



**NATIONAL
WEATHER
SERVICE**

NWS Grand Forks Spring Flood Outlook

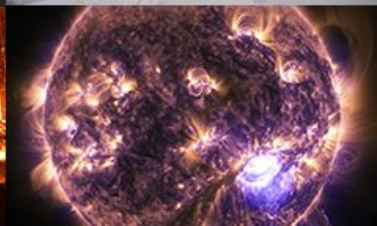
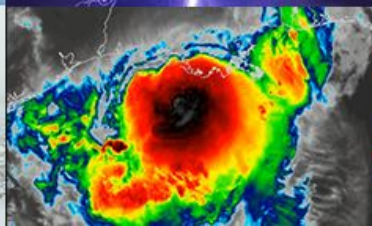
Amanda Lee

Service Hydrologist
NWS Grand Forks

Jim Kaiser

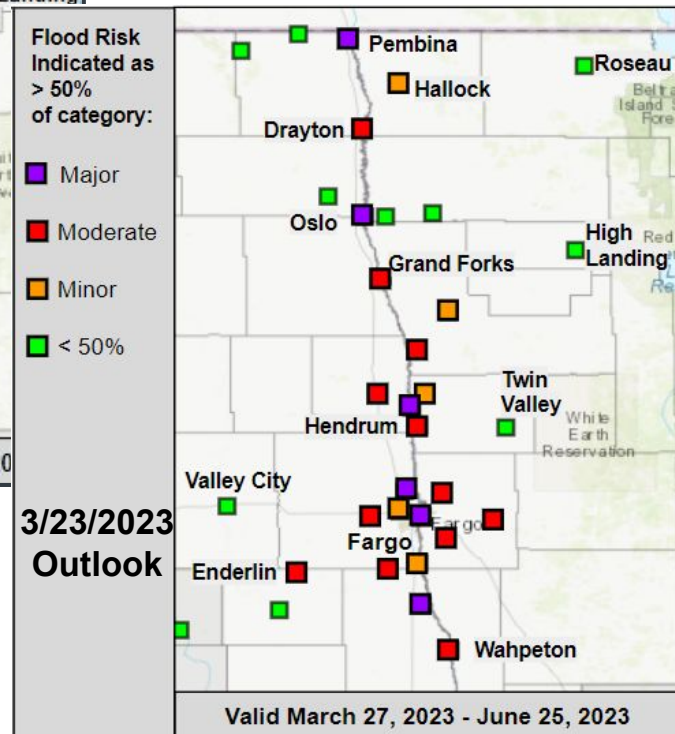
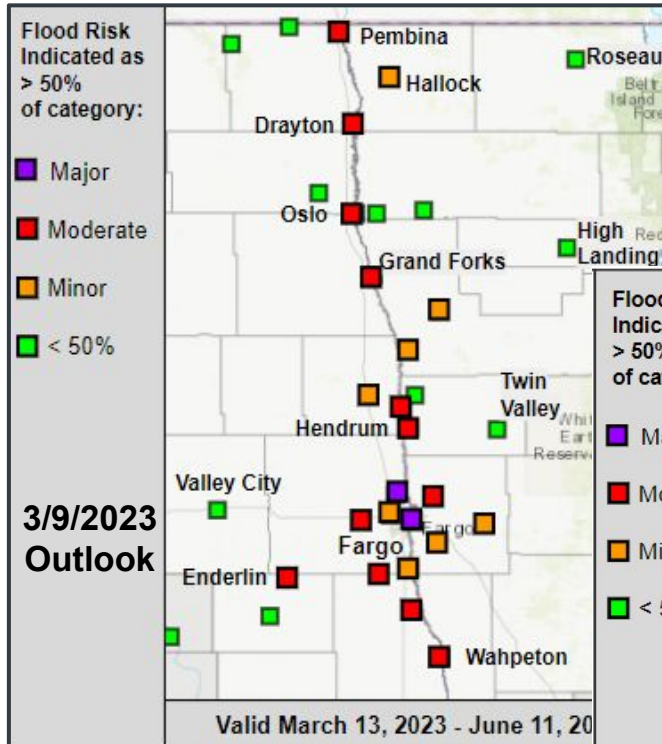
Warning Coordination Meteorologist
NWS Grand Forks

March 23, 2023








Key Message

- The risk for significant (moderate or higher) spring flooding has increased due to additional snowfall and delayed melt conditions.
- Generally above long-term historical averages for most of the Red River Basin.





Key Points

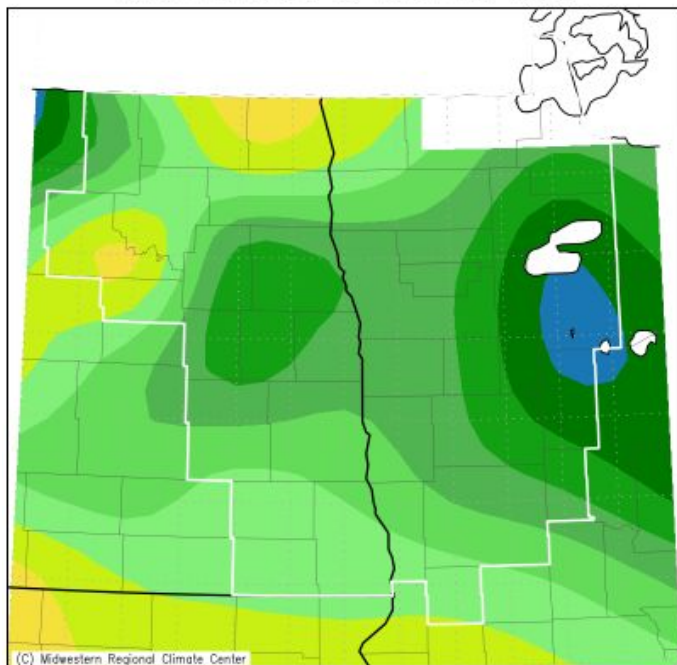
- Risk of moderate to major spring flooding (50% probability) has increased for the mainstem Red River and southeastern North Dakota tributaries. Minor to isolated moderate flooding is depicted for most of the Minnesota tributaries.
 - Below normal soil moisture and near normal streamflows heading into freeze-up.
 - Above normal snowfall and precipitation has occurred since freeze-up (with the exception of the far northern basin).
 - **The continuation of below normal temperatures is leading to a delayed melt.**
 - **Snowmelt timing/thaw cycle, along with any additional snow and/or rain this spring, continue to be the most important factors contributing to the spring flood risk.**
- 
- 
- 
- 
- 



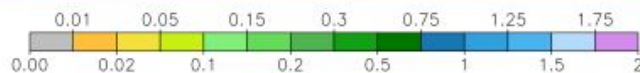
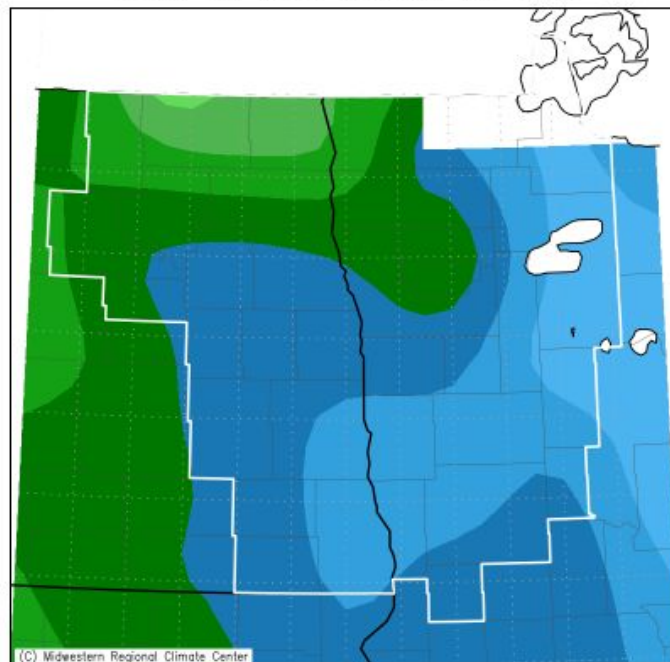
Since March 9th Outlook



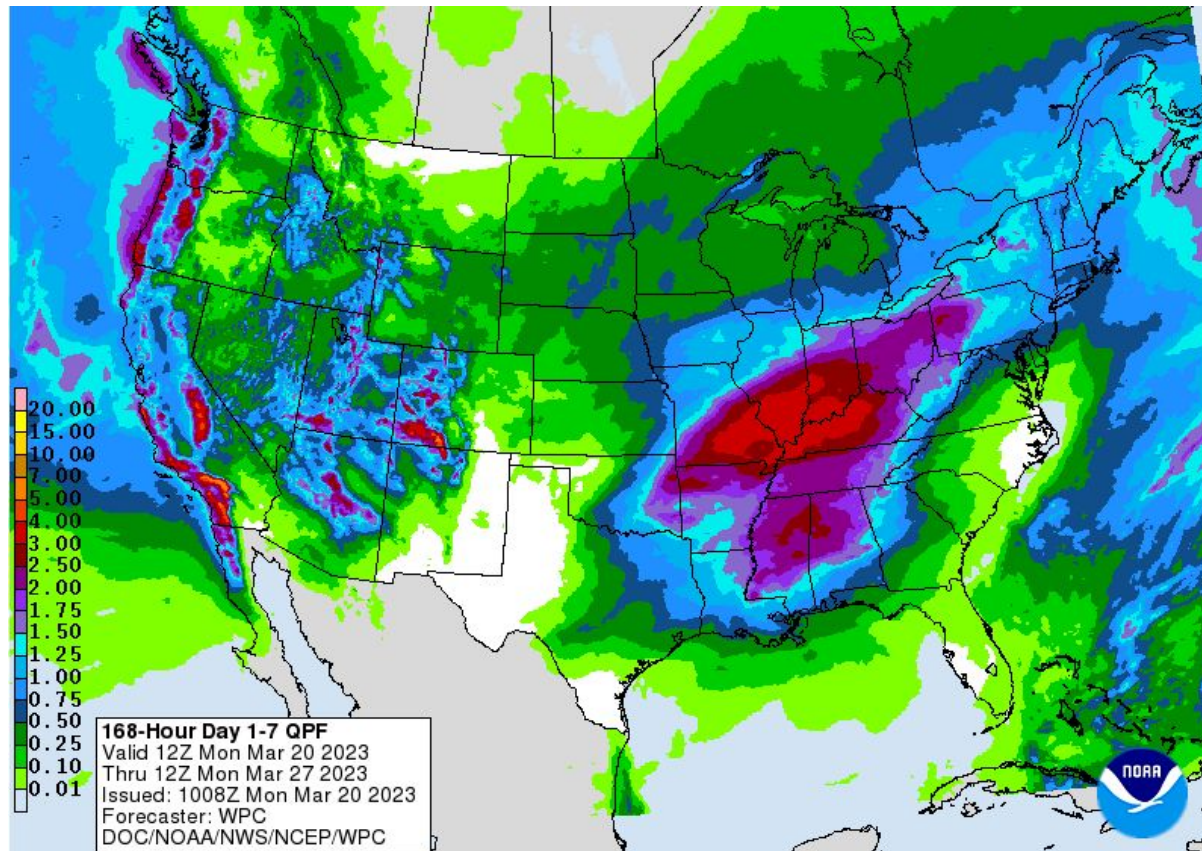
Accumulated Snowfall (in)
March 10, 2023 to March 22, 2023

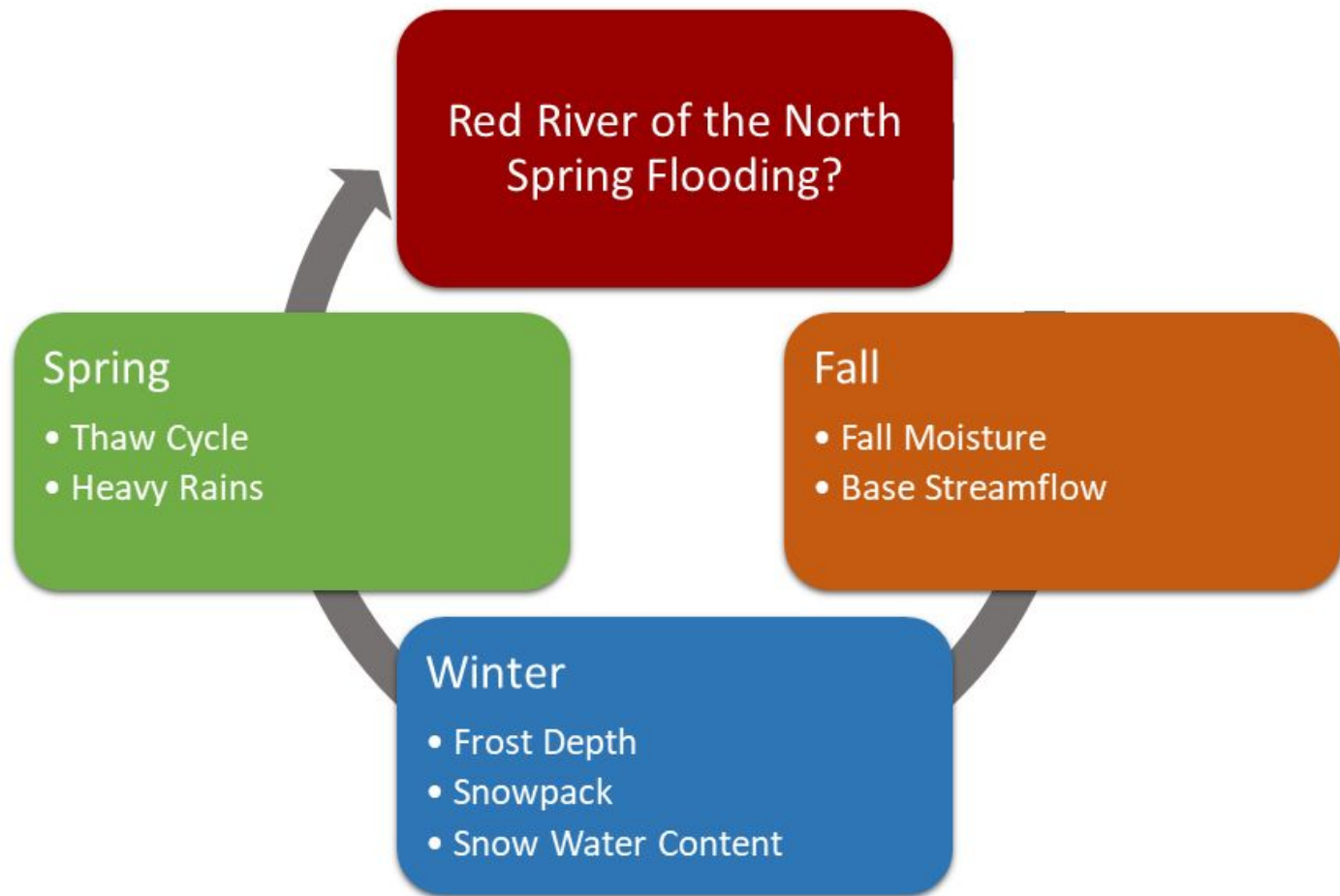


Accumulated Precipitation (in)
March 10, 2023 to March 22, 2023



Forecast Precipitation in this Outlook (7 days beginning 6 am Monday, March 20th)

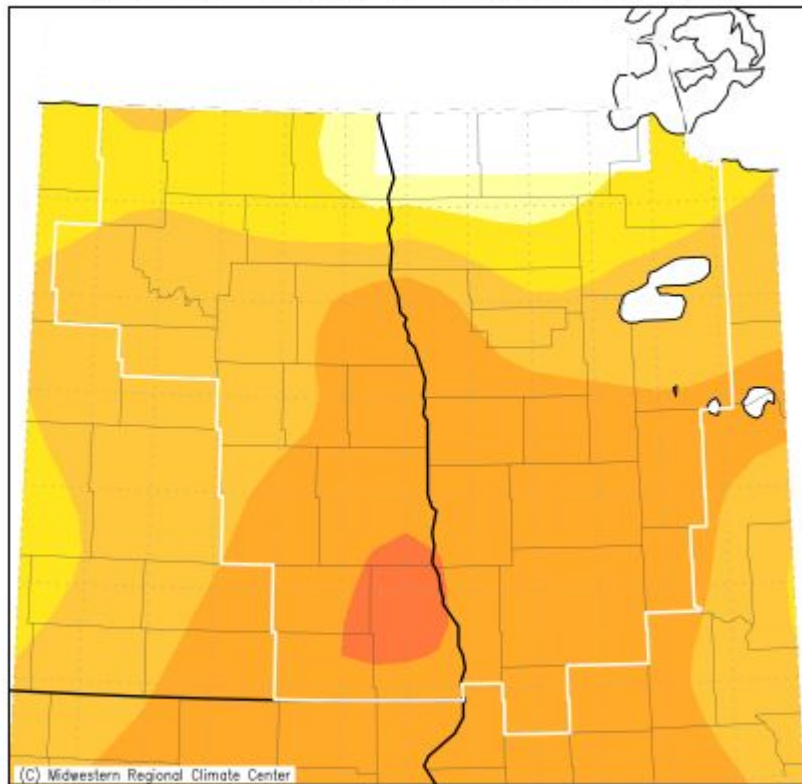




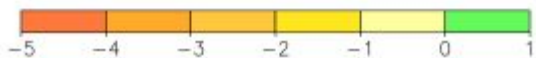
[Bluemle: Factors Affecting Flooding in the Red River Valley, 1997]



