

# NOAA's Colorado Basin River Forecast Center

## The National Weather Service's River Forecast Centers – Who We Are and Our Role in Dam Safety

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DOI Dam Safety and Security Training

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# The Take Away

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- River Forecast Centers provide a broad array of products and services, including short-term forecasts, peak flow forecasts, and seasonal water supply forecasts
  - Data and coordination is extremely important
  - Every RFC is different, but all provide decision support and welcome stakeholder engagement
  - Western RFCs are particularly adept at seasonal water supply forecasting
- RFCs are a great resource for dam safety information and implementing of emergency action and safety plans



# Overview

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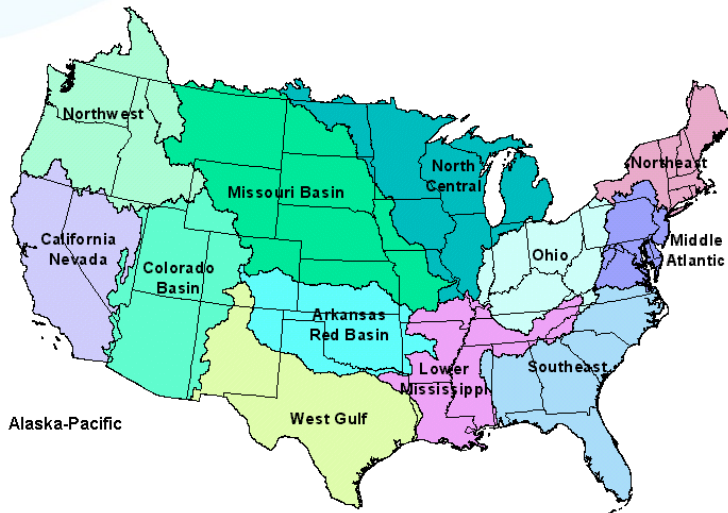
- What and Who are River Forecast Centers
- Summary of key operations, products, and services
- Services available during a dam incident or failure



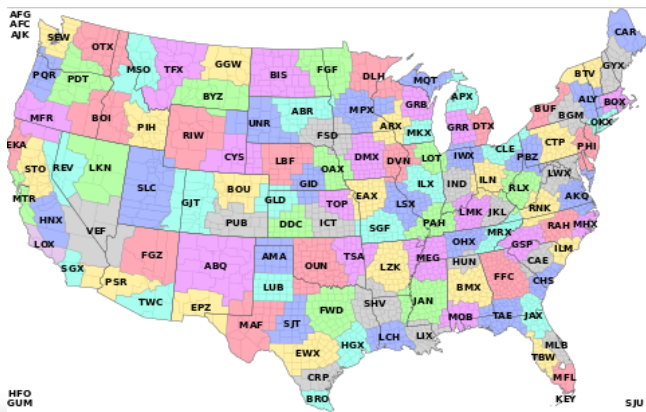


# River Forecast Centers

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- 13 RFCs nationwide
  - Co-located with a subset of the 122 Weather Forecast Offices (WFOs)
  - Support NOAA's hydrologic services and products
- Focused on decision support
- Western RFCs are particularly adept at water supply services





# River Forecast Centers

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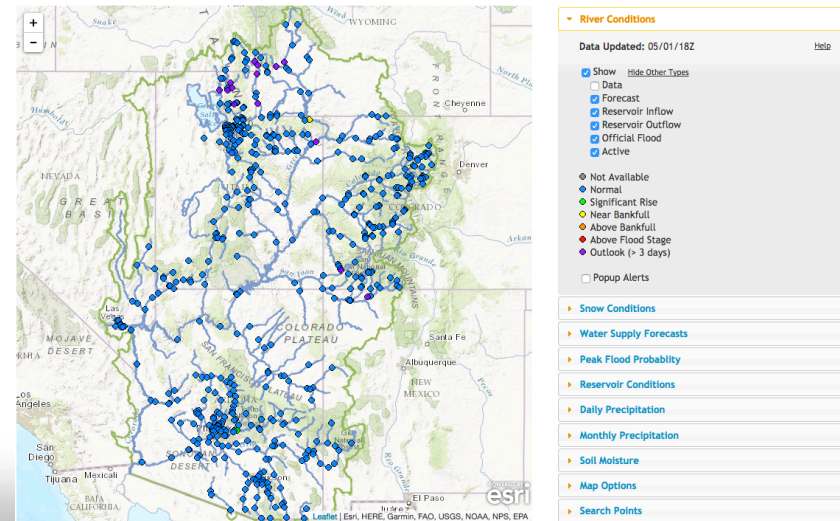
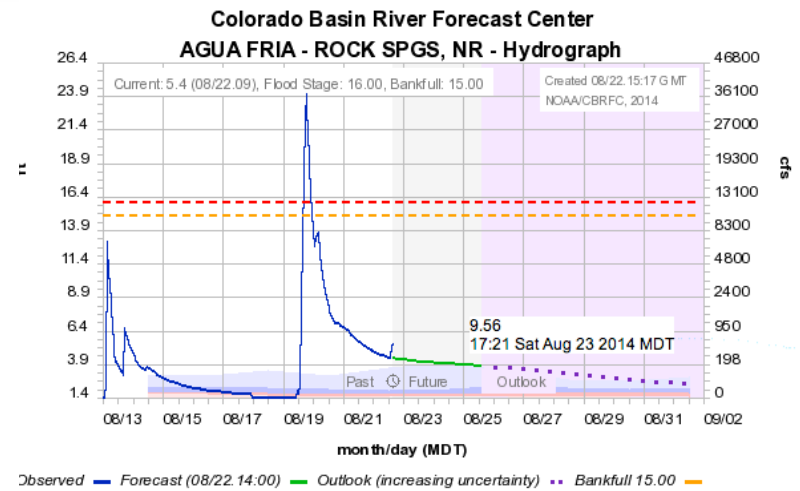
- Work with a broad and diverse set of stakeholders
  - Federal agencies (e.g. Reclamation, USACE)
  - Municipal and Agricultural Water Users
  - State, academic, NGOs
- Data consumers – we rely on information provided by many of our stakeholders



