RECLAMATION
Managing Water in the West

Flaming Gorge Technical Working Group

March 5, 2018 Hydrology Summary

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For the purposes of discussions related to implementing the ROD in 2018, an evaluation has been made of the current hydrologic conditions in the Upper Green River (*i.e*. above Flaming Gorge Dam) and Yampa River Basins. The evaluation centered on the historical unregulated inflow statistics for Flaming Gorge Dam during the period from 1963 through 2017. The March 1, 2018 final forecast is 940,000 acre-feet for Flaming Gorge, which falls in the average (below median) hydrologic classification. Information regarding the Yampa River hydrology indicates that the hydrologic classification will likely be moderately dry (<70% and >90% exceedance) for spring 2018.

The combined April through July forecast of the Yampa River at Maybell and Little Snake at Lily is 790,000 acre-feet. This forecast would fall into the moderately dry hydrologic classification of the ROD.

Snow water equivalent (SWE) as of March 5, 2018, for the Upper Green River and Yampa/White River Basins are 108 and 80 percent of median, respectively. Flaming Gorge SWE is similar to 1989 and 2012, while Deerlodge SWE is similar to 2013 and 2002. The Tower snotel site, used as a reference point for Yampa snowpack and runoff, currently has 27.9 inches of SWE (75 percent of median). On March 5, Tower SNOTEL measured SWE inches of:

- 2002 = 22.6 in (3/1); Yampa 359 kaf obs spring (28%)
- 2013 = 26.5 in; Yampa 676 kaf obs spring (53%)

The difference between the Tower SNOTEL figures and Yampa River observed spring volume differs significantly and needs to be considered when comparing any values this early in the snow accumulation season.

Basin Hydrology

Green River Basin Hydrology

The March 1, 2018, ESP forecast of April through July unregulated inflow (current forecast) for Flaming Gorge Reservoir is 940,000 acre-feet (AF) (96% of 30-year average). This forecast falls at 59 percent exceedance based on the historic unregulated inflow record (1963-2017).

Figure 1 illustrates the Upper Green River SWE as of March 5, 2018 and compares it against water years 1989 and 2012. Figures 2 and 3 show the spatial extent of significant areas of modeled snow accumulation for the Upper Green River Basin and how this is incorporated into the water supply forecasts. Figure 3 indicates that the forecast for Flaming Gorge Reservoir has remained fairly stable and the March 1, 2018, final forecast has increased from 870 kaf to 940 kaf from two weeks ago.

Historic year unregulated inflow volumes that compare with current snowpack are 1989 with total inflow into Flaming Gorge of 611 kaf (62 percent of average) and 2012 with total inflow into Flaming Gorge of 570 kaf (58 percent of average).

Figure 4 illustrates the current forecast in relation to the historic unregulated inflow volumes. Figure 5 illustrates Flaming Gorge Reservoir March final forecast probability (percent exceedance).

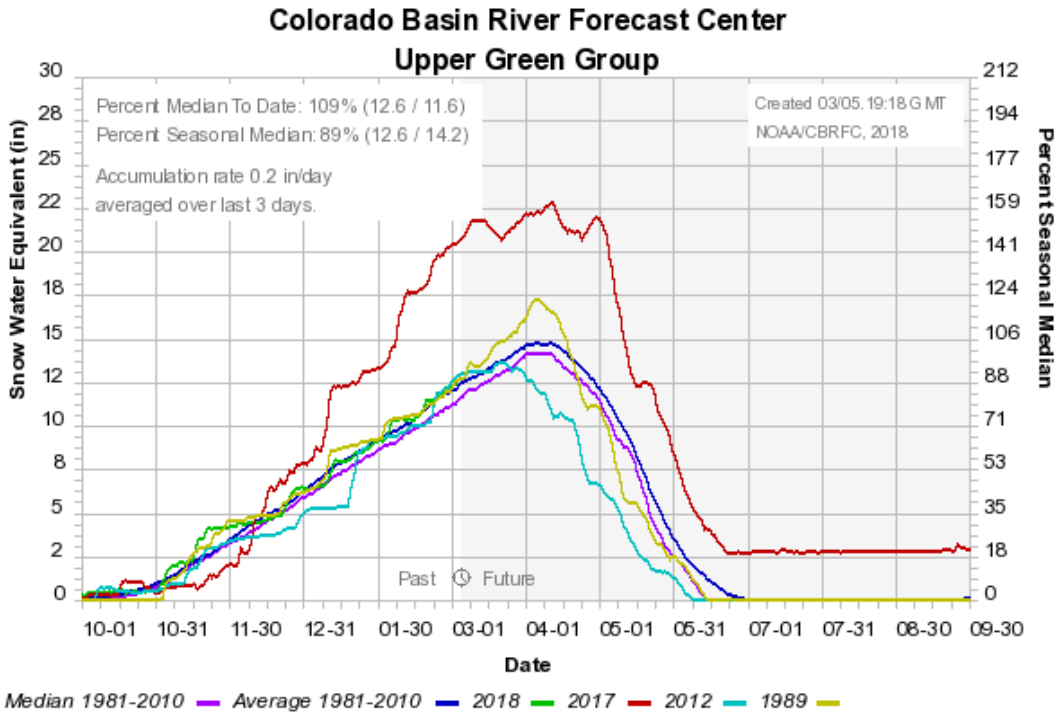

FIGURE 1. Upper Green River Basin Snotel Tracking. 1981-2010 percent of median compared against 2018 YTD Snow Water Equivalent (SWE) and 1989 and 2012 percent of average SWE, and 2017 percent of median SWE.

