

# 1854 Ceded Territory



## Climate Summary 2016-2017 (12/1/2016 – 11/30/2017)

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**Technical Report 18-10**  
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## Introduction

The 1854 Treaty Authority Climate Change Program has developed the 2016-2017 Climate Summary to support implementation of the 1854 Ceded Territory Climate Change Vulnerability Assessment and Adaptation Plan. The plan was developed through collaboration between the 1854 Treaty Authority, Bois Forte Band of Chippewa, Fond du Lac Band of Lake Superior Chippewa and Grand Portage Band of Lake Superior Chippewa.

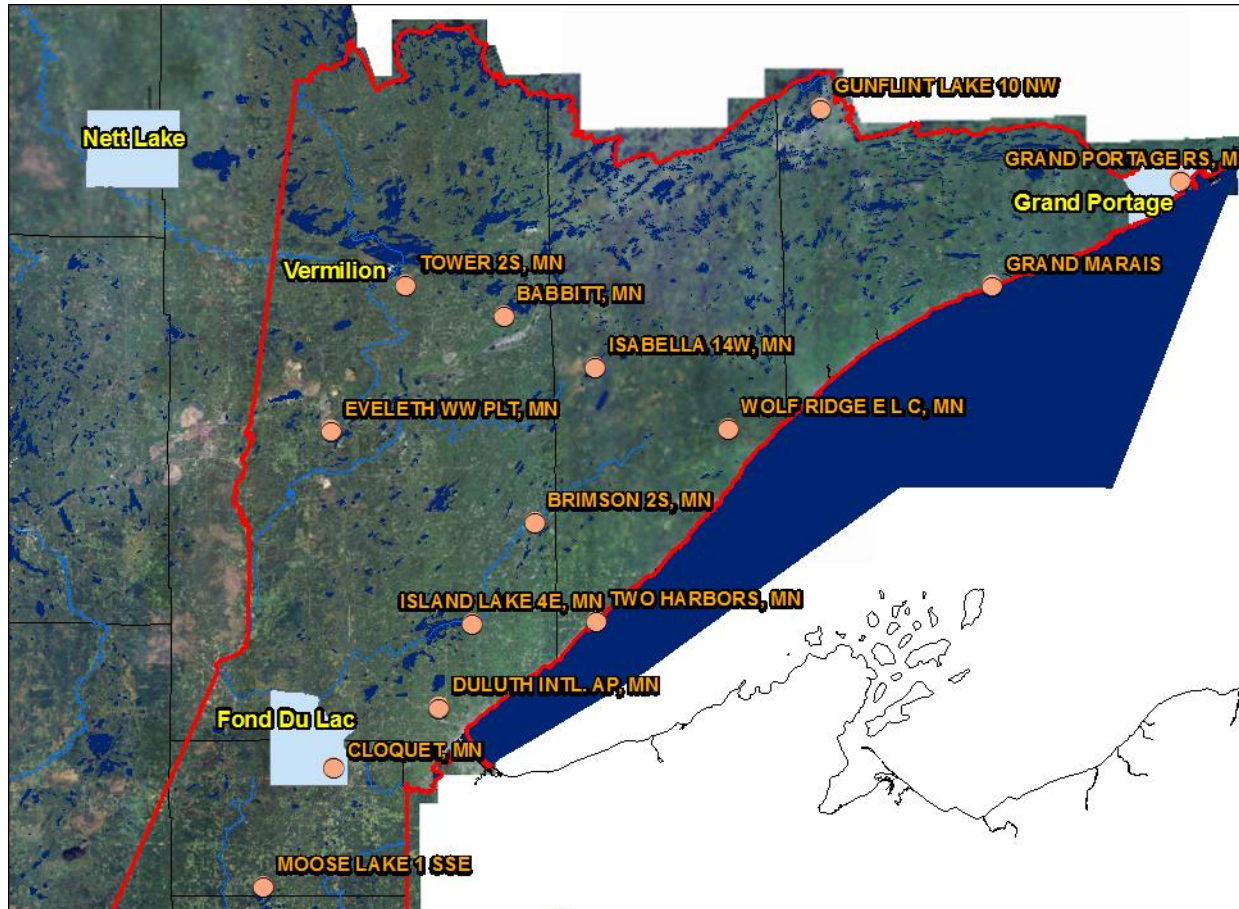


Figure 1: Weather Stations in Ceded Territory Used for the Climate Summary

Climate data can provide information that can be used for decision making processes. The Climate Change Program has summarized available data to review trends over time. The information will be used to monitor climate change impacts to resources in the Ceded Territory.

The National Weather Service Cooperative Observers stations in Figure 1 were identified by geographic location and period of record for use in this Climate Summary. For this summary, we defined seasons as Winter (December 1, 2016 to February 28, 2017), Spring (March 1 - May 31, 2017), Summer (June 1 - August 31, 2017) and Fall (September 1 - November 30, 2017). Table 1 provides data on each weather station in the Ceded Territory that was utilized for the climate summary.

**Table 1: Weather Stations in Ceded Territory Used for the Climate Summary**

Station	Period of Record	Station	Period of Record
GRAND MARAIS	1916-2017	TWO HARBORS, MN	1894-2017
WOLF RIDGE	1993-2017	BRIMSON 1E, MN	1989-2017
EVELETH WW PLT	1987-2017	GRAND PORTAGE RS, MN	1966-2017
MOOSE LAKE 1 SSE	1914-2017	DULUTH INTL. AP, MN	1928-2017
CLOQUET, MN	1911-2017	ISABELLA 14W, MN	2010-2017
BABBITT, MN	1999-2017	ISLAND LAKE 4E, MN	2009-2017
TOWER 2S, MN	1895-2017	GUNFLINT LAKE 10 NW	1962-2017

Since most of the climate data is retrieved through volunteer observers, some information may not be available. Climate data varies between stations due to the availability of observers and installation of automated weather stations. Throughout the summary there will be occasions where another station was used to provide weather data for a particular location.

Most of the climate data is taken from the Duluth National Weather Station. Since there is not a focus on the 1854 Ceded Territory, Duluth is the closest weather station that provides the most updated and frequent climate data.

The precipitation data in the climate summary tables are taken from the State Minnesota Climatology Office website. Precipitation amounts are a combination of rain and melted snow observations.

Most of the climate data has been researched through the High Plains Regional Climate Center (HPRCC). HPRCC serves to increase the use and availability of climate data and information. They provide climate services, developing climate data and information products, and engaging stakeholders. The Regional Climate Centers are supported by National Oceanic Atmospheric Administration (NOAA) and National Centers for Environmental Information (NCEI) as part of a three-tiered approach, emphasizing services that are local, regional, and national in scope. The HPRCC has on line data services, where you can customize climate data within your state and region.

In the Climate Summary tables, “wettest” locations found in the precipitation ranked column are defined as rain and liquid equivalent of snowfall (melted snowfall). The temperature ranked as “warmest” or “coolest” locations are defined as average of daily maximum and minimum temperatures.

Table 2: Winter Climate Summary (2016-2017)

## BIBOON (WINTER)

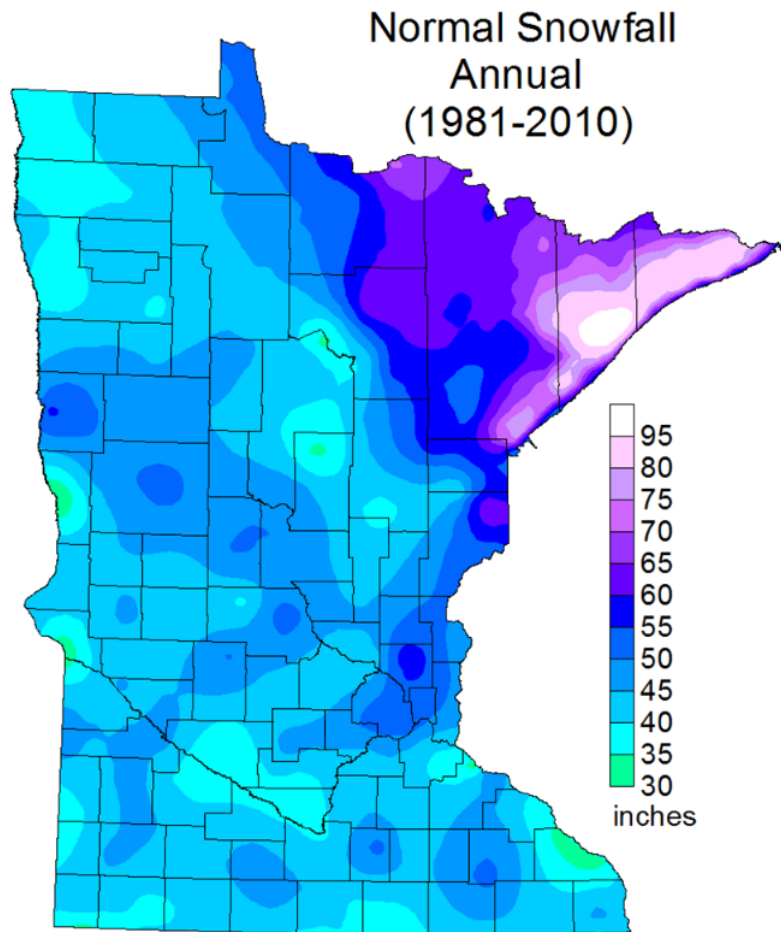
Climate Summary Winter Season 12/1/16-2/28/17												
Station	High Temperature (F°)	Low Temperature (F°)	Climate Normal Average	Temperature Departure (F°)	Temperature Rank	Period of Record	Total Rainfall Equivalent (in.)	Precipitation Departure	Precipitation Rainfall Rank	Period of Record	Snowfall (in.)	Period of Record
GRAND MARAIS	*55	*-16	*19.5	1.3	2nd warmest	1916-2017	*5.42	3.15	76th wettest	1918-2017	*43	1900-2017
WOLF RIDGE	54	*-21	16.6	3.3	3rd warmest	1993-2017	*7.39	3.68	1st wettest	1993-2017	*50.5	1993-2017
EVELETH WW PLT	54	-25	14.5	3.7	3rd warmest	1987-2017	4.49	2.29	21st wettest	1987-2017	*27.7	1986-2017
MOOSE LAKE 1 SSE	NCN	-25	NCN	NCN	6th warmest	1914-2017	3.61	1	14th wettest	1914-2017	*12.2	1914-2017
CLOQUET, MN	54	-30	18.1	4.2	7th warmest	1911-2017	6.48	NCN	3rd wettest	1911-2017	*37	1911-2017
BABBITT, MN	57	-35	13.2	5.8	2nd warmest	1999-2017	NCN	NCN	ID	2000-2014	*48.2	1999-2017
TOWER 2S, MN	57	*-36	*12.7	4.1	4th warmest	1895-2017	3.72	1.85	11th wettest	1895-2017	*42.5	1895-2017
TWO HARBORS, MN	56	-18	21.9	3.3	7th warmest	1894-2017	4.07	0.85	19th wettest	1894-2017	31.9	1894-2017
BRIMSON 1E, MN	52	-35	13.4	3.5	4th warmest	1989-2017	4.74	1.97	7th wettest	1948-2017	45.9	1948-2017
GRAND PORTAGE RS, MN	56	-17	17.3	4.4	1st warmest	1966-2017	5.88	1.83	4th wettest	1895-2017	38.5	1896-2017
DULUTH INTL. AP, MN	52	-22	18	4.7	11th warmest	1928-2017	5.03	2.05	9th wettest	1941-2017	50.9	2004-2017
ISABELLA 14W, MN	*55	*-33	*13.2	NCN	2nd warmest	2010-2017	*2.91	NCN	4th wettest	2010-2017	70.5	2009-2017
ISLAND LAKE 4E, MN	54	-28	15.2	NCN	2nd warmest	2009-2017	NCN	NCN	ID	2010-2016	*41.9	2009-2017
GUNFLINT LAKE 10 NW	*53	*-34	*13.3	5.9	3rd warmest	1962-2017	*3.75	1.01	8th wettest	1961-2017	*43	1894-2017

\*- some missing data    NCN – No Climate Normal available    NDA – No Data Available    T – trace of snow    ID – insufficient data

Note: Total Rainfall Equivalent is rain and melted snow amounts

In reviewing each month of the winter season, December, January, and February were all above normal for temperature. The greatest departure from normal temperatures occurred in February with 5-8.1°F above normal. 10 of the 14 stations ranked in the top warmest on record. These locations were Grand Portage (1st), Grand Marais (2nd), Babbitt (2nd), Isabella (2nd), Island Lake (2nd), Gunflint Lake (3<sup>rd</sup>), Eveleth (3<sup>rd</sup>), Wolf Ridge (3<sup>rd</sup>), Tower (4<sup>th</sup>), and Brimson (4<sup>th</sup>). The 2016-17 winter was warm and very wet throughout the 1854 Ceded Territory. It was the warmest winter on record in 51 years for the Grand Portage area and 4<sup>th</sup> warmest for the Tower area in 122 years.

Grand Portage was ranked as 4th wettest for the winter season. Isabella received 70.5 inches of snow, which was below the annual snowfall for a normal year. Each winter month was among the top 9 wettest on record. The top 4 wettest locations out of the 14 weather stations were Wolf Ridge (1st), Cloquet (3rd), Grand Portage (4th), and Isabella (4th); Table 2.



**Figure 2: Normal Snowfall Annual**  
State Climatology Office-MDNR

According to the State Climatology Office of the Minnesota Department of Natural Resources (MDNR), the normal annual snowfall for this area is 80-95 inches of snow. Average temperatures were generally 2-4°F above normal (Figure 2). There was 50.9 inches of snow for the winter in Duluth, which was 1.4 inches above the normal of 49.5 inches. The greatest amount of snowfall in a 24-hour period occurred December 11<sup>th</sup> when 8.2 inches of snow fell. However, no monthly precipitation or snowfall records were broken this winter. <http://w2.weather.gov/climate/getclimate.php?wfo=dlh>

The following maps (Figures 3-5) include NOAA snow depth data for December 31, 2016, January 31, 2017 and February 28, 2018. The snow data is part of the National Operational Hydrologic Remote Sensing Center Interactive Snow Information.

