



OWP | OFFICE OF
WATER
PREDICTION

Implementation of Forecast Flood Inundation Services To The Nation - An Update



David R. Vallee

*Director, Service Innovation and Partnership Division
NOAA/NWS Office of Water Prediction/National Water Center*

Outline for this session

- FIM Rollout
- Some “Light” FIM Science
- Success stories and usage
- Introducing our new National Water Prediction Service!!!
(formally known as AHPS)



Outline for our Rollout Discussion

- Background on what got us to where we are today
- Progress to Date on our FIM Services Implementation for the Nation
- Examples of our new Experimental Flood Inundation Services
- Where you can access our Experimental National Water Model & Flood Inundation Services
- Some recent examples of both the services & the IDSS from the field offices



Why are we doing this?

To fill a significant service gap!

Current Flood Services

- Flood and Flash Flood Watches & Warnings
 - Providing general information on timing and impact on small streams
 - Detailed timing and impacts in the vicinity of our river forecast locations
- Impact-based Decision Support Briefings, packages and Webinars

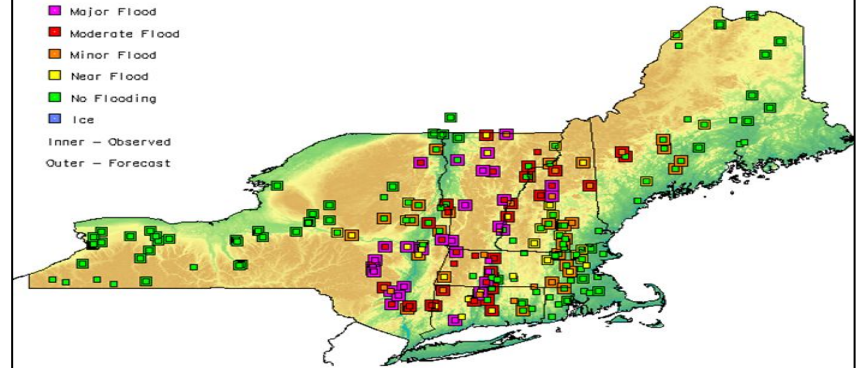
Partner Feedback

While our current services are tremendously valuable, **warnings lack specificity of location, timing and detailed impacts such as potential extent of inundation & duration of flooding**

- Lead time is critical in preparation
- Knowing what roadways, bridges, etc. could be impacted is invaluable

Observed and Forecast River Conditions

August 28, 2011 7:11pm EDT



Source: NOAA/NWS/Northeast RFC

BULLETIN - EAS ACTIVATION REQUESTED
FLASH FLOOD WARNING
NATIONAL WEATHER SERVICE ALBANY NY
218 AM EDT SUN AUG 28 2011

THE NATIONAL WEATHER SERVICE IN ALBANY HAS ISSUED A

* FLASH FLOOD WARNING FOR...
GREENE COUNTY IN EAST CENTRAL NEW YORK...
THIS INCLUDES THE CITIES OF...HUNTER...CATSKILL...
ULSTER COUNTY IN EAST CENTRAL NEW YORK...
THIS INCLUDES THE CITIES OF...SAUGERTIES...NEW PALTZ...KINGSTON...
ELLENVILLE...

* UNTIL 815 AM EDT

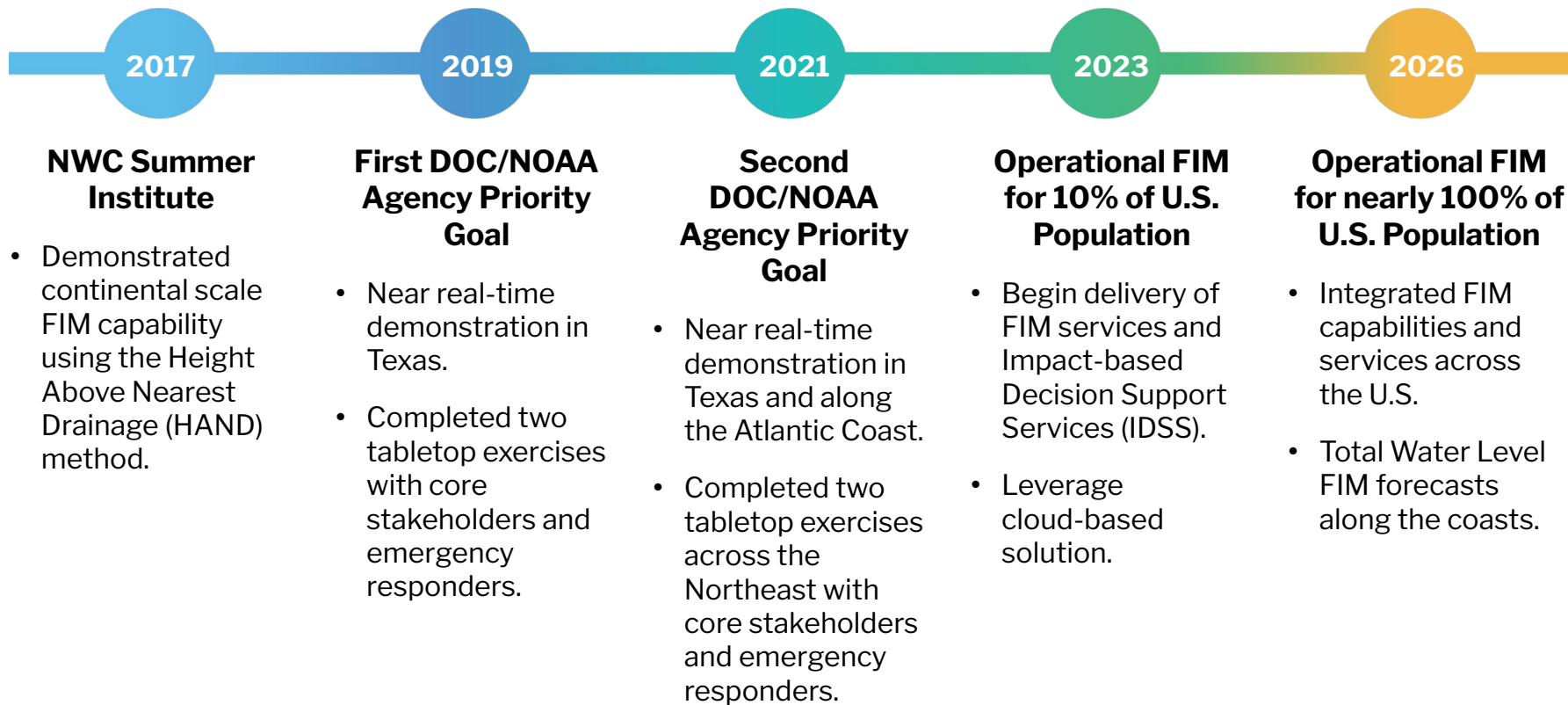
* AT 209 AM EDT...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED
FLASH FLOODING FROM BANDS OF HEAVY RAIN WITH EMBEDDED
THUNDERSTORMS ASSOCIATED WITH HURRICANE IRENE.

* LOCATIONS IN THE WARNING INCLUDE BUT ARE NOT LIMITED TO NORTH-SOUTH
LAKE CAMPGROUND...NEW BALTIMORE...WINDHAM...PRATTSVILLE...COXSACKIE
AND ATHENS

PRECAUTIONARY/PREPAREDNESS ACTIONS...

ADDITIONAL RAINFALL AMOUNTS OF 2 TO 4 INCHES ARE POSSIBLE IN THE
WARNED AREA THROUGH 8 AM.

Flood Inundation Mapping Timeline



Map Legend



Population served by **October 2023.**



Population served by **October 2024.**



Population served by **October 2025.**

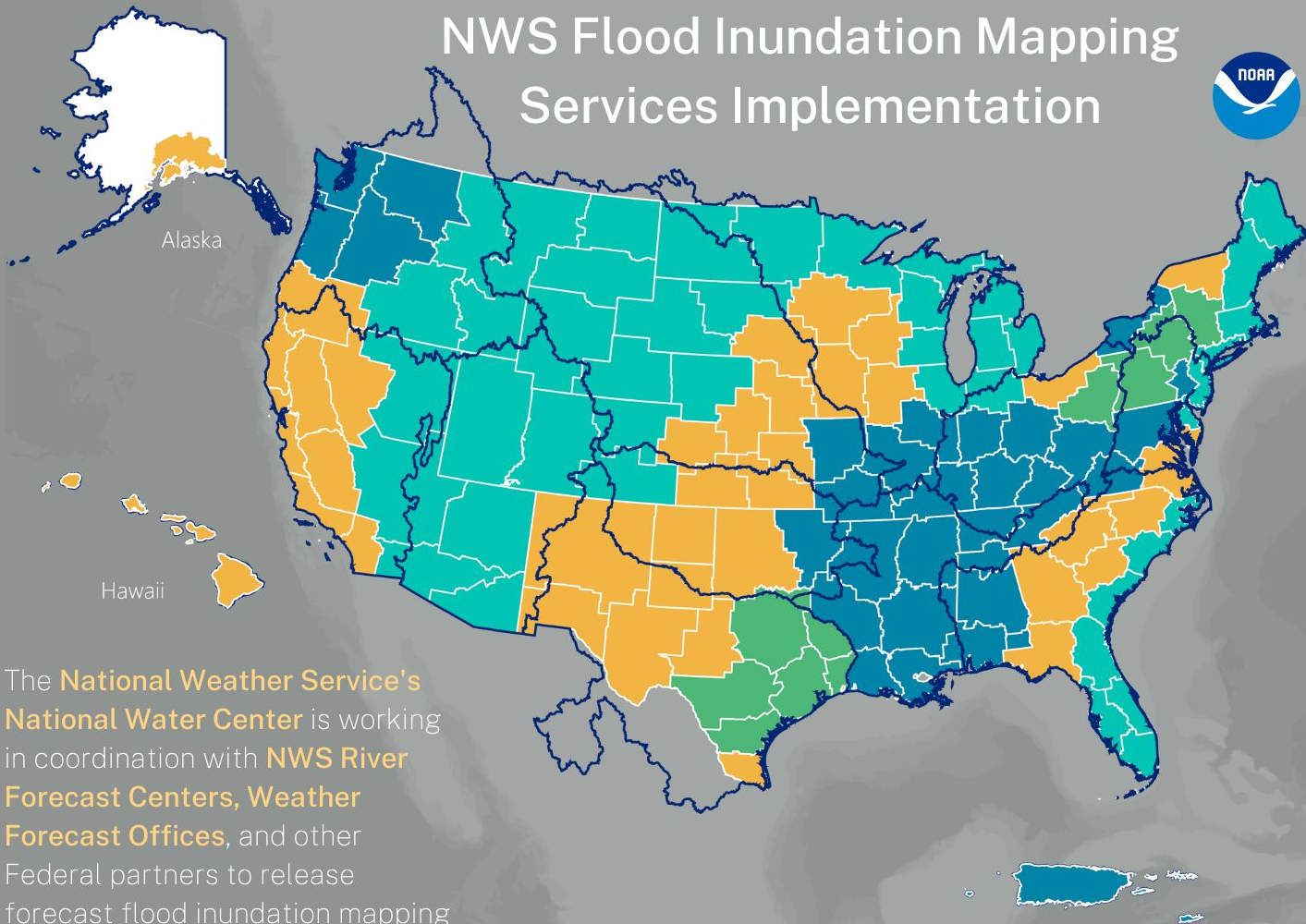


Population served by **October 2026.**

 NWS County Warning Areas

 NWS River Forecast Center Boundaries

NWS Flood Inundation Mapping Services Implementation



The **National Weather Service's National Water Center** is working in coordination with **NWS River Forecast Centers, Weather Forecast Offices**, and other Federal partners to release forecast flood inundation mapping services to the Nation.

**100% is approximate. Does not include all parts of Alaska, American Samoa, and Guam. Implementation areas are subject to change.*

Puerto Rico & U.S. Virgin Islands

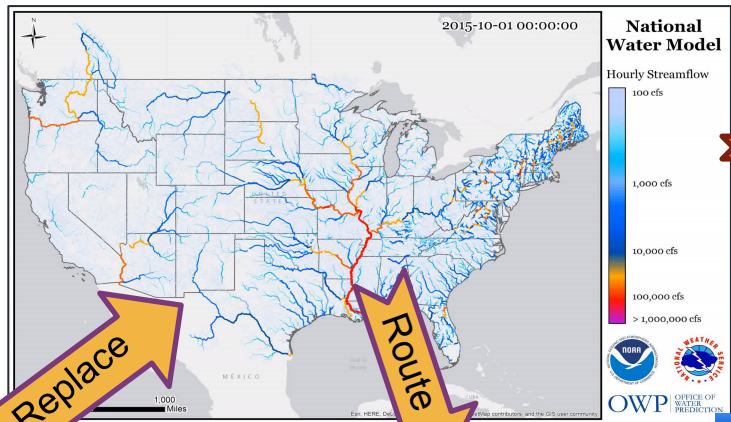
The Method behind FIM Services: Height Above Nearest Drainage (HAND)

Deliver Forecast Flood Inundation Services

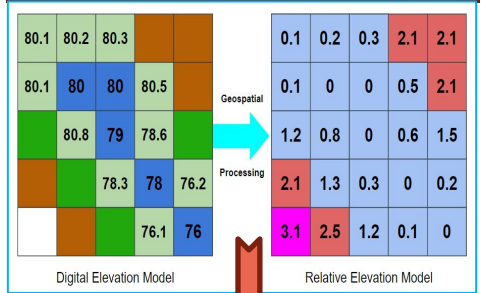
National Water Model

Guidance

Completely automated process with no forecaster engagement – but provides complimentary guidance on ~3.4 million stream miles nationwide, including Puerto Rico and the Virgin Islands, Hawaii, and by the fall - portions of Alaska

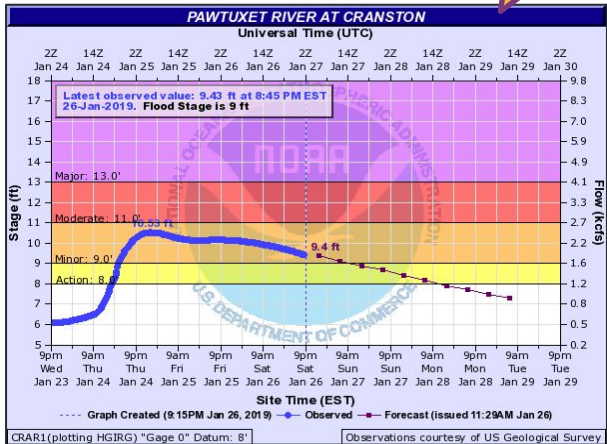


Height Above Nearest Drainage (HAND)

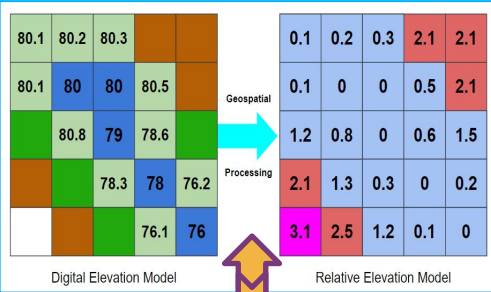


River Center Forecasts

Forecasters heavily engaged in the forecast production

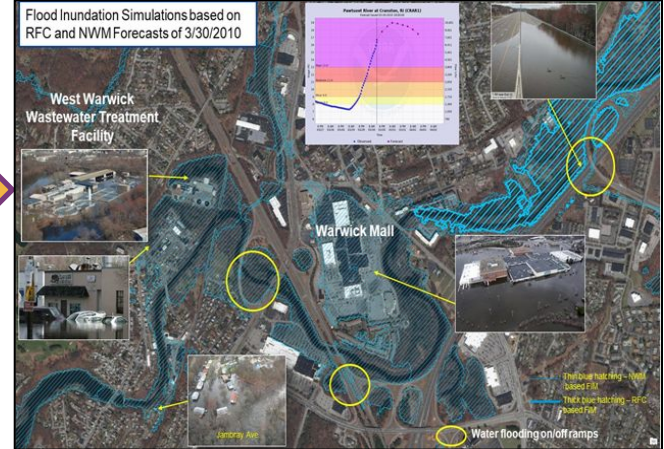


Height Above Nearest Drainage (HAND)

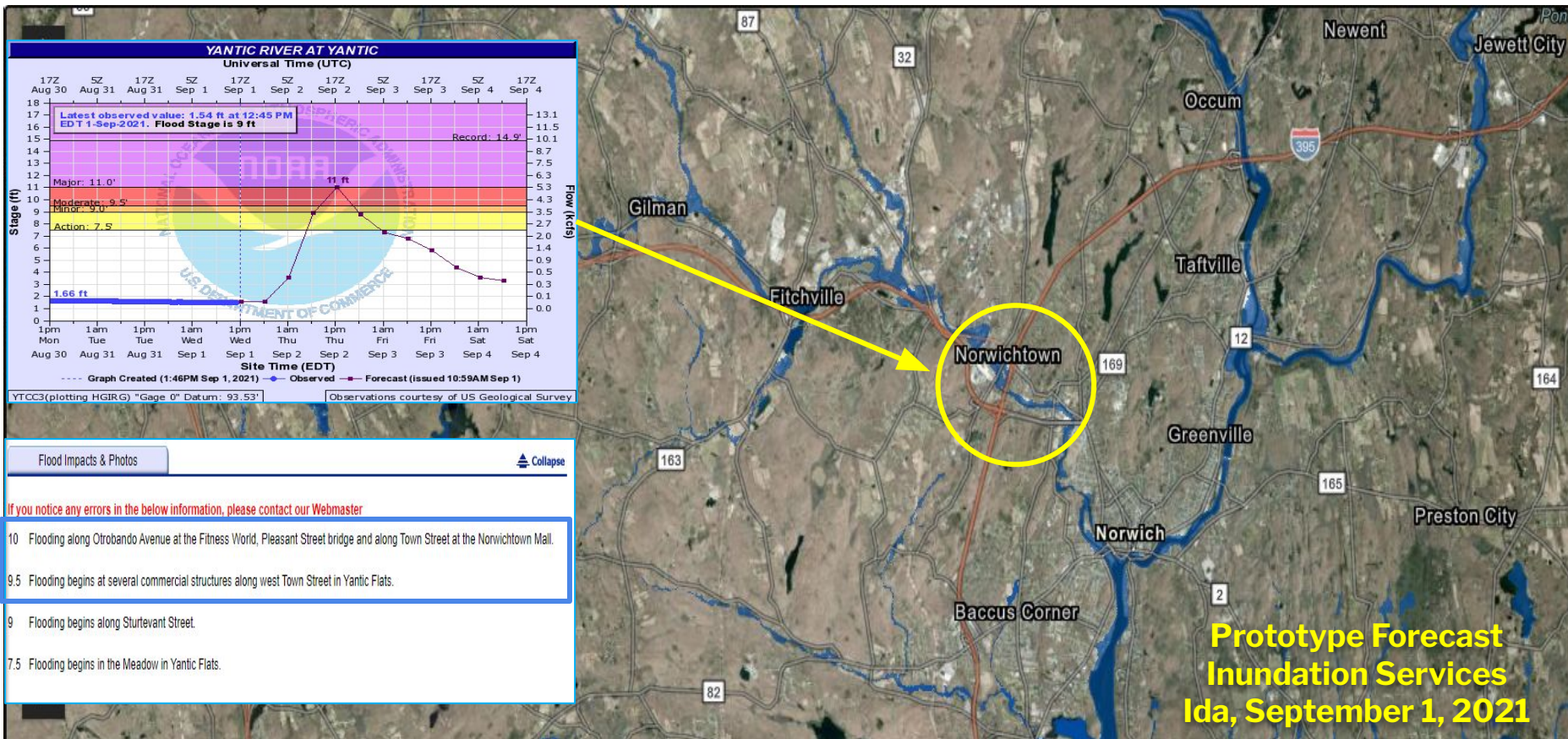


+RASToFIM & RASoREM techniques

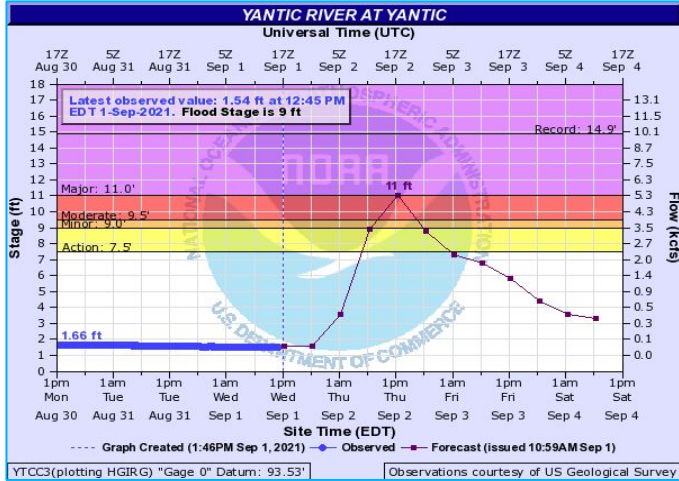
Pawtuxet River Valley – West Warwick/Warwick



Value of FIM Services - Visualizations to depict impacts



Value of FIM Services - Visualizations to depict impacts



Integrating FIM Services into our IDSS

Disclaimer: This experimental map represents the NWS's best approximation of inundation based upon modeled river discharge

Yantic River at Yantic, CT

Forecast Crest Height: 11 Feet

Map Height Shown: 11 Feet

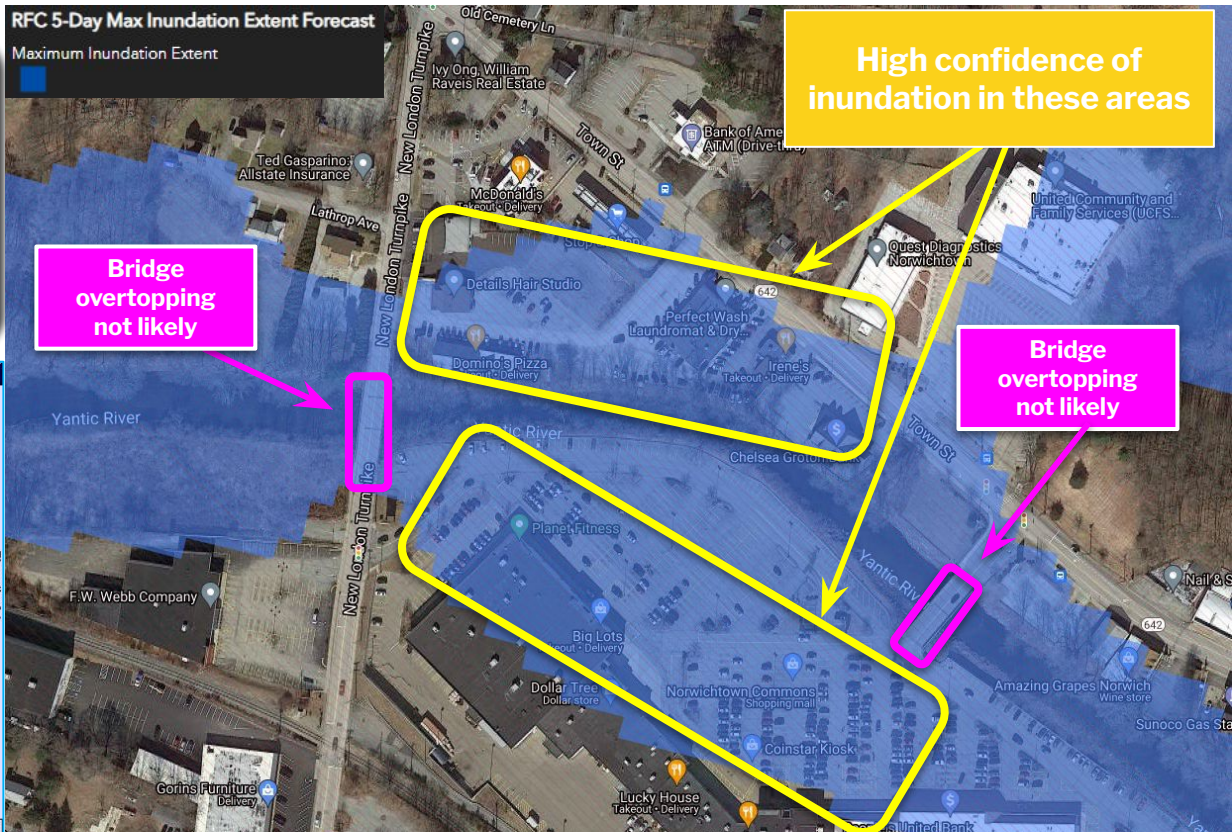
FIM Source: RFC FIM 5 Day Max Extent

FIM Type: Dynamic (Depth NOT Included)

FIM Creation Time: Sept 1st, 1 pm

RFC 5-Day Max Inundation Extent Forecast

Maximum Inundation Extent



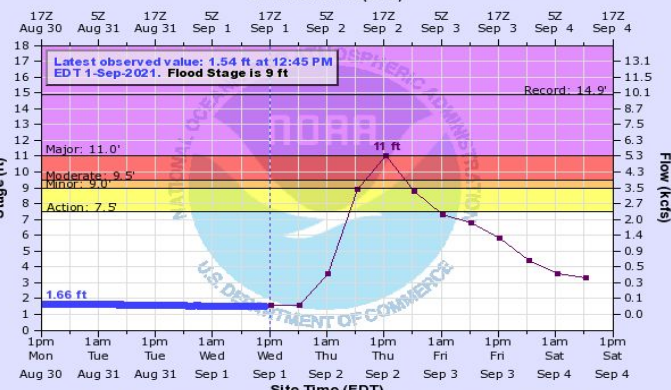
High confidence of inundation in these areas

Bridge overtopping not likely

Bridge overtopping not likely

YANTIC RIVER AT YANTIC

Universal Time (UTC)



--- Graph Created (1:46PM Sep 1, 2021) --- ● Observed --- Forecast (issued 10:59AM Sep 1)
 YTCC3(plotting HGIRG) "Gage 0" Datum: 93.53' Observations courtesy of US Geological Survey

FIM & NWM Visualizations

Experimental Services

FIM Services available for 10% of the nation


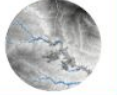


- *NWM Latest Analysis FIM*
- *RFC 5-Day Max Extent FIM*
- *NWM 5-Day Max Extent FIM*

Non-FIM NWM Services

- *High Water & Peak Flow Arrival Time, Max High Flow Magnitude Forecast, & High Water Probability Forecasts*
- *Rapid Onset Flooding Probability Forecasts*
- Services available for ingest into your local GIS systems

Visualizations available on NWPS & the NWS GIS Viewer

- **NWPS** (<https://water.noaa.gov>)
Includes FIM services, CATFIM in 10% area, RFC & NWM forecast hydrographs, and a few NWM non-FIM visualizations
- **NWS GIS Viewer** (<https://viewer.weather.noaa.gov/water>)
Includes FIM services and all Non-FIM NWM services

Dynamic FIM Services Comparison Table			
FIM Service	NWM Latest Analysis FIM	RFC 5-Day Max FIM	NWM 5-Day Max FIM
			
Data Type	Observation based simulations [precip. estimates & USGS gage observations]	Forecast [5-day RFC forecasts]	Forecast [5-day GFS]
Total Latency	55 minutes	45 minutes	6 hours 30 minutes
Updates	Hourly	Hourly [if new forecasts available]	Every 6 hours
HAND Inputs	Flow	Flow	Flow
Threshold Source [NWM/RFC]	NWM High Water	RFC	NWM High Water
Error Sources	<ul style="list-style-type: none"> • RADAR or gage malfunctions • For ungaged reaches, errors associated with NWM & estimated precipitation • HAND errors [10m DEM resolution] 	<ul style="list-style-type: none"> • Rainfall forecast • RFC flow simulations • Routing of flow using NWM physics • HAND errors [10m DEM resolution] 	<ul style="list-style-type: none"> • GFS forecast • NWM flow simulations • HAND errors [10m DEM resolution]
FIM Domain	Entire NWM domain [CONUS, HI, PR, US Virgin Islands]	Downstream of AHPS forecast points	CONUS
Mapping Threshold	Only available for reaches that meet and/or exceed the "High Water" threshold	Only available based on active RFC forecasts at or above "Action Stage"	Only available for reaches that meet and/or exceed the "High Water" threshold
When to Use	Use as a snapshot of the most recent modeled inundation	Use when RFC forecast is available	Use for rivers and streams not covered by RFC forecast

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NWC Operations Page: <https://www.weather.gov/owp/operations>

National Water Center Products and Services

Operational and Experimental

[Weather.gov](#) > [Office of Water Prediction](#) > National Water Center Products and Services

Office of Water Prediction
National Program

NWC National Water Center

2023 National Hydrologic Assessment



Area Hydrologic Discussion

Experimental short range, episodic, discussion and graphic which highlights locations across the nation that may be impacted by rapid-onset flooding, using National Water Model and other guidance.

AHD Product Description Document
Provide Feedback on AHD
AHD One-Pager



Flood Hazard Outlook

High Level graphical depiction and key messages highlighting the potential threat of inland flood hazards (flash, urban, small stream and riverine) and their associated impacts (catastrophic, considerable, and limited) for the next seven days.

FHO Product Description Document
Provide Feedback on FHO
FHO One-Pager



National Hydrologic Discussion

Experimental discussion of the current and forecast hydrologic conditions across the nation, including a variety of short and medium range (Days 1-10) observed and modeled hydrologic guidance.

NHD Product Description Document
Provide Feedback on NHD
NHD One-Pager



Significant River Flood Outlook

Operational flood outlook intended to provide a general outlook for significant (moderate and above) river flooding. It is not intended to depict all areas of minor flooding or small-scale events such as localized flooding and/or flash flooding.



NWC Visualization Services

Experimental geospatial services depicting forecasts from the River Forecast Centers and the National Water Model. Services available via the prototype NWS National Map Viewer, or directly via URLs hosted on the Hydrologic Visualization and Inundation Services (HydroVIS) cloud resource. Refer to the "Public Handbook" for additional details.

NWC Visualization Services Service
Description Document
Provide Feedback on NWC Visualization Services
High Flow Magnitude
High Water Arrival Time
High Water Probability
Rapid Onset Flooding
Streamflow Anomaly



!NEW! - Flood Inundation Mapping (FIM) Services - !NEW!

Experimental services depicting the extent of predicted inundation, as derived from River Forecast Center forecasts and National Water Model analyses and forecasts. Services are available via the "Viewer", or directly via URLs hosted on the Hydrologic Visualization and Inundation Services (HydroVIS) cloud system. These services are currently only available for an area that includes 10% of the U.S. population but will be expanded later. Additional informational resources are available below.

Public Notification Statement (PNS)
FIM Fact Sheet
Frequently Asked Questions (FAQs)
FIM Service Description Document (SDD)
Viewer Access Instructions
API Access Instructions

[CLICK HERE to Provide Feedback](#)



!NEW! - National Water Prediction Service (NWPS) - !NEW!

In Spring 2024, the Advanced Hydrologic Prediction Service (AHPS) hosted at <https://water.weather.gov> will be replaced by the National Water Prediction Service (NWPS) at a repositioned <https://water.noaa.gov>. A Service Change Notice (SCN) will be issued at least 60 days ahead of implementation. Information is available below to guide the transition from AHPS to NWPS. A preview of the NWPS site is available [here](#).

Service Change Notice (SCN)
Public Notification Statement (PNS)

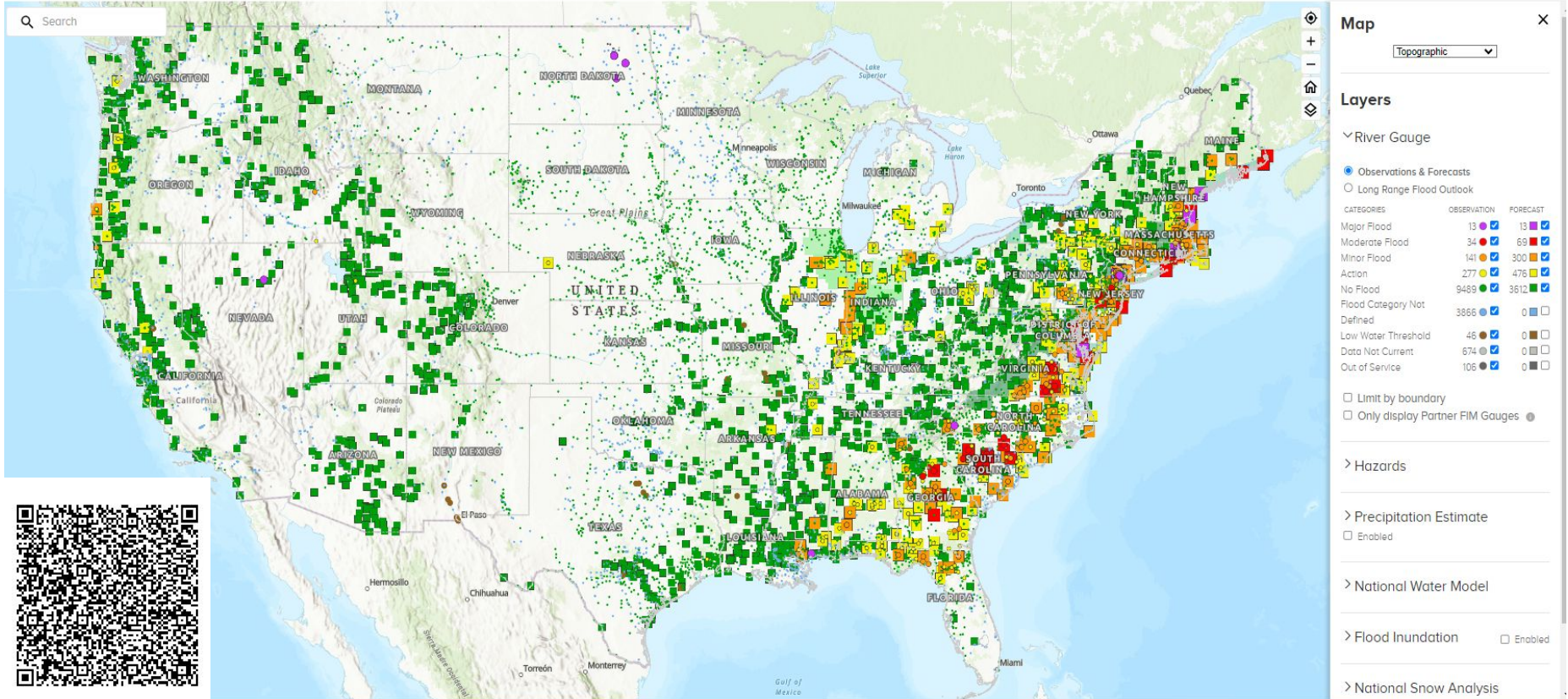
NWPS Flyer (Coming Soon)
NWPS Fact Sheet
NWPS Overview (Story Map)
NWPS Product and User Guide
Recording of NWPS Partner Webinar
Recording of NWPS API Webinar
Service Description Document (SDD)

Contact: nwps.webmaster@noaa.gov



National Water Prediction Service (NWPS)

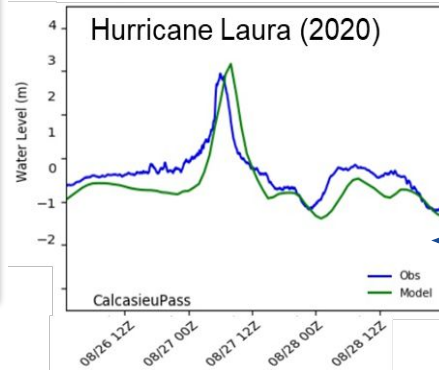
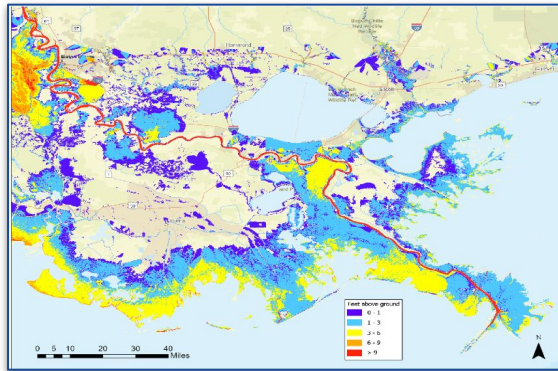
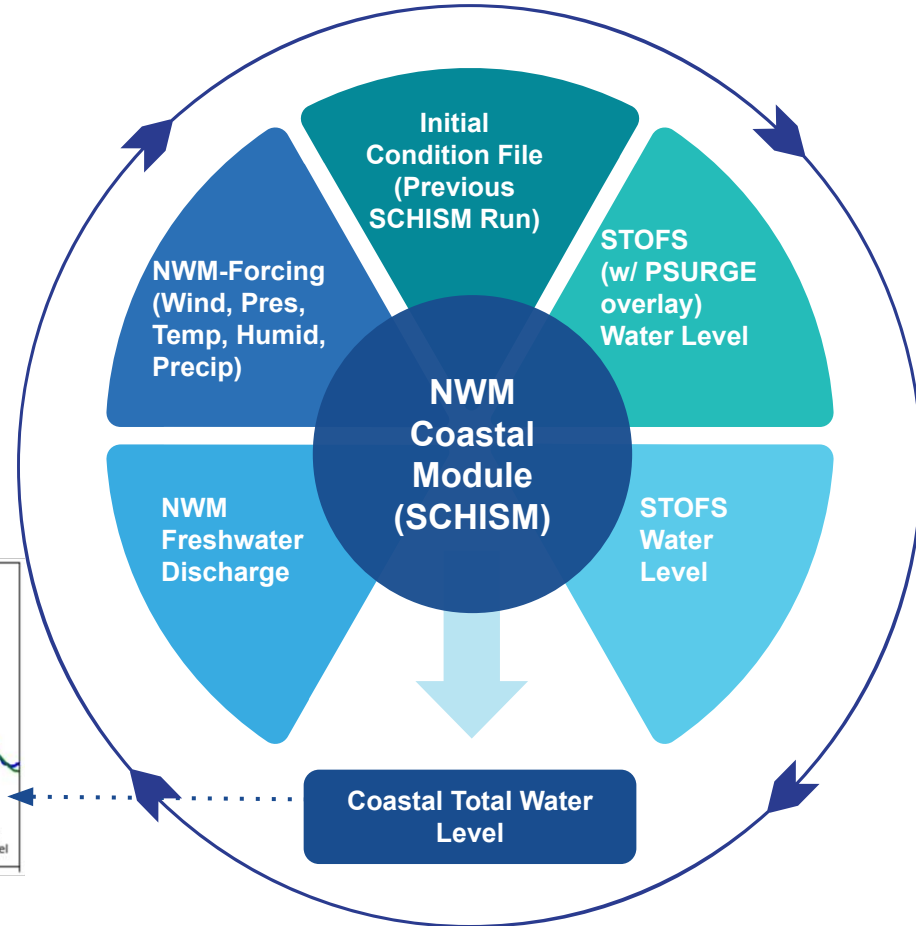
Implementation today!!

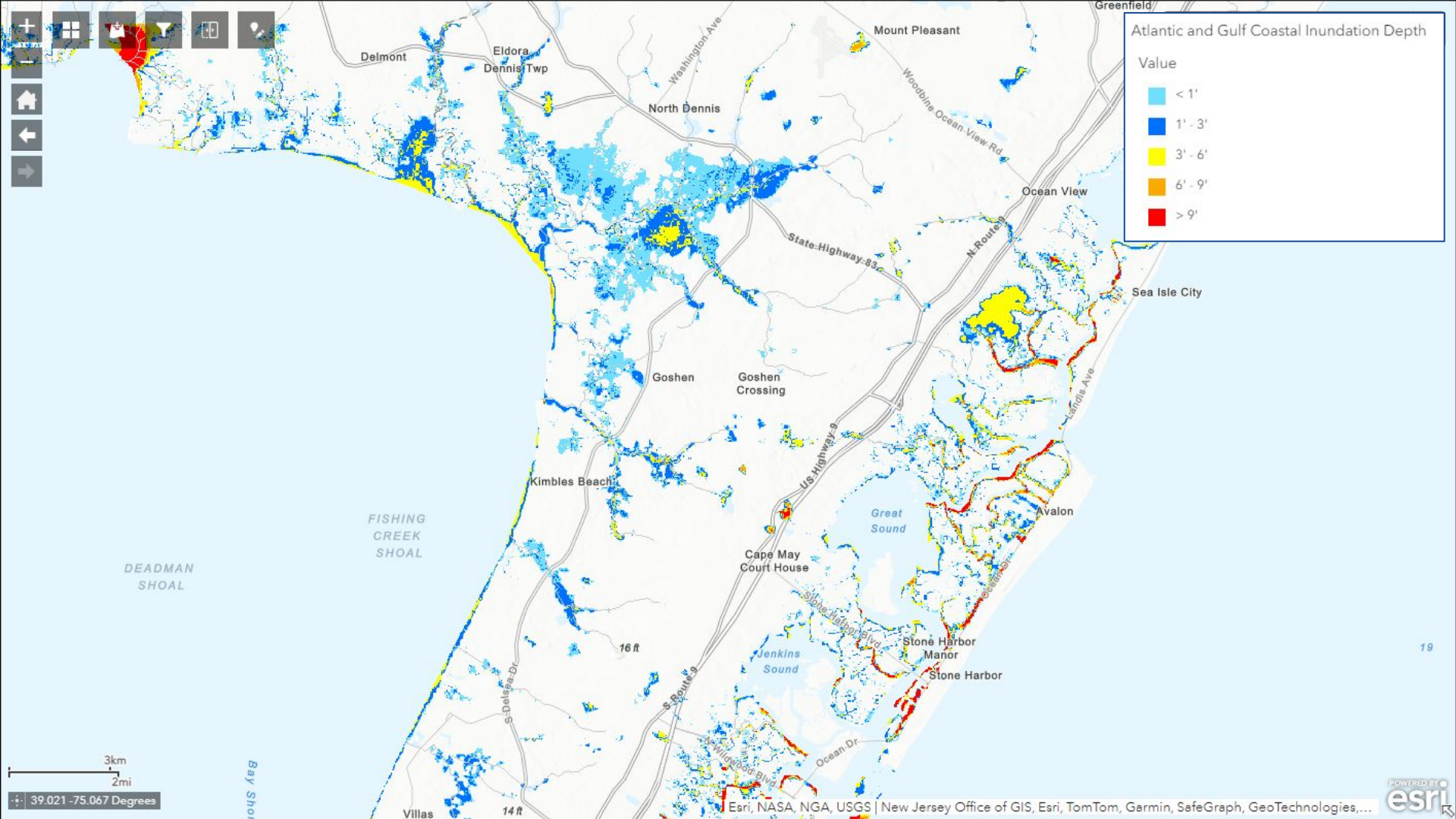


NWM v.3.0 (2023): New Total Water Level Forecasting Capability

Filling the capability gap

- TWL guidance is increasingly critical to the 100 million+ people living near the coast
- National total water level forecasts from the NWM will complement existing regional forecasts with *CONUS-wide, Hawaii, and PR/VI guidance*
- This new freshwater-estuary-ocean coupling will leverage the NWM, SCHISM, STOFS & PSURGE, execute in both Analysis and Forecast modes.





FIM IDSS workshops for field SMEs

- Intensive 3 day workshop
- Event simulations including the delivery of IDSS to partners
- Since November of 2022 we've trained:
 - **~ 133 field staff in 52 offices**
 - **10 RFCs, 42 WFOs, 4 ROCs, and the NWS NOC**
- Field offices SMEs train their staff & train their partners
- Suite of training and outreach resources for local office and partner training



Local Field Office Partner Training Resources

Training Partners and Stakeholders

[Presentations](#)

[Best Practices](#)

[Templates](#)

[Local Examples](#)

Presentations

Basic Partner Training Slides

Advanced Partner Training Slides

[BASIC] FIM CONOPS Partner Training Talking Points

Why We Use FIM

Slide 3

- This is the "WHY" slide where you introduce partners to the concept of and buy-in for FIM
- FIM is changing the way we communicate flood forecasts and associated impacts by allowing us to predict and visually portray inundation extent
- This improves how you protect lives and property by allowing for more timely and accurate inundation predictions and inundation extents

Slide 3 - Do not underestimate the importance of the "WHY" and buy-in at the beginning of this training. It will set the stage for the partner's interaction with FIM going forward as well as their willingness to engage the FIM training. Be sure to accurately emphasize the advantages and "WHY" of using FIM, specifically the area in which your partners operate

[ADVANCED] FIM CONOPS Partner Training Talking Points

National Weather Service

Slide 3

- This is a look at the National Weather Service, where the National Water Model came from, and where the people the partners talk to [use forecasters at an RFC or WFO] fit into the structure of things

Slide 3 - Feel free to customize this slide with organization/office names your partner deals with on a regular basis to make it more pertinent

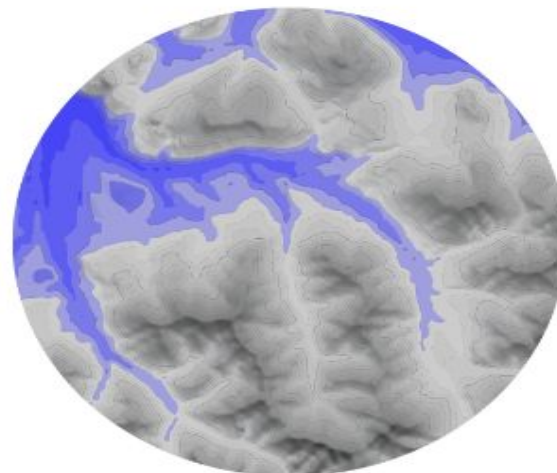
HAND Method

Slide 4

- HAND [Height Above Nearest Drainage] is the method by which water elevation in a stream or reach is applied to a grid representing the terrain to depict inundation extent (GF on this slide represents that process)







Customizable Template: Tabletop Exercise Manual [Date of Exercise]

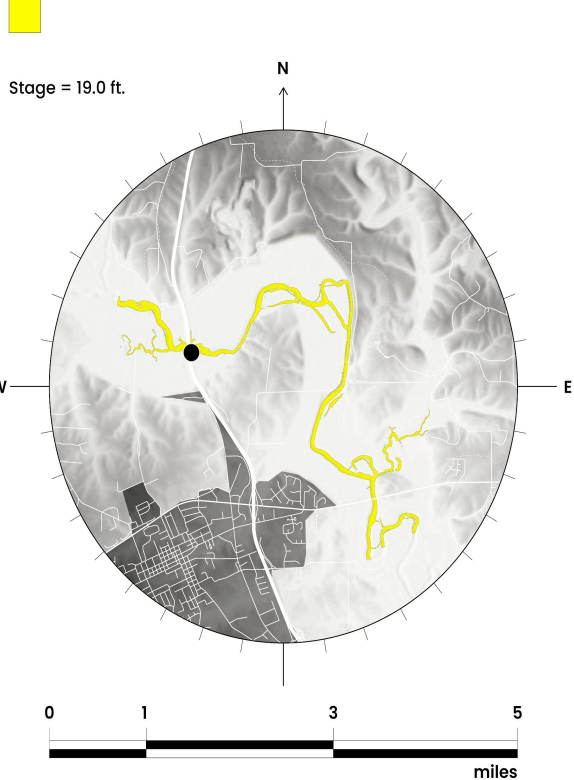


Local Office & Partner Training Reference Information

Dynamic FIM Services Comparison Table

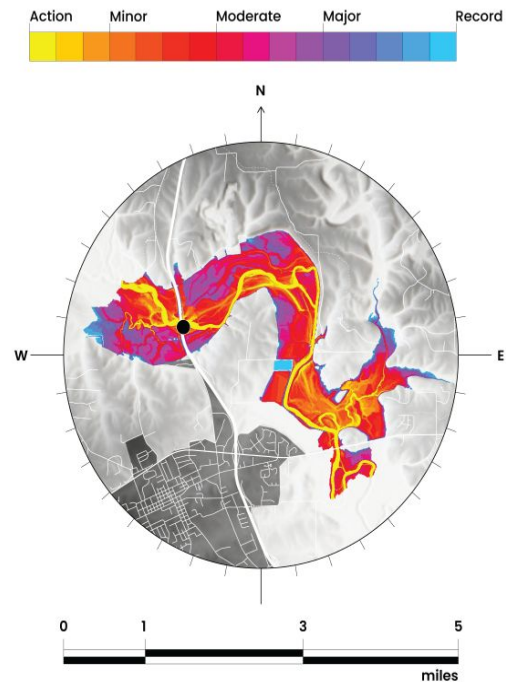
FIM Service	NWM Latest Analysis FIM	RFC 5-Day Max FIM	NWM 5-Day Max FIM
			
Data Type	Observation-based simulations [precipitation estimate and assimilated with USGS gage observations]	Forecast [5-day RFC forecasts]	Forecast [5-day QFS]
Total Latency	55 minutes	45 minutes	6 hours 30 minutes
Update Frequency	Hourly	Hourly [if new forecasts are available]	Every 6 hours
FIM Domain	NWM domain for FIM 10% [parts of eastern TX and mid-Atlantic]	Downstream of AHPs forecast points for FIM 10% [parts of eastern TX and mid-Atlantic]	NWM domain for FIM 10% [parts of eastern TX and mid-Atlantic]
When to Use	Use as a snapshot of the most recent modeled inundation	Use when RFC forecast is available	Use for rivers and streams not covered by RFC forecast

Action Minor Major Record



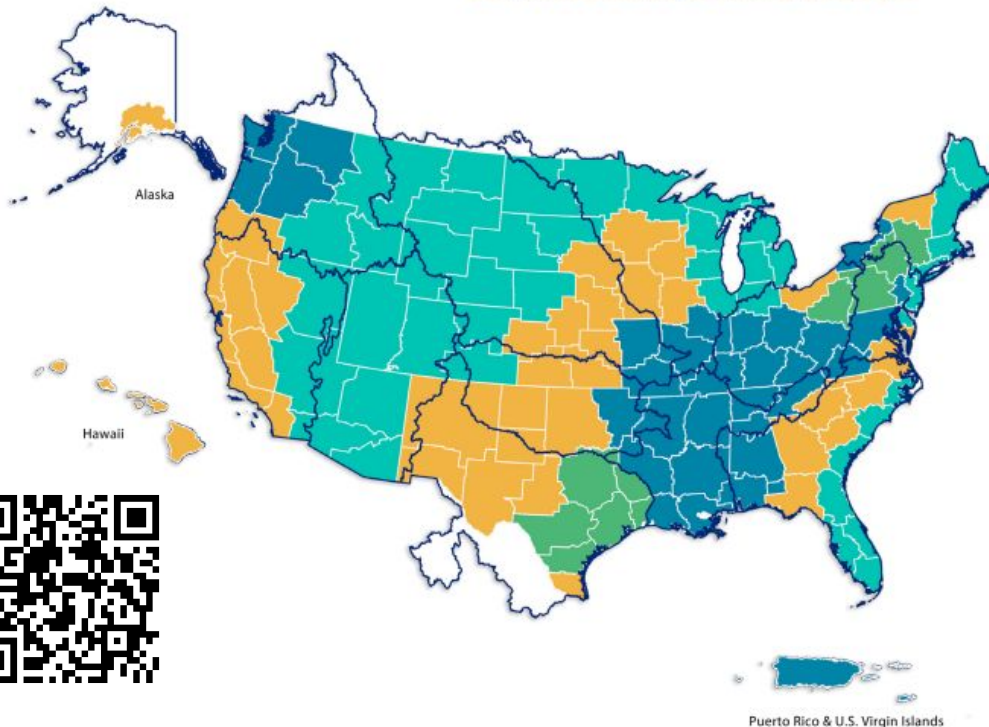
National Oceanic and Atmospheric Administration

Stage-Based Categorical FIM Summary Sheet



Phased Implementation Approach Through 2026

NWS Flood Inundation Mapping Services Implementation



Map Legend



- NWS County Warning Areas
- NWS River Forecast Center Boundaries

*100% is approximate. Does not include all parts of Alaska, American Samoa, and Guam. Implementation areas are subject to change.

OWP
Operations



<https://www.weather.gov/owp/operations>



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Thank You!



David R. Vallee



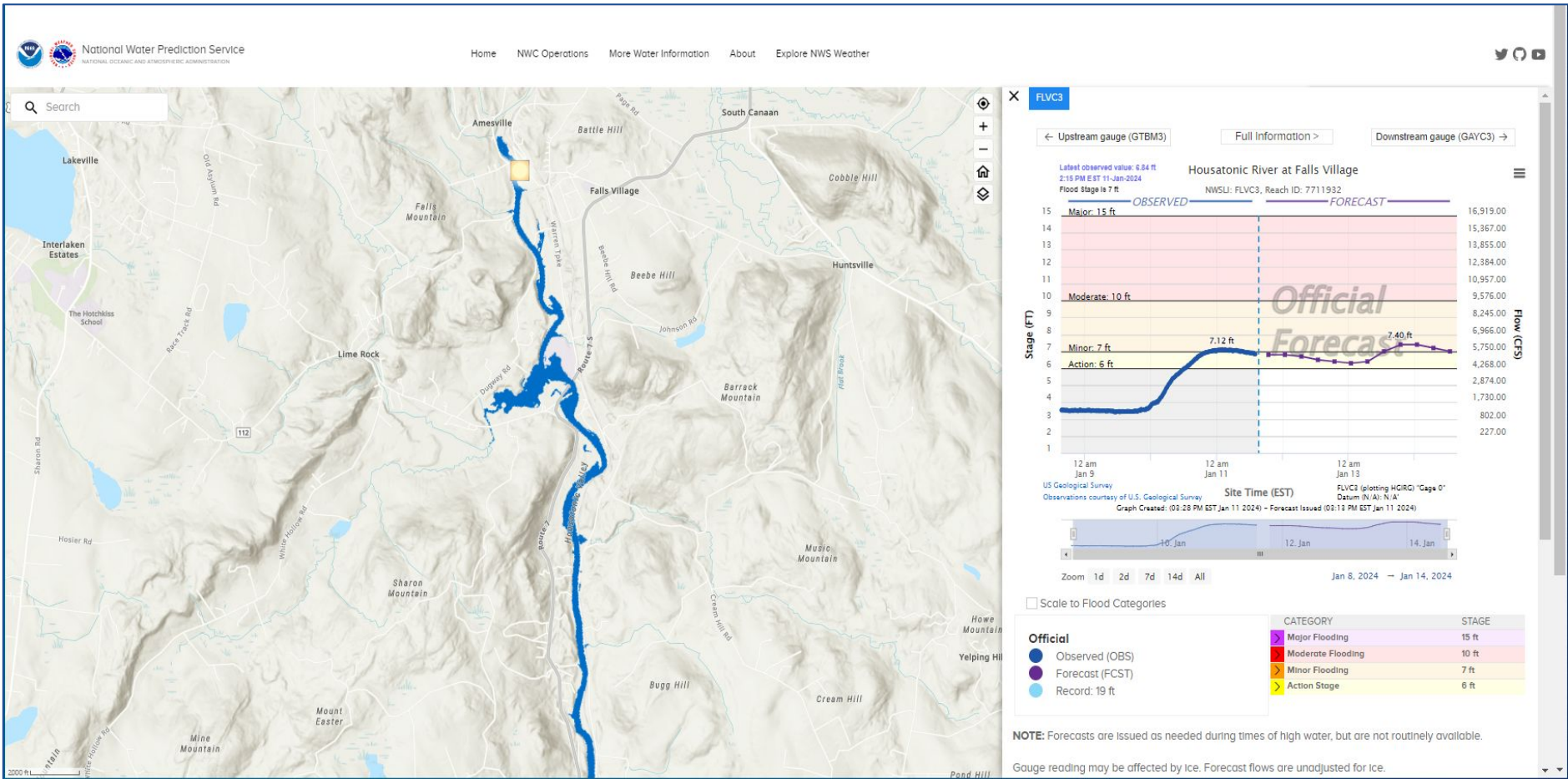
david.vallee@noaa.gov



<https://water.noaa.gov>

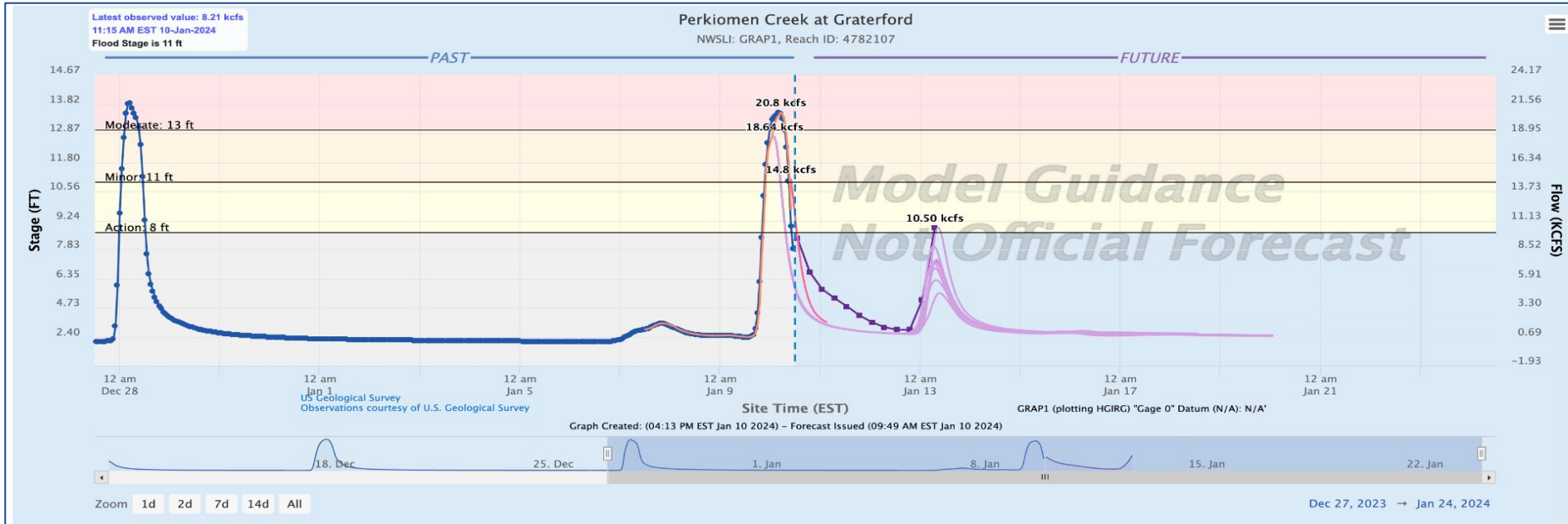
National Water Prediction Service (NWPS)

Linking RFC Forecasts and RFC FIM Services



National Water Prediction Service (NWPS)

NWM Guidance at Point Locations



Official
 ● Observed (OBS)
 ● Forecast (FCST)

CATEGORY	STAGE
Major Flooding	16 ft
Moderate Flooding	13 ft
Minor Flooding	11 ft
Action Stage	8 ft

National Water Model

- Analysis (ANA)
- Medium Range Blend (MRB)
- Short Range (SR)

∨ **Medium Range Ensembles**

- Medium Range Ensemble Mean (MRM)
- Medium Range Ensemble 1 (MR 1)
- Medium Range Ensemble 2 (MR 2)
- Medium Range Ensemble 3 (MR 3)
- Medium Range Ensemble 4 (MR 4)

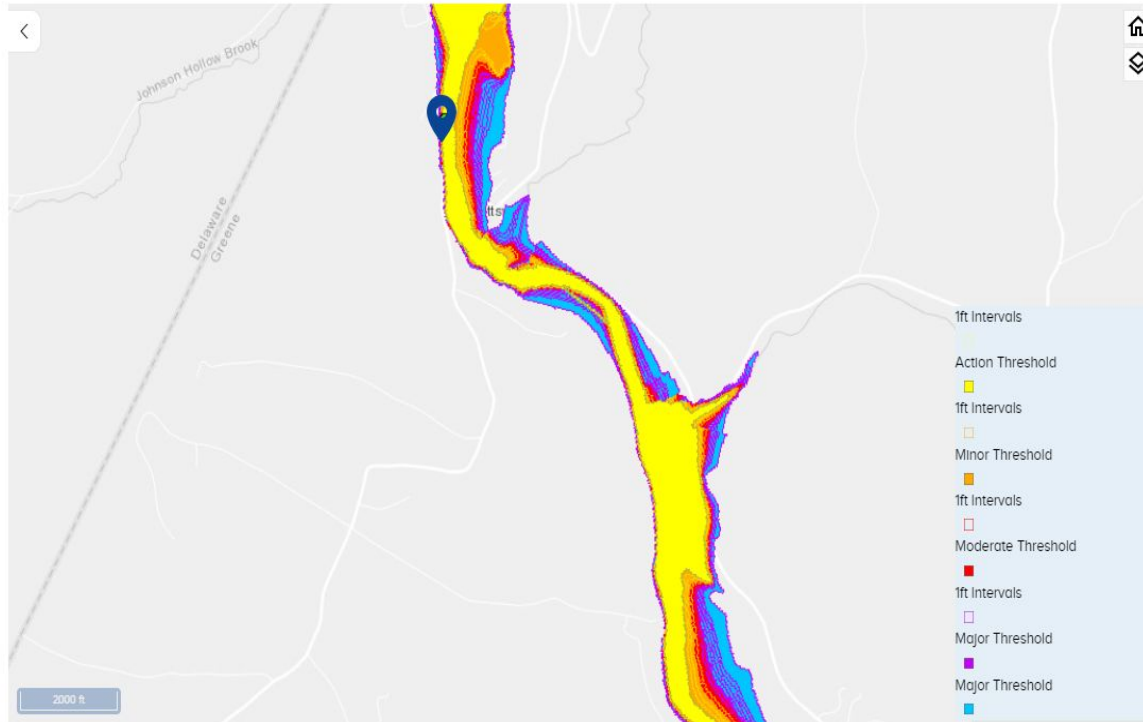
Example of NWM Guidance for Perkiomen Creek, January 10th, 2024

National Water Prediction Service (NWPS)

Example of Stage-based Categorical FIM

Gauge Location

- Action 1ft Intervals
- Action Threshold
- Minor 1ft Intervals
- Minor Threshold
- Moderate 1ft Intervals
- Moderate Threshold
- Major 1ft Intervals
- Major Threshold
- Major Threshold



- Display PTVN6 marker
- Activate PTVN6 FIM Gauge
- Deactivate PTVN6 CATFIM
- Display FEMA's National Flood Hazard Layers

Current Stage:
3.89 ft at 2023-12-01 23:22:05 UTC

Highest Forecast: 6.3 ft

Current Mouse Location

Recent Crests

- 13.85 ft on 10-26-2021 (P)
- 17.53 ft on 12-25-2020 (P)
- 13.55 ft on 10-30-2017
- 12.03 ft on 02-25-2016
- 13.71 ft on 09-07-2011

[SHOW ALL CRESTS](#)

Historic Crests

- 24.38 ft on 08-28-2011
- 19.57 ft on 03-05-1979
- 19.5 ft on 01-26-1978
- 19.39 ft on 01-19-1996
- 19.14 ft on 10-16-1955

[SHOW ALL CRESTS](#)

Some Light

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Science Behind the Flood Inundation Mapping

Derek Giardino

Flood Inundation Program Lead

Geo-Intelligence Division

March 27, 2024



Flood Inundation Mapping



The Mapping Process

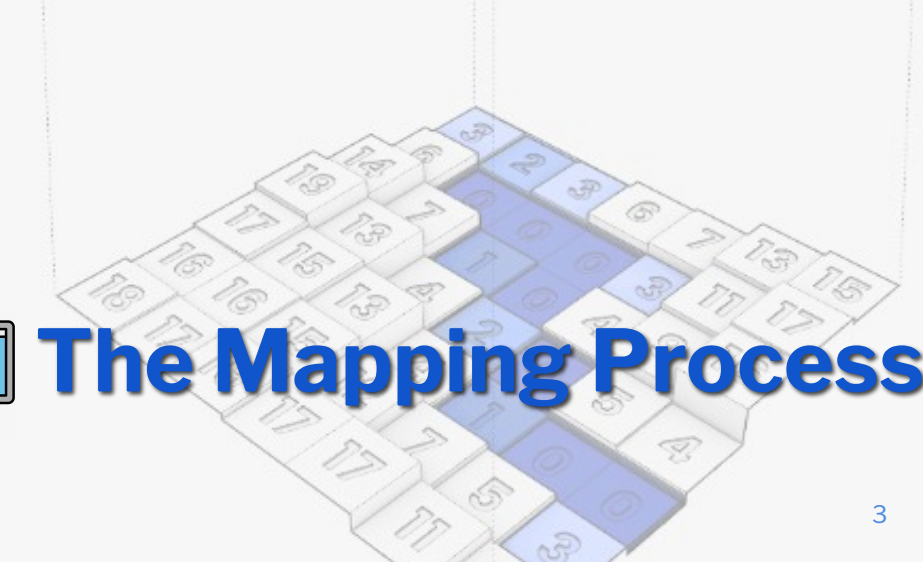
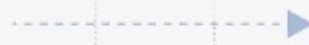
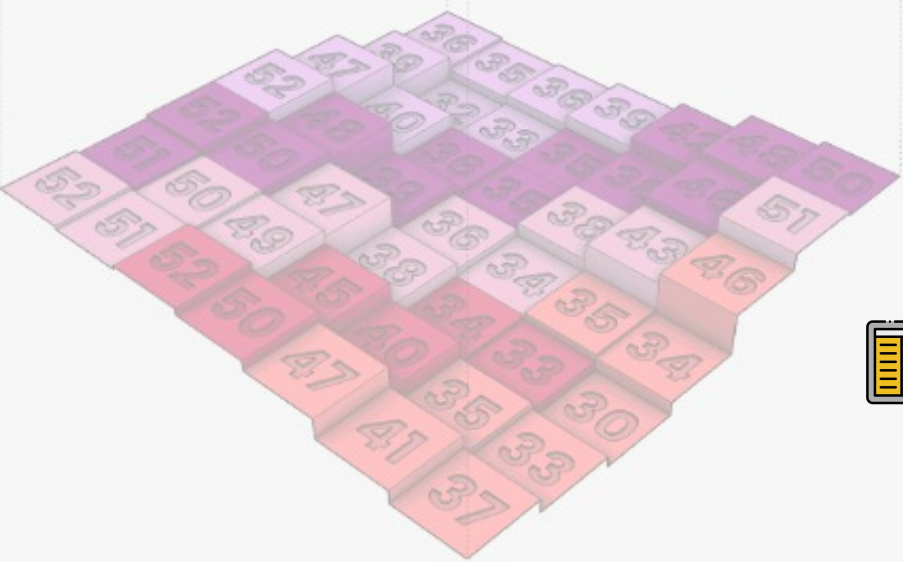


Different Types of Mapping



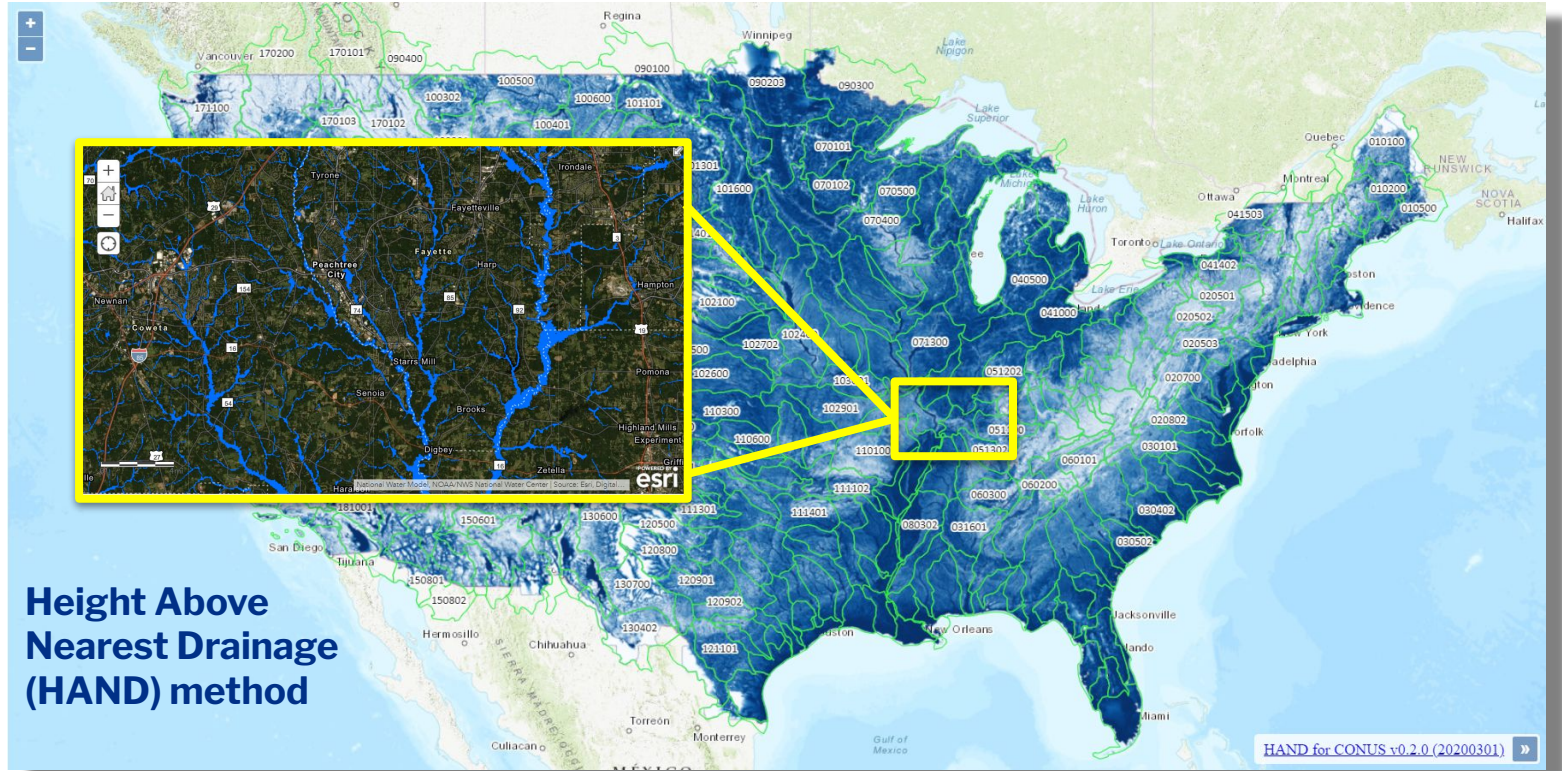
Coastal Total Water Level Mapping





The Mapping Process

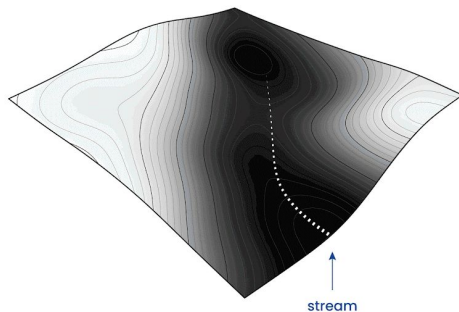
Continental Scale Flood Inundation Mapping System



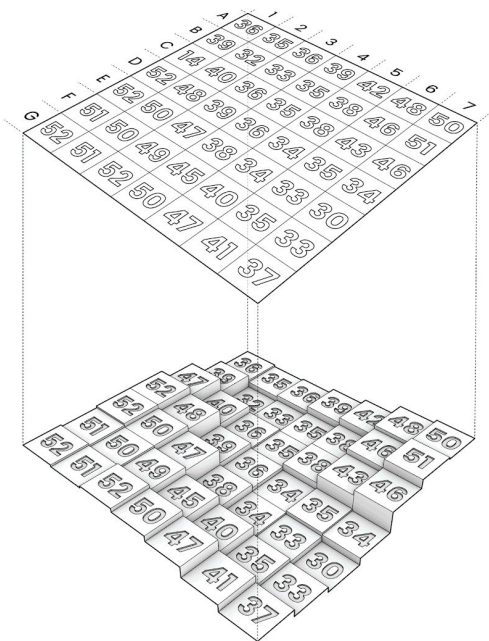
Hydrofabric = USGS 3DEP + USGS NHD+

Height Above Nearest Drainage (HAND) Terrain Model

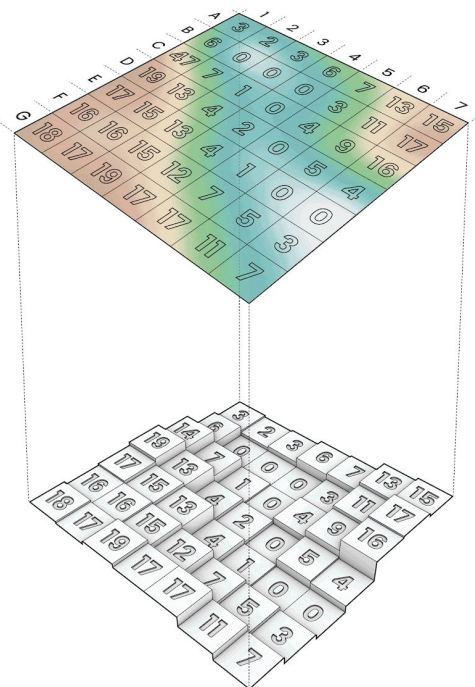
Step 01. DEM Hydroconditioning & Waterflow Analysis



Step 02. DEM to REM Conversion Using HAND Method



Step 03. Applying FIM to REM Grid



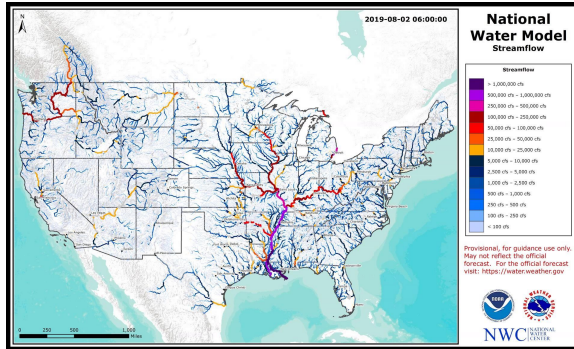
3DEP terrain

10m Resolution DEM-Derived Terrain

3D Visualization of HAND-Derived REM

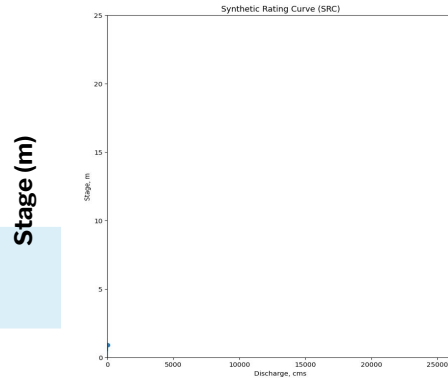
Forecast Streamflow to Forecast Flood Maps

Streamflow Forecasts



RFC Forecasts
NWM Forecasts

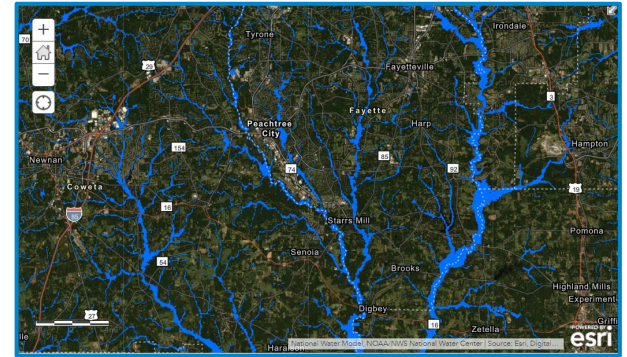
Stage Forecasts



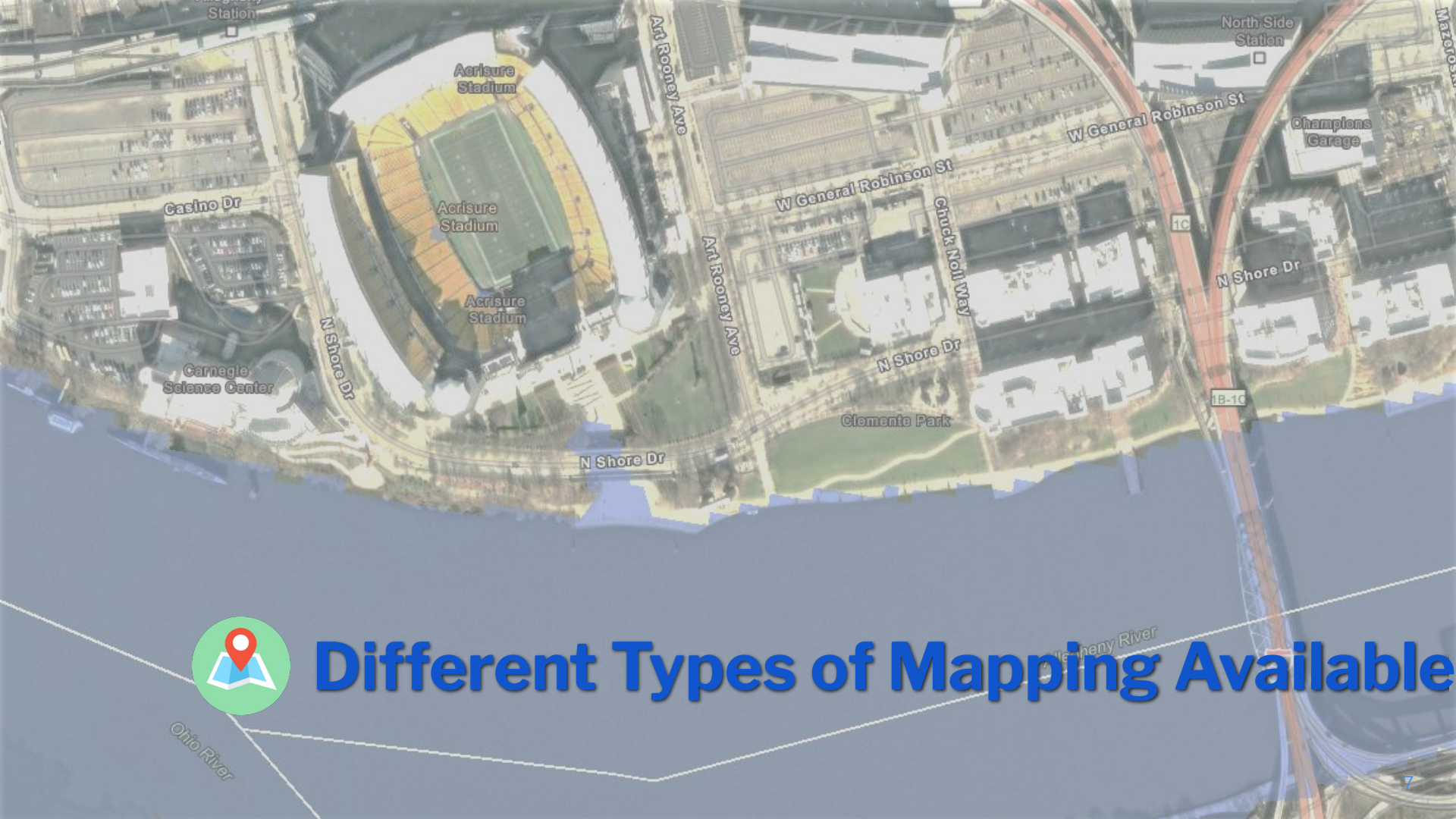
Discharge (cms)

Leveraging Synthetic Rating Curves (SRCs)

Inundation Forecasts



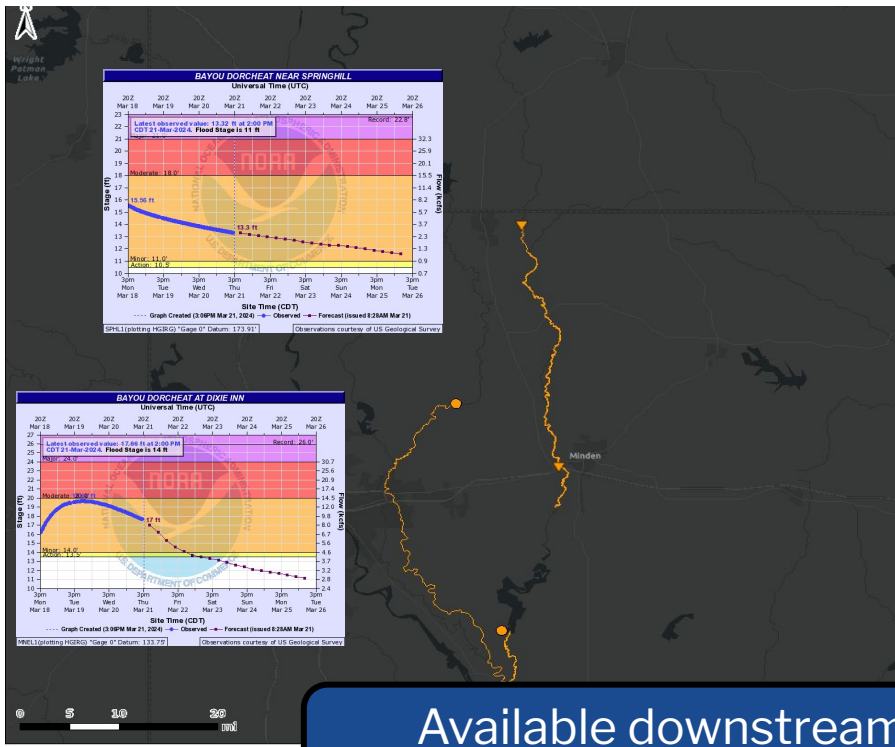
Leveraging HAND Method



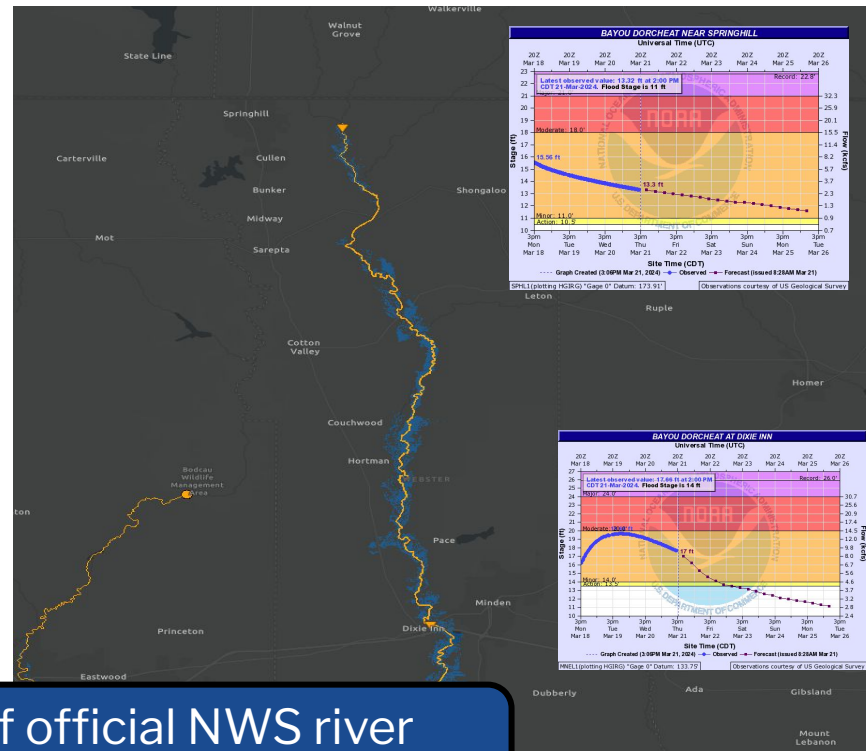
Different Types of Mapping Available

River Forecast Center Flood Mapping

The Forecast Used



The Mapping Available



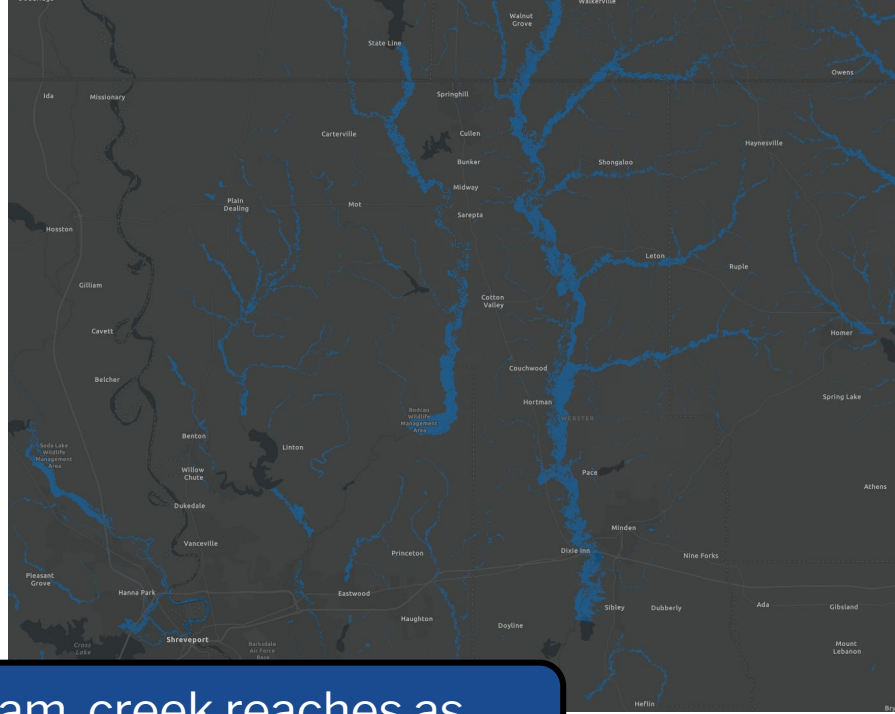
Available downstream of official NWS river forecast point locations

National Water Model Flood Mapping - 3.4 million river miles

The Forecast Used



The Mapping Available



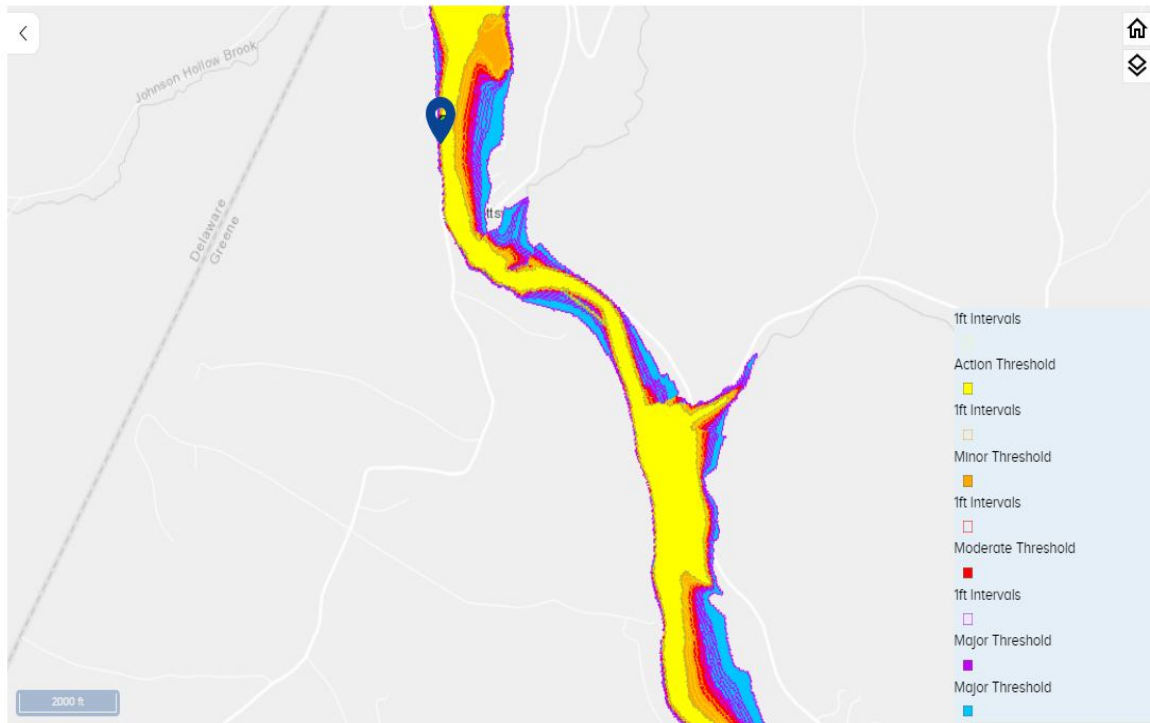
Available at all river, stream, creek reaches as defined in the National Water Model Hydrofabric

National Water Prediction Service (NWPS)

Example of Stage-based Categorical FIM

Gauge Location

- Action 1ft Intervals
- Action Threshold
- Minor 1ft Intervals
- Minor Threshold
- Moderate 1ft Intervals
- Moderate Threshold
- Major 1ft Intervals
- Major Threshold
- Major Threshold



- Display PTVN6 marker
- Activate PTVN6 FIM Gauge
- Deactivate PTVN6 CATFIM
- Display FEMA's National Flood Hazard Layers

Current Stage:

3.89 ft at 2023-12-01 23:22:05 UTC

Highest Forecast: 6.3 ft

Current Mouse Location

Recent Crests

13.85 ft on 10-26-2021 (P)

17.53 ft on 12-25-2020 (P)

13.55 ft on 10-30-2017

12.03 ft on 02-25-2016

13.71 ft on 09-07-2011

[SHOW ALL CRESTS](#)

Historic Crests

24.38 ft on 08-28-2011

19.57 ft on 03-05-1979

19.5 ft on 01-26-1978

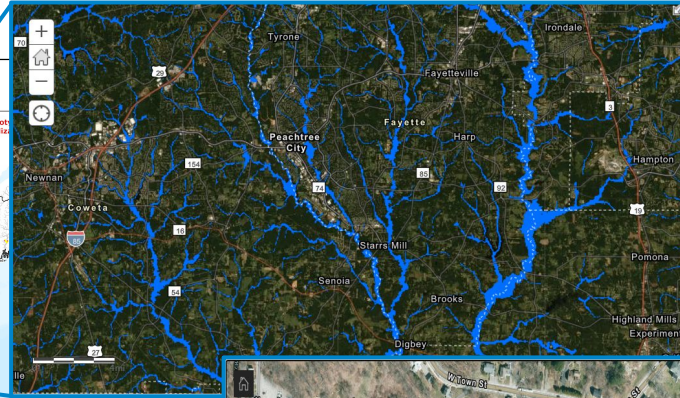
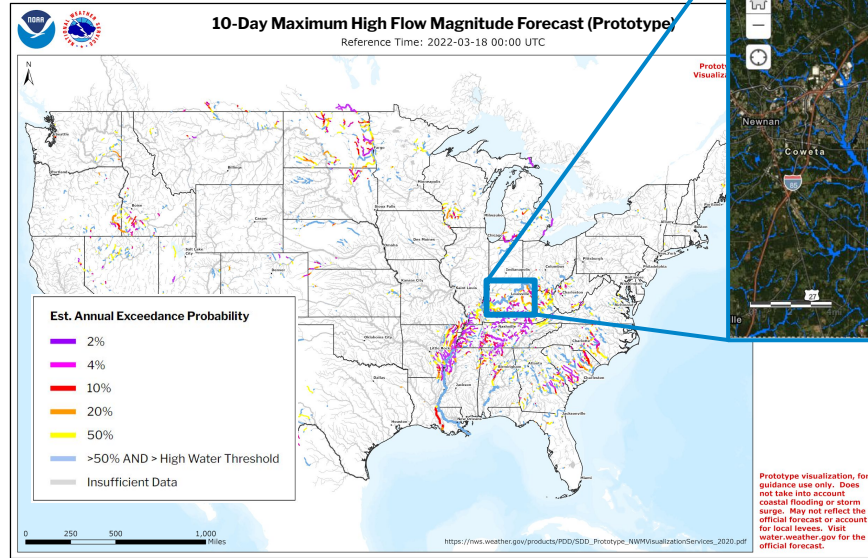
19.39 ft on 01-19-1996

19.14 ft on 10-16-1955

[SHOW ALL CRESTS](#)

Building a Common Operating Picture for Flood Events

NWC Visualization Services



Actionable,
neighborhood
level **intelligence**
on current and
impending floods



National Water Model
10-Day High Flow Magnitude Forecast

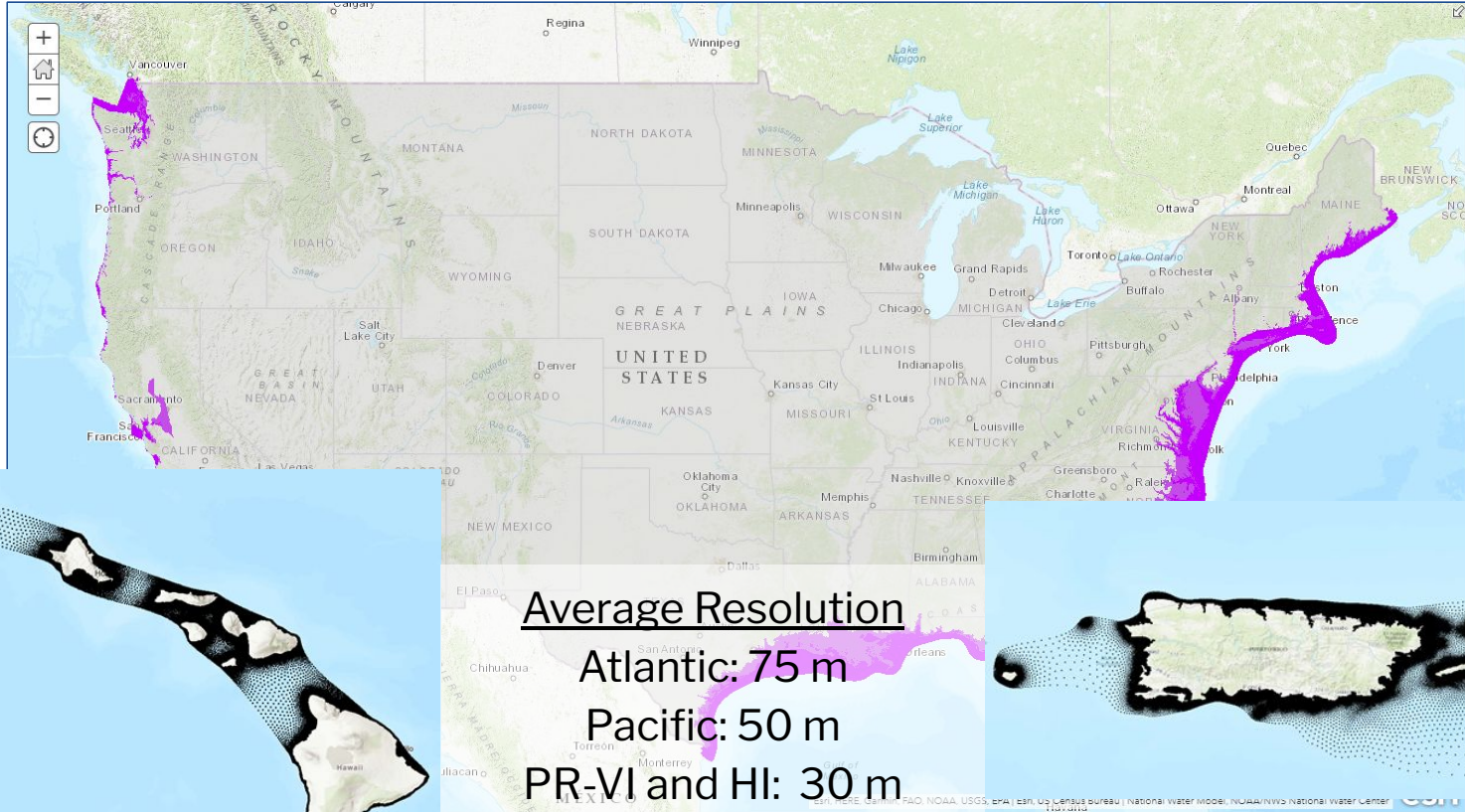
*Synthesizing ~ 1 TB of NWM and RFC
forecast data each day*

Geospatial services hosted in HydroVIS cloud

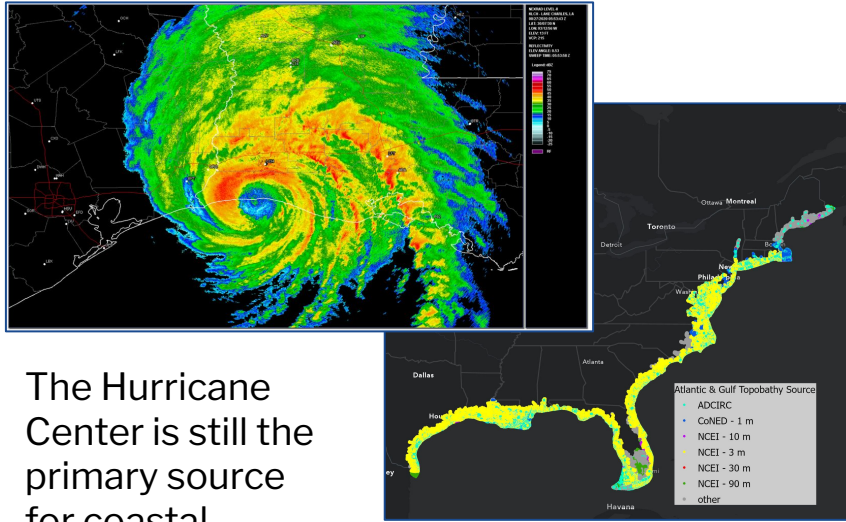


Coastal Total Water Level Modeling

Inland and Coastal FIM Services



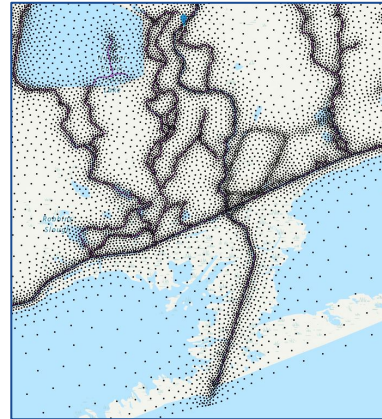
Total Water Level (TWL) Forecasts



The Hurricane Center is still the primary source for coastal impacts in advance of a landfalling tropical system

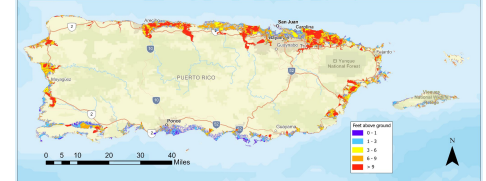
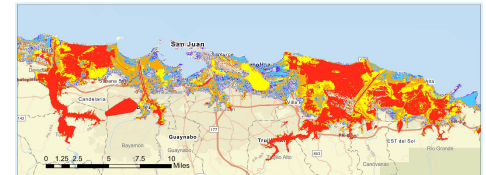
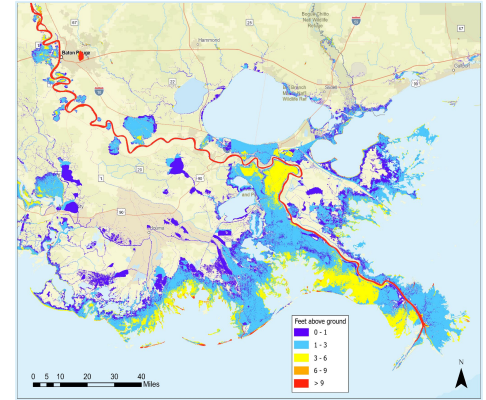
Integrated topobathy DEM compiled from multiple data sources and resolutions.

Inundation Depth



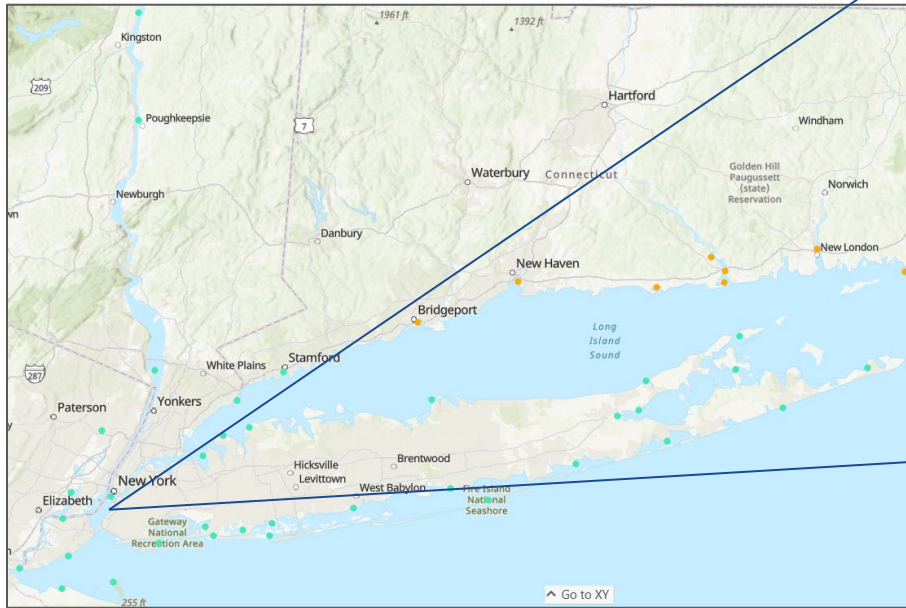
NWM v3.0 SCHISM model mesh along coastal fringe.

TWL forecast extent and depth

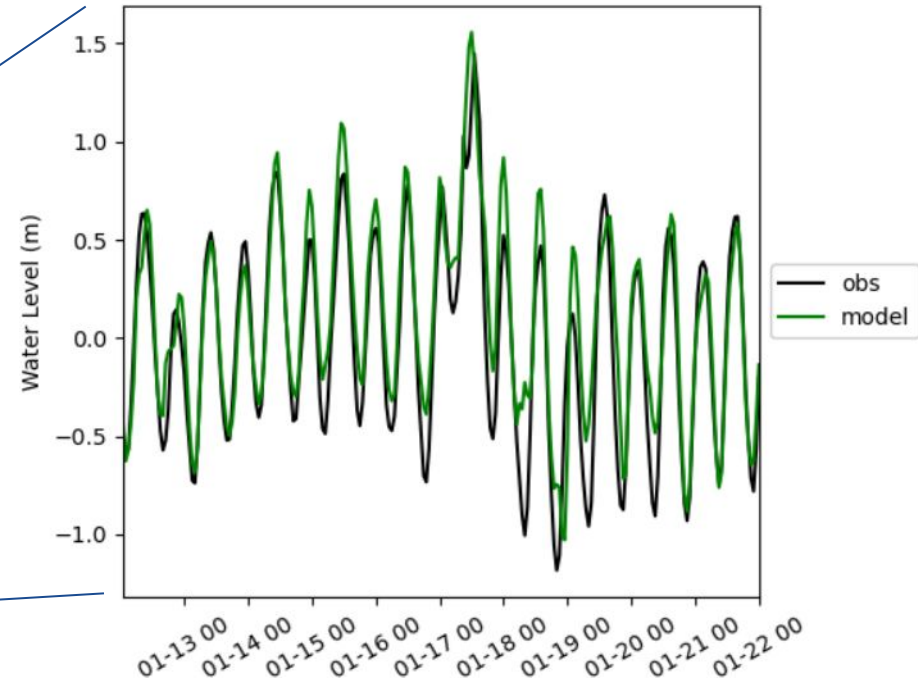


Total Water Level for Strong Nor'easter January, 2022

Service available for any coastal event, not just tropical, providing guidance for Nor'easters, non tropical offshore storms, etc.



New York Harbor at The Battery (BATN6)



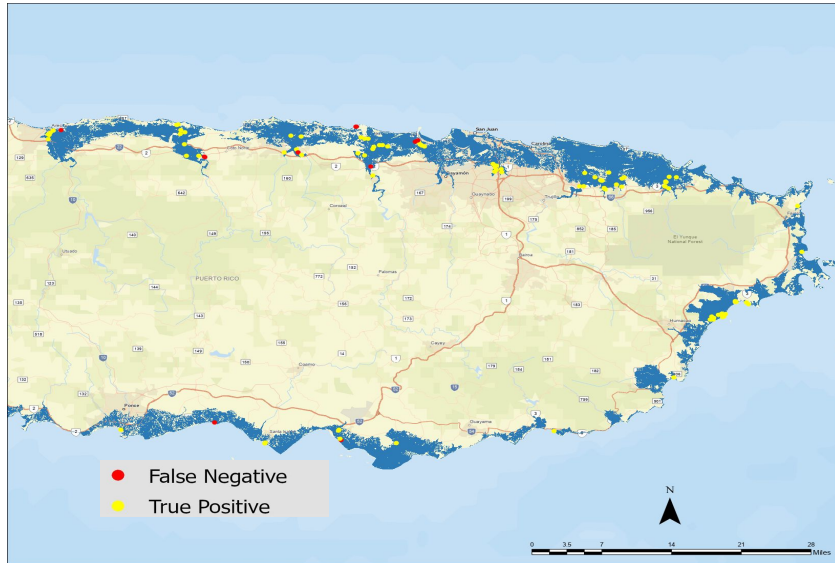
Coastal flooding in New York City



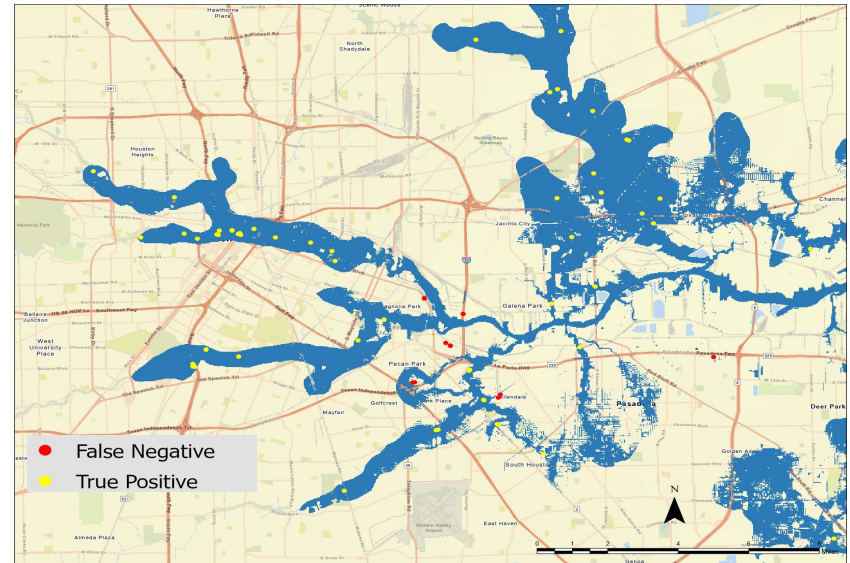
NWM v3.0: Supporting Flood Inundation Mapping

Examples of Coastal FIM derived from NWM v3.0 SCHISM output

NWM-Driven Maximum FIM, Hurricane Maria (PR)



NWM-Driven Maximum FIM, Hurricane Harvey (Houston, TX)



- Internal real-time FIM TWL testing will transition to public experimental phase with 60% CONUS coverage
- This will make possible summit-to-sea inundation maps, with impacts of inland freshwater and coastal TWL



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Thank You!



Derek Giardino



derek.giardino@noaa.gov



<https://water.noaa.gov>

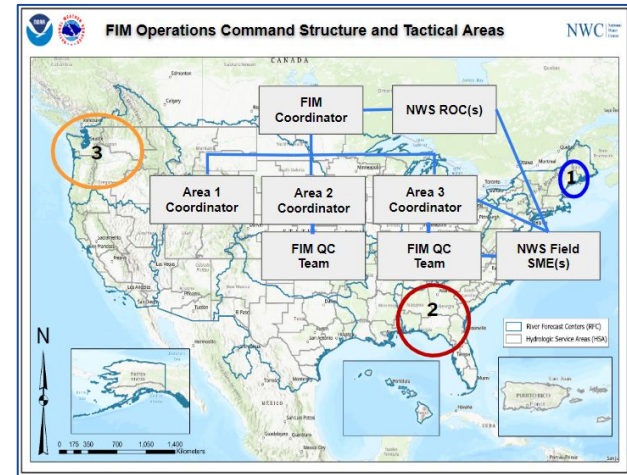
Operationalizing Flood Inundation Mapping (FIM) in the NWS

Jason Elliott

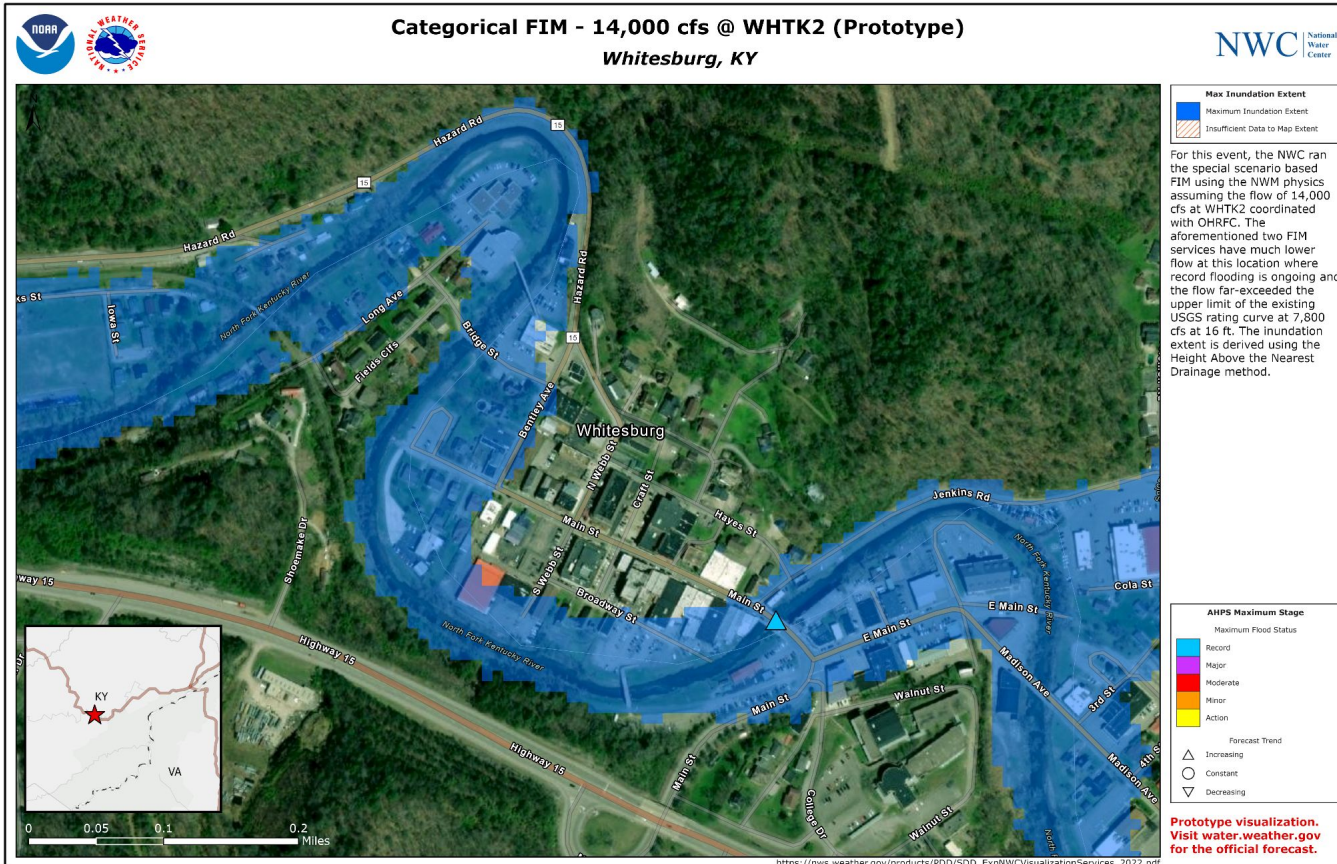
*Service Coordination Hydrologist, Water Prediction Operations Division
Office of Water Prediction | National Water Center*

FIM Operations within NWC

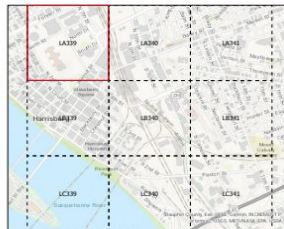
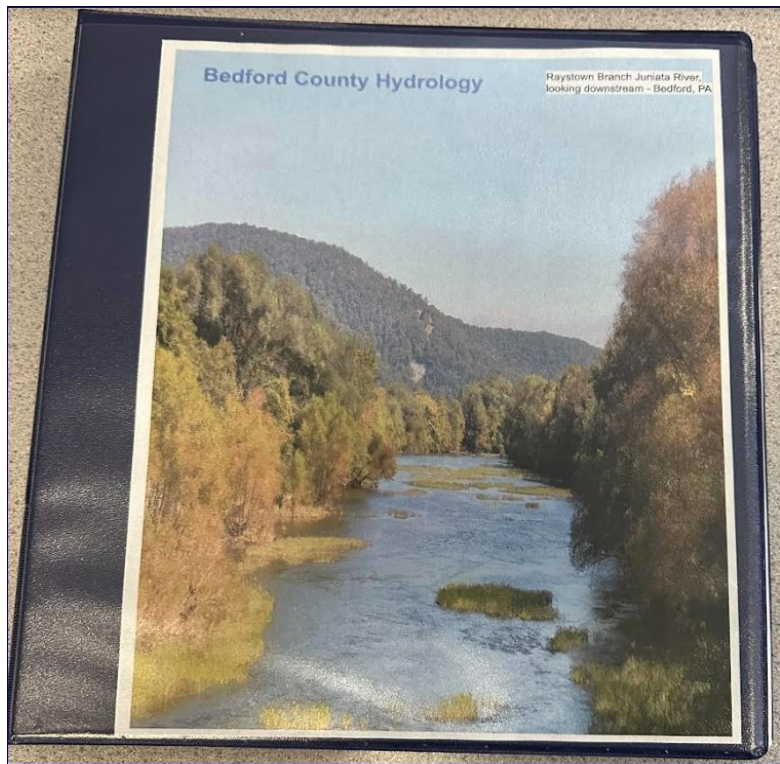
- Facilitate evaluation and coordination of the NWS FIM
- Provide FIM Impact-based Decision Support Services (IDSS)
- Provide FIM-based forecast guidance to NWS core partners, and
- Provide reach-back capabilities to our internal NWS partners
 - Support scientific understanding, interpretation, and IDSS based on FIM



Categorical FIM for Whitesburg, KY



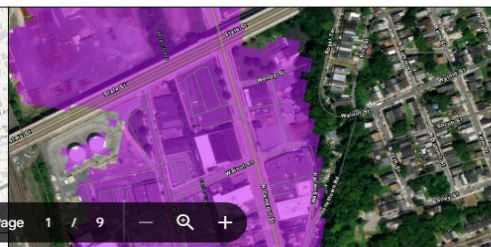
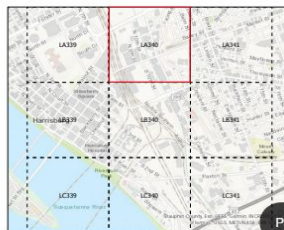
State College, PA - Outreach Efforts



Name: Harrisburg 50-Year Flood Map

Description: This map zooms in on areas of Harrisburg, PA to show potential flooding at roughly the 50-year flood event. The National Water Model (NWM) AEP (annual exceedance probability) maps were based on the 40-year NWM v2.1 reanalysis simulation, utilizing a flow frequency analysis method described in Bulletin 17C guidelines developed by the United States Geological Survey (USGS). The "high water" conditions depicted in the maps are approximated regionally with an AEP that aligns with the "Action" flood threshold of the NWS forecast points within each region. Regions are defined by McCabe and Woolck (2016) based on a spatial analysis of variability in water-year runoff efficiency across HUC8 units. These NOAA AEP inundation maps represent a model simulation and do not have any regulatory authority. See FEMA fact sheet on flood insurance HERE (<https://www.fema.gov/flood-insurance/rules-legislation>).

Page 1 of 9



State College, PA - Internal Training



NWS CTP FIM Training

michael.jurewicz@noaa.gov [Switch account](#)



* Indicates required question

Email *

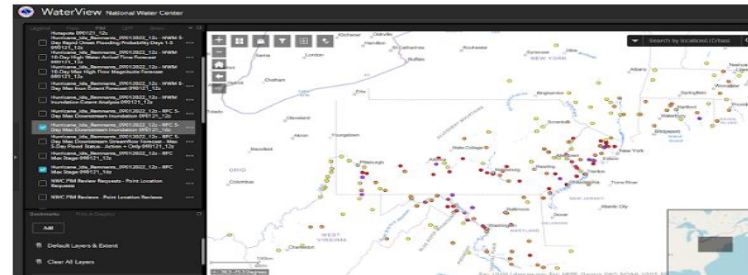
Record michael.jurewicz@noaa.gov as the email to be included with my response

If this is your first time every using the WaterView application, follow [these](#) instructions before returning to this training.

Open up the [WaterView](#) application and login using NOAA credentials (It may require 2 logins).

Your answer

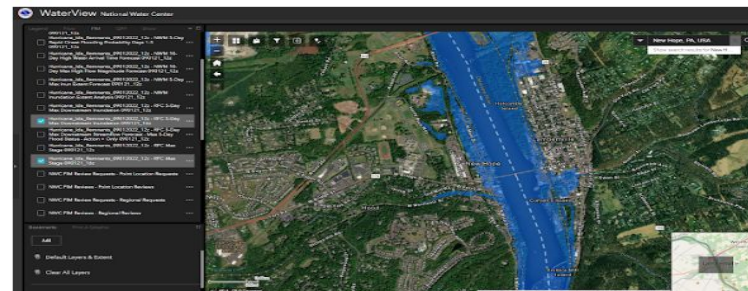
Click the "Add Data" button highlighted in yellow below:



Your answer

Using the Search location feature, type in New Hope, PA (NHPP1)

Change your map background to imagery hybrid



Your answer



A few recent success stories

David R. Vallee

*Director, Service Innovation and Partnership Division
Office of Water Prediction | National Water Center*

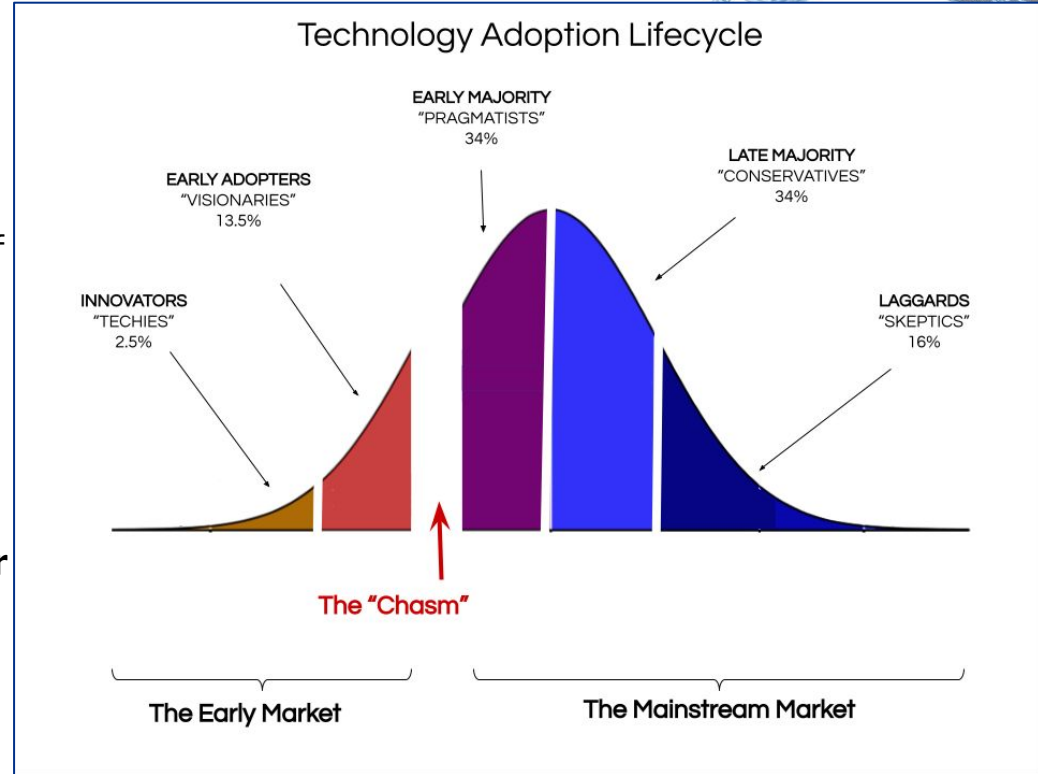
Integrating FIM Services into your Operations

Diffusion of Innovation

E. M. Rogers 1962.

Basic principle is the tiered **level of adoption** of a new idea, behavior, or **product for people to accept the innovation**

The **chasm concept** was added in 1991 by Geoffrey Moore discussing the adoption difficulty of new technology reaching the market and becoming **“a complete solution for one intractable problem to the mainstream market”**



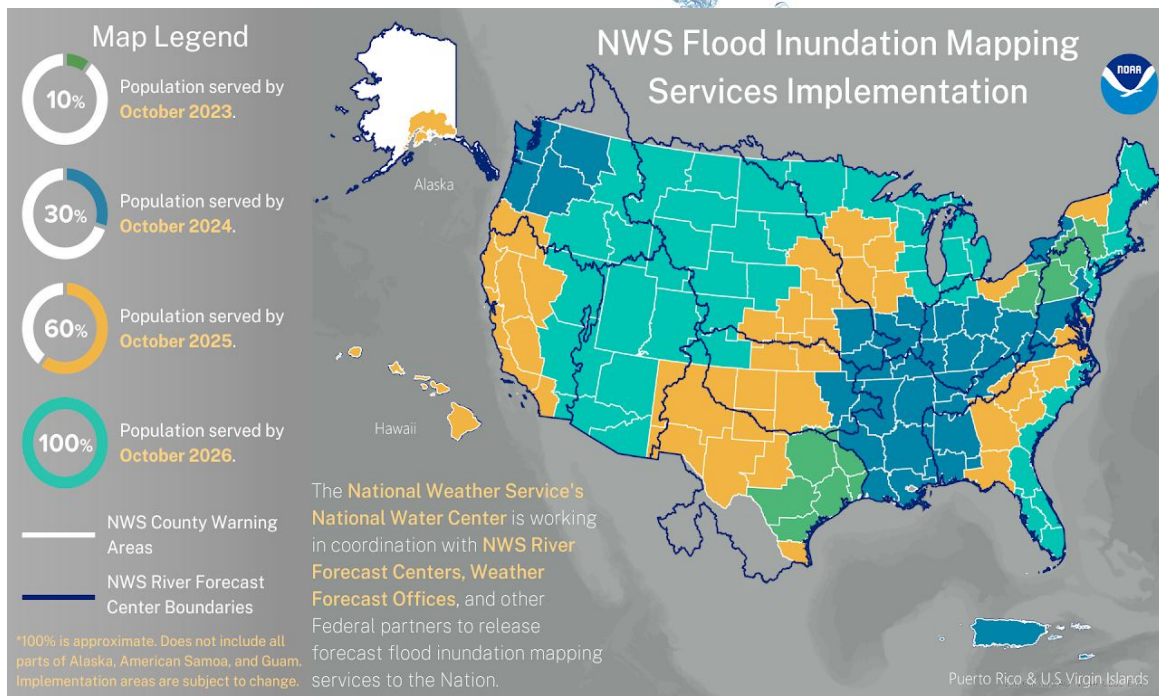
Integrating FIM Services into your Operations

Diffusion of Innovation for Flood Mapping

Currently flood mapping is **between the innovators and the early adopters**

Approaching the chasm for adoption as the revolutionary solution to flood hazards

A flood map on its own will not save any lives or protect anyone property, its adoption by critical decision makers and the general public is required



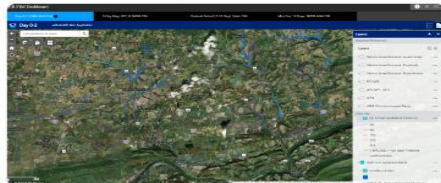
FIM IDSS in action: WFO State College, PA: Using SLACK



NWS - State College - Michael Dangelo 9:01 PM

Here's a look at some Flood Inundation Mapping output for now (01Z) in Montour and northern Columbia County. We'd love to know how this compares to reality. Any folks out there who have local knowledge of the area, please let us know if it seems accurate or at least reasonable.

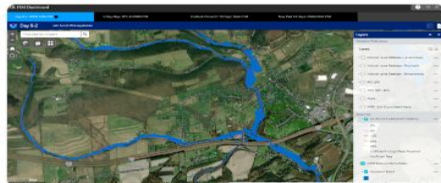
FIM_Columbia_Montour_09092023.PNG ▾



NWS - State College - Michael Dangelo 9:09 PM

Here's a zoom into Buckhorn and, in particular, the Hemlock Creek and Frozen Run. The red and purple lines along the creeks (see legend) mean that this level of water/flow only has about a 2-4% chance of occurring in any year. The larger blue area spread out from the creek center/normal channel is meant to be an approximation of the areal extent of the water.

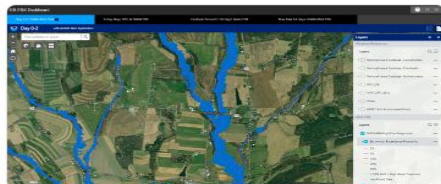
FIM_Columbia_Montour_09092023_2.PNG ▾



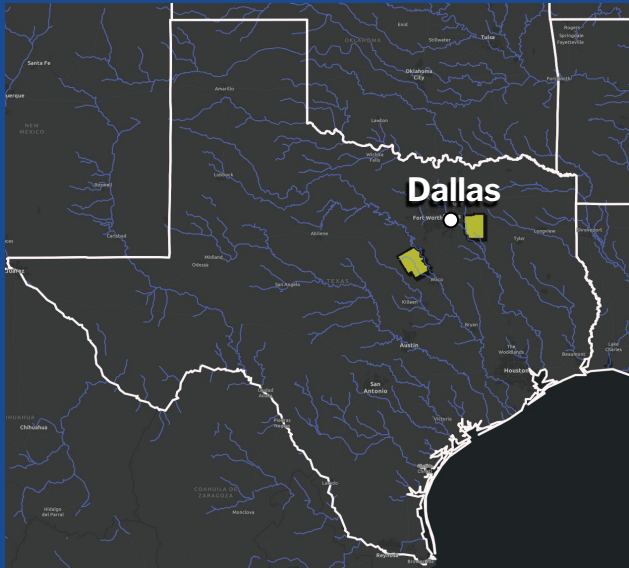
NWS - State College - Michael Dangelo 9:18 PM

Here's a shot near Rohrsburg where the Little Green Creek joins the Green Creek. The model is expecting that the water may be encroaching on some buildings in town. It'd be great to hear what the real conditions may be like there now. (edited)

FIM_Columbia_Montour_09092023_3.PNG ▾



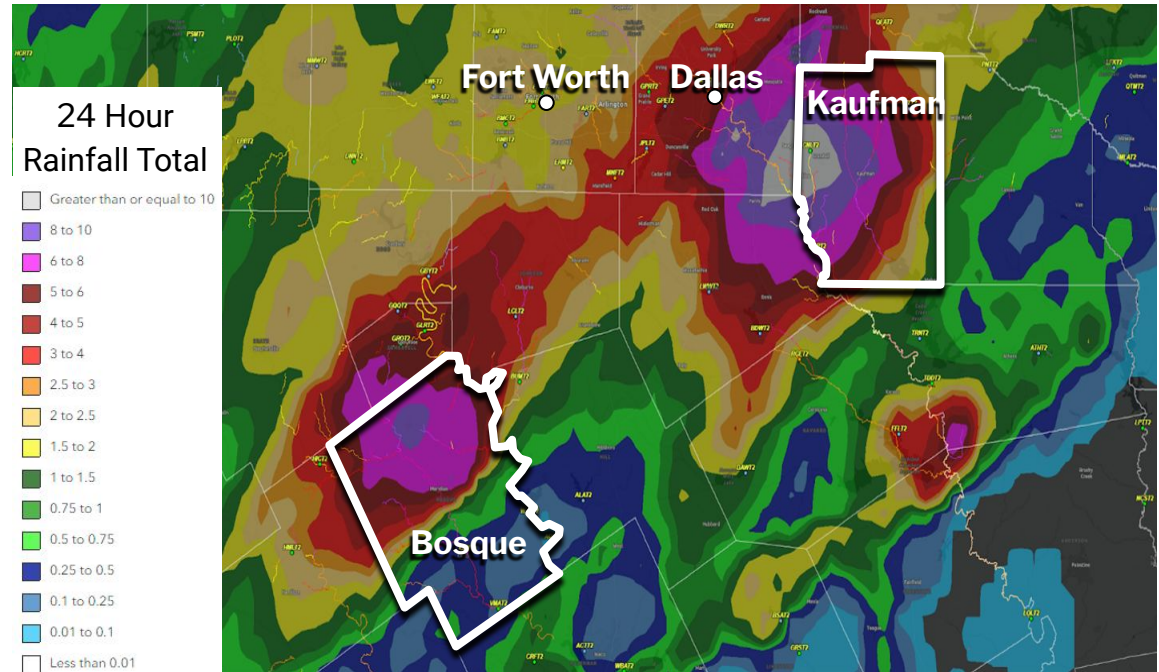
Bosque County: Example of Utility from Publicly Available Flood Mapping in 2023



Having a Cellphone Conversation

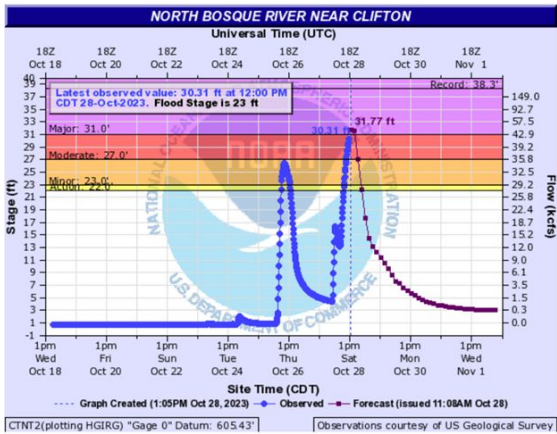
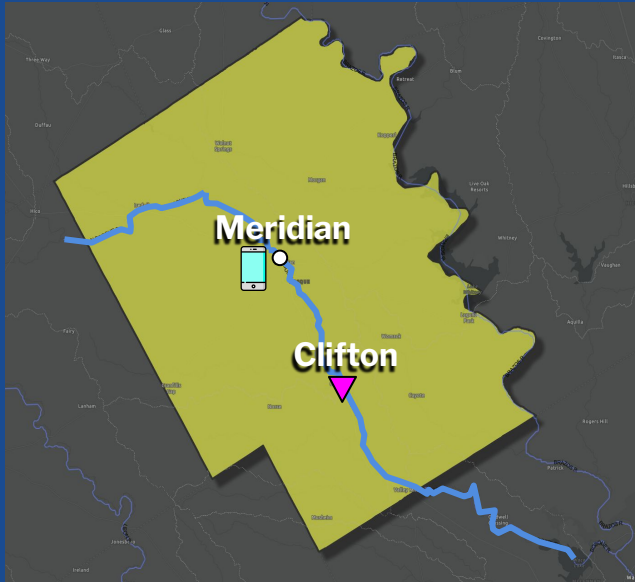
Evening of October 27th 2023 a **second wave of locally heavy rainfall** impacts North Texas

The overnight rainfall led to **significant rises on local rivers** in both Kaufmann and Bosque Counties



Bosque County:

Example of Utility from Publicly Available Flood Mapping in 2023



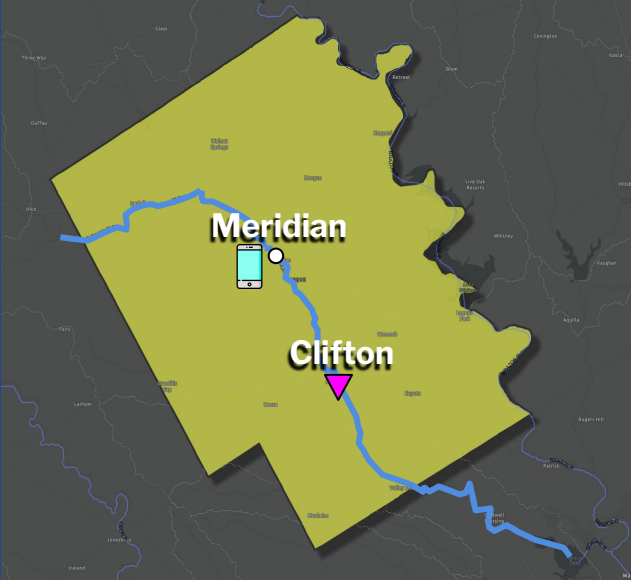
Emergency Manager in Meridian calls about potential flooding impacts

However, only forecast available is downstream at Clifton



Bosque County:

Example of Utility from Publicly Available Flood Mapping in 2023





***RFC Max Stage Forecast**

Record Forecasts

- ▲ Increasing
- Constant
- ▼ Decreasing

Max Status - Forecast Trend

- ▲ Major (Increasing)
- Major (Constant)
- ▼ Major (Decreasing)
- ▲ Moderate (Increasing)
- Moderate (Constant)
- ▼ Moderate (Decreasing)
- ▲ Minor (Increasing)
- Minor (Constant)
- ▼ Minor (Decreasing)
- ▲ Action (Increasing)
- Action (Constant)
- ▼ Action (Decreasing)

***RFC 5-Day Max Downstream Flow Forecast**

5 Days - Max Flood Status Forecast - Action + Only

- Major
- Moderate
- Minor
- Action

● 5 Days - Related RFC Forecast Points

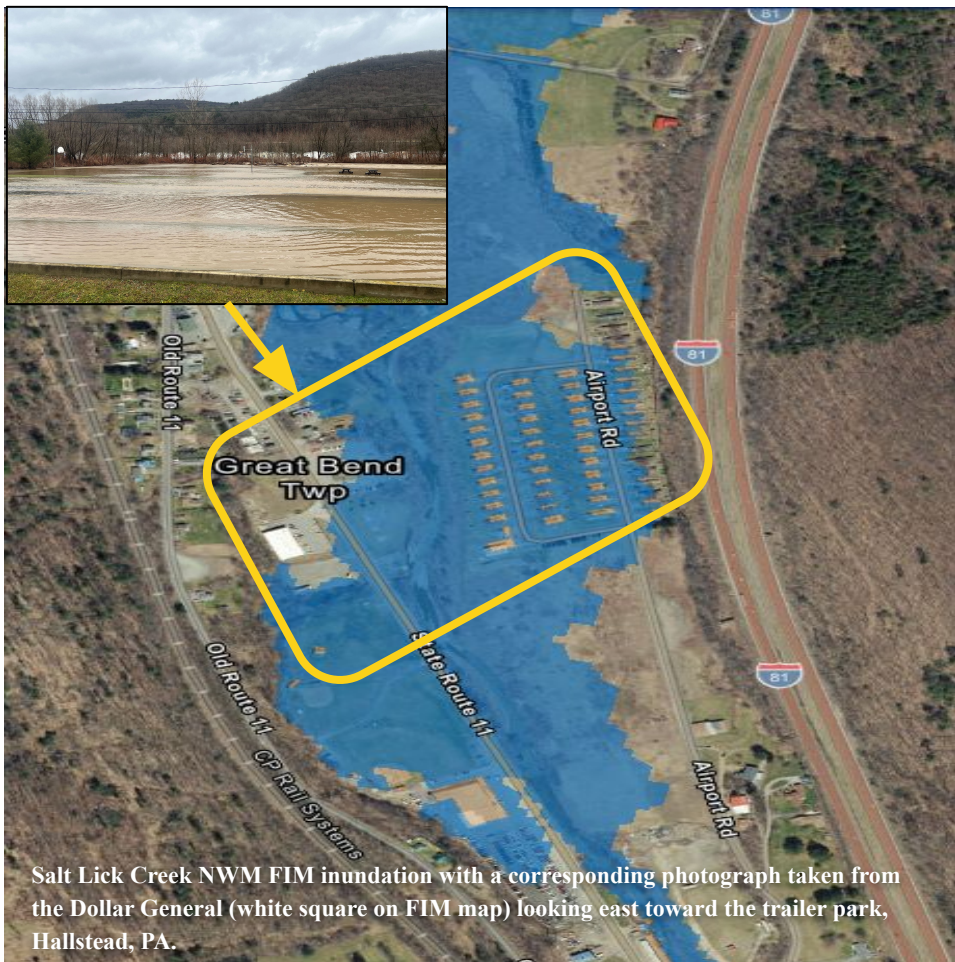
RFC 5-Day Max Downstream Inun Extent Forecast

■ 5 Days - Inundation Extent

The NWM FIM and RFC FIM services are prototypes and should not be shared unless coordinated with the NWC. These FIM visualizations are for guidance use only. These services do not take into account coastal flooding or storm surges, nor depict inundation over or around lakes and reservoirs. Levee overtopping is not incorporