Analyzing Satellite Images from the July 2016 Floods

Look through the satellite photos, passing them around your group. Note the date on each photo. Work together to describe the changes from one photo to the next in the following table:

Dates	**Changes seen in the photos**
From July 9th to July 13th	
From July 16th to July 19th	
From July 21st to July 25th	
Compare July 9th and July 25th	

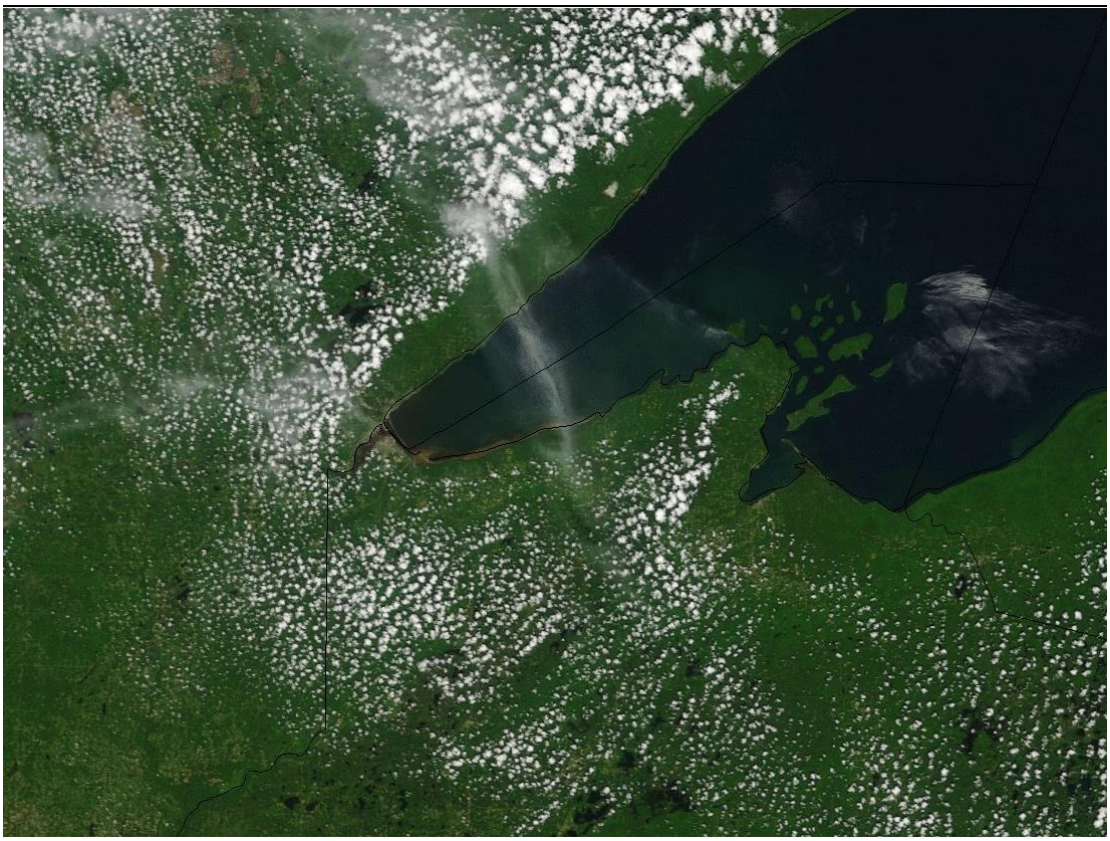
What is the reddish-brown color you can see in Lake Superior in the photos? Where is it coming from?

Turbidity is a measure of clay and silt (or sediment) in water, making it cloudy or "turbid". When a lot of turbid water enters a lake or the ocean at once, we call it a sediment plume. What direction and where do the sediment plumes go?

Use four sentences (no more and no less!) to tell a story of what happened in these photos during the July 2016 Flood. Your group must discuss and agree on the sentences before you write them.

Satellite Imagery from July 2016 Flood Event

1. July 9th, 2016



2. July 13th

Satellite Imagery from July 2016 Flood Event

3. July 16th

Close Up July 16th

Satellite Imagery from July 2016 Flood Event

4. July 19th

5. July 21st

Satellite Imagery from July 2016 Flood Event

6. July 22nd

7. July 25th

Analyzing Streamflow from the July 2016 Floods

Peak discharge occurs when a river or stream is carrying the maximum amount of water from a rain storm. What is the peak discharge in cubic feet per second for each stream? What date does peak discharge occur on?

River	Peak discharge amount (in cubic feet per second)	Date peak discharge occurred
Nemadji River		
Whittlesey Creek		
Bad River		

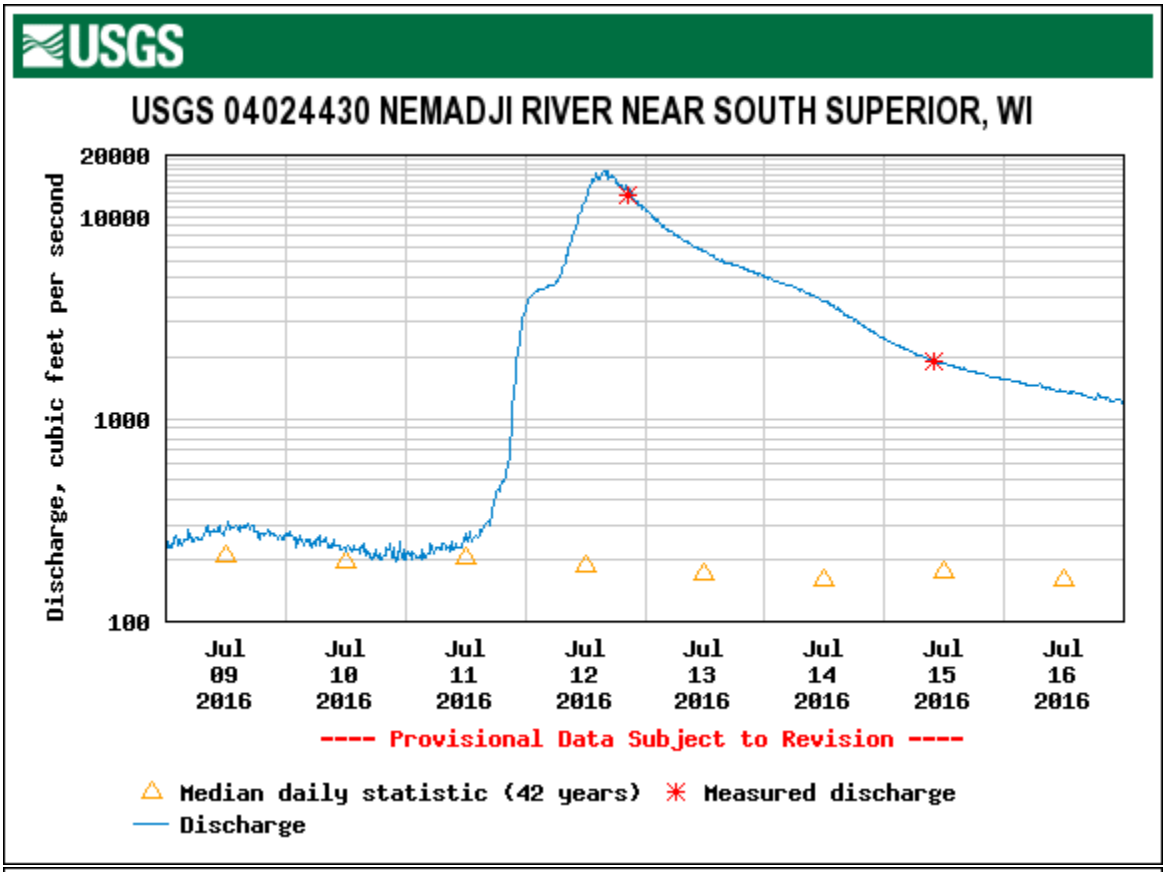
Specific conductance is a measure of salts and minerals in water. What happened to specific conductance on the Bad River after the storm?