**Modeled Snow Depth (Shallow-snow Legend) for 2017 December 31, 18:00 UTC**

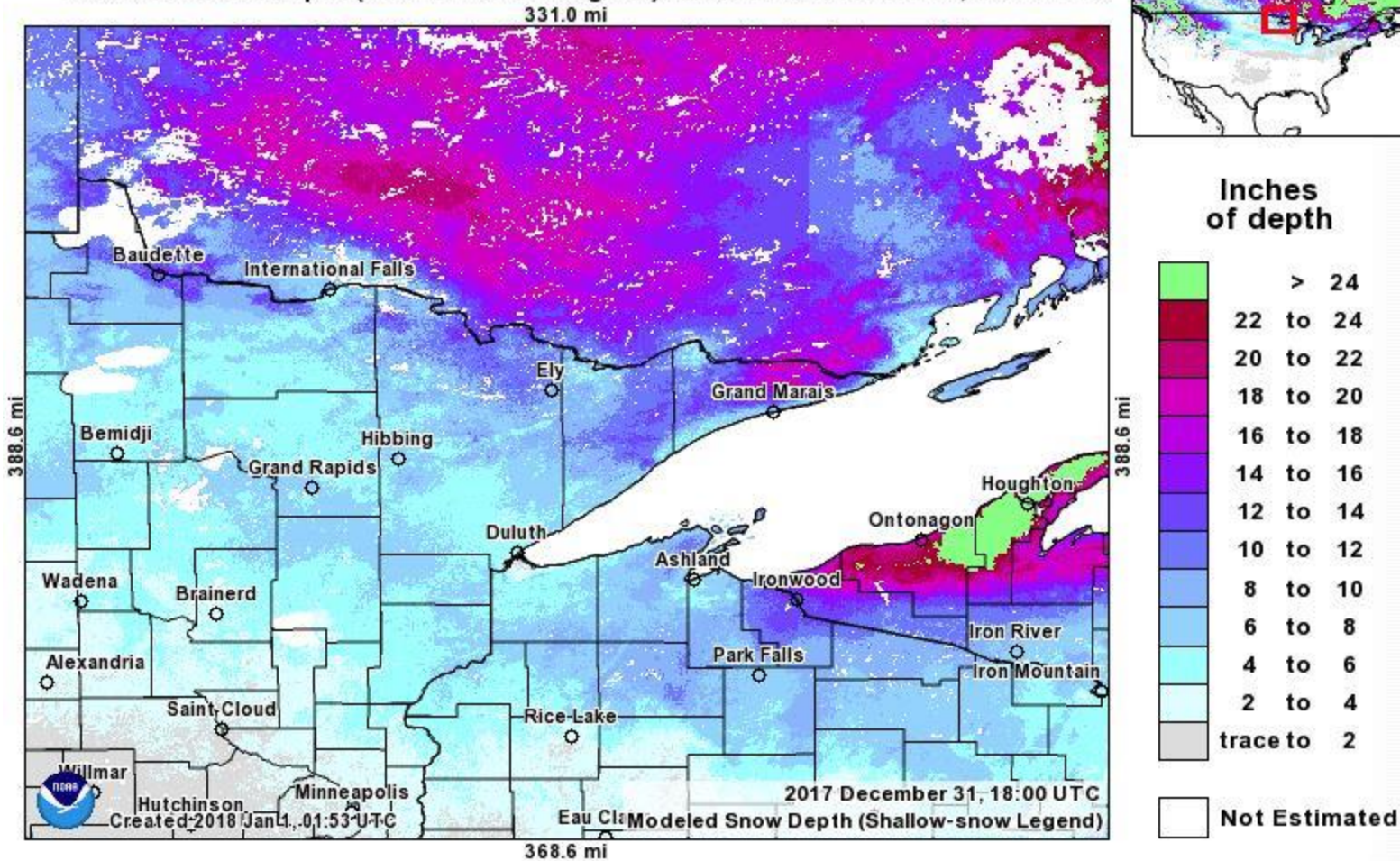


Figure 3: NOAA Modeled Snow Depth for December 31, 2016

**Modeled Snow Depth (Shallow-snow Legend) for 2017 January 31, 18:00 UTC**

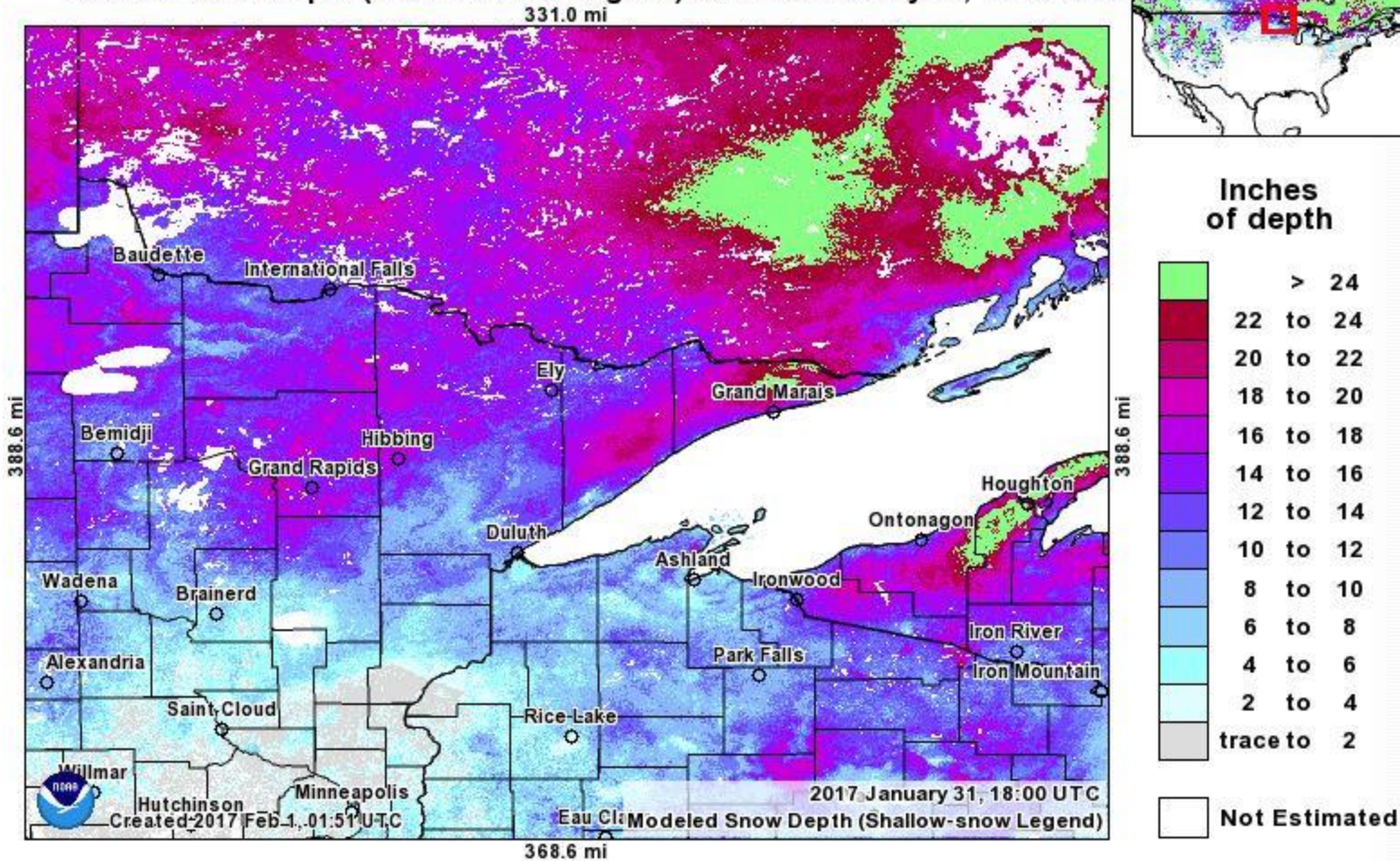


Figure 4: NOAA Modeled Snow Depth for January 31, 2017

Modeled Snow Depth (Shallow-snow Legend) for 2017 February 28, 18:00 UTC

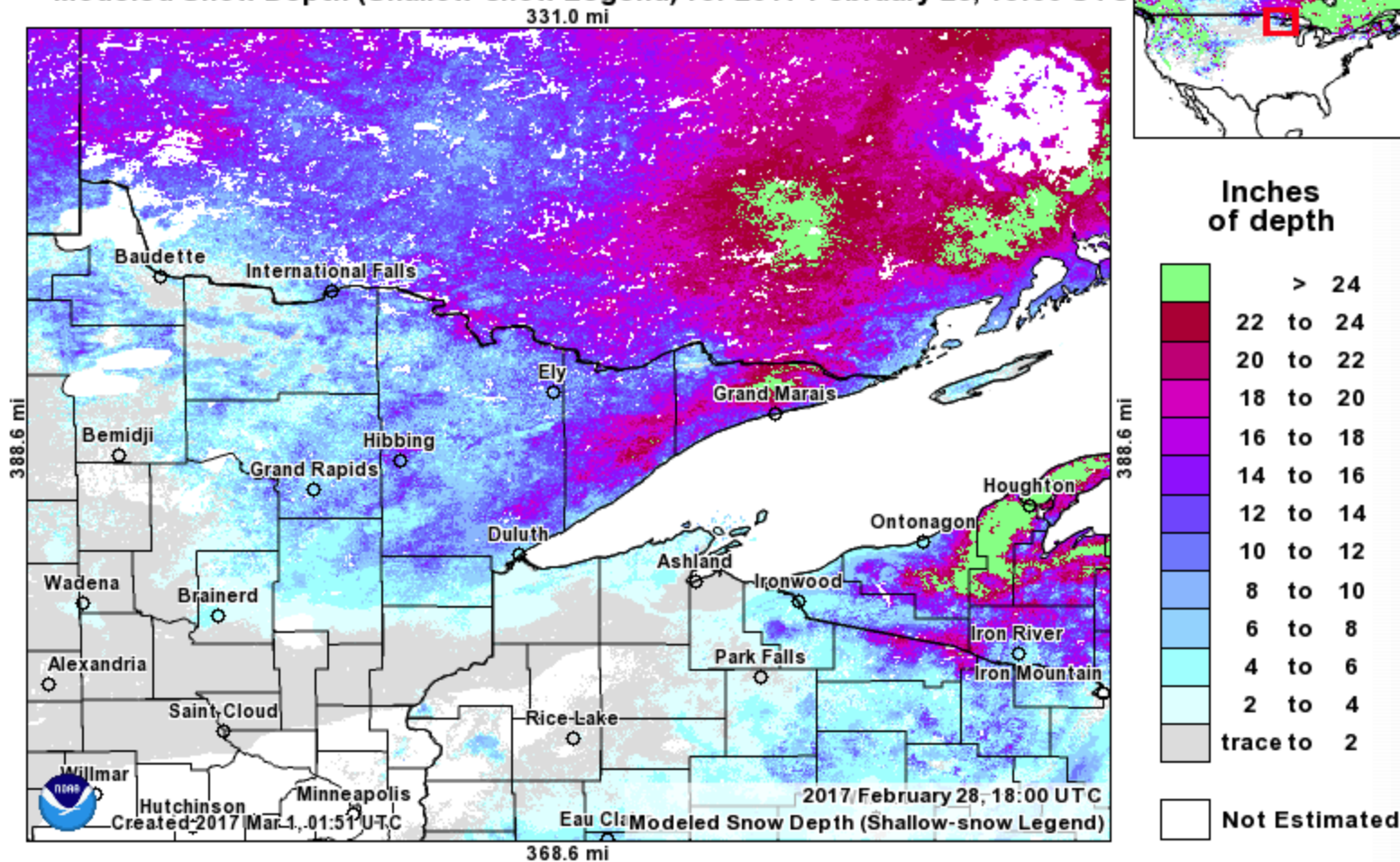


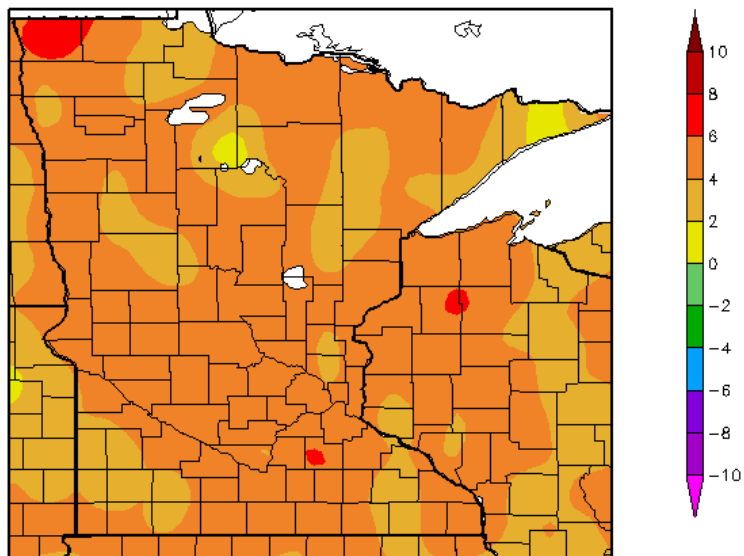
Figure 5: NOAA Modeled Snow Depth for February 28, 2017



**Table 3: NOAA Modeled Snow Depth Data (Winter 2016-2017)**

Winter Months Snow Depth 2016-2017				
	Northern Portion of 1854 Ceded Territory	Western Portion of 1854 Ceded Territory	Eastern Portion of 1854 Ceded Territory	Southern Portion of 1854 Ceded Territory
December 31, 2016	10-12 inches	10-20 inches	18-24 inches	4-10 inches
January 31, 2017	12-16 inches	14-18 inches	16-24 inches	6-12 inches
February 28, 2017	8-14 inches	4-12 inches	18-24 inches	6-18 inches

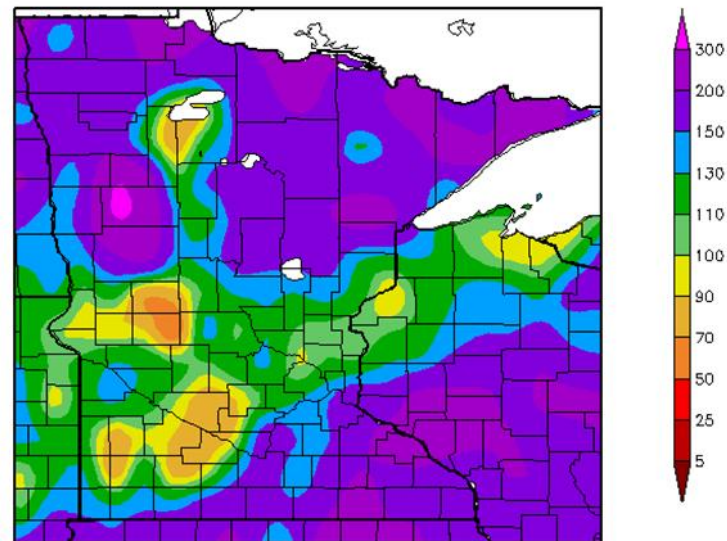
Departure from Normal Temperature (F)  
12/1/2016 – 2/28/2017



Generated 3/11/2017 at HPRCC using provisional data.

Regional Climate Centers

Percent of Normal Precipitation (%)  
12/1/2016 – 2/28/2017



Generated 3/11/2017 at HPRCC using provisional data.

Regional Climate Centers

