An Overview of New and Upcoming Water Prediction Services from the NWS

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Topics Covered

Review of current NWS Hydrologic Information

- HEFS
- AHPS
- NWM

Future Hydrologic Application: NWPS (National Water Prediction Services)

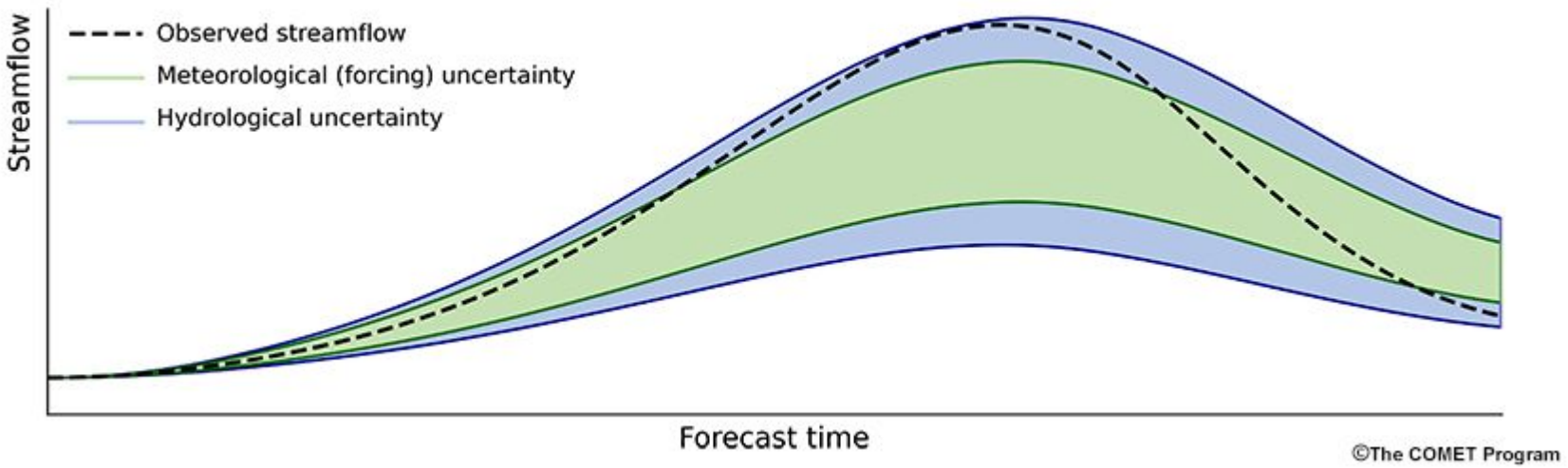
- Features and Functionality
- FIM (Flood Inundation Mapping) IDSS Services
- Proposed Timeline

HEFS (Hydrologic Ensemble Forecast Service)

What is HEFS?

- Probabilistic river level guidance that uses 10 days of forecast temperatures and precipitation, as well as current water levels, soil conditions, snowpack information (as needed), and recent precipitation.
- Uses multiple (50+) runs of the river model with variable weather scenarios to produce a range of possible river stage and/or flow outcomes.
- These outcomes are arranged into percentiles that can help determine confidence in reaching certain river levels (most likely, likely, least likely).
- HEFS is updated twice per day, and is available for most standard NWS forecast points.

HEFS (Hydrologic Ensemble Forecast Service)



HEFS (Hydrologic Ensemble Forecast Service)

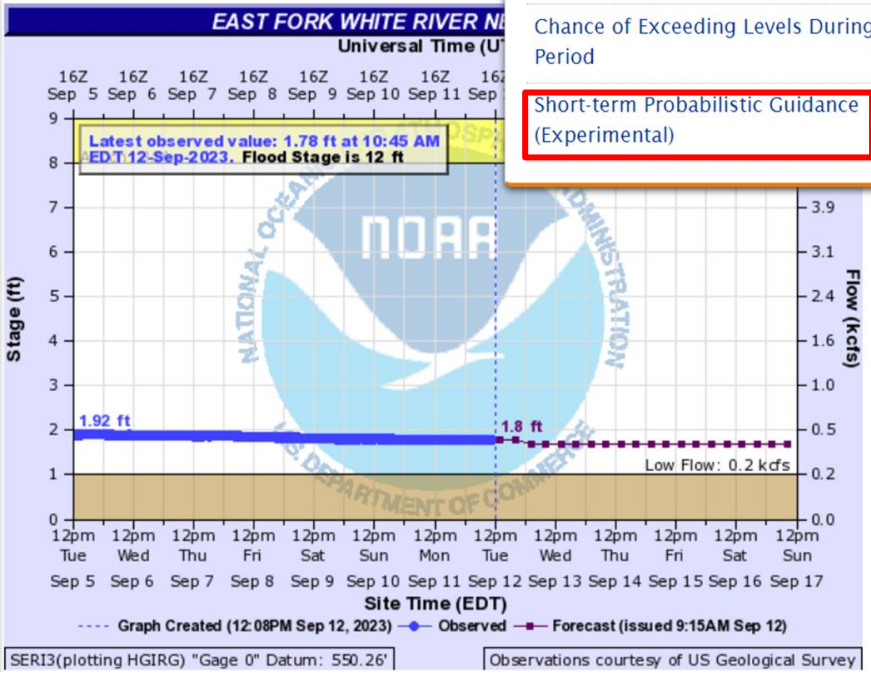
Weather Forecast Office Indianapolis, IN

Ohio River Forecast Center

Hydrograph | River at a Glance | Download | Probability Information

Auto Refresh: OFF

- Weekly Chance of Exceeding Levels
- Chance of Exceeding Levels During Entire Period
- Short-term Probabilistic Guidance (Experimental)



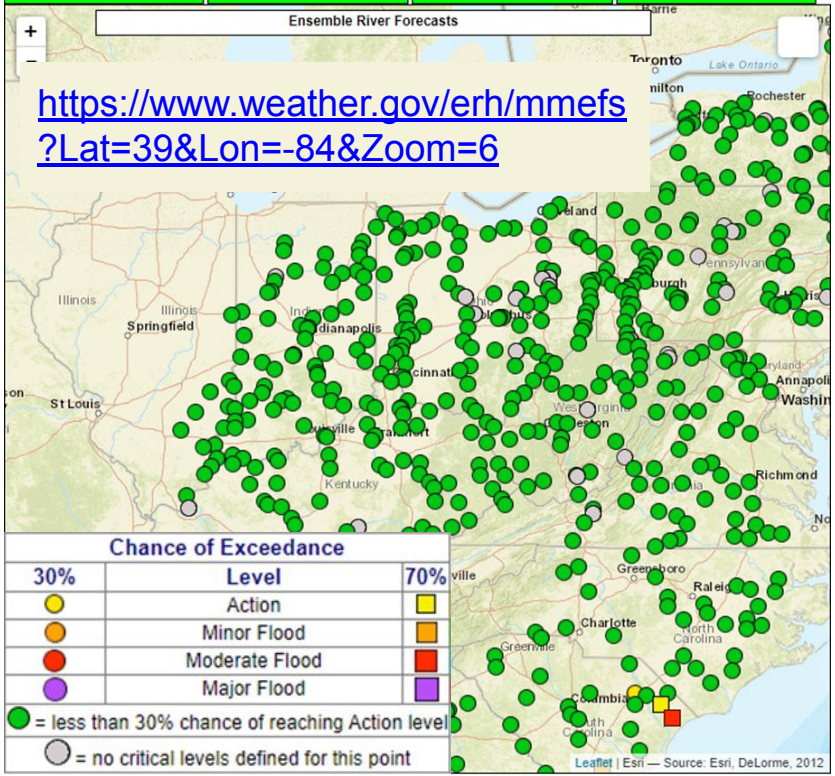
GEFS | NAEFS | HEFS

Product Description Document | Data in KML format | Data in table format | Recorded Training

What's the difference between the Official River Forecast vs. HEFS vs. MMEFS?

"How to Interpret the Hydrologic Ensemble Forecast Service (HEFS) Short-Term Probabilistic Guidance" training materials at COMET (free registration required)

MARFC Status & News | NERFC Status & News | OHRFC Status & News | SERFC Status & News



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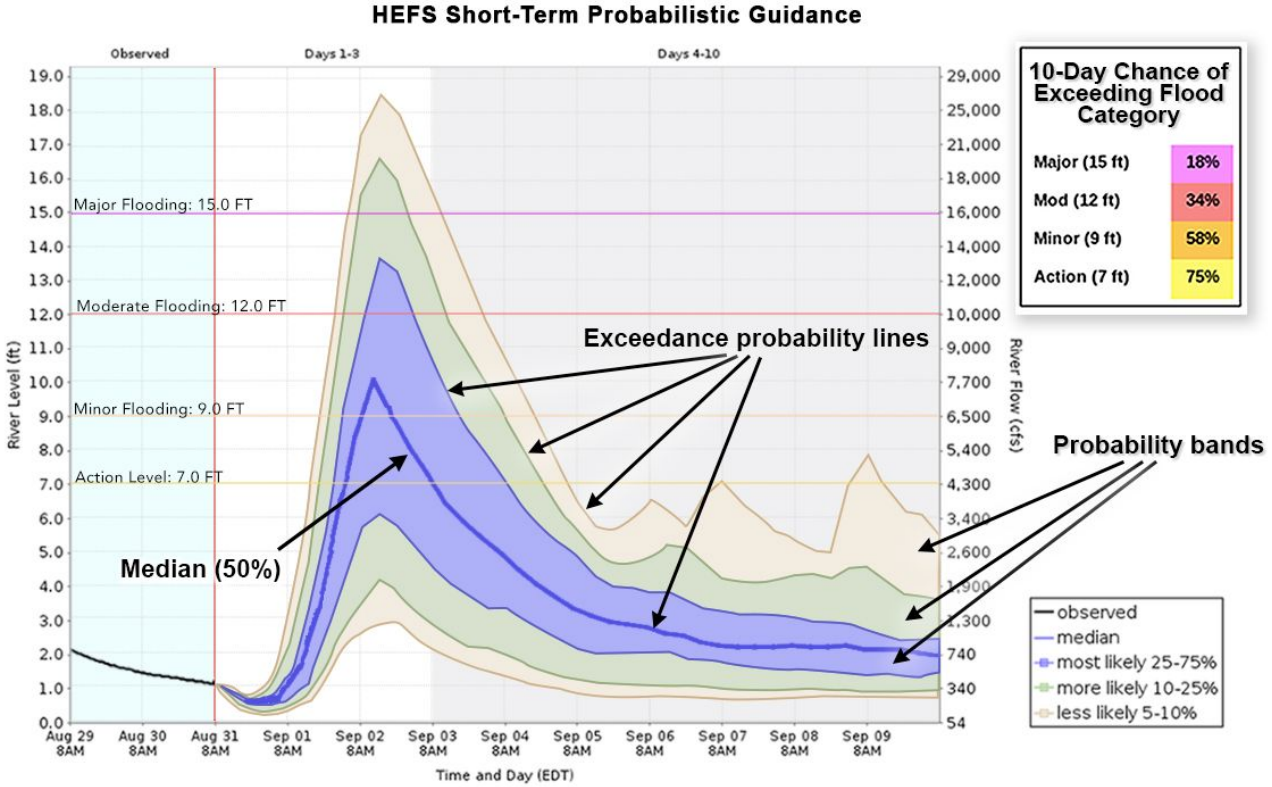
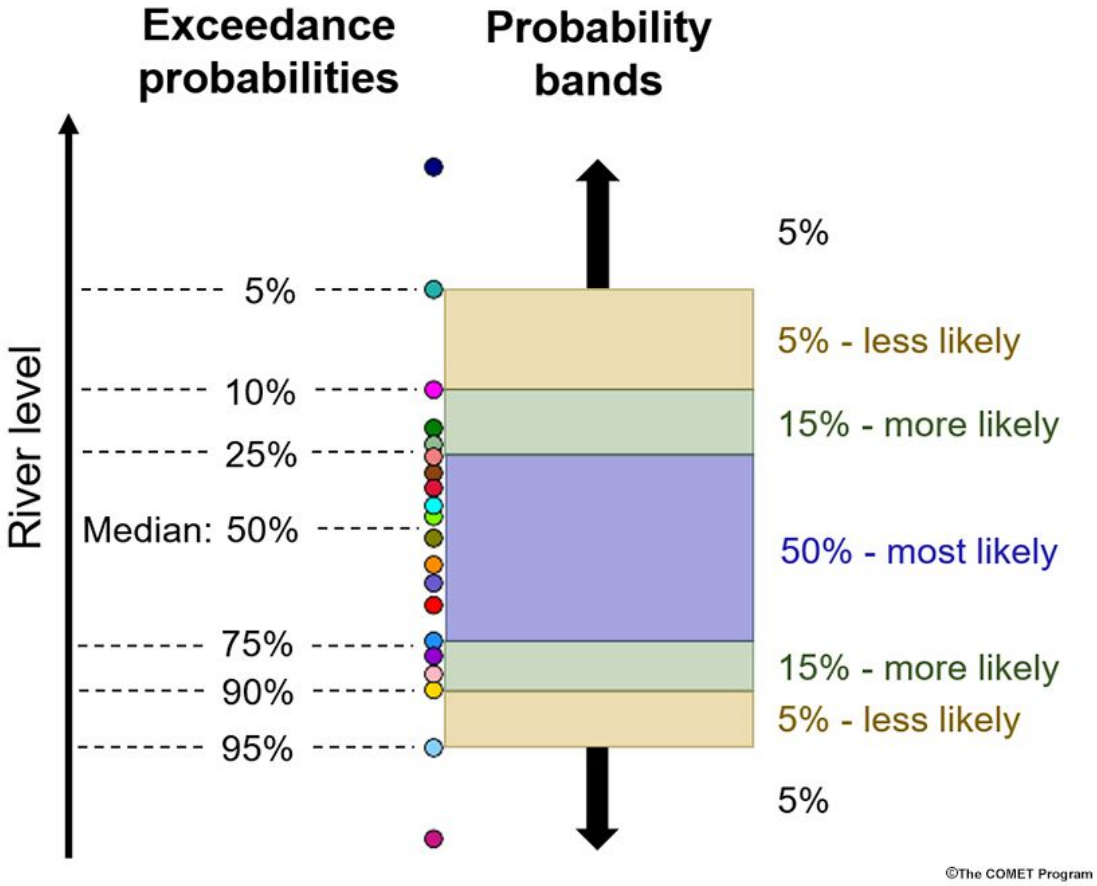


Focus on the **blue shaded area** for the most likely outcome.