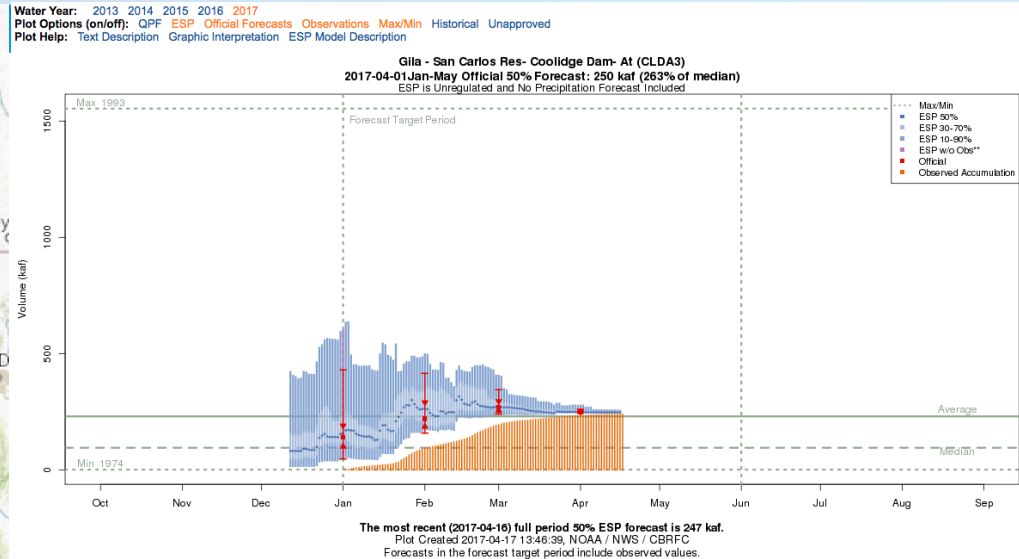
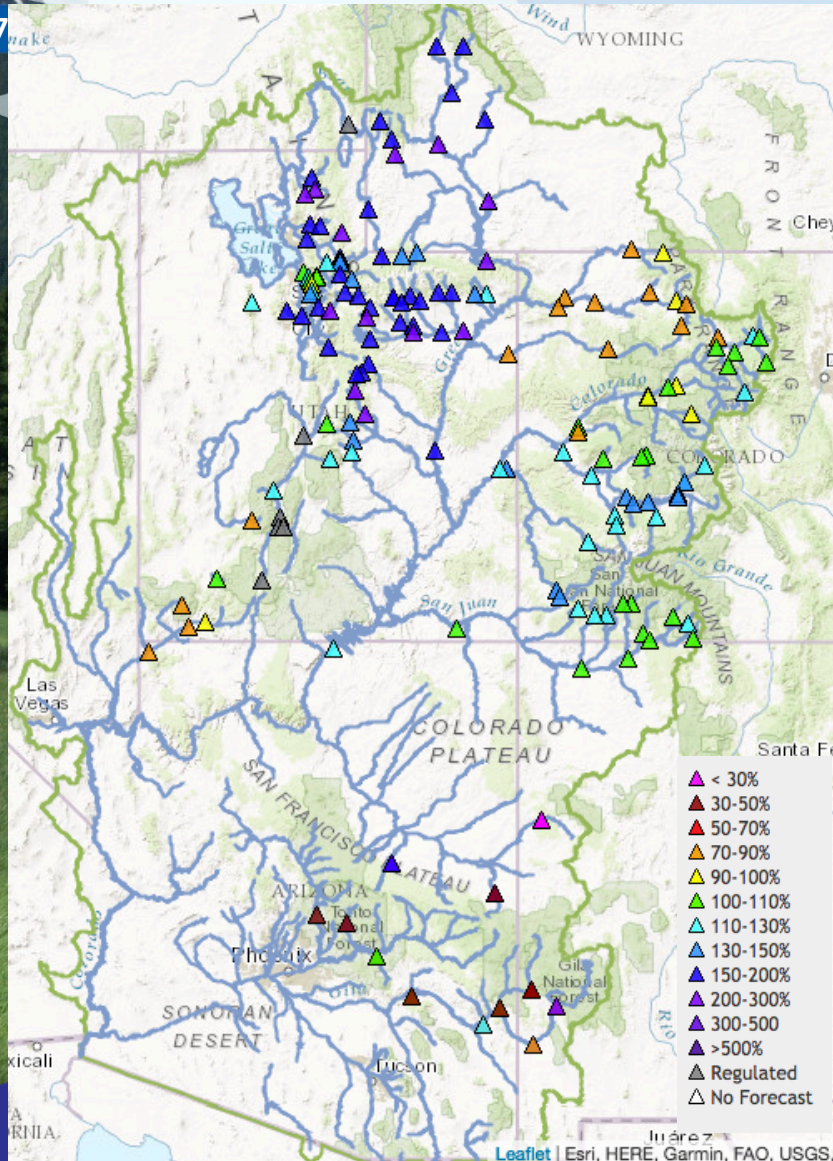
# River Forecast Centers

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- WFOs are a key stakeholder
  - WFOs issue Flood watches and warnings based on RFC guidance
  - Flexible support abilities
  - Provide actionable, risk-based, information
- WFOs coordinate with emergency managers and public in their local areas



# Water Supply Forecasts



- Probabilistic, volume forecasts
- Updated daily, with monthly “official” forecasts
- Monthly and seasonal time steps
- 1 – 5 years into the future
- Used by Reclamation in reservoir operations model, and other water managers



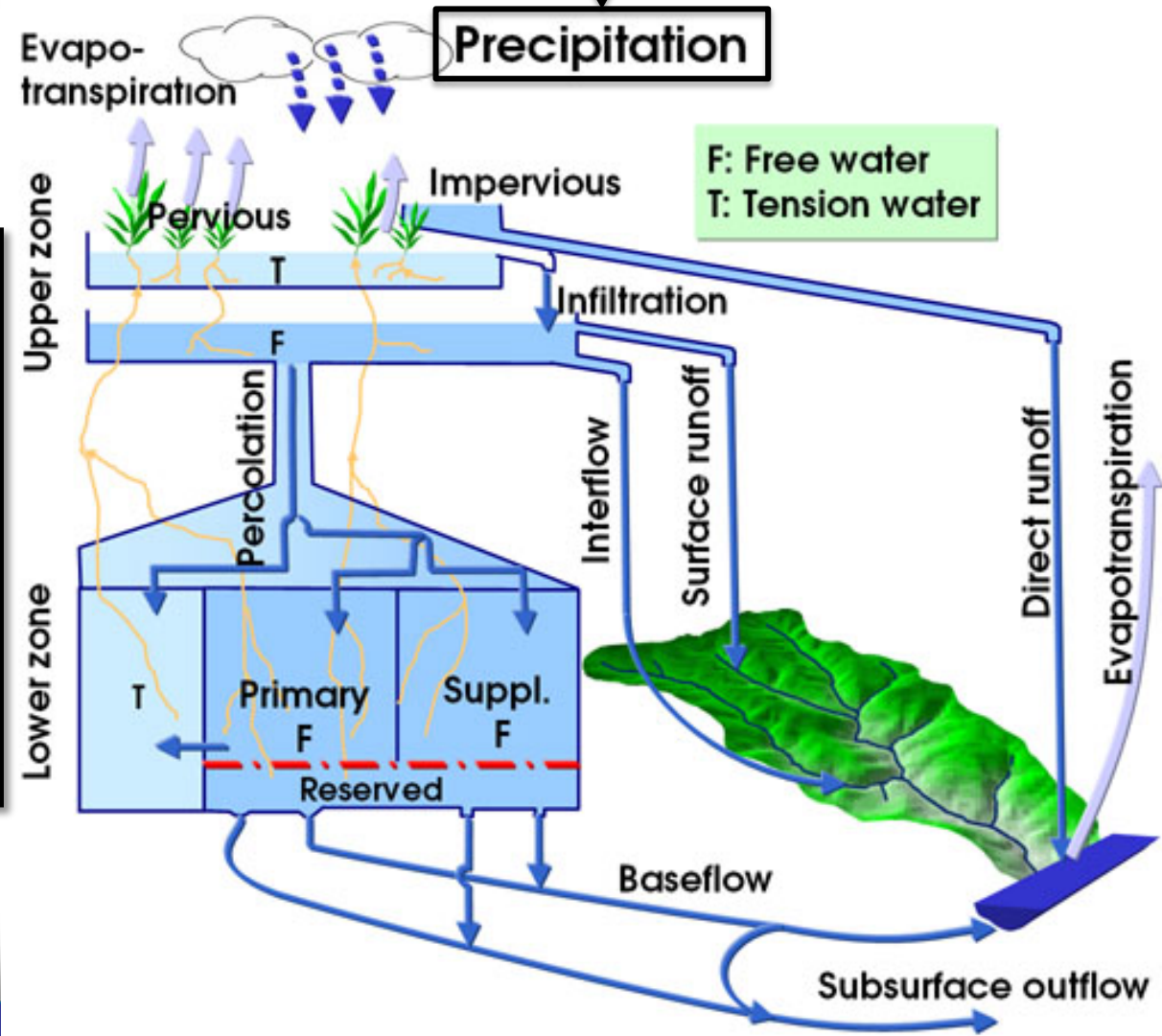
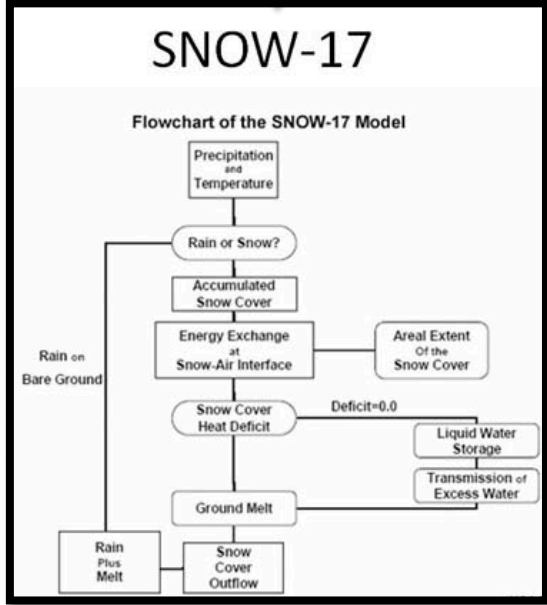
# Products and Services

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- We use a hydrologic model (Sac-SMA) coupled with a snow accumulation and ablation model (SNOW-17) to develop forecasts
  - Calibration is highly dependent on gage observations
  - Calibrations vary between RFCs, so make sure you contact your RFC of interest for more details!



# Our models



# Gage Data is Vital

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Gage data is really at the heart of what we do. Quality data allows us to make accurate forecasts; without it, our forecasts have significantly more uncertainty

