological drought risk class ratings increased in severity and there was a growing risk that water supplies for irrigation in some parts of the interior and lower mainland would be limited, or that water licences would be restricted for fish conservation purposes. Provincial authorities requested a 30 per cent voluntary reduction in water use. In Alberta, conditions were drier but temperatures were lower relative to the Pacific region. As the risk of significant crop damage continued to increase, rural municipalities in Alberta began to declare a state of agricultural disaster beginning with MacKenzie County on July 3rd. Twelve more counties declared in the following weeks, and then on August 21st the Alberta government declared the province an Agricultural Disaster Area.[4]

Crops and livestock were particularly impacted by drought conditions in Alberta and western Saskatchewan (Figure 11). Heat and dry conditions damaged crops, causing flower abortions, poor pod sets, poor grain fill and an increase in pests such as grasshoppers. Sixty-five per cent of crops were rated as poor or worse and crops in several locations of south-west Saskatchewan were close to lost production value. Production in the Pacific region, especially on irrigated acres, were somewhat better, with crop and forage conditions in the central and northern regions of average to slightly below -average conditions.

Hay and pasture lands in western Canada were also negatively impacted (Figure 12). In Alberta only 12 per cent of pasture and hay land was rated good or excellent and the first cut of hay was significantly below average yields. Production could not keep pace with grazing and in many areas, poor quality crops and hayfields were being grazed or baled for feed. In Saskatchewan, the Province opened approximately 90,000 acres of conservation lands to grazing for cattle producers dealing with drought.[5] In British Columbia, an increase in hay prices and livestock for market was reported, and by the end of July livestock producers were requesting help securing hay and feed.

Although still experiencing lingering dry conditions, eastern Saskatchewan and Manitoba began to recover from the dry spring in July. Eastern Saskatchewan received more precipitation since May and had adequate soil moisture by mid-July. Manitoba received enough precipitation through July to improve crop and forage outlooks and replenish water supplies. By the end of the month, rain significantly improved surface soil moisture conditions, leading to excess moisture conditions in the central and eastern regions.

[4] Government of Alberta. "Orders in Council Approved August 21, 2015." Available online at www.alberta.ca.
[5] Government of Saskatchewan. "90,000 Acres of Conservation Land Made Available to Cattle Producers for Grazing." Available online at www.saskatchewan.ca

Figure 9: Poor vegetation conditions in western Canada, July 27 to August 3, 2015

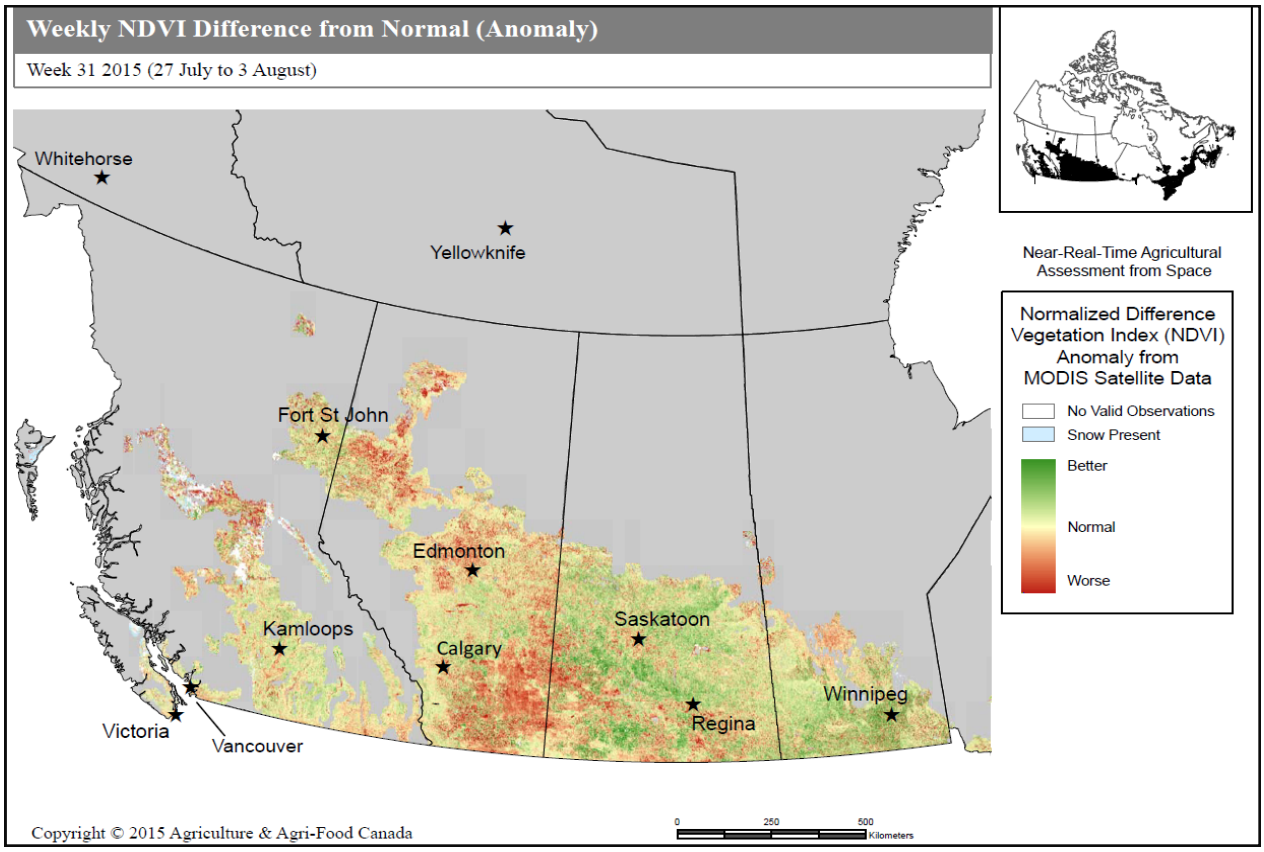
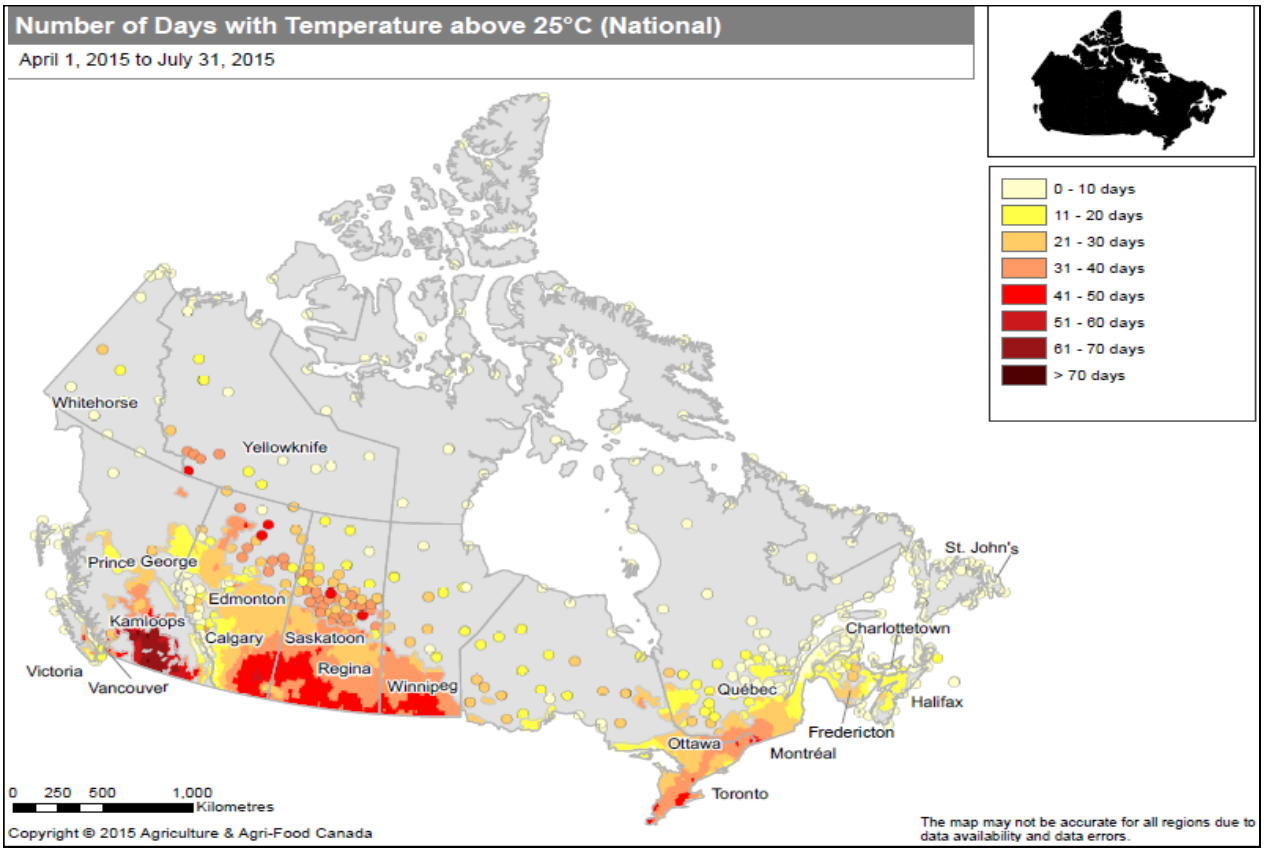


