RECLAMATION

Managing Water in the West

Navajo Unit Operations
August 21st, 2019
Coordination Meeting

U.S. Department of the Interior
Bureau of Reclamation

WY 2019 Summary

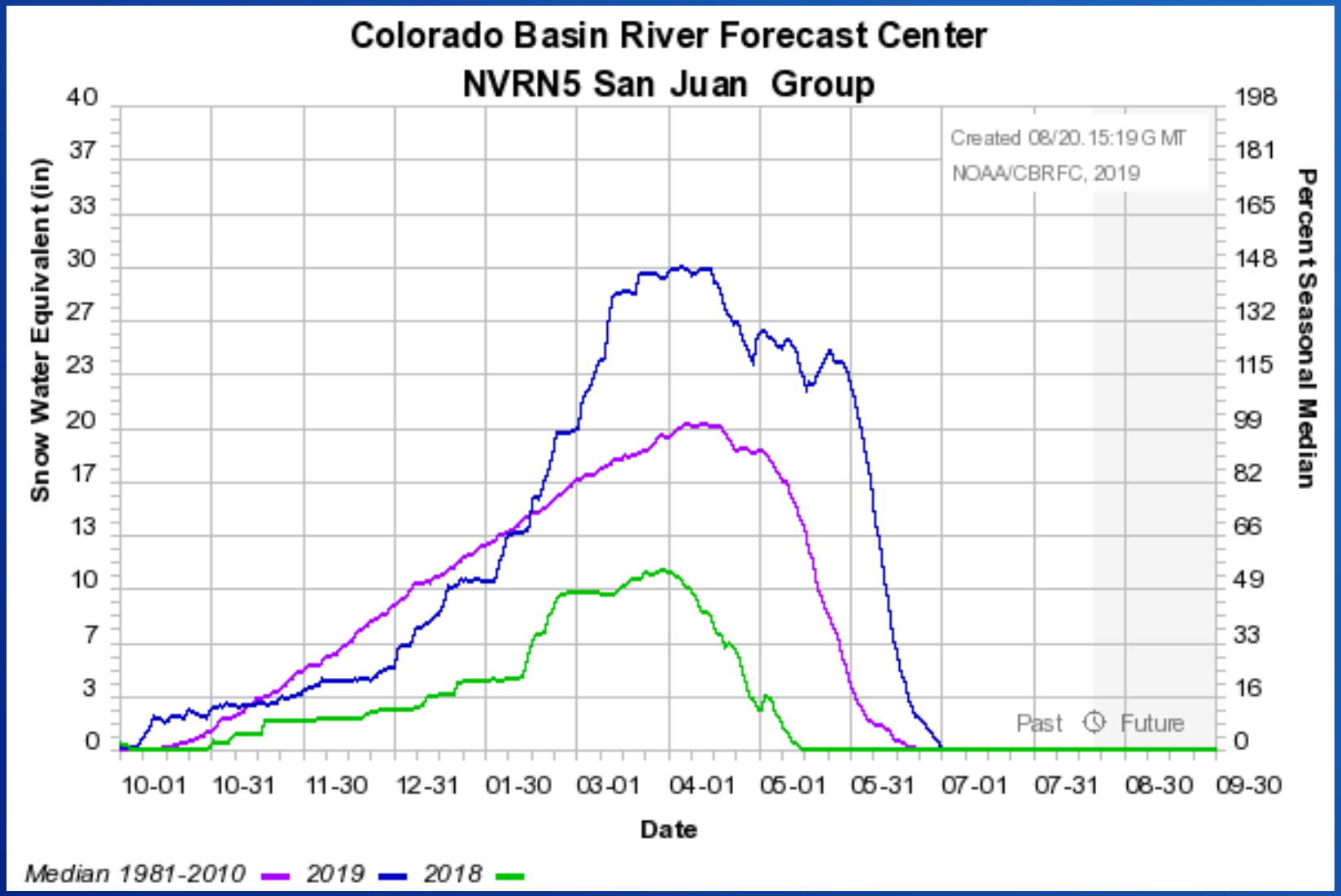
- Snowpack peaked at 144% of average
- A maintenance release peaking at 5,000 cfs was conducted in June. Volume released over base was 85kaf. When combined with Animas River, flow targets for ESA species achieved.
- Final April-July inflow volume 1,162,400 af (158% avg)
- SJRIP request for increased baseflows to move excess water.

  (Navajo Operations ROD, 2006. Adaptive management component of SJRIP Flow Recommendations, 1999, revised 2018)

RECLAMATION

REVIEW OF WY 2019 OPERATIONS

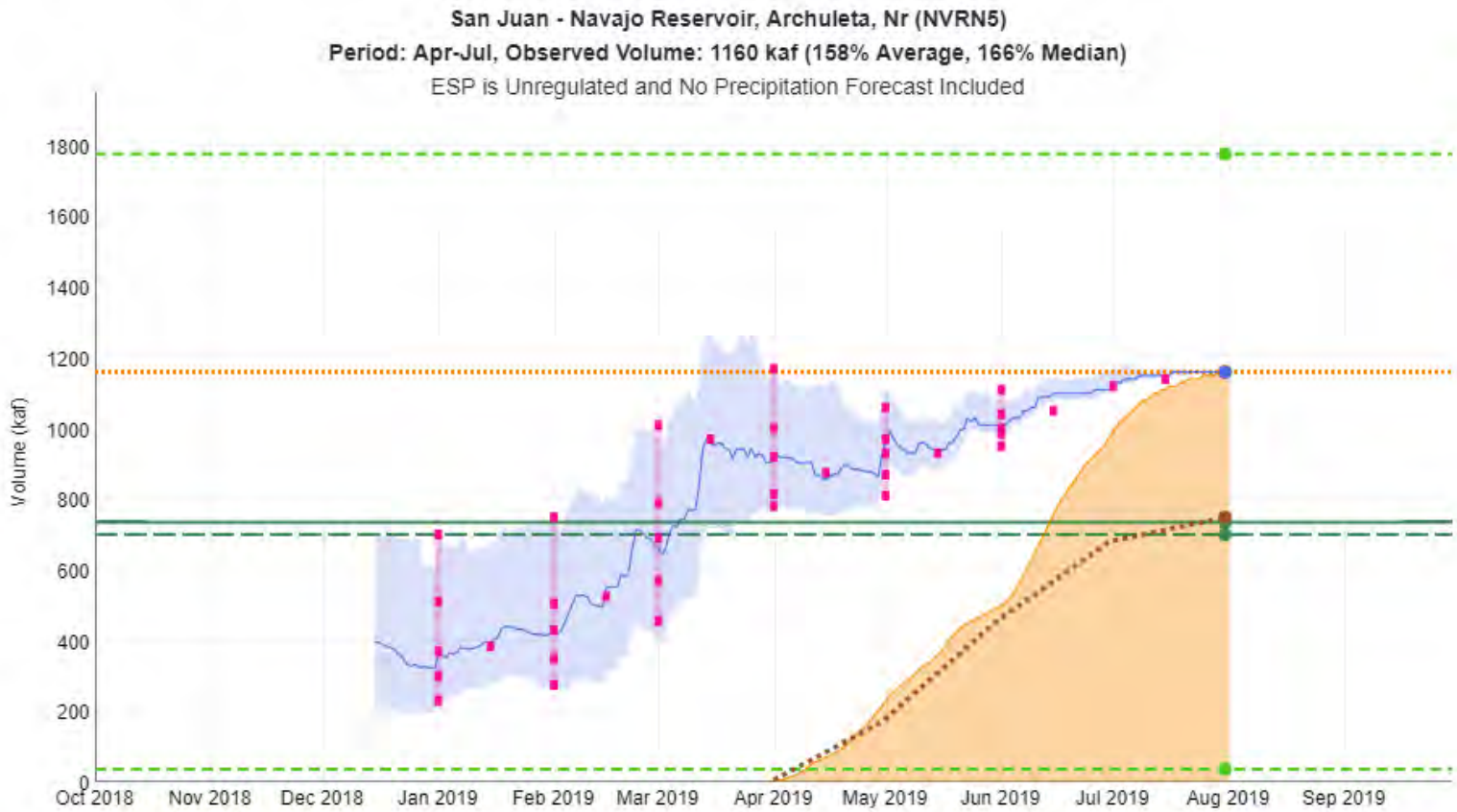
2019: Snow above Navajo peaked at 144% of average (29.9 in. SWE)



RECLAMATION

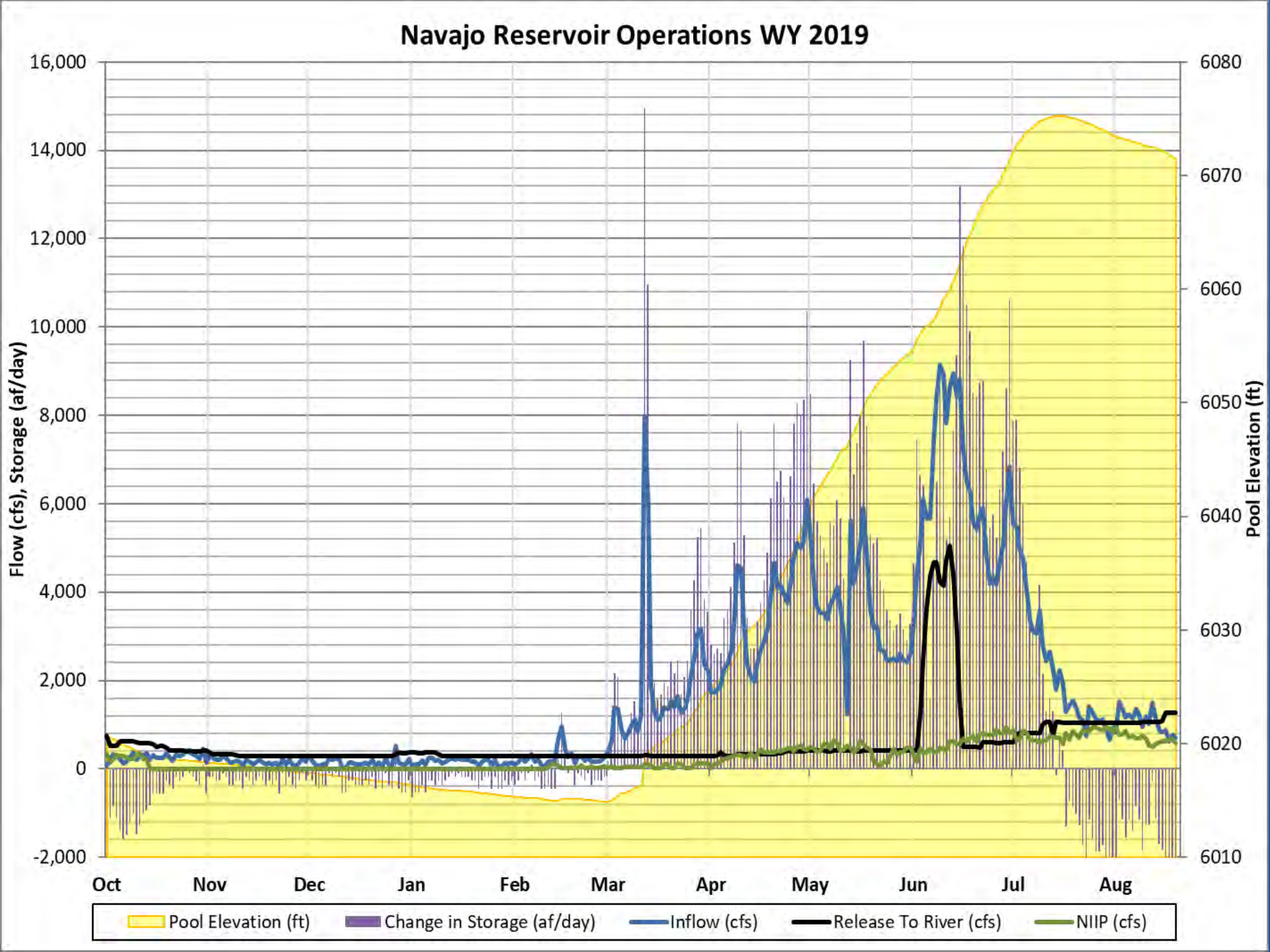
2019: Forecasts increased throughout the season

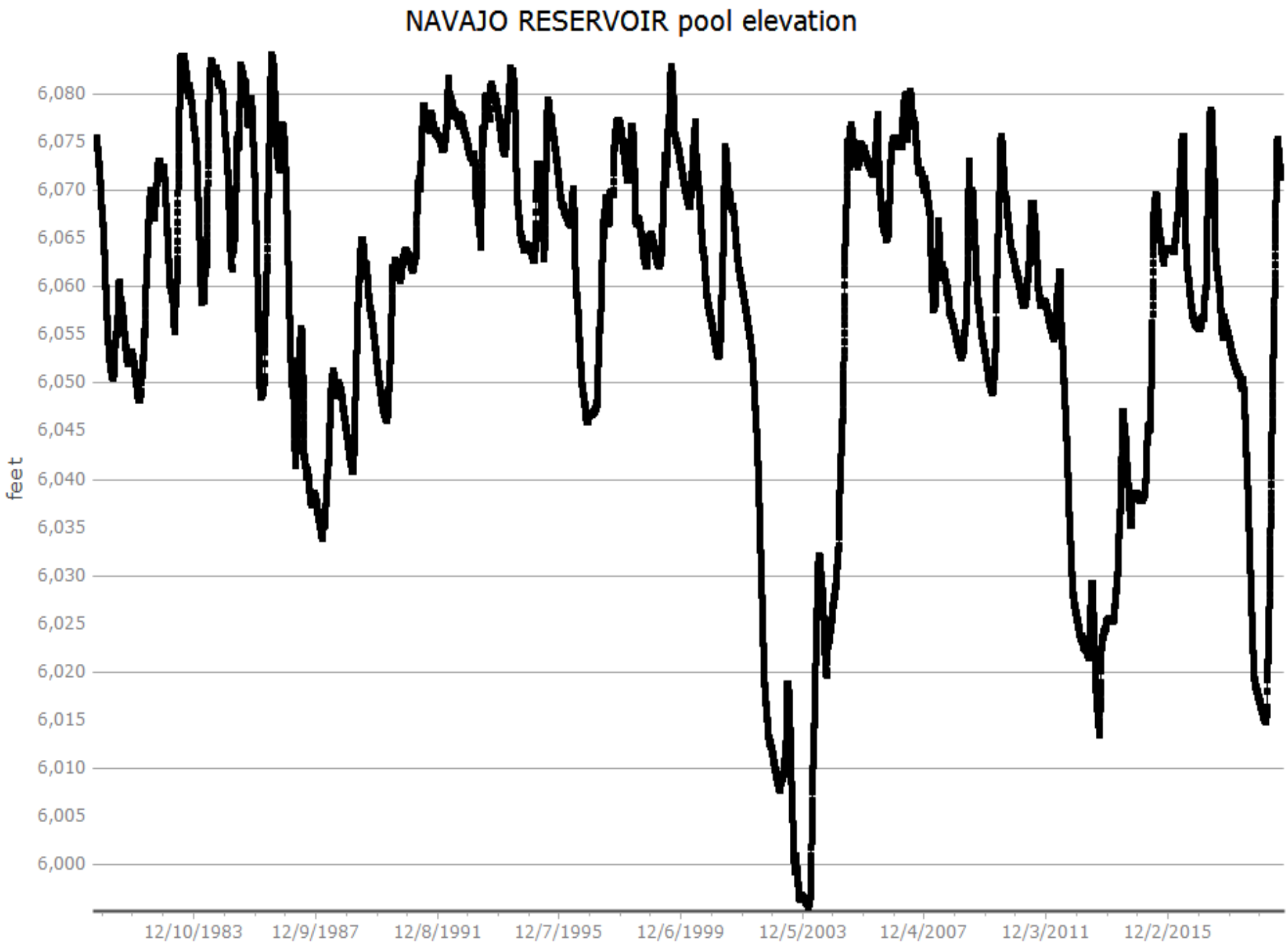
Water Supply Forecast

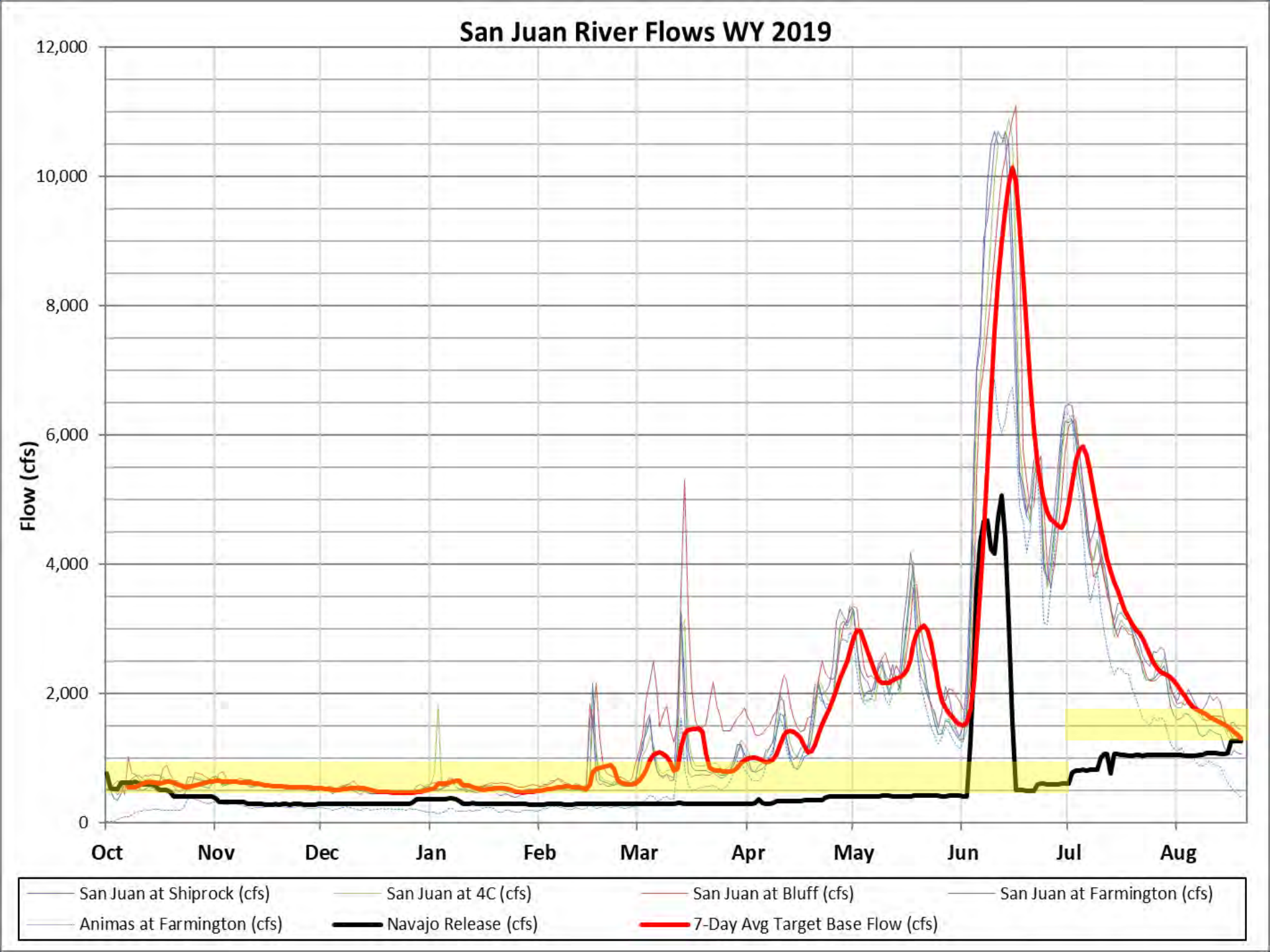


2019/07/31:
Max 1979: 1776.84
Min 2002: 36.74
Average: 735
Median: 700
Observed Accumulation: 1160
Observed Total: 1160
Normal Accumulation: 749
ESP: 1160