HEFS (Hydrologic Ensemble Forecast Service)



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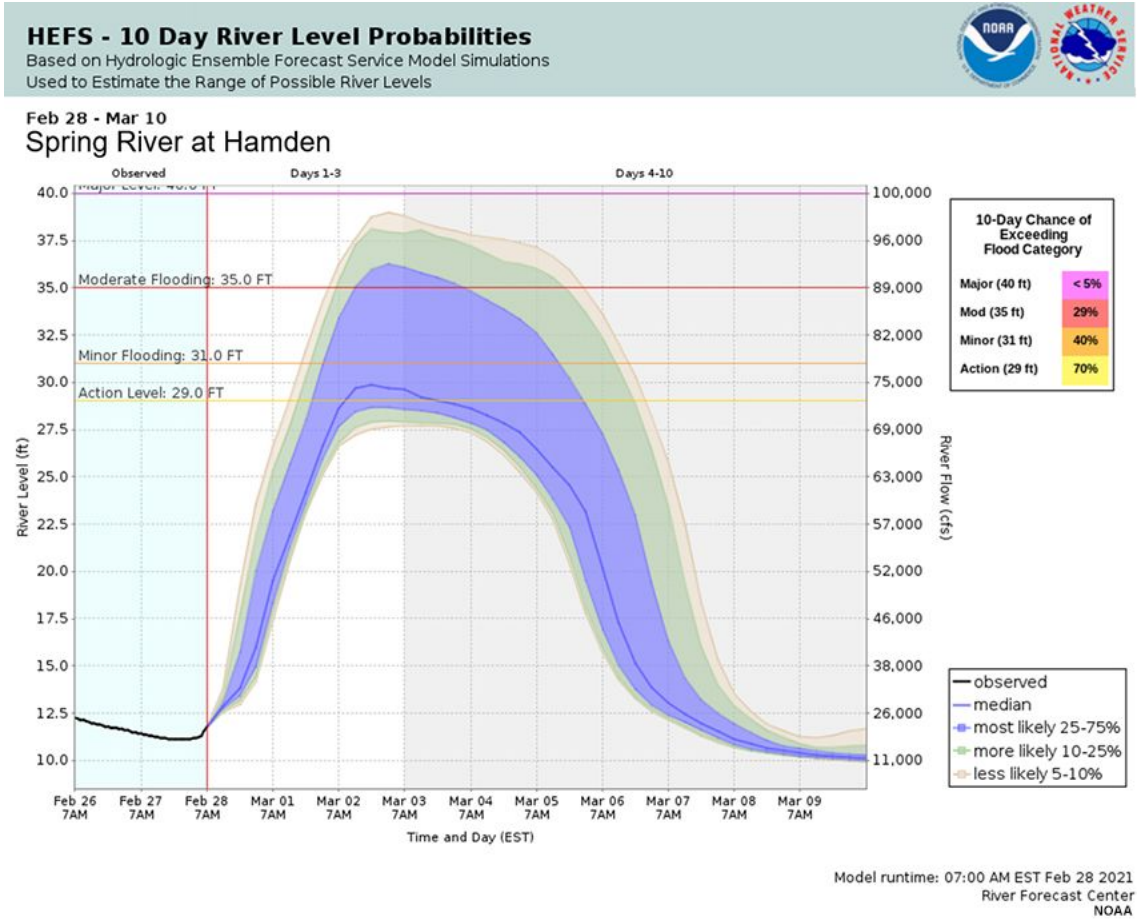


Use HEFS for:

- A range of possible river levels 24-48 hrs.
- Planning >48 hrs out from an event.
- Confidence:
  - Narrower the color band = small range of solutions = greater confidence
  - Wider the color band = large range of solutions = lesser confidence

HEFS (Hydrologic Ensemble Forecast Service)

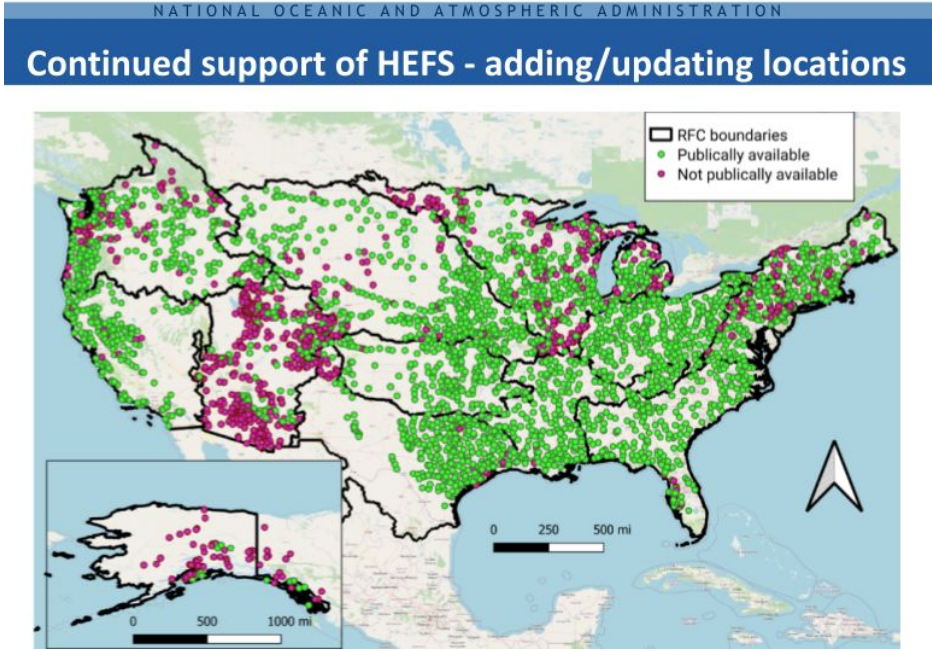
Differences between Official RFC Forecasts and HEFS Guidance:

OFFICIAL FORECAST	PROBABILISTIC GUIDANCE (HEFS)
Typically Includes 48 hours of forecast precipitation, depending on season and situation (24 to 72)	Includes 10 days of model forecast precipitation
Forecast model with hydrologist QC and oversight	Raw model output with no human intervention or QC
Issued twice per day as needed, can be updated anytime	Issued twice per day, no updates
Shows single deterministic forecast	Shows range of possible outcomes, though actual crest may still be outside of highest/lowest

HEFS Status (and Future Plans)

- HEFS v1 implementation completed May 2023
  - HEFS configured, validated, and output graphics displayed on AHPS and regional RFC web pages

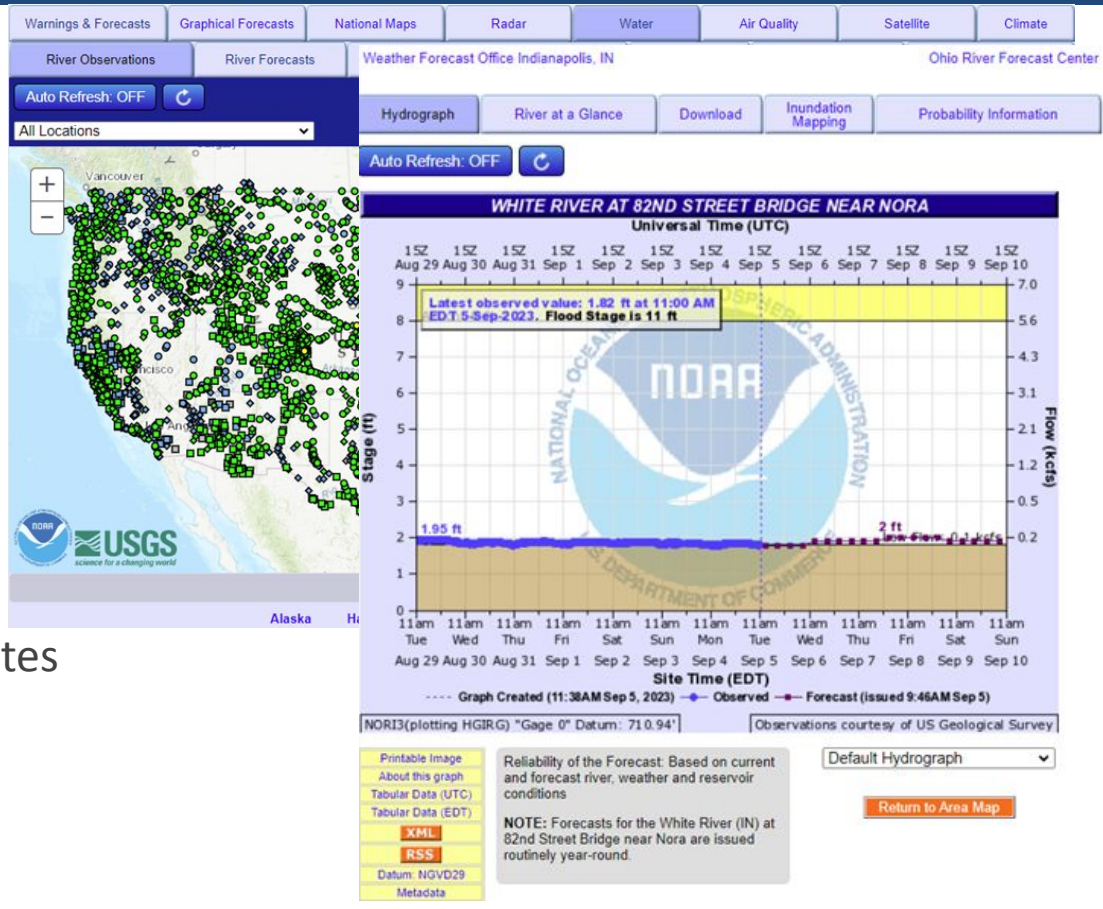
- Work ongoing to prioritize development activities for HEFS v2



Current NWS Advanced Hydrologic Prediction Service Page (AHPS)

- Main portal for NWS river forecasts
  - water.weather.gov

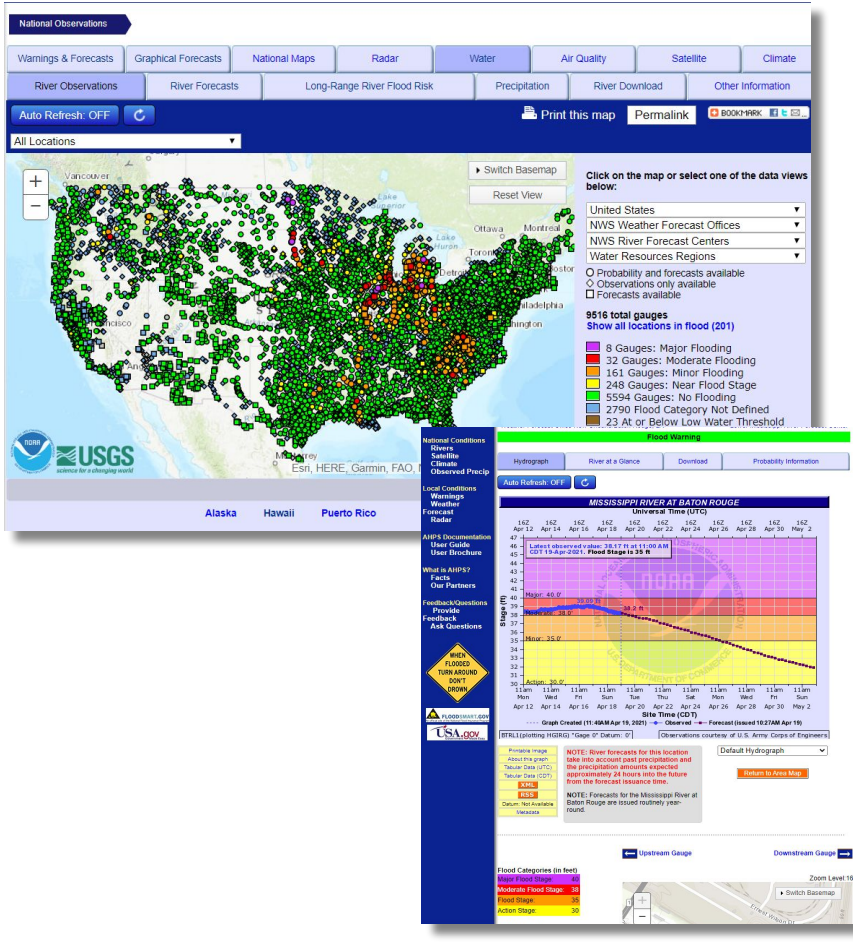
- Main Functions
  - Near Real-Time River Data and Forecasts
  - Probability of Exceedance Data
  - Static FIM Libraries
  - Quantitative Precipitation Estimates
  - Data download



Moving to the National Water Prediction Service (NWPS)

Why Transition AHPS → NWPS?

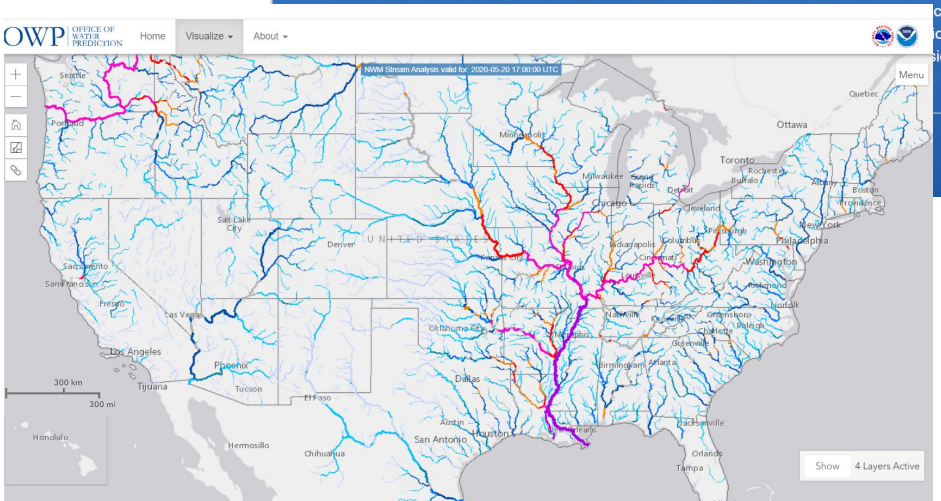
- NWS is developing a ***new*** gateway to water resources forecasts and information on the web, the **National Water Prediction Service (NWPS)**
- The NWS river observations and forecast display, the Advanced Hydrologic Prediction Service (AHPS), has been in use since the late 1990s.
- The legacy AHPS has been rewritten to bring its web functionality into modern, efficient, and mobile-friendly web code.



Office of Water Prediction (OWP) Webpages

- **Main point of public access for the National Water Model (NWM) :**
  - *Experimental/Developmental* Weather Model to River Model continuous forecast
  - water.noaa.gov

- **Main Functions**
  - Interactive map for NWM access
  - Image Viewer for NWM output
  - General information
    - National Water Center
    - National Water Model
    - Flood Inundation Mapping



National Water Model (NWM)

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

National Water Model 2.1: Cycling Overview

Lookback Range 3-28 hrs

New for V2.1…open loop (non-DA) members

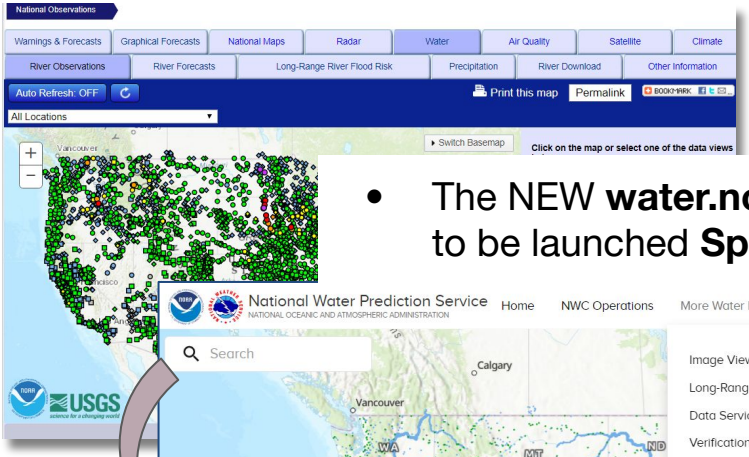
18 Hour Forecast

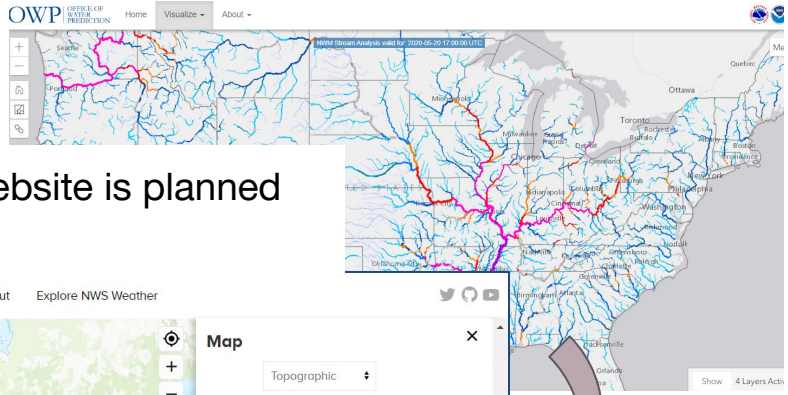
~10 Day Ensemble Forecast

New for V2.1…open loop (non-DA) member

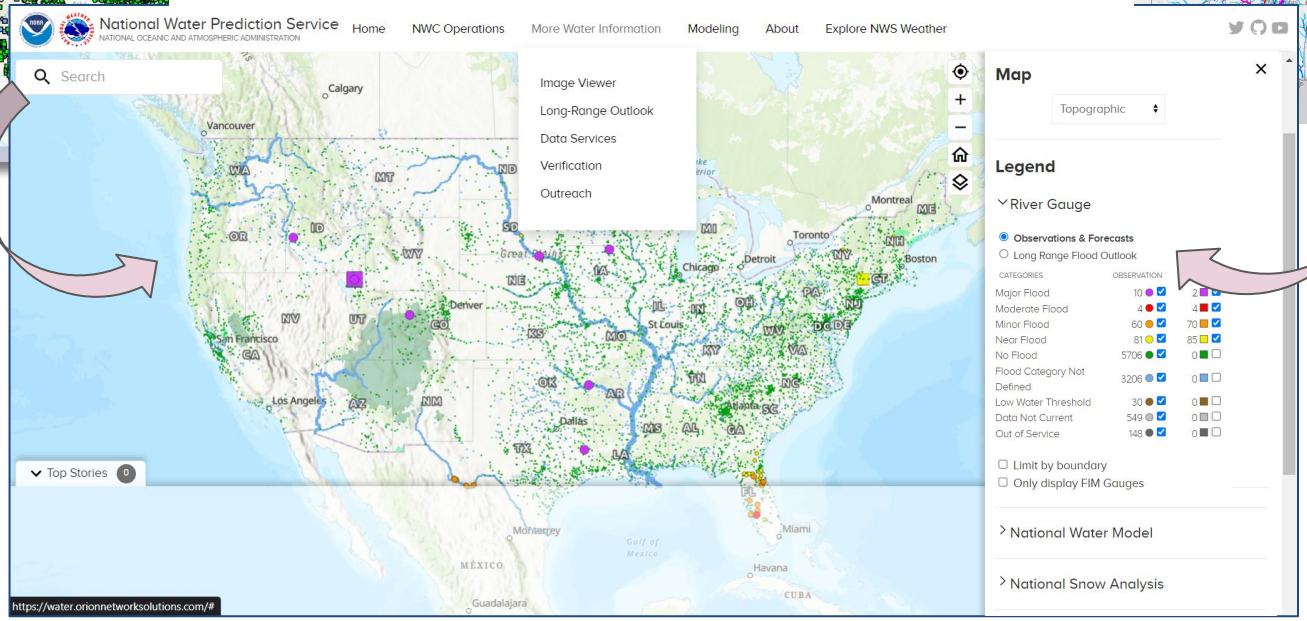
30 Day Ensemble Forecast

Moving to the National Water Prediction Service (NWPS)





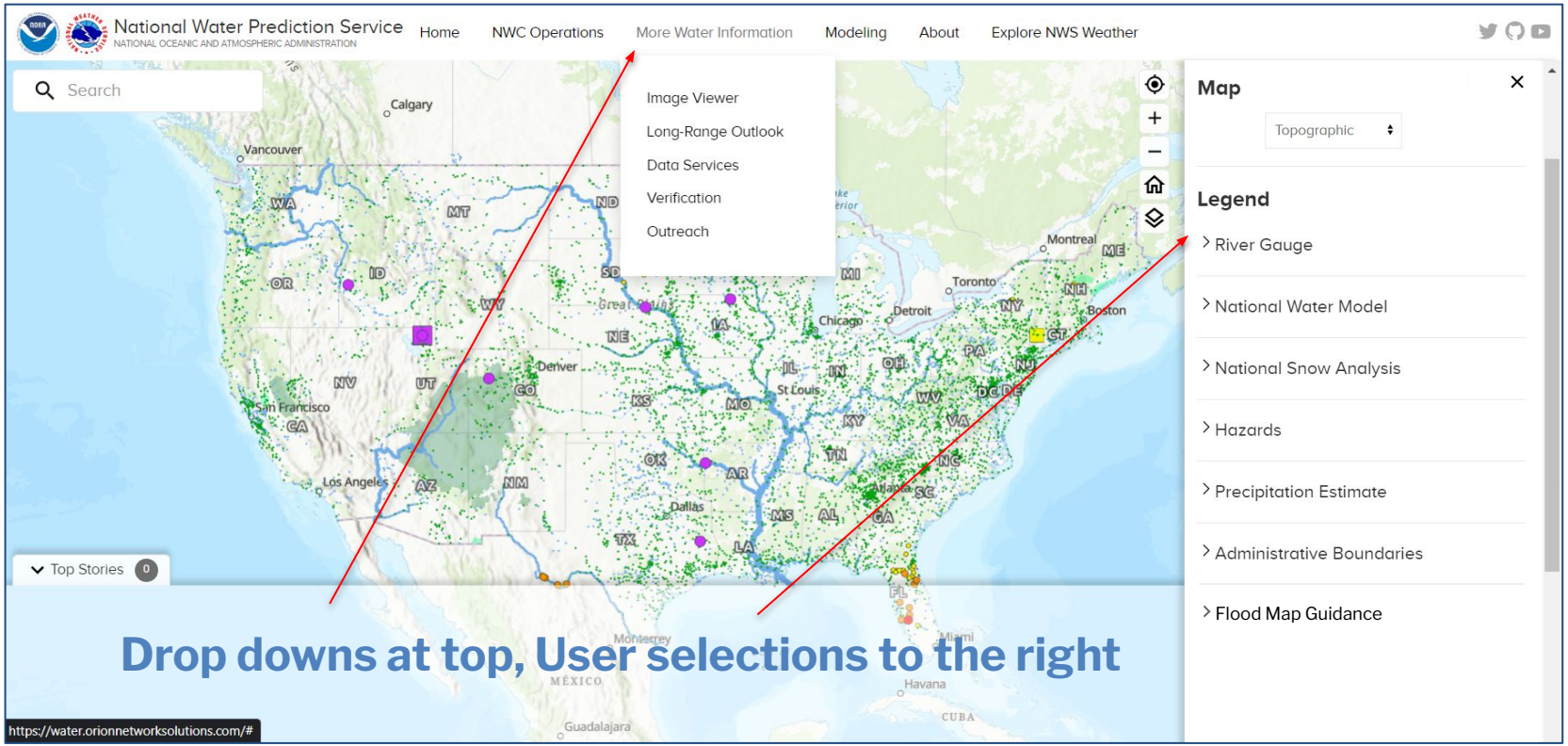
- The NEW **water.noaa.gov** website is planned to be launched **Spring 2024**



https://storymaps.arcgis.com/stories/fce72e9168a7402dbfc49fc5b49cee2e

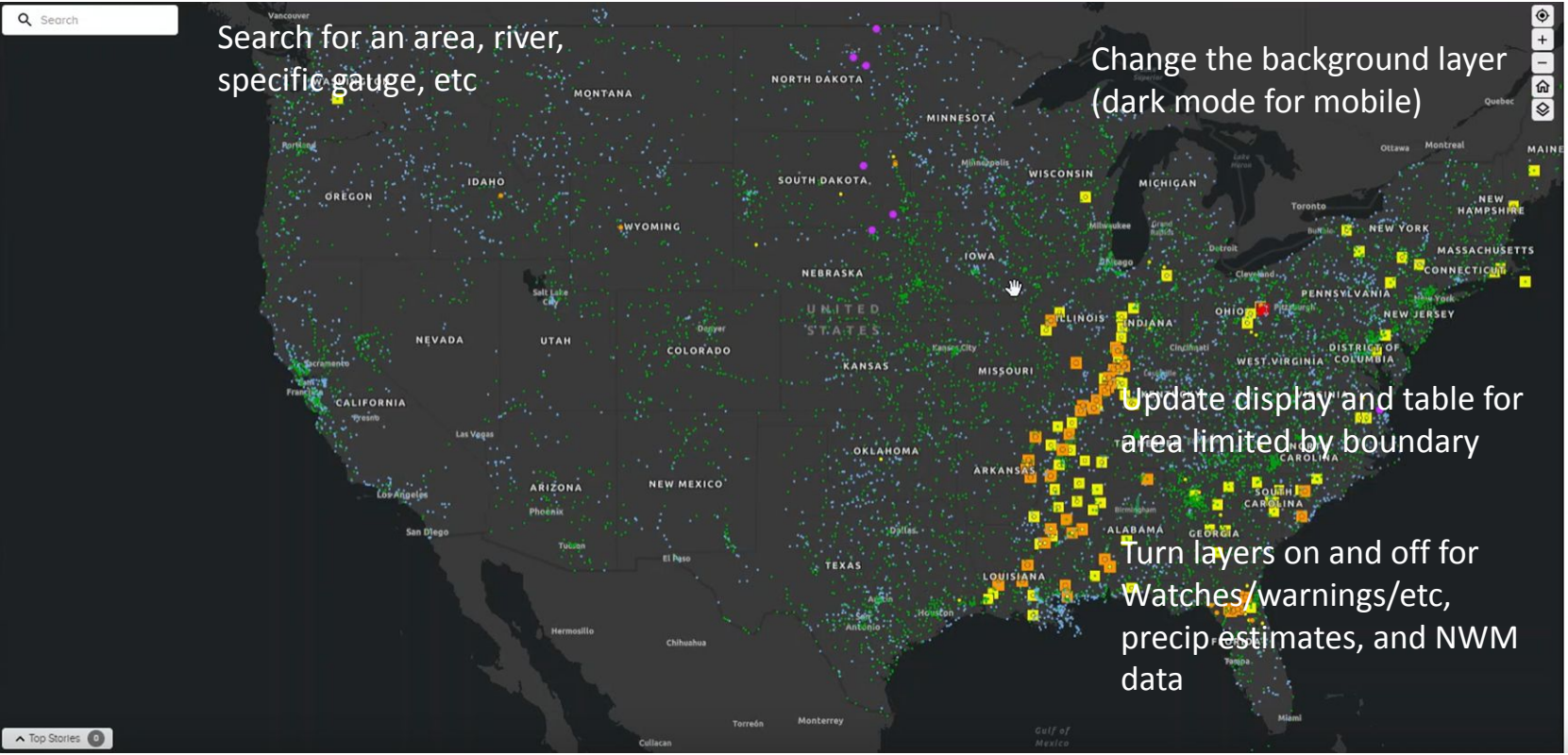
Storymap Direct Link

National Water Prediction Service (NWPS)



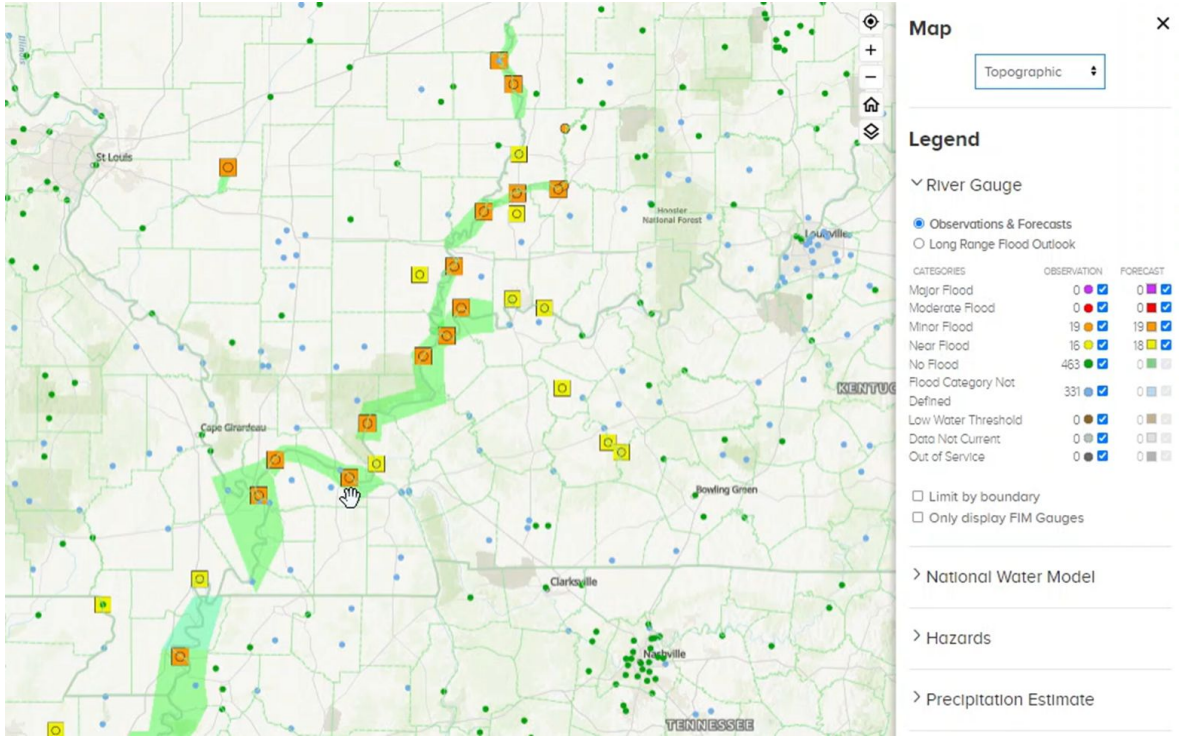
Final look/feel still under development, with changes possible.

New Functionalities with NWPS



New Functionalities with NWPS

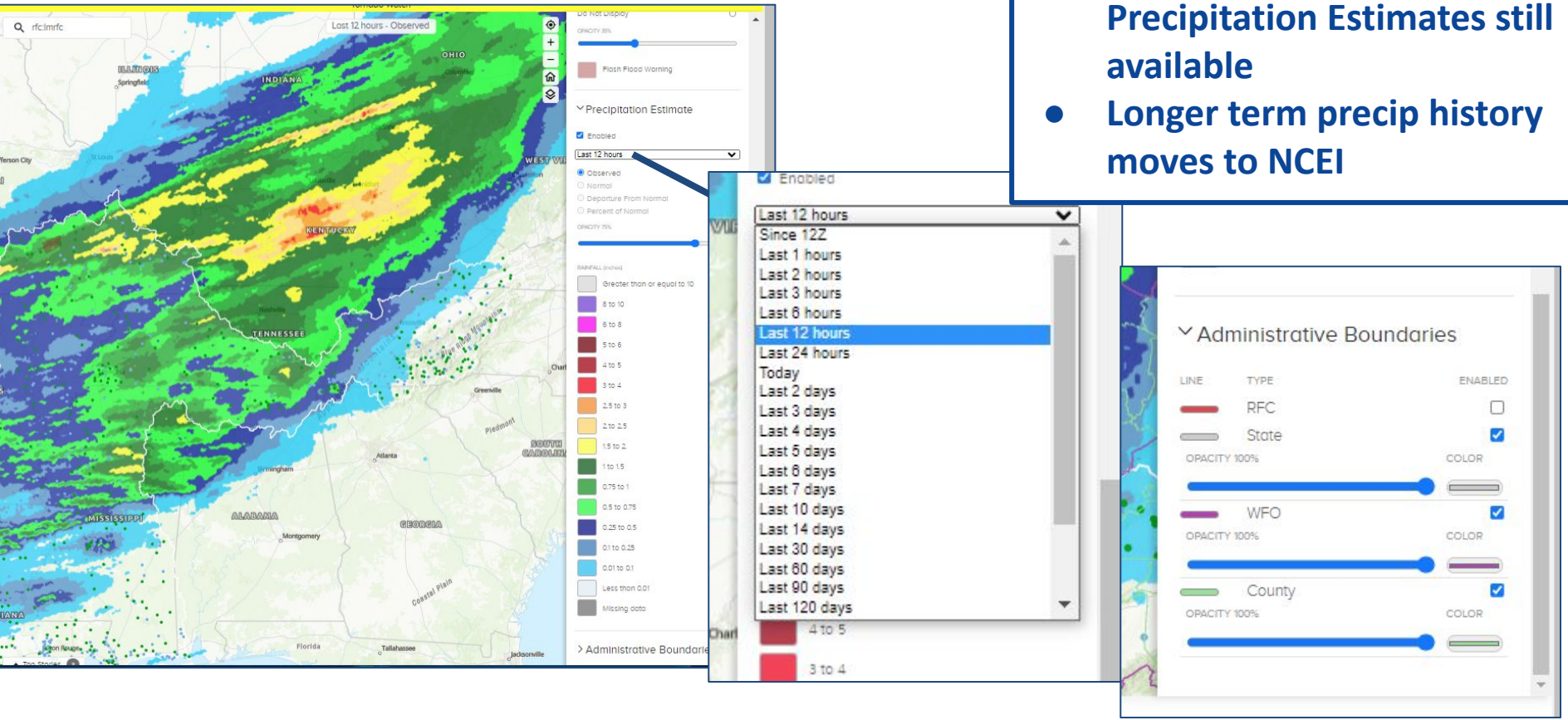
- Observations (inner circle) and Forecasts (outer square) on same map
- Can turn each flood category on/off (ie filter for only moderate and major flooding and only see those symbols on the map
- In this example, flood warnings are turned on as well. Can click on them to see the warning product



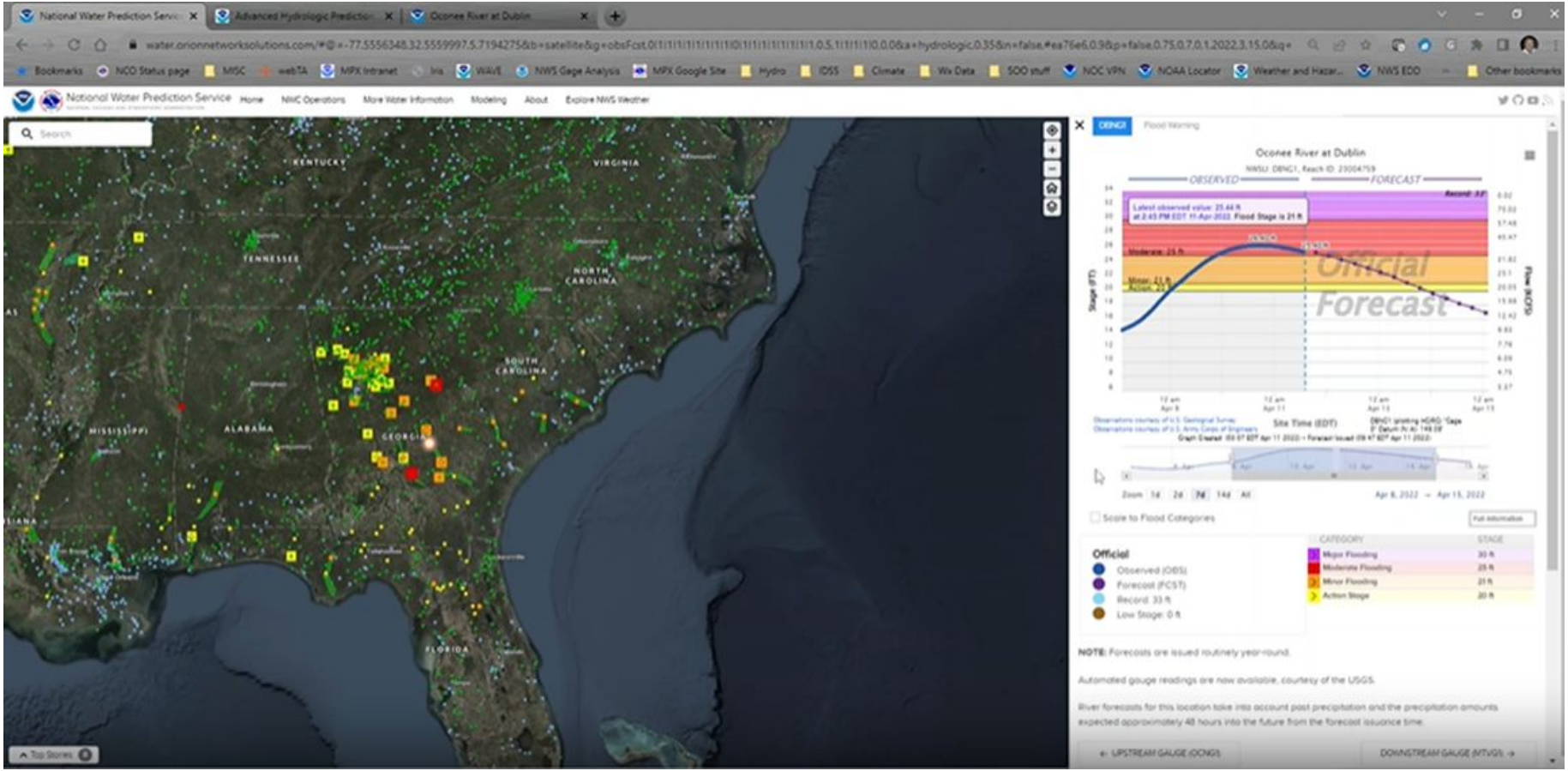
National Water Prediction Service (NWPS)

Radar/Rain Gage Merged Precipitation

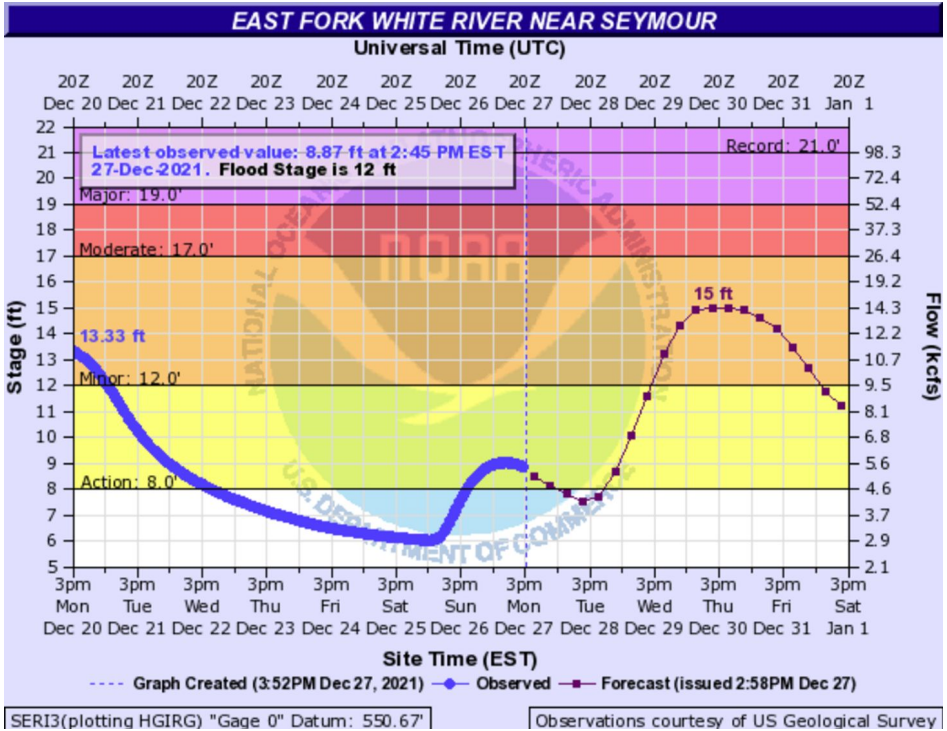
- Download of recent Precipitation Estimates still available
- Longer term precip history moves to NCEI

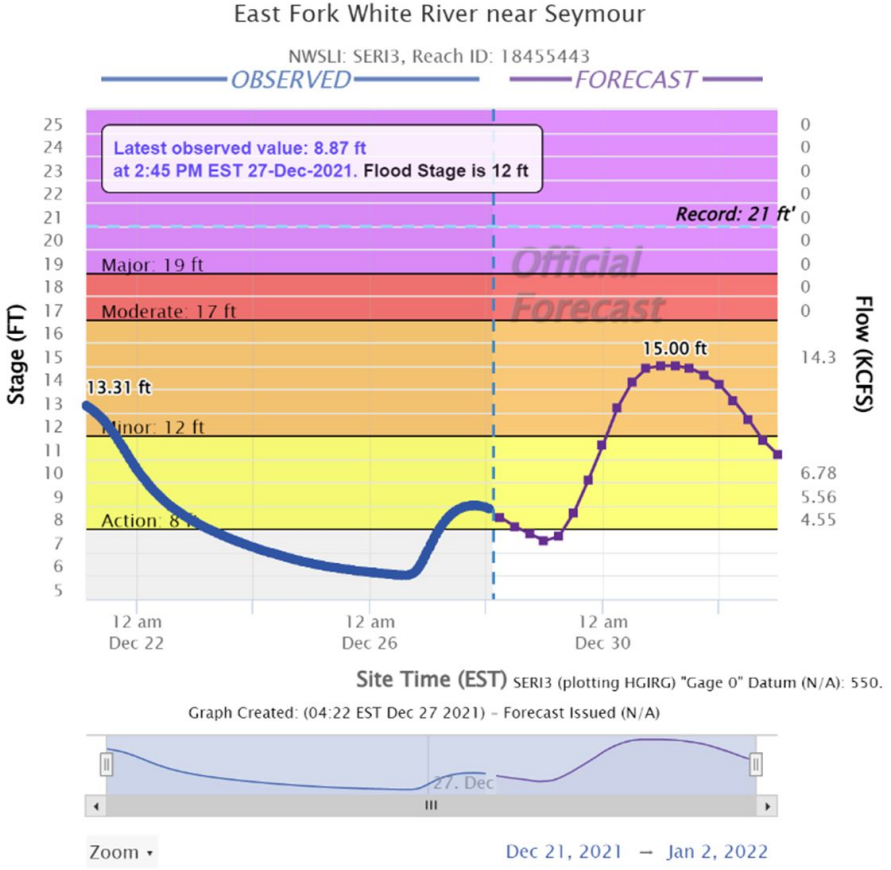


Pop-up Hydrograph

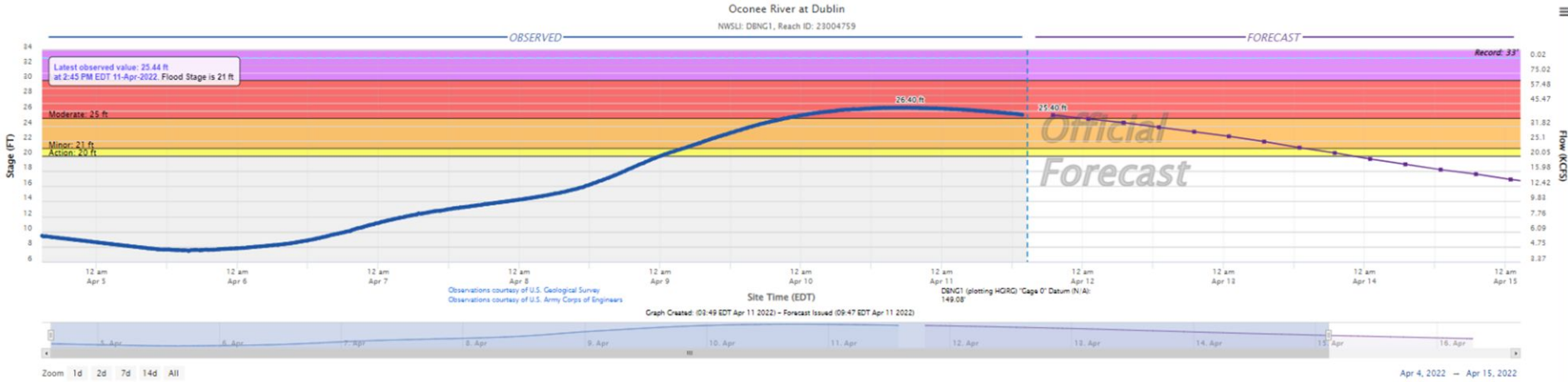


Hydrograph Examples (AHPS→NWPS)





Hydrograph Page



Scale to Flood Categories

Official

- Observed (OBS)
- Forecast (FCST)
- Record: 33 ft
- Low Stage: 0 ft

CATEGORY	STAGE
Major Flooding	30 ft
Moderate Flooding	25 ft
Minor Flooding	21 ft
Action Stage	20 ft

Hydrograph Page

Flood Impacts

25 ft Water may reach top of improved levee at 2nd and River Streets.

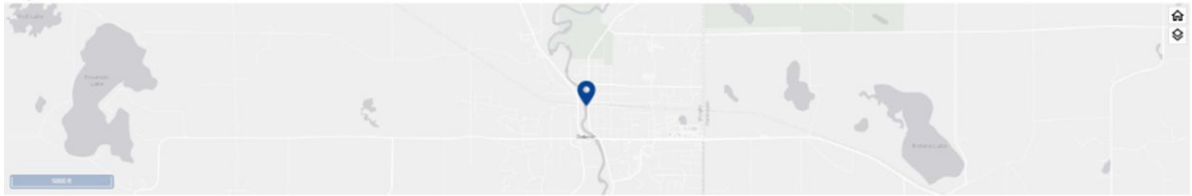
24.95 ft Water begins to flow over the levee on the west side of town.

21.85 ft Water may begin to flow over the bridge on Bridge Street.

Gauge Info

Coordinates	45.0419, -93.7897
RFC	NCRFC
State	MN
WFO	MPX
County	Wright

Gauge Location



Display DELMS marker

Display FEMA's National Flood Hazard Layers

Recent Crests

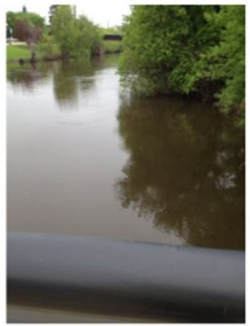
19.84 ft on 03-25-2019 **(P)**
16.35 ft on 04-27-2018 **(P)**
17.56 ft on 10-11-2017
16.68 ft on 08-21-2016
11.05 ft on 05-25-2015
21.02 ft on 06-24-2014
17.03 ft on 06-09-2014
17.9 ft on 06-29-2013
17.17 ft on 06-25-2012
16.76 ft on 05-31-2012
SHOW ALL CRESTS

Historic Crests

23.25 ft on 04-14-1965
21.02 ft on 06-24-2014
20.45 ft on 04-12-1969
20.3 ft on 03-21-2010
20 ft on 03-28-2011
19.95 ft on 04-15-2001
19.84 ft on 03-25-2019 **(P)**
19.25 ft on 04-08-1997
18.85 ft on 04-30-2001
18.75 ft on 06-25-1993
SHOW ALL CRESTS

Gauge Photos

Photo 1 of 8



Upstream from west side of bridge during high water

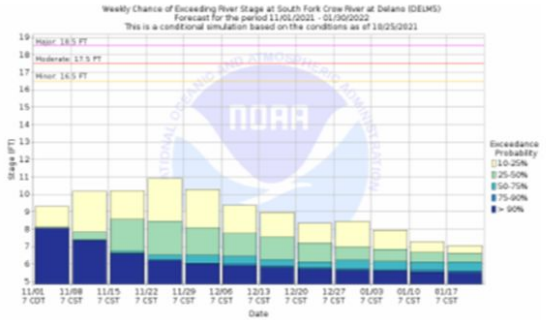
Probability Information

Photo 2 of 2

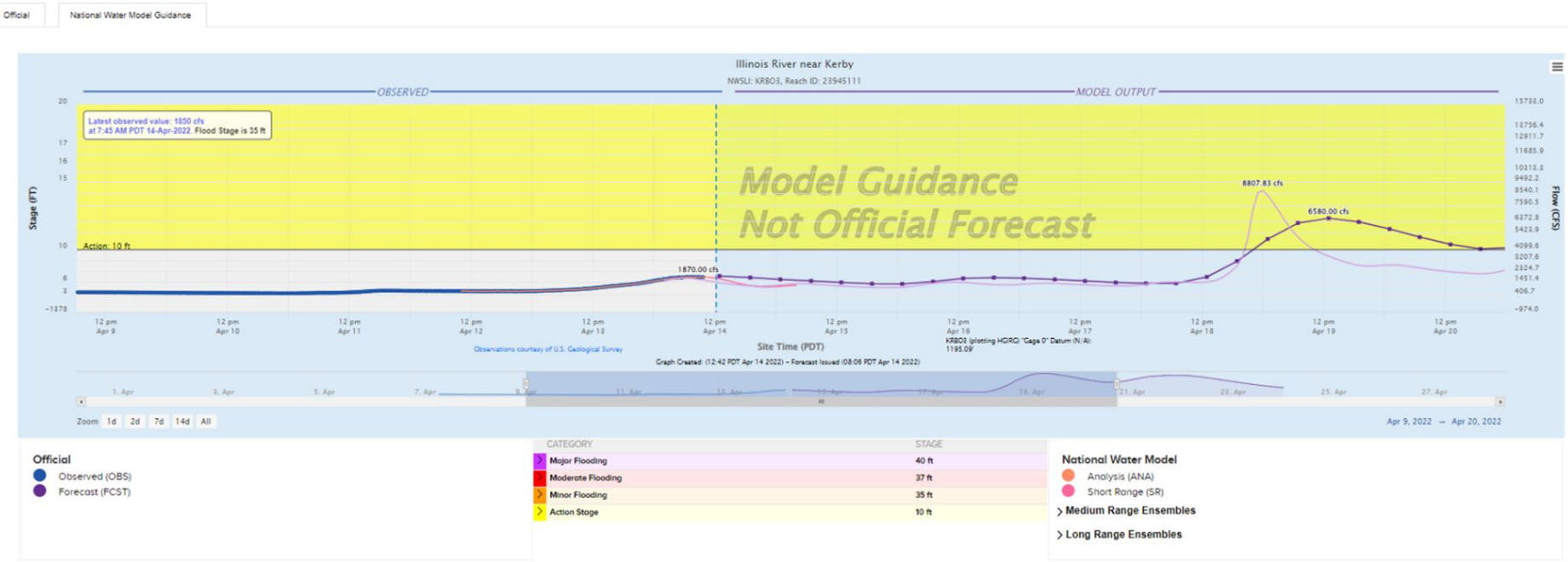
Weekly Chance of Exceeding Levels

About this graph

Stage



Hydrograph Page–NWM tab

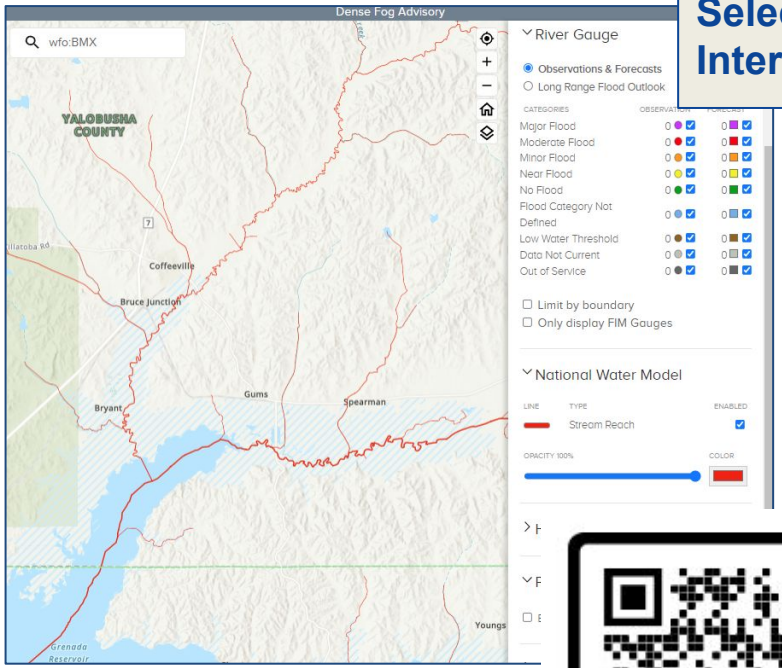


Hydrograph Page

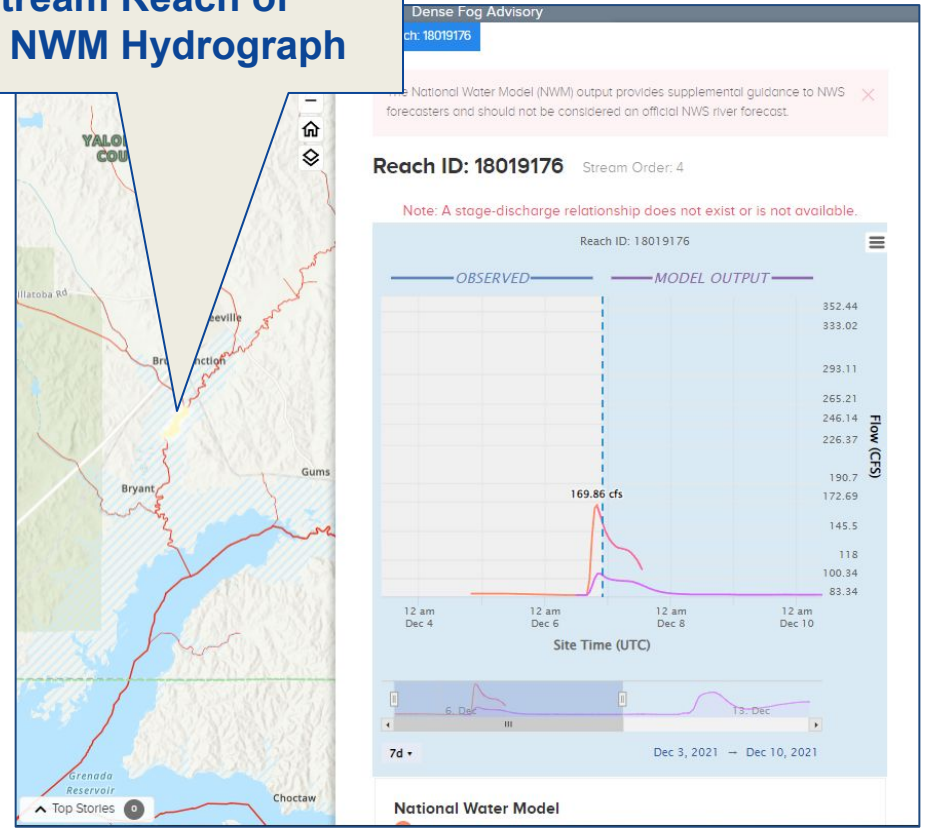
National Water Prediction Service (NWPS)

National Water Model - Experimental/Under Development!

Select NWM Stream Reach of Interest to get NWM Hydrograph

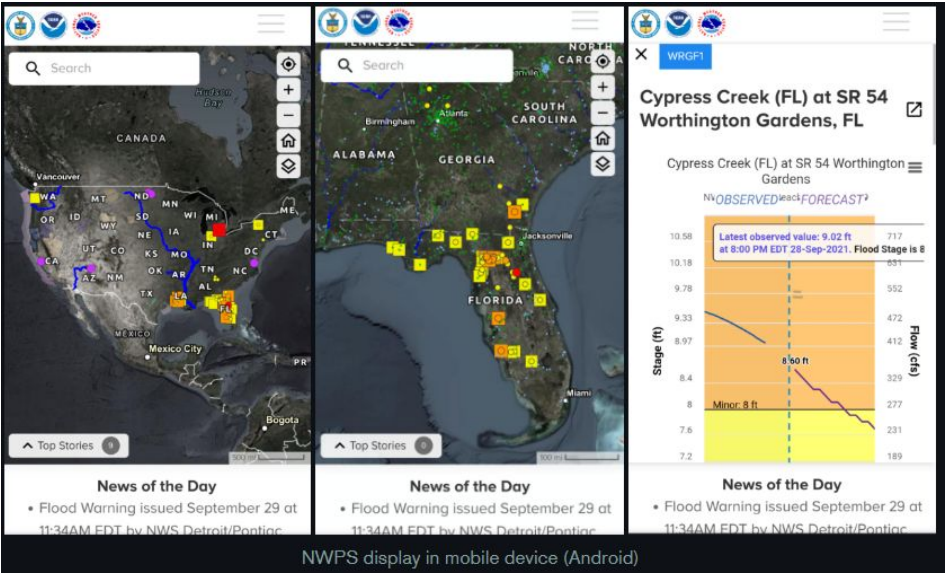


About the National Water Model
water.noaa.gov/about/nwm

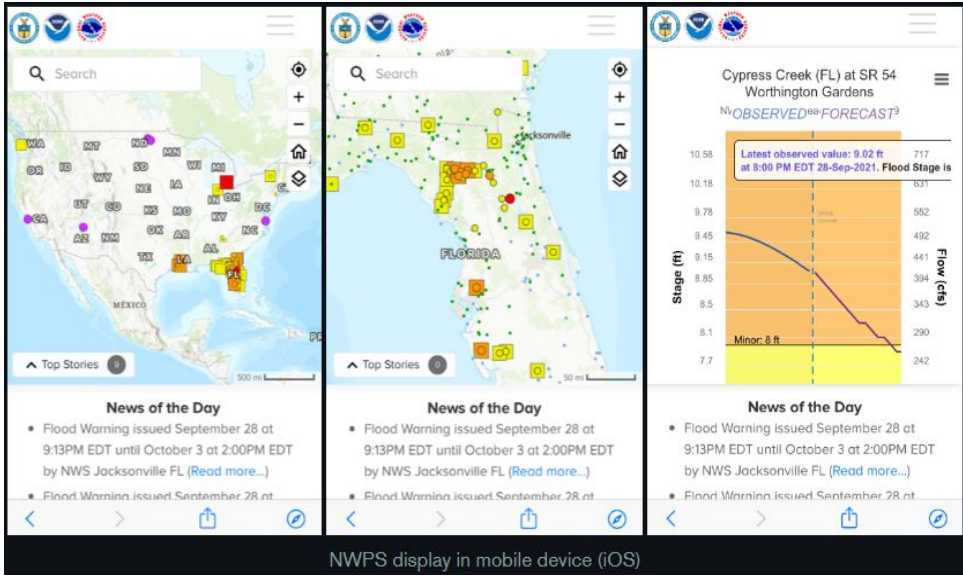


NWPS–Mobile Device Friendly

- More **Mobile ready** interface



NWPS display in mobile device (Android)



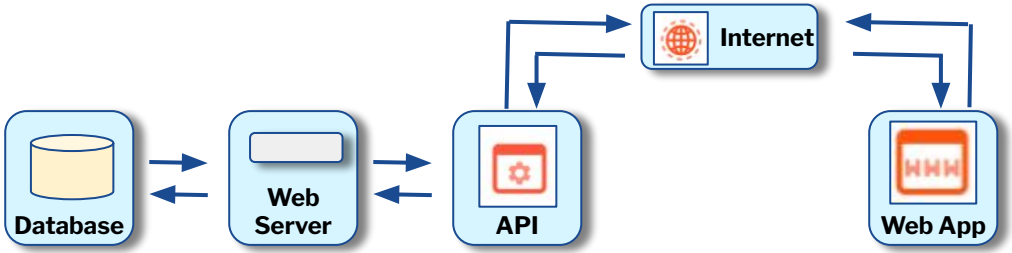
NWPS display in mobile device (iOS)

Beta version *look and feel subject to change*

Data Driven Application Programming Interfaces (API)

NWPS is an API driven Web App for the dissemination of integrated water information across the NWS

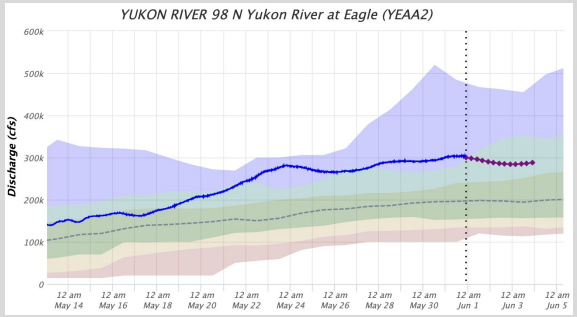
Core Partners, Third Party APIs and Web Apps can leverage the NWPS API to integrate observations and forecast data into **their own** decision support tools.



USGS API

Example Web App

NWPS API



Observed Data - USGS
River Forecast - NWS
Flow Statistics - USGS

Multiple Sources Integrated for Decision Support Services

Data Access with API

Gauges

GET	`/v1/gauges`	Gets a list of gauges.
GET	`/v1/gauges/{identifier}`	Gets a gauge and it's metadata.
GET	`/v1/gauges/{identifier}/ratings`	Get ratings for a gauge (sort is based off of STAGE data, limit defaults at 10,000 records, all defaults false)
GET	`/v1/gauges/{identifier}/stageflow`	Gets observed and forecast stage/flow product data for a gauge.
GET	`/v1/gauges/{identifier}/stageflow/{product}`	Gets observed or forecast stage/flow product data for a gauge.

Reaches

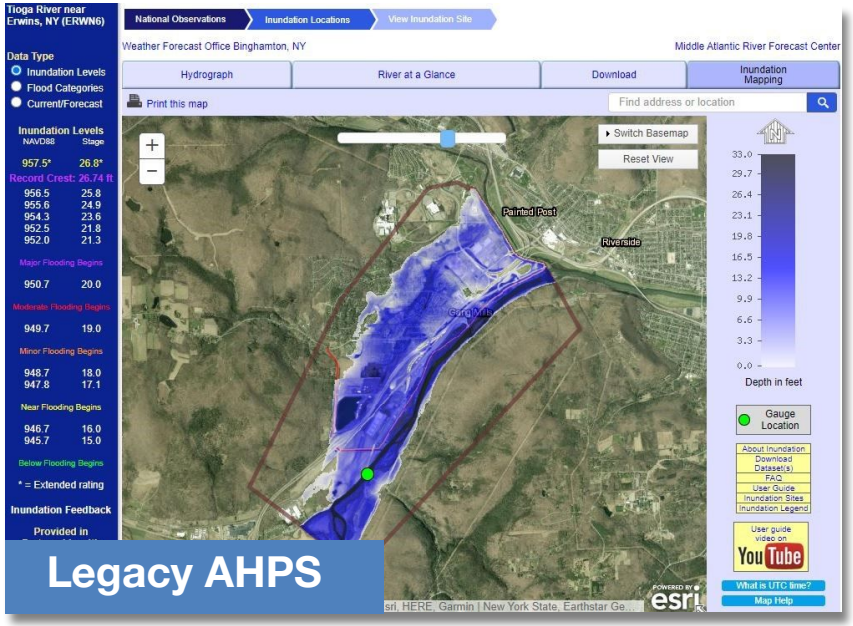
GET	`/v1/reaches/{reachId}`	Get metadata for a specific reach.
GET	`/v1/reaches/{reachId}/streamflow`	Returns streamflow forecast values for a specific reach.

Products

GET	`/v1/products/precipitation/{identifier}`	Get Precipitation for a specific gauge.
GET	`/v1/products/stageflow/{identifier}/{pedts}`	Get Stage/Flow for a specific gauge.

Flood Inundation Mapping (FIM) Display

The FIM capability developed for legacy AHPS will transition to the NWPS website as a custom local web map from the gage hydrograph view page. It will provide the same visualization of the legacy AHPS multi-agency partnered static FIM libraries. At this time, FIM services are available for 180 gauges across the country.

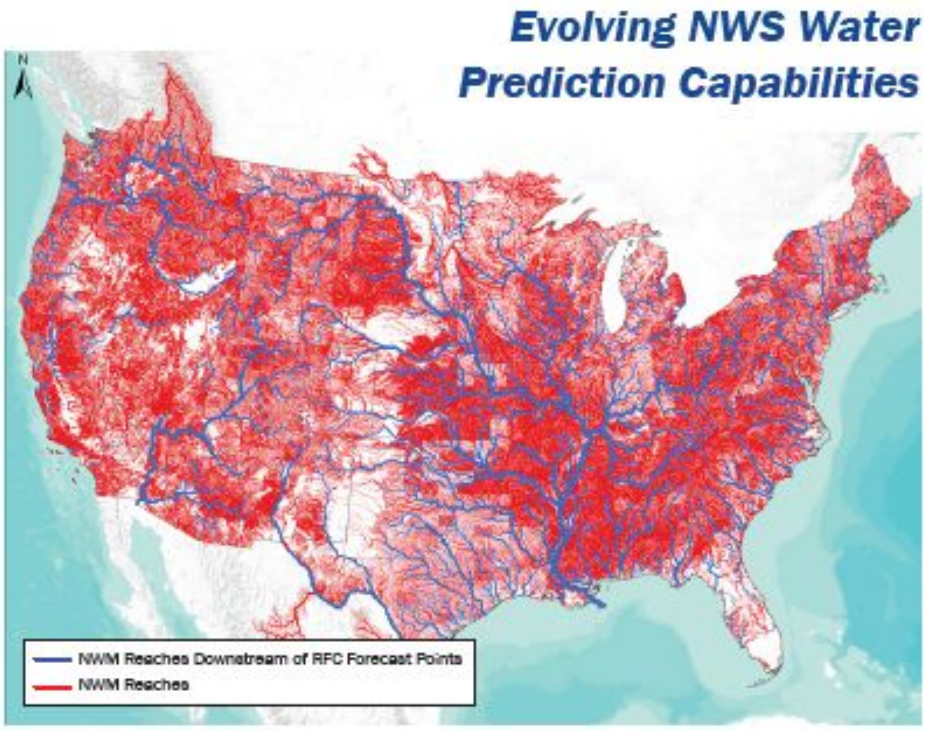


Flood Inundation Map (FIM) IDSS

- Demand for event driven flood inundation mapping (FIMs)
- Provide actionable information for emergency and water resource managers to prepare, mitigate and respond to flood impacts.

- NWC (National Water Center) in coordination with RFCs (River Forecast Centers) and WFOs (Weather Forecast Offices) are coming together to meet that need and deliver NWS FIM IDSS.

Flood Inundation Map (FIM) IDSS



- The RFC-based inundation mapping will cover about 110,000 river miles downstream from RFC forecast locations. (blue lines)
- The NWM-based inundation mapping will cover the roughly 3.4M river miles in the National Hydrography Dataset (NHD) catalog. (red lines)

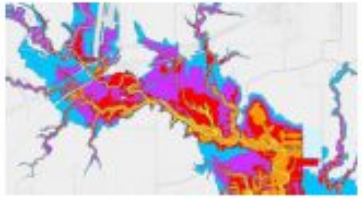
Flood Inundation Map (FIM) IDSS

STATIC

Advanced Hydrologic Prediction Service FIM Libraries (AHPS FIM)

< 1,000 river miles

Static maps at ~ 200 RFC forecast locations. Maps derived from engineering scale hydraulic models.



NWS Flood Categorical HAND FIM Libraries (CatFIM)

~ 20,000 river miles

Static maps at ~3,600 RFC forecast locations. Maps derived from 10-m Height Above Nearest Drainage (HAND) solution.

DYNAMIC

River Forecast Center FIM (RFC FIM)

~ 100k river miles

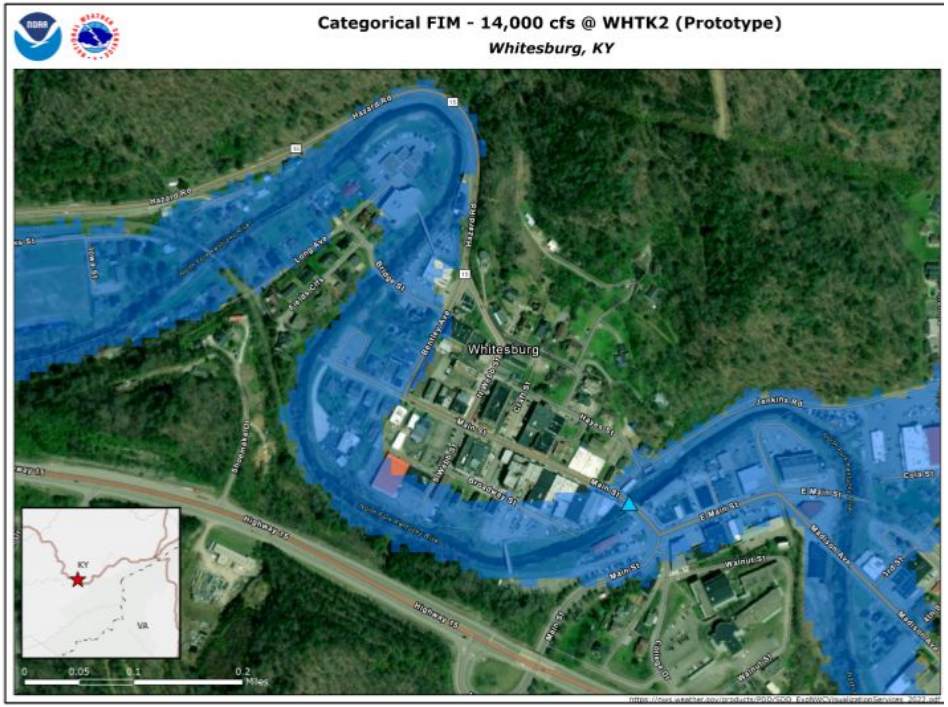
Dynamic maps downstream of ~ 3,600 RFC forecast locations. Maps derived from RFC forecast and 10-m Height Above Nearest Drainage (HAND) solution.

National Water Model FIM (NWM FIM)

~ 3.4M river miles

Dynamic maps along NHDPlus reach locations. Maps derived from NWM forecast and 10-m Height Above Nearest Drainage (HAND) solution.

Flood Inundation Map (FIM) IDSS



NWM-based FIM uses both current NWM analyses and NWM forecast streamflow to map inundation extents. This results in FIM products based on three different model configurations:

1. The **Analysis and Assimilation (AnA) FIM** is updated hourly, showing expected inundation for current conditions.
2. The **Short Range FIM** is updated hourly, extending 18-hours into the future, showing expected maximum inundation over the 18-hour period.
3. The **Medium Range FIM** is updated every 6 hours, extending 10-days into the future, showing expected maximum inundation over the 10-day period.

Flood Inundation Map (FIM) IDSS

3. Example graphic using NWC RFC FIM during Hurricane Ian

NWS Flood Inundation Mapping Services

Disclaimer: This map shows the flood extent based on a river crest of 20.6 feet. This is an approximate-based FIM which should be used more conservatively.

North Fork Black Creek near Middleburg (MDLF1)

Forecast Crest Height: **20.6 Feet**
Map Height Shown: **20.6 Feet**
FIM Source: **NWC RFC FIM**
FIM Type: **Dynamic (Depth NOT Included)**
FIM Creation Time: **9/28/22 4:00 PM ET**

DO NOT DISTRIBUTE

RFC 5-Day Max Inundation Extent Forecast
Maximum Inundation Extent

Predicted rainfall
in basin: 7.73 inches
in 48 hours

Additional screen captures are available upon request

9/28/22 @ 4:00 pm

Flood Inundation Map (FIM) IDSS

4. Example graphic using USACE FIM during Hurricane Ian to address a specific location request from a local emergency manager.

NWS Flood Inundation Mapping Services

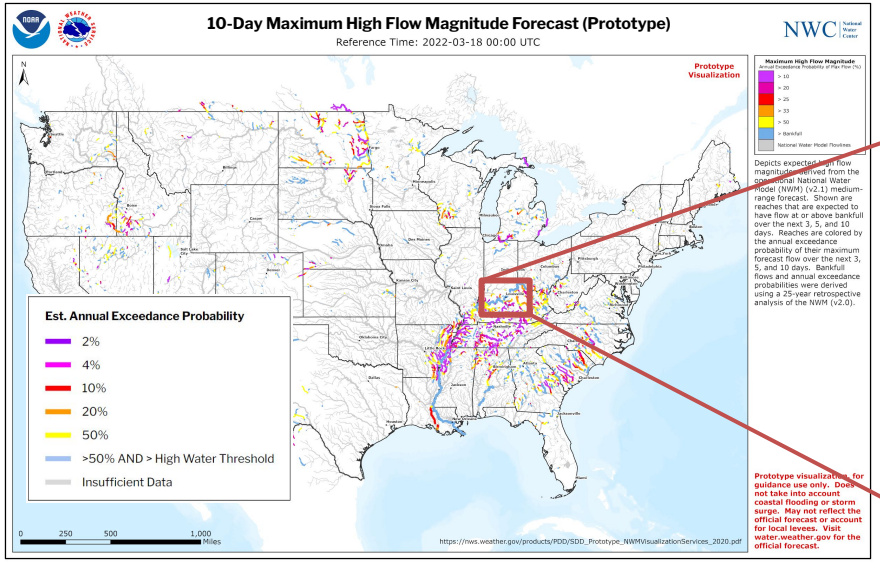
Disclaimer: This map shows the flooding based on previous rainfall and may not account for any backwater or tidal effects. This is an approximate-based FIM which should be used more conservatively.

Area of Interest: Englewood United Methodist Church
700 East Dearborn Street

FIM Type: *USACE FIM - using accumulated rainfall only*

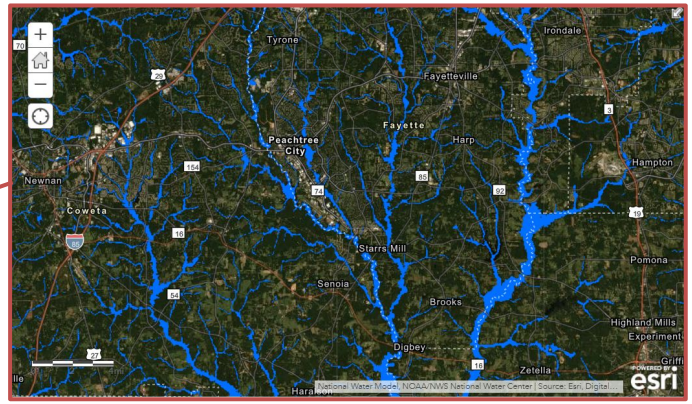
Comments: *The church is just east of the Gottfried Creek, which is shown to be flooding residential areas in vicinity. The church is likely experiencing flooding around the structure, and could be entering the building. Some residential areas could have 2-4 feet of inundation. The church is near the intersection of the 100/500 year flood plain, which supports the magnitude of flooding depicted in the model.*

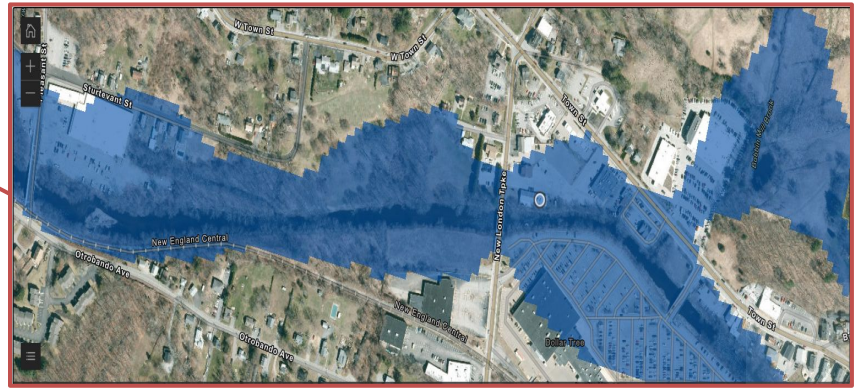
Flood Inundation Map (FIM) and NWM Services



National Water Model

10-Day High Flow Magnitude Forecast





(sample FIM images)

Flood Inundation Map (FIM) IDSS

2017

NWC Summer Institute

- Demonstrated continental scale FIM capability using the Height Above Nearest Drainage (HAND) method.

2019

First DOC/NOAA Agency Priority Goal

- Near real-time demonstration in Texas.
- Completed two tabletop exercises with core stakeholders and emergency responders.

2021

Second DOC/NOAA Agency Priority Goal

- Near real-time demonstration in Texas and along the Atlantic Coast.
- Completed two tabletop exercises across the Northeast with core stakeholders and emergency responders.

2023

Operational FIM for 10% of the U.S. population

- Begin delivery of FIM services and Impact-based Decision Support Services (IDSS).
- Leverage cloud-based solution.

2026

Operational FIM for nearly 100% of the U.S. population

- Integrated FIM capabilities and services across the U.S.
- Total Water Level FIM forecasts along the coasts.

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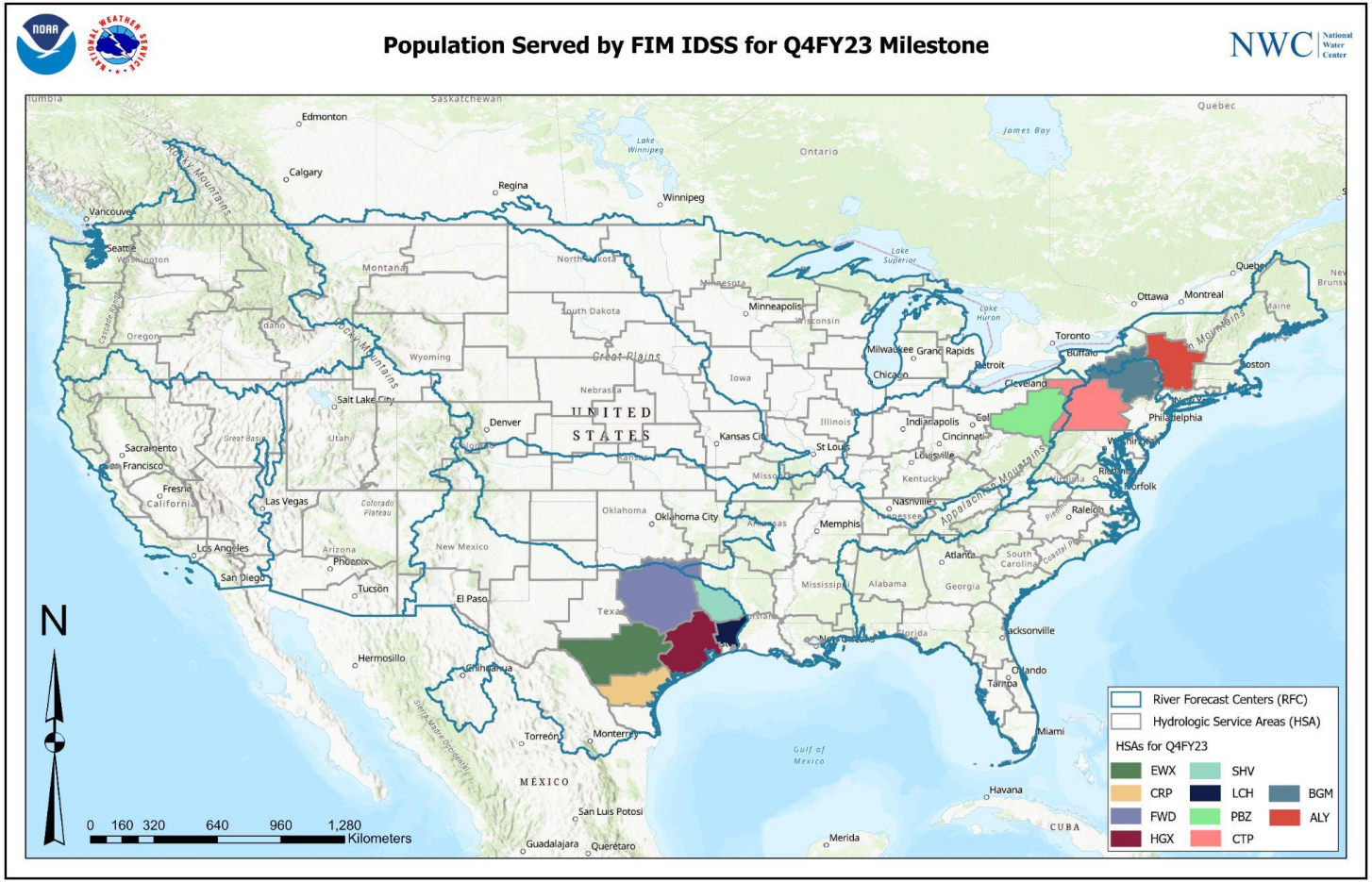
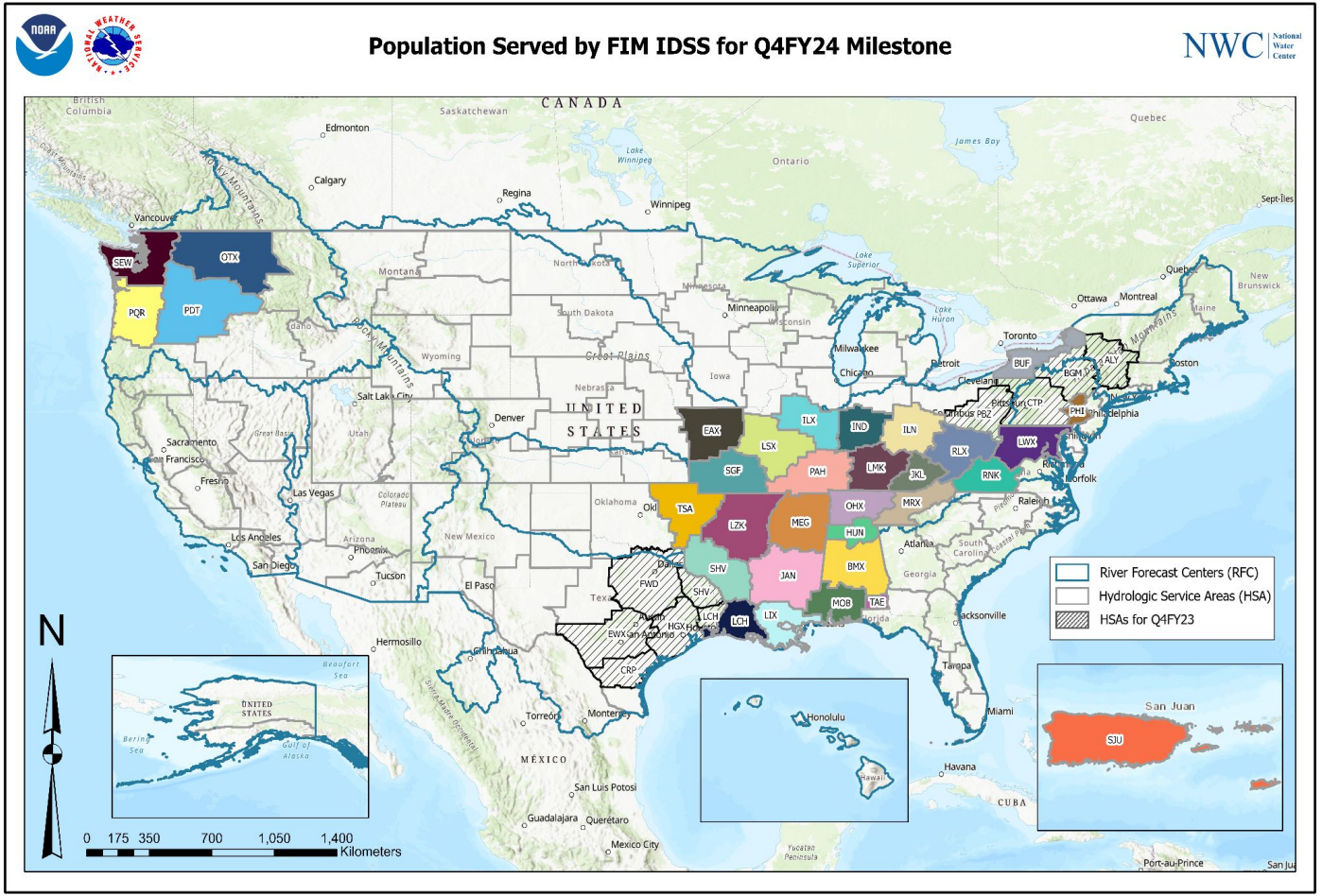
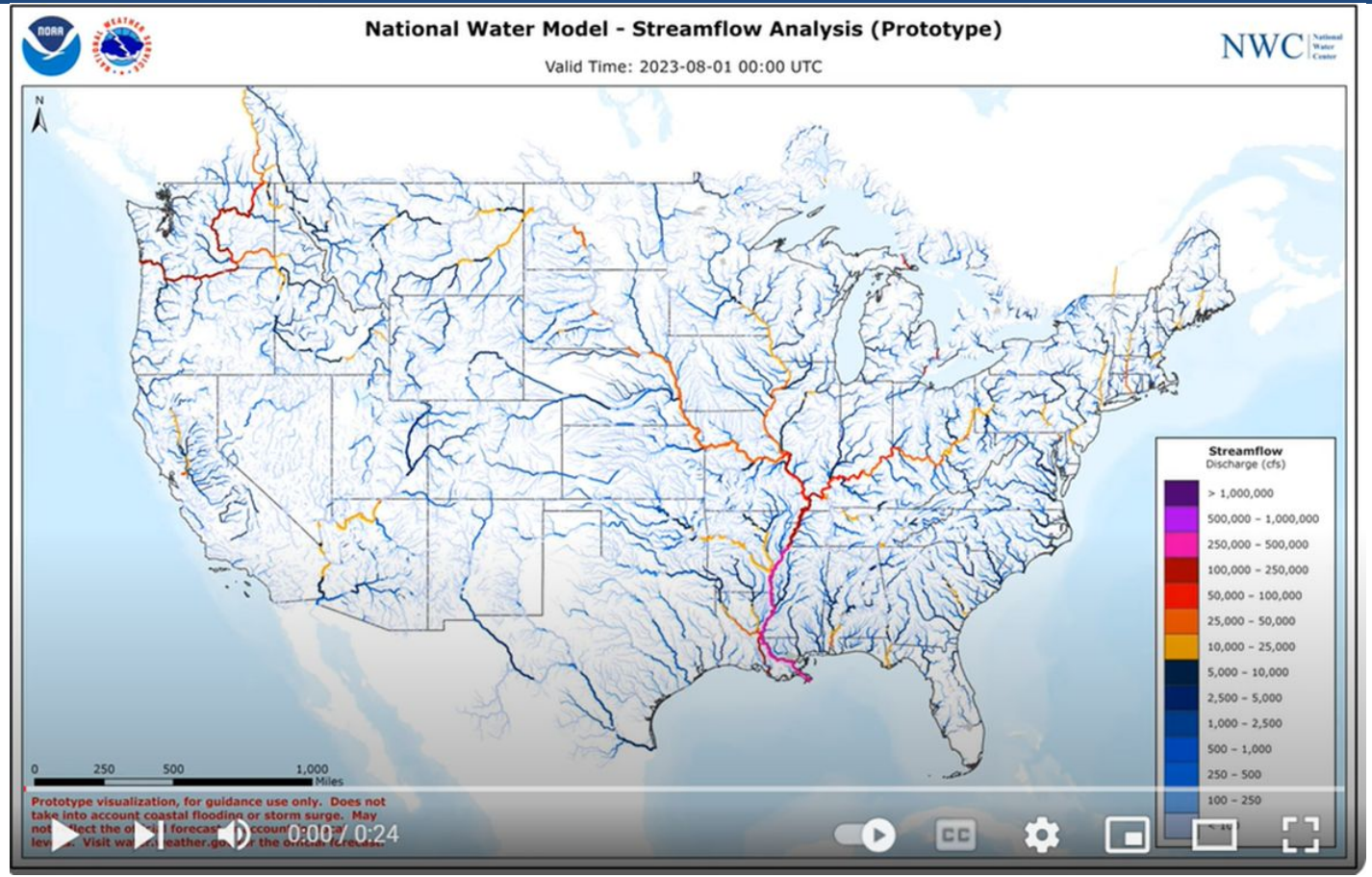
Flood Inundation Map (FIM) IDSS



Flood Inundation Map (FIM) IDSS



Thank you!



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