Figure 10: Heat wave days, April 1 to July 31, 2015

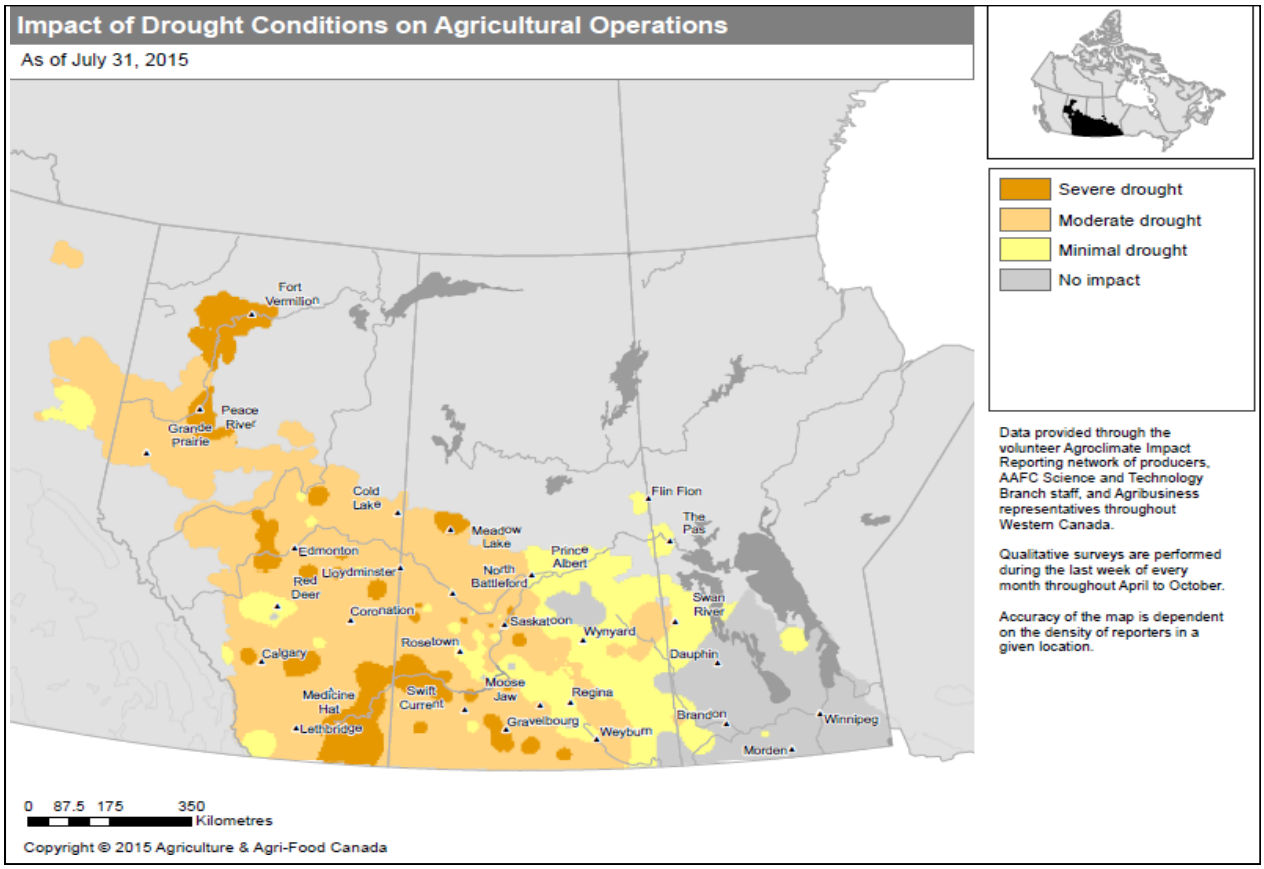


In the Atlantic and Central regions, conditions generally improved over the summer after operational delays in the early and late spring. Although there were no significant impacts, the lasting effects of excess moisture, combined with new precipitation, presented challenges for agricultural operations until mid-August. In Ontario, excess moisture resulted in fungal diseases on cereals and potatoes in some cropland, and lodging of cereals occurred in localized areas of heavy rain. In the Atlantic region, potato development was variable due to excess moisture. Through July, conditions for cutting and drying hay continued to be challenging across the Central and Atlantic regions, particularly in New Brunswick and Ontario.

Despite the excess moisture in the Atlantic region, crop development generally reached near-seasonal levels by early July and the fruit harvest began. Some corn crops remained a week delayed due to below-normal temperatures and minor frost damage experienced earlier in June. Early yields of fruits in the Atlantic region, including strawberries and apples, was above-average with excellent quality and New Brunswick producers were expecting high forage yields.

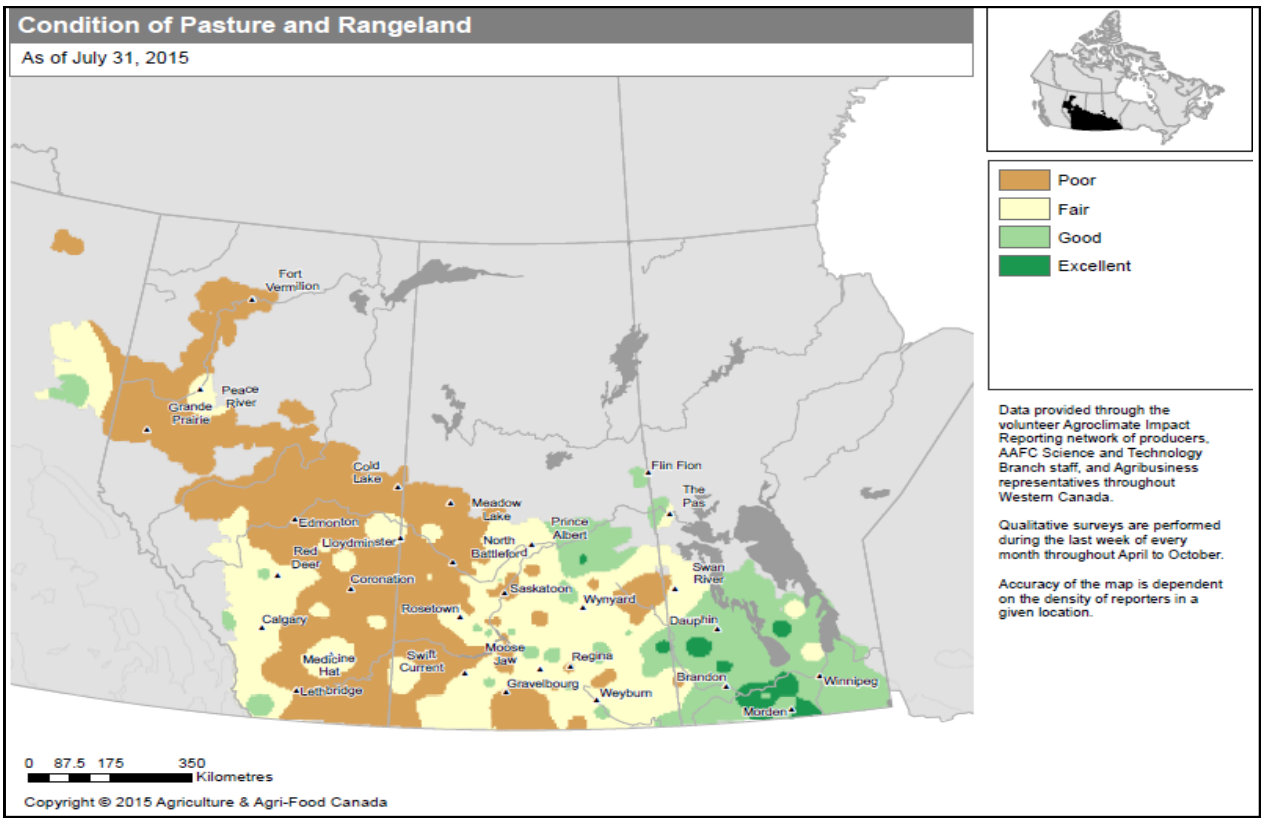
Thunderstorm activity began in mid-July across the country. Hail significantly damaged crops in parts of Alberta and localized flooding occurred in some areas after torrential rain. Three storms were categorized as "catastrophes" causing more than $25 million in insurance claims – strong wind, rain, hail and a tornado impacted agricultural areas around Medicine Hat in July and Calgary in early August[6]. The Prairie region received over 130 per cent of their average severe summer storm events.[7] In the Central region, rain increased the presence of fungal diseases and reduced the quality of some crops. High winds and hail at the end of July in Ontario caused minor crop damage in the south-west while an F2 tornado in north Wellington County significantly damaged crops in localized areas. In early August, fruit crops, wheat, soybean, corn and forage were damaged in localized areas of southern Quebec. Heavy rain continued to damage crops in the Central and Prairie regions through the month, causing locally severe damages.