**Figure 6: Departure from Normal Temperature (Winter 2016-2017)**

**Figure 7: Percent of Normal Precipitation (Winter 2016-2017)**

### Significant Events

The departure from normal temperature for the winter season was 2-4 degrees F° above normal, with the northeast portion staying the same. (Figure 6). Most locations in the Ceded Territory received 150-200 percent of normal precipitation (Figure 7). By the end of the season, many locations experienced one of their wettest seasons on record.

For the month of December, the lowest temperature in the Ceded Territory was recorded in Tower at -30 degrees Fahrenheit. On December 25<sup>th</sup> an ice storm was reported in Aitkin County with tree damage and freezing rain. Snowfall totals were somewhat higher in the "Superior Uplands" near Isabella, and along the ridge running parallel to the Lake Superior shoreline ([http://www.dnr.state.mn.us/climate/journal/161225\\_.html](http://www.dnr.state.mn.us/climate/journal/161225_.html)). The National Weather Service Cooperative observers in Cotton and Embarrass recorded lows of -42 on January 13, 2017. It was a warmer and wetter than normal in Duluth.

The average temperature for February was 22.5 F° which was 7.4 F° above the normal of 15.1 F°, making this the 9<sup>th</sup> warmest February in Duluth weather station history. <http://w2.weather.gov/climate/getclimate.php?wfo=dlh>