We spend a significant amount of time on data quality control

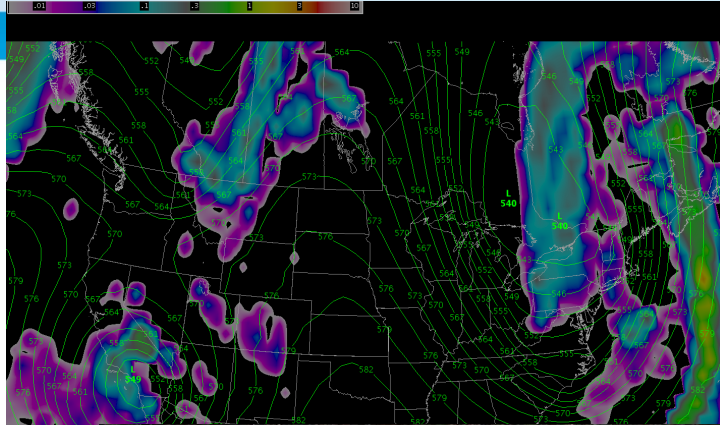




# Forecast Data is Vital

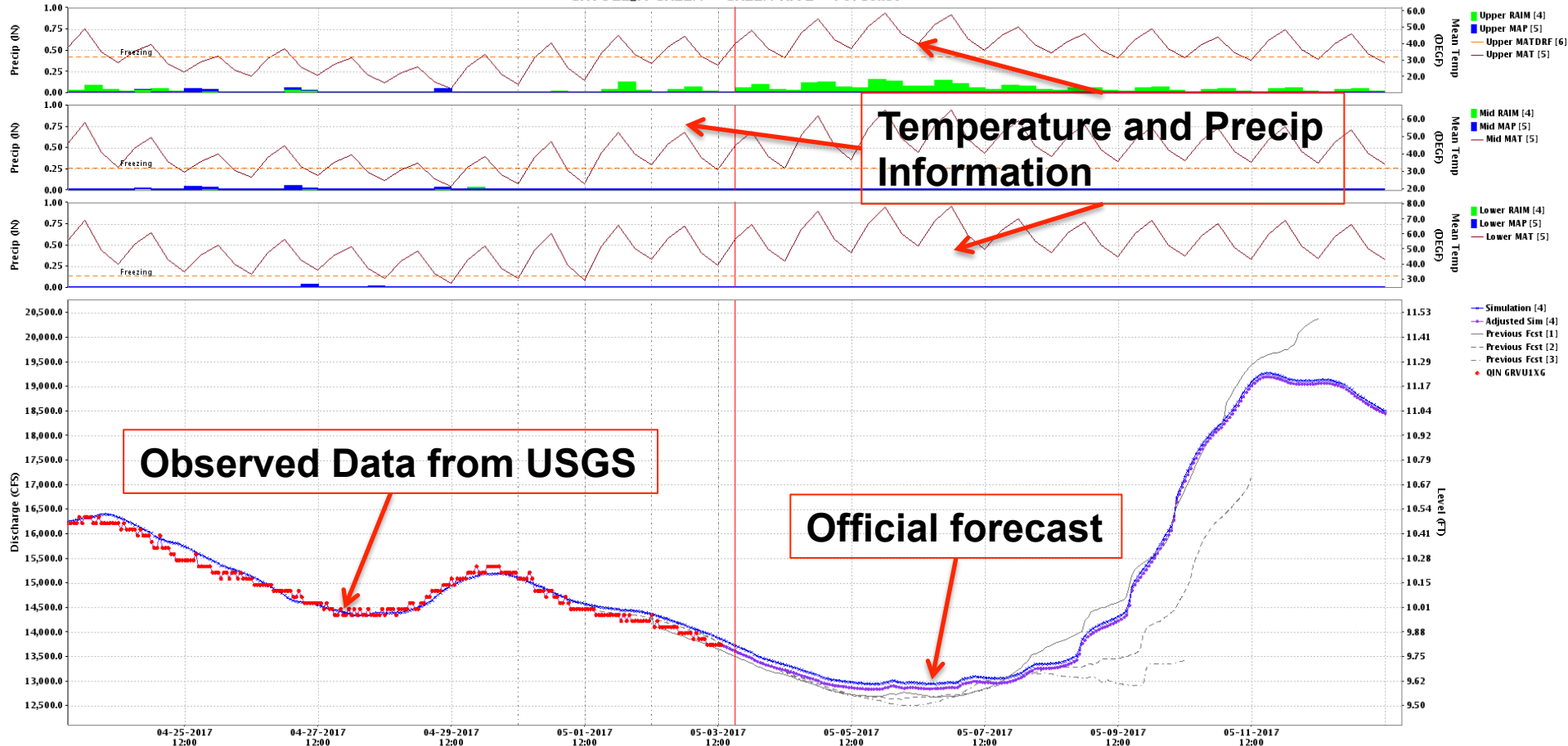
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- Short term skill limitations
  - Dependent on skill in weather forecast
  - Knowledge of planned operations (e.g., reservoir operations and use)



# Developing a Forecast

GRVU1L\_F: GREEN - GREEN RIVE - Forecast



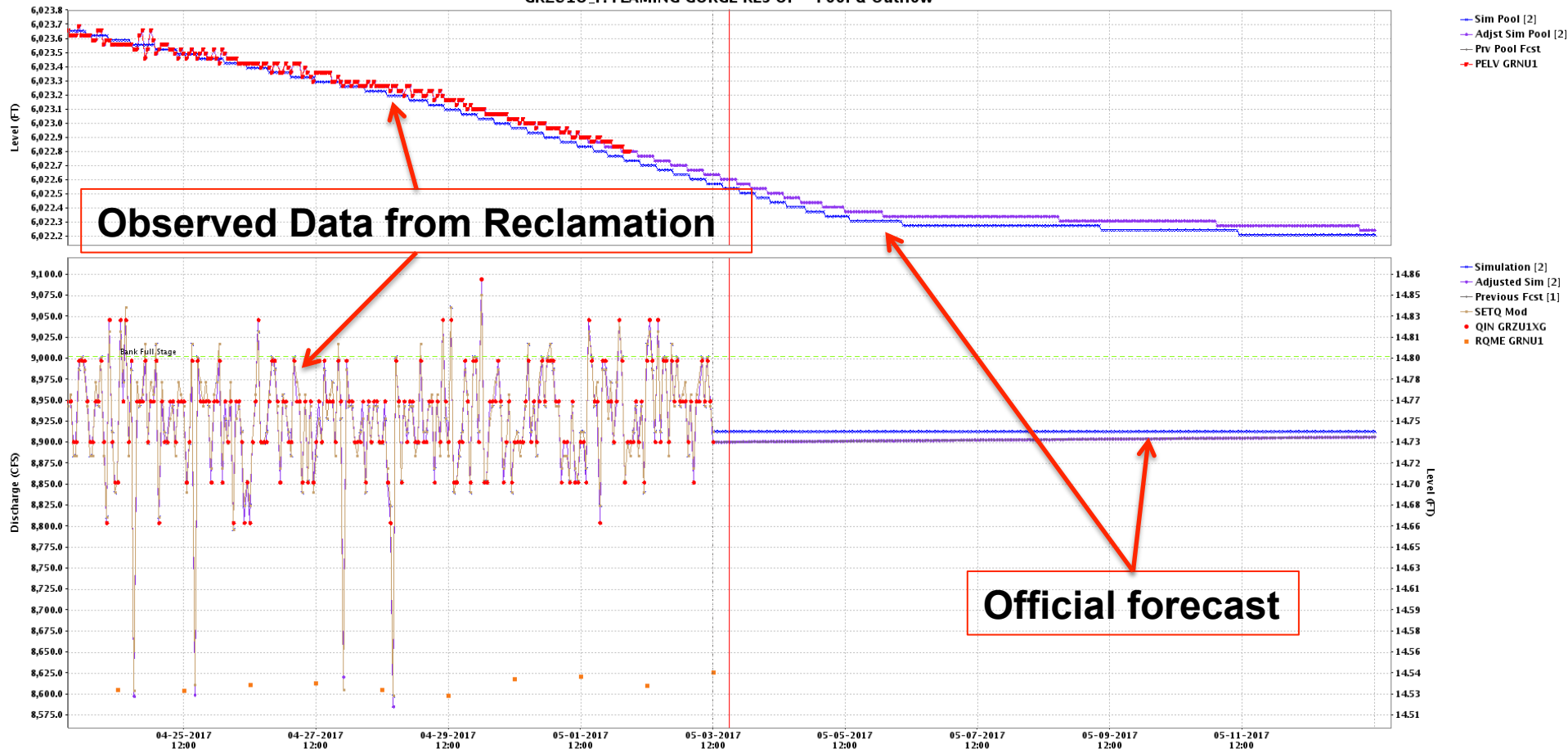
External: [1] 05-02-2017 12:00:00 GMT [2] 05-01-2017 12:00:00 GMT [3] 04-30-2017 12:00:00 GMT GREEN\_Approved\_Forecast: [4] Green 05-03-2017 12:00:00 GMT Current MergeScalars\_Forecast: [5] pi\_service\_run 05-03-2017 12:00:00 GMT Current Compute DRF TAD: [6] 05-03-2017 12:00:00 GMT Current