Figure 11: Impact of drought on agricultural operations, July 2015



[6] Morin, Margeaux. "Alberta's costliest storms of 2015." Available online at http://globalnews.ca/news/2423258/albertas-costliest-storms-of-2015/
[7] Canadian Meteorological and Oceanographic Society. "Canada's Top Ten Weather Stories for 2015." Available online at http://cmos.ca/site/top_ten?a=2015

Figure 12: Impact of drought on pasture and rangeland, July 2015



In July, the average monthly temperature were below-normal for agricultural regions in the Central and Atlantic regions. Late in the month, Newfoundland experienced well below-normal temperatures, and rain and fog that delayed crop development. Corn development in New Brunswick and Prince Edward Island was approximately two weeks behind due to cool overnight temperatures. By mid-August however, temperatures warmed up in the Atlantic region and the harvest of spring-seeded crops such as barley and wheat began early. In the Central region, temperatures were relatively cooler and crop development ranged from near-seasonal to a week behind. Below-average temperatures slowed grain fill on corn and soybeans and placed additional stress on crops in Ontario. These temperatures combined with adequate moisture were good for forage growth but made harvest of high-quality crops challenging. The spring cereal harvest was completed as weather allowed, and lodging in some fields slowed both crop drying and combine speed.

Near-normal precipitation occurred in August with the exception of pockets of southern Ontario and Quebec. Harvest was delayed in Ontario as rain damaged crops in localized areas and high humidity slowed crop drying. In Quebec, rain and humidity caused mold in some vegetable crops and poor yields and quality in hay crops.

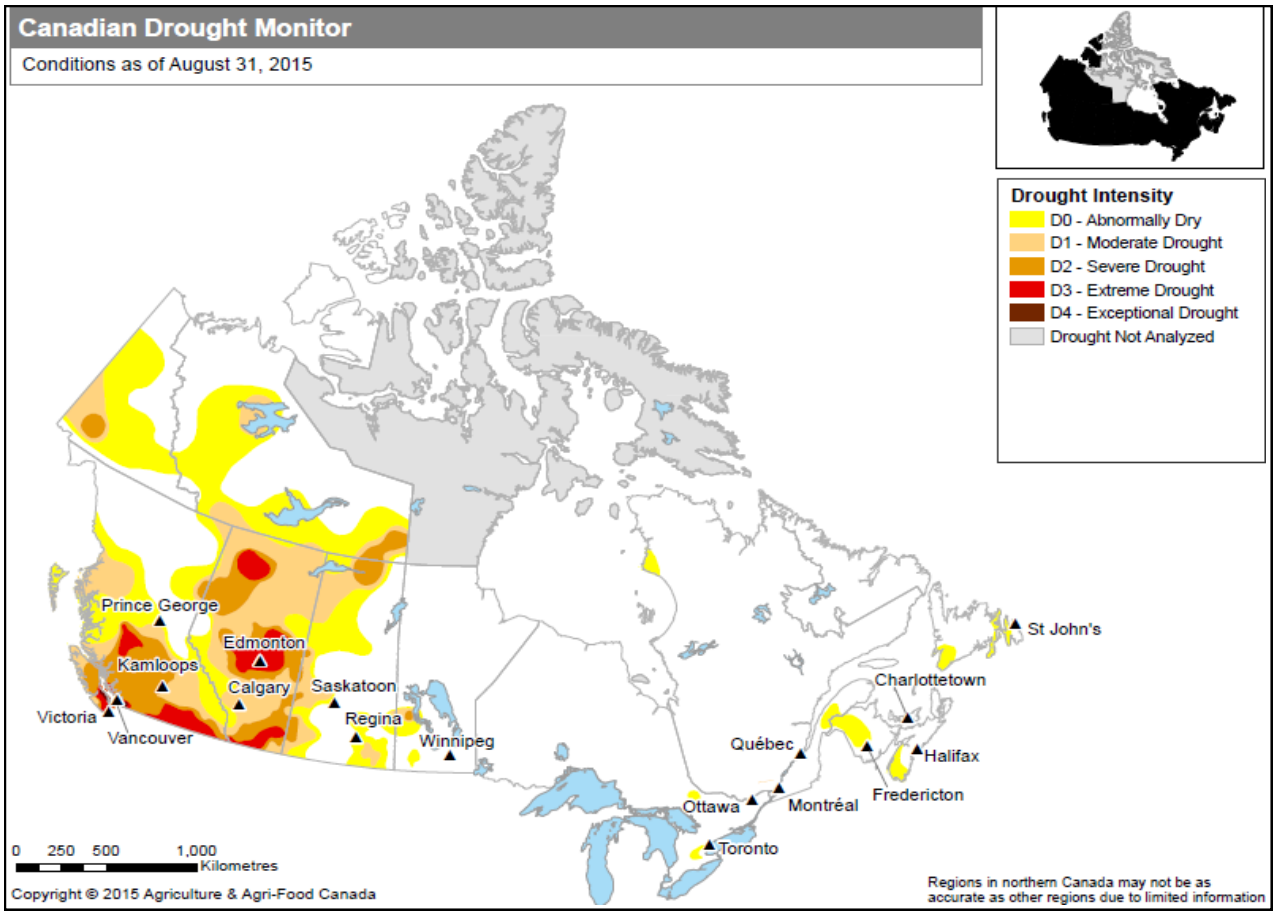
In the Pacific and Prairie regions, south-west Saskatchewan, southern and north-central Alberta, and central and south-central British Columbia remained in drought and temperatures continued to be above-normal for the entire month. The Canadian Drought Monitor reported severe (D2) and extreme drought (D3) in many of these areas during August (Figure 13). For other regions in the western provinces, rain arrived just in time to improve crop development. August rains alleviated drought conditions in a large part of central Alberta and west-central Saskatchewan. Although drought conditions still represented a significant risk to production, rain increased surface soil moisture ratings to just over 50 per cent good to excellent in Alberta. Precipitation improved the conditions of some late-seeded crops and heat advanced development rapidly.

By mid-August, most pastures and hay lands were rated as poor or fair and approximately 30 to 40 per cent of crops were rated good or excellent as harvest began.

Most of Saskatchewan had adequate soil moisture by mid-August, with the exception of the south-west and extreme south-east. Excess moisture in some regions increased pests like aphids and diamondback moths and in some areas heavy rains and strong winds caused localized crop damage and lodging. Crops were ahead of development by up to two weeks. In Alberta and Saskatchewan, producers still experienced feed shortages and continued to search for feed despite the appearance of new growth on hay and rangelands. In Manitoba, drought subsided by August. Crops were well developed well, with good yields and quality. Harvest progressed without incident.

In the Pacific region, drought conditions continued to deteriorate and peaked in August. Most of the southern and central interior, as well as Vancouver Island were in severe (D2) to extreme (D3) drought. Provincial drought risk class ratings were raised through the month and many low streamflow advisories were in place in the south and interior regions. The Coldwater River system in the Nicola region was temporarily closed under Section 9 of the Fish Protection Act, directly impacting at least 12 ranching operations. There were reports of increased numbers of cattle through auctions in Kamloops and Vancouver Island due to water and feed shortages. Significant increases in demand for hay and hay prices were also noted. Producers requested assistance in securing hay for cattle from the Province of British Columbia. Moderate to high wildfire danger risk class ratings spanned the majority of the province and several fires in the southern interior threatened agriculture. Large wildfires burning near the Rock Creek and Oliver regions of the southern interior forced the evacuation of livestock, and some producers reported losses of property and livestock.