**Table 3: Spring Climate Summary (2017)**

**ZIIGWAN (SPRING)**

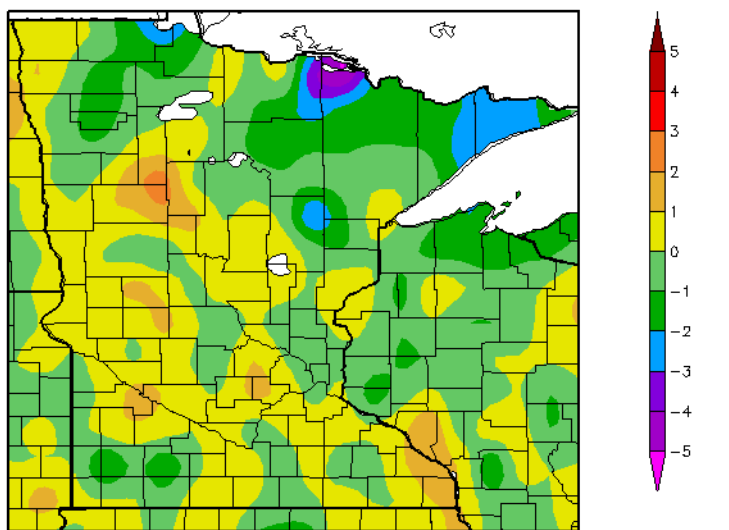
Climate Summary Spring Season 3/1/17-5/31/17												
Station	High Temperature (F°)	Low Temperature (F°)	Climate Normal Average	Temperature Departure (F°)	Temperature Rank	Period of Record	Total Rainfall Equivalent (In.)	Precipitation Departure	Precipitation Rainfall Rank	Period of Record	Snowfall (in.)	Period of Record
GRAND MARAIS	64	-9	35.3	-2.4	27th coolest	1917-2017	6.24	1.17	29th wettest	1917-2017	8.5	1900-2017
WOLF RIDGE E L C, MN	*74	*-11	*35.9	-2.1	9th coolest	1994-2017	*9.77	2.48	6th wettest	1994-2017	7.1	1993-2017
EVELETH WW PLT, MN	74	-11	38.2	-0.6	11th coolest	1987-2017	6.71	0.49	12th wettest	1987-2017	0	1986-2017
MOOSE LAKE 1 SSE	51	-7	*41	NDA	56th coolest	1915-2017	*7.12	NDA	ID	1914-2017	*3.7 T	1914-2017
CLOQUET, MN	75	-14	40.1	-0.2	56th coolest	1912-2017	9.21	2.17	19th wettest	1912-2017	3.2	1911-2017
BABBITT, MN	*74	*-12	*35.8	-1	11th coolest	2000-2017	NCN	NCN	ID	2014-2017	3.5	1999-2017
TOWER 2S, MN	73	-17	36	-1.2	42nd coolest	1896-2017	6.48	0.81	44th wettest	1896-2017	5.2	1895-2017
TWO HARBORS, MN	72	-5	38.8	-0.5	58th coolest	1894-2017	8.9	1.78	94th wettest	1894-2017	5.1	1894-2017
BRIMSON 2S, MN	74	-23	36.1	-0.2	10th coolest	1987-2017	7.53	1.19	40th wettest	1949-2017	6.6	1948-2017
GRAND PORTAGE RS, MN	71	-9	34.9	-1	13th coolest	1965-2017	8.67	1.52	12th wettest	1895-2017	7	1896-2017
DULUTH INTL. AP, MN	75	-9	39.6	0.6	45th coolest	1928-2017	8.18	1.03	25th wettest	1942-2017	8	2004-2017
ISABELLA 14W, MN	72.2	-19	72.2	NDA	2nd coolest	2010-2017	*6.22	NDA	ID	2011-2012	*19	2009-2017
ISLAND LAKE 4E, MN	74	-15	37.2	NCN	4th coolest	2012-2016	NCN	NCN	ID	2010-2017	*8.9	2009-2017
GUNFLINT LAKE 10 NW	72	-14	34.5	-1.3	30th coolest	1962-2017	5.3	-0.29	29th wettest	1962-2017	8.5	1894-2017

\*- some missing data    NCN – No Climate Normal available    NDA– No Data Available    T – trace of snow    ID – insufficient data

Note: Total Rainfall Equivalent is rain and melted snow amounts

The departure from normal temperature for most of the Ceded Territory was below the normal temperature. During the spring it was 0 to 3 degrees below normal temperatures with the greatest departure at Grand Marais with temperatures 2.4°F below normal (Figure 8). The locations that experienced temperatures for coolest include Isabella (2<sup>nd</sup>), and Island Lake (4<sup>th</sup>); Table 3. As for spring precipitation, the northwestern portion of the Ceded Territory was approximately 1.5 inches below normal precipitation. The rest of the Ceded Territory was approximately 1.5 inches above normal precipitation amounts. (Figure 9).

Departure from Normal Temperature (F)  
3/1/2017 – 5/31/2017

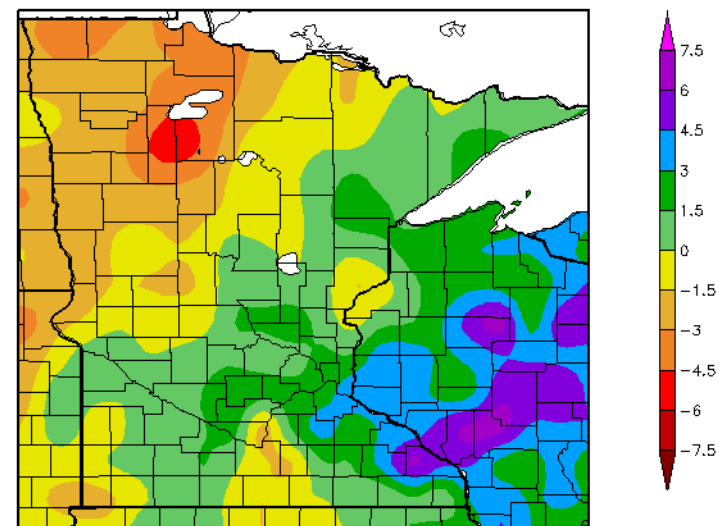


Generated 6/11/2017 at HPRCC using provisional data.

Regional Climate Centers

**Figure 8: Departure from Normal Temperature (Spring 2017)**

Departure from Normal Precipitation (in)  
3/1/2017 – 5/31/2017



Generated 6/11/2017 at HPRCC using provisional data.

Regional Climate Centers

**Figure 9: Departure from Normal Precipitation (Spring 2017)**

## Significant Events

March is typically considered a windy month and a strong wind event was observed in 2017. The winds were so strong on March 7th in Two Harbors that a wooden statue known as Pierre the Voyageur lost its arm (Figure 10). The wind gusts in Two Harbors reached 50-mph, while Grand Marais recorded a 66-mph gust.



**Figure 10: Pierre the Voyageur, Two Harbors, photo credit: Duluth News Tribune**

## Ice-Out

The timing of ice-out, when a lake becomes mostly or completely free of ice cover in the spring, can vary from lake to lake in the 1854 Ceded Territory. It can be influenced by environmental factors (air temperature, precipitation, wind), lake characteristics (size/acres, bathymetry/depth, watershed type/area) and location (north vs south, proximity to Lake Superior/lake effect). Generally, ice-out has occurred between late March and mid-May for lakes with ice-out records in the 1854 Ceded Territory.

According to available ice-out records on the Minnesota Department of Natural Resources (MNDNR) website ([http://www.dnr.state.mn.us/ice\\_out/index.html](http://www.dnr.state.mn.us/ice_out/index.html)), the timing of ice-out in 2017 appeared to be slightly earlier than average.

Not all lakes on the MNDNR website have long-term (20 or more years) ice-out records. Long-term records can help detect changes in the timing of ice-out. Figure 11 displays locations for five of the lakes in the 1854 Ceded Territory that have long-term ice-out records which includes Saganaga, Shagawa, Vermilion, Embarrass and Pike. These lakes were selected for the Climate Summary due to their locations and having long-term records available. Ice-out records for each lake are summarized in Table 4. For these five lakes, ice-out occurred 1-2 weeks earlier than their average. The MNDNR website provides median (middle) ice-out dates and not the average. The calculated averages in Table 4 are similar to the median dates provided on the website. Information for each lake includes dates for ice-out in 2017, average ice-out, earliest and latest ice-out on record and period of record. Year(s) with no record for each lake are provided below Table 4.