# Developing a Forecast

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GRZU10\_F: FLAMING GORGE RES OP - Pool & Outflow





# Developing a Forecast

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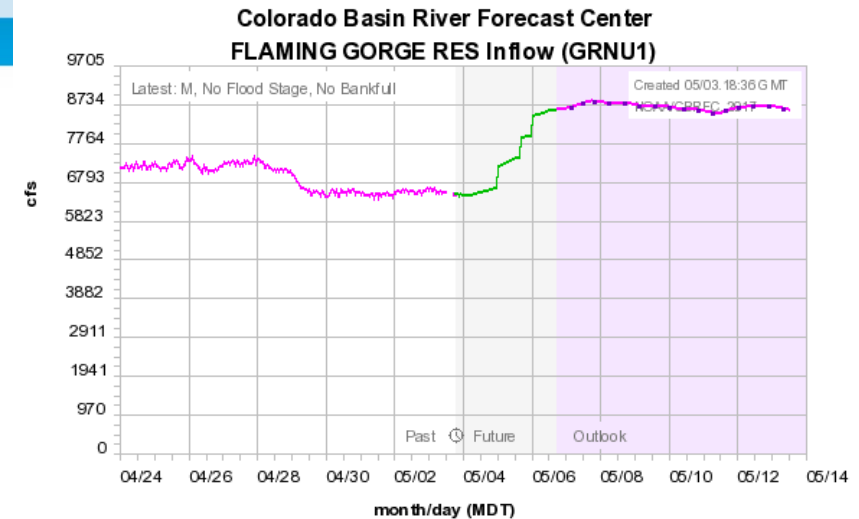
- Forecasters analyze historical and future precipitation and temperature information
- Utilize observations to assess model performance
- Make any adjustments (snow, diversions, etc...). We refer to these as “modifications” or “mods”
- This is done at least once per day



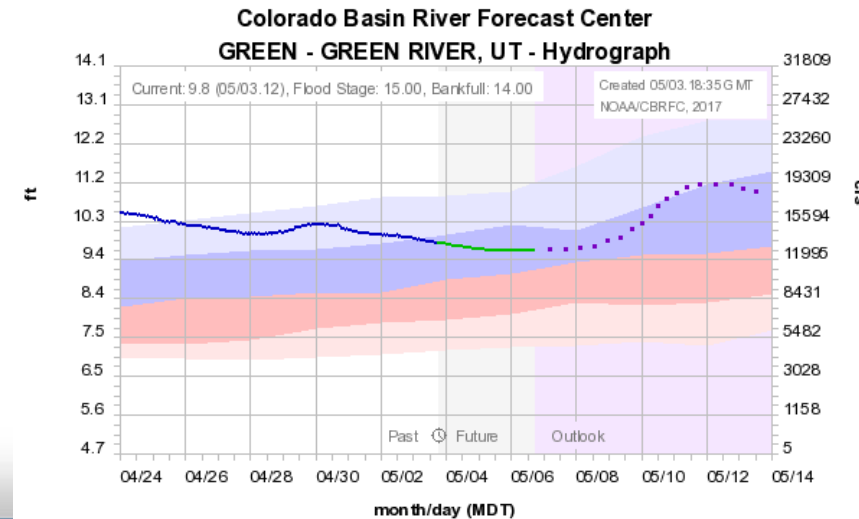
# Developing a Forecast

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- Products are published to our websites and communicated to stakeholders in a variety of ways
- Information provided by each RFC is presented slightly differently, but generally available!