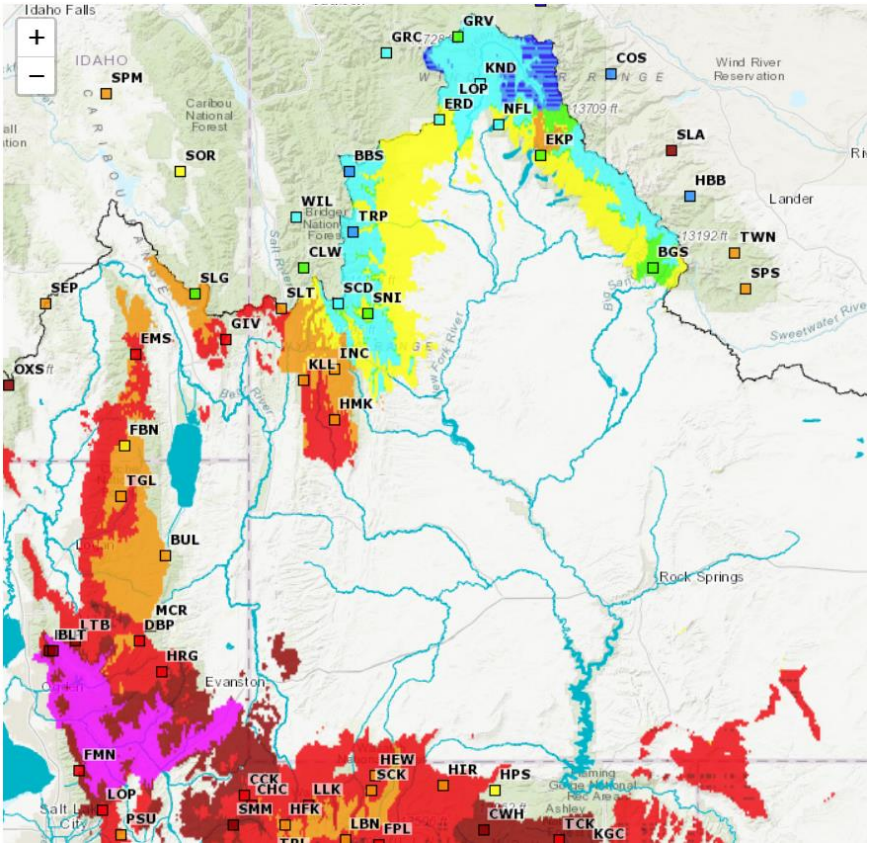

FIGURE 2. Upper Green River Basin modeled SWE significant areas as of March 5, 2018.

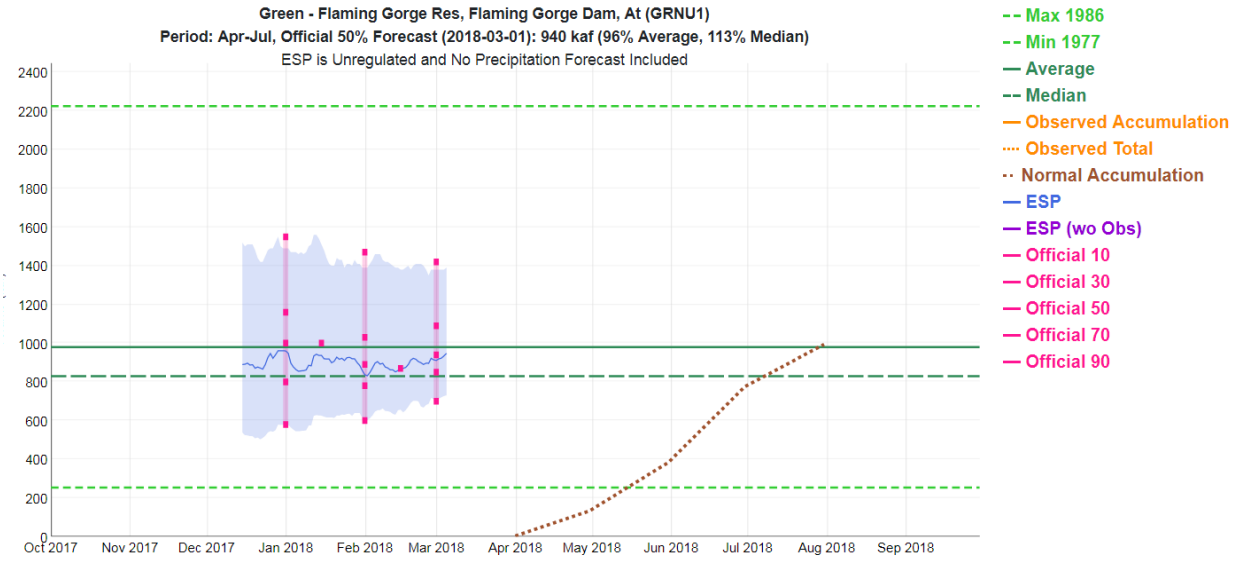

FIGURE 3. Upper Green River Basin Water Supply Forecast as of March 5, 2018.

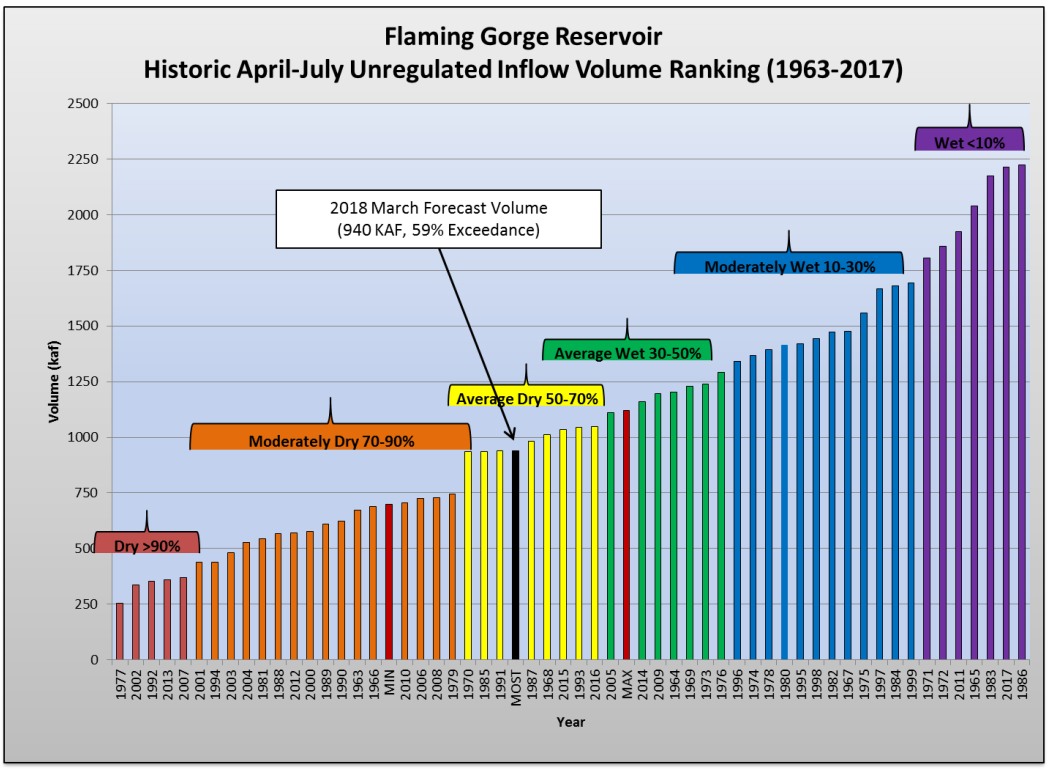

FIGURE 4. Flaming Gorge Reservoir March 1, 2018 forecast and ranked historic April-July unregulated inflow volume for years 1963-2017.

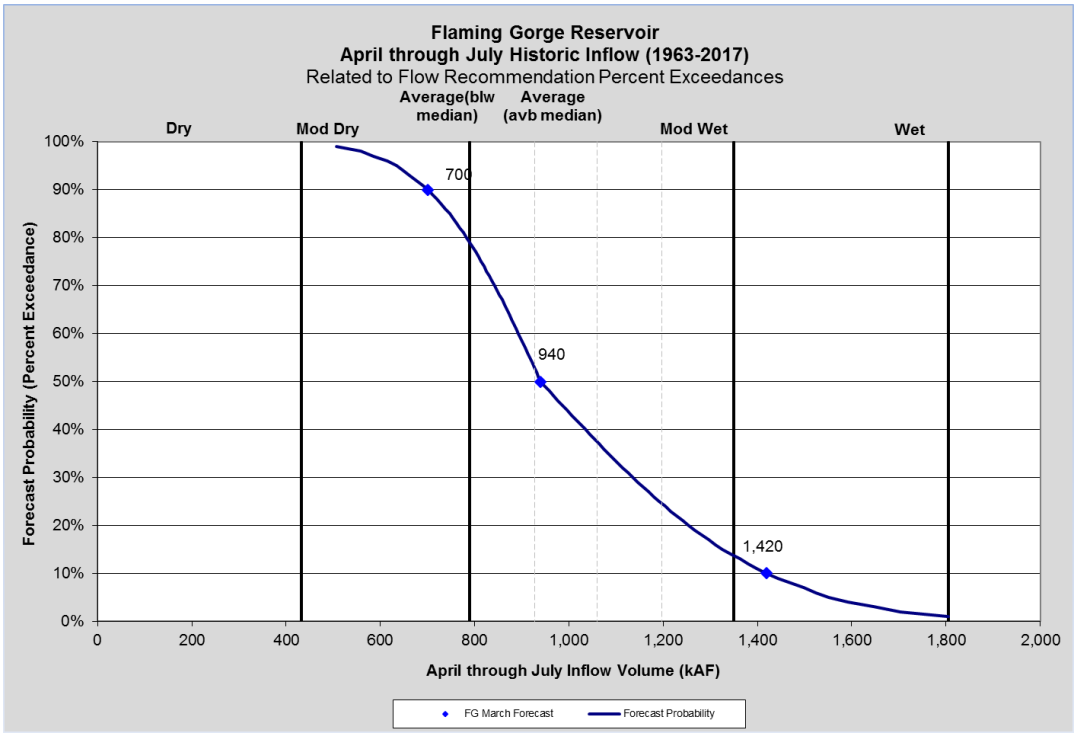

FIGURE 5. Flaming Gorge Reservoir March final forecast probability (percent exceedance) and historic April-July unregulated inflow volume for years 1963-2017

Yampa River Basin Hydrology

The combined current forecast for the Little Snake at Lily plus Yampa River at Maybell is 790,000 AF (64% of 30-year average). This forecast falls at approximately 84% exceedance based on a ranking of the historic record (1922-2017).

Figure 6 illustrates the Yampa River at Deerlodge Park SWE as of March 5, 2018 and compares it against water years 2002 and 2013.

Figures 7 and 8 show the spatial extent of significant areas of modeled snow accumulation for the Yampa River Basin and how this is incorporated into the water supply forecasts. Figure 8 indicates that the forecast for the Yampa River at Deerlodge is stable and the March 1, 2018, final forecast remained at 790 kaf from two weeks ago.[1]

Figure 9 below shows the current forecast in relation to historic flow volumes. Figure 10 illustrates the Yampa River at Maybell plus Lily March final forecast probability (percent exceedance).

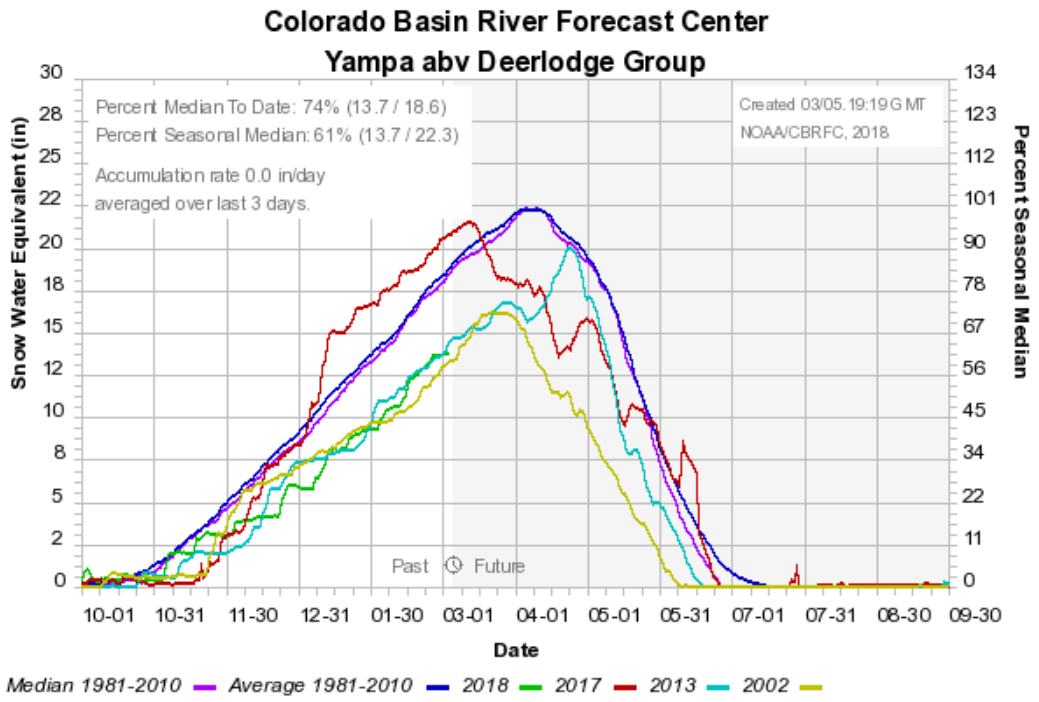

FIGURE 6. Yampa River above Deerlodge SNOTEL Group. 1981-2010 percent of average SWE compared against 2018 YTD, and analog years 2002, 2013, and 2017 percent of median SWE

[1] The Yampa River at Deerlodge forecast volume differs from the Yampa River – Maybell Plus Lily volume. The historic gage record to calculate the Maybell plus Lily forecast volume is significantly longer than the Deerlodge dataset. The forecast volumes will be close, but the actual volume may differ due to routing in the CBRFC forecast model.

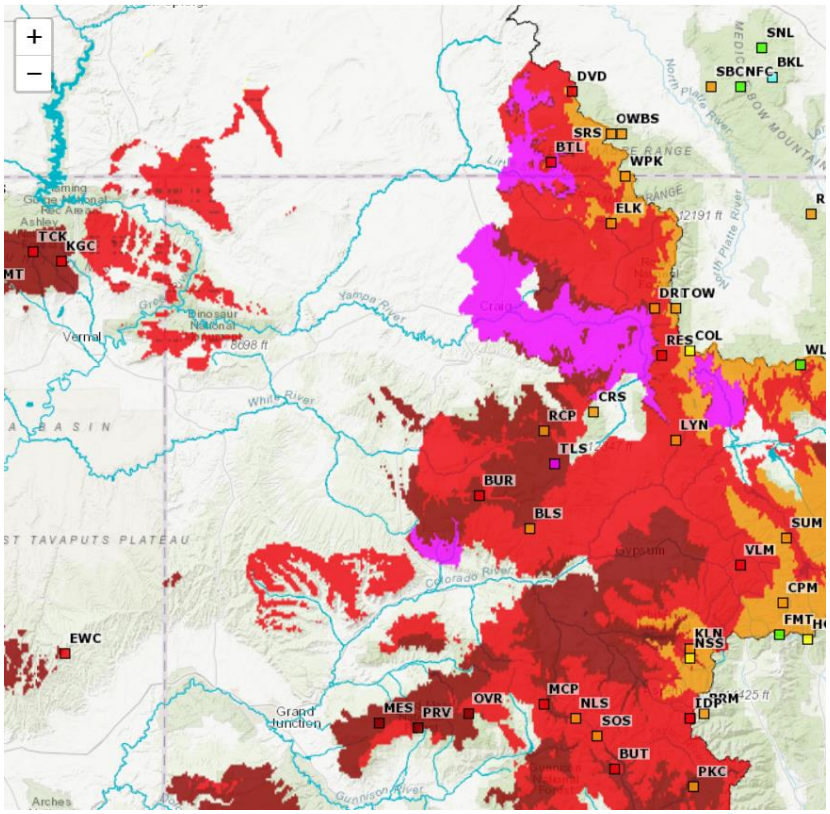

FIGURE 7. Yampa River Basin modeled SWE significant areas as of March 5, 2018.

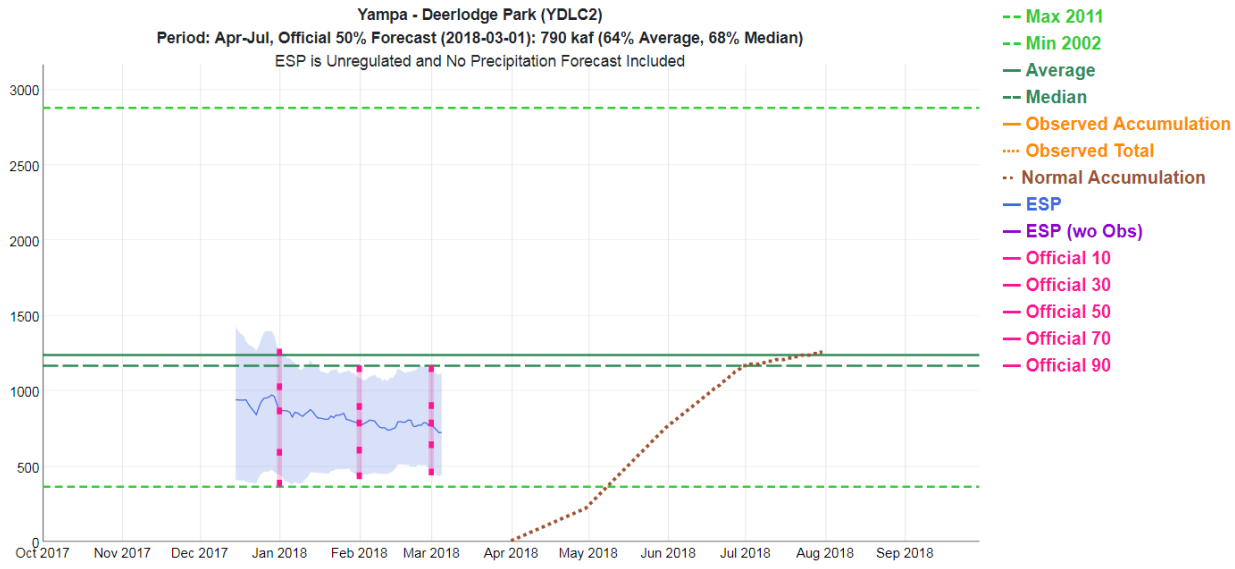

FIGURE 8. Yampa – Deerlodge Park Water Supply Forecast as of March 5, 2018.

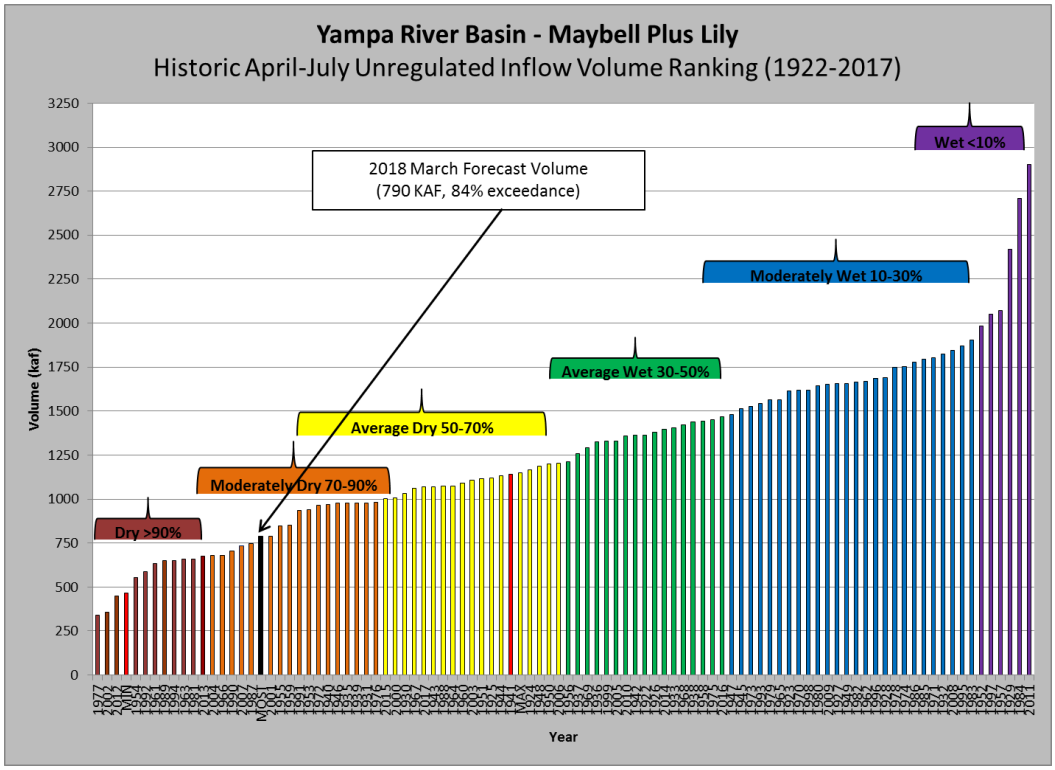

FIGURE 9. Yampa River Basin (Maybell plus Lily) March forecast and ranked April-July unregulated inflow volume for years 1922-2017

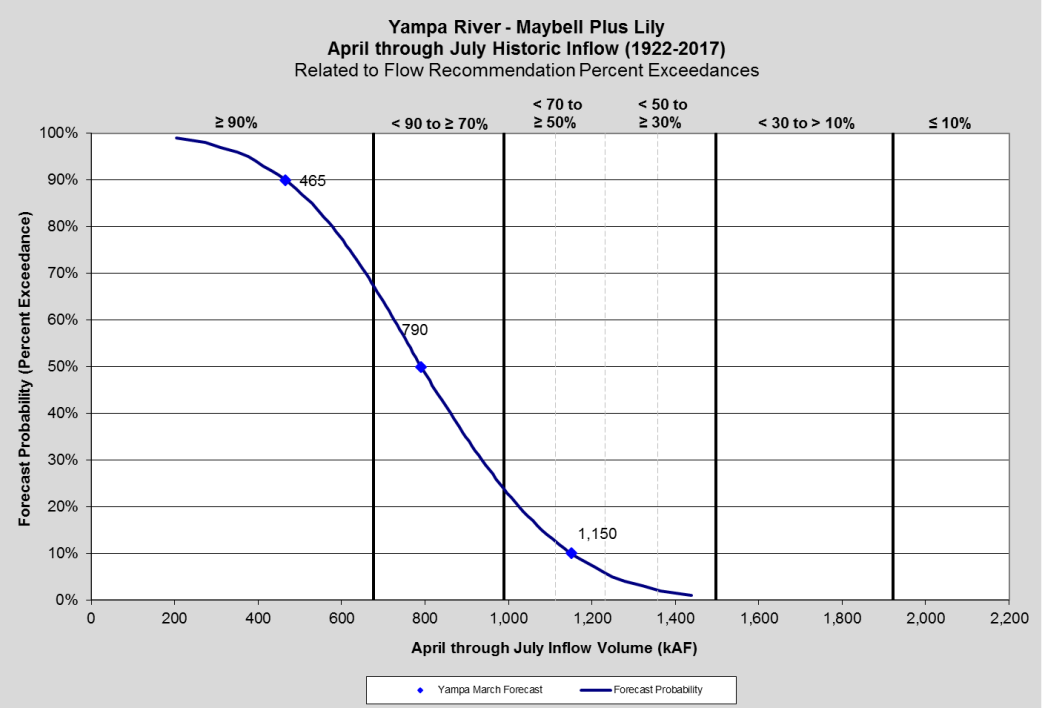

FIGURE 10. Yampa River – Maybell Plus Lily March final forecast probability (percent exceedance) and historic April-July unregulated inflow volume for years 1963-2017

Probabilities of Flow Events for Spring 2018

The Flaming Gorge unregulated inflow and Yampa River forecasts are average (below median) and moderately dry, respectively, and trending drier. An analysis was completed to assist in the determination of appropriate flow objectives for spring and summer 2018. The ten most similar historic years for the Yampa River Basin (Maybell plus Lily) compared to the current forecast (Table 1) were analyzed assuming a normal distribution.

