

Natural Hazards Assessment

Olmsted County, MN

Prepared by: NOAA / National Weather Service La Crosse, WI



Natural Hazards Assessment for Olmsted County, MN

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Last Update: October 2013

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Overview

Olmsted County is in the Upper Mississippi River Valley of the Midwest with rolling hills and relatively flat farm land. The City of Rochester is a large urban area in the middle of the county.

The area experiences a temperate climate with both warm and cold season extremes.

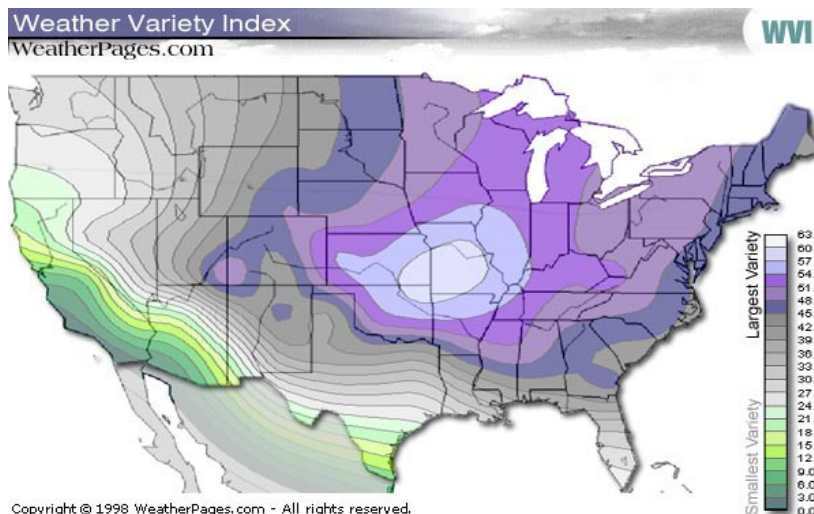
Winter months can bring occasional heavy snows, intermittent freezing precipitation or ice, and prolonged periods of cloudiness. While true blizzards are rare, winter storms impact the area on average about 4 times per season. Occasional arctic outbreaks bring extreme cold and dangerous wind chills.

Weather conditions are measured at the airport which is on a relatively open and high area (plateau), different than may be observed in downtown Rochester (urban and lower area).

Thunderstorms occur on average 30 to 50 times a year, mainly in the spring and summer months. The strongest storms can produce associated severe weather like tornadoes, large hail, or damaging wind. Both river flooding and flash flooding can occur, along with urban-related flood problems. Heat and high humidity is occasionally observed in June, July, or August.

The autumn season usually has the quietest weather. Dense fog occurs several times during mainly the fall or winter months. High wind events can also occur from time to time, usually in the spring or fall.

The variability in weather can be seen in the following graphic, created by a private company (weatherpages.com) that rated each city on variations in temperature, precipitation, and other factors. Rochester, MN ranked 3rd highest in variability out of 277 cities.



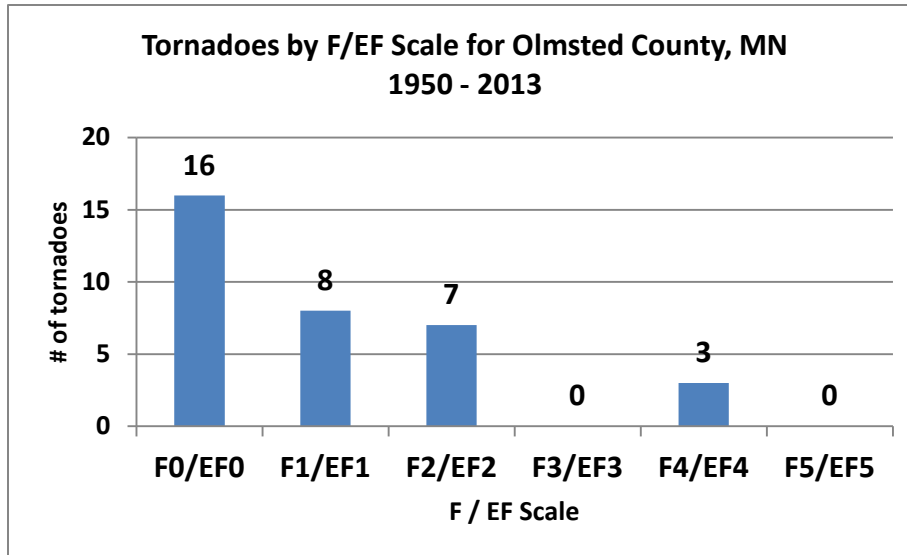
Since 1998, Olmsted County has been included in a FEMA Federal Disaster Declaration 6 times:

- 1998 – Severe storms
- 2001 – Flooding
- 2004 – Severe storms / flooding
- 2007 – Severe storms / flooding
- 2010 – Severe storms / tornado
- 2010 – Severe storms / flooding

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Tornadoes

Even though Minnesota averages about 24 tornadoes per year, Olmsted County has only had 34 tornadoes since 1950, averaging about one tornado every 1-2 years. Most tornadoes are short-lived and small. May and June are the peak months and most occur between 3 and 9 p.m., but they can occur nearly any time of year and at all times of the day. Tornadoes are less common east of the county.



Most recent tornadoes:

- Aug.13, 2010 (EF0*)
- June 17, 2010 (EF1*)
- May 1, 2001 (F0)
- June 24, 1998 (F0)
- May 15, 1998 (F1)
- Aug.13, 1995 (F0)
- June 8, 1993 (F0)
- June 8, 1993 (F0)
- June 7, 1984 (F1)
- May 17, 1982 (F0)
- May 17, 1982 (F2)
- Apr.29, 1981 (F0)

On August 21, 1883, a large, killer tornado (F5) hit Olmsted County and the city of Rochester destroying most of the homes and commercial structures on the north side of town. A total of 24 people were killed in Rochester, but the tornado itself killed a total of 37 residents in southeast Minnesota. At least 200 people were injured. Hundreds of homes were damaged or destroyed. At the time of the tornado, the city of Rochester did not have a medical facility that could treat all the injured. A local doctor, William W. Mayo and his two sons worked together with the sisters of St. Francis church to care for the wounded. This was the start of the Mayo Clinic.

Strongest tornadoes: (1850-2013)

- Aug.21, 1883 (F5) – 200 inj, 37 dead
- Oct.3, 1903 (F4) – 45 inj, 9 dead
- July 21, 1883 (F4) – 30 inj, 4 dead
- May 10, 1953 (F4) – 11 inj, 1 dead
- Sept.16, 1962 (F4) – 34 inj, 0 dead

Olmsted County Tornado Facts:

- One F5 tornado in history
- Last violent tornado - 1962
- 55 deaths and 377 injuries since 1850
- Tornadoes have occurred April – October
- Most have occurred in June (12)

Tornado Watches		Tornado Warnings	
Year		Year	
2013	3	2013	1
2012	2	2012	0
2011	2	2011	0
2010	5	2010	5
2009	3	2009	0
2008	7	2008	1
2007	4	2007	0
2006	5	2006	1
2005	7	2005	2
2004	10	2004	1
2003	5	2003	0
2002	5	2002	0

Enhanced Fujita (EF*) Scale	
EF0	65-85 mph
EF1	86-110 mph
EF2	111-135 mph
EF3	136-165 mph
EF4	166-200 mph
EF5	>200 mph

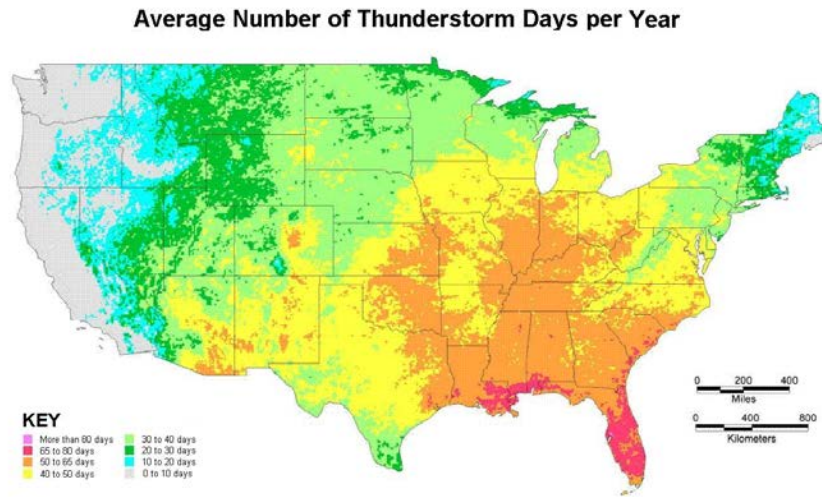
* Started February 1, 2007

Severe Thunderstorms / Lightning

Olmsted County averages 39 thunderstorm days per year. The National Weather Service (NWS) considers a thunderstorm severe when it produces wind gusts of 58 mph (50 knots) or higher, 1 inch diameter hail or larger, or a tornado.

Downdraft winds from a severe thunderstorm can produce local or widespread damage, even tornado-like damage if strong enough. Most severe thunderstorm winds occur in June or July and between the hours of 4 and 8 p.m., but can occur at other times. Most damage involves blown down trees, power lines, and damage to

weaker structures (i.e. barns, outbuildings, garages) with occasional related injuries. In 1998, a large squall line moved through the region with wind gusts in excess of 100 mph knocking down hundreds of trees and damaging buildings. Power was also out in many communities. In June 2010 a squall line produce a tornado (see picture below) and wind gusts close to 80 mph near Rochester causing a lot of damage. There have been 142 damaging wind reports since 1982 in the county.



Large hail can also occur in a severe thunderstorm. May and June are the peak months with the most common time between 1 and 9 p.m., but it can occur in other warm season months and at any time of day. Hail is typically a crop damaging hazard but can damage roofs, windows, and vehicles if large enough (> 1"). Expenses can be high. Injuries or fatalities are rare for hail. In August 1999, a severe thunderstorm moved through the county during the early afternoon dropping hail up to 2" in diameter. Hundreds of cars were damaged, especially in Rochester, causing several million in damage. In August 2006, a series of morning storms dropped large hail (golf ball size) in Oronoco, Rochester, and Byron. There have been 205 large hail ($\geq 3/4"$) reports in the county since 1982.

Severe Thunderstorm Watches		Severe Thunderstorm Warnings	
Year	Year	Year	Year
2013	4	2013	11
2012	9	2012	9
2011	8	2011	13
2010	14	2010	13
2009	6	2009	7
2008	9	2008	13
2007	15	2007	10
2006	12	2006	10
2005	14	2005	6
2004	11	2004	6
2003	8	2003	1

Non-severe thunderstorms still pose a lightning risk. According to the Vaisala Group, an average of nearly 400,000 cloud-to-ground strikes hit Minnesota each year based on data from 1997 to 2010. Nationally, Minnesota ranks 28th in lightning related fatalities with 64 deaths since 1959. There have been lightning fatalities in Minnesota in 2007, 2009, 2012, and 2013.



Flooding and Hydrologic Concerns

On occasion intense, heavy rain producing thunderstorms or consecutive thunderstorms (“training”) can bring excessive rainfall leading to flash flooding in Olmsted County. The hilly terrain promotes rapid runoff and can enhance the threat. Intense rainfall rates also lead to occasional urban street flooding, especially in/around the city of Rochester.

June is the most common month for flash floods, but they can occur from May through September. They are most common in the evening hours, between 8-10 p.m., but can occur at other times and typically last from 3-6 hours. Between 1995 and 2013 there were 18 flood related deaths in Minnesota.

In August 2007, a major flash flood event hit the region with widespread 12 to 17 inches of rain over a 24-hour period. Some highways were closed and numerous homes and business were damaged, especially in eastern areas of the county. The county was declared a federal disaster area with an estimated 40 million dollars in damage.

Two river basins impact Olmsted County – the South Branch of the Zumbro River and the Root River. There are numerous creeks that also converge with these rivers in the county. Flooding can occur from spring snowmelt and area rain, although many of the worst floods have occurred from heavy rain scenarios.

The flood of record in the area was 1978 when several rounds of thunderstorm complexes brought flash flooding and eventually widespread river flooding. Six to seven inches of rain fell on July 5-6, 1978 in Olmsted County causing the South Branch of the Zumbro River to flood large parts of Rochester and nearby communities. There were at least 5 fatalities and over 5000 people evacuated. A major flood control project was completed in 1995 because of this flood. (Photos below – 1978 Flood in Rochester, MN)

Flash Flood Warnings	
Year	
2013	3
2012	0
2011	2
2010	3
2009	1
2008	0
2007	2
2006	1
2005	0
2004	4
2003	0



Zumbro River @ Rochester Top 5 Crests (FS: 14 feet)	
Date	Crest
7/6/1978	23.4'
9/21/1986	20.8'
3/1/1965	19.1'
3/29/1962	18.5'
7/21/1951	17.5'

The Root River flows through southern ends of the county, including the communities of Stewartville and Chatfield, but has less of a flood history in Olmsted County.

Winter Storms and Extreme Cold

Hazardous winter weather can bring a variety of conditions to Olmsted County. Since 1982, an average of 4 winter storms impact the area each season. The relatively flat terrain does lead to blizzard or near-blizzard conditions more frequently than counties to the east, with about 9 blizzards documented since 1961. Heavy snow, sleet, and periods of blowing/drifted snow all occur.

The 30-year average seasonal snowfall at Rochester is 52.5 inches with a record of 85.1 inches set during the 1996-1997 winter. The bulk of snow falls between December and March. The largest winter storms tend to form over the central or southern Plains, then move northeast towards the western Great Lakes.

On February 23-25, 2007, a major winter storm impacted Olmsted County. The combination of heavy snow, sleet, and significant blowing and drifting over the weekend paralyzed much of the region. A true blizzard also impacted the area on December 10-11, 2010 with over 12 inches of snow and an extended period with low visibilities and high winds making travel near impossible. On January 29, 2008, a strong cold front passed through with temperatures dropping 52°F in one day (40°F down to -12°F). As snow began to fall, winds also increased leading to blizzard conditions very quickly.

Top 5 Seasonal Snowfalls in Rochester	
Years	Snowfall
1996-97	85.1"
1950-51	77.5"
2012-13	74.0"
1961-62	73.7"
1951-52	73.6"

March can often be a snowy month. Even though snowfall may be less frequent, heavy wet snow can form from large spring storms. In 2005, a large winter storm dropped 22.5 inches of snow around Byron, MN and 20.1 inches at Rochester on March 18-19th. The 19.8 inches that fell on March 18th established a new one-day snowfall record at Rochester.

Ice storms (1/4" of ice or more) can occur but are relatively rare with only 7 occurrences since 1993.

Arctic cold outbreaks can occur in the upper Midwest as well. Snow depth can modify these cold temperatures leading to sub-zero readings on average 33 times a winter. Occasionally strong northwest winds will combine with arctic outbreaks to create dangerous wind chill conditions as well. The coldest temperatures are usually in January and February with average lows in the single digits and record lows colder than -30°F most days. The all-time record low is -42°F set in 1887.

Since 1993 there have been 8 fatalities in Minnesota due to extreme cold.



In 1996, Rochester went 5 consecutive days with temperatures below zero degrees (F) following a blizzard about a week earlier. Low temperatures of -27°F, -35°F, and -30°F were set on three straight mornings.

Coldest Lows at Rochester, MN	
Low	Date
-42°F	1/7/1887
-40°F	1/30/1951
-39°F	2/20/1930
-39°F	1/13/1912
-39°F	1/12/1912

The La Crosse National Weather Service issues Wind Chill Advisories when wind chill readings of -20°F to -34°F are expected. Wind Chill Warnings are issued when wind chill values at or below -35°F are expected or occurring. In January 2009, a 3-day cold wave produced wind chills of -35°F to -50°F.

Heat, Drought, and Wildfires

On occasion the weather pattern across the upper Midwest favors prolonged heat and humidity, leading to heat waves. June through August are the warmest months with average high temperatures around 80°F and record highs above 100°F most days. The warmest temperature on record at Rochester is 108°F set on July 14, 1936.

In Olmsted County, there have been 8 heat waves since 1993. During that same time period, there were 16 fatalities directly related to heat waves in Minnesota, including a fatality in Stewartville, MN in August 2013.

One of the longest heat waves on record occurred in July 1936 when Rochester hit 90°F or higher on 14 consecutive days, including 12 days at or above 100°F and an all-time record of high of 108°F as noted above. In more recent years, heat waves occurred in July 1995 (99°F) and again in July and August of 2001 when a fatality occurred in Rochester.

Warmest Highs at Rochester, MN	
High	Date
108°F	7/14/1936
107°F	7/13/1936
107°F	7/12/1936
106°F	5/31/1934
105°F	7/10/1936

In July 2011 record warm dew points and heat indices were set. The heat indices from July 17-20 were 108, 118, 112, and 105 at Rochester after the dew points topped off at 83.



Prolonged dry spells can also lead to drought causing extreme damage to crops. Droughts vary in length and intensity but abnormally dry to moderate drought conditions can occur quite frequently. Severe to extreme droughts occur far less frequently.

Droughts have occurred in Minnesota as recently as 1999, 2000, and 2006 through 2009. Mild drought conditions were reached again in 2011 but a major drought struck in 2012. The USDA declared the region a drought disaster.

Dry weather can also lead to a wildfire threat, especially in the spring before foliage has emerged (i.e. before green up) or in the fall after vegetation has started to die off. Warm, dry (i.e. lower relative humidities), and windy conditions all favor higher fire danger and can lead to sporadic grass and cropland field fires in Olmsted County. Thick, wooded areas also pose a threat for wildfires under extremely dry conditions but occur far less frequently.



Local Climatology

Here are some basic climatology figures for the Olmsted County area. Data is valid for Rochester, MN based on normals from a 30-year period (1981-2010).

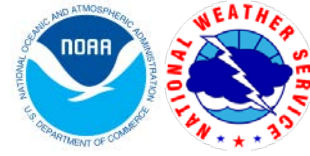
Month	Normal Maximum Temperature	Normal Minimum Temperature	Average Temperature	Precipitation	Snowfall
JAN	22.8	6.8	14.8	0.86"	12.1"
FEB	27.2	11.5	19.3	0.84"	8.7"
MAR	39.6	23.4	31.5	1.88"	8.9"
APR	56.1	35.4	45.7	3.23"	3.4"
MAY	67.9	46.5	57.2	3.63"	0.0"
JUN	77.2	56.3	66.7	4.67"	0.0"
JUL	80.6	60.4	70.5	4.54"	0.0"
AUG	78.1	58.3	68.2	4.52"	0.0"
SEP	70.5	49.5	60.0	3.45"	0.0"
OCT	57.5	37.5	47.5	2.23"	0.8"
NOV	40.8	25.1	32.9	1.91"	6.1"
DEC	26.2	11.3	18.8	1.22"	12.5"
Year	53.7	35.2	44.4	32.99"	52.5"

Miscellaneous facts:

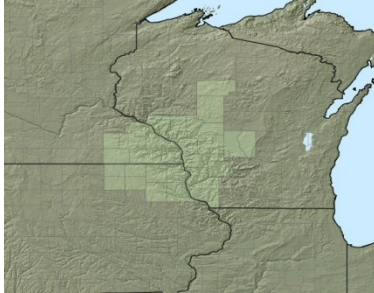
- Warmest year on record – 2012 (50.3°F)
- Warmest month on record – July 1936 (77.7°F)
- Warmest day on record – July 14, 1936 (108°F)
- Greatest number of days with 90°F or warmer – 1934 (38 times)
- Coldest year on record – 1917 (40.6°F)
- Coldest month on record – January 1912 (-3.8°F)
- Coldest day on record – January 7, 1887 (-42°F)
- Greatest number of days at 0°F or colder – 1978 (63 times)
- Wettest year on record – 1990 (43.94")
- Wettest month on record – August 2007 (14.07")
- Wettest day on record – July 11, 1981 (7.47")
- Driest year on record – 1910 (11.65")
- Driest month on record – December 1943 (Trace)
- Highest seasonal snowfall on record – 1996/97 (85.1")
- Highest monthly snowfall on record – December 2010 (41.3")
- Highest one-day snowfall on record – March 18, 2005 (19.8")
- Least seasonal snowfall on record – 1967/68 (9.1")



NOAA/National Weather Service Support and Weather Monitoring



NOAA's National Weather Service (NWS) forecast office at La Crosse, WI serves Olmsted County with weather information and support on a continuous basis. Operating 24 hours a day, a staff of 23 issues routine and non-routine informational products for the area, including all watches, warnings, and advisories related to natural hazards. Doppler radar (WSR-88D) is co-located with the La Crosse NWS office and covers the region.



NWS La Crosse has a web site at: www.weather.gov/lacrosse

Normal communication during hazardous weather scenarios is via 800 MHz (MN ARMER) radio with the Olmsted County Emergency Operations Center (EOC), amateur radio, or telephone. There is a National Warning System (NAWAS) drop at the MN State Patrol in Rochester as well.

NOAA Weather Radio coverage in Olmsted County includes WXX41 (Rochester) on 162.475 MHz.

Storm spotter groups are very active and consist of amateur radio operators, fire department personnel, law enforcement, EMS, and the general public. They are coordinated via the Olmsted County EOC. Spotter training is held annually with an average attendance in the past 5 years of 176.

There are a variety of weather monitoring sources in Olmsted County, including:

Automated weather station(s):

- Rochester Int'l Airport (KRST)

River Gauge(s):

- Bear Creek @ Rochester
- Cascade Creek @ Rochester
- Silver Creek @ Rochester
- S.Fork Zumbro River @ Beltline (Rochester)
- S.Fork Zumbro River @ 37th Street (Rochester)
- S.Fork Middle Branch Zumbro River @ Oxbow Park
- Middle Fork Zumbro River @ Pine Island
- Whitewater River @ Whitewater State Park

Cooperative Observers

- Byron 3N
- Rochester Airport 2NE



In addition, numerous volunteer reports from around the county are received at the La Crosse NWS office including rainfall, snowfall, and temperatures, on a routine basis.

Resources

National Weather Service – La Crosse	www.weather.gov/lacrosse
NWS La Crosse Tornado Database	www.weather.gov/lacrosse/?n=tornadomain
NWS La Crosse River Monitoring	http://www.crh.noaa.gov/ahps2/index.php?wfo=arx
NWS La Crosse Climate	www.weather.gov/climate/index.php?wfo=arx
NWS La Crosse Drought information	www.weather.gov/lacrosse/?n=drought
NWS La Crosse Storm Summaries	www.weather.gov/lacrosse/eventsum.php
NWS La Crosse NOAA Weather Radio page	www.weather.gov/lacrosse/nwr.php
NWS La Crosse Severe Weather Climatology	www.weather.gov/lacrosse/svr_climate.php
NWS Storm Prediction Center	http://www.spc.noaa.gov/
SPC Online Severe Weather Climatology	http://www.spc.nssl.noaa.gov/climo/online/grids/ http://www.spc.noaa.gov/climo/online/rda/ARX.html

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