Observed — Simulated — Forecast (05/03. 14:00) — Outlook (increasing uncertainty) ••  
Historical Exceedance Probability (USGS): 90-75% 75-50% 50-25% 25-10%

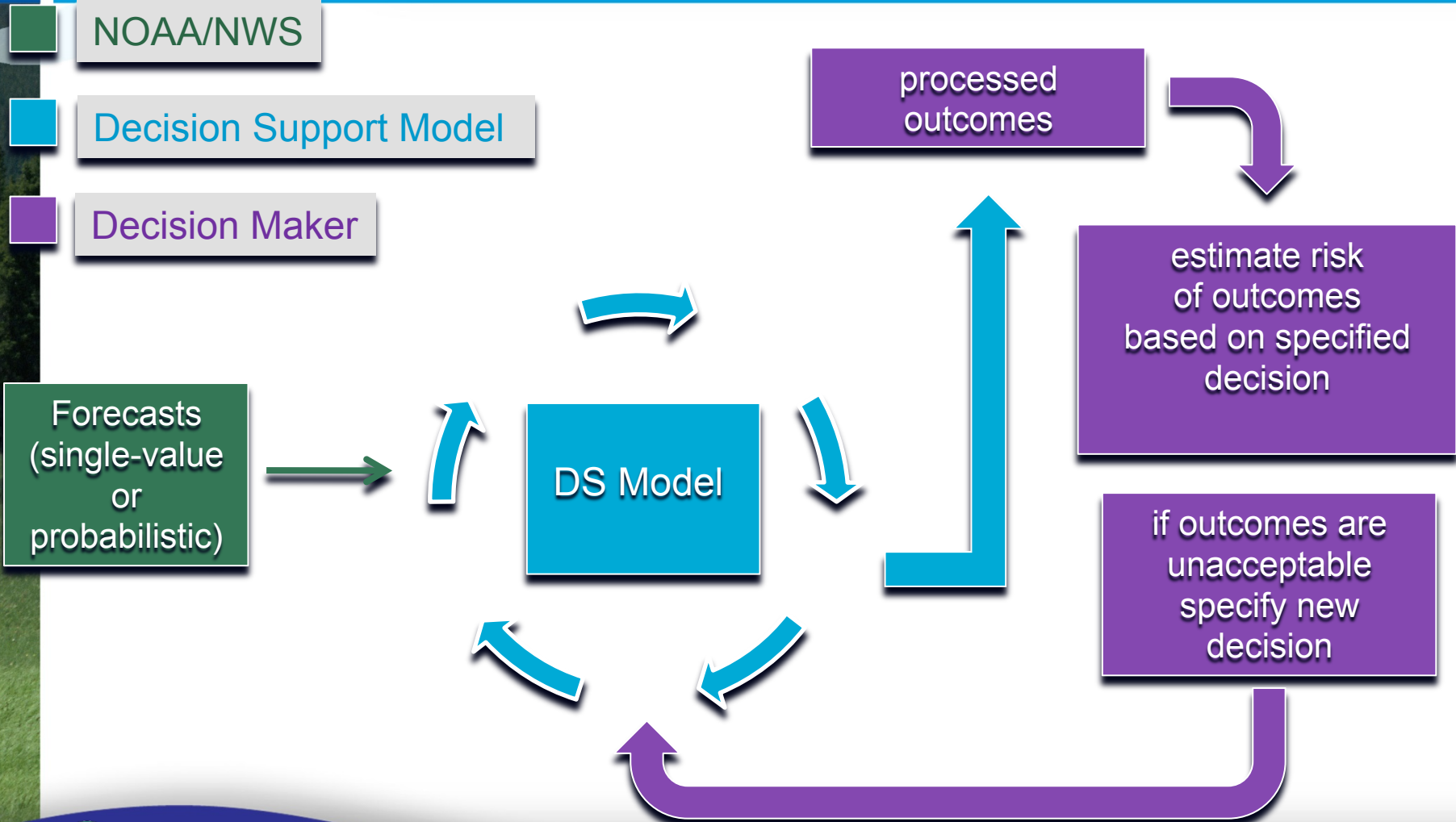


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# Roles of Forecasts in Decision Support

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# Role of Forecasts in Decision Support Typical Reservoir Operations

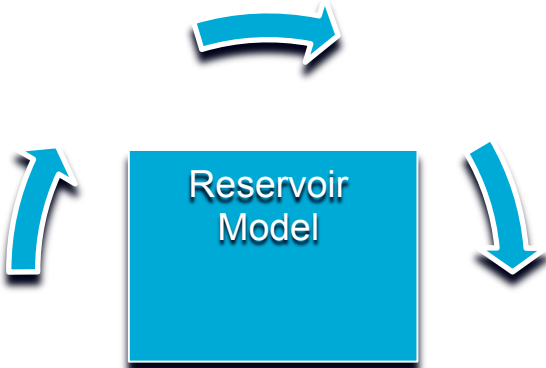
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NOAA/NWS

