Of Saturated (and Frozen) Roots...

Some Area Weather, Water, and Climate Observations...

And Prospects for a 2020 Spring Flood.

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A Red River and Devils Lake Basin 2020 Spring Flood Outlook, 24 January 2020.

Bottom Line up Front:

- 2020 Outlooks start <u>at</u> or <u>higher</u> than the 2019 Spring Flood.
 - Last year was a Top Ten Flood along the mainstem Red.
 - This year could be a Top Five Flood, tho much is left to be determined.
- On track for Record Fall-Winter period precipitation.
 - Fall to early winter was a record (SOND). Soils are really really wet!
 - Late winter to early spring (JFMA) precipitation is tracking high.
- Good News: Frost Depths/Ice Thicknesses are much less than '19.
- Not so Good: Lots of Winter yet to go!

Flood Risk by Category at River/Lake Forecast Points



Risk starts out quite high. Nearly all Basins will be impacted!

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Setting the Stage

September through November.

Average Temperature (°F): Departure from Mean December 1, 2019 to January 20, 2020 Average Temperature (°F): Departure from Mean September 1, 2019 to November 30, 2019 C) Midwestern Regional Climate Center (C) Midwestern Regional Climate Center Mean period is 1981-2010. Mean period is 1981-2010 Ó -3 -2

December thru January - to date.

If we ignore the miserable Fall (SON) season!

Winter to date: Plenty of snow, yet mild. Well, kinda...

For 2019, Record Heat made Global news...



NOAA Climate.gov, NCEI





Created: Mon Jan 06 2020

Data Source: 5km Gridded Dataset (nClimGrid)

Statewide Precipitation Ranks January-December 2019 Period: 1895-2019



Record Driest (1)

Below Average

Much Below

Average

e

Near Average Above Average Much Above Average





Contiguous U.S., Precipitation, January-December

Rankings:

1. 34.96 inches in 1973

2. 34.78 inches in 2019

3. 34.76 inches in 1983

4. 34.65 inches in 2018

5. 34.59 inches in 2015



Aggregate Annual RRB Precipitation (1895 thru 2019)

The Red River Basin annual total precipitation for the period of record (POR 1895-2019) as calculated by an areal weighted average of the six Climate Divisions which comprise the U.S. portion of the Red River of the North drainage. The green line is the RRB annual mean, purple is the ten year running mean, and grey is the linear trend. While the orange line represents an average for the period of record, one can see a nearly 2.5 inch increase that over that period. Such a very high interannual variability is typical for an extreme continental climate, like that of the U.S. Northern Plains, though a somewhat dramatic shift is seen in the post 1992 era, which follows the last significant RRB drought of the late 1980s. Other than the flash droughts of 2006, 2012, and 2018 the net annual increase in rainfall since 1992 has increased sharply by GTE 1.7 inches.





Annual flow along the Red River of the North as measured at Fargo, Grand Forks, and near the Canadian border at Emerson MB. Note the persistent uptick over time and the surge during the 1993-20xx wet period.

Within the Northern Plains Region... when does the majority of our runoff and streamflow occur?



- Generally in the spring.
- Generally charged with melting snowpack.
- Generally with landscape still frozen or not yet growing.
- Generally before the heavier convective rains of summer.
- And thus before significant Evapo-Transporation occurs.
- Or it's in the fall, when ET is largely over.

Within the Northern Plains Region... when does the majority of our runoff and streamflow occur?



I've superimposed a typical local river cross section to show how within low-bank crosssectional area, and resulting river flow, is often much-much smaller than flow in an overbank area, or the even wider out-of-bank areas.

Though the period of very high water may be small, the total volume of river flow during this time is maximized.



When and How Much Lag Time is there? And for any one precipitation event anywhere in the basin to flow at Emerson the timing could range from days, to weeks, months, even years. From a bulk comparison mode, the highest volume flows occur with spring snowmelt runoff and that is most closely related to the stored moisture from the preceding fall and winter period - that stored as excess soil moisture and base streamflow, and that gained in snowpack and snow-water equivalent, along with any early season rainfall over still frozen ground Here we show the aggregate basin averaged precipitation for each of the local fall-winter season periods, effectively running from September through April where evapotranspiration is negligible. Note that precipitation for the early Fall-Winter 2019-20 period (SOND) is measured, and is a record value, but the late Winter period (JFMA) has been conservatively estimated at the long-term climate average and not at the CPC outlook suggesting a higher risk for near to above-average values.