Figure 13: Canadian drought conditions at the end of August 2015



Overall, it was a hot and dry summer for much of Canada's agricultural area in the Prairie and Pacific regions, but rain repeatedly arrived in time to significantly improve production outlooks. In July, as much as 60 per cent of agricultural land in Canada received low to record low precipitation since April 1st. By August 31st, precipitation across western Canada reduced the affected area to 43 per cent, which represents 32,000 farms and 5.1 million cattle (Figure 14). Nationally, 34 per cent of cereal and grain production, and 52 per cent of the beef sector was affected by drought (Figure 15). Drought conditions peaked from east to west across the Prairie and Pacific regions – in early July for Manitoba and eastern Saskatchewan, in late July for western Saskatchewan and Alberta, and in August for British Columbia. Lasting impacts of the drought on crops and livestock continued into the fall for the most severely impacted areas in the Pacific and Prairie regions. Crop development and harvest was ahead of normal due to hot and dry conditions. Rangeland and pasture conditions had gradually improved over the summer, but many producers were still facing livestock feed shortages as fall arrived.

Relative to the drought in western Canada, the Central and Atlantic regions experienced a mild summer with minimal weather and climate risks to agriculture. Crop development progressed well and harvest was near-seasonal by the end of the summer season.

Figure 14: Precipitation compared to historical distribution, April 1 to August 31, 2015

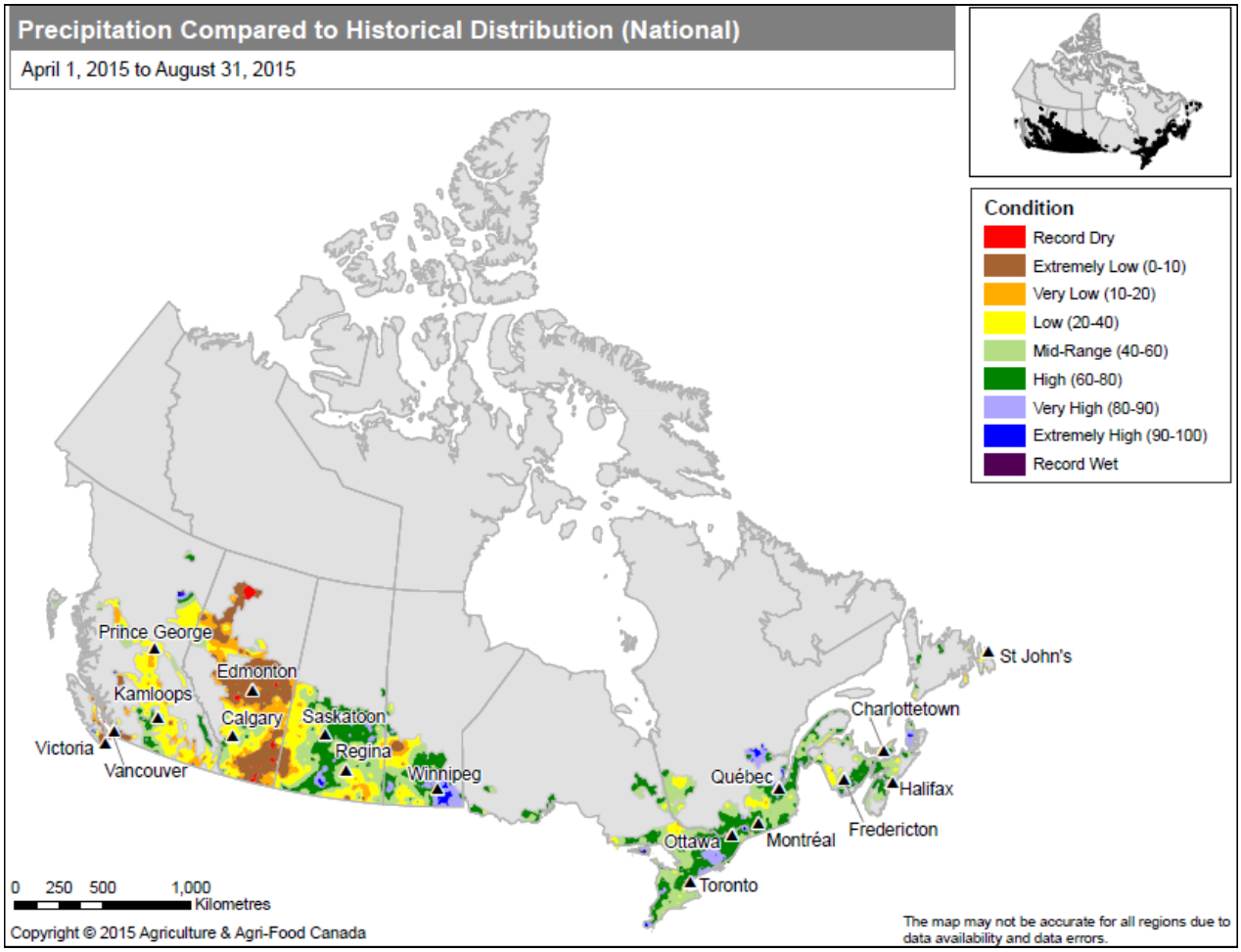
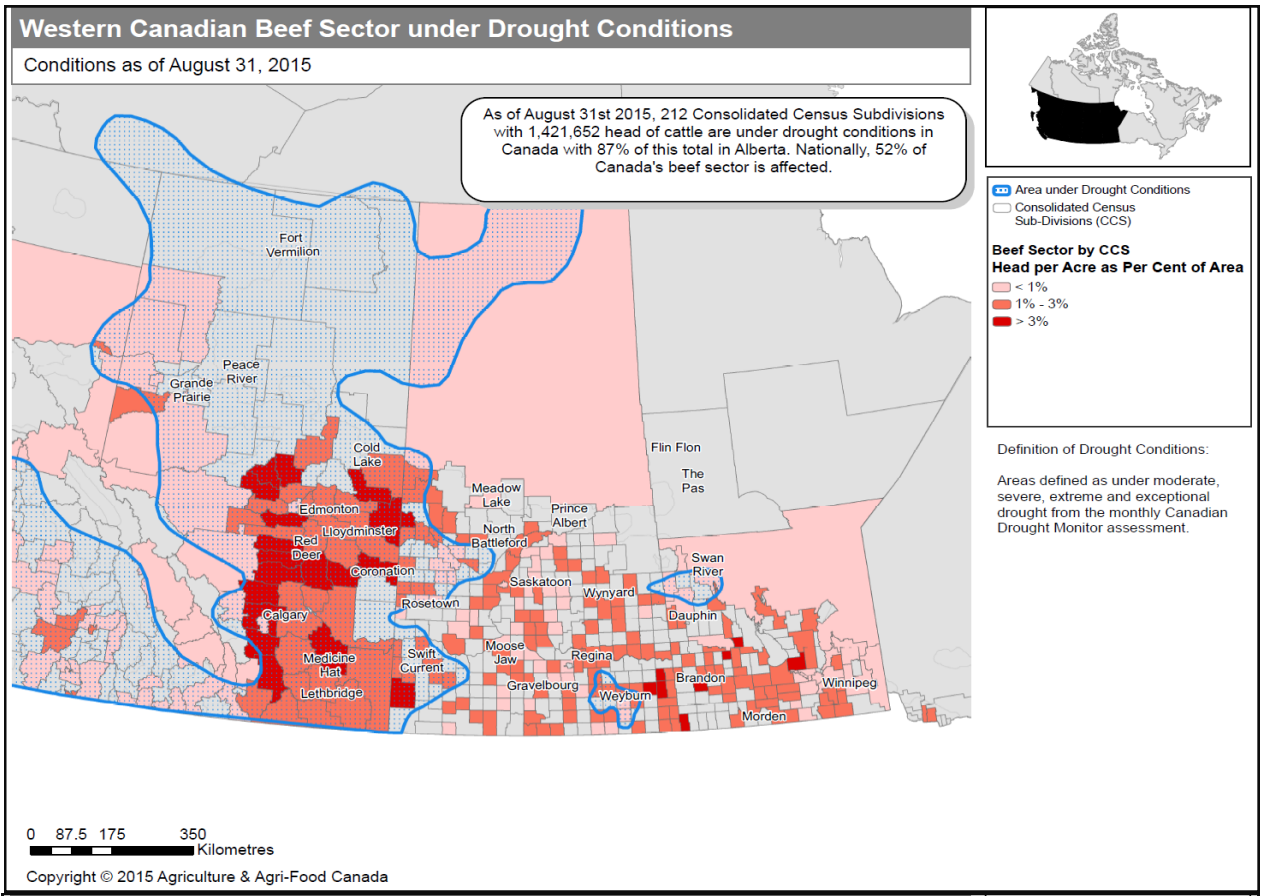
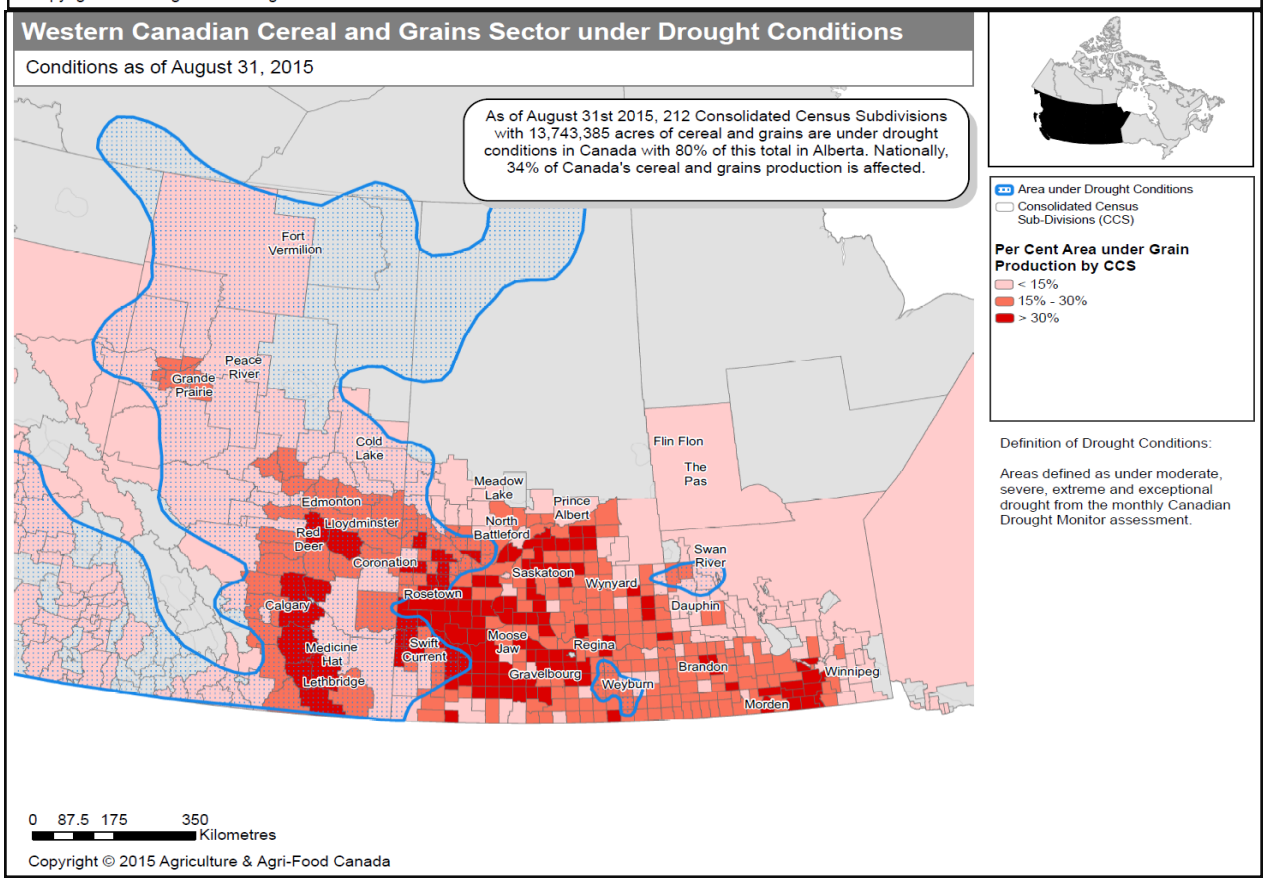