Table 2 presents the percent exceedance of cumulative days greater than or equal to various flow levels at Yampa River (Maybell plus Lily). The current analysis indicates that it is likely Yampa River flows above 10,000 cfs will not be achieved this year.

Table 1
Yampa River (Maybell plus Lily) – April through July Unregulated Volume
Ten Similar Years to the March 1, 2018 Forecast
Thousand Acre-Feet (KAF)

Year	April-July Unreg Inflow Volume (KAF)
MIN	465
2004	678
1966	679
1990	703
2007	736
1987	746
MOST	790
2001	790
1955	845
1959	852
1991	934
1953	938
MAX	1,150

Table 2
Spring 2018 – Days above Specific Flow Thresholds in the Yampa River
(Maybell plus Lily)
Based on the March 1, 2018 Forecast
Percent Exceedance (%)

March 1, 2018 Forecast	% Exceed	Days above 4000 cfs	Days above 5000 cfs	Days above 6000 cfs	Days above 8000 cfs	Days above 10000 cfs	Days above 12000 cfs	Days above 14000 cfs
YAMPA	25%	44	35	24	8	2	0	0
	50%	40	31	19	3	0	0	0
	75%	33	17	11	1	0	0	0
	90%	30	14	8	0	0	0	0

Colorado Basin River Forecast Center Yampa River Analysis

The Colorado Basin River Forecast Center (RFC) calculates exceedance probabilities based on thirty-five years of historic temperature and precipitation data (1981-2015) and current hydrologic conditions to provide projections of flow. The RFC provides projections based upon (1) strict observance to the historic dataset and (2) current hydrologic conditions including SWE, flow, and soil moisture and (3) incorporation of the five-day quantitative precipitation forecast (QPF). QPF is the expected amount of forecasted precipitation.

The RFC provides a synopsis of the current seasonal outlook for the Yampa River at Deerlodge. This synopsis is provided below:

> *This outlook is based on flows from ESP with model states as of March 4. Water year precipitation is below average in the Yampa River Basin at 77 percent of normal. Precipitation has been below average for all months of the water year with the exception of February. February precipitation was 103 percent of average. The current snow water equivalent as of March 1 is 75 percent of median in the Yampa River Basin.*
>
> *The Yampa River basin should see a warming and drying trend through late in week. Models are currently indicating increasing chances for the return of a more active weather pattern early next week; however confidence is low on any details regarding a storm early next week.*

The RFC provides updated Yampa River April through July seasonal exceedance probabilities for both the river flows and daily maximum peak flow. Table 3 presents the RFC projections of maximum peak flow based on current information. Figures 11 and 12 illustrate the probabilities of the Yampa River at Deerlodge river flows exceeding certain thresholds and exceedance probabilities over the April through July spring period.

Table 3
Maximum Peak Daily Flow on the Yampa River at Deerlodge
Based on the March 4, 2018, RFC Analysis
Percent Exceedance (%)

CBRFC March 4, 2018 Projections	% Exceed	Maximum Daily Peak (cfs)	Number of Days to Peak from 04/01/18	Number of Days Above 4,000 cfs	Number of Days above 5,000 cfs	Number of Days above 6,000 cfs	Number of Days above 8,000 cfs	Number of Days above 10,000 cfs	Number of Days above 12,000 cfs
YAMPA	10%	13,692	51	51	43	38	32	17	6
	25%	10,334	47	47	36	27	12	1	0
	50%	8,444	40	40	23	16	2	0	0
	75%	6,799	24	24	13	2	0	0	0
	90%	5,547	10	10	2	0	0	0	0

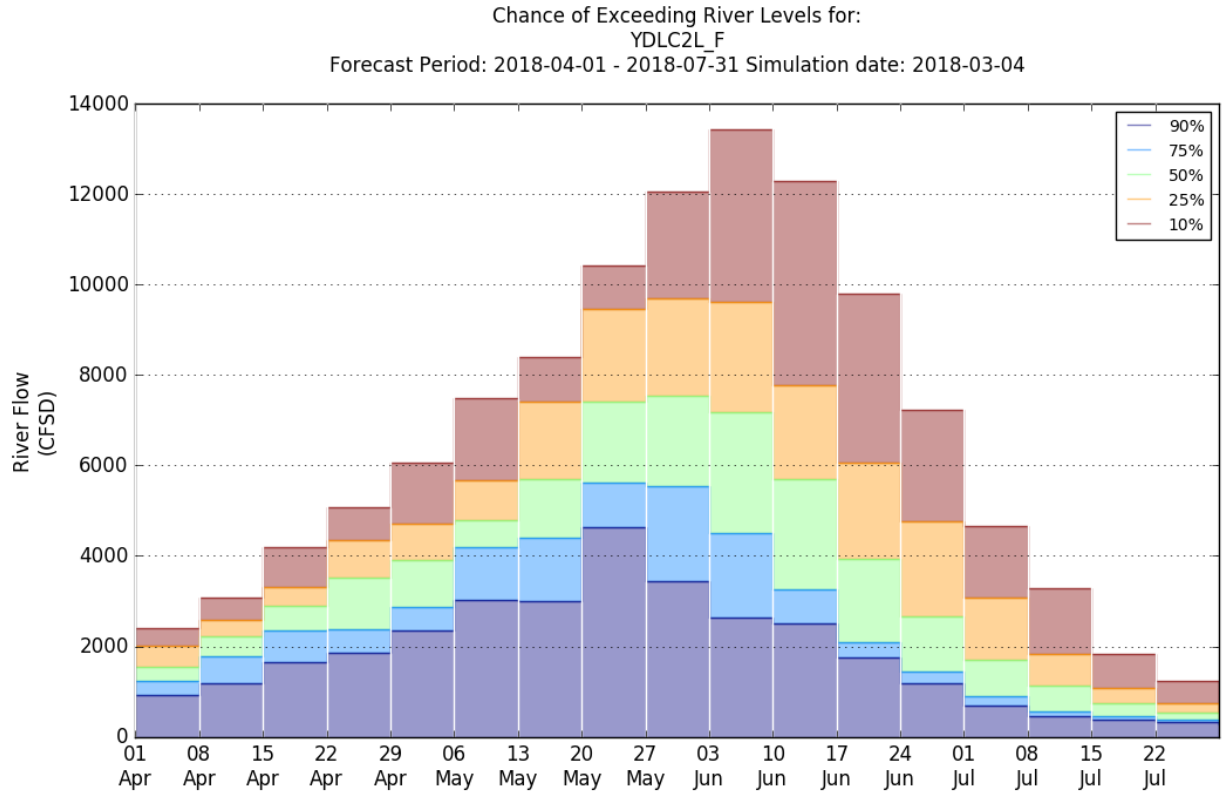

FIGURE 11. RFC March 4, 2018 projection of Yampa River at Deerlodge flows exceeding thresholds for various percent exceedance at a weekly time step for the 2018 April through July spring period.

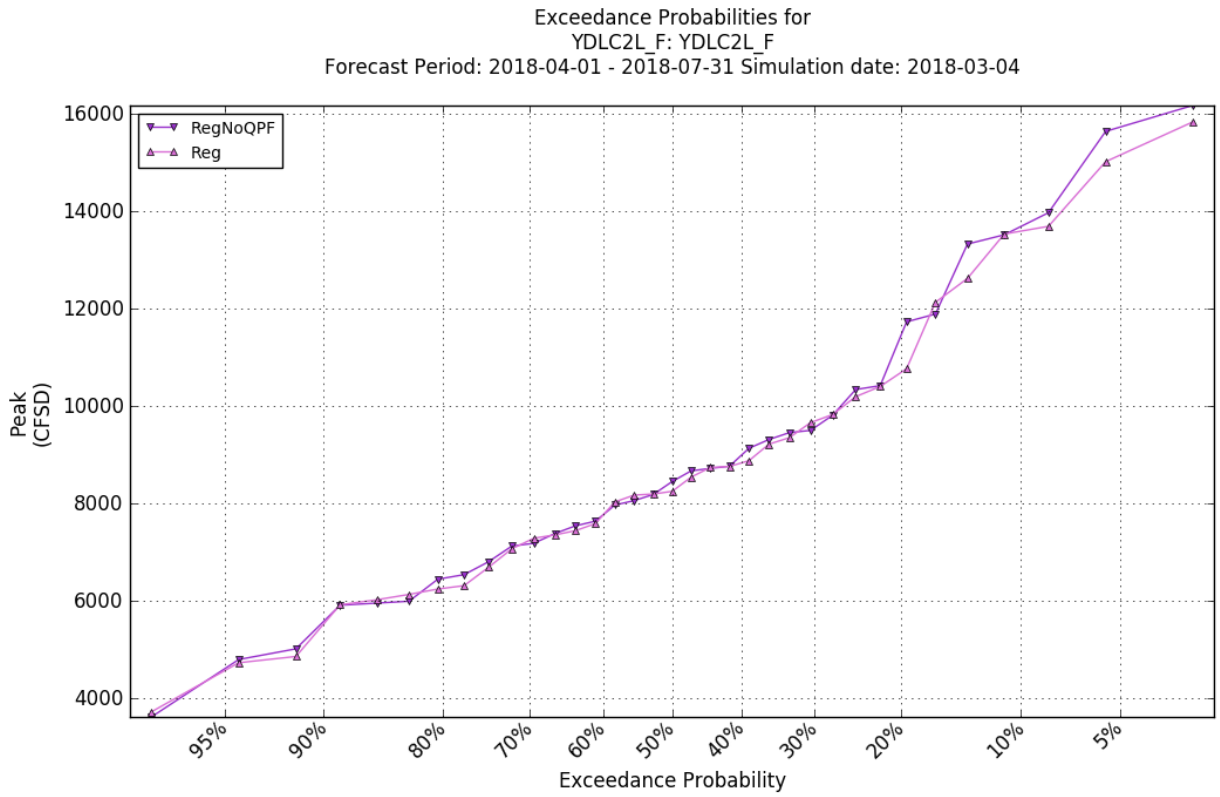

FIGURE 12. RFC March 4, 2018 projection of Yampa River at Deerlodge maximum peak daily flow exceedance probabilities based on current hydrologic conditions and historical precipitation and temperature.