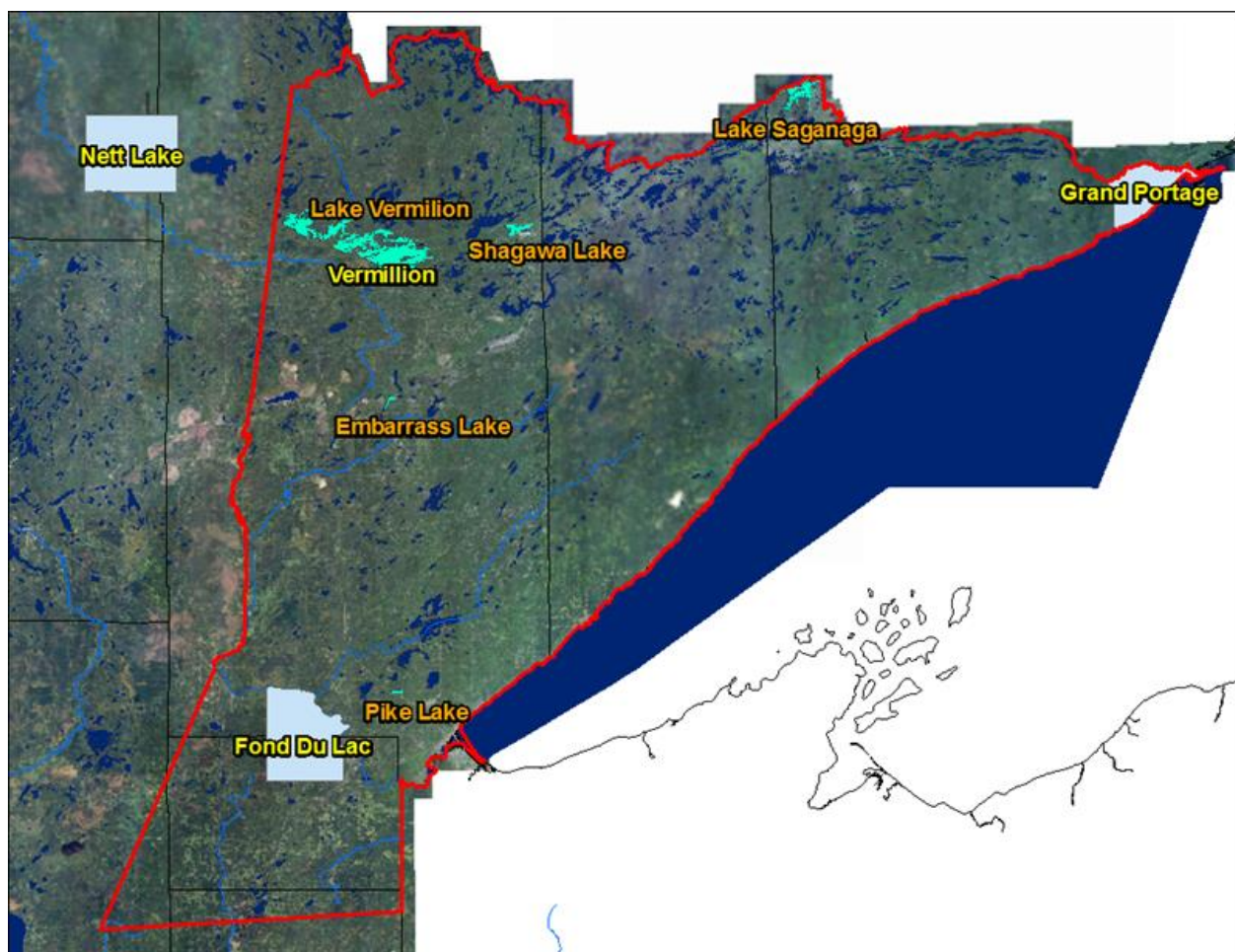


Figure 11: Lakes Selected with Ice-Out Data in the 1854 Ceded Territory

**Table 4: Ice-Out Information for Five Lakes in the 1854 Ceded Territory (in order from north to south)**

Lake	2017 Date	Average Date	Ice-Out		Period of Record
			Earliest Date	Latest Date	
Saganaga	4/23/2017	May 3	4/2/2012	5/19/2014	1988-2017
Shagawa	4/14/2017	April 26	3/27/2012	5/16/1996	1965-2017
Vermilion	4/15/2017	April 29	3/28/2012	5/23/1950	1893-2017
Embarrass	4/11/2017	April 21	3/27/2012	5/12/2013	1975-2017
Pike	4/10/2017	April 24	3/31/2012	5/15/2013	1961-2017

Years with no ice out records:

-Saganaga: 1990, 1995, 1997

-Shagawa: 2013, 2016

-Vermilion: 1894-1905, 1907-1909, 1911-1913, 1916-1922

-Embarrass: 2001

-Pike: 2011, 2014, 2015, 2016

Tracking the timing of ice-out can be useful for natural resource management. The timing of ice-out can indicate when to start monitoring certain resources such as walleye and wild rice. For walleye, partnering with the Fond du Lac Band of Lake Superior Chippewa, we perform adult spawning assessments shortly after ice-out on select lakes in the 1854 Ceded Territory. This is because adult walleye typically start to spawn shortly after ice-out and when water temperatures warm to the 42-50°F range. We assess adult walleye population abundance, age and size structure in key spawning areas on each lake. In 2017, lakes assessed and dates that our staff observed ice-out included Harriet (4/19/17), Tait (4/21/17) and Caribou which is located near Lutsen (4/24/17). On the 10 wild rice lakes we monitor annually, we start recording lake levels and temperature shortly after ice-out. This information can help describe conditions leading up to germination and may help explain wild rice growth and development for a given year. In 2017, staff observed that ice-out on lakes in Carlton/southern St. Louis counties was during the week of 4/2/17, in most of St. Louis County during the week of

4/9/17 and in Lake and Cook counties during the weeks of 4/16/17 and 4/23/17. Below are approximate ice-out dates or observations at some of the wild rice lakes we monitor:

- Big Rice Lake, St. Louis County - 4/9/17
- Campers Lake, Lake County - 4/11/17 (open when checked this date)
- Stone Lake, St. Louis County - 4/16/17 (iced up again on 4/28/17)
- Round Island Lake, Lake County - 4/16/17 (iced up again on 4/28/17)
- Cramer Lake, Lake County- 4/18/17 (open when checked this date)

Time lapse cameras (photos every hour) were placed early spring 2017 at Stone and Round Island lakes to track wild rice growth throughout the season. Photographs also provided ice-out information. The ice was completely off on Stone Lake by April 16<sup>th</sup>, then reformed on April 28<sup>th</sup> and melted by the end of the next day. The ice on Round Island Lake appeared off by April 16<sup>th</sup> (Figure 12). However, more ice formed on the lake by April 28<sup>th</sup> (Figure 13). The ice then melted by the end of the next day.



**Figure 12: Round Island Lake Ice out April 16, 2017**



**Figure 13: Round Island Lake Ice on April 28, 2017**



Table 5: Summer Climate Summary (2017)

## NIIBIN (SUMMER)

Climate Summary Summer Season 6/1/17-8/31/17												
Station	High Temperature (F°)	Low Temperature (F°)	Climate Normal Average	Temperature Departure (F°)	Temperature Rank	Period of Record	Total Rainfall Equivalent (in.)	Precipitation Departure	Precipitation Rainfall Rank	Period of Record	Snowfall (in.)	Period of Record
GRAND MARAIS	85	40	58.3	-1.3	4th coolest	1913-2017	9.28	-0.16	49th wettest	1900-2017	0	1919-2017
WOLF RIDGE E L C, MN	NCN	*40	NCN	NCN	5th coolest	1993-2017	12.76	1.59	7th wettest	1993-2017	0	1993-2017
EVELETH WW PLT, MN	86	*40	*63.8	-0.1	9th coolest	1987-2017	16.71	4.95	3rd wettest	1987-2017	0	1986-2017
MOOSE LAKE 1 SSE	*76	*53	64.4	NDA	16th coolest	1914-2017	*15.31	NDA	ID	1914-2016	0	1913-2017
CLOQUET, MN	91	33	63.9	-0.7	29th coolest	1911-2017	13.01	0.56	33rd wettest	1912-2017	0	1911-2017
BABBITT, MN	*73	*50	*61.8	NDA	ID	1999-2017	*10.75	NDA	ID	1999-2014	0	1999-2017
TOWER 2S, MN	85	34	60.7	-1.1	5th coolest	1895-2017	13.22	1.31	30th wettest	1896-2017	0	1963-2017
TWO HARBORS, MN	*89	*41	*62.9	0.6	7th coolest	1894-2017	*15.58	4.1	77th wettest	1894-2017	0	1894-2017
BRIMSON 2S, MN	86	29	59.7	-1.4	9th coolest	1990-2017	12.49	0.97	25th wettest	1949-2017	0	1951-2017
GRAND PORTAGE RS, MN	86	39	59.7	-0.8	3rd coolest	1895-2017	13.03	2.39	4th wettest	1895-2017	0	1997-2017
DULUTH INTL. AP, MN	88	40	62.6	-0.9	11th coolest	1928-2017	16.55	4.77	7th wettest	1941-2017	0	1928-2017
ISABELLA 14W, MN	*72	*50	*61.1	NDA	3rd coolest	2010-2017	*13.33	NDA	ID	2011-2012	0	2009-2017
ISLAND LAKE 4E, MN	87	38	61.9	NCN	3rd coolest	2010-2016	15.68	NCN	5th wettest	2010-2017	0	2009-2017
GUNFLINT LAKE 10 NW	*72	*50	*61.1	NDA	16th coolest	1962-2017	*13	NDA	ID	1950-2017	0	1962-2017

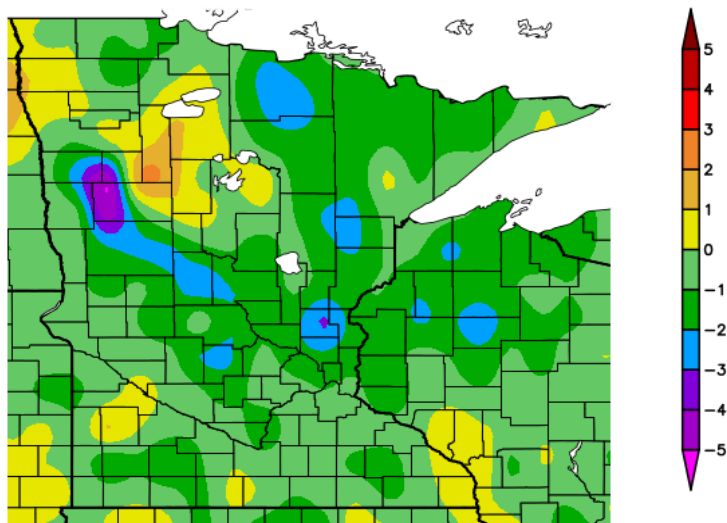
\*- some missing data    NCN – No Climate Normal    NDA – No Data Available    T – trace of snow    ID – insufficient data

Note: Total Rainfall Equivalent is rain and melted snow amounts

Most of the Ceded Territory was 1-2 degrees below normal temperature in summer 2017 (Figure 14), with the greatest departure at Brimson with temperatures 1.4 degrees below normal. There were 6 locations that experienced temperatures that were among the 5 coolest periods on record. Grand Portage (3<sup>rd</sup>), Isabella (3<sup>rd</sup>), Island Lake (3<sup>rd</sup>), Grand Marais (4<sup>th</sup>), Tower (5<sup>th</sup>) and Wolf Ridge as (5<sup>th</sup>); Table 5. The weather station Brimson 2S was used because Brimson 1E climate data was not available for this season.

As for summer precipitation, a majority of the Ceded Territory was approximately 1-5 inches above normal. The western portion was approximately 5 inches or more above normal, where the northeast portion ranged from 1 inch below to 2 inches above normal precipitation amounts (Figure 15).

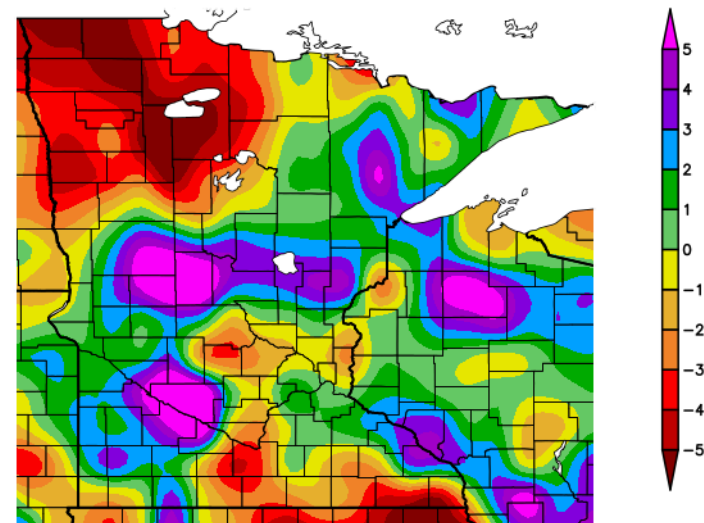
Departure from Normal Temperature (F)  
6/1/2017 – 8/31/2017



Generated 10/12/2017 at HPRCC using provisional data.

NOAA Regional Climate Center: Generated 10/12/2017 at HPRCC using provisional data.

Departure from Normal Precipitation (in)  
6/1/2017 – 8/31/2017



NOAA Regional Climate Centers

**Figure 14: Departure from Normal Temperature (Summer 2017)**

**Figure 15: Departure from Normal Precipitation (Summer 2017)**

## Significant Events

June brought cold and wet weather to the Ceded Territory. The coldest location in the state was in St. Louis County at Brimson with 29 degrees on June 1. Duluth was above normal for precipitation with a total of 4.11 inches recorded for June, 0.26 inches above the normal of 3.85 inches. The greatest amount of precipitation in a 24-hour period occurred on July 21<sup>st</sup> when 1.34 inches was recorded in Duluth. No daily precipitation records were broken for the month of July. August was the wettest month, with 7.18 inches of rain in Duluth. Overall, August was cooler than normal and was 3.1 degrees below average in Duluth. (<http://www.weather.gov/dlh/>).

**Table 6: Fall Climate Summary (2017)**

### DAGWAGIIN (FALL)

Climate Summary Fall Season 9/1/17-11/30/17												
Station	High Temperature (F°)	Low Temperature (F°)	Climate Normal Average	Temperature Departure (F°)	Temperature Rank	Period of Record	Total Rainfall Equivalent (in.)	Precipitation Departure	Precipitation Rainfall Rank	Period of Record	Snowfall (in.)	Period of Record
GRAND MARAIS	75	1	44.1	0	46th warmest	1913-2017	10.95	3.15	48th wettest	1900-2017	5	1919-2017
WOLF RIDGE E L C, MN	87	-5	42.3	0.3	6th warmest	1993-2017	12.07	2.7	17th wettest	1993-2017	9.8	1993-2017
EVELETH WW PLT, MN	*83	-4	*42.1	1.1	14th warmest	1987-2017	10.55	3.12	23rd wettest	1987-2017	9	1986-2017
MOOSE LAKE 1 SSE	*54.6	*36.1	*45.4	NDA	NDA	1914-2017	*9.2	NDA	ID	1914-2016	*1	1913-2017
CLOQUET, MN	84	-8	*44.4	1.1	47th warmest	1911-2017	*9	NDA	71st wettest	1912-2017	*4.1	1911-2017
BABBITT, MN	*83	*-12	*40.8	1.2	10th warmest	1999-2017	NCN	NCN	ID	1999-2014	*T	1999-2017
TOWER 2S, MN	82	-12	*40.9	1	31st warmest	1895-2017	*8.58	0.31	30th wettest	1896-2017	22.1T	1963-2017
TWO HARBORS, MN	82	-7	42.7	1.3	55th warmest	1894-2017	9.32	0.05	105th wettest	1894-2017	3.5	1894-2017
BRIMSON 2S, MN	*83	-13	41.1	1.1	12th warmest	1951-2017	9.84	1.71	36th wettest	1949-2017	7.6T	1951-2017
GRAND PORTAGE RS, MN	79	-1	42.4	0.7	13th warmest	1895-2017	13.36	4.02	35th wettest	1895-2017	7	1997-2017
DULUTH INTL. AP, MN	83	-5	43.3	0.8	33rd warmest	1928-2017	8.26	-0.79	71st wettest	1941-2017	14.6T	1928-2017
ISABELLA 14W, MN	82	-12	40.6	NDA	2nd warmest	2010-2017	*8.84	NDA	ID	2011-2012	*13.0T	2009-2017
ISLAND LAKE 4E, MN	82	-5	42.2	NCN	5th warmest	2010-2016	NCN	NCN	5th wettest	2010-2017	*4.7T	2009-2017
GUNFLINT LAKE 10 NW	80	-6	40.6	NCN	21st warmest	1962-2017	8.96	NCN	ID	1950-2017	*7.2T	1962-2017

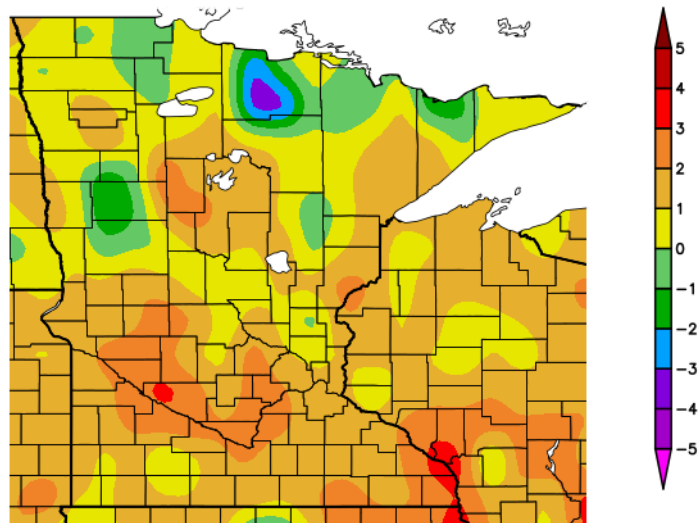
\*- some missing data    NCN – No Climate Normal    NDA – No Data Available    T – trace of snow    ID – insufficient data

Note: Total Rainfall Equivalent is rain and snow amounts

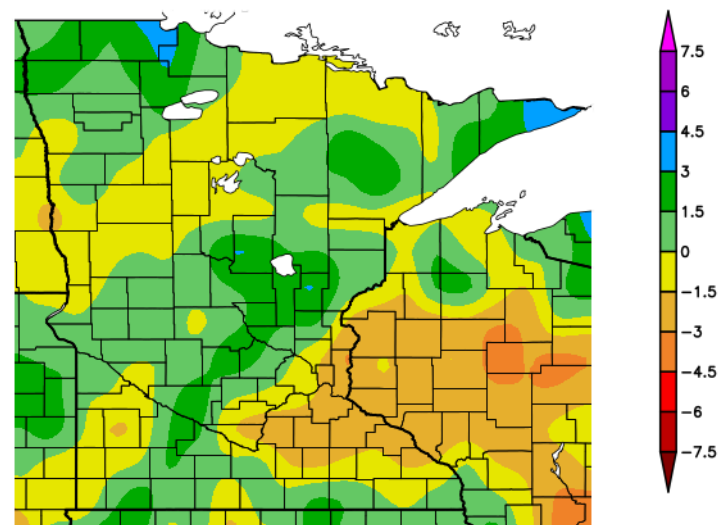
Overall, fall 2017 temperatures were above normal in the 1854 Ceded Territory. Temperatures ranged up to 1.3 degrees above average. (Figure 16). The locations that experienced temperatures that ranked in the top 5 for warmest include Isabella (2<sup>nd</sup>) and Island Lake (5<sup>th</sup>). The weather station Brimson 2S was used because Brimson 1E climate data was not available for this season. (Table 6).

Fall precipitation for much of the Ceded Territory was within 1.5 inches above normal, while the northeast experienced above normal precipitation of approximately 3 inches (Figure 17).

Departure from Normal Temperature (F)  
9/1/2017 – 11/30/2017



Departure from Normal Precipitation (in)  
9/1/2017 – 11/30/2017



Generated 12/10/2017 at HPRCC using provisional data.

NOAA Regional Climate Centers

Generated 12/10/2017 at HPRCC using provisional data.

NOAA Regional Climate Centers

**Figure 16: Departure from Normal Temperature (Fall 2017)**

**Figure 17: Departure from Normal Precipitation (Fall 2017)**



**Figure 18: October 28, 2017 Brighton Beach, Duluth, MN**

### **Significant Events**

A significant weather event occurred on October 28, 2017 that caused damage along the north and south shore of Lake Superior. The winds, subsequent waves and high surf caused portions of the lake walk in Duluth to get torn up and strewn with rocks and debris. Storms like these highlight the need to prepare our infrastructure to better withstand these extreme weather events (<http://www.weather.gov/dlh/lateoctoberstorm>).

### **Ice-Up**

Field observations indicated that smaller lakes in the Ceded Territory were icing up toward the end of October and early November 2017, perhaps earlier than most years. The time lapse cameras at Round Island and Stone Lakes did capture ice formation. On Round Island Lake, ice started forming on the lake by October 27, 2017. Full ice appeared to cover Stone Lake by October 28, 2017.

### **Future Plans**

The 1854 Treaty Authority will continue to develop annual climate summaries based on winter, spring, summer, and fall seasons. The climate summary will provide useful information to evaluate impacts to the Ceded Territory resources and to better adapt and prepare for changing climate conditions. The climate change program is working to implement strategies that have been identified in the Climate Change Vulnerability Assessment and Adaptation Plan: 1854 Ceded Territory Including the Bois Forte, Fond du Lac and Grand Portage Reservations. The plan can be found at <http://www.1854treatyauthority.org/reports/reports.html>

## Sources Cited

NWS Forecast Office Duluth, MN July 21, 2017

<http://www.weather.gov/dlh/>

“Create a Minnesota Climate Summary Table” State Climatology Office Minnesota Department of Natural Resources (MDNR)

<http://www.dnr.state.mn.us/climate/historical/summary.html>

Duluth, MN October 28, 2017 Storm Surge <http://www.duluthnewstribune.com/news/4350193-show-force-storm-drops-record-snow-causes-havoc-along-lake-superior-shore>

Duluth News Tribune <http://www.duluthnewstribune.com/news/4230768-high-winds-damage-two-harbors-landmark-pierre-voyageur>

Furious Winds and Snow- The October 27th-28th Storm

<http://www.weather.gov/dlh/lateoctoberstorm>

High Plains Regional Climate Center CLIMOD Page <https://hprcc.unl.edu/maps.php?map=ACISClimateMaps>

Ice, heavy rain, thunder, snow: December 25, 2016 <http://www.dnr.state.mn.us/climate/journal/161225.html>

MDNR Ice out records [http://www.dnr.state.mn.us/ice\\_out/index.html](http://www.dnr.state.mn.us/ice_out/index.html)

Minnesota Normal Annual Snowfall: 1981-2010. Minnesota Department of Natural Resources, 2018. February 2018.

[http://www.dnr.state.mn.us/climate/summaries\\_and\\_publications/normals\\_snow\\_1981\\_2010.html](http://www.dnr.state.mn.us/climate/summaries_and_publications/normals_snow_1981_2010.html)

National Operational Hydrologic Remote Sensing Center Interactive Snow Information National Oceanic Atmospheric Administration (NOAA), March 16, 2017. February 2018.

[http://www.nohrsc.noaa.gov/interactive/html/map.html?ql=station&zoom=&loc=48.36+N%2C+98.41+W&var=snow\\_depth\\_shallow&dy=2016&dm=12&dd=31&dh=17&snap=1&o11=1&o9=1&o13=1&lbl=m&mode=pan&extents=us&min\\_x=-98.500000000001&min\\_y=42.249999999996&max\\_x=-87.691666666668&max\\_y=50.358333333329&coord\\_x=-93.095833333345&coord\\_y=46.304166666662496&zbox\\_n=&zbox\\_s=&zbox\\_e=&zbox\\_w=&metric=0&title=1&width=600&height=450&nw=600&nh=450&h\\_o=0&font=0&js=1&uc=0](http://www.nohrsc.noaa.gov/interactive/html/map.html?ql=station&zoom=&loc=48.36+N%2C+98.41+W&var=snow_depth_shallow&dy=2016&dm=12&dd=31&dh=17&snap=1&o11=1&o9=1&o13=1&lbl=m&mode=pan&extents=us&min_x=-98.500000000001&min_y=42.249999999996&max_x=-87.691666666668&max_y=50.358333333329&coord_x=-93.095833333345&coord_y=46.304166666662496&zbox_n=&zbox_s=&zbox_e=&zbox_w=&metric=0&title=1&width=600&height=450&nw=600&nh=450&h_o=0&font=0&js=1&uc=0)

The Duluth Climate Summary for the Season, from 12/1/2016 TO 2/28/2017 <http://w2.weather.gov/climate/getclimate.php?wfo=dlh>

The Duluth MN Climate Summary for the Month of February 2017. <http://w2.weather.gov/climate/getclimate.php?wfo=dlh>

Tyler Kaspar, Lakes Selected with Ice-Out Data in the 1854 Ceded Territory. [1:1,155,846]. 1854 Treaty Authority: ArcGIS 10.0 Desktop-ArcMap, 2017.

Tyler Kaspar, Weather Stations in Ceded Territory Used for the Climate Summary. [1:1,155,846]. 1854 Treaty Authority: ArcGIS 10.0 Desktop-ArcMap, 2017.