Figure 15: Western Canadian grain and beef under drought conditions, August 31, 2015





Fall 2015 (September – October)

Producers began harvesting early. Heat through the summer accelerated crop growth so that harvest progressed at a near normal pace across Canada. Consistent precipitation alleviated dry conditions, but hampered field activities and reduced crop quality. Overall, weather risks to agriculture continued to decline over the fall and conditions were generally stable through harvest and heading into the winter.

Drought-affected areas received some relief from cool temperatures and rain through September. The average monthly temperature ranged from 0 to 2 degrees Celsius below-normal in British Columbia and much of Alberta to 0 to 4 degrees Celsius above-normal in the Central and Atlantic regions. The Prairie region and New Brunswick received 115 to 200 per cent of average precipitation, whereas the British Columbia southern-interior, Peace River region of Alberta and much of the Central region received below-normal amounts.

Drought remained the most significant risk to agriculture in British Columbia and Alberta through September due to the extent and intensity of the moisture deficits from spring. Rain helped to alleviate dry conditions in some areas. Much of the Prairie and Pacific regions received greater than 85 per cent of average precipitation in the fall, with the exception of the Thompson-Okanagan, Kootenay and northern Peace River regions. Saskatchewan, in particular, received greater than 150 per cent of average precipitation, with accumulations over 75 mm (Figure 16 and 17). Rain in the Pacific region contributed to reduced or lifted provincial drought class ratings and low streamflow advisories in some areas in the south and along the coast. Several fish protection orders to reduce or stop water diversions remained in effect in the southern interior in September. In Alberta, rain provided some relief in many of the province's agricultural areas. Combined with precipitation from August, soil moisture conditions significantly improved over the month in the south and central regions. The areas north-east and north-west of Edmonton remained dry, while the Peace River region received variable precipitation.

While providing some drought relief, intermittent rain delayed harvest activities across the Pacific and Prairie regions. Most fruit crops in the Pacific Region had already been harvested, but September rain delayed grain and oilseed harvest in the Peace River region. In Alberta, rain subsided by the end of the month and harvest was 46 per cent complete provincially, which is only 6 per cent below 2014 levels. In Manitoba, soil moisture ranged from adequate to excessive in some areas. Drier conditions by the end of September allowed harvest to progress and near completion. The quality of cereal crops in the field after this point declined largely due to mildew and sprouting.

Saskatchewan experienced some of the most significant impacts from the rain. A storm at the beginning of September completely halted harvest in the south-east where flooding prevented field access. As rain continued through the month, northern agricultural regions became increasingly wet, causing excess soil moisture which prevented field access, and caused higher humidity which led to secondary growth of weeds. Cool and wet conditions caused grain crops to sprout in swaths, stain and bleach. Some lodging of standing grain crops also occurred as a result of strong winds. Producers faced additional costs aerating bins to dry grains. Despite these delays, crop development was sufficiently advanced from the heat over the summer that yields remained near the long-term average.

The Prairie region experienced isolated incidences of frost in September, but there was no significant damage to agriculture. Alberta in particular received very cold and early frost events in the northern and Peace River region and the south-west, but because most crops were fully mature prior to being exposed to below-normal temperatures, these events had minimal impact on agriculture.