RECLAMATION

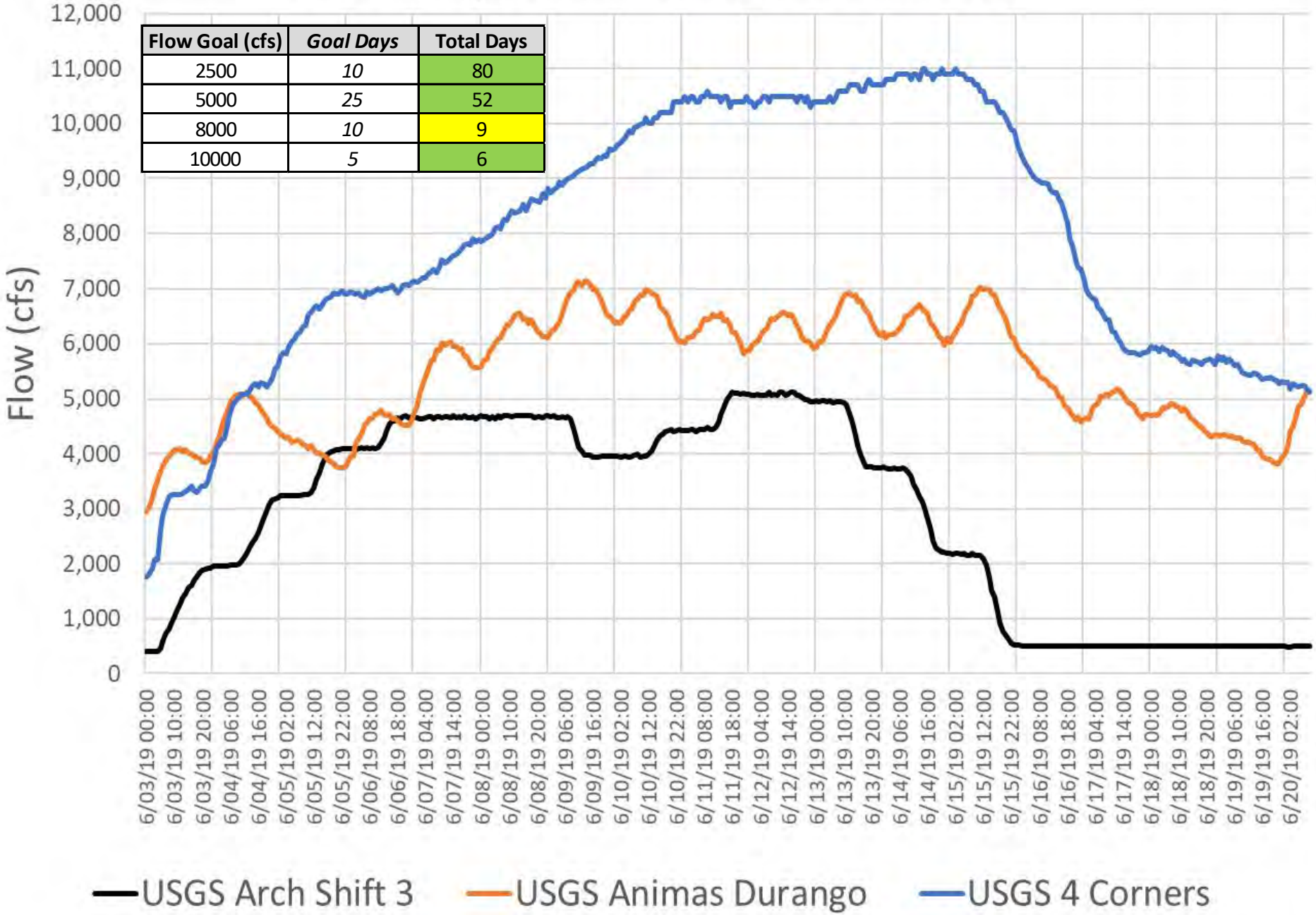

Navajo Reservoir Operations WY 2019
Flow (cfs), Storage (af/day)
Pool Elevation (ft)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
-2,000
6080
6070
6060
6050
6040
6030
6020
6010
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Pool Elevation (ft)
Change in Storage (af/day)
Inflow (cfs)
Release To River (cfs)
NIIP (cfs)


NAVAJO RESERVOIR pool elevation
feet
6,080
6,075
6,070
6,065
6,060
6,055
6,050
6,045
6,040
6,035
6,030
6,025
6,020
6,015
6,010
6,005
6,000
12/10/1983
12/9/1987
12/8/1991
12/7/1995
12/6/1999
12/5/2003
12/4/2007
12/3/2011
12/2/2015

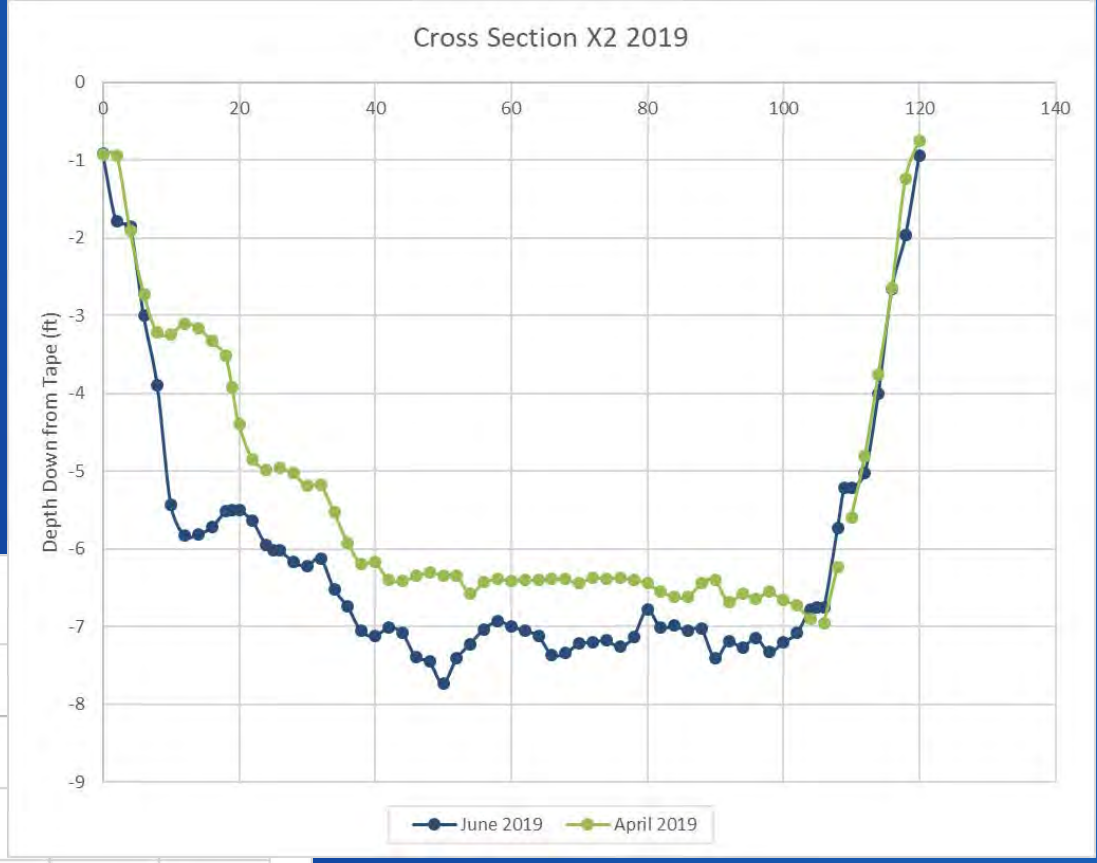

San Juan River Flows WY 2019
Flow (cfs)
12,000
10,000
8,000
6,000
4,000
2,000
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
San Juan at Shiprock (cfs)
San Juan at 4C (cfs)
San Juan at Bluff (cfs)
San Juan at Farmington (cfs)
Animas at Farmington (cfs)
Navajo Release (cfs)
7-Day Avg Target Base Flow (cfs)

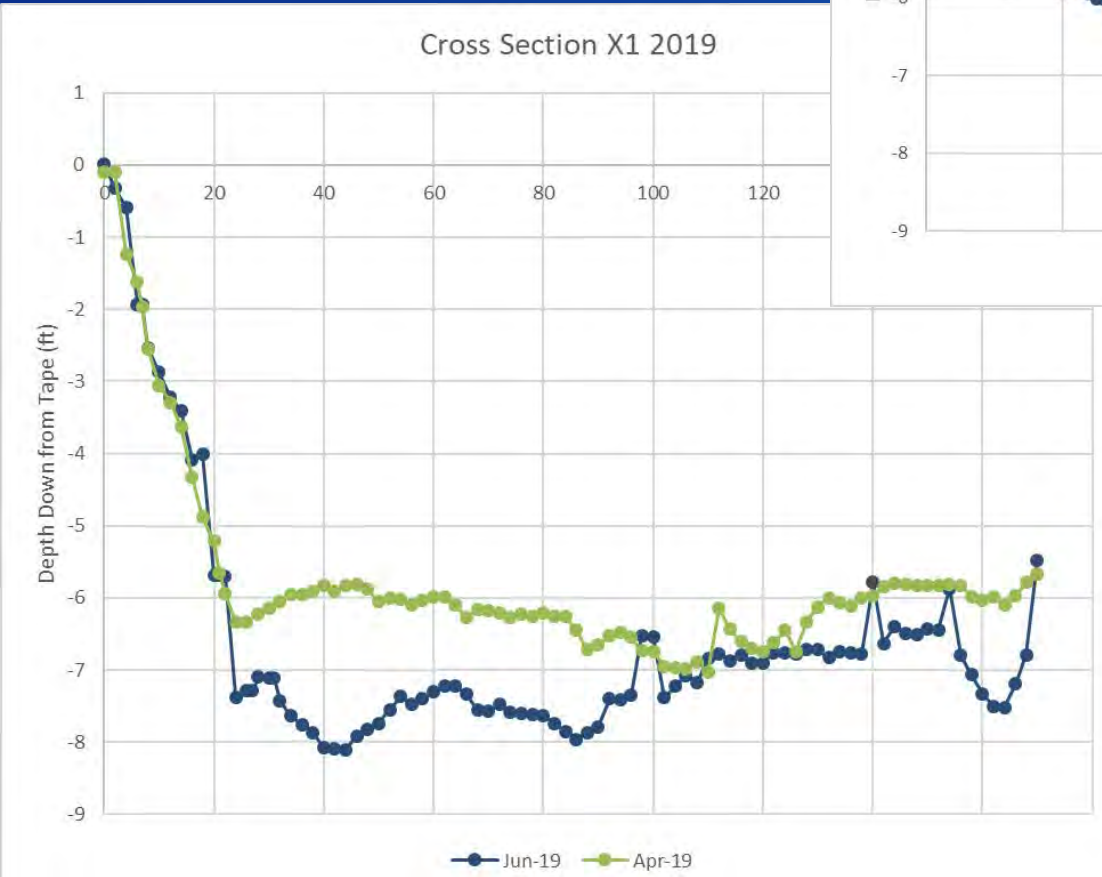
2019 Navajo Dam Maintenance Release

Flow Goal (cfs)	*Goal Days*	Total Days
2500	*10*	80
5000	*25*	52
8000	*10*	9
10000	*5*	6



Scour Measurement Stations
San Juan River



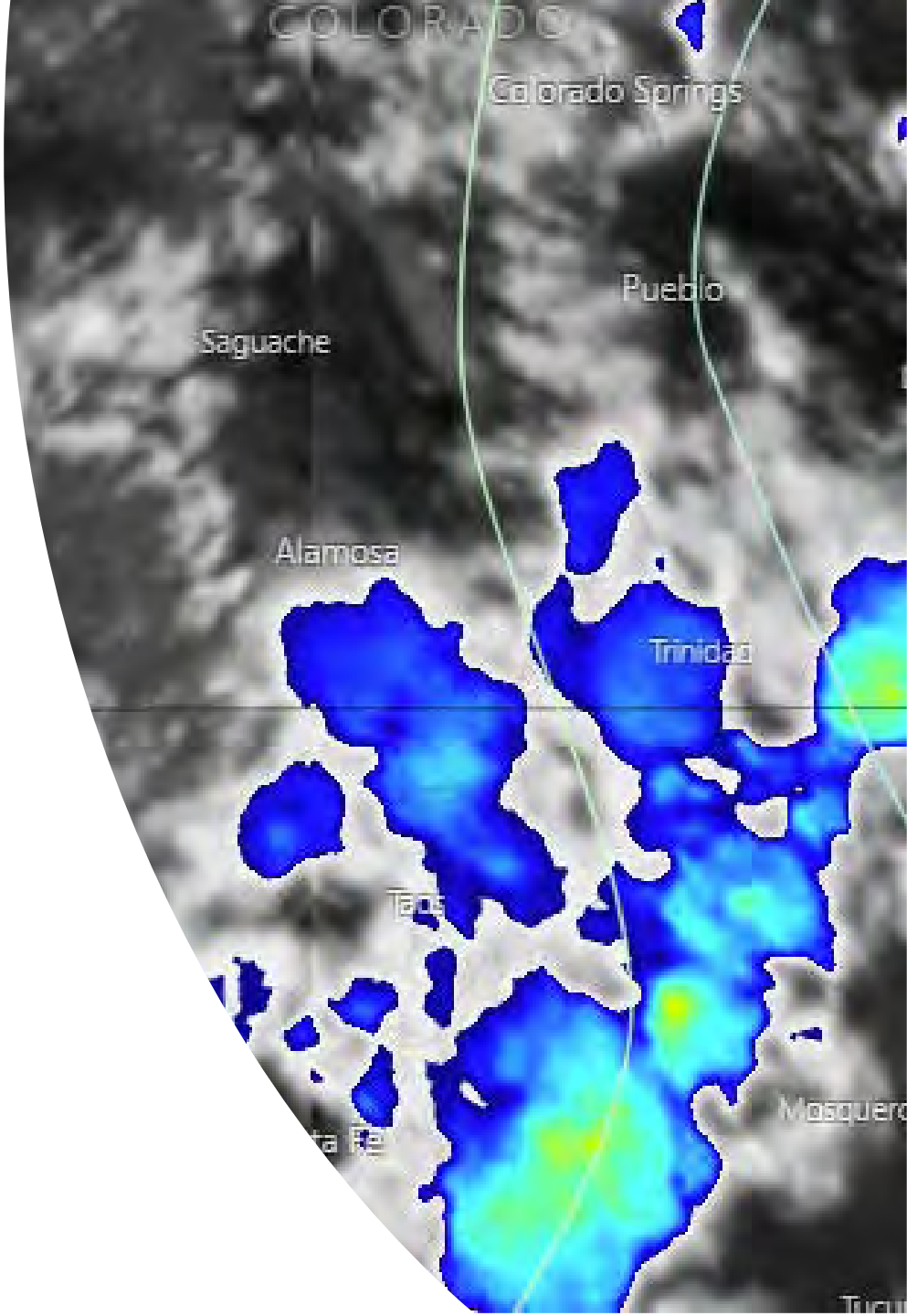


Date	Archuleta Gage Flow (cfs)	Archuleta Gage Stage (ft)
10/04/2018	500	3.12
6/22/2019	500	3.09
8/26/2018	830	3.65
7/9/2019	830	3.58

ECLAMATION

WEATHER AND FLOW FORECASTS

Greg Smith Sr. Hydrologist Colorado Basin River Forecast Center



Greg Smith – Sr. Hydrologist
Colorado Basin River Forecast Center

Navajo Unit Coordination Meeting

Aug 21 2019
Farmington, New Mexico

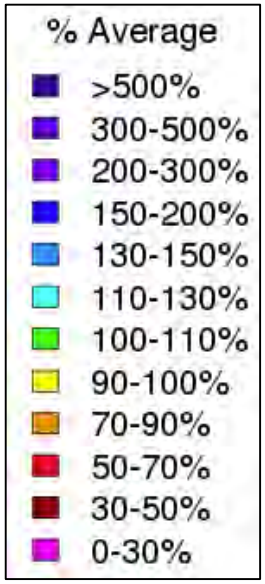
Characteristics of 2019 runoff season

Largest challenges of 2019 runoff season

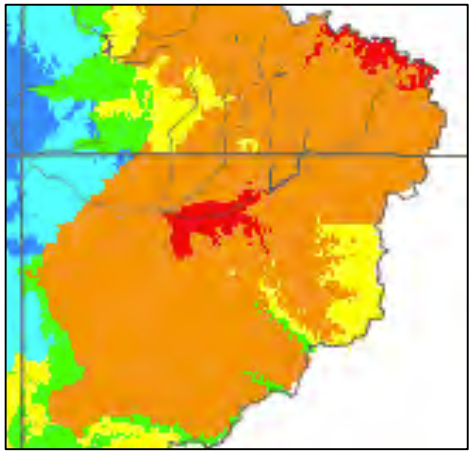
Forecast performance / verification

Final thoughts . . .

San Juan Basin: A slow start before an amazing turn around



Oct – Dec 2018



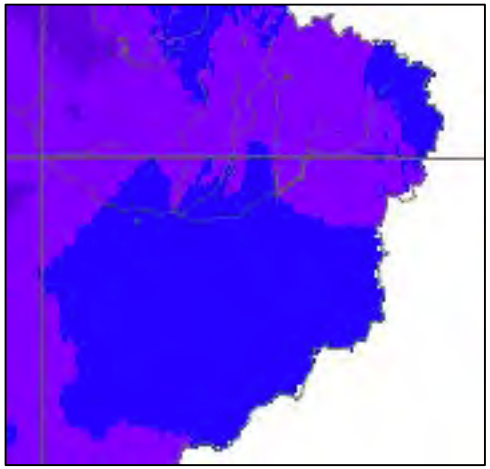
75-80% of average

Below average precipitation through December.

Snowpack was below average to start the season ~65-70% of normal along with dry soils.

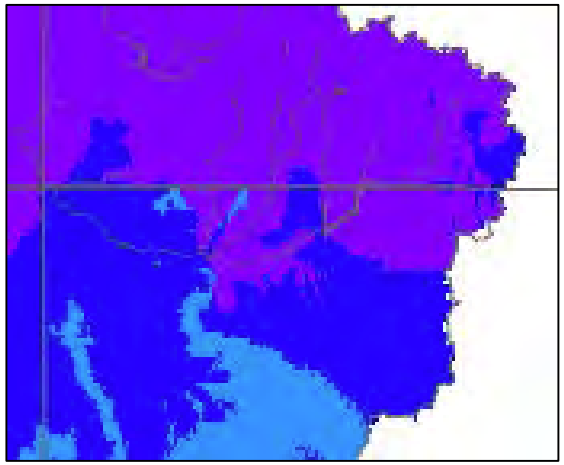
Here we go again ?