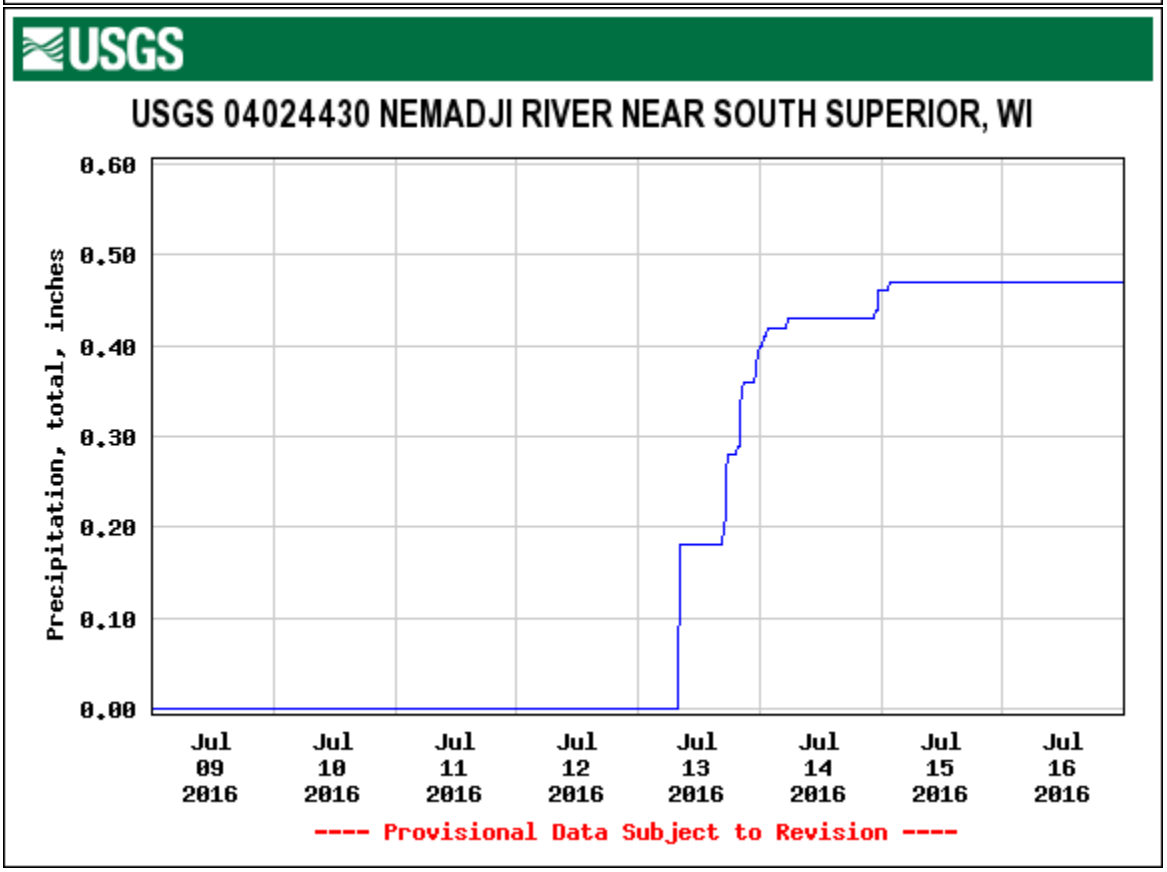
Turbidity is a measure of clay and silt in water, making it cloudy or "turbid". What happened to the turbidity of the Bad River?

Why did these changes occur?

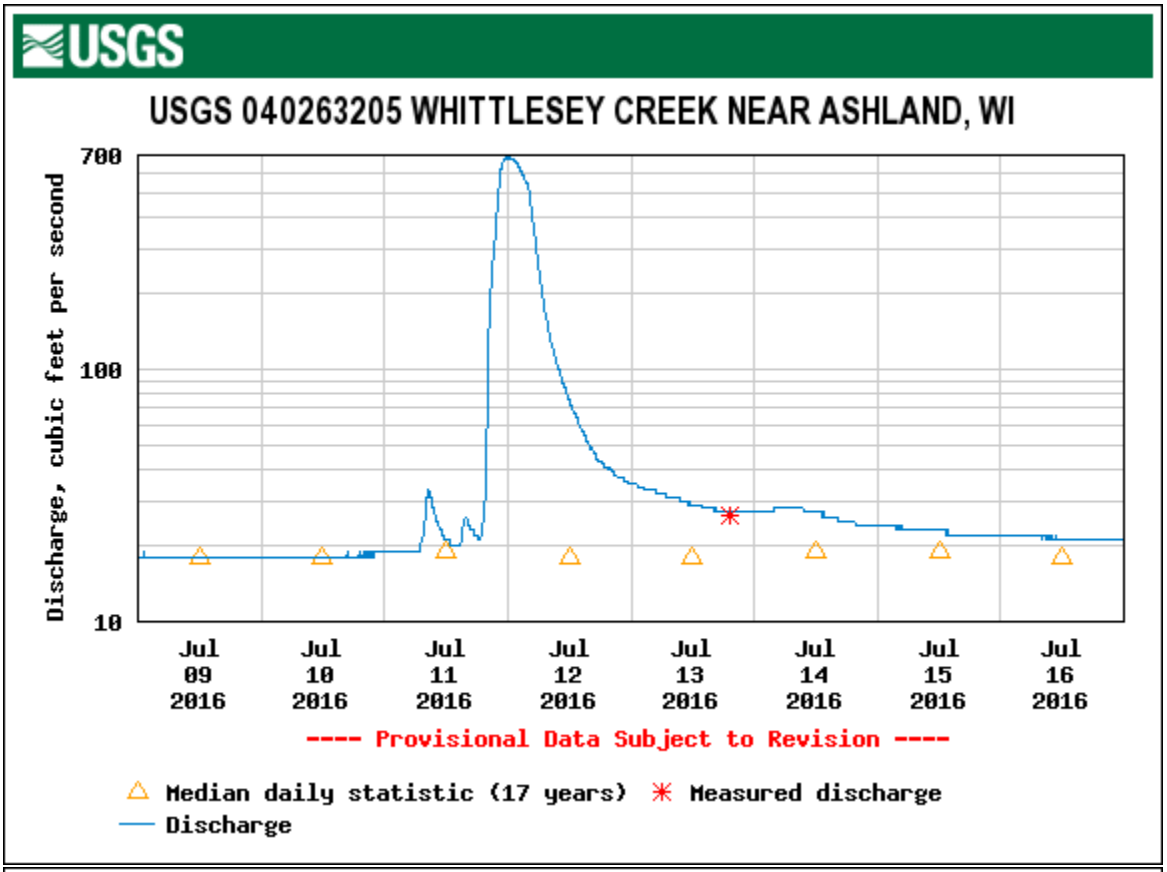
Use four sentences (no more and no less!) to tell a story of what happened to these rivers during the July 2016 Flood. Your group must discuss and agree on the sentences before you write them.

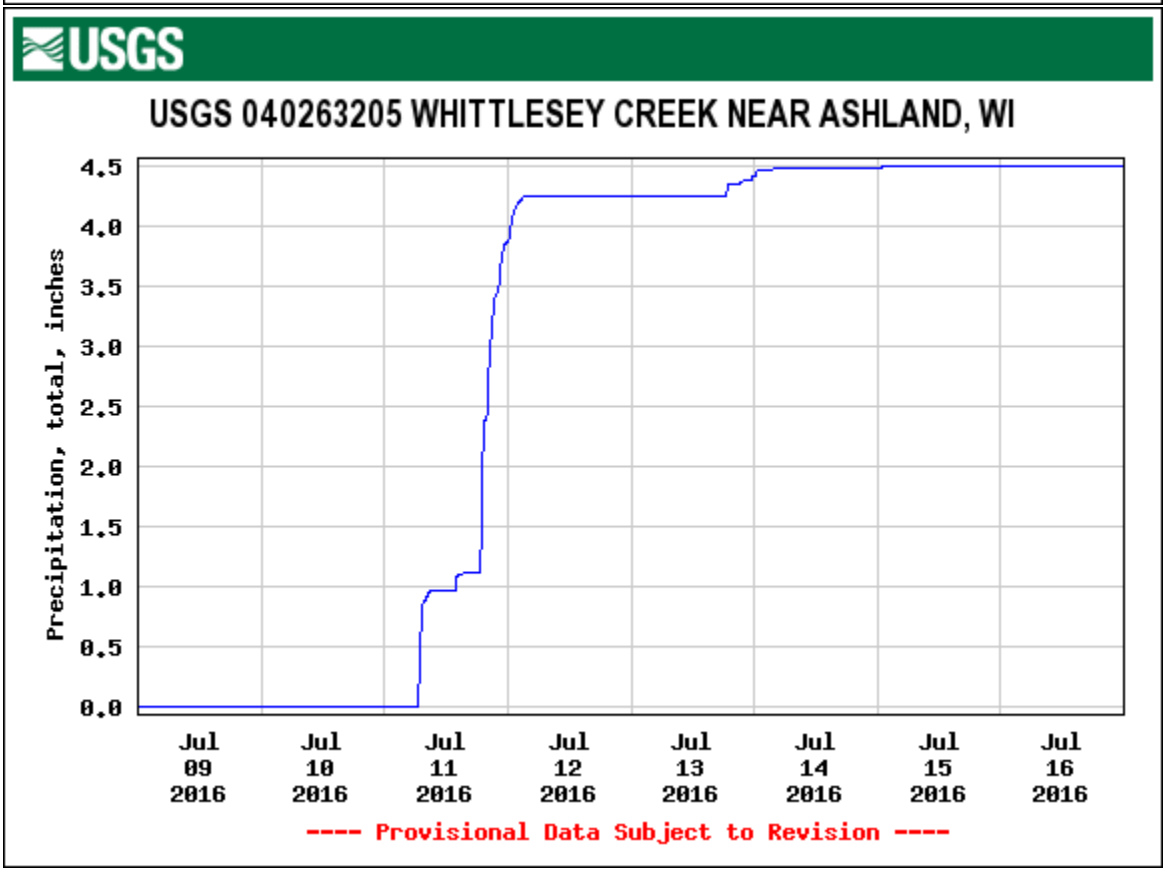
Streamflow Data from July 2016 Flood Event



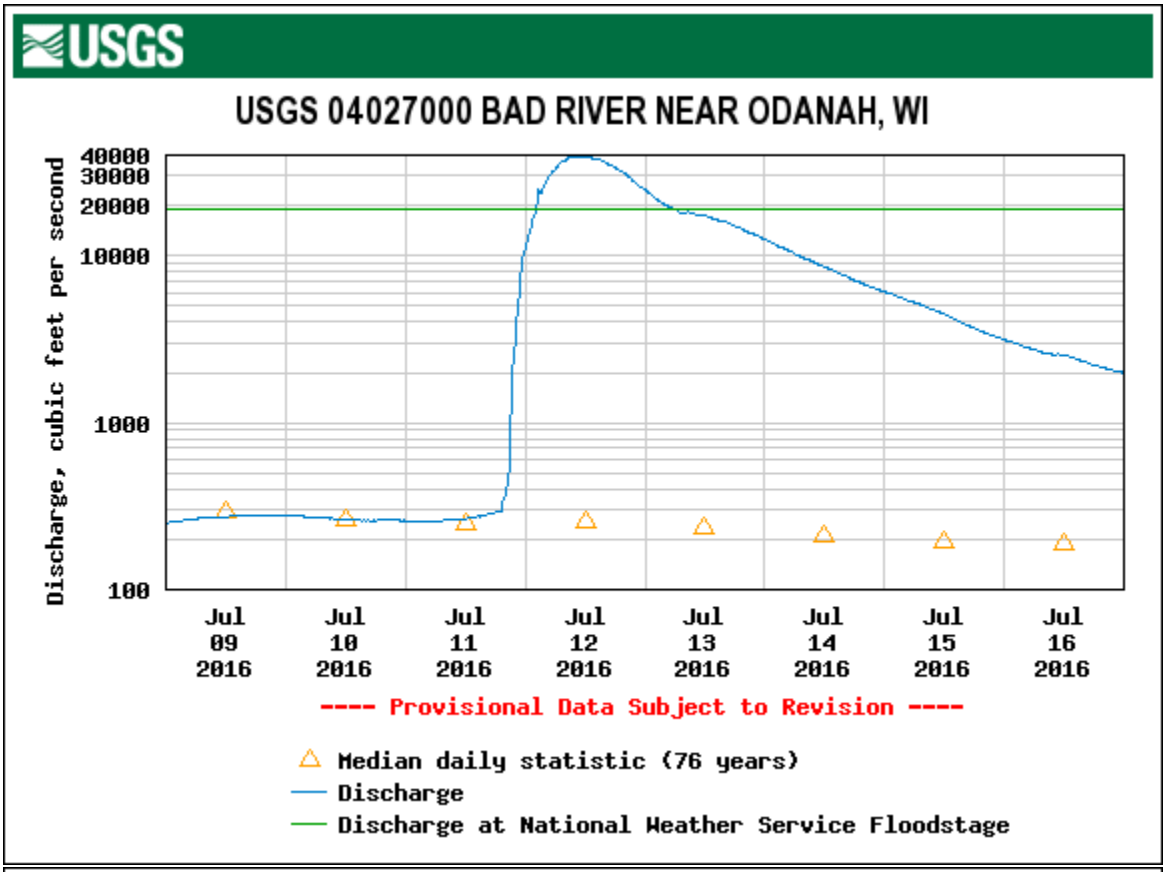


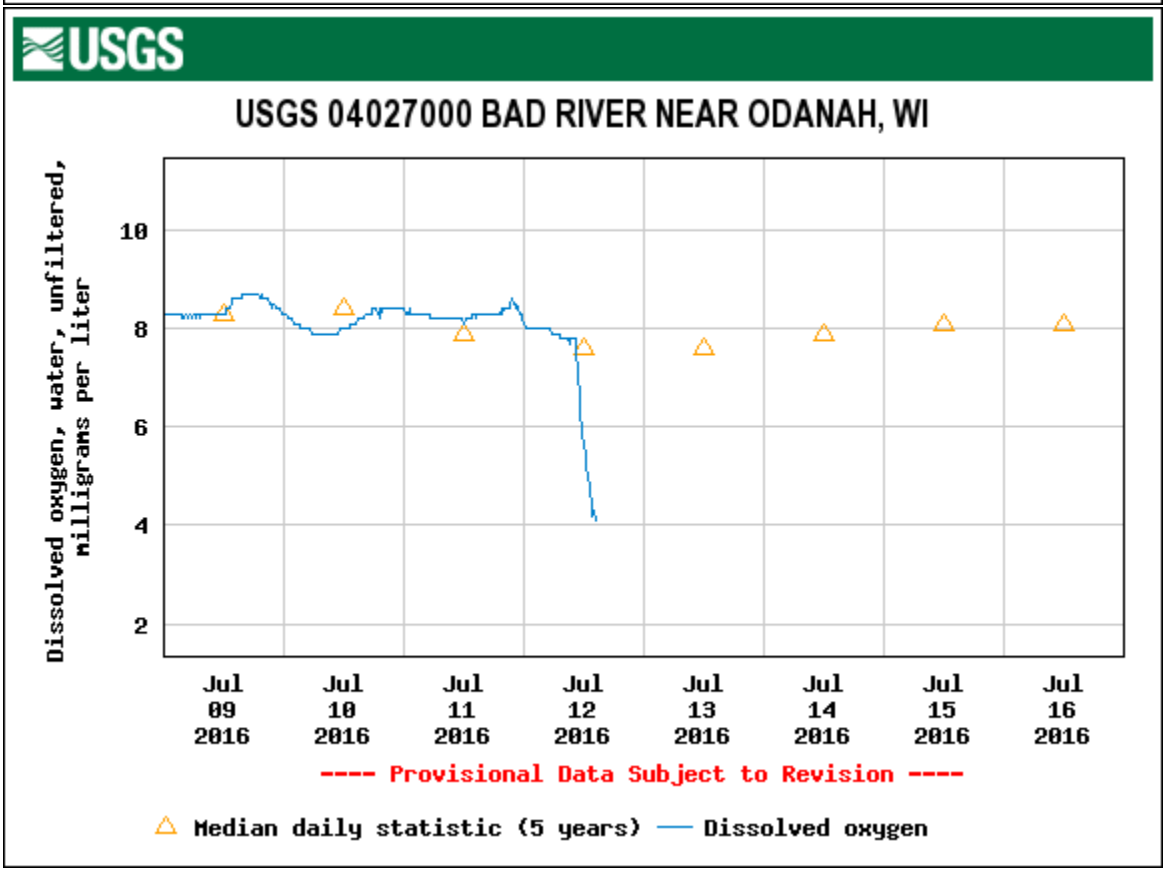
Streamflow Data from July 2016 Flood Event



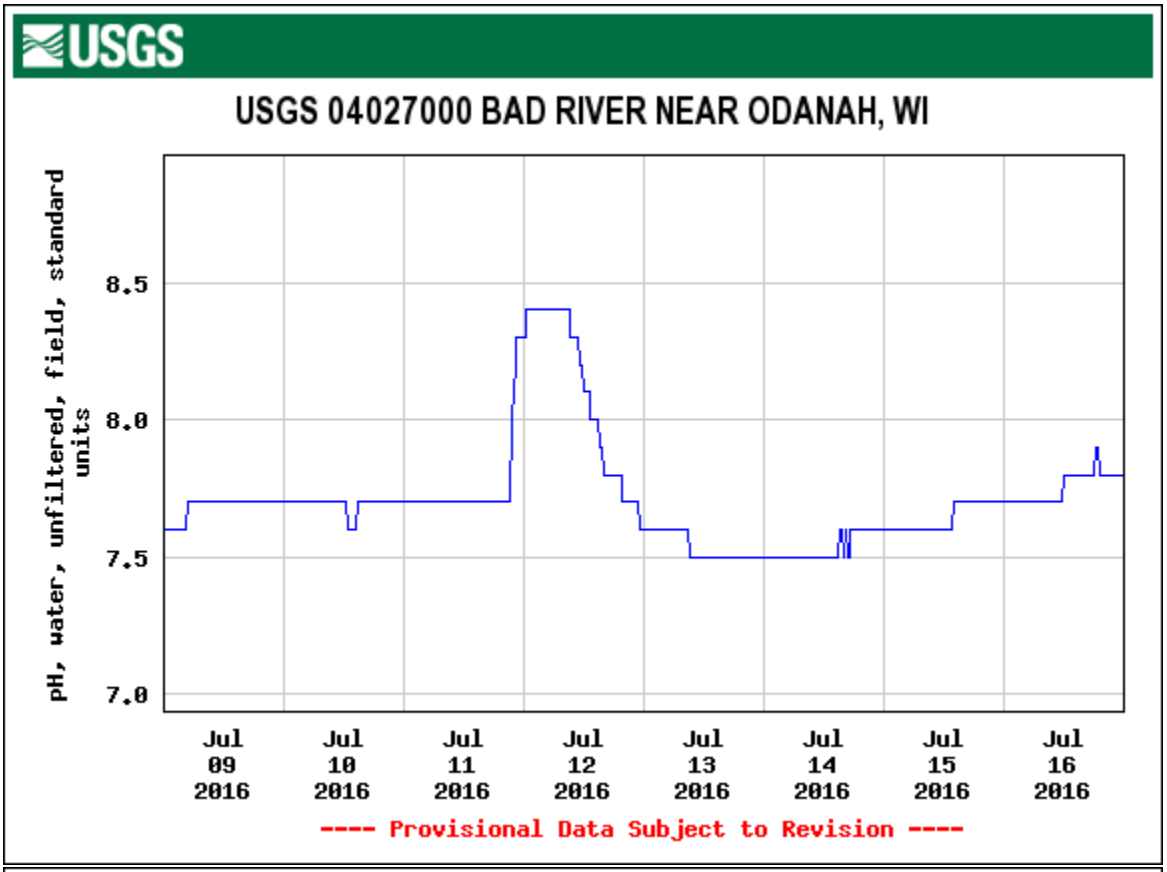


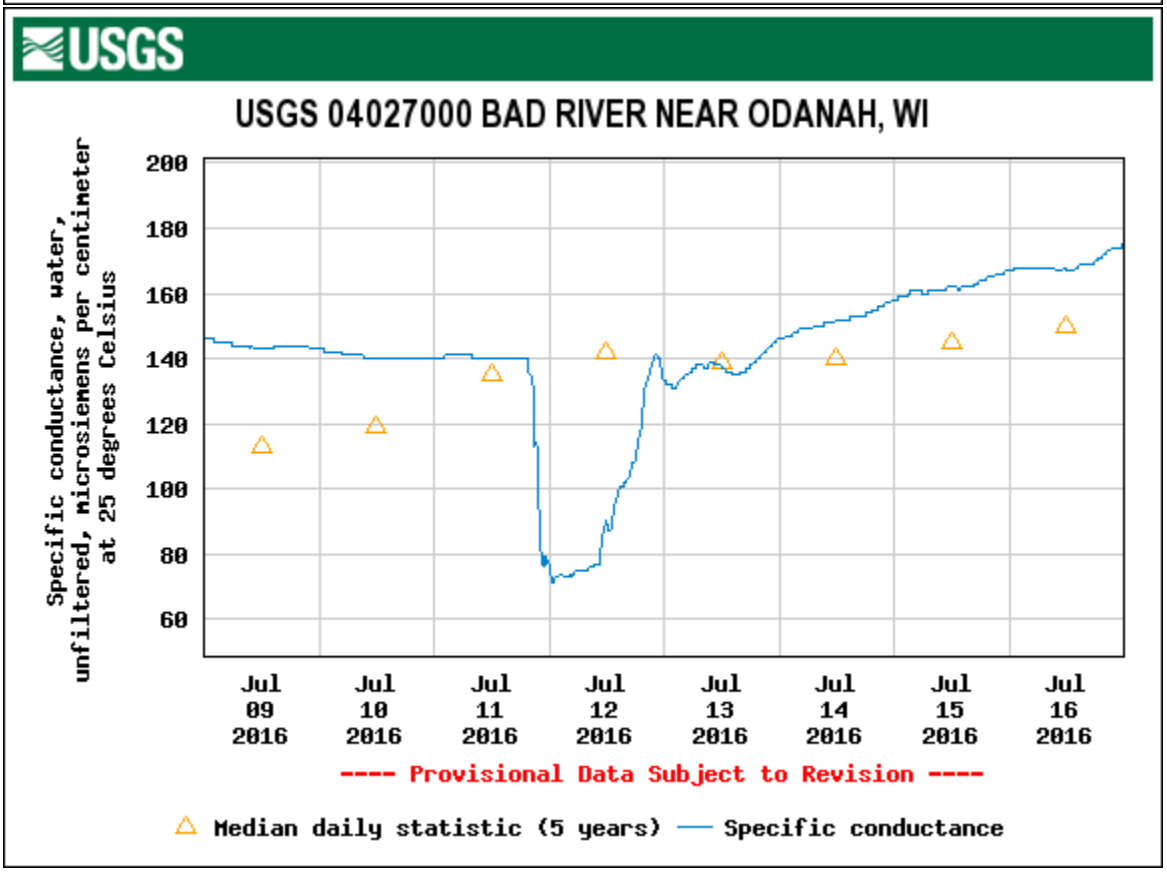
Streamflow Data from July 2016 Flood Event



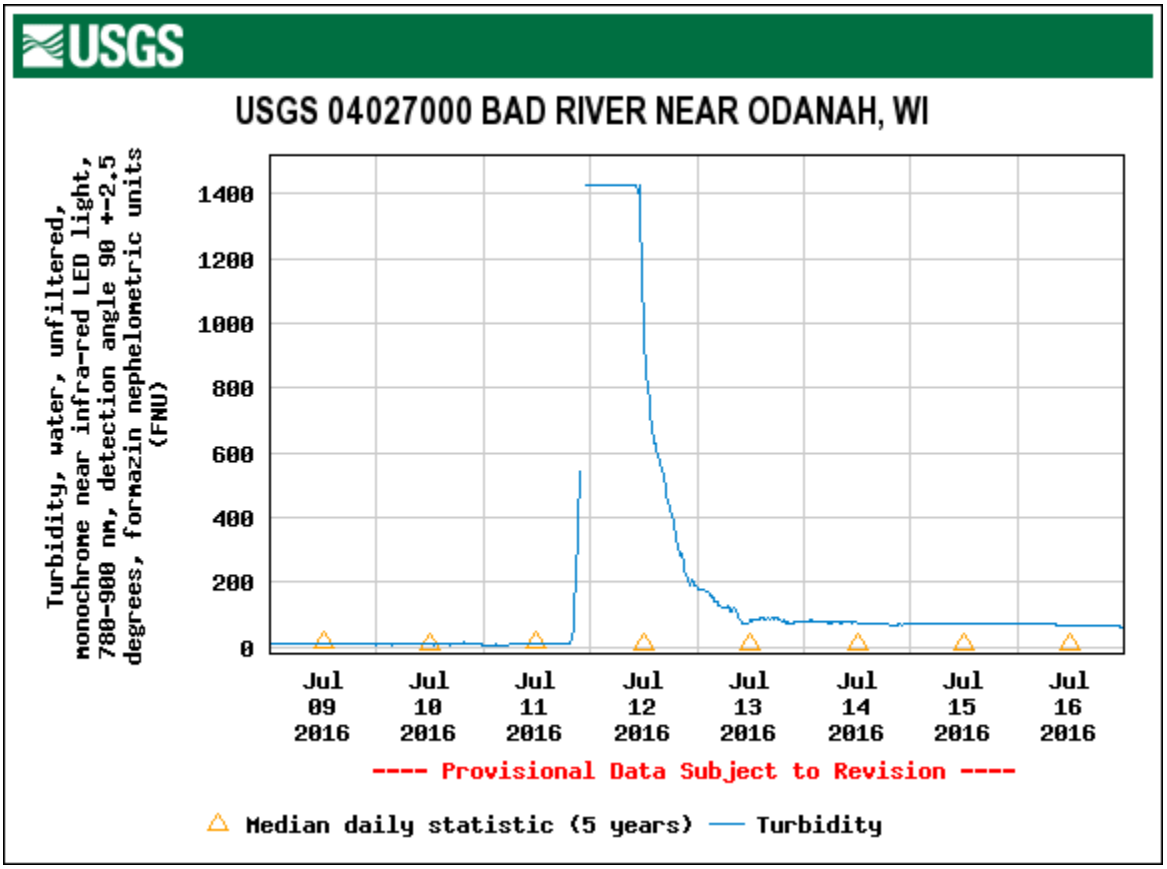


Streamflow Data from July 2016 Flood Event





Streamflow Data from July 2016 Flood Event



Analyzing Weather Data from the July 2016 Floods

Using the data you have available, fill in the chart below to the best of your ability. You will not have all the information, but this is often the case in scientific investigations.

Date	Peak Wind Speed	Precipitation (inches)	High Air Temperature	Water Temperature
July 11, 2016				
July 12				
July 13				
July 14				
July 15				
July 16				

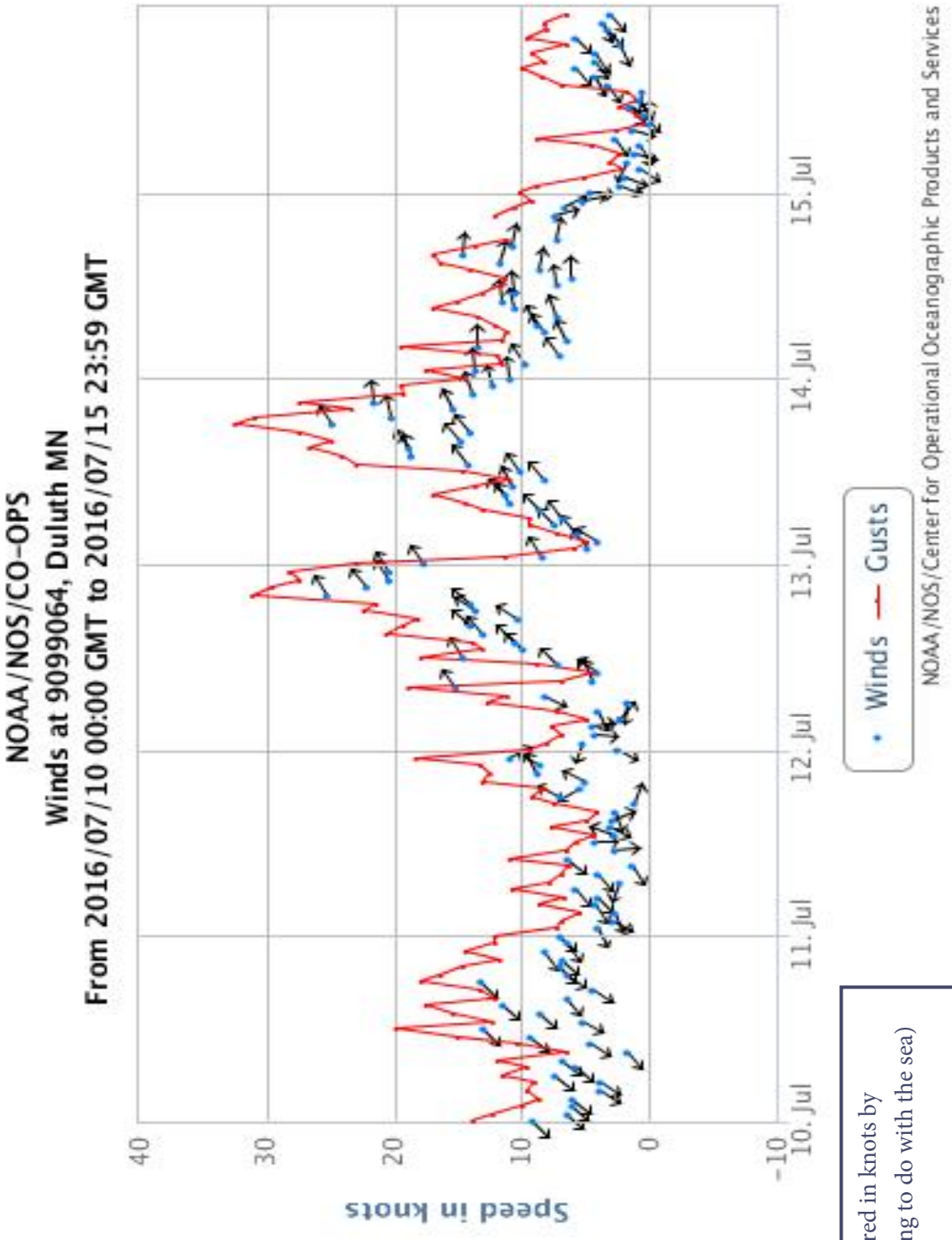
What patterns do you observe in the rainfall and precipitation data? When and where was the most intense rainfall?

Use four sentences (no more and no less!) to tell a story of what happened in this weather data during and after the July 2016 Flood. Your group must discuss and agree on the sentences before you write them.

Weather Data from July 2016 Flood Event

Wind Speeds and Direction from July 10-July 15, 2016

The arrows on the chart show the direction the wind was blowing. Use the compass rose to figure out which direction the wind is going.



Wind is measured in knots by maritime (having to do with the sea) tradition.

1 knot = 1.151 mph

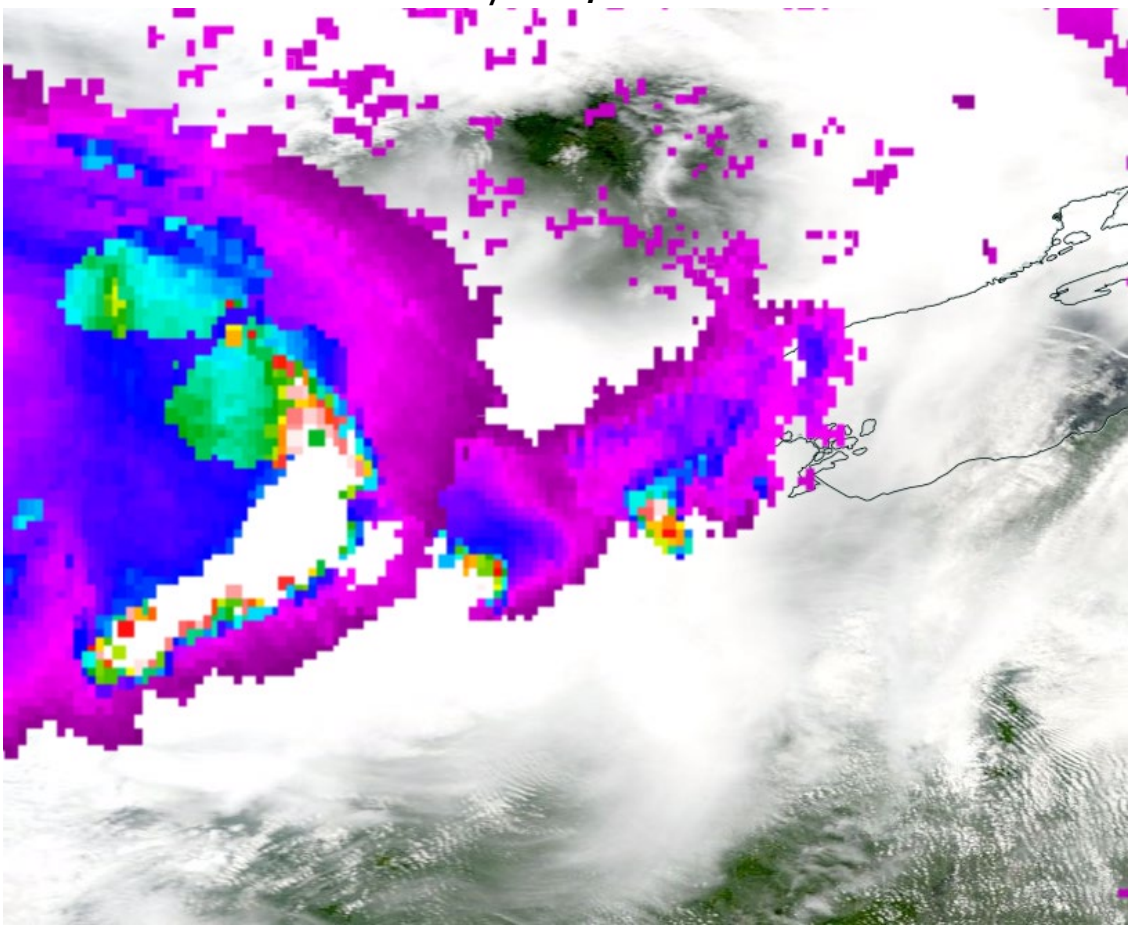
Weather Data from July 2016 Flood Event

Precipitation and Temperature Data from Sand Island- Apostle Islands National Park

Date	Precipitation (in)	Tmax (F)	Tmin (F)
07/09/2016	0	70	55
07/10/2016	0	72	59
07/11/2016	1.53	71	54
07/12/2016	0.37	74	54
07/13/2016	0.04	72	58
07/14/2016	0.1	63	55
07/15/2016	0	63	54
07/16/2016	0	75	51

Weather Data from July 2016 Flood Event

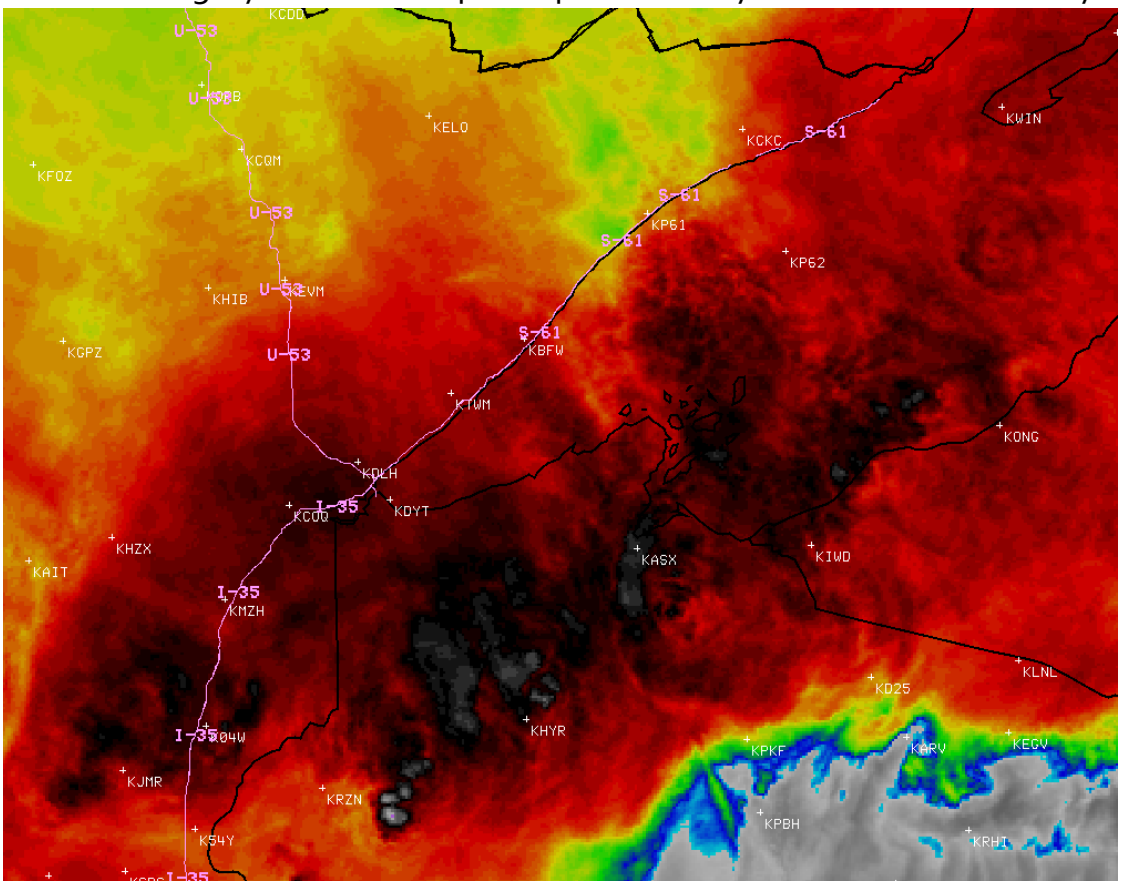
Surface Rain Rate for July 11th, 2016



Scale: 

Weather Data from July 2016 Flood Event

Infrared Imagery of Storm-Top Temperature Bayfield Peninsula for July 12th, 2016,