Fall-Winter Precipitation compares much better with Annual Streamflow. The bulk of our basin runoff comes during the spring snowmelt runoff period when stored winter precipitation and carryover moisture from the preceding year are able to move into the river system, before the ground thaws and before the warm-season plant growth and evapotranspiration processes can take-over in balancing the short-term water-cycle. Note that the long term trend of increasing annual streamflow is still at a lower rate that the trend in increasing Fall-Winter season (SONDFMA) precipitation, but their 10 year running means are much more similar, and years like 1916 and 1977 both show similar relationships in direction and magnitude.



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Statewide Precipitation Ranks September-November 2019 Period: 1895-2019



(125)

Average

Average

(1)

Accumulated Precipitation (in): Departure from Mean September 1, 2019 to January 20, 2020



...and did I mention that we've been wet?

Rank	Ending Date	Total Precipitation Sep 1 to Jan 20	Missing Count
1	2009-01-20	12.97	0
2	2020-01-20	11.52	0
3	1978-01-20	11.12	0
4	2011-01-20	10.95	0
5	1904-01-20	10.72	0
6	1997-01-20	10.67	0
7	2014-01-20	10.64	0
8	2001-01-20	10.60	0
9	1897-01-20	10.43	0
10	1972-01-20	10.42	0
11	1999-01-20	10.14	0
12	1882-01-20	10.00	0
13	2010-01-20	9 96	0

 As of Jan 20th, the Fargo area is
← holding as the 2nd wettest on record for *early* Fall-Winter Precipitation (8/1/19 through 1/20/20).

While the Grand Forks area, and → the north-central RRV in general, is soundly in **1**st **place**!

Data from NOAA/NCEI, via the XMACIS2 system, with long term records back through the 1890s.

Rank	Ending Date	Total Precipitation Sep 1 to Jan 20	Missing Count
1	2020-01-20	14.81	0
2	2009-01-20	12.15	0
3	2011-01-20	9.70	0
4	1982-01-20	9.26	0
5	1974-01-20	9.07	0
6	1966-01-20	8.82	0
7	1901-01-20	8.81	0
8	1999-01-20	8.80	0
9	1978-01-20	8.74	0
10	2001-01-20	8.65	0
11	2017-01-20	8.62	0
12	1932-01-20	8.34	5



All of this helped to produce an Historic* Autumnal River Crest at GF!

The Red River at Grand Forks had a record fall season crest on Oct 16th at close to 41 ft.

This was **10 ft. higher** and over **40% greater** volume flow than the previous record fall season crest of 30.76 ft., set early on Nov 2nd of 2010.

*note: Fall 2019 sets a new fall river record for all the RR gage points north of Fargo: Halstad, GF, Oslo, Drayton, and Pembina.



Explanation - Percentile classes							
lowest- 10th percentile	5	10-24	25-75	76-90	95	90th percentile -highest	Flow
Much below Normal		Below normal	Normal	Above normal	Much a	bove normal	1104

Notice the little bump at the end... in Dec 2019 we freeze-up at a new record high winter level!

Not quite the highest Autumnal River Crest at Fargo-Moorhead!

The Red River at Fargo-Moorhead had a 2nd Place fall season crest on Oct 16th at around 23.40 ft.

This was about **2 ft. lower** and over **17% lower** volume flow than the fall season crest of 25.49 ft., set early Oct 17th 2008.

*note: Fall 2019 sets a new fall river record for all the RR gage points north of Fargo: Halstad, GF, Oslo, Drayton, and Pembina.



Explanation - Percentile classes							
						_	
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		Below	Normal	Above normal	Much a	bove normal	

Notice the little bump at the end... in Dec 2019 we freeze-up at a near record high winter level!

In general, flow at freeze-up was at or near record high levels for the time of year... 95th percentile or greater.



Monday, January 20, 2020

Explanation - Percentile classes							
Low	<10	10-24	25-75	76-90	>90	High	No Data
LOW	Much below normal	Below normal	Normal	Above normal	Much above normal	ngn	











Photo courtesy of Mark Rohrich. See DTN Progressive Farmer - 2019 Corn Harvest: Will it Ever End?