Feb 2019



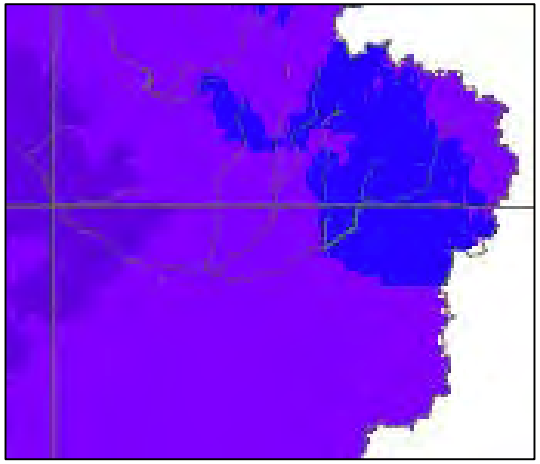
205 % of Average

Mar 2019



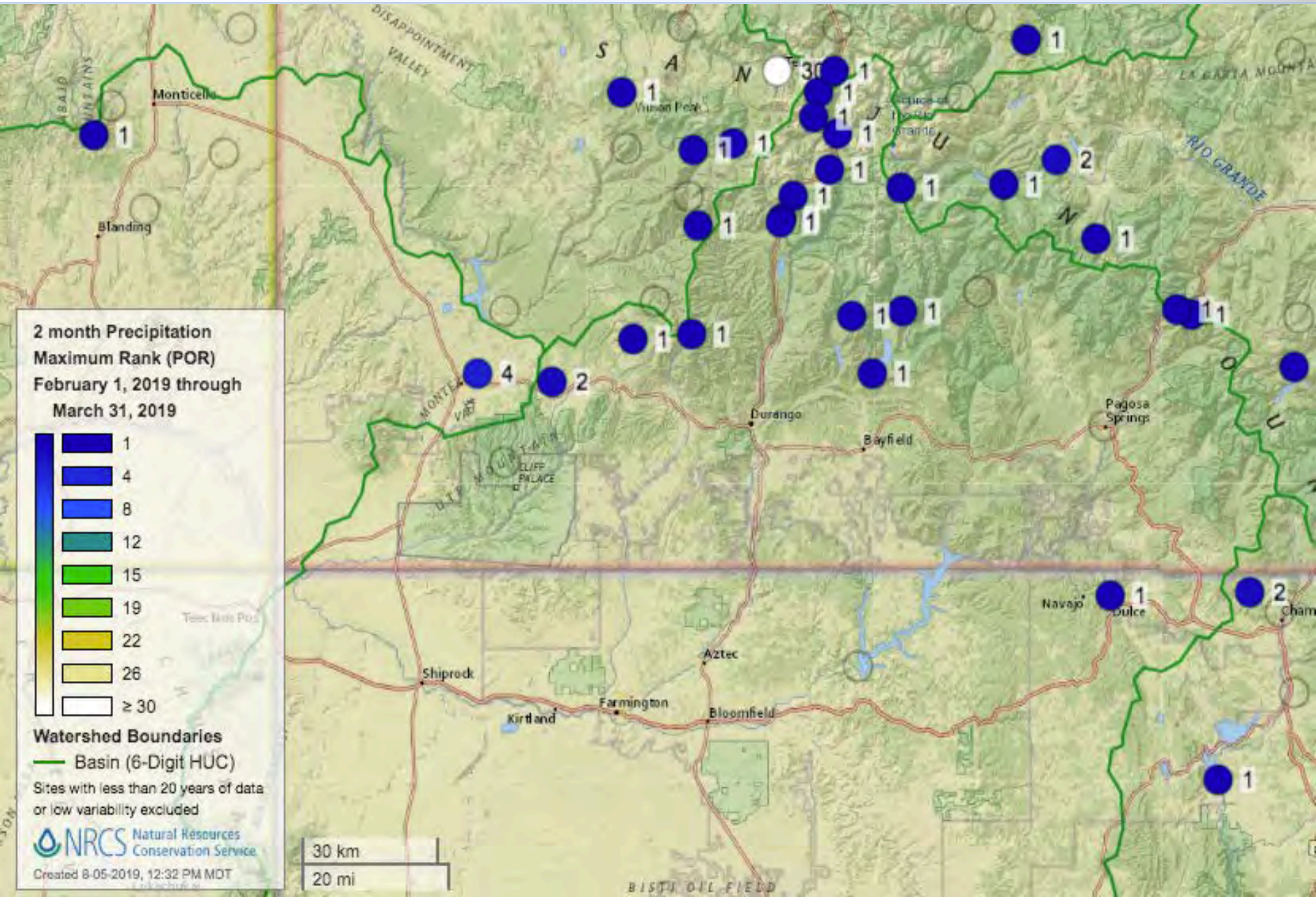
220 % of Average

May 2019



205 % of Average

San Juan Basin: February-March precipitation ranked among the highest on record



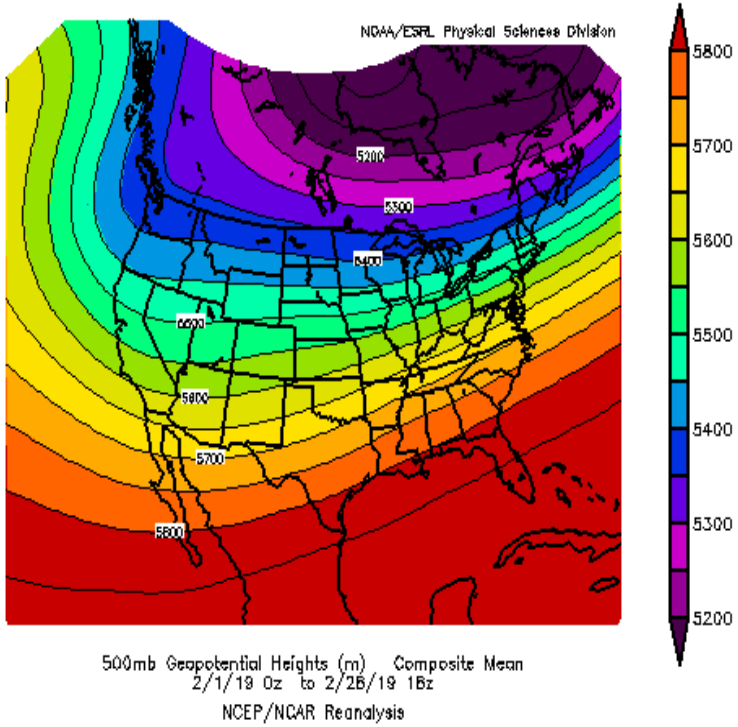
The winter / spring weather pattern

Persistent trough of low pressure was located over the western U.S.

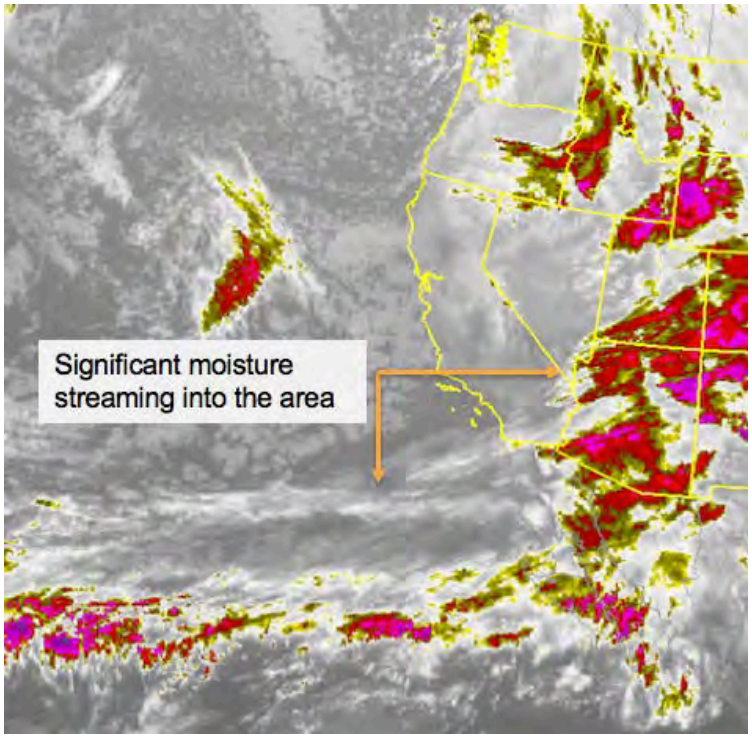
Multiple storm systems moved eastward through the Colorado River Basin.

Several storms had a sub tropical moisture source that resulted in significant precipitation

Mean upper atmospheric pattern for February shows the strong trough over the Colorado and Great Basins.

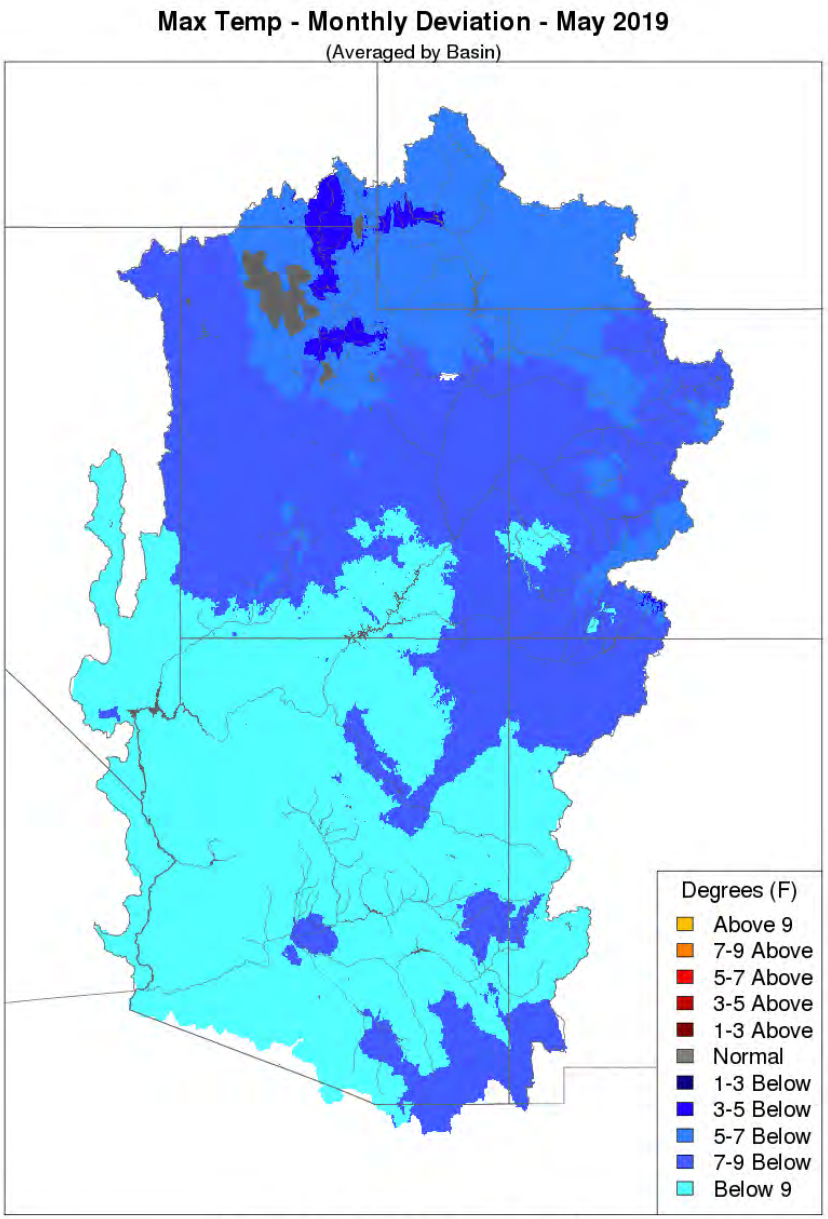


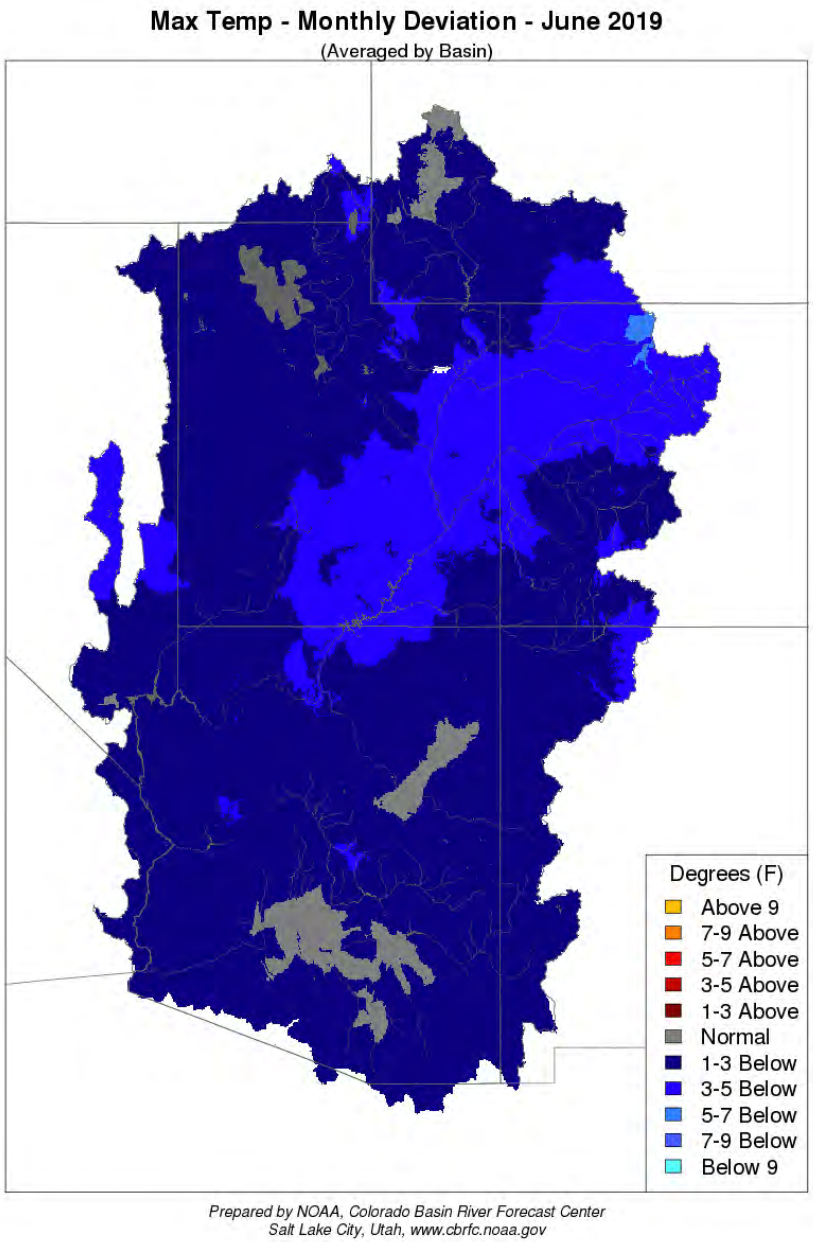
Early April satellite image showing another storm system with a sub-tropical moisture tap. Several inches of precipitation resulted from this system.



May / June 2019 – Warm Up Already !

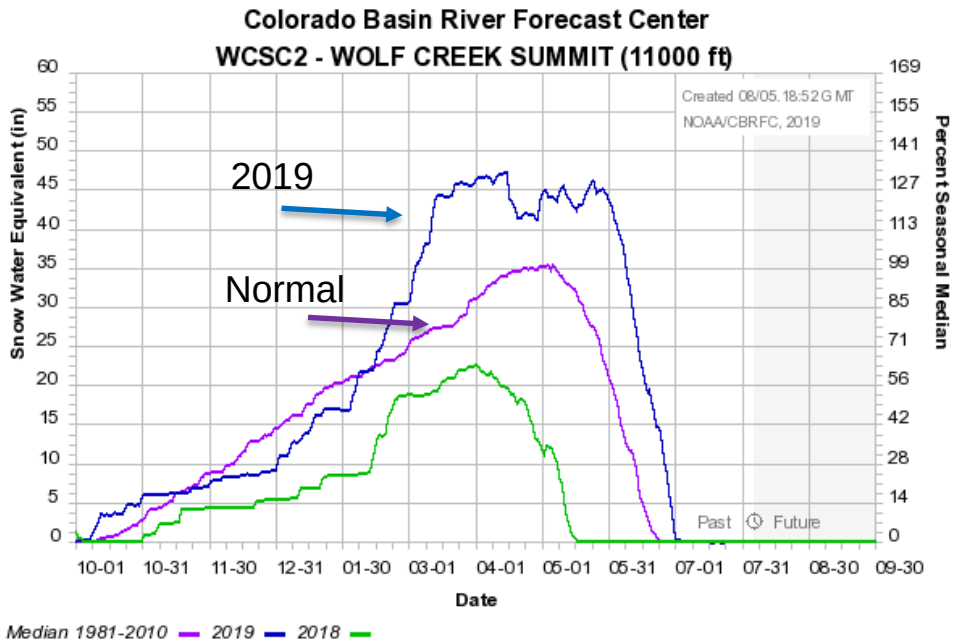
Persistent cool / wet weather - delayed Snowmelt (occasional snowfall high elevations)