Decision Support Model

Decision Maker

Reservoir Inflow Forecasts

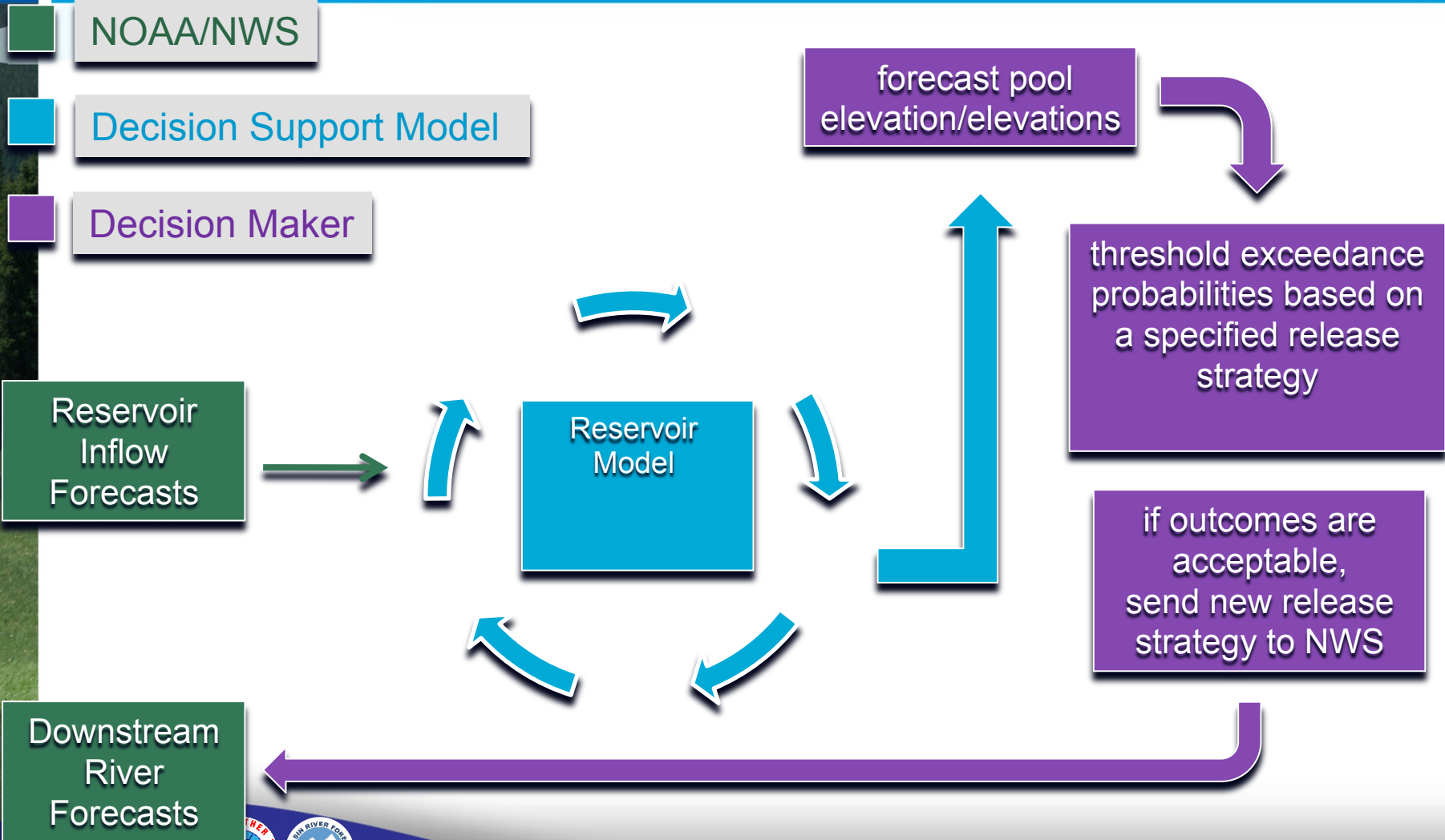


forecast pool elevation/elevations

threshold exceedance probabilities based on a specified release strategy

if outcomes are unacceptable specify new release strategy

# Role of Forecasts in Decision Support for Reservoir Operations



# NWS Role Before Potential Dam Failure

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- WFOs and RFCs are available to contribute to table-top exercises and other planning events





# NWS Role During Potential Dam Failure

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- When there is the potential for a Dam Failure
  - Contact your local WFO immediately. If the relationship isn't there now, let's build it
  - WFO will issue an appropriate watch or warning and coordinate with emergency managers
  - WFO will coordinate with the appropriate RFC to provide support during the incident
  - Disseminate information to public



# Role of RFCs during a Dam Incident and Flash Flooding

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We can provide quantitative estimates based on information we have catalogued in our database – but we need to have the information!

## FLAMING GORGE - UT10121 Dam Catalog Interface

\*\*\* Please refer to this dam's Emergency Action Plan \*\*\*

View: Record | **Model Run** | Maps  
Office Source: **STR**  
Scenario: **High Fast** | High Normal | High Slow | Low Fast | Low Normal | Low Slow | Middle Fast | Middle Normal | Middle Slow  
Cross Section Type: **CBRFC** | OH  
Input Source: **Database** | Custom | Edit Custom  
Output Source: **Database** | Run Model  
Mode: **Test** | Real

```
SLCRMSTR
COLORADO BASIN RIVER FORECAST CENTER
NATIONAL WEATHER SERVICE, SALT LAKE CITY, UTAH
1855 UTC Wed May 03, 2017

** INTERNAL NATIONAL WEATHER SERVICE PRODUCT FOR GUIDANCE PURPOSES ONLY **
FORECASTS BASED ON LATEST SIMPLIFIED DAMBREAK PROG ISSUED BY HRL

!!!!!!THIS IS ONLY A TEST!!!!!!

*** GJT HSA
... DAM BREAK FORECAST ...

FLAMING GORGE on GREEN RIVER

Time and Flood Wave Forecast:

Forecast Distance Time Est Time Depth Peak
Point From to Flood to of
Dam Flood Stage Peak of Flow
(mi) (min) (ft) (min) (ft) (cfs)
-----
DAMSITE 0.00 0 13 10 261 24687782
UT/CO LINE 27.00 37 13 47 228 19606800
```

This is an internal product that we use – not available publicly



# Role of RFCs during a Dam Incident and Flash Flooding



Lake Oroville – Feb 11th 2017

Erosion threatened the integrity of the emergency spillway at Lake Oroville following heavy rains in Feb. 2017

NWS issued a Flash Flood Warning for downstream locations on Feb. 12<sup>th</sup>, 2017

While the NWS has tools for estimating flows and travel times associated with dam breaches, we had no tools for producing such estimates for an emergency spillway structural failure.

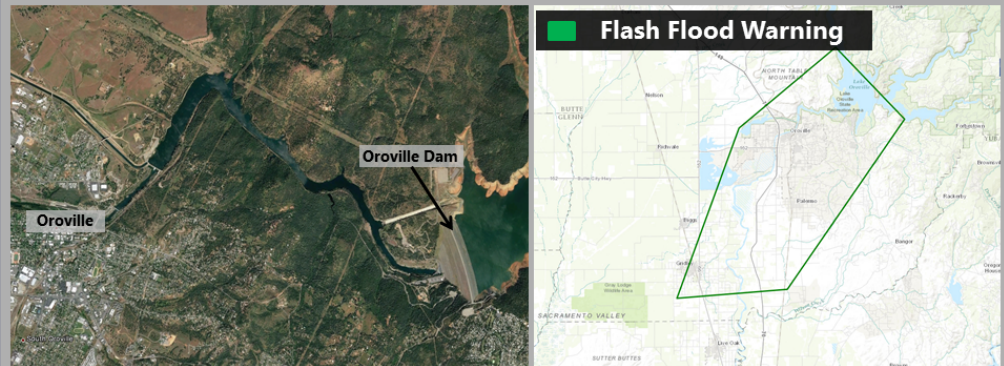


National Weather Service  
Sacramento, CA

## Flash Flood Warning

Until 4:15 PM PST February 13, 2017

Potential Dam Failure for residents in South central Butte County in northern CA



As per CA Department of Water Resources:

- Officials now anticipate a failure of the Auxiliary Spillway at Oroville Dam within the next 60 minutes.
- **Residents of Oroville should evacuate in a northward direction such as towards Chico.**

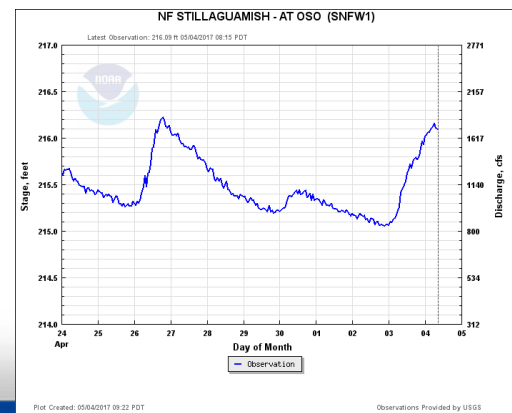
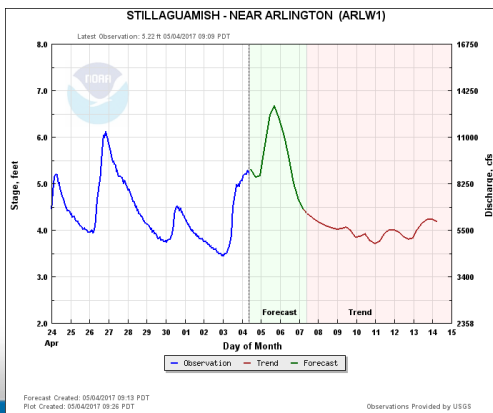




# Role of RFCs After a Dam Incident and Flash Flooding

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- NWS will be heavily involved in post-disaster recovery
  - On site support
  - Localized weather/river forecasts
- RFCs can develop custom products and services to meet stakeholder needs





# National Water Center



## National Water Model

### Improving NOAA's Water Prediction Services



In August 2016, NOAA took a giant leap forward in its ability to forecast the flow of rivers and streams throughout the entire continental United States with the launch of the

new high resolution National Water Model (NWM).

The NWM will enhance and expand NOAA's water flow forecasts, which to date have been available for approximately 4,000 river locations with stream gauges operated by the U.S. Geological Survey. This new model will expand forecasts to 2.7 million stream locations nationwide. Leveraging the full network of nearly 8,000 U.S. Geological Service stream gauges and NOAA's investment in atmospheric modeling, the NWM will provide high-resolution forecasts of soil moisture, surface runoff, snow water equivalent, and other parameters.

We all recognize that water is an essential component of sustainable and resilient communities. But its also a stressed natural resource and potential threat to life, property, and livelihoods during extreme weather events.

#### Improved Water Information Services

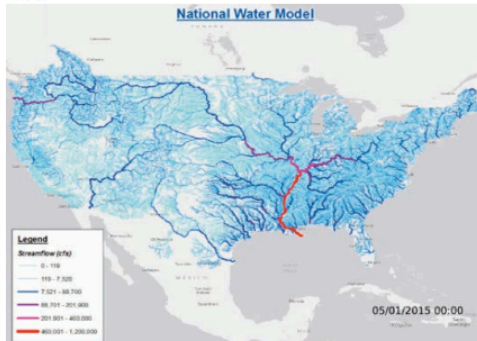
The new NWM improves the National Weather Service's ability to deliver impact-based decision support services nationwide by providing "street level" water information and guidance, as well as serve as the foundation for additional private sector water services. At a minimum, the NWM will immediately provide predictive water information for many locations where none previously existed.

Initially, this new NWM-based information will be particularly useful in headwater areas in support of NOAA's flash flood mission.

#### How it Works

The NWM simulates the water cycle with mathematical representations of the different processes and how they fit together. This complex representation of physical processes such as snowmelt and infiltration and water movement through the soil layers varies significantly with changing elevations, soils, vegetation types and a host of other variables.

Additionally, extreme variability in precipitation over short distances and times can cause the response on rivers and streams to change very quickly. Overall, the processes are so complex that to simulate it with a mathematical model means that it needs a "supercomputer" in order to run in the time frame needed to support decision makers when flooding is threatening.



National Water Model is a new forecasting tool that will help forecasters predict when and where flooding can be expected.

[www.water.noaa.gov](http://www.water.noaa.gov)

### National Water Model Image Viewer

The viewer below has been made available to view the pre-generated imagery depicting output from the National Water Model. For direct access to the imagery shown in the viewer, visit the following location: [http://www.noahrs.noaa.gov/pub/staff/keicher/WRFH\\_ppd/web/static\\_images/](http://www.noahrs.noaa.gov/pub/staff/keicher/WRFH_ppd/web/static_images/)

Dataset: Stream Flow Forecast Type: Long Range

5.0 s Apply

2016-09-09 06:00:00 UTC	2016-09-09 06:00:00 UTC
2016-09-09 12:00:00 UTC	
2016-09-09 18:00:00 UTC	
2016-09-10 00:00:00 UTC	
2016-09-10 06:00:00 UTC	
2016-09-10 12:00:00 UTC	
2016-09-10 18:00:00 UTC	
2016-09-11 00:00:00 UTC	
2016-09-11 06:00:00 UTC	
2016-09-11 12:00:00 UTC	
2016-09-11 18:00:00 UTC	
2016-09-12 00:00:00 UTC	
2016-09-12 06:00:00 UTC	

# Conclusions

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- RFCs can be a great resource and partner for your agency, and can provide information to drive your decision support tools
- Regarding dam safety
  - Can provide quick, quantitative values if information is available
  - Highly dependent on data and current EAPs
  - Engage your WFO and RFC to identify gaps, if any, and work to fill them





# Contact Us!

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CBRFC – Paul Miller: [paul.miller@noaa.gov](mailto:paul.miller@noaa.gov)

If you are interested in another region, contact me and I'll get you in touch with the right person