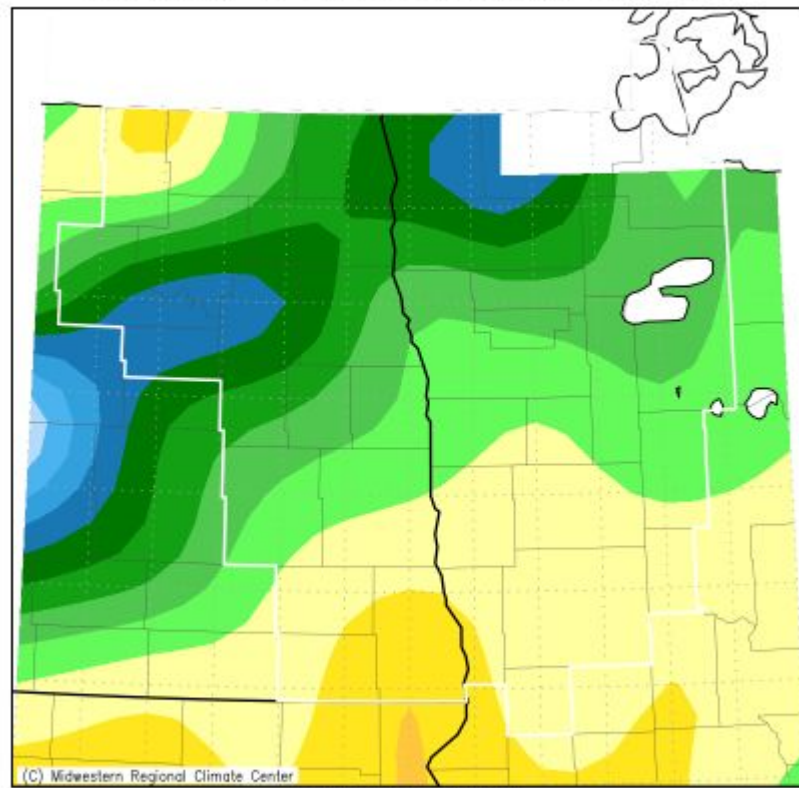
Accumulated Precipitation (in): Departure from Mean
September 1, 2022 to November 30, 2022



Mean period is 1991–2020.



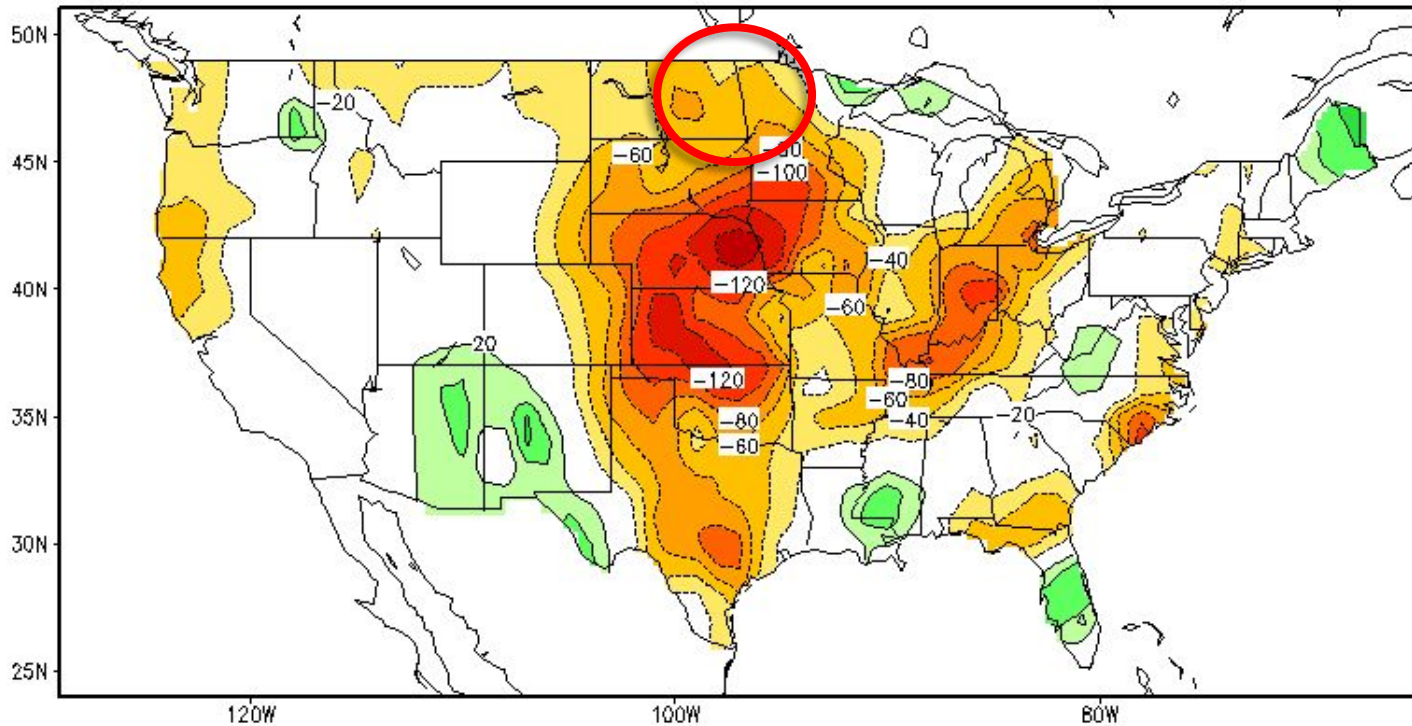
Accumulated Snowfall (in): Departure from Mean
September 1, 2022 to November 30, 2022



Mean period is 1991–2020.

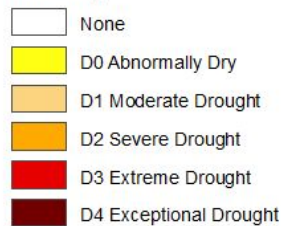
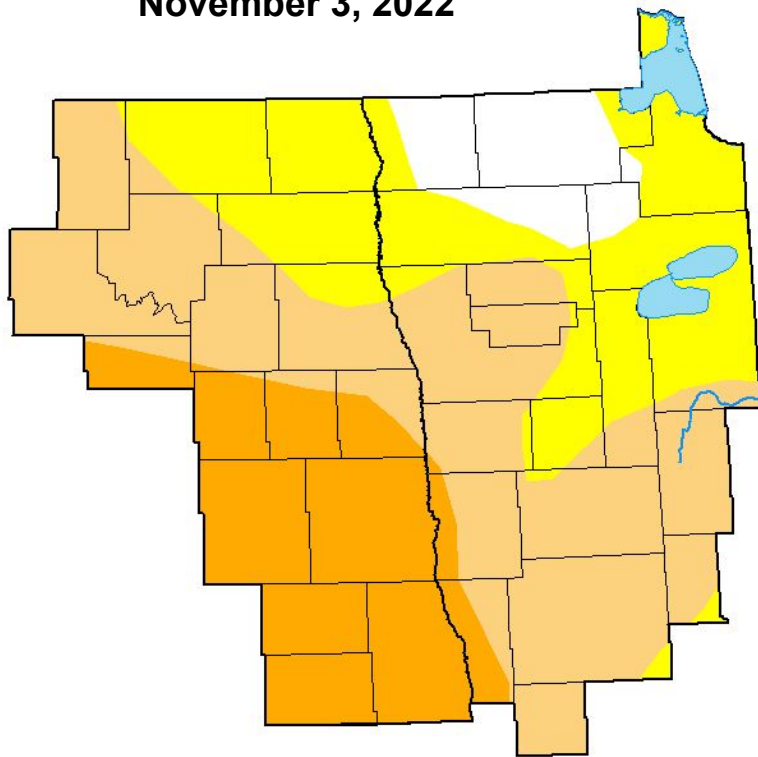


Calculated Soil Moisture Anomaly (mm) DEC, 2022



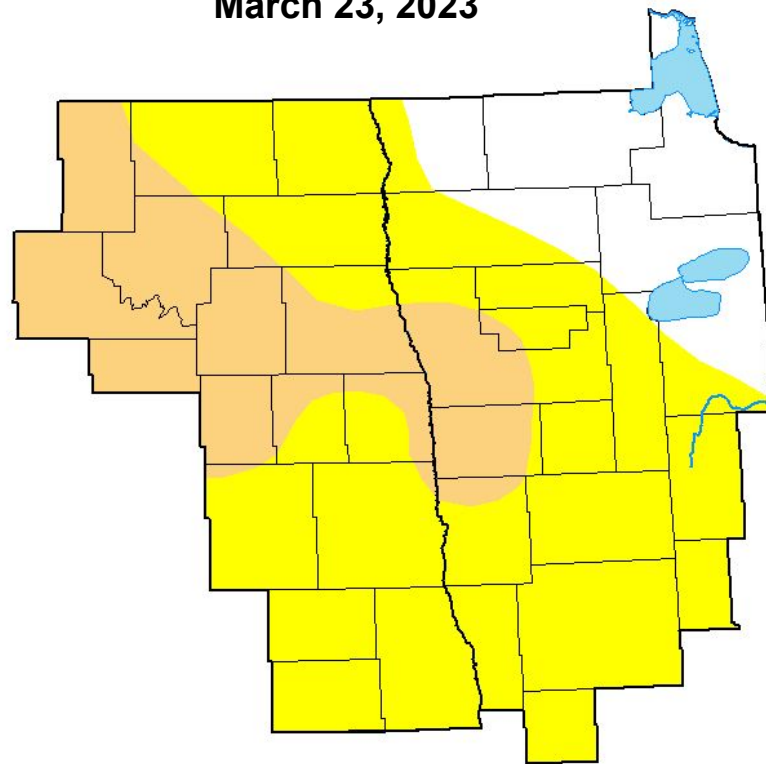
U.S. Drought Monitor
Grand Forks, ND WFO

November 3, 2022

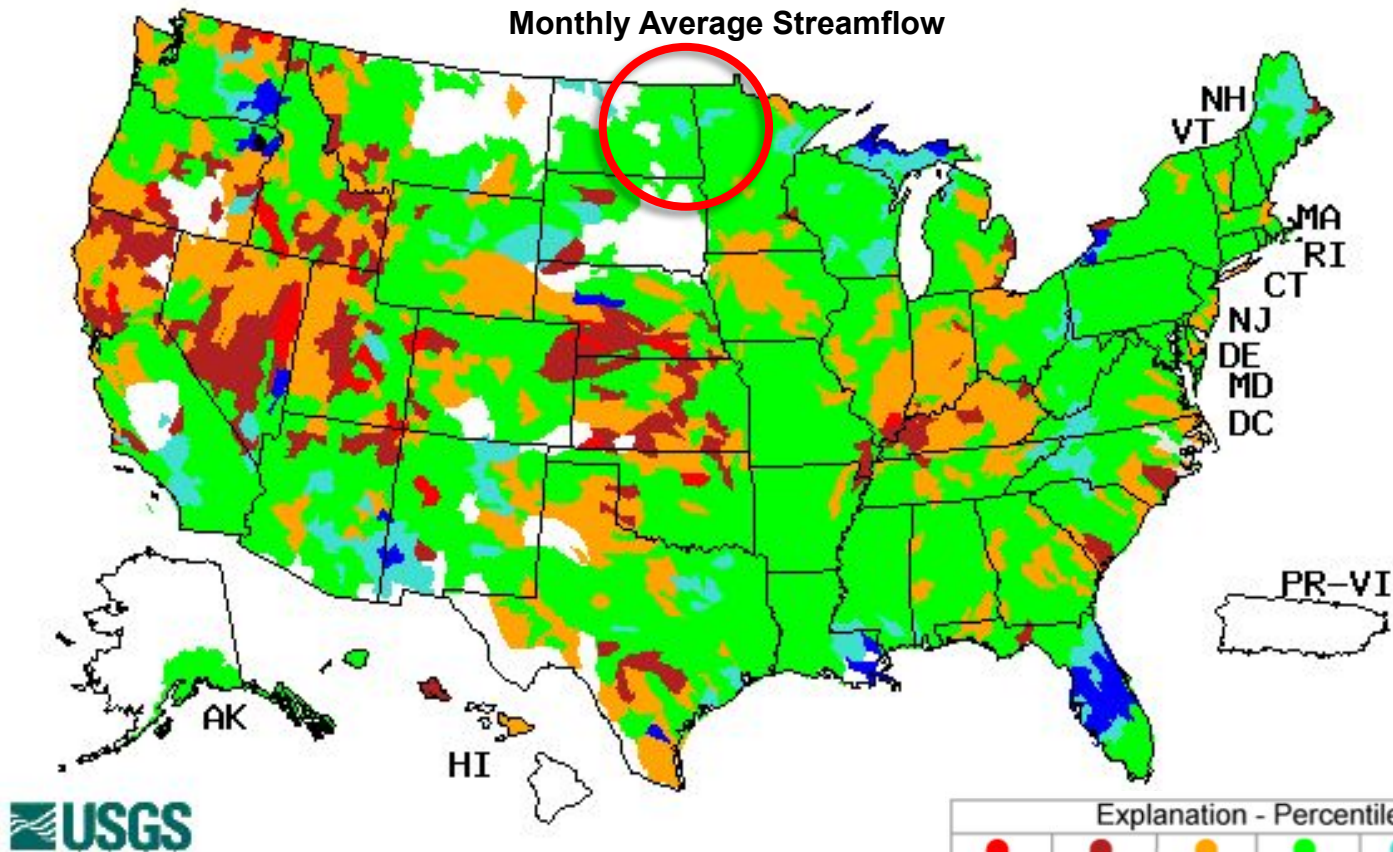


U.S. Drought Monitor
Grand Forks, ND WFO

March 23, 2023



November 2022
Monthly Average Streamflow



Explanation - Percentile classes

Low	<10 Much below normal	10-24 Below normal	25-75 Normal	76-90 Above normal	>90 Much above normal	High





Red River of the North Spring Flooding?