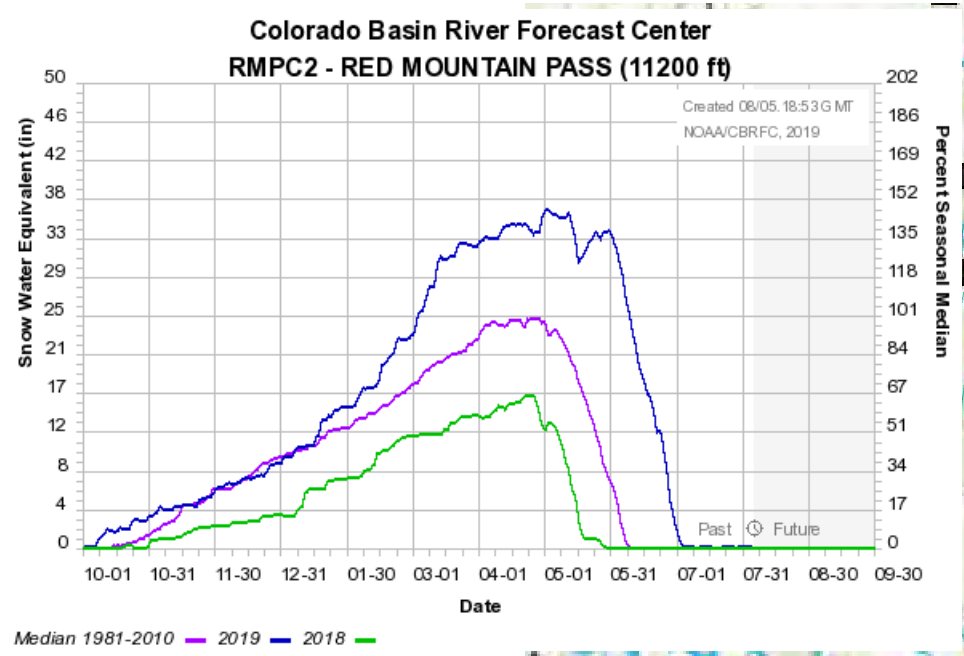


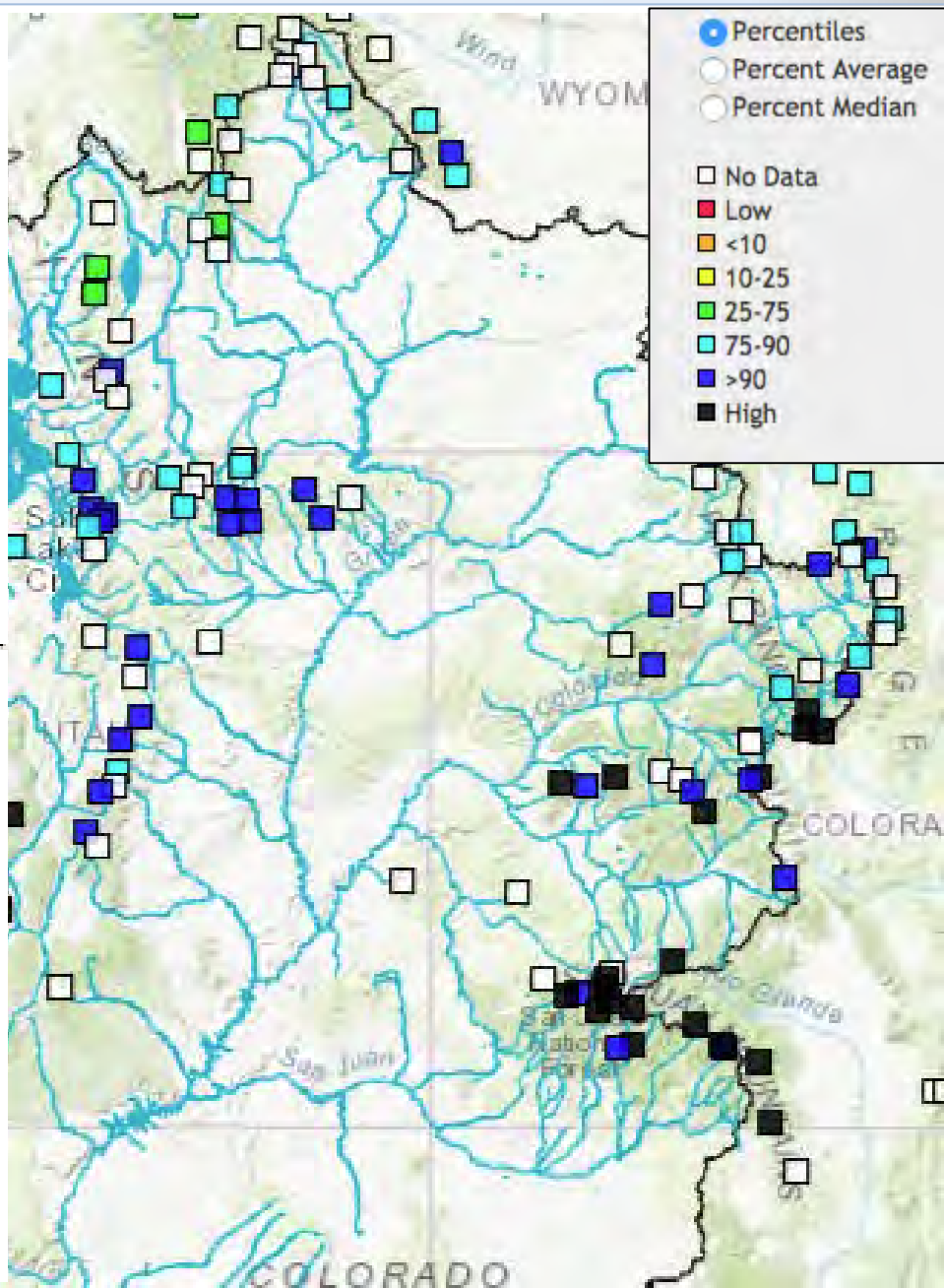


Snow Ranking as of June 6th 2019

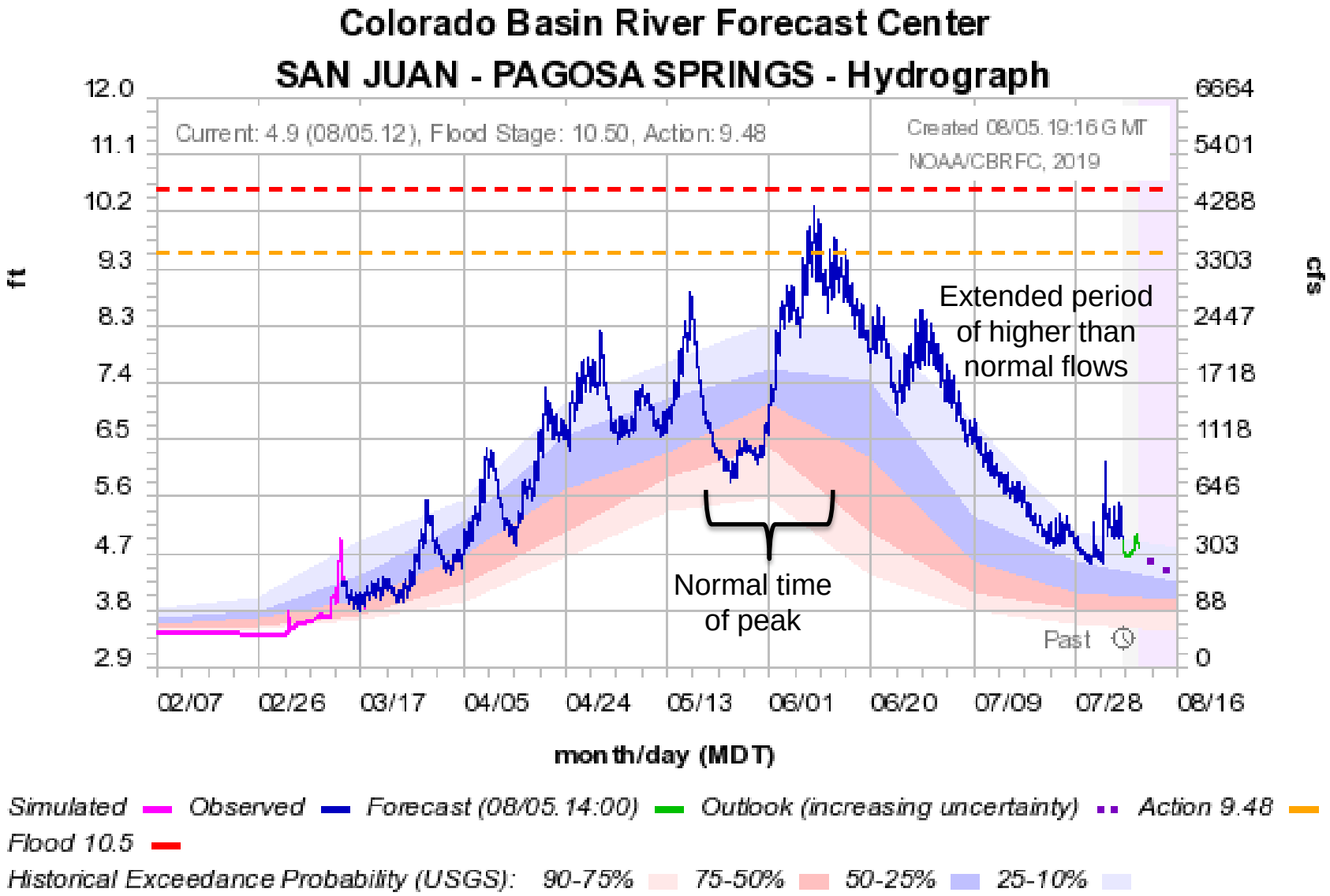
Black is highest for this time of year
Blue is 2nd or 3rd highest for this time of year



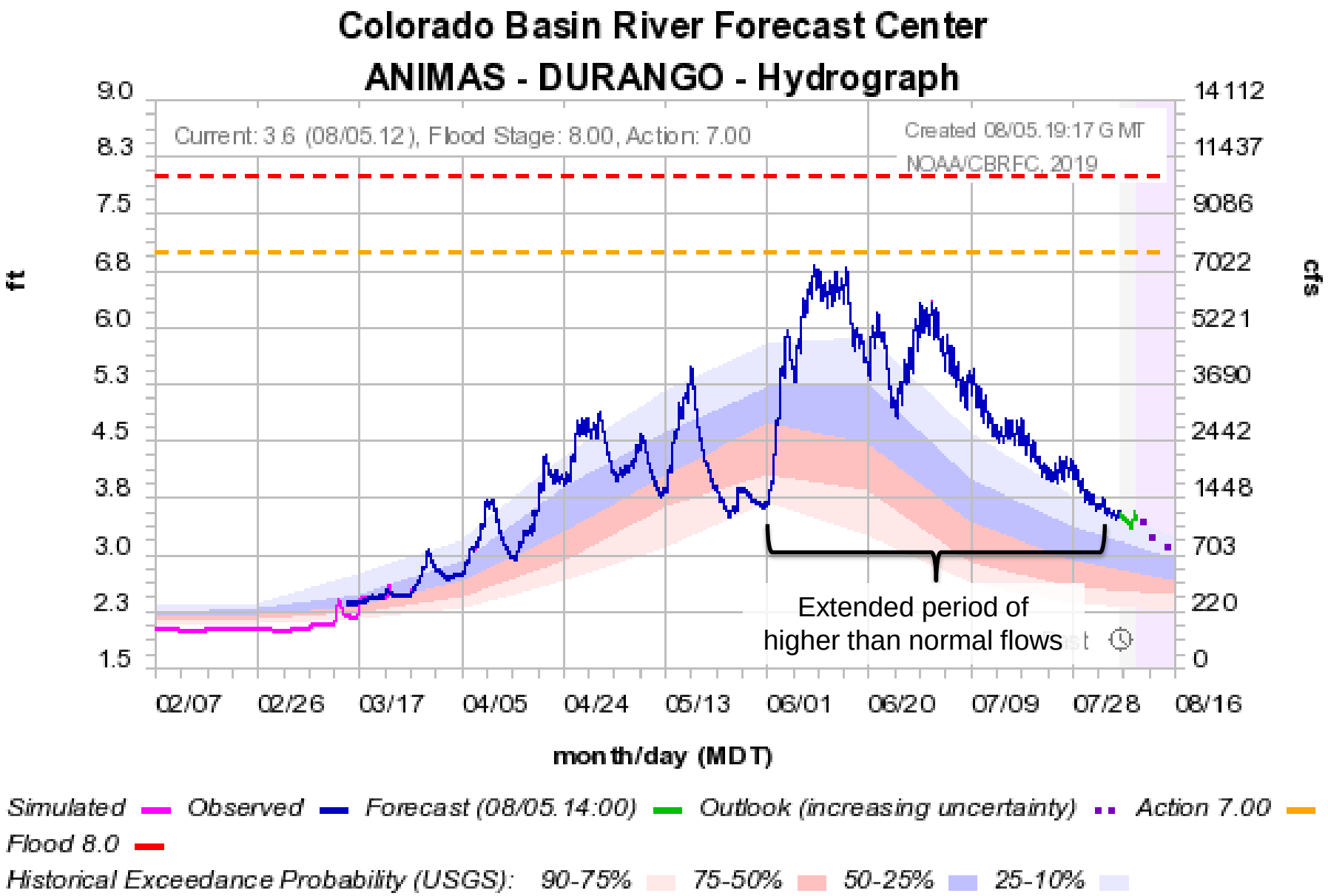




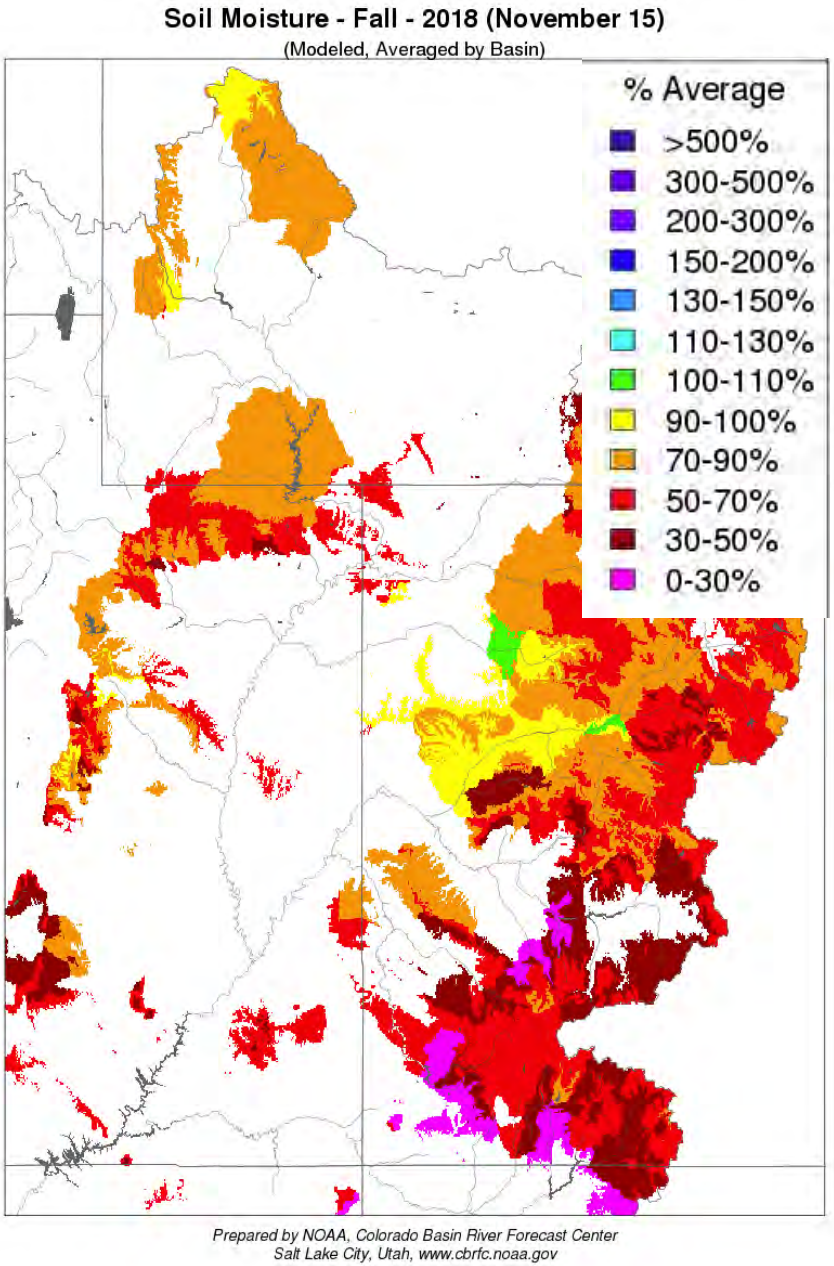
Peak runoff a little later than usual with much above average runoff extending through July



Peak timing was within the normal time frame but high flows extended through June



Forecast Challenges: How would dry soils impact overall runoff volumes ?

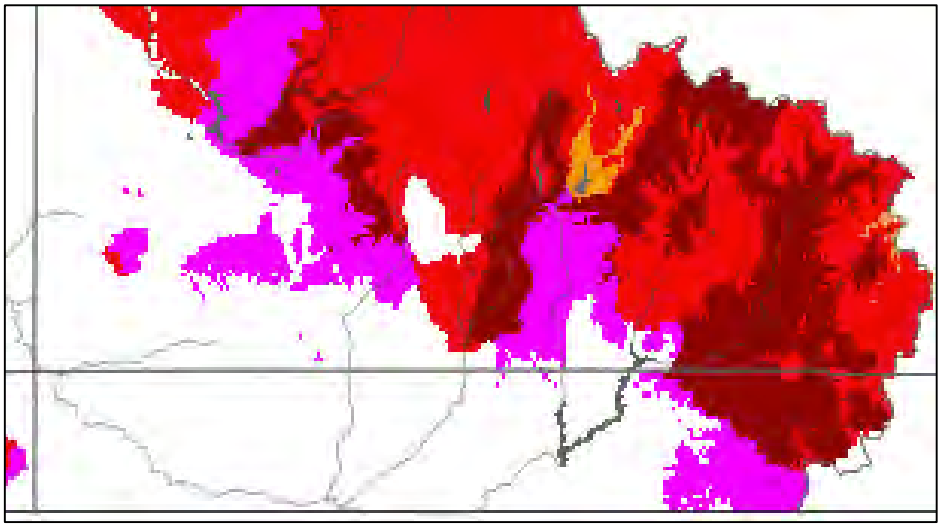


Very dry soils entering the winter season

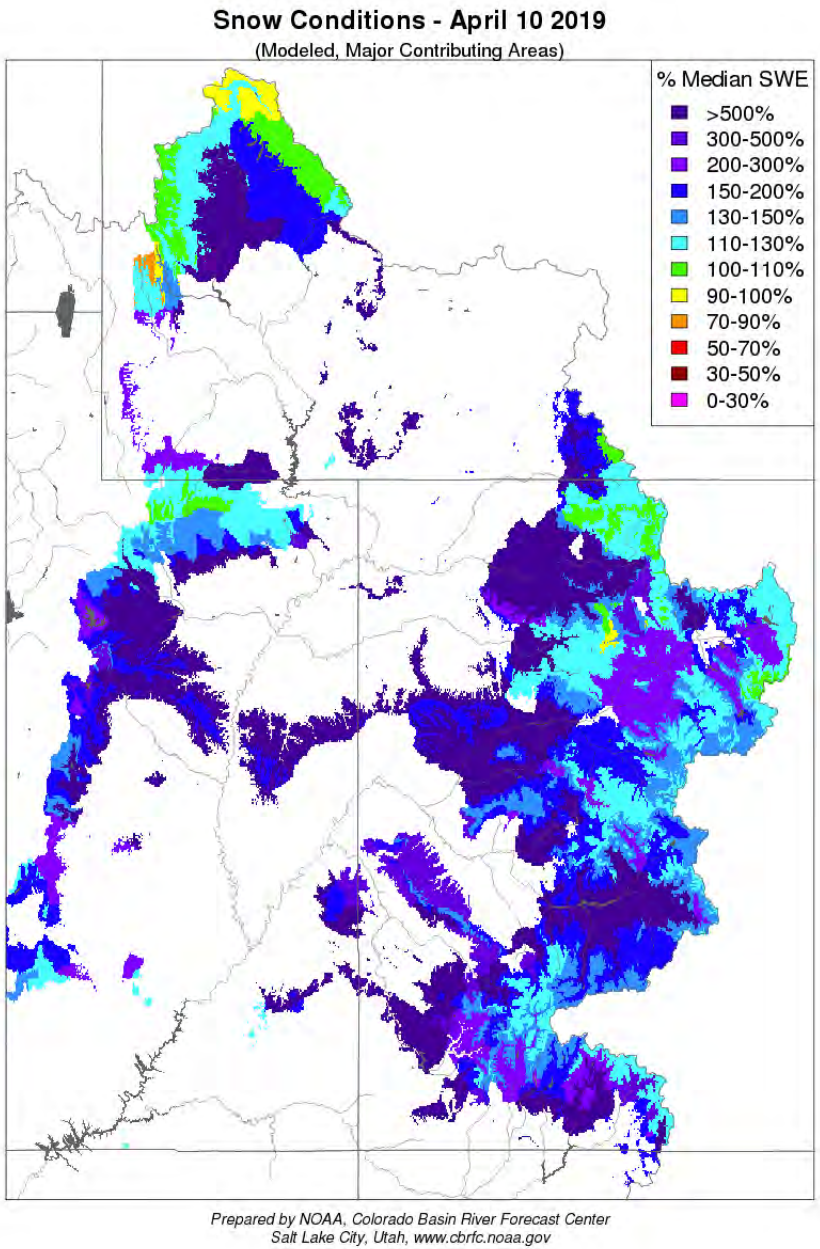
The Questions:

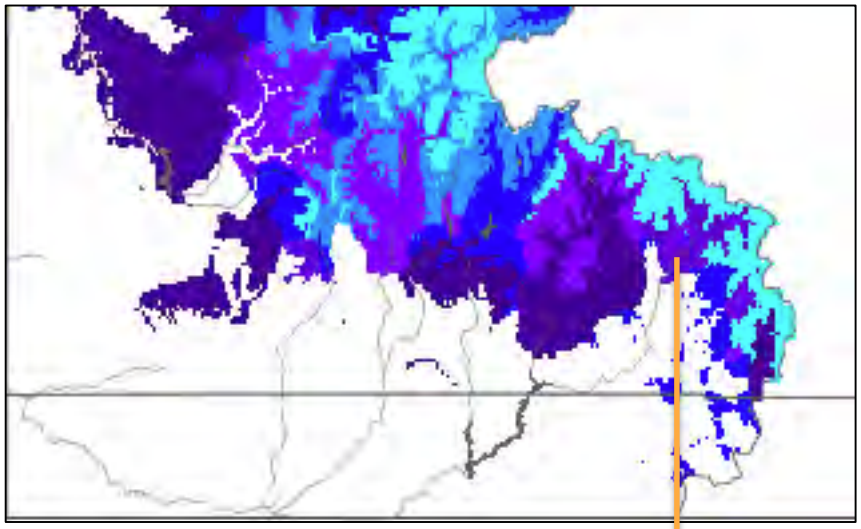
Would a slower melt result in lower volumes overall?