9 Dec 2019 - Satellite Image of Corn fields poking through snow cover in east-central ND.



Landsat 7 Image 9 Dec 2019 https://earthobservatory.nasa.gov/images/145956/patchwork-of-corn-in-the-snow

So what is next?

The first 2 of 7 key flood ingredients are *well* met. [both near record!]

Our recent 2009, 2010, and 2011 "historic" Spring Flood years *also* had our previous "historic" Autumn season flood crests ... in the falls of '08, '09, and '10.



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3. Frost Depths are running Below Normal... less deep than last year, still at 8 to 30 inches.

- 4. Winter Snowpack is Above Normal... except for the far northern RRB.
- 5. Snow Water Equivalent (SWE) is High... near typical "winter season" values already.

NDAWN and NCRFC Frost Depth Analysis... 22 Jan 2020



Deep Soil Temperature data courtesy of NDAWN (North Dakota Ag Weather Network), NRCS SCAN, and other GOV sites.

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By comparison... Jan 2011 had an additional 1-2" SWE in the south/central RRV, and higher runoff potential overall than we *currently* see in 2020.



Note 1. By comparison... Jan 1997 had higher, Jan 2009 had lesser SWE overall than current.

Note 2. Across the Red River Basin, 2011 ended up as the highest volume of runoff year, with 2009 in second place and 1997 in third place. Though runoff came out over a longer period in 2011 than in 1997 or 2009.



7-Day QPF ... Less than a tenth of an inch over the RRB.



[WPC 7-Day QPF issued at 23/2056z, for Jan 24-31 2020]

First... Mild and Dry, Wk 1; Snowier Wk 2.



Week 2 (8-14 day) Outlook, updated 23 Jan 2020

Then... a Further Plunge into Deep Winter



February Outlook, issued 16 Jan 2020

And Then... ewww! Late Thaw Perhaps?



Feb-Mar-Apr Outlook, issued 16 Jan 2020

Flood Risk by Category at River/Lake Forecast Points



Risk starts out quite high. Nearly all Basins will be impacted!

Wild Rice River nr Abercrombie: mid-hi Major (CR3 bridge and bridge near gage flooded)



New! Probabilistic Flood Outlook Summary (PFOS)

An Experimental Product

Now for <u>all</u> Red River mainstem and Tributary locations.

At a Glance,

- relates risk to recent years,
- to flood stages, and
- to floods of record.

Let us know what you think!



https://www.weather.gov/fgf/PFOS

Red River at Fargo-Moorhead: mid-hi Major (floodwalls installed, some bridges closed)



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Sheyenne River at Valley City: Major (flood wall closures, emergency levees?)



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Red River at Grand Forks-East Grand Forks: Major (flood wall closures, rail bridge?)



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Red River at Oslo: Major Flood stage (lots of breakouts, town access closed)



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COME I	ПОЛА	Valid 01-27-2020 through 05-19-2020	SEATHS P
		% Chance of reaching or exceeding this level	ET AN AND ST
40 -	1		
			Record 38.3 ft 200 37.8 ft - 201
	Major (36 ft)	36.7 ft — 95%	
35 -			
30 -	Moderate (30 ft)		
	Minor (26 ft)		
25 -			
	Action (23 ft)		
20.			
20 -			
15 -	-		
		Piver Level: 11 5 ft as of 01 24 2020	
		Niver Level, 11.3 (Las 0) 01-24-2020	

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Park River at Grafton: Min-Mod Flood stage

(some rural breakouts, else *new* city bypass operational)



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Red River at Pembina: Major Flood stage

(dike patrols, south airport road closes)



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Creel Bay at Devils Lake: 2-3 ft. rise expected

(rise back to levels last seen in 2015-16)

Probability of Rising to High Lake Levels on the Devils Lake at Devils Lake 5SW-Creel Bay (DCBN8) Forecast for the period 01/20/2020 - 09/30/2020 This is a conditional simulation based on the conditions as of 01/20/2020





baseflows up enough to cause an unusual cold season rise of about 0.7 ft





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Lots of Winter yet to play out!

Official Probabilistic Outlooks:						
NCRFC Basins by noon, FridayJan 24 th						
	- by noon, Thursday	Feb 13 th				
	- by noon, Thursday	Feb 27 th				
	- by noon, Thursday	Mar 12 th				

Text and Numbers may be ready earlier, while Graphics to web take a bit longer.

Contact us at: nws.grandforks@noaa.gov Phone: 701-795-5127

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