Spring

- Thaw Cycle
- Heavy Rains

Fall

- ~~Fall Moisture~~
- Base Streamflow ✓

Winter

- Frost Depth
- Snowpack
- Snow Water Content

[Bluemle: Factors Affecting Flooding in the Red River Valley, 1997]





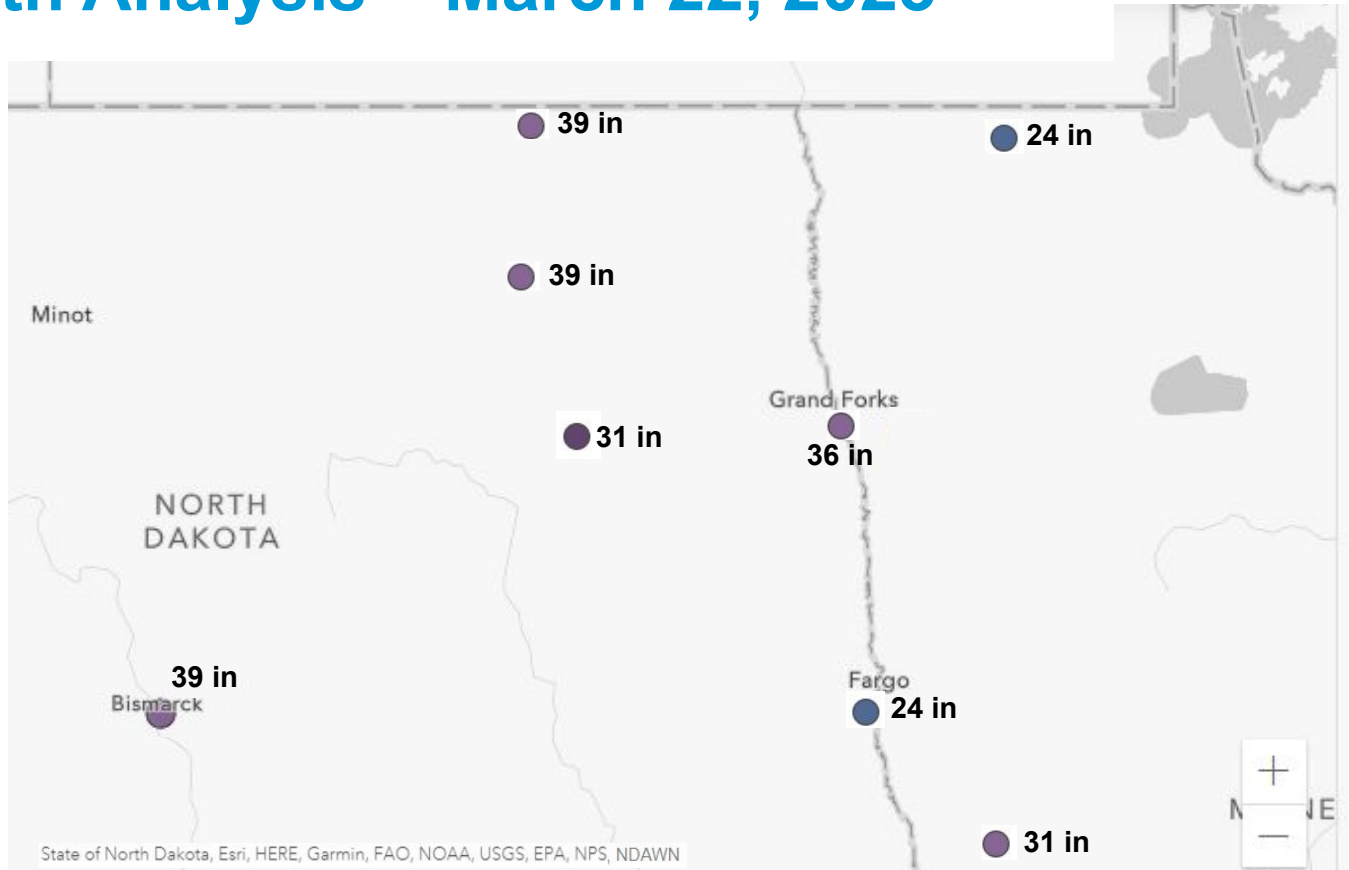
Frost Depth Analysis – March 22, 2023



Soil Frost Depth (Inches)

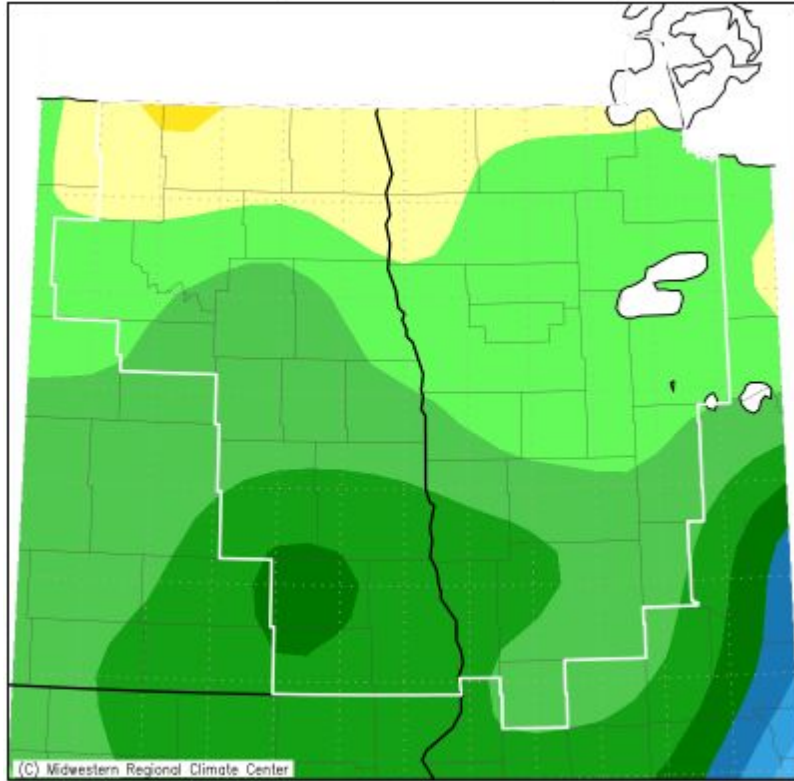
FrostDepth

- > 36" - 60"
- > 24" - 36"
- > 12" - 24"
- > 6" - 12"
- > 0" - 6"
- 0"





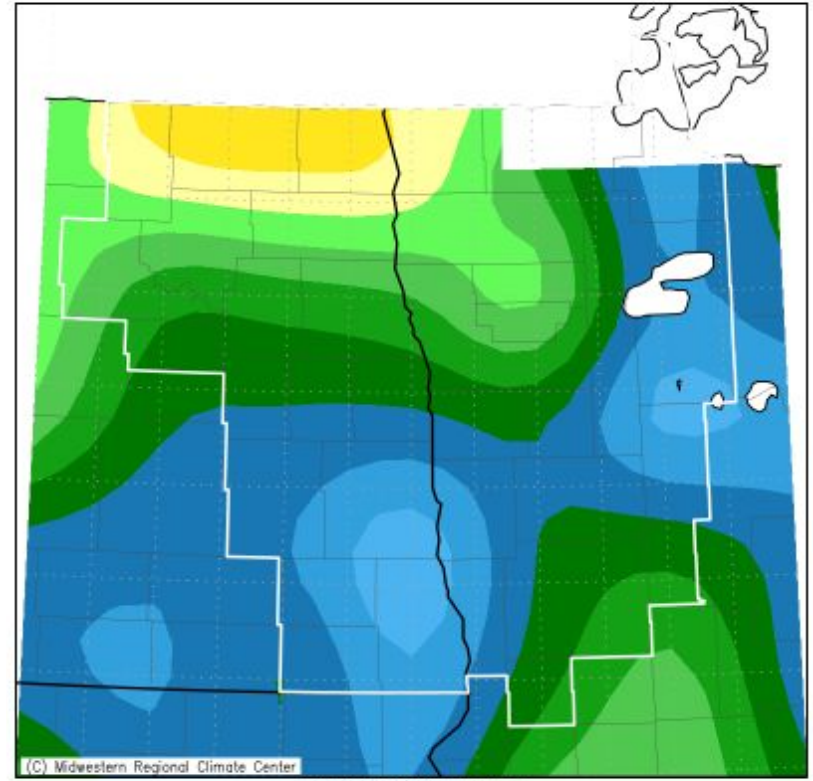
Accumulated Precipitation (in): Departure from Mean
December 1, 2022 to February 28, 2023



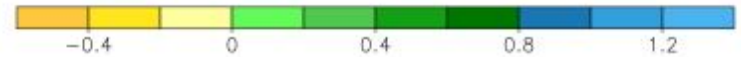
Mean period is 1991-2020.



Accumulated Precipitation (in): Departure from Mean
March 1, 2023 to March 22, 2023

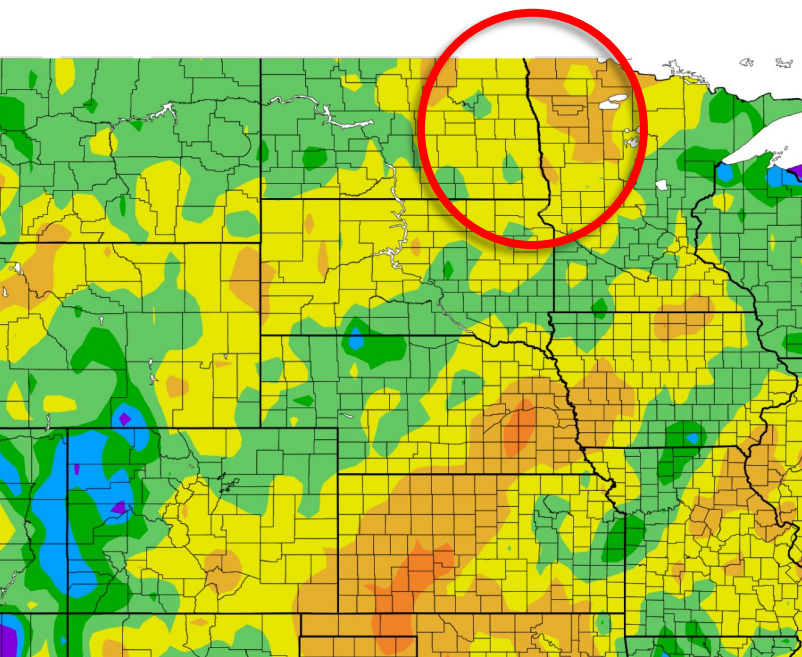


Mean period is 1991-2020.



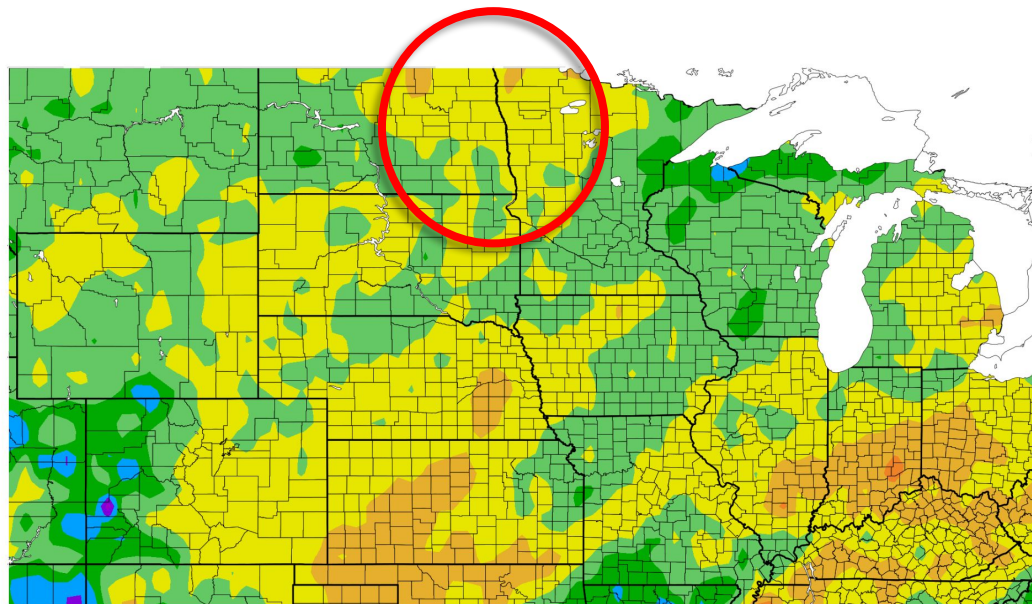
Departure from Normal Precipitation (in)

10/1/2022 – 1/26/2023



Departure from Normal Precipitation (in)

10/1/2022 – 3/21/2023



ated 1/27/2023 at HPRCC using provisional data.

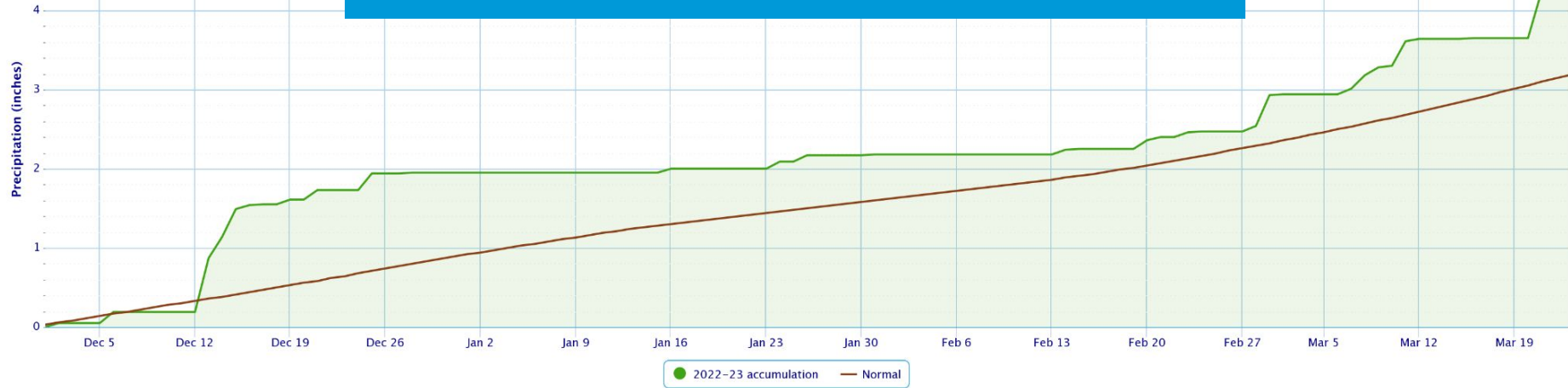


Generated 3/22/2023 at HPRCC using provisional data.

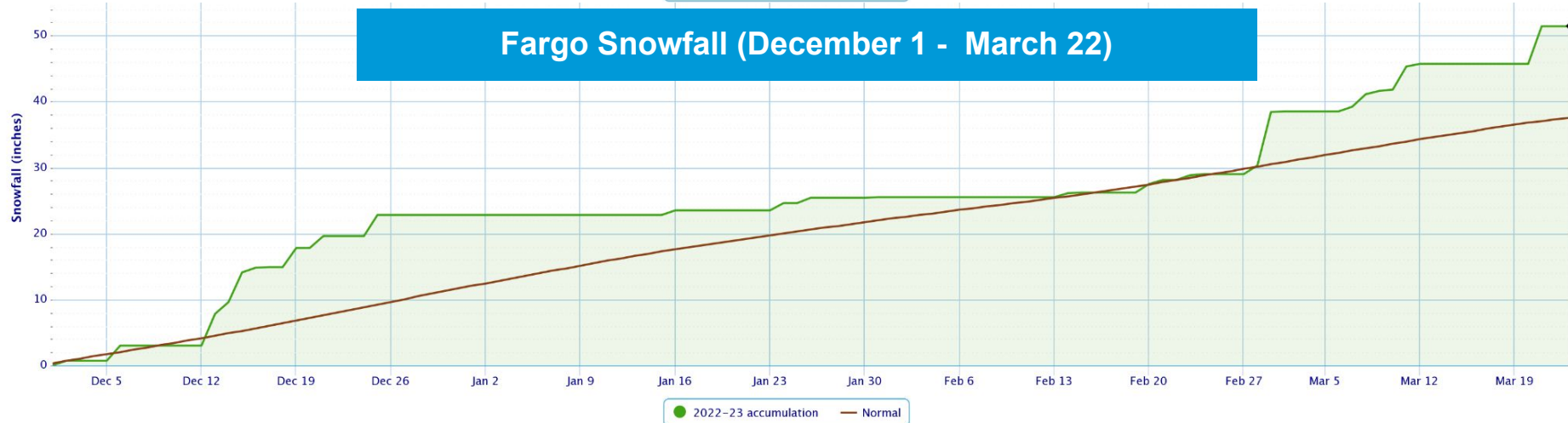
NOAA Regional Climate Centers



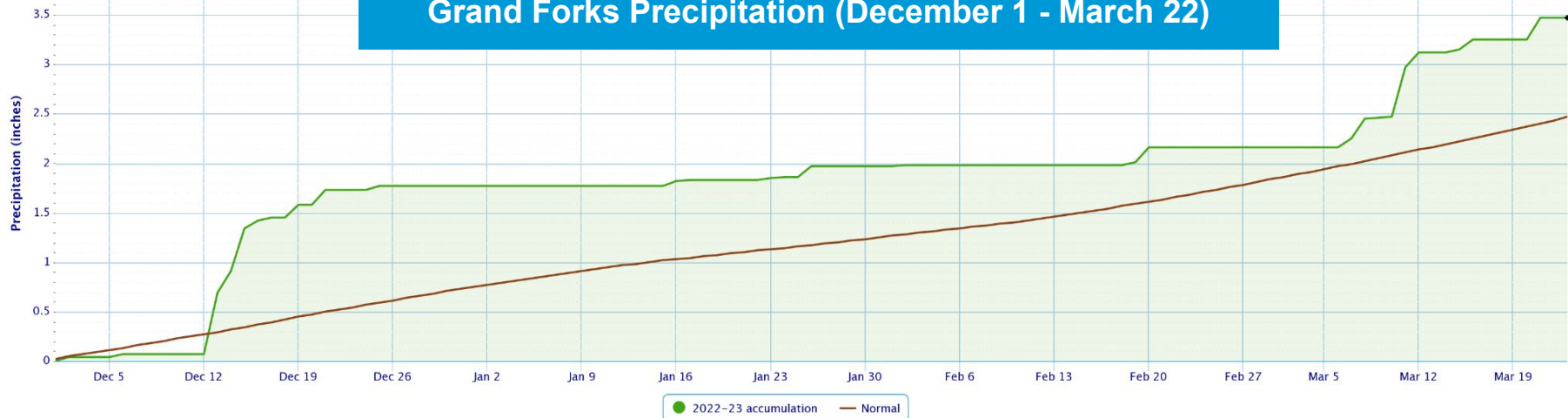
Fargo Precipitation (December 1 - March 22)