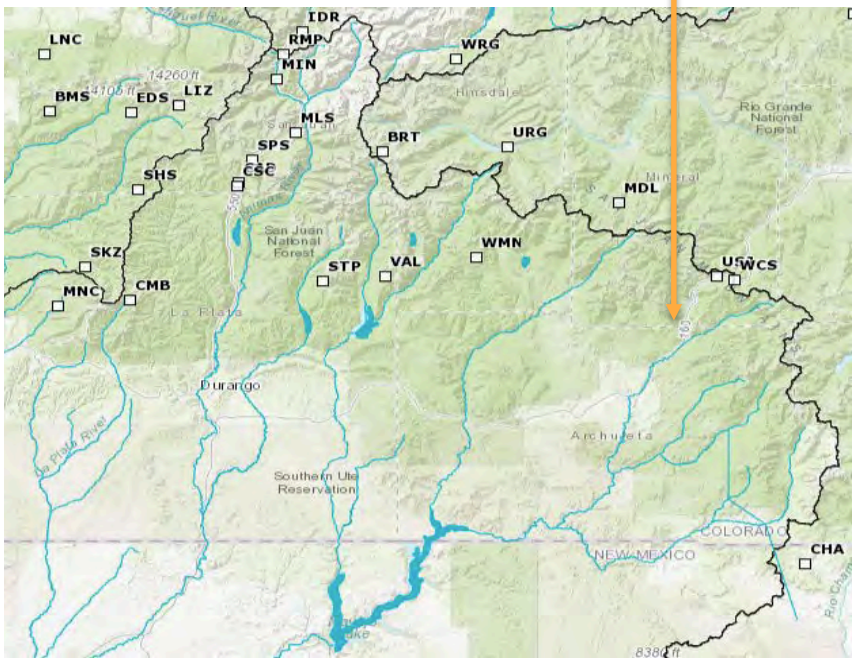
Is there enough snow to overcome soil moisture deficits?



Forecast Challenges: Large snowpack (as a percent of normal) at lower elevations

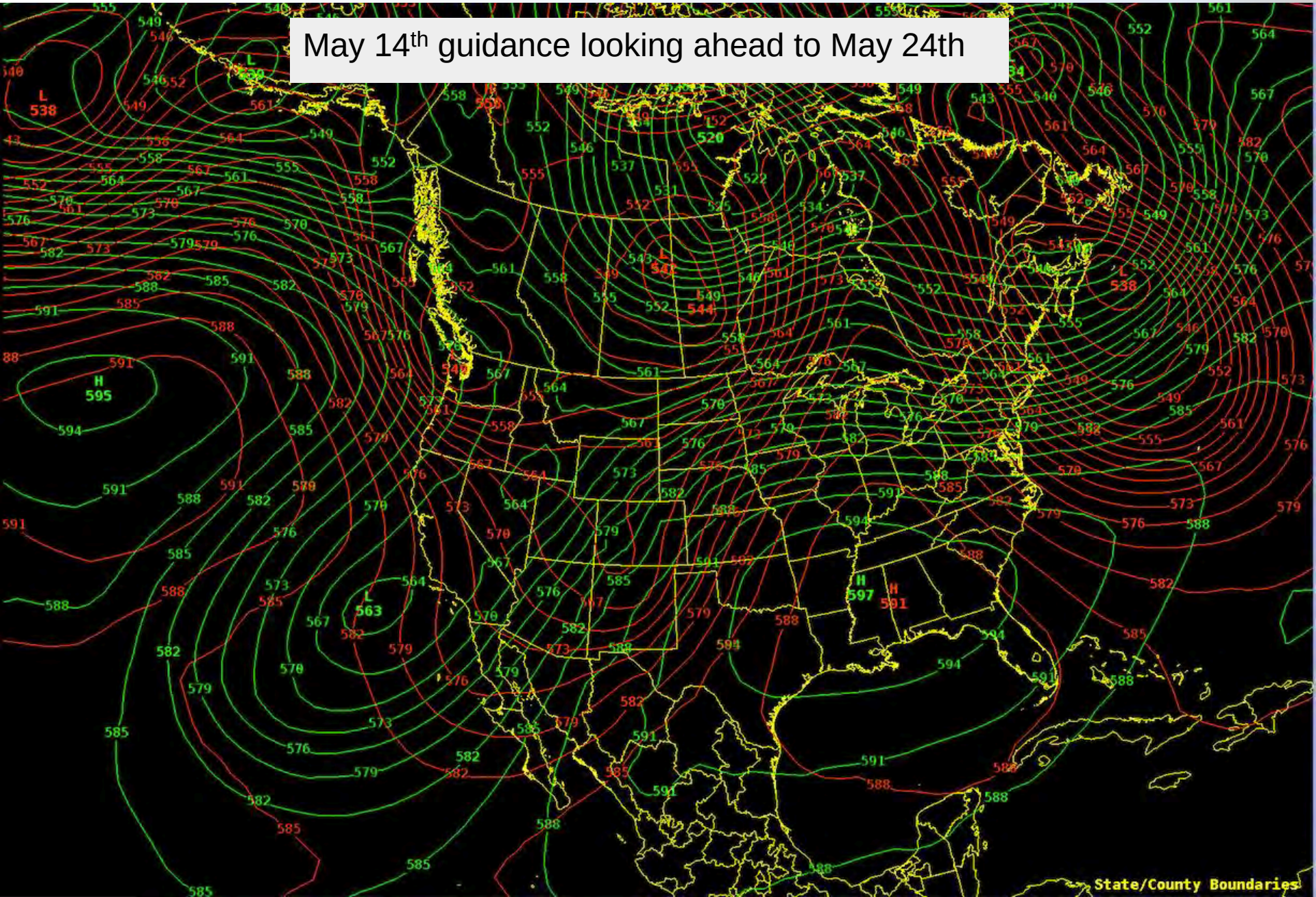






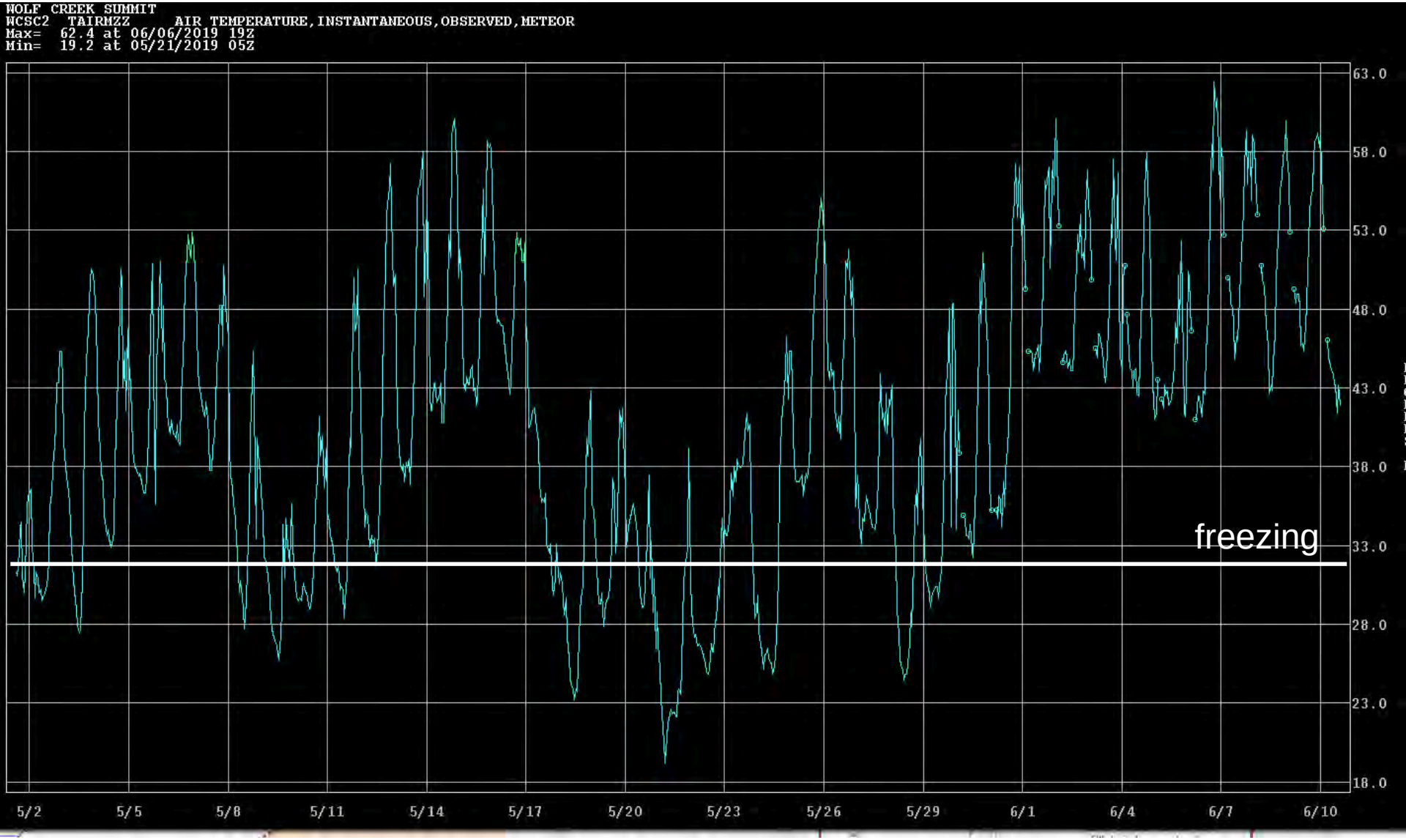
Forecast Challenges:

Different scenarios in meteorological guidance (Impacting Animas peak flow lead time)

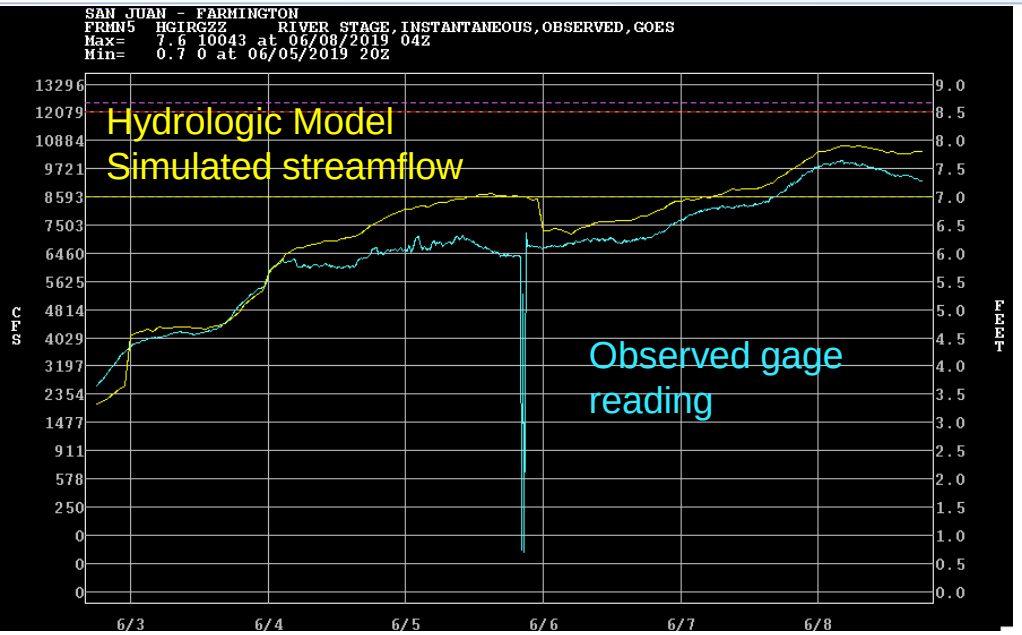


Forecast Challenges: Wide temperature variations and impacts to snowmelt pattern

Observed temperatures May 2nd – June 10th – Wolf Creek Summit – 11,000 feet



Forecast Challenges: Observed data issues (not uncommon especially in high years)



Daily Operations:
We often see a discrepancy between an observed reading and our model simulation.

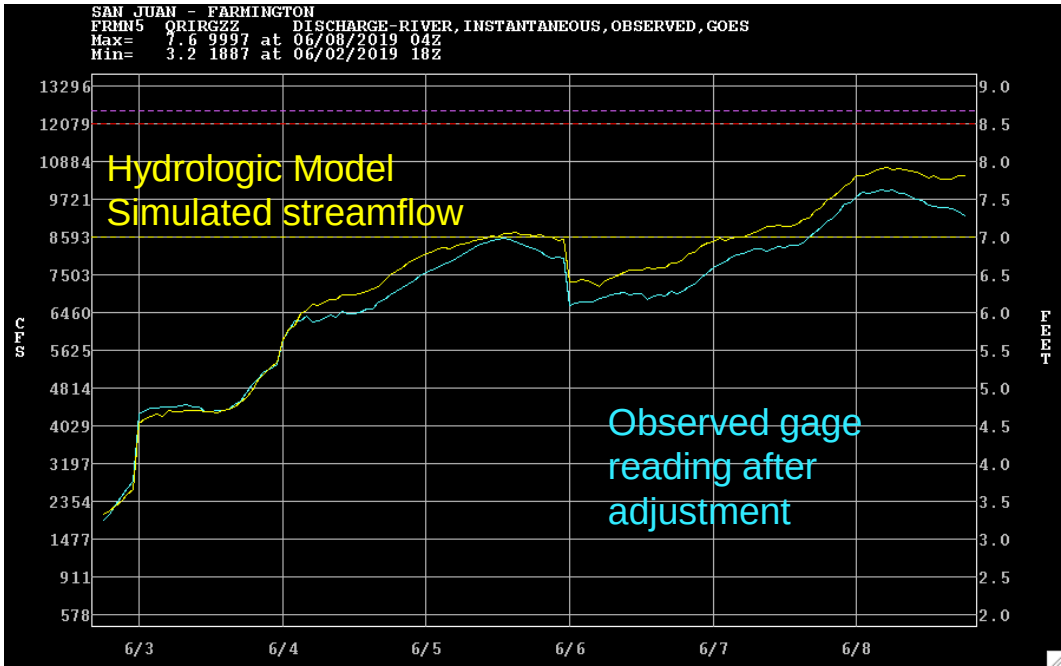
The Decision:
Is a model state incorrect or might something in the stream be impacting readings (debris, scour, etc.)

In this case upstream and downstream readings were close to model simulation suggested some issue at the gage.

Eventually a field measurement was made and the gage readings adjusted, validating the model performance.

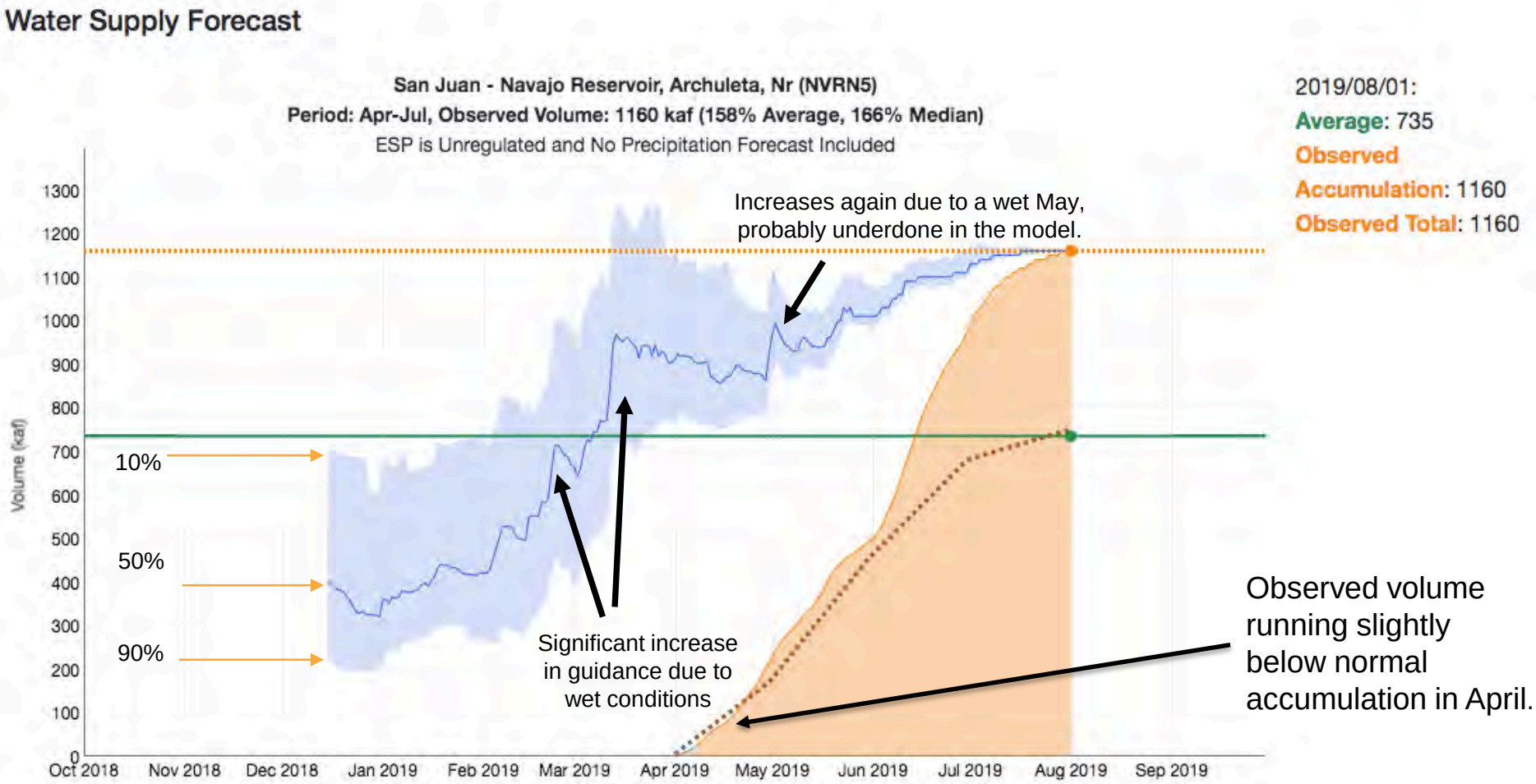
The decision to be patient and not adjust model states to lower values was correct.

This result is not always the case however, especially in data sparse areas and when the gage reading was indeed accurate.



Forecast Performance: 2019 Forecast Evolution Plot Navajo Reservoir

April-July runoff volume was 158% of average
June-July runoff volume was the 3rd highest in 49 years of record. Last year was 2nd lowest.