Figure 16: Fall accumulated precipitation, September 2 to October 31, 2015

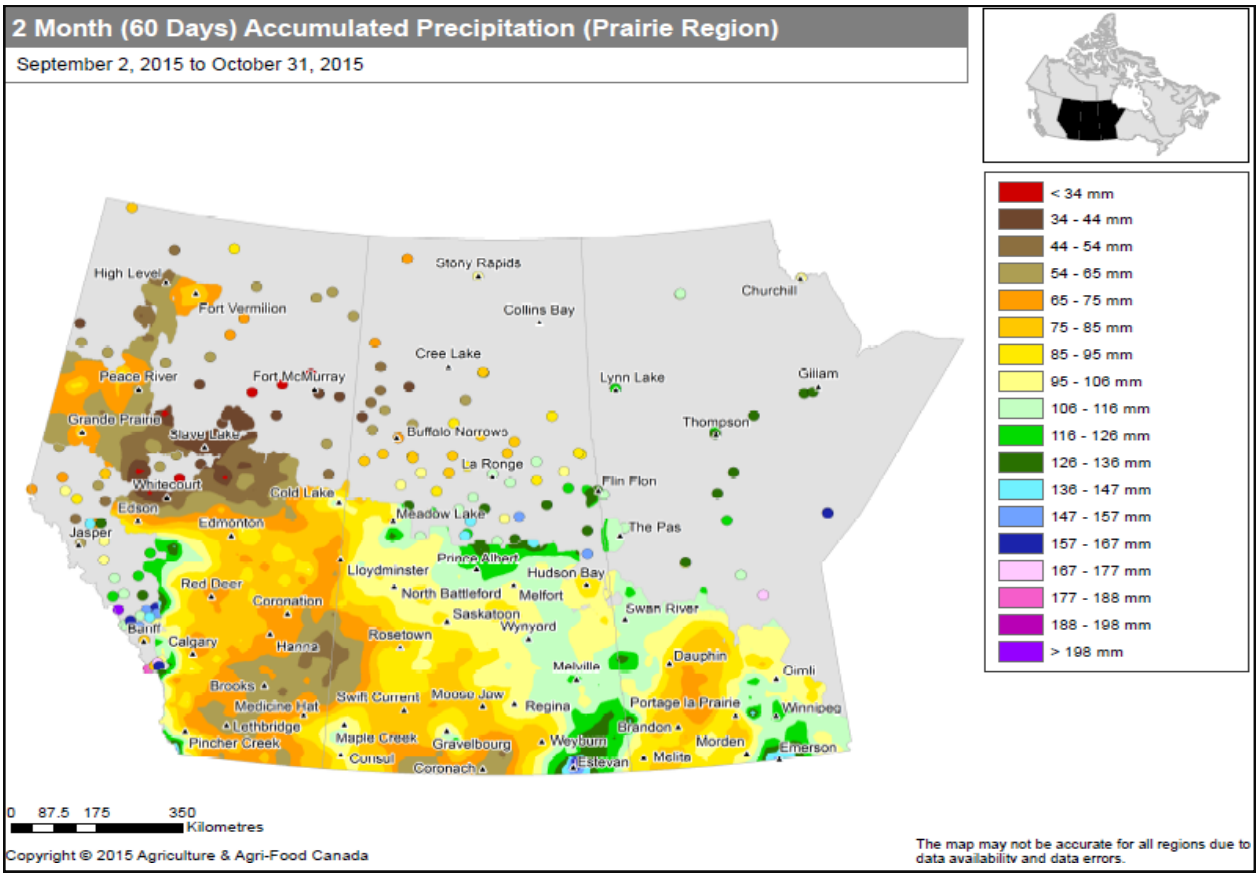
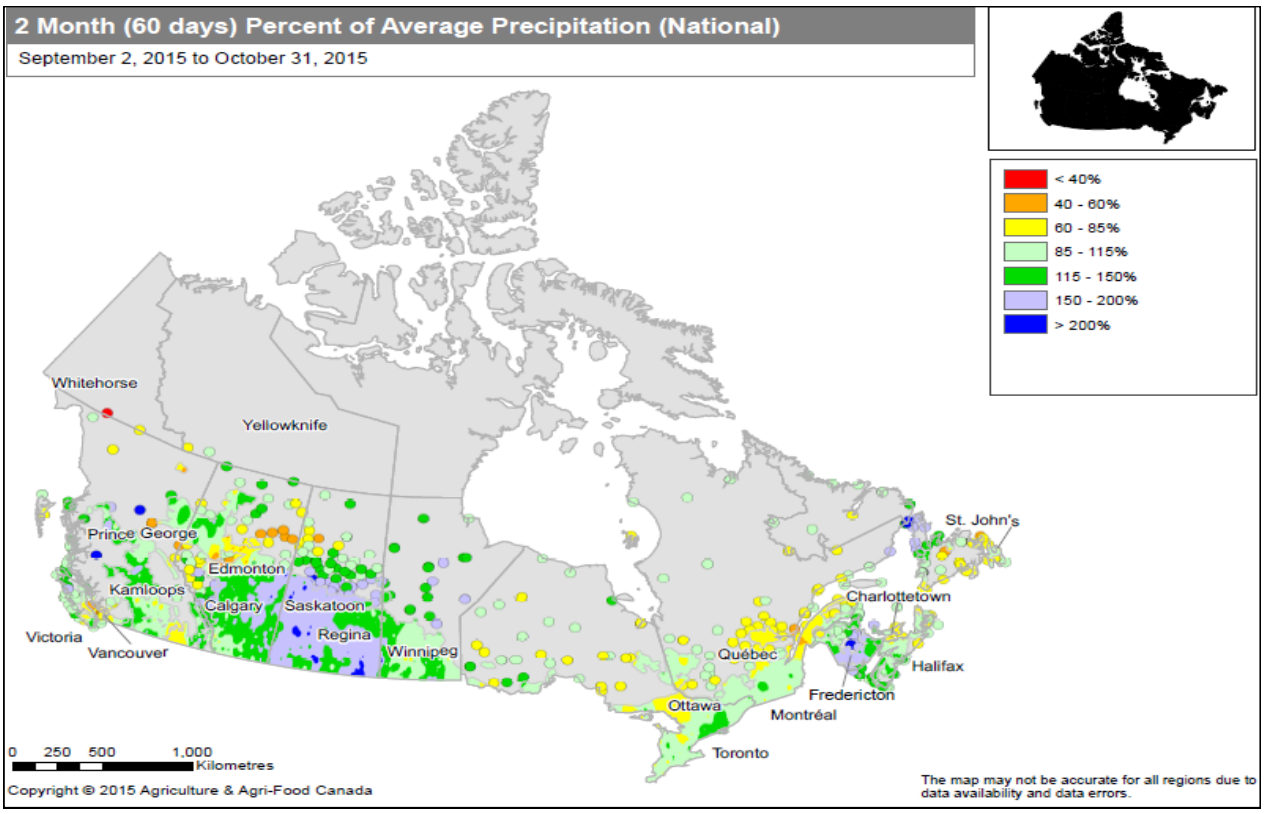


Figure 17: Fall per cent of average precipitation, September 2 to October 31, 2015



Eastern Canada was unseasonably warm in September. Although interspersed with cool days, above-normal temperatures in the Central region helped crops mature, while regular but below-average precipitation helped finish grain fill on soybean and corn. Cases of early bolting in vegetable crops were reported. Despite these minor setbacks, dry conditions meant crop development and harvest progressed normally, especially towards the end of the month. Dry conditions were also ideal for harvest of late-season crops such as corn and soybeans, and the planting of winter wheat.

The Atlantic region experienced conditions similar to the Central region and crop development advanced without serious weather-related impacts. Hail had damaged some blueberry crops at the end of August but harvest was complete by the end of September with near-average yields in Prince Edward Island, Nova Scotia and New Brunswick. Central Prince Edward Island and New Brunswick and southern Nova Scotia and Newfoundland were dry and additional moisture was required for apples and potatoes impacted by heat and humidity. In New Brunswick there were areas too dry to produce adequate forage or a third cut of hay. Relatively dry conditions facilitated the harvest of spring cereals and late-season crops. Intermittent rain slightly delayed harvest of pumpkins, potatoes and apples.

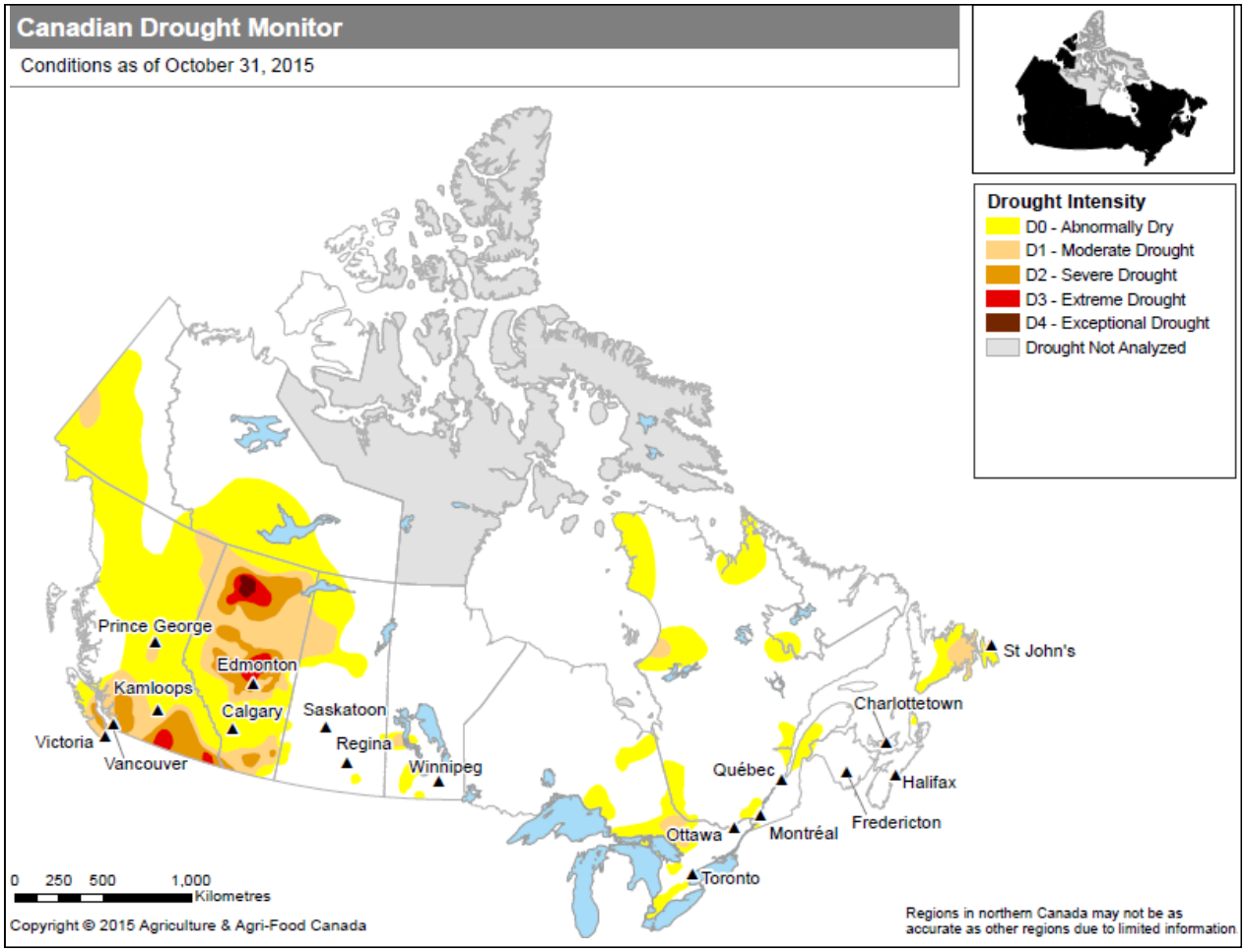
In October, there was a trend of warmer temperatures in the west and cooler temperatures in the east. Alberta and the Atlantic region received below-normal precipitation while Saskatchewan continued to experience much above-normal amounts. Warm, dry conditions allowed for a timely completion of harvest in almost all agricultural areas, particularly the Pacific and Prairie regions.

In the Pacific region, precipitation continued to alleviate drought conditions and gradually improve soil moisture levels. Provincial hydrological drought risk class ratings continued to decrease, but low streamflow advisories remained in place in the southern interior due to seasonal total moisture deficits. Similarly, in Alberta, moisture deficits continued to gradually improve, but pasture conditions remained poor with limited fall growth. In October, only 30 per cent of pasture was rated good to excellent provincially. Rain continued to fall in Saskatchewan at much-above seasonal levels, causing localized harvest delays and minor sprouting. Soil moisture conditions significantly improved from the summer and most areas were reporting adequate or above levels. Pastures recovered in time for producers to achieve adequate feed supplies for winter. Livestock water and feed supplies were in adequate or good supply in Manitoba, with some producers reporting a surplus.

In the Central and Atlantic regions the growing season ended in October as temperatures dropped below-normal. These regions began to receive frosts and some snow flurries, both with little impact to agriculture. Harvest was delayed in some localized areas from resulting wet conditions and additional rain early in the month, particularly on Prince Edward Island. Overall however, a timely harvest occurred in both regions, as weather conditions remained generally fair and soil conditions were dry for field work. Most grains and oilseeds and over half of late-season crops were harvested by the end of October. Generally only later-variety apples, corn and soybeans remained to be harvested.

In the Pacific and Prairie regions, harvest was largely complete by the end of October. Standing crops were primarily late germinating crops, reseeded crop and some late-seeded canola. Yields were below the 5-year average but significantly higher than expected during the spring and summer. In the Peace River region of British Columbia, yields were 80 per cent of normal. Soy, corn and hay on non-irrigated land suffered from the dry, hot conditions throughout the growing season and frost reduced the quality of wheat and canola. High temperatures also impacted many horticulture crops. Yields for apples and silage corn were below-average due to heat and frost. In the Prairie region, yields were near-average or slightly above-average in Manitoba and most of Saskatchewan and between 85 to 95 per cent of normal in Alberta. Generally, earlier-seeded crops produced lower yields because of damage from heat and lack of moisture, while later-seeded crops were of lower quality due to fall precipitation and fewer drying days. Localized hailstorms between Calgary and Red Deer and along the Alberta-Saskatchewan border, drastically reduced crop yields.

Figure 18: Canadian drought conditions at the end of October 2015



In the Central region, yields for grains, oilseeds and late-season crops were generally above-average. The most significant impact to crops through the year was a severe frost in May that damaged half of the apple crops in Ontario[8]. In the Atlantic region, spring cereals were above-average in yield and quality. Potatoes and apples were of good quality with above-average yields. Pumpkin yields were below-average.

As October concluded, the majority of crops were harvested with slightly below-average yields in the Pacific and Prairie regions. In the Central and Atlantic regions harvest of late-season crops was almost complete.

Winter Outlook (November 2015 to April 2016)

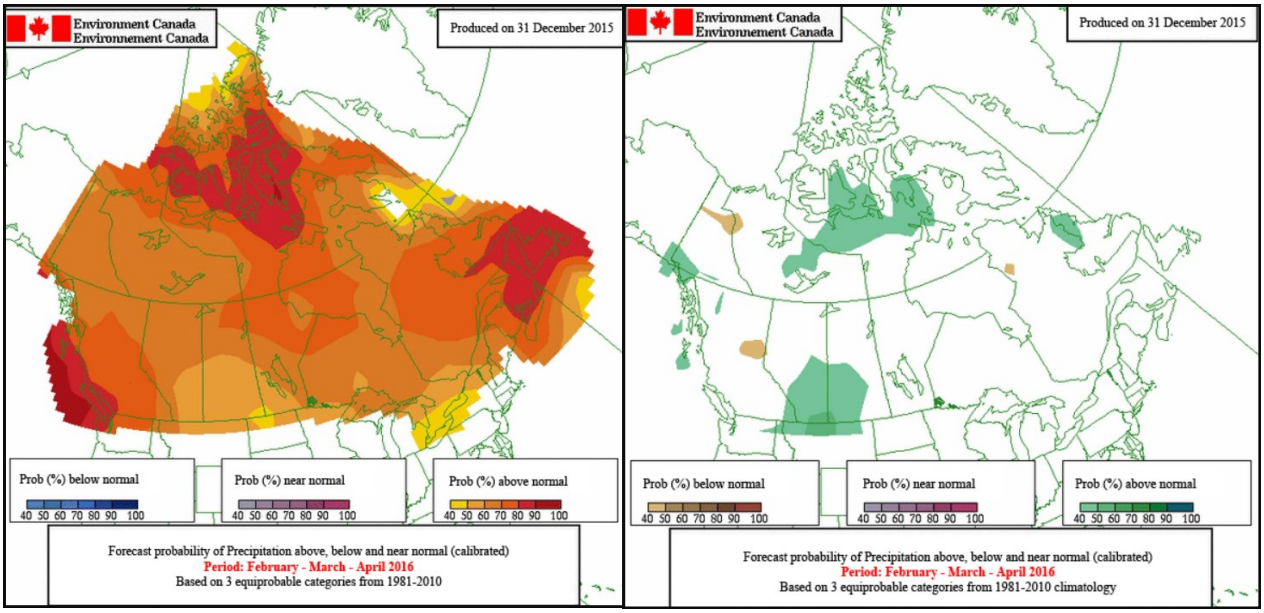
Agroclimate conditions in early winter were generally stable across Canada. The significant concerns about drought had diminished by November, although limited drought conditions remained in Alberta and British Columbia, but these were not an immediate concern to agriculture. In the Prairie region, some producers reduced seeded acreage due to wet conditions, especially in the east and south-east. In Manitoba, there was a minor risk of surplus moisture. Warmer temperatures late into the fall contributed to advanced growth on fall seeded cereals which may reduce quality in the spring.

[8] Pfeffer, Amanda. "Ontario apple farmers hope weird winter weather won't damage 2016 crop." Available online at http://www.cbc.ca/news/canada/ottawa/apple-farmers-weather-ontario-winter-1.3382267

In Ontario and Quebec, much of the agricultural land received between 40 to 85 per cent of average precipitation through November. These conditions allowed for a rapid progression in the harvest of remaining late-season crops, and the majority of soybeans and corn was harvested by mid-month. The Central region had adequate soil moisture limited precipitation that allowed producers to plant average to above-average acres of winter wheat. The mild weather also facilitated the completion of harvest in the Atlantic region. Potato, corn, apple and soybean crops were harvested by the end of November, although wet fields in some areas delayed harvest of some high moisture corn and apple varieties.