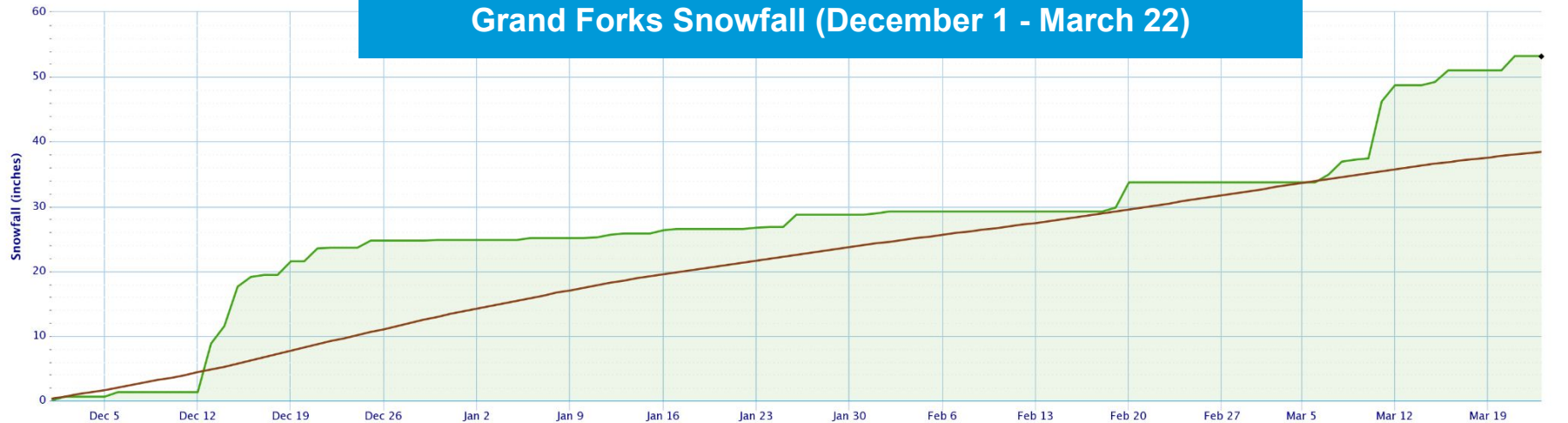
Fargo Snowfall (December 1 - March 22)



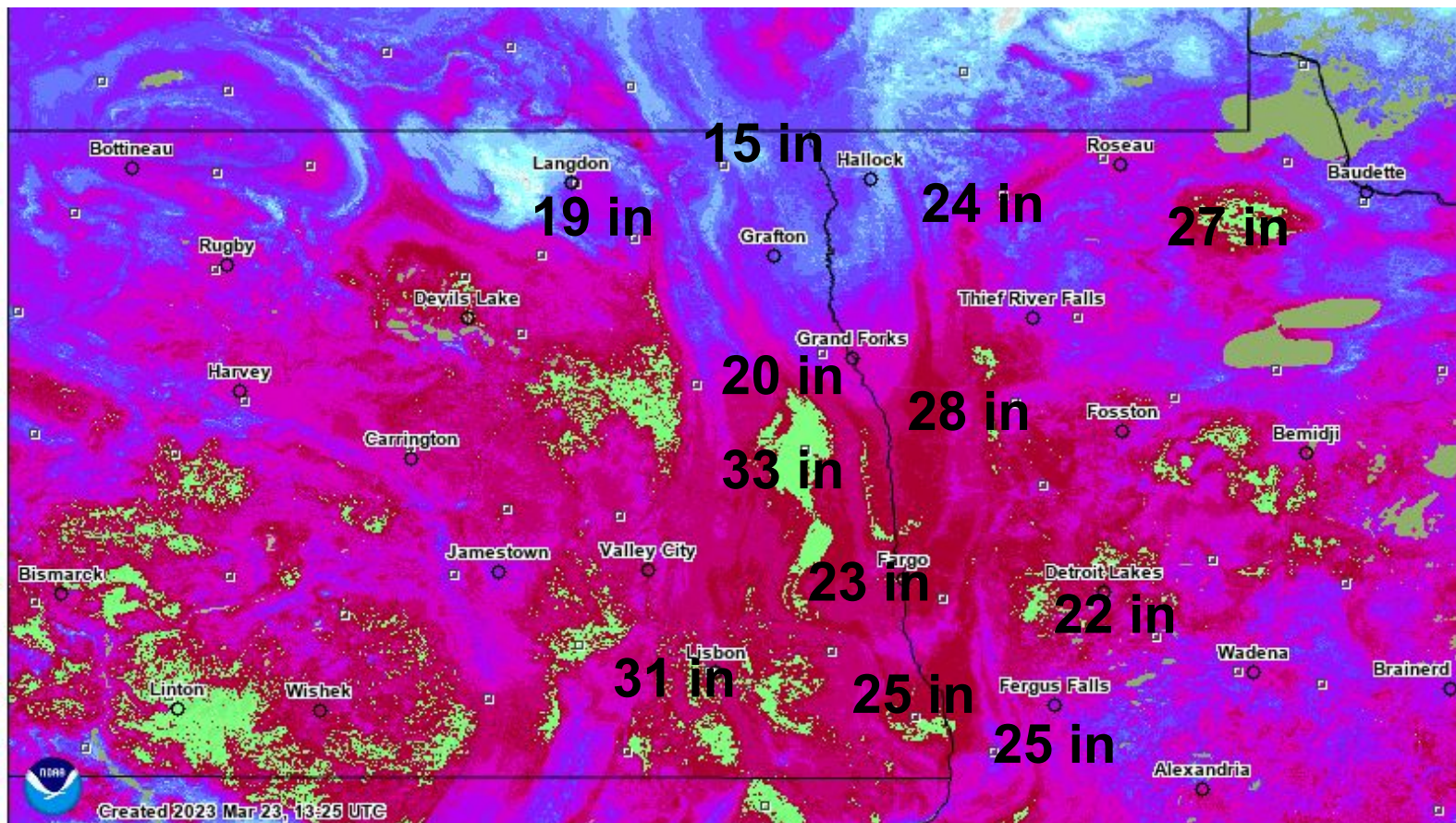
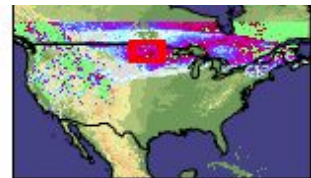
Grand Forks Precipitation (December 1 - March 22)



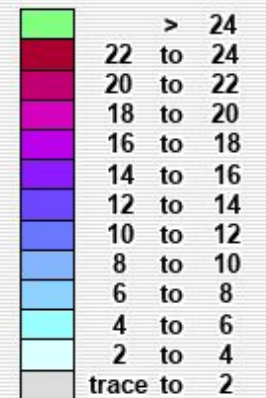
Grand Forks Snowfall (December 1 - March 22)



Modeled Snow Depth - March 23, 2023



Inches of depth



Not Estimated

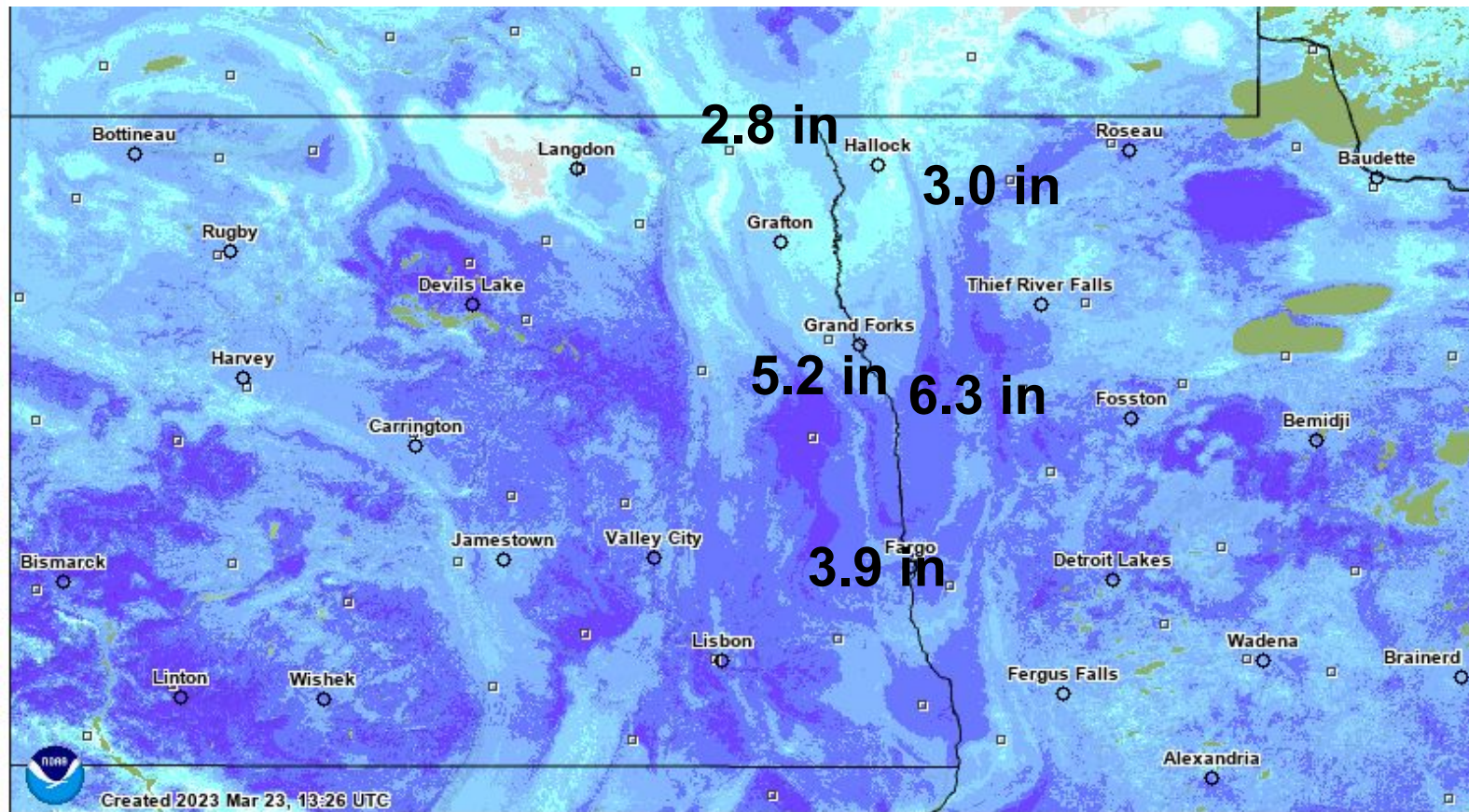
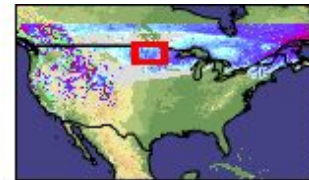
Elevation in feet



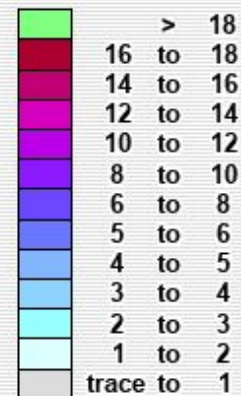
Created 2023 Mar 23, 13:25 UTC



Modeled Snow Water Equivalent - March 23, 2023



Inches of water equivalent



Not Estimated

Elevation in feet

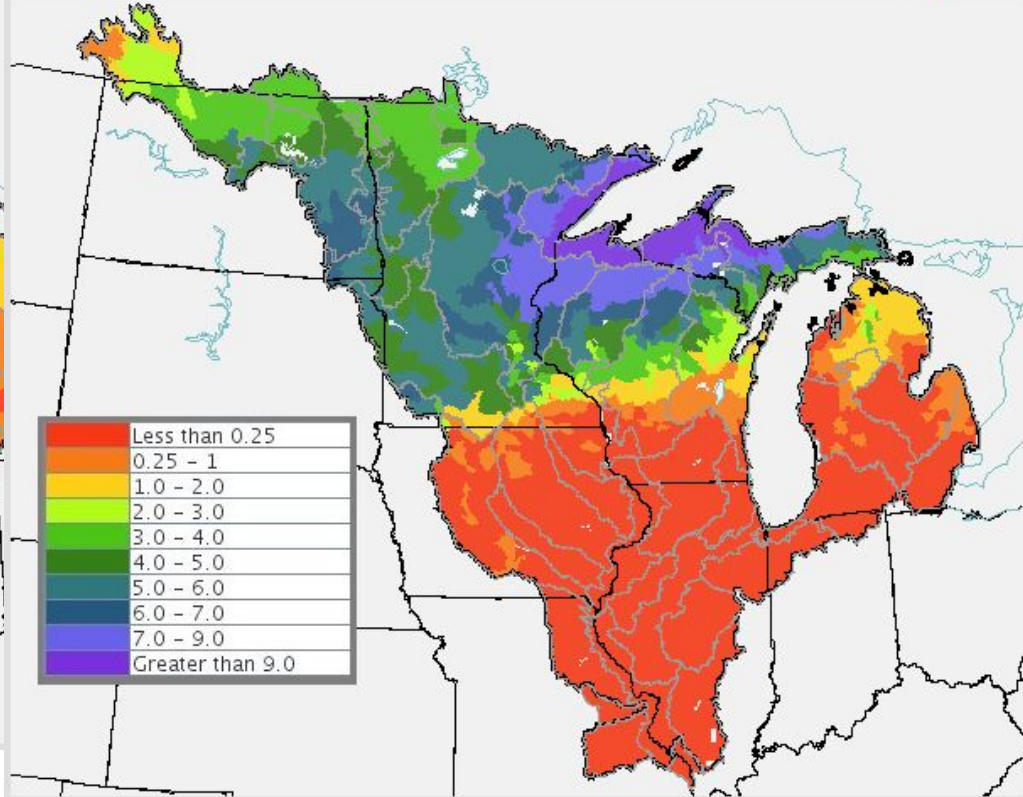
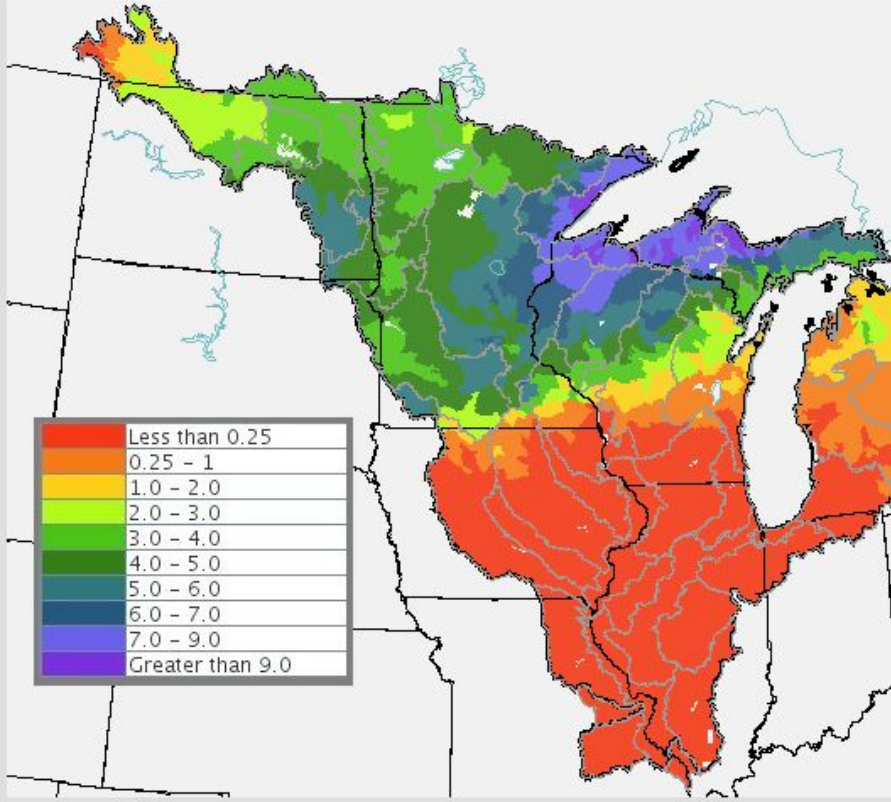




North Central River Forecast Center
 Model Simulated Snow Water Equivalent
 Valid for 03/06/2023 12 GMT



North Central River Forecast Center
 Model Simulated Snow Water Equivalent
 Valid for 03/20/2023 12 GMT





Red River of the North Spring Flooding?

Spring

- Thaw Cycle
- Heavy Rains

Fall

- ~~Fall Moisture~~
- Base Streamflow ✓

Winter

- Frost Depth ✓
- Snowpack ✓
- Snow Water Content ✓

[Bluemle: Factors Affecting Flooding in the Red River Valley, 1997]





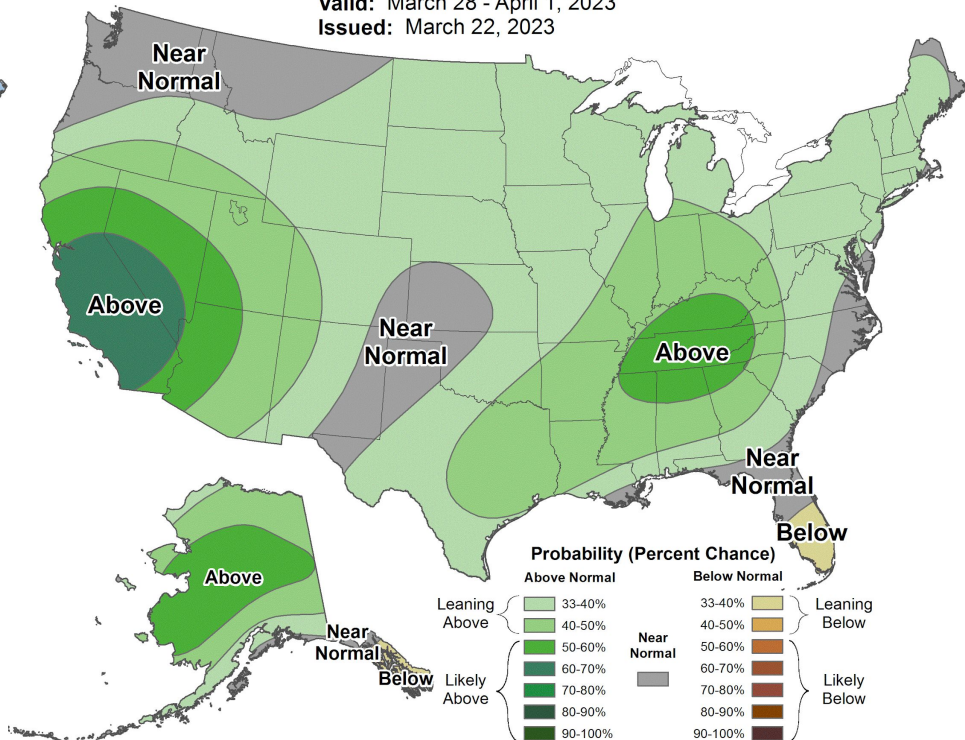
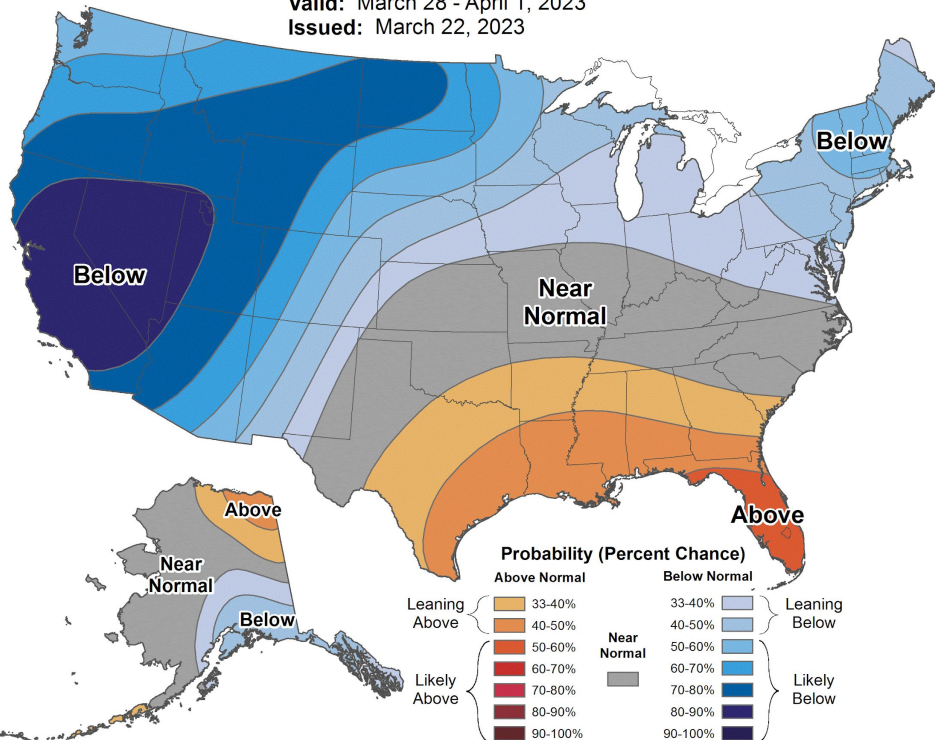
6-10 Day Temperature Outlook

Valid: March 28 - April 1, 2023
Issued: March 22, 2023



6-10 Day Precipitation Outlook

Valid: March 28 - April 1, 2023
Issued: March 22, 2023





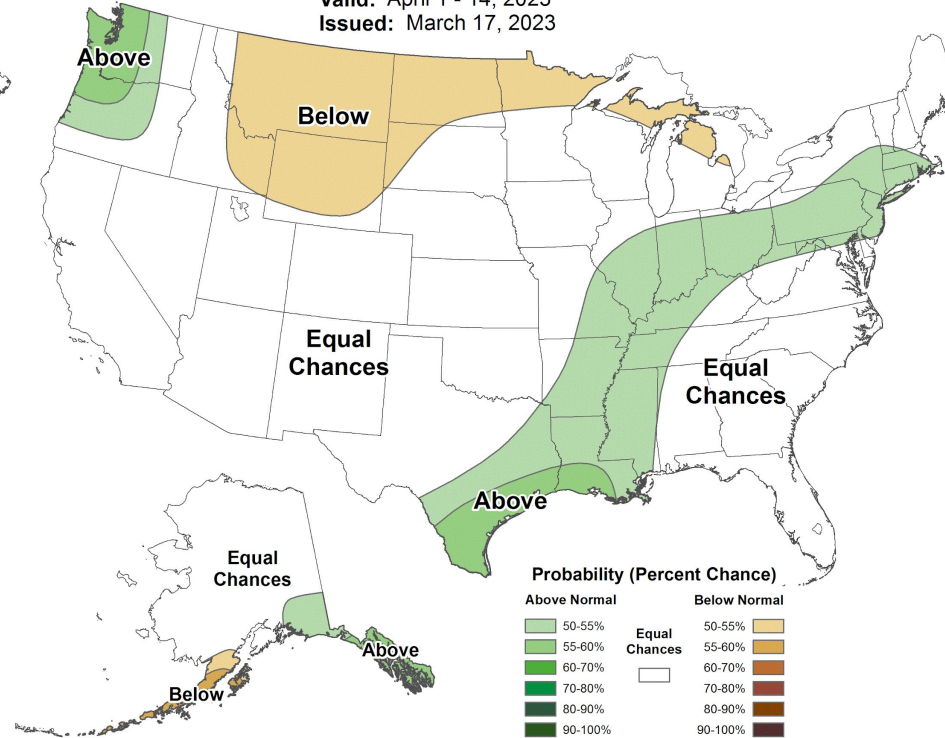
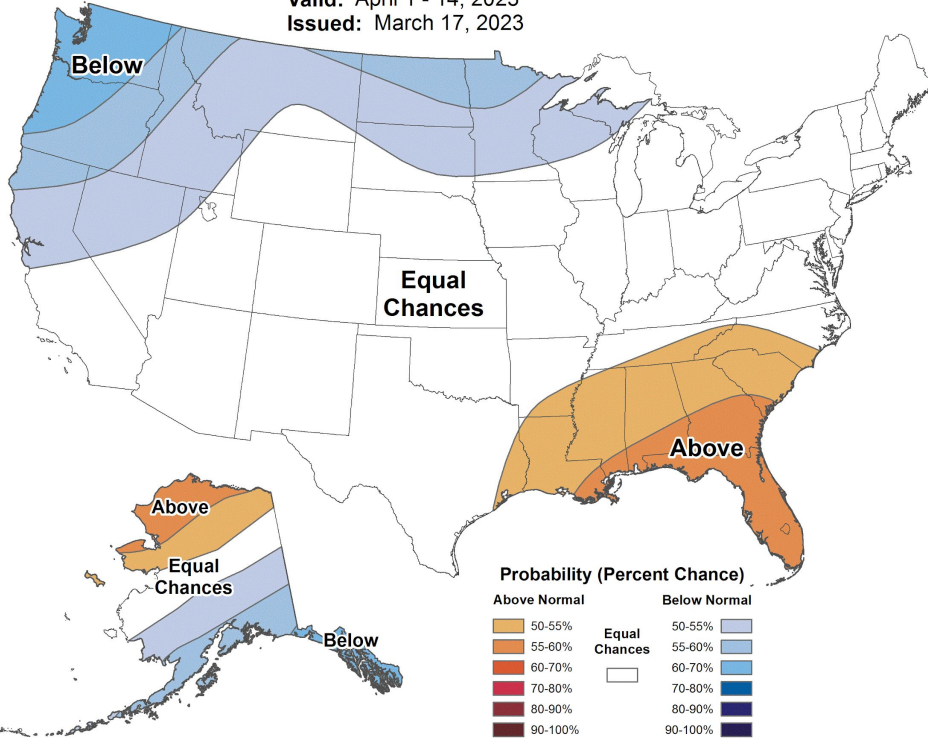
Weeks 3-4 Temperature Outlook

Valid: April 1 - 14, 2023
Issued: March 17, 2023



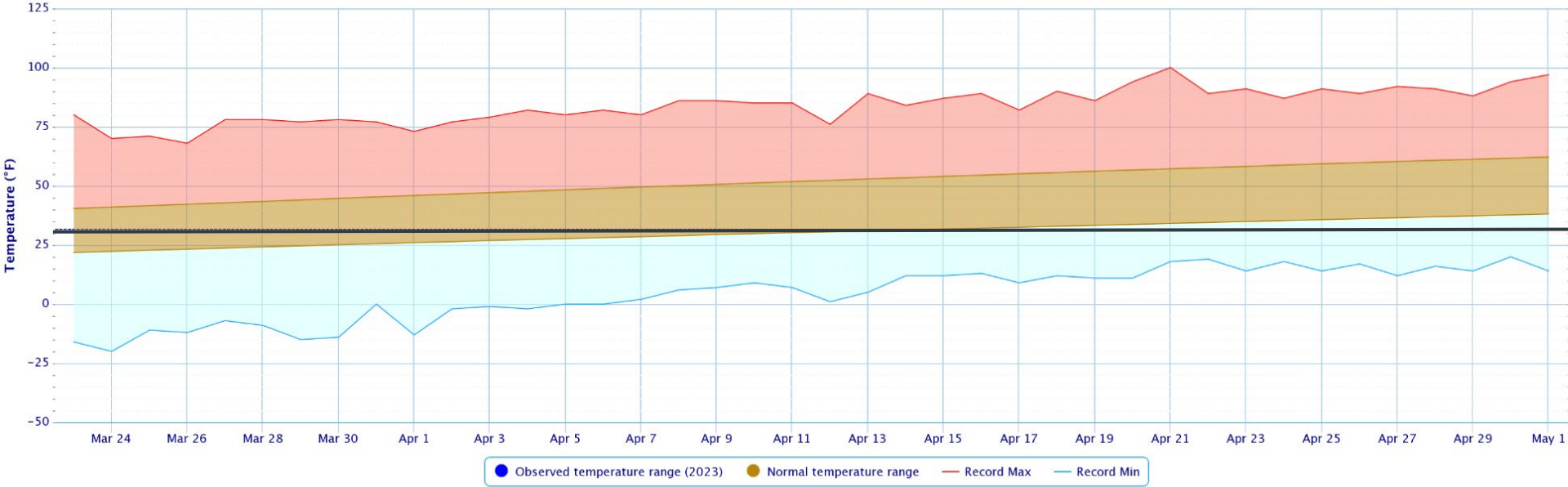
Weeks 3-4 Precipitation Outlook

Valid: April 1 - 14, 2023
Issued: March 17, 2023



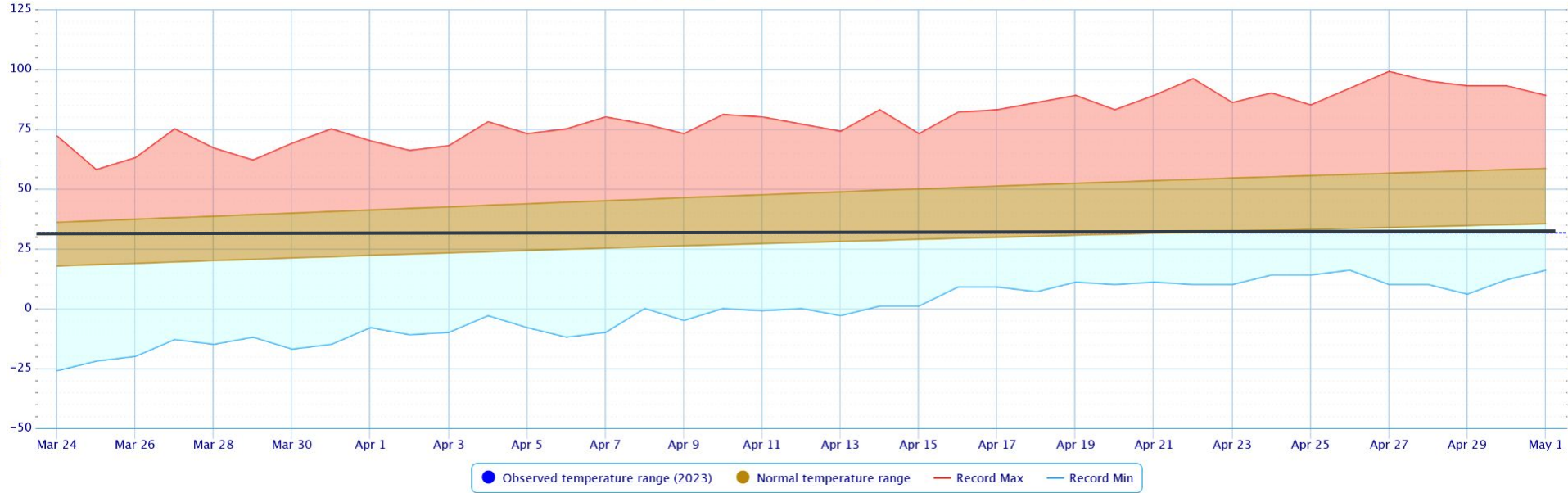
Daily Temperature Data – Fargo Area, ND (ThreadEx)

Period of Record – 1881-01-01 to 2023-03-22. Normals period: 1991-2020. Click and drag to zoom chart.



Daily Temperature Data – PEMBINA, ND

Period of Record – 1898-05-01 to 2023-03-23. Normals period: 1991-2020. Click and drag to zoom chart.

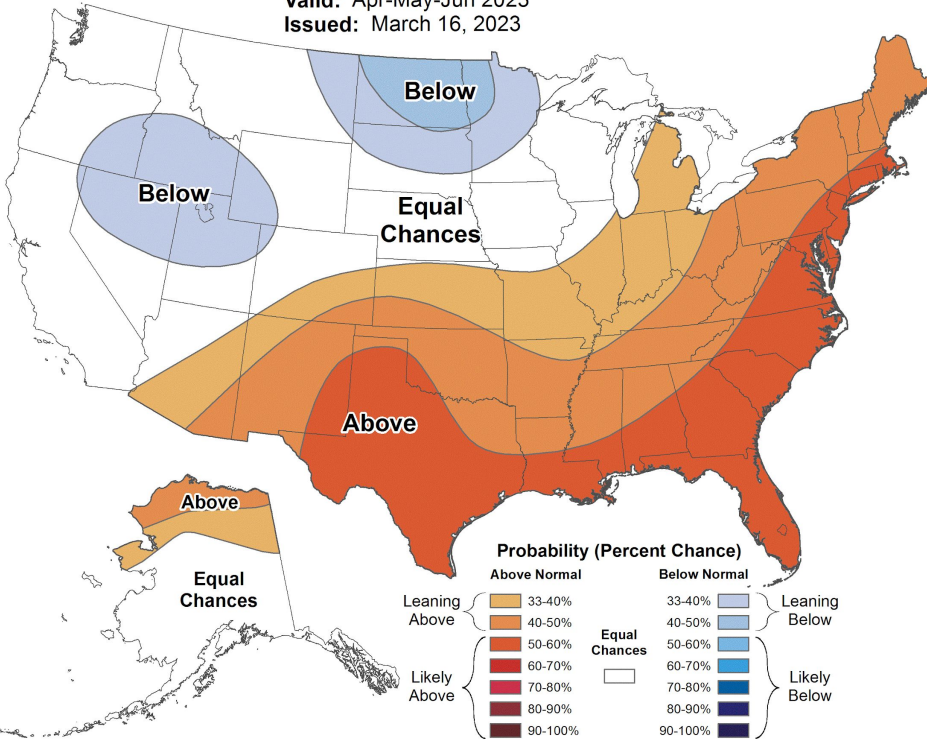




Seasonal Temperature Outlook

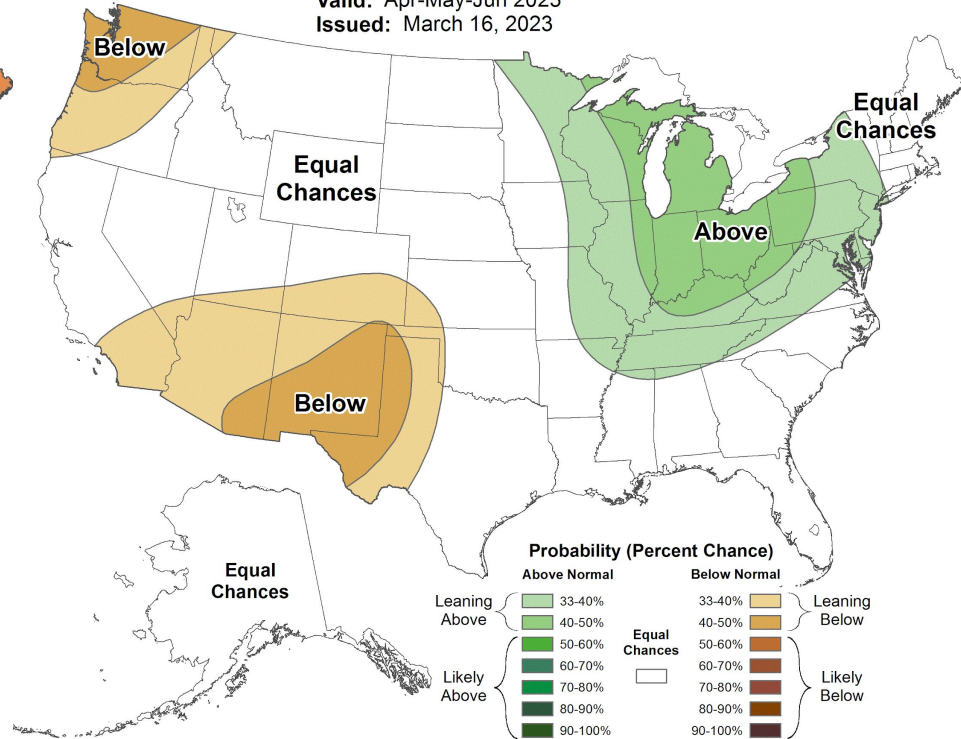


Valid: Apr-May-Jun 2023
Issued: March 16, 2023



Seasonal Precipitation Outlook

Valid: Apr-May-Jun 2023
Issued: March 16, 2023





Red River of the North Spring Flooding?

Spring

- Thaw Cycle ?
- Heavy Rains ?

Fall

- ~~Fall Moisture~~
- Base Streamflow ✓

Winter (thus far)

- Frost Depth ✓
- Snowpack ✓
- Snow Water Content ✓

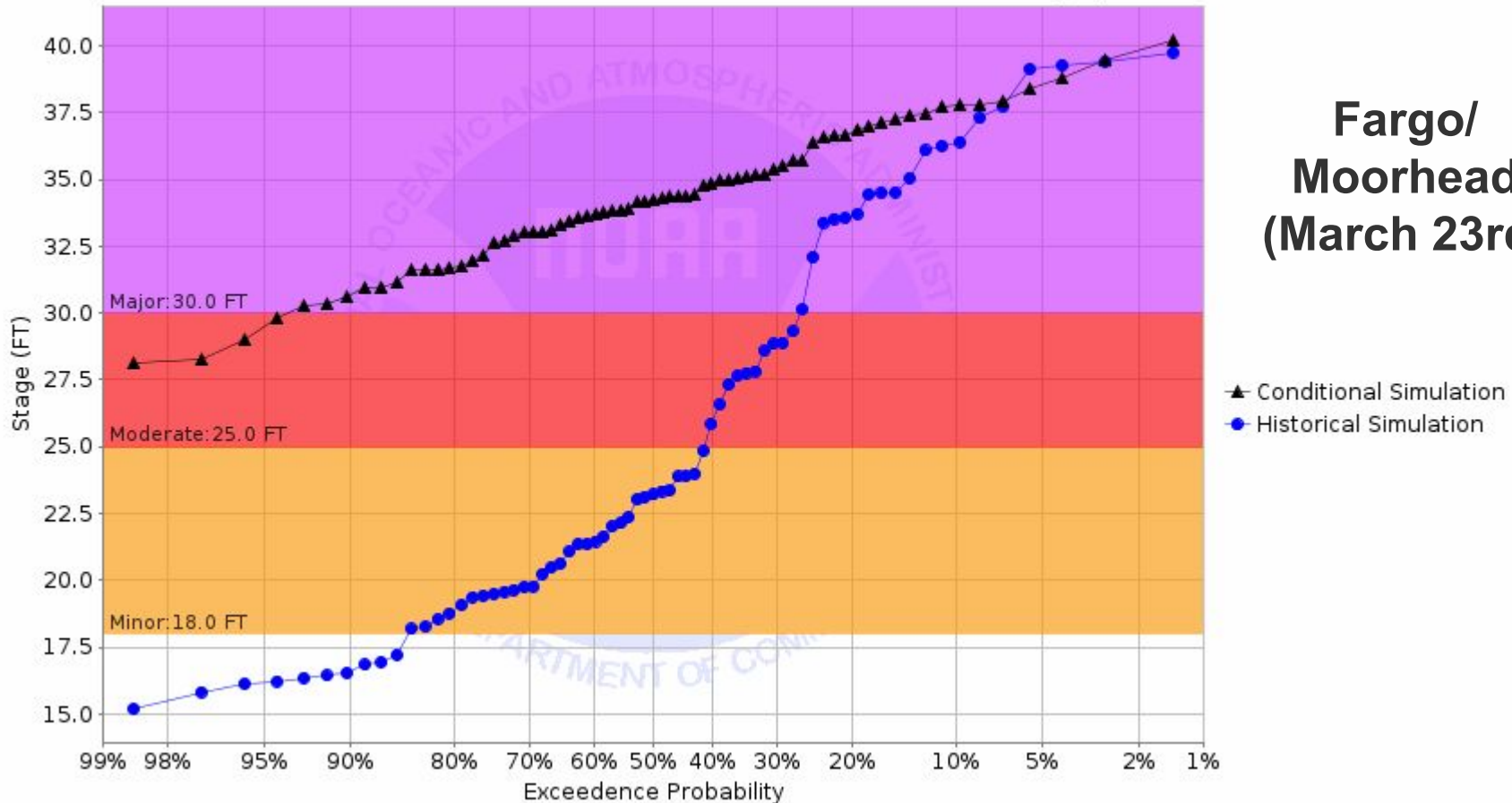
[Bluemle: Factors Affecting Flooding in the Red River Valley, 1997]



Chance of Exceeding River Stage at Red River of the North at Fargo WTP (FGON8)

Forecast for the period 03/27/2023 - 06/25/2023

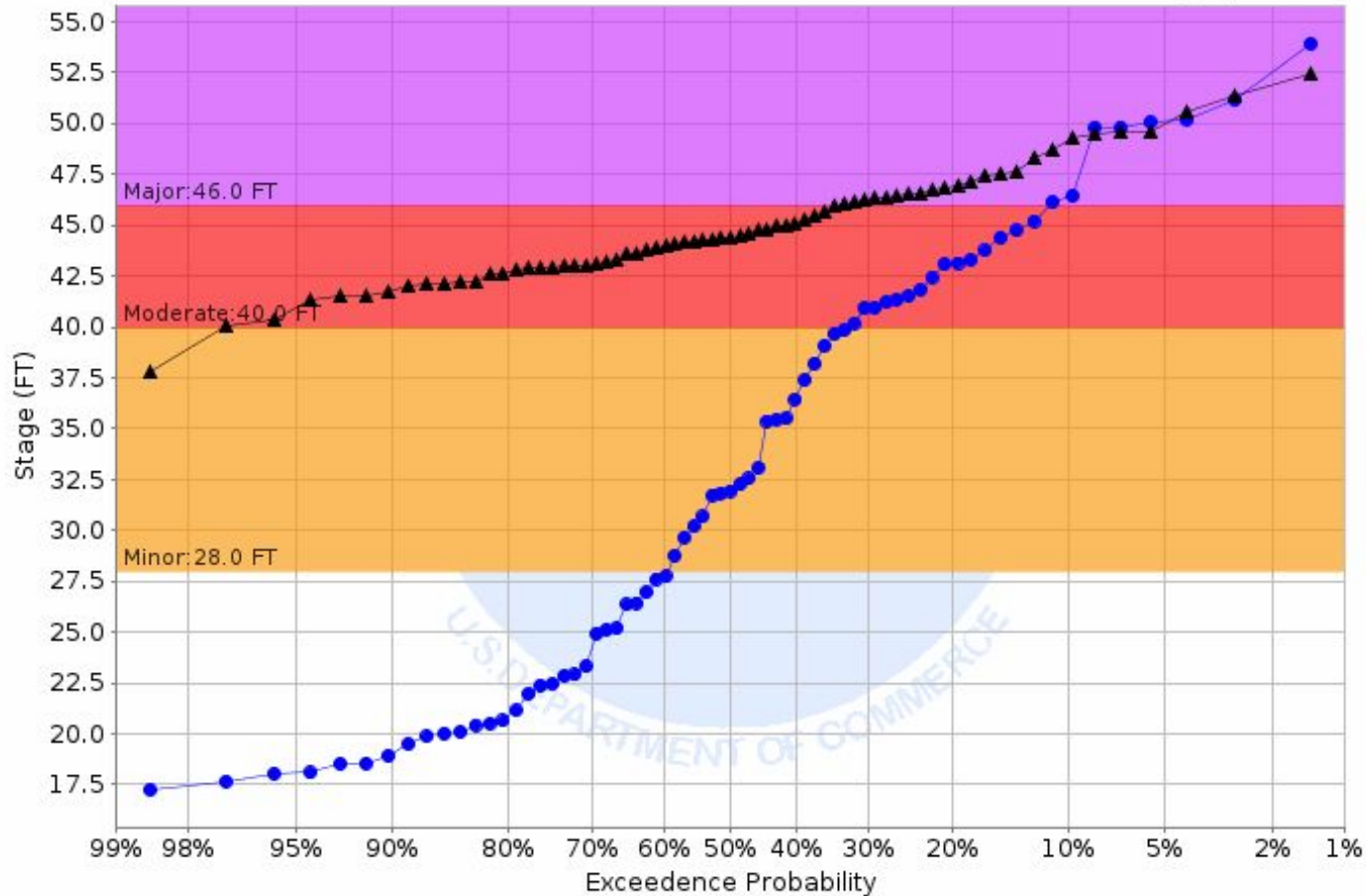
This is a conditional simulation based on the conditions as of 03/20/2023



Fargo/ Moorhead (March 23rd)

- ▲ Conditional Simulation
- Historical Simulation





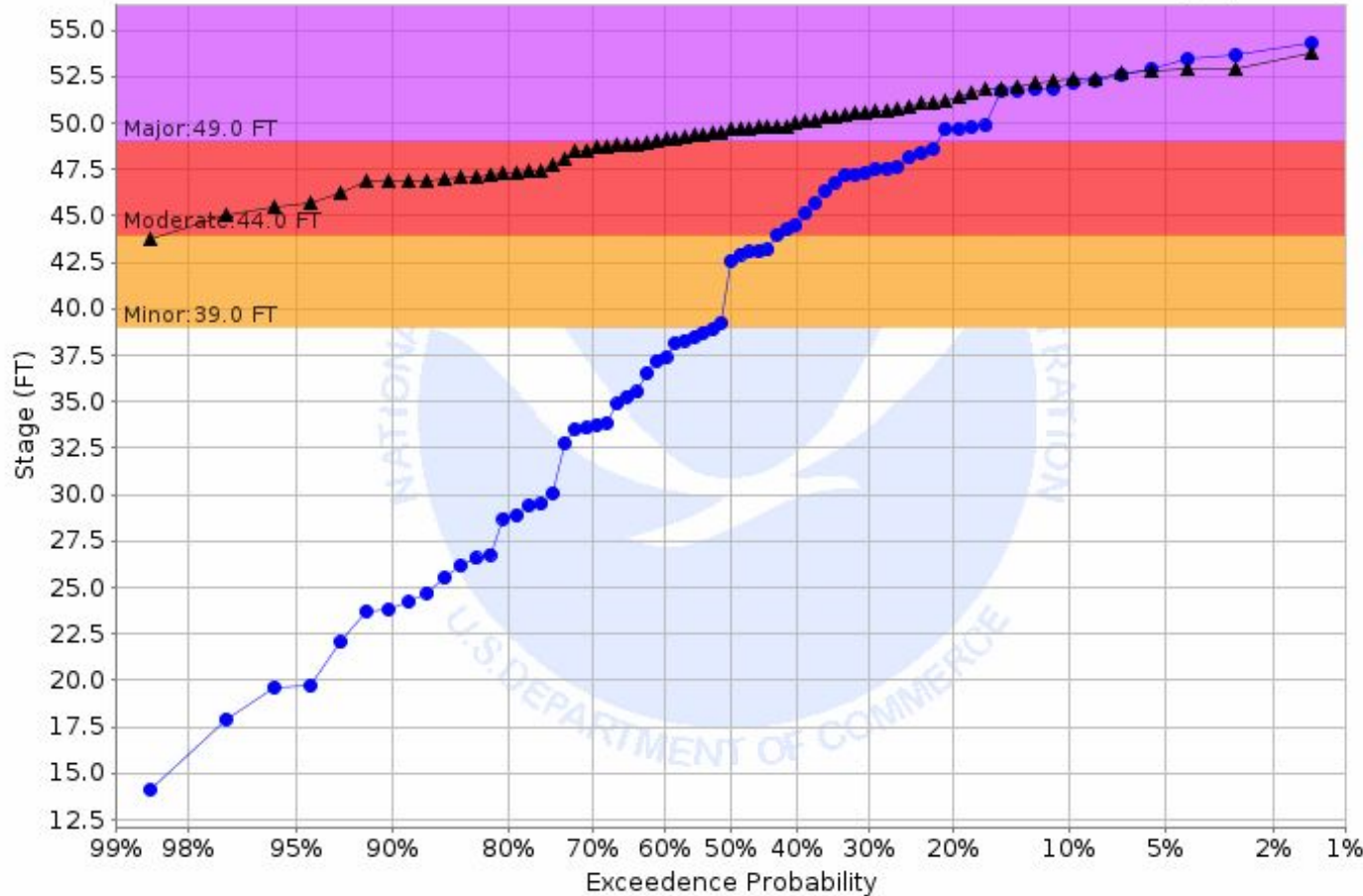
Grand Forks/ East Grand Forks (March 23rd)

- ▲ Conditional Simulation
- Historical Simulation

Chance of Exceeding River Stage at Red River of the North at Pembina (PBNN8)

Forecast for the period 03/27/2023 - 06/25/2023

This is a conditional simulation based on the conditions as of 03/20/2023

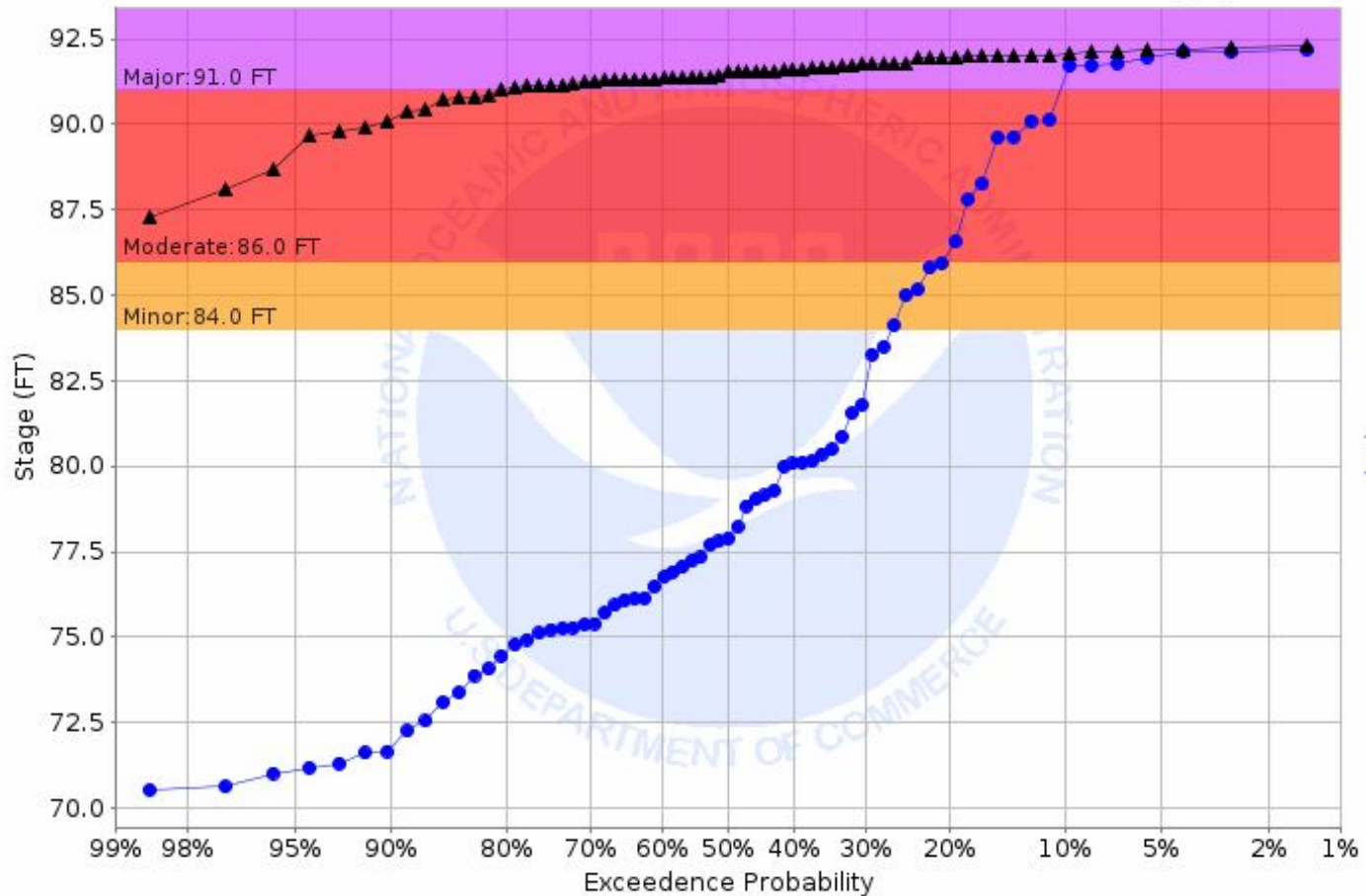


Pembina (March 23rd)

- ▲ Conditional Simulation
- Historical Simulation



Chance of Exceeding River Stage at Shyenne River at Harwood (HWDN8)
Forecast for the period 03/27/2023 - 06/25/2023
This is a conditional simulation based on the conditions as of 03/20/2023



Harwood (March 23rd)

- ▲ Conditional Simulation
- Historical Simulation



Valid March 13, 2023 - June 11, 2023

RED RIVER MAINSTEM	95%	90%	75%	50%	25%	10%	5%
Wahpeton	11.7	11.7	12.2	13.2	14.9	15.7	16.8
Hickson	25.8	26.0	27.4	30.0	33.3	35.1	36.1
Fargo	25.7	27.2	28.9	31.8	34.0	36.5	38.5
Halstad	28.0	29.9	32.3	35.3	38.3	39.5	40.0
Grand Forks	36.6	37.4	40.0	42.6	44.2	46.6	49.9
Oslo	33.9	34.1	34.7	35.6	36.3	37.3	38.6
Drayton	34.6	35.5	38.0	40.0	41.0	42.2	43.3
Pembina	41.6	43.0	45.7	47.8	49.9	51.8	52.5
NORTH DAKOTA TRIBUTARIES	95%	90%	75%	50%	25%	10%	5%
Wild Rice River							
Abercrombie	13.0	13.8	15.2	17.4	20.0	22.6	24.1
Sheyenne River							
Valley City	10.4	11.7	12.4	13.3	14.2	16.3	18.7
Lisbon	11.3	12.0	13.4	14.1	15.1	18.9	19.7
Kindred	15.2	16.1	17.8	19.2	19.9	21.1	21.2
West Fargo Diversion	15.1	15.2	17.2	19.2	19.9	21.3	21.3
Harwood	87.5	88.9	89.5	91.0	91.5	92.0	92.1
Maple River							
Enderlin	11.3	11.4	11.9	12.6	13.0	14.0	14.4
Mapleton	21.0	21.2	21.7	22.0	22.4	23.1	23.5
Goose River							
Hillsboro	7.8	8.6	10.1	12.2	13.6	14.7	15.4
Forest River							
Minto	4.0	4.2	4.6	5.2	6.2	7.0	7.2
Pembina River							
Walhalla	5.1	5.4	6.0	6.7	8.2	10.4	12.2
Neche	8.3	9.5	10.5	12.2	15.5	19.6	20.9

March 9th

Legend:
 Below Flood Stage
 Minor
 Moderate
 Major
 Flood of Record



Valid March 27, 2023 - June 25, 2023

RED RIVER MAINSTEM	95%	90%	75%	50%	25%	10%	5%
Wahpeton	11.9	12.1	13.1	14.3	15.3	16.4	16.8
Hickson	27.5	28.1	30.4	32.6	34.0	35.4	36.3
Fargo	29.5	30.7	32.7	34.2	36.4	37.8	38.6
Halstad	32.5	33.7	35.7	38.2	39.5	39.9	40.2
Grand Forks	41.0	41.8	42.9	44.4	46.5	49.2	50.0
Oslo	35.0	35.3	35.7	36.3	37.3	38.4	38.7
Drayton	38.6	39.5	40.1	40.8	41.8	42.9	43.5
Pembina	45.6	46.8	47.7	49.6	50.9	52.3	52.8
NORTH DAKOTA TRIBUTARIES	95%	90%	75%	50%	25%	10%	5%
Wild Rice River							
Abercrombie	15.7	16.1	17.5	19.2	21.8	24.0	25.0
Sheyenne River							
Valley City	11.6	12.0	12.6	13.3	14.3	18.0	19.5
Lisbon	12.0	12.6	13.2	13.9	15.2	18.5	20.1
Kindred	16.8	17.2	18.3	19.6	20.5	21.2	21.2
West Fargo Diversion	16.5	17.2	17.6	19.3	21.3	21.3	21.3
Harwood	89.3	90.1	91.1	91.5	91.8	92.1	92.2
Maple River							
Enderlin	11.4	11.6	12.3	12.9	13.2	13.8	14.2
Mapleton	21.0	21.6	22.0	22.4	22.8	23.2	23.7
Goose River							
Hillsboro	9.8	11.6	13.0	13.9	14.4	15.1	15.6
Forest River							
Minto	4.3	4.6	5.2	5.7	6.5	7.1	7.2
Pembina River							
Walhalla	5.4	5.7	6.2	6.9	8.3	10.4	11.3
Neche	9.1	9.8	11.3	12.7	16.7	19.6	20.5

March 23rd

Legend:
 Below Flood Stage
 Minor
 Moderate
 Major
 Flood of Record





Valid March 13, 2023 - June 11, 2023

MINNESOTA TRIBUTARIES	95%	90%	75%	50%	25%	10%	5%
South Fork Buffalo River							
Sabin	13.5	13.9	14.3	14.9	15.4	16.3	16.7
Buffalo River							
Hawley	6.8	7.3	7.8	8.6	9.5	10.3	10.6
Dilworth	16.8	18.1	18.9	20.3	21.6	22.8	23.3
Wild Rice River							
Twin Valley	6.2	6.5	7.3	8.3	9.2	10.8	11.6
Hendrum	24.1	25.9	27.1	28.7	30.5	31.8	32.5
Marsh River							
Shelly	10.3	11.0	11.5	13.0	14.7	17.3	19.1
Sand Hill River							
Climax	15.6	16.7	19.3	21.7	25.4	29.0	31.3
Red Lake River							
High Landing	6.1	6.7	7.3	8.2	9.4	10.6	11.9
Crookston	11.5	12.1	13.8	15.8	18.6	22.2	23.8
Snake River							
Above Warren	62.6	62.7	63.2	63.9	64.5	66.4	67.3
Alvarado	98.4	98.7	99.7	101.9	104.1	107.5	108.3
Two Rivers River							
Hallock	799.3	800.2	801.7	803.5	806.0	808.3	809.2
Roseau River							
Roseau	8.1	8.3	9.0	9.9	12.0	15.7	17.6

March 9th

Legend:
 Below Flood Stage
 Minor
 Moderate
 Major
 Flood of Record





Valid March 27, 2023 - June 25, 2023

MINNESOTA TRIBUTARIES	95%	90%	75%	50%	25%	10%	5%
South Fork Buffalo River							
Sabin	14.0	14.4	14.8	15.3	15.8	16.4	16.8
Buffalo River							
Hawley	8.2	8.7	9.1	9.8	10.3	10.8	11.2
Dilworth	19.3	19.8	20.6	21.6	22.5	23.3	23.9
Wild Rice River							
Twin Valley	6.8	7.2	7.8	8.9	9.6	11.0	11.9
Hendrum	26.7	28.1	29.1	30.5	31.7	32.5	33.1
Marsh River							
Shelly	10.9	12.4	13.5	15.1	17.3	19.5	20.2
Sand Hill River							
Climax	19.9	20.7	22.7	24.9	28.3	30.7	32.1
Red Lake River							
High Landing	7.0	7.3	8.3	9.3	9.5	11.4	11.8
Crookston	13.8	14.2	15.7	17.9	20.1	22.4	23.5
Snake River							
Above Warren	63.4	63.7	64.1	64.9	65.7	67.3	68.1
Alvarado	100.1	100.8	102.0	103.5	105.6	108.1	108.6
Two Rivers River							
Hallock	800.3	800.6	802.0	804.1	807.1	808.3	809.0
Roseau River							
Roseau	8.0	8.5	9.3	10.6	13.2	15.6	17.0

March 23rd

Legend:
 Below Flood Stage
 Minor
 Moderate
 Major
 Flood of Record

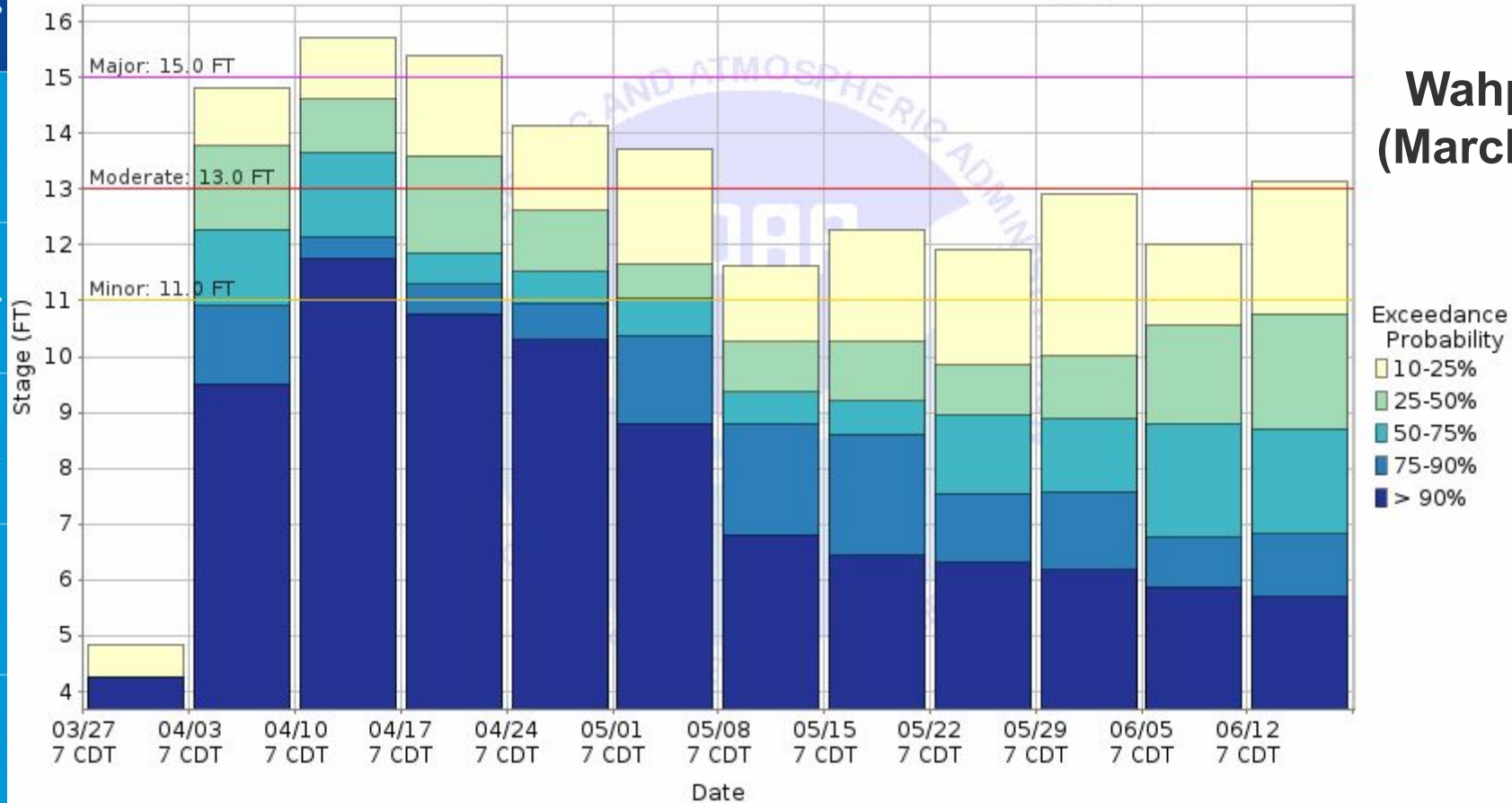


Weekly Chance of Exceeding River Stage at Red River of the North at Wahpeton (WHNN8)

Forecast for the period 03/27/2023 - 06/25/2023

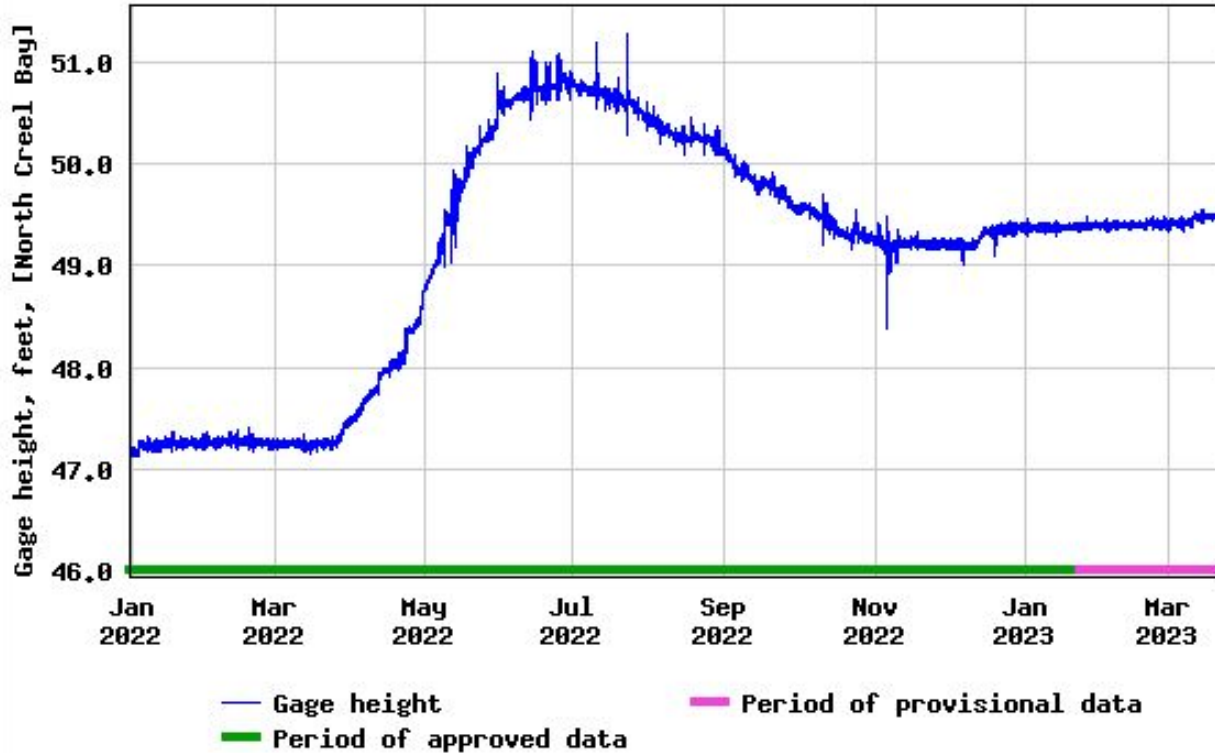
This is a conditional simulation based on the conditions as of 03/20/2023

Wahpeton (March 23rd)





USGS 05056500 DEVILS LAKE NR DEVILS LAKE, ND

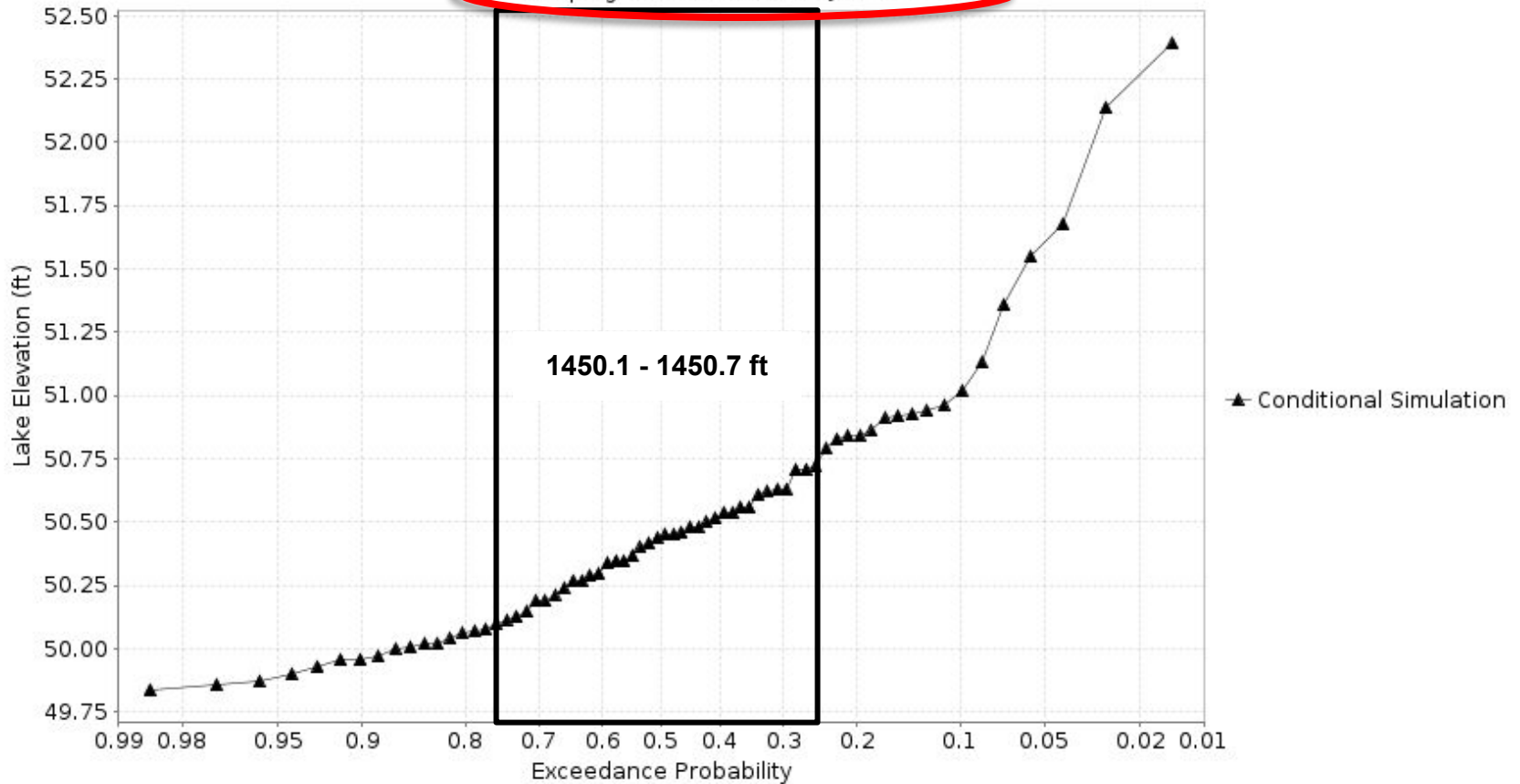


Probability of Rising to High Lake Levels on the Devils Lake at Devils Lake 5SW-Creel Bay (DCBN8)

Forecast for the period 03/20/2023 - 09/30/2023

This is a conditional simulation based on the conditions as of 03/20/2023

Pumping schedule : 350cfs Jun 1 - Nov 10



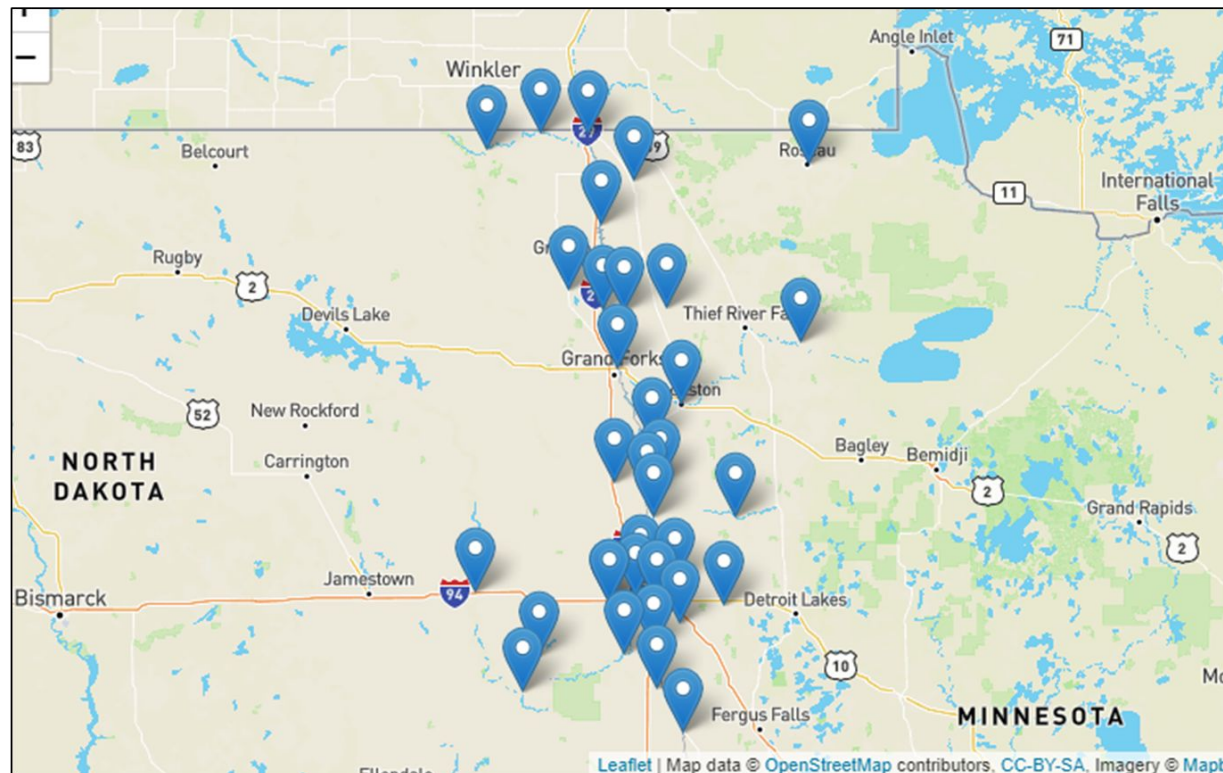


Probabilistic Flood Outlook Summary (PFOS)

- Same probabilistic data, just in a different format
- Includes all Red River mainstem and tributary forecast points
- At a glance, relates current risk to:
 - flood categories
 - recent crests
 - floods of record

Use the map below to view forecast point PFOS Graphics

(click a site marker below, then click on the image to expand)



www.weather.gov/fgf/PFOS





Probabilistic Flood Outlook Summary (PFOS)

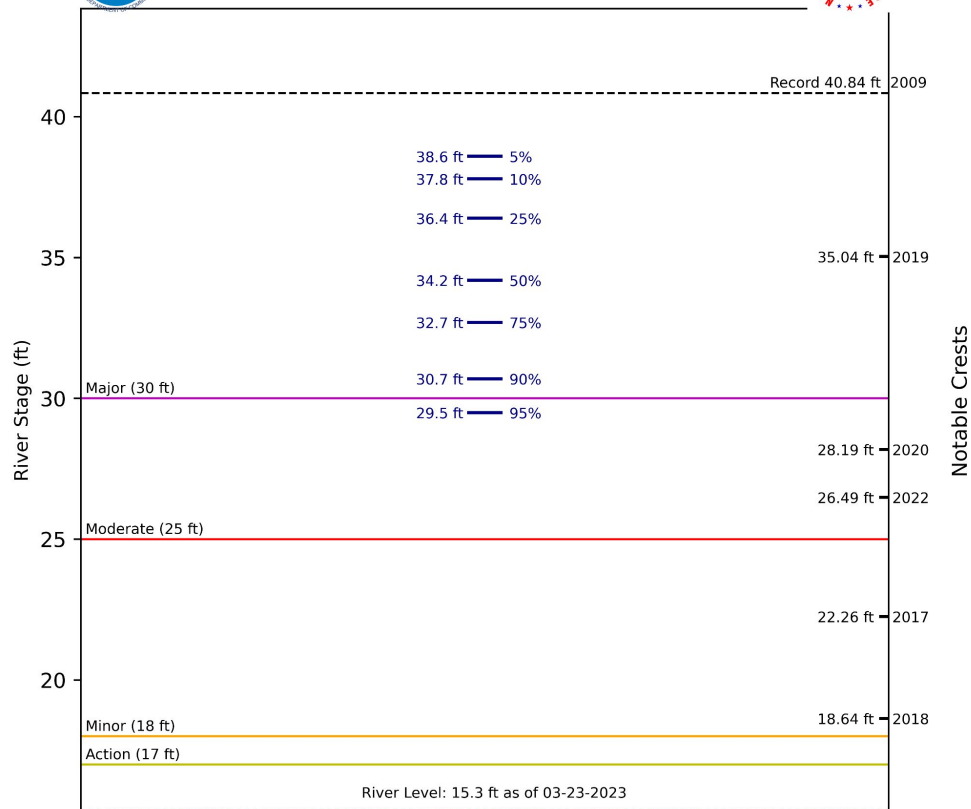
Please provide feedback!

amanda.lee@noaa.gov

or

Survey link via website

www.weather.gov/fgf/PFOS



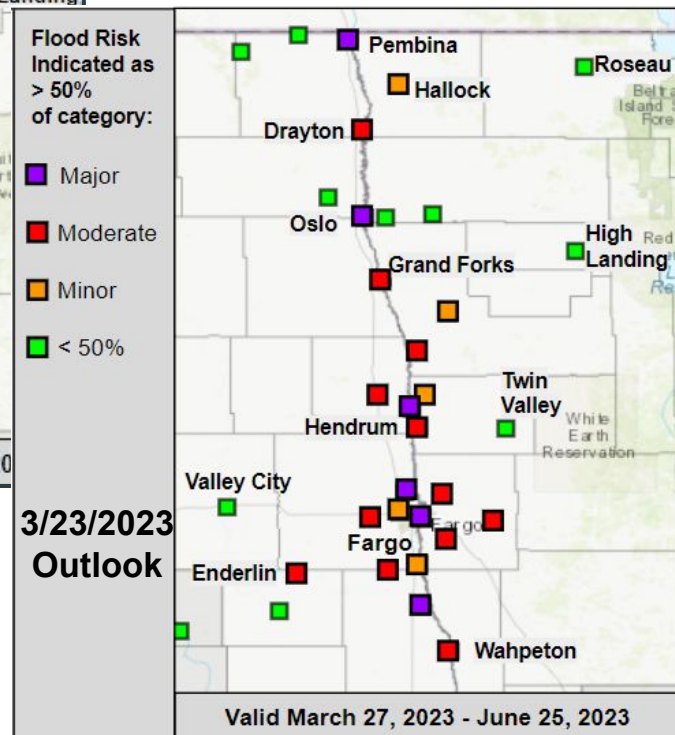
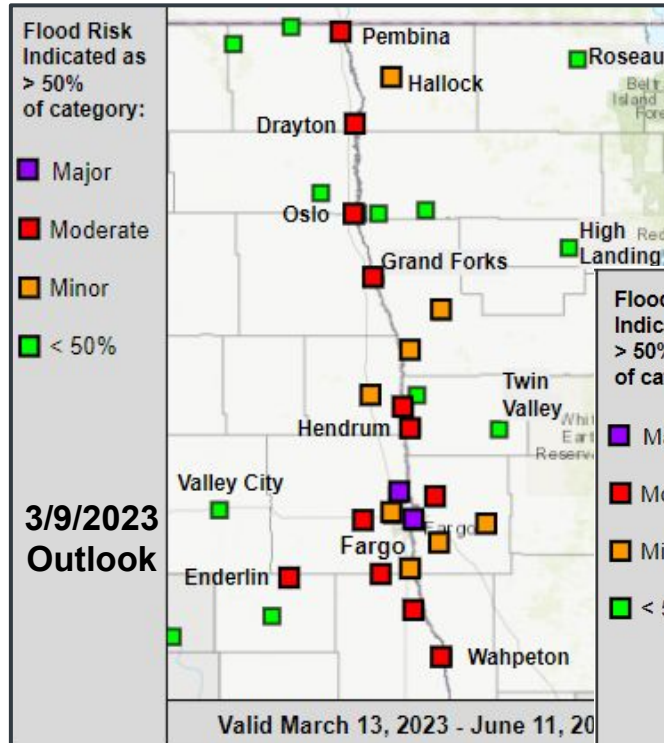
*This outlook graphic shows the most likely river stage range based on the latest forecast. There is a 5% chance of values higher than depicted here.
 **Figure created on 03-23-2023





Key Message

- The risk for significant (moderate or higher) spring flooding has increased due to additional snowfall and delayed melt conditions.
- Generally above long-term historical averages for most of the Red River Basin.





No additional 2023 probabilistic outlooks!

Expect thaw updates via e-mails/text products
before we begin issuing 7-day river forecasts

Amanda Lee

Service Hydrologist
amanda.lee@noaa.gov

Jim Kaiser

Warning Coordination Meteorologist
james.kaiser@noaa.gov