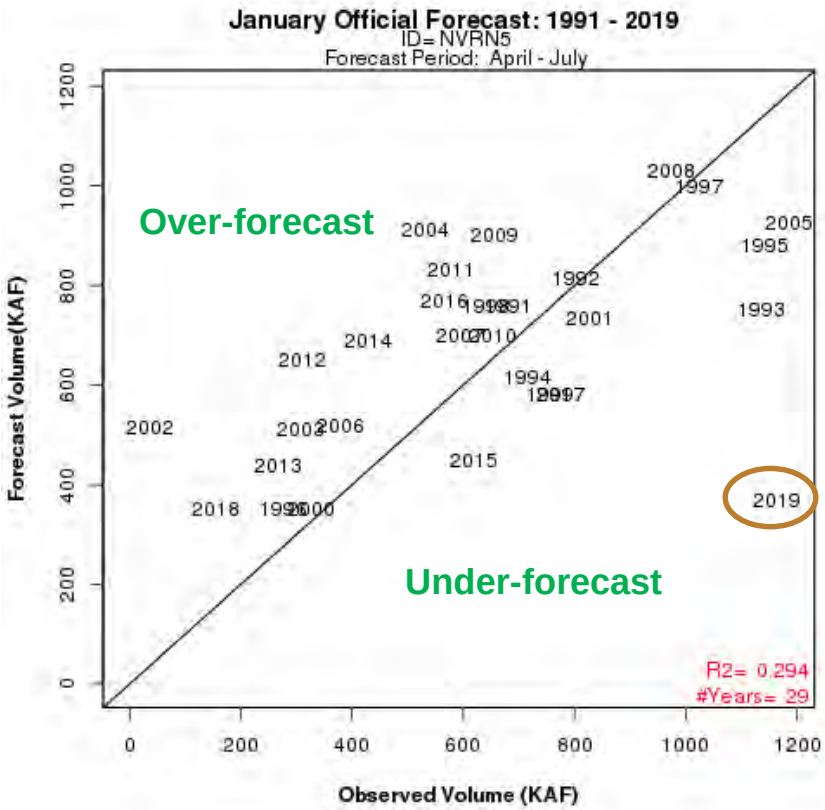
Significant snowpack and cool / wet weather resulted in a late snow melt
Snow at lower elevations contributed this year, in most years it's melted out by April
Below average runoff early gave way to efficient snow melt and high runoff conditions late

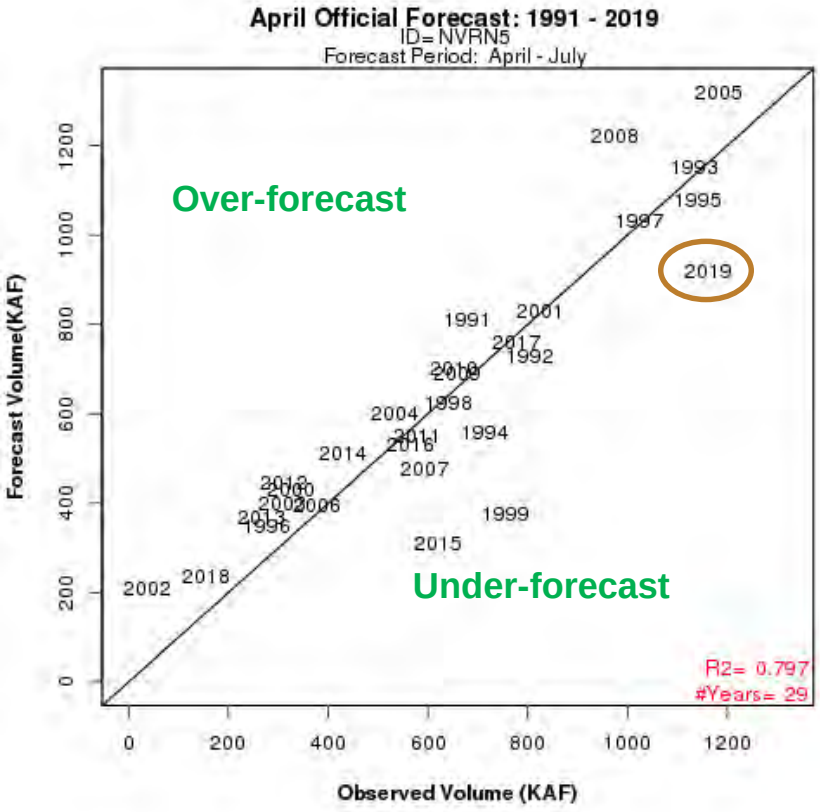
Forecast Performance: Navajo Reservoir Inflow

Large errors early (expected). Model caught up some but wasn't stellar in performance

Extreme years are challenging, the model tends to over-forecast very low years and under-forecast very high years
This year was no different. Forecasts assume average conditions in the future. The pattern was very wet and cold.
Forecasts error this year were greater than the historical mean absolute error in every month (April-June).
Observed volume was not forecast at the 10% probability level until mid March. (May precipitation top 5-10% of record)

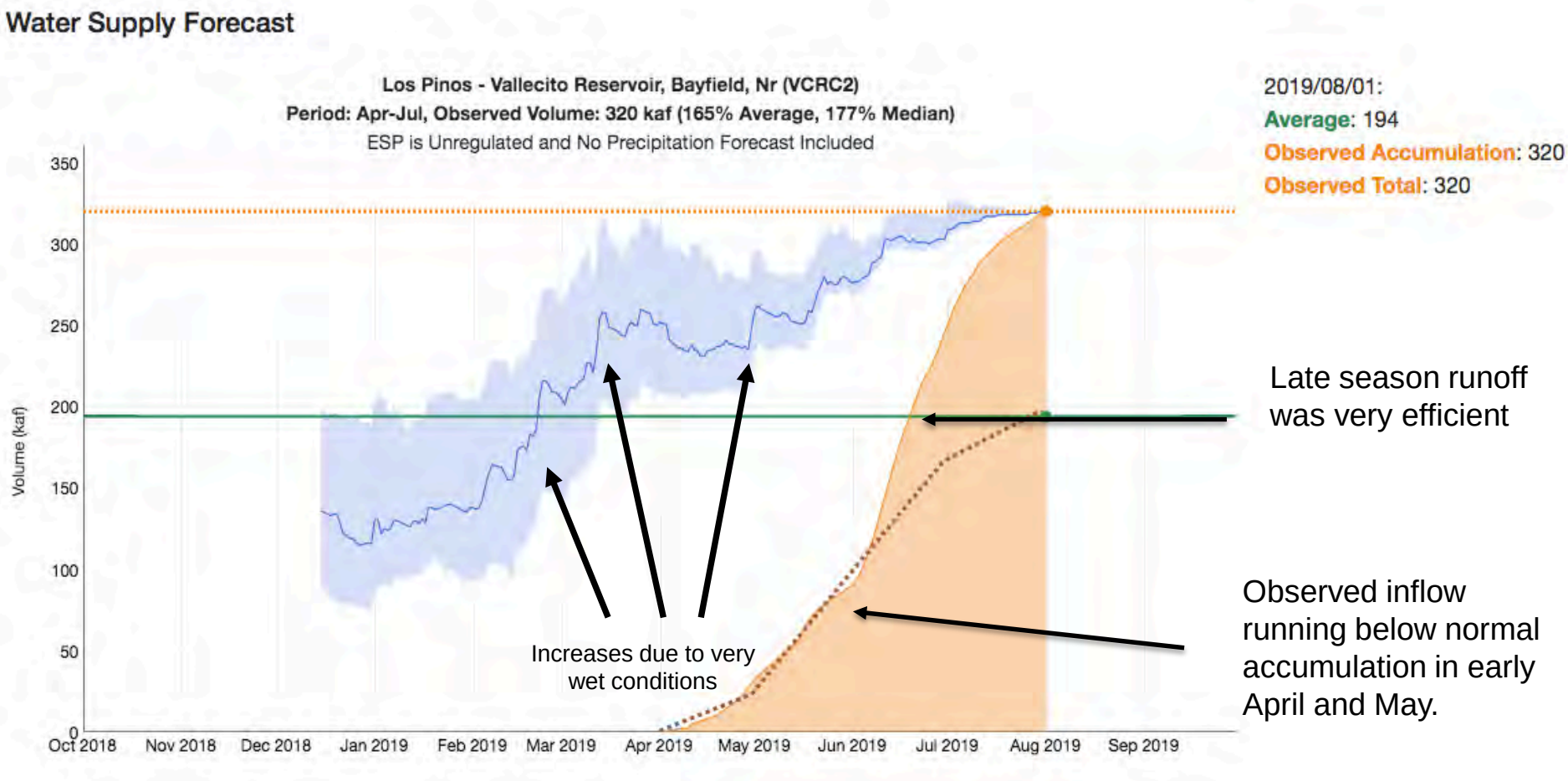
Soil Moisture deficits in higher elevations of the model were significant, likely too much to overcome.
May precipitation inputs into the model (particularly high elevation snow gains) may have been too little.
Overall model snow estimates, particularly in the eastern headwaters, were somewhat underdone.





Forecast Performance: 2019 Forecast Evolution Plot Vallecito Reservoir

Runoff volume of 320 KAF / 165 % of average was 2nd highest in 78 years. Last year 3rd lowest



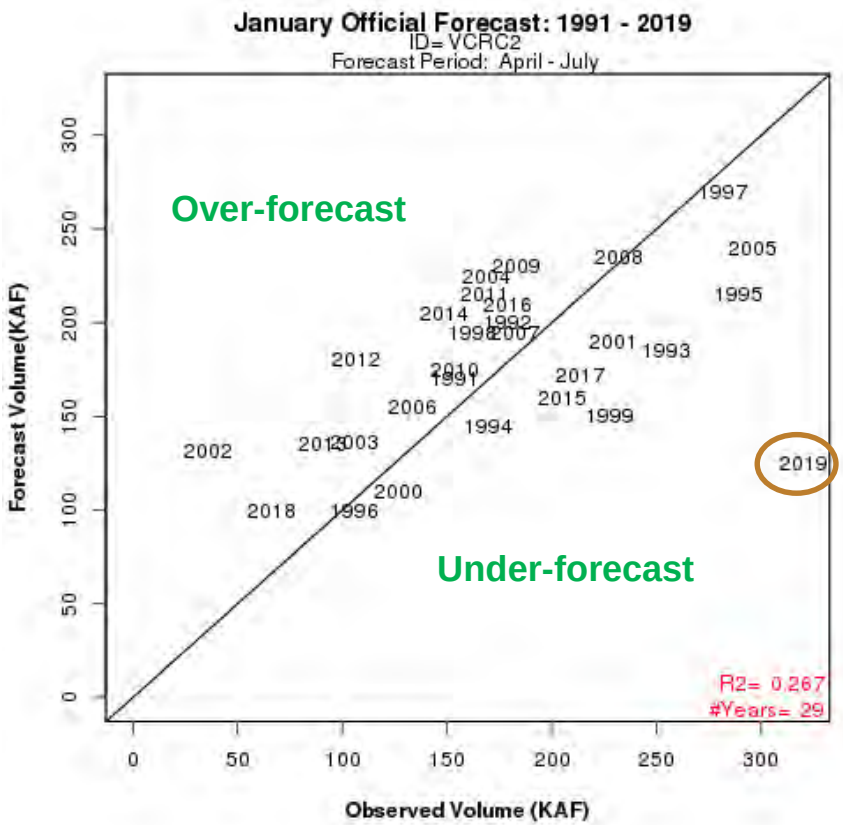
Model was too low on the snowpack at higher elevations, greater contribution from lower elevation snow
Below normal inflow in early April and below average precipitation resulted lower guidance
Similar condition occurred in May resulting in a slight decrease between May 1st and May 15th

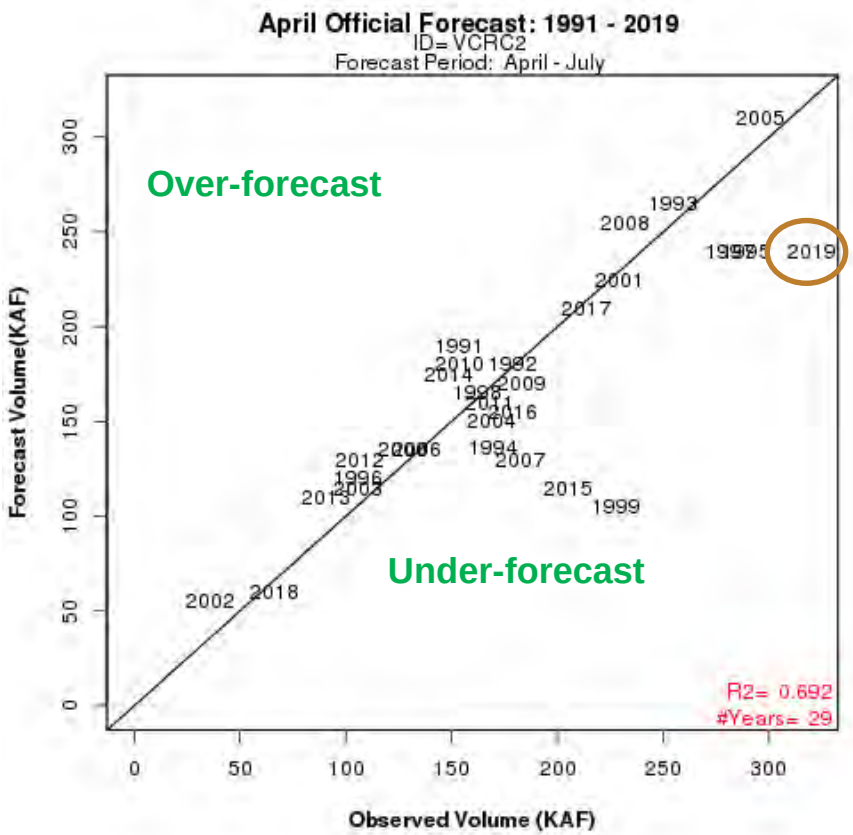
Forecast Performance: Vallecito Reservoir Inflow

Large errors early in season that carried into spring
Somewhat expected with very wet conditions that developed after forecast dates

Errors were larger (as a percentage) compared to the Navajo inflow forecast
The model took longer to forecast the observed value at the lower probability levels (i.e. 10% exceedance)

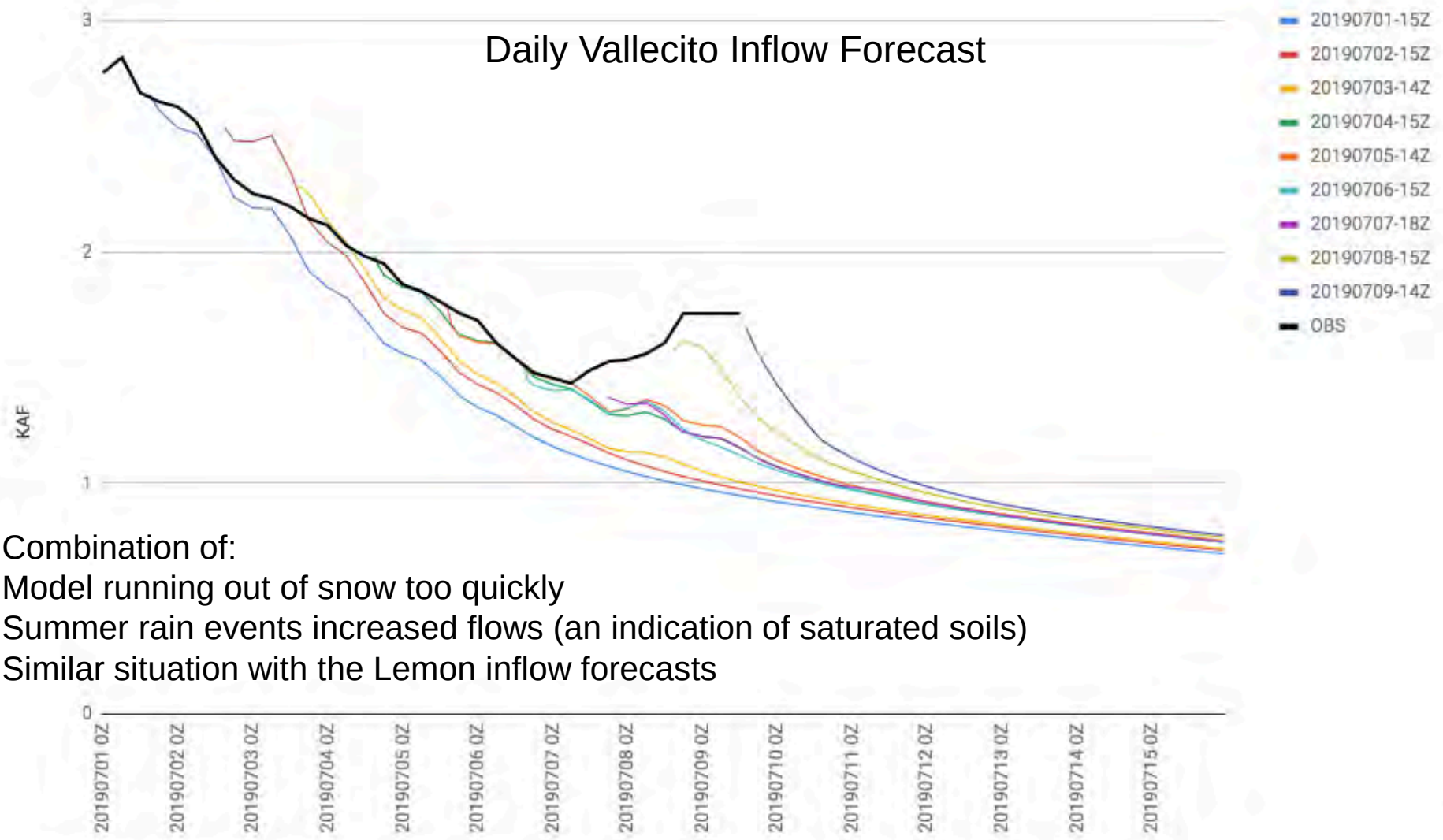
Similar snow and soil moisture issues but potentially greater impacts from low snow model states
May precipitation was the 2nd / 3rd highest on record – Did enough precipitation make it into the model?
Model soil moisture deficits may have continued to have too large of an impact





Forecast Performance:

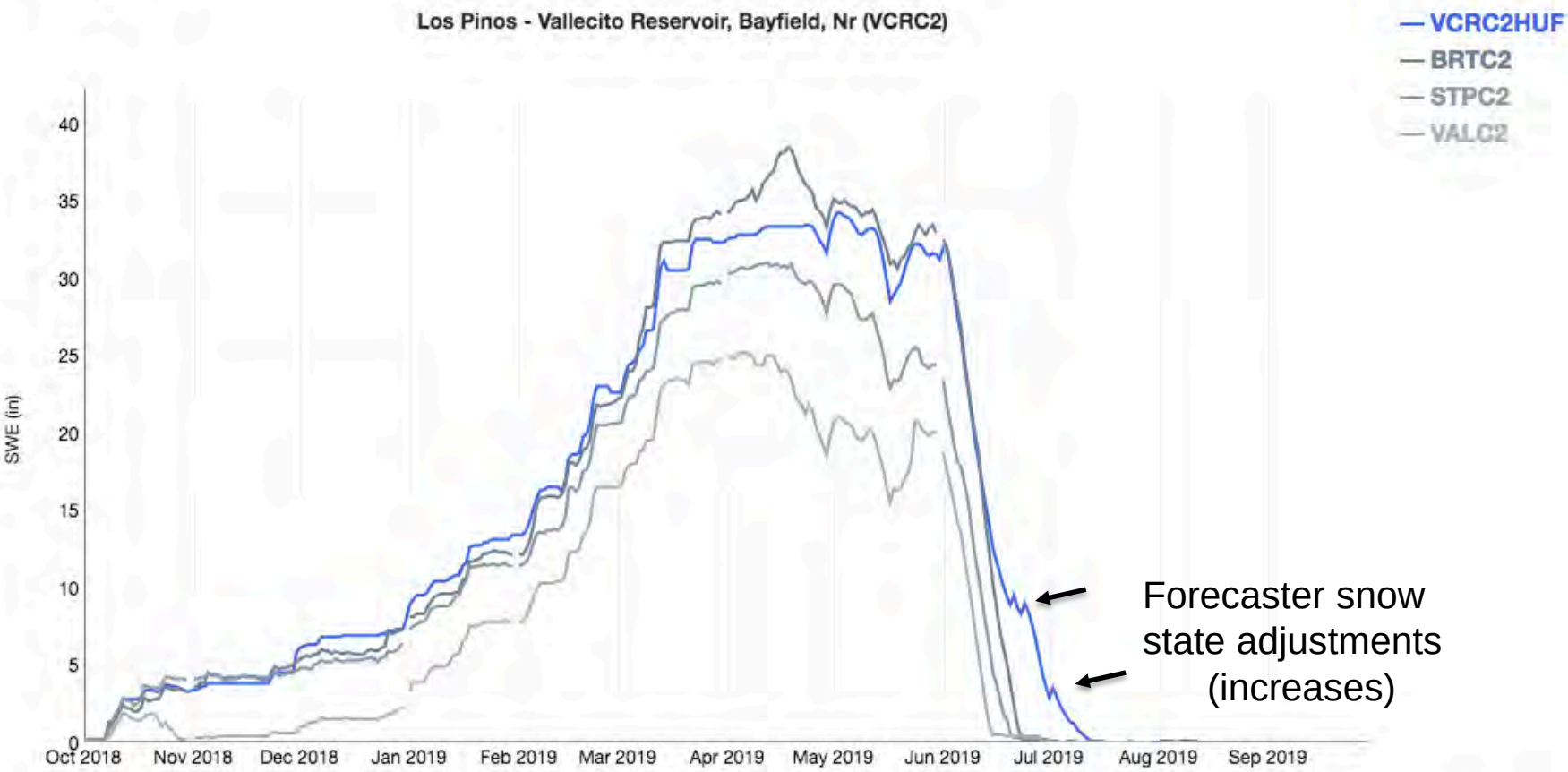
Day to day forecasts indicated too quick of a seasonal recession



Combination of:
Model running out of snow too quickly
Summer rain events increased flows (an indication of saturated soils)
Similar situation with the Lemon inflow forecasts

Forecast Performance: Vallecito Forecast Segment Model Snow States

Model Snow



Forecaster snow state adjustments (increases)

Water Year

2019

Basin Zone

VCRC2HUF (11000-13231 ft)

Basin SNOTEL

All selected (3)

All SNOTEL

None selected

Plot Options

- Sim Median
- Sim Max/Min
- SNOTEL Median
- Percent Seasonal Median
- Percent Daily Median

Summary

Despite playing catch up with the forecasts it was a very beneficial year on the heels of a disastrous 2018.

Communication success with Reclamation and other stakeholders reached a new plateau. We processed a lot of information, talked daily, tried to identify shortcomings in the forecast (daily and monthly) in a timely manner. Timing for the Animas peak was reasonable.

Model performance was not optimal regarding the volumes. However years like this allow us to identify limitations and provide an opportunity to improve performance (you don't learn much from an average well behaved year).

For 2019 these Include:

- Soil moisture deficits at high elevations were perhaps too large to overcome
- Not enough precipitation / snow gain in May at higher elevations
- Overall the snow as underdone in the model at higher elevations (less so in the Animas)
- Contribution from lower elevation snow more significant than model anticipated
- Record snow existed in early June, another extreme situation for the model

Heading into Fall:

- ENSO Neutral conditions expected fall / winter - No strong climate signal
- Northern Jet seems strong / active for this time of year

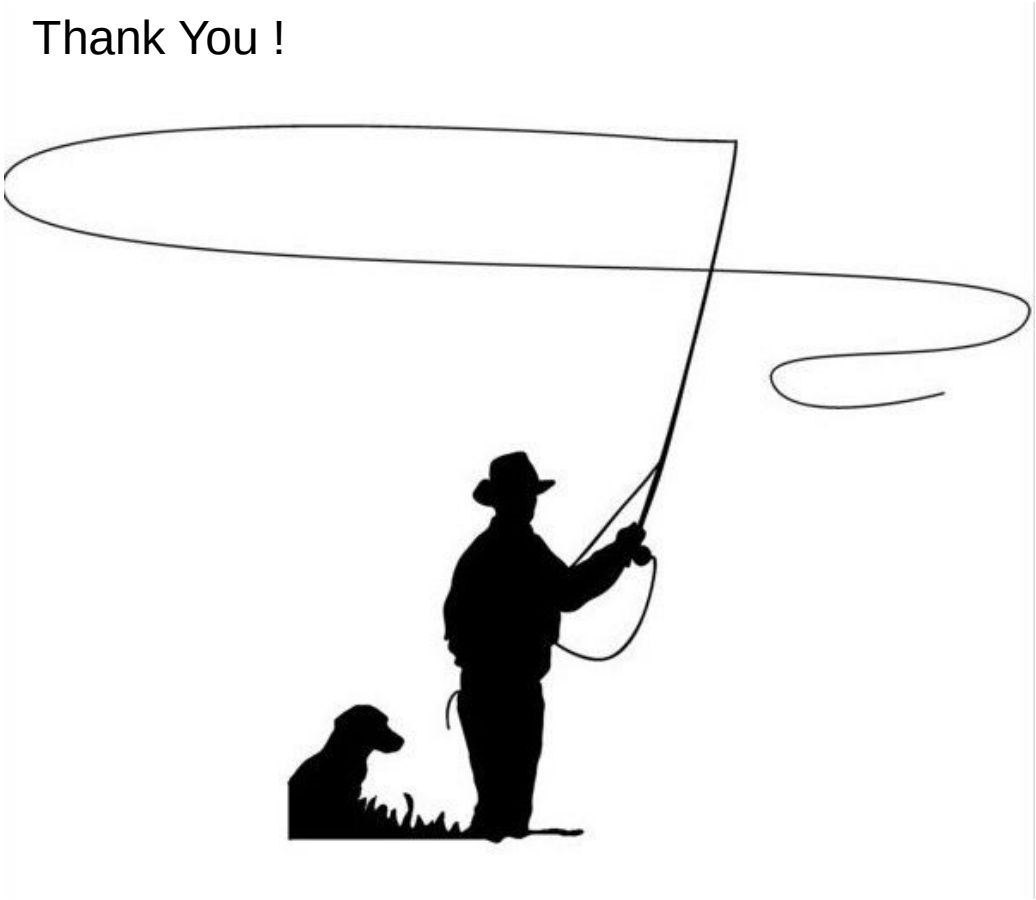
It’s time for the next chapter …

Meeting with you all to solve the annual runoff puzzle…

The value of the communication we’ve established …

Data ! ….

Thank You !



CBRFC 2020 Water Supply Contacts

Ashley Nielson – San Juan, Gunnison, Dolores, Lake Powell Focal Point
ashley.nielson@noaa.gov

Brenda Alcorn– Upper Green River Basin, Yampa, Duchesne Focal Point
brenda.alcorn@noaa.gov

Cody Moser – Upper Colorado Mainstem Focal Point
cody.moser@noaa.gov

Tracy Cox - Lower Green (San Rafael & Price) River Basin Focal Point
tracy.cox@noaa.gov

Zach Finch - Lower Colorado Basin, Virgin Basin Focal Point
zach.finch@noaa.gov

Brent Bernard – Six Creeks, Provo , Sevier Focal Point
brent.bernard@noaa.gov

Patrick Kormos – Bear, Weber Basin Focal Point
patrick.kormos@noaa.gov

Michelle Stokes – Hydrologist In Charge
michelle.stokes@noaa.gov

Paul Miller– Service Coordination Hydrologist
paul.miller@noaa.gov

PLAN FOR WY 2020 OPERATIONS

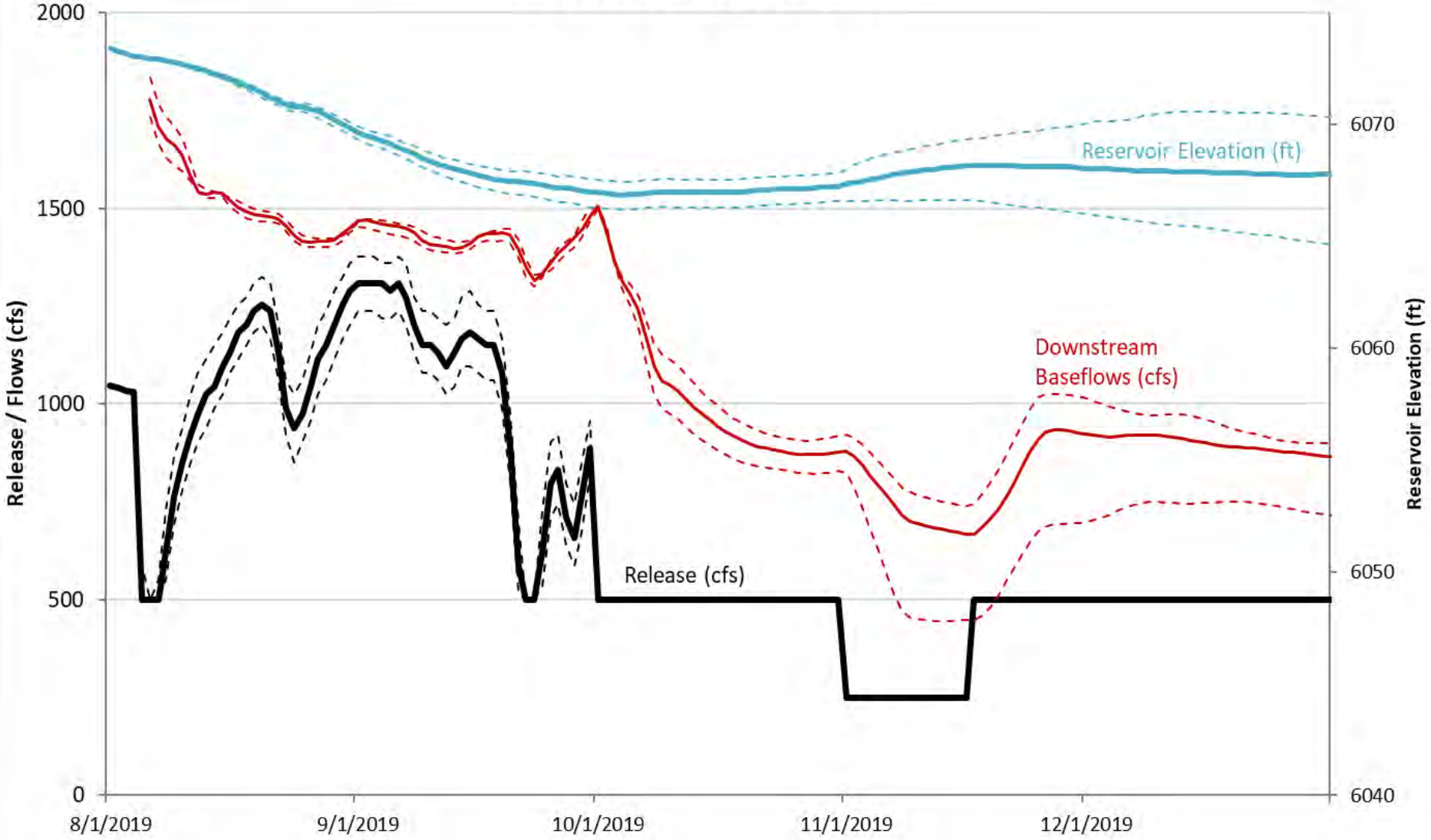
Summer Baseflows

For the summer of 2019, the San Juan River Basin Recovery Implementation Program has recommended a target base flow of 1,500 cfs through the critical habitat area. The target base flow is calculated as the weekly average of gaged flows throughout the critical habitat area from Farmington to Lake Powell. Reclamation will attempt to maintain this augmented baseflow as long as water is available over the end of water year storage target (a reservoir elevation of 6063 ft).

Based on current conditions and flow forecasts, which are for warm dry weather, high releases (1,000-1,500 cfs) are expected from the dam through the first two weeks of September, after which the release will most likely be decreased back below 1000 cfs.

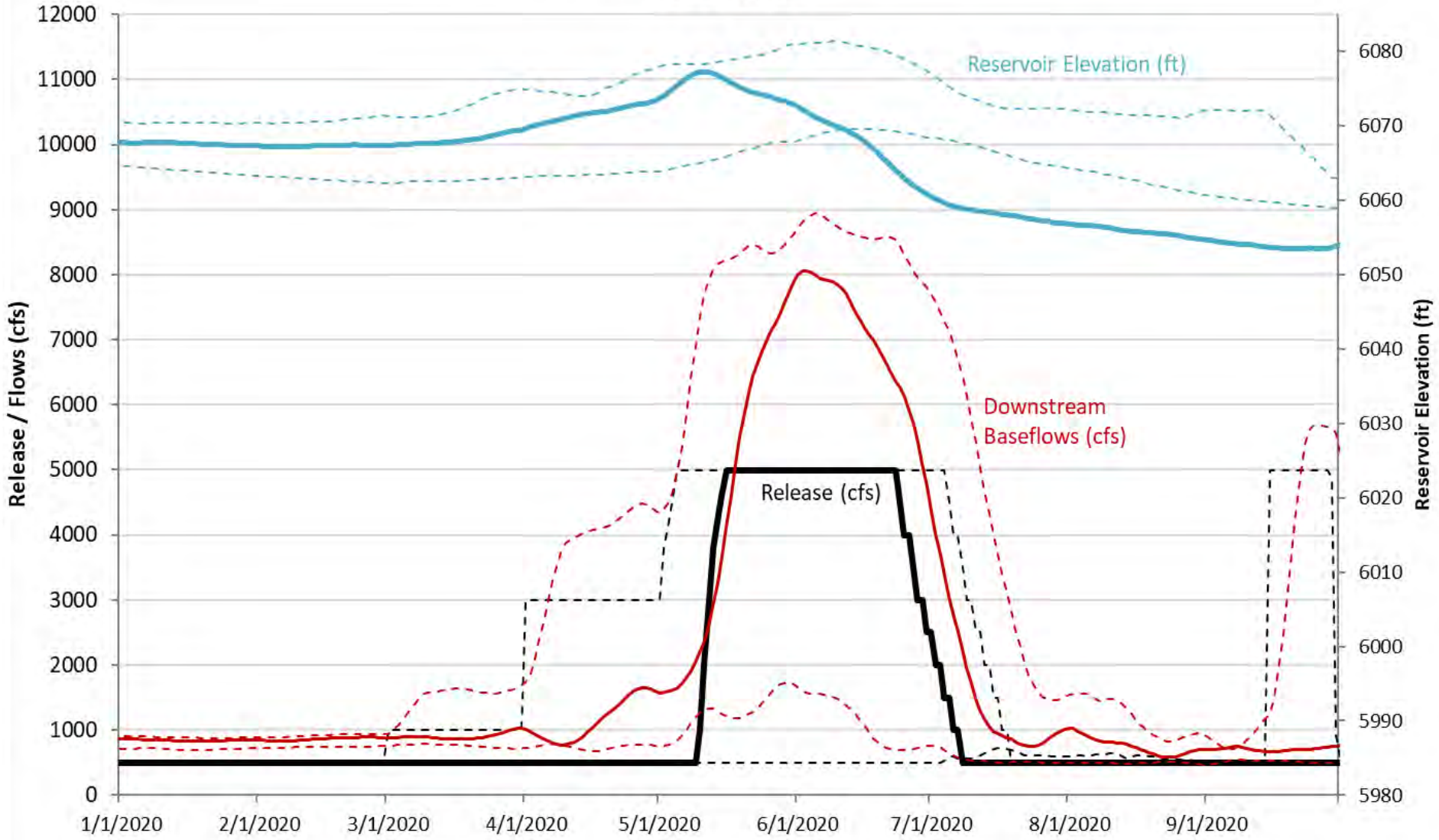
RECLAMATION

Navajo Reservoir Forecast Operations
Summer and Fall 2019

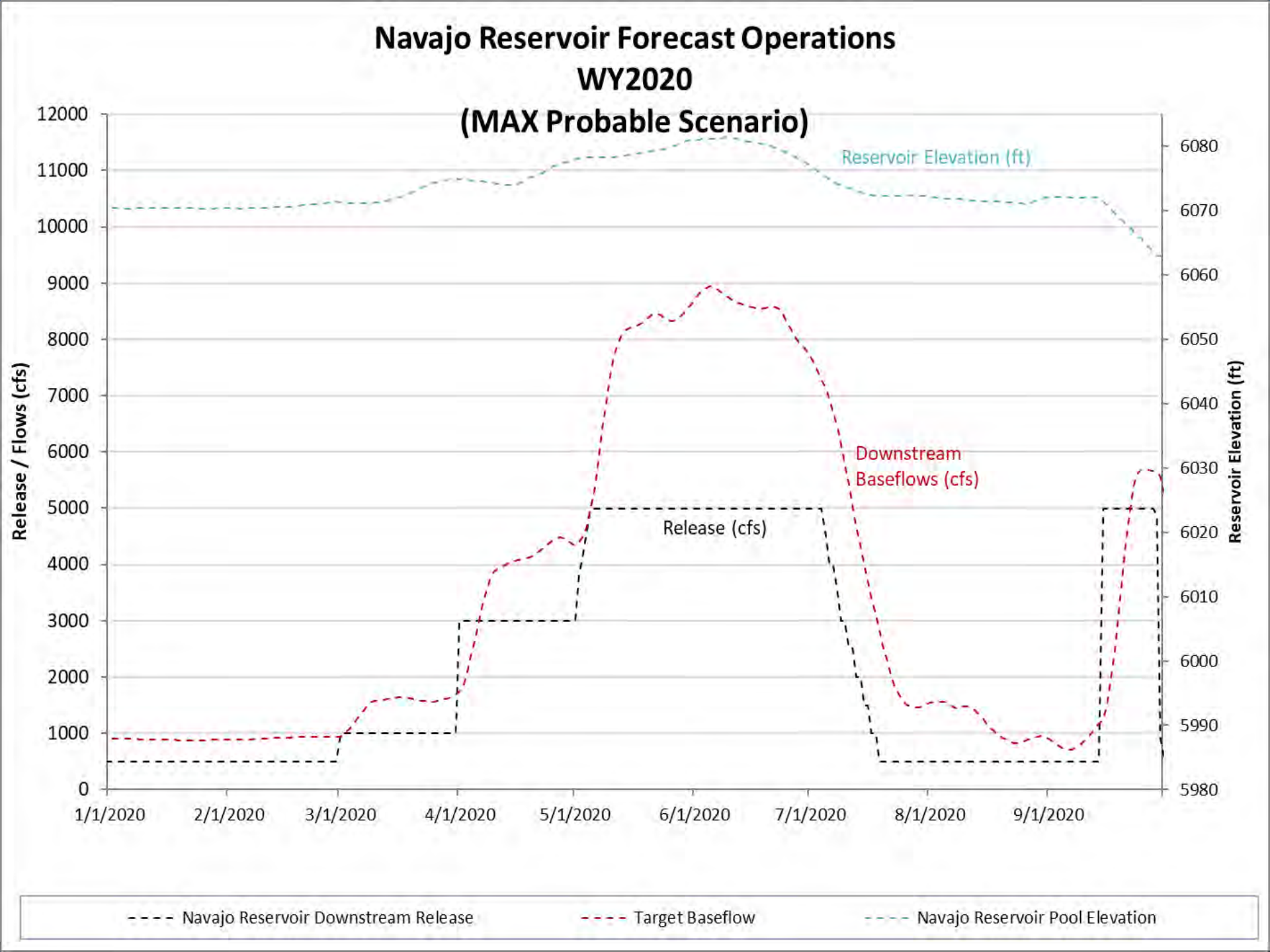


Navajo Reservoir Downstream Release — Target Baseflow — Navajo Reservoir Pool Elevation

Navajo Reservoir Forecast Operations
WY 2020



Navajo Reservoir Downstream Release — Target Baseflow — Navajo Reservoir Pool Elevation

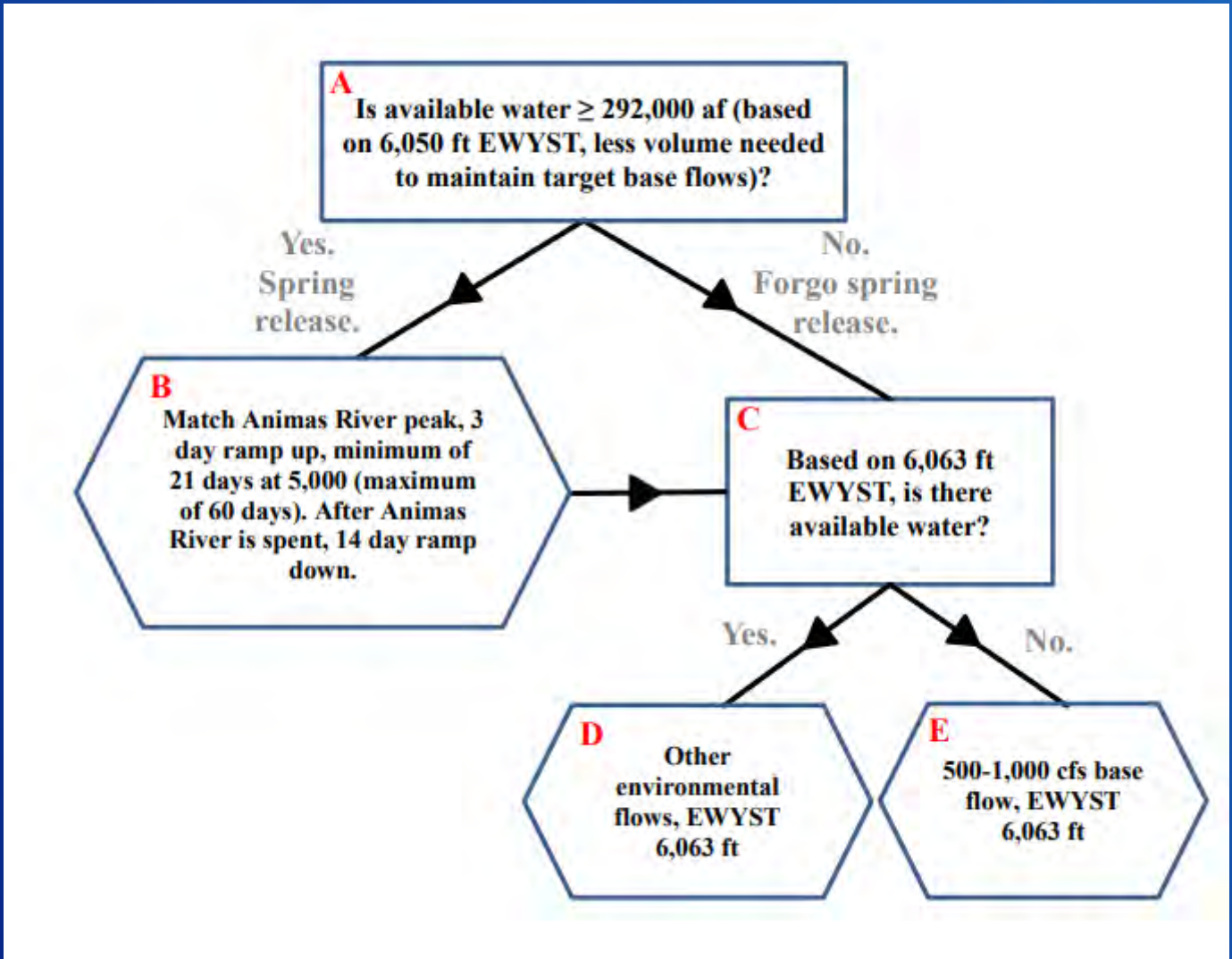

Navajo Reservoir Forecast Operations
WY2020
(MAX Probable Scenario)
Reservoir Elevation (ft)
Downstream
Baseflows (cfs)
Release (cfs)
Release / Flows (cfs)
Reservoir Elevation (ft)
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
6080
6070
6060
6050
6040
6030
6020
6010
6000
5990
5980
1/1/2020
2/1/2020
3/1/2020
4/1/2020
5/1/2020
6/1/2020
7/1/2020
8/1/2020
9/1/2020
Navajo Reservoir Downstream Release
Target Baseflow
Navajo Reservoir Pool Elevation

SJRIP FLOW RECOMMENDATIONS DECISION TREE

Navajo Dam Operations Governing Documents

- Record of Decision for the Navajo Reservoir Operations, Navajo Unit – San Juan River New Mexico, Colorado, Utah Final Environmental Impact Statement (Reclamation, 2006)
  - Flow Recommendations for the San Juan River (San Juan River Basin Recovery Implementation Program, 1999, revised 2018)
  - Recommendations for San Juan River Operations and Administration for 2017 – 2020 (Collectively known as “The Shortage Sharing Agreement)
- Navajo Dam and Reservoir San Juan River Water Control Manual (US Army Corps of Engineers, 1970, revised 2011)

RECLAMATION



https://www.fws.gov/southwest/sjrip/pdf/DOC_San_Juan_Dam_Modified_FlowProcedures_2018.pdf

RECLAMATION

Maintenance Releases

- Maintenance Releases are not currently part of the SJRIP Decision Tree.
- Reclamation Operation designed for channel maintenance and to support Navajo's Authorized Purposes.
- Short release designed primarily to mobilize sediment, push back channel encroachment.
- Maintenance releases are still timed like a regular spring peak release in an effort to meet flow goals.

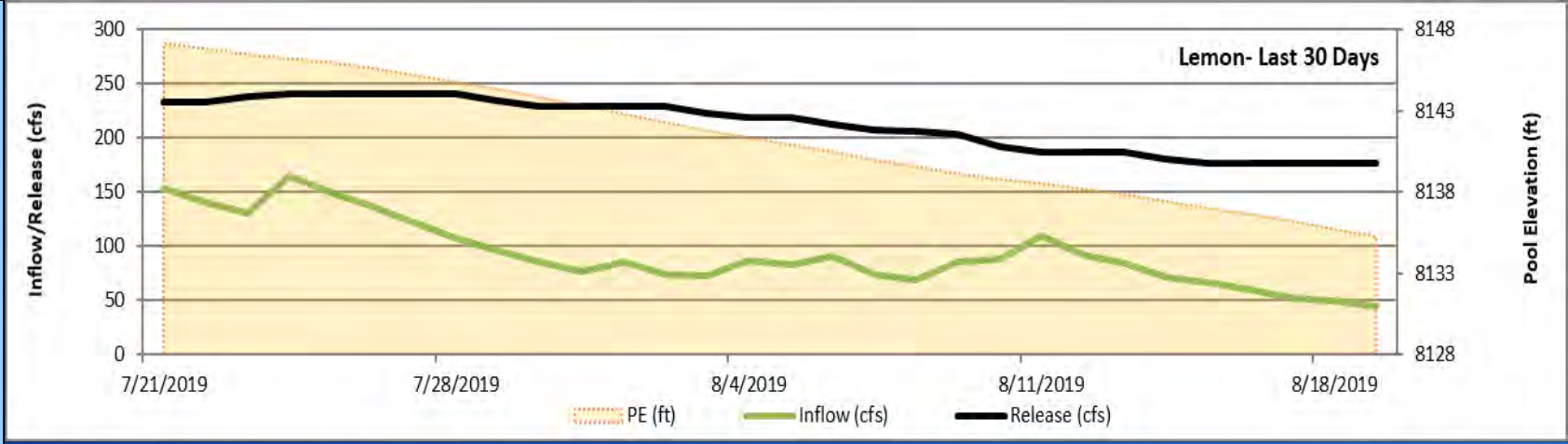
Technical Report SRH-2016-33, Reclamation
San Juan River Channel Processes and Flow Conveyance below Navajo Dam, NM (2016)

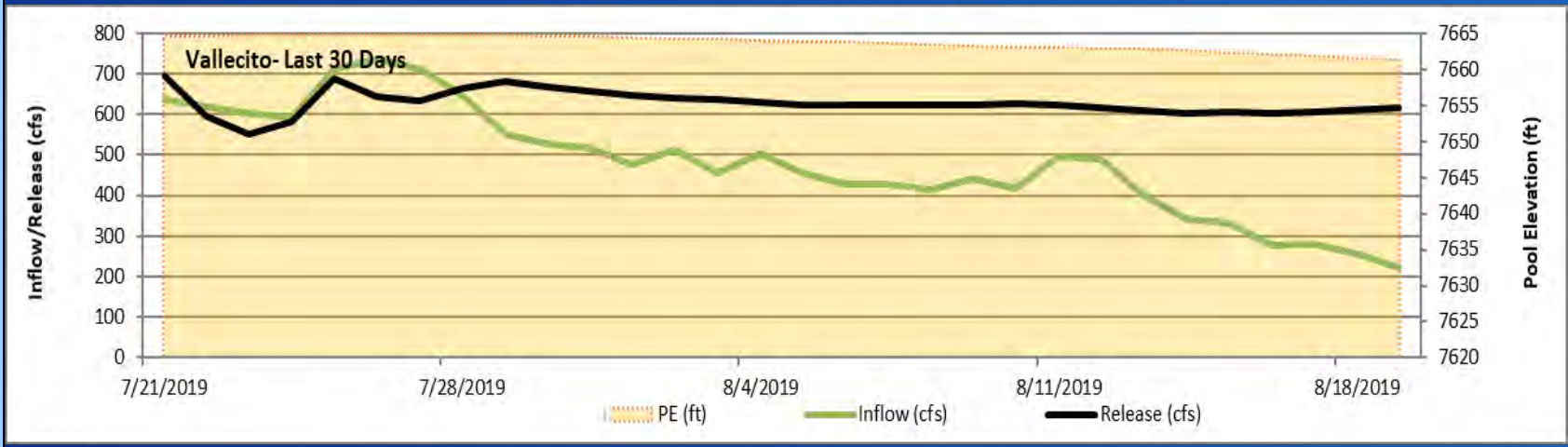
RECLAMATION

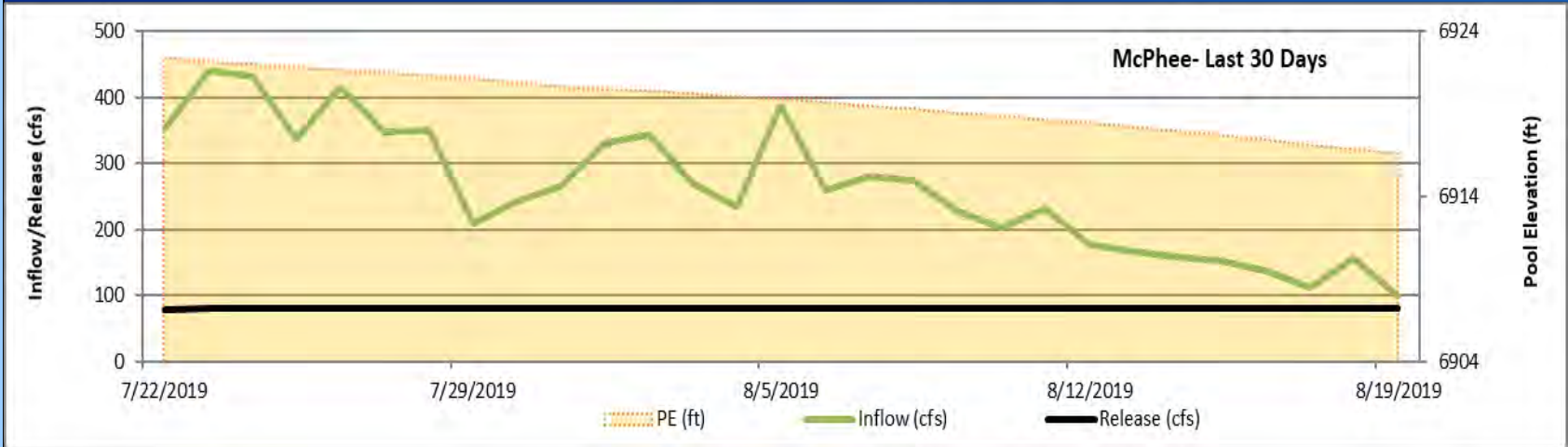
OTHER AREA PROJECTS

Major San Juan River Basin Reservoirs

(8/19/2019)

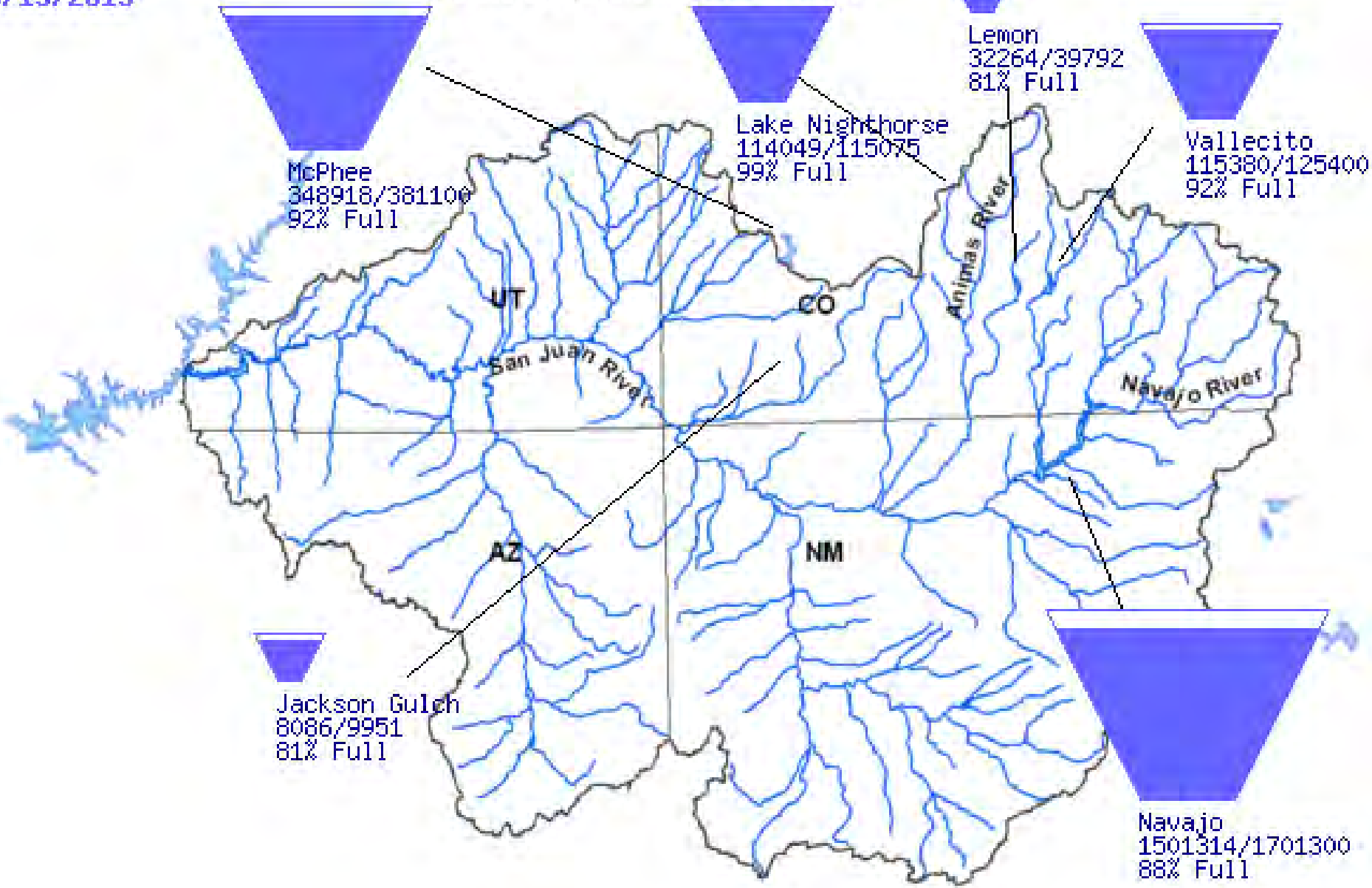




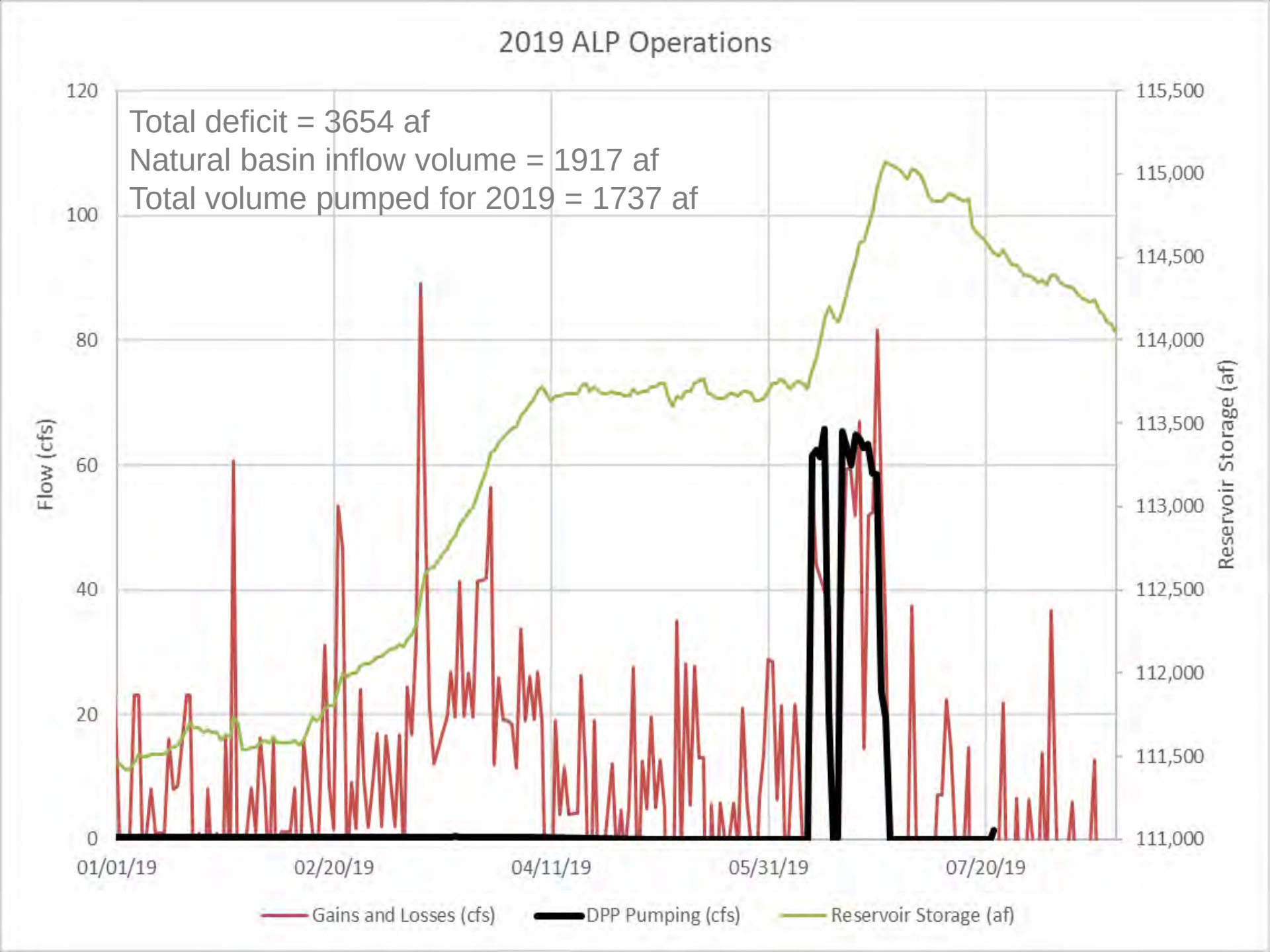


Data Current as of:
08/19/2019

San Juan River Basin



RECLAMATION


2019 ALP Operations
Total deficit = 3654 af
Natural basin inflow volume = 1917 af
Total volume pumped for 2019 = 1737 af
Flow (cfs)
Reservoir Storage (af)
120
100
80
60
40
20
0
115,500
115,000
114,500
114,000
113,500
113,000
112,500
112,000
111,500
111,000
01/01/19
02/20/19
04/11/19
05/31/19
07/20/19
Gains and Losses (cfs)
DPP Pumping (cfs)
Reservoir Storage (af)

MAINTENANCE UPDATES

Maintenance Updates…

- Rehab jobs of 72” Hollow Jets and 30” Hollow Jet are complete.
- Working with NMDOT to repair fences for spillway and address issues of oversized loads going over the spillway bridge.
- New gravel on parking lot on top of dam and new pavement in the turnaround area.

RECLAMATION

SJRIP UPDATE

Summary

WY 2019 Summary

- Snowpack peaked at 144% of average
- A maintenance release peaking at 5,000 cfs was conducted in June. Volume released over base was 85kaf. When combined with Animas River, flow targets for ESA species achieved.
- Final April-July inflow volume 1,162,400 af (158% avg)
- SJRIP Request for increased baseflows to move excess water.
  - Releases now through Sept will likely range between 800 and 1500 cfs.
  - September – October, releases will likely be 1000 cfs or less.
  - First two weeks of November, the release will drop as low as needed to make the lowest baseflow (as low as 250 cfs).
  - After mid-November, operations will resume as normal and releases will range between 350 and 650 cfs on average.

RECLAMATION

NEXT OPERATIONS MEETING:

Tuesday, January 21st, 2020

UPDATES FROM OTHER AGENCIES

How You Can Access Information

Bureau of Reclamation

www.usbr.gov/uc

USGS

http://water.usgs.gov/nwis

Colorado Basin River Forecast Center

www.cbrfc.noaa.gov

RECLAMATION

For Operations Updates

- EMAIL UPDATES
  - to be added, email rswickard@usbr.gov
- WEBSITE
  - Navajo Reservoir: http://www.usbr.gov/uc/wcao/water/rsvrs/notice/nav_rel.html
  - All UC Operations https://www.usbr.gov/uc/water/index.html
- PHONE
  - Susan Behery 970-385-6560
  - WCAO Main Office 970-385-6500

RECLAMATION

Reclamation Contacts:

Marc Miller

970-385-6541 mbmiller@usbr.gov

Susan Novak Behery

970-385-6560 sbehery@usbr.gov

Ruth Swickard

970-385-6523 rswickard@usbr.gov

RECLAMATION