Most regions had adequate feed and forage as winter approached. Drought is a potential risk in western Canada for the spring if below-normal precipitation occurs over the winter. Adequate snow cover is required to alleviate low soil moisture conditions in parts of Alberta and south-west Saskatchewan. In British Columbia moisture deficits were present in more than 50 per cent of agricultural land at the end of October. Levels were especially low in the Okanagan region. Significant winter precipitation is required to recharge the mid-elevation snowpack, which fell to well-below normal levels in 2015.

Figure 19: Temperature and precipitation 3-month forecasts, February to April, 2016



The Environment Canada three-month winter and early spring forecast for February, March and April is for above-normal temperatures across the country (Figure 19). The highest probability for above-normal temperatures is in the Pacific and Atlantic regions. There are also strong signals for above-normal temperatures in Quebec and the foothill region of Alberta. The strong El Niño that influenced Canada's weather during 2015 is expected to continue to produce above-normal temperatures until April 2016, and then weaken over the summer.

Globally, early forecasts suggest that 2016 will be another year of above-normal average temperatures, likely among the warmest years on record, and possibly even warmer than 2015 [9].

[9] UK Met Office. "2016 global mean temperature forecast." Available online at http://www.metoffice.gov.uk/news/releases/archive/2015/global-temperature

Summary

According to the National Oceanic and Atmospheric Administration, 2015 was the warmest year on record globally since 1880[10]. The combined impact of El Niño and "The Blob" (a patch of warm water off the Pacific coast) made for a warm and dry growing season across western Canada. These conditions were in sharp contrast to recent previous years in which western Canada experienced widespread excess moisture and flooding.

The 2015 crop year was subject to diverse weather across Canada, according to the Canadian Meteorological and Oceanographic Society[11]. Despite being one of the warmest years globally, eastern Canada experienced one of the coldest winters on record. January through March was the coldest period in 68 years for the Atlantic provinces, Toronto experienced its coldest February since 1840 and Montreal did not reach melting temperatures for 43 consecutive days. Moncton and Charlottetown broke previous snowfall records, with accumulations of more than five meters. In contrast, on the west coast of the country, Vancouver went the entire year without accumulating any snow. The spring mountain snowpack was less than half of normal in British Columbia, leaving rivers at their lowest recorded flows in 100 years. Wildfires occurred across western Canada, burning four times the 25-year average of hectares in British Columbia and prompting the largest evacuation in history in Saskatchewan. There were 307 severe storm events (compared to an average of 234) recorded in the Prairie Provinces in 2015, 70 per cent of which were hailstorms.

In western Canada, the growing season was challenging for producers due to drought, heat waves and dry soils. In British Columbia, a below-normal snowpack followed by a hot and dry growing season resulted in an above-normal number of wildfires, limited the availability of water, and stressed dryland crops and pastures. Producers in the Prairie region faced killing frosts in May, severe drought conditions across the summer, and damaging storms and precipitation through harvest that reduced crop yields, quality and forage for livestock. Drought severely limited feed supplies for many livestock producers in western Canada through the growing season and many producers were forced to reduce herd sizes. Federal tax deferral provisions were announced in July for eligible regions in coastal British Columbia, and in Alberta, south-west Saskatchewan and northern Manitoba.[12]

In eastern Canada, many producers experienced an average growing season after a difficult spring. Fears that drought would emerge in the Central region did not materialize. Crops were, however, subject to frosts and lingering excess moisture issues through the spring and early summer. In the Atlantic region, heavy snowfalls, record cold temperatures and precipitation damaged infrastructure and damaged 40 per cent of the maple trees. AAFC provided support for maple syrup producers impacted by the harsh winter. In the spring, flooding and cool temperatures delayed spring seeding by a month. After these concerns diminished, producers experienced only minor weather-related impacts in the late summer, and harvest progressed near-normally in both regions with average yields.

Overall, production was better than expected for crop farmers. While final yields were near or below 2013 and 2014 yields, they generally remained above the 10-year averages.[13] The warm growing season and fall allowed more acres to be seeded and harvested. Despite the emergence of drought conditions in western Canada, sufficient rains arrived just in time through the growing season and resulted in better yields than what was expected earlier in the year. An additional contributing factor was that many of the most drought-affected regions during 2015 had good soil moisture reserves heading into the growing season, allowing later-season precipitation to more quickly alleviate moisture deficits.

[10] NOAA National Centers for Environmental Information. "State of the Climate: Global Analysis for December 2015." Available online from http://www.ncdc.noaa.gov/sotc/global/201512
[11] Canadian Meteorological and Oceanographic Society. "Canada's Top Ten Weather Stories for 2015." Available online at http://cmos.ca/site/top_ten?a=2015
[12] Government of Canada. "Harper Government Announces Tax Relief for Western Livestock Producers." Available online at http://news.gc.ca/
[13] Statistics Canada. "Canada: outlook for principal field crops, December 18, 2015. Available online at http://www.agr.gc.ca

Appendix A: Summary of 2015 Agroclimate Conditions

	BC	AB	SK	MB	ON	QC	ATL
Dec. 2, 2015	1	1	1	1	1	1	1
Nov. 17, 2015	1	1	1	1	1	1	1
Oct. 20, 2015	2 drought	2 dry	1	1	1 frost	1	1
Sept.29, 2015	3 drought	3 drought, excess moisture	2 excess moisture	1	1	1	1
Sept. 15, 2015	4 drought	4 drought, excess moisture	2 excess moisture	1	1	1	2 hail
Sept. 1, 2015	4 drought, wildfire	4 drought	2 dry, frost	1	1	1	1
Aug. 18, 2015	4 drought	4 drought	2 drought	1	1	2 (excess moisture)	1
Aug. 5, 2015	3 drought	4 drought	3 drought	1	1 excess moisture	1	1
Jul. 21, 2015	3 drought, heat	4 drought, heat	3 drought	1	2 excess moisture	1	1
Jul. 7, 2015	3 drought	3 drought	3 drought	2 drought	1 (excess moisture)	1	1
Jun.23, 2015	2 drought	2 drought	2 drought	2 dry	2 rain, delayed seeding	2 rain, delayed seeding	2 excess moisture, delayed operations, flooding
Jun. 9, 2015	1 (drought)	2 drought	2 drought	2 frost	1	1	1 delayed operations
May 26, 2015	1 (drought)	1 (drought)	1 (drought)	2 frost	1 (drought)		2 delayed operations
May 12, 2015	1 (drought)	1	1	2 low temps, drought	1 drought	1	2 excess moisture, delayed operations
Apr. 28, 2015	1	1	1	1	2 excess moisture, cold, delayed seeding	1	2 excess moisture, delayed operations
Apr .14, 2015	1	1	1	1	2 wet, delayed seeding, winter-kill	2 wet, delayed seeding	2 excess moisture, delayed seeding, winter-kill
Mar.31, 2015	1	1	1	1	2 low temps	2 low temps, (delayed operations)	2 excess moisture, (flooding, delayed operations)
Dec. 2, 2014	1 drought	3 snow, cold	2 excess moisture	1	3 excess moisture	2 excess moisture	2 excess moisture

Green (1) /Yellow (2) /Orange (3) /Red (4) is a continuum of 'No significant risk' to 'Large or Urgent risk'. Text not in brackets indicates the event was currently occurring at the time of the report; text in brackets highlights 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 between April and 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, 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 by NAIS with data from federal and provincial climate monitoring networks, consisting of more than 2000 climate stations. A system of automated and manual quality control are applied to the data to ensure suitable values 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, 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 Canadian Drought Monitor page on AAFC's Drought Watch website: **www.agr.gc.ca/drought**

AAFC Earth Observation

Per Cent 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 maps depict 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.

Normalized Difference Vegetation Index (NDVI) from MODerate Resolution Imaging Spectro-radiometer (MODIS)

The NDVI is calculated from the red and near infrared reflectances acquired by most optical sensors, and correlates well with aboveground live biomass, a biophysical indicator of crop condition. This index has emerged as one of the most robust and well-used tools for monitoring vegetation condition. The Canadian Ag-Land Monitoring System (CALMS) provides weekly vegetation conditions and anomalies using the NDVI at a spatial resolution (pixel size) of 250 meters from the MODerate Resolution Imaging Spectro-radiometer (MODIS) satellites.

Acknowledgements

We acknowledge and thank the following groups and organizations whose reports and data were utilized to produce this 2015 Annual Review of Agroclimate Conditions Across Canada:

- AAFC's Agroclimate Impact Reporter network of volunteer producers and industry representatives that are consulted monthly to obtain agroclimate impact information; and
- Environment Canada, Natural Resources Canada, and the multiple provincial agencies that provide weather and 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; and the
- National Oceanographic and Atmospheric Administration (NOAA), National Weather Service, Climate Prediction Center.