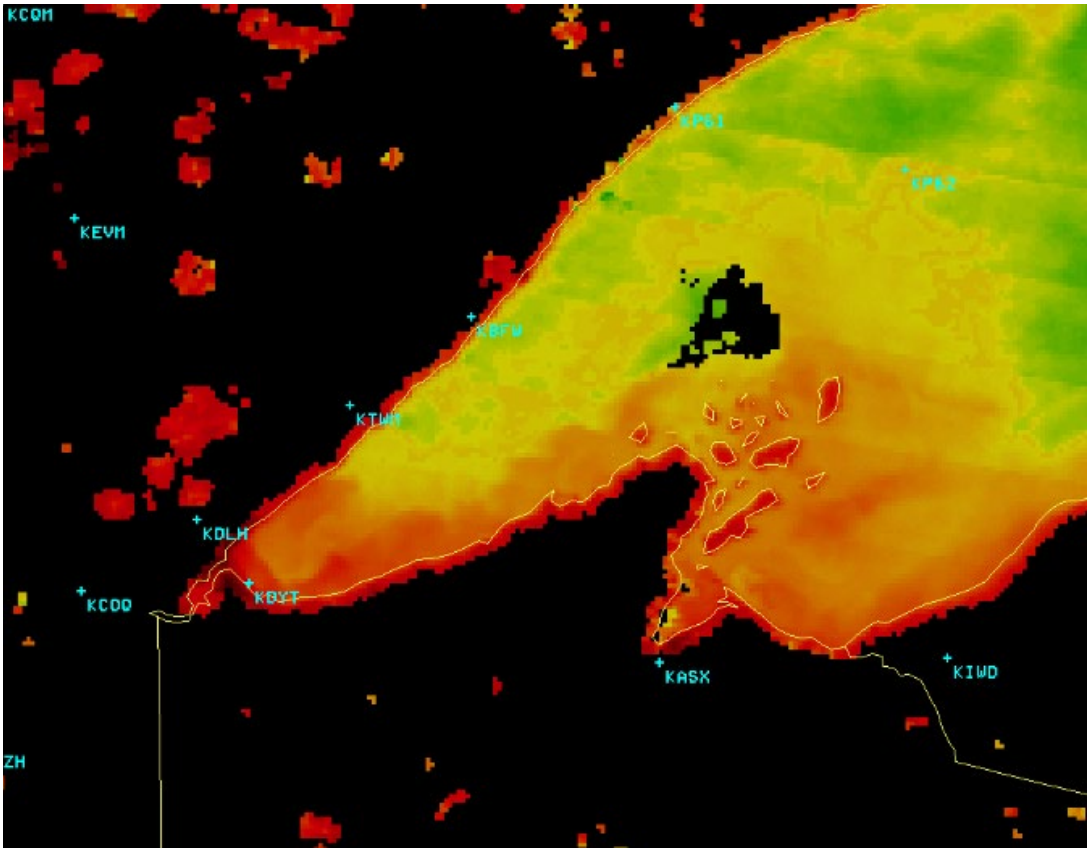


Scale in Celsius

Note: Storm-top (also called echo top) temperatures near freezing are associated with lightening in a storm system.

Weather Data from July 2016 Flood Event

Surface Water Temperature on July 16, 2016



Scale in Degrees Fahrenheit

Weather Data from July 2016 Flood Event

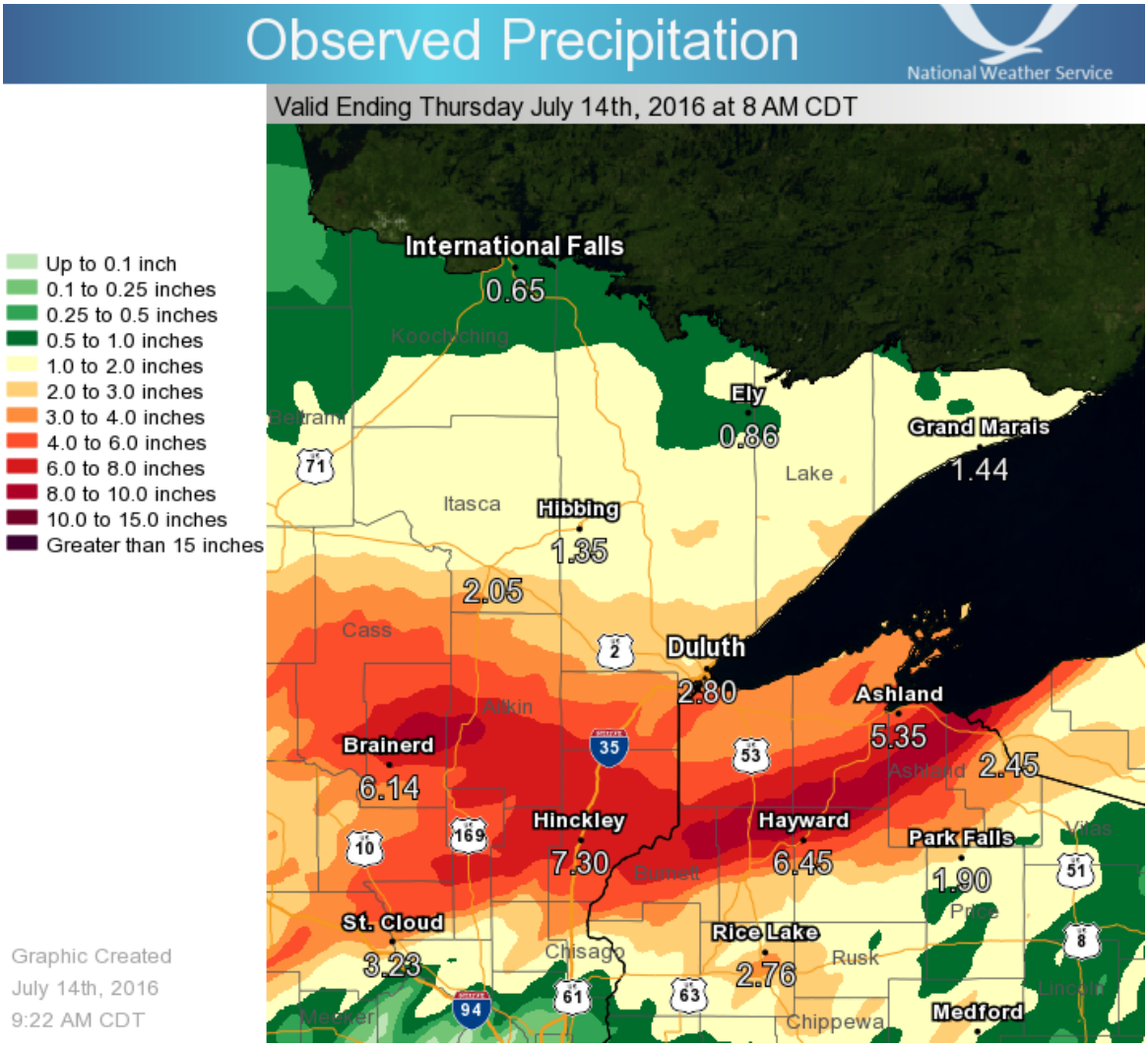


Table 1. Scientific confidence that climate change has *already* impacted common Minnesota weather/climate hazards

Level of Confidence	Hazard/Impact of Changing Climate	Recent & Current Observations of Minnesota Climate
Highest	Extreme cold	Rapid decline in severity, frequency of extreme cold
	Extreme rainfall	Extreme rainfall events are becoming larger and more frequent
High	Heavy snowfall	Large snowfall events have become more frequent
Moderately Low	Severe thunderstorms & tornadoes	Historical comparisons are difficult to make; There have been few major tornadoes in MN since late 2010
Lowest	Heat waves	No recent increases or worsening of heat waves or drought in Minnesota
	Drought	

Credit: Dr. Kenneth Blumenfeld, State Climatology Office, Minnesota Department of Natural Resources

Table 2. Scientific confidence that climate change will impact common Minnesota weather/climate hazards beyond 2025

Level of Confidence	Hazard	Expectations beyond 2025
Highest	Extreme cold	Continued rapid decline of extreme cold weather in Minnesota
	Extreme rainfall	Unprecedented rainfall events are expected
High	Heat waves	Increases in severity, coverage, and duration of heat waves is expected
Moderately High	Drought	Increases in severity, coverage, and duration of droughts is possible
Moderately Low	Heavy snowfall	Large snowfall events will become less frequent as winter warms
Moderately Low	Severe thunderstorms & tornadoes	More "super events" (extreme storms) possible, even if the frequency decreases

Credit: Dr. Kenneth Blumenfeld, State Climatology Office, Minnesota Department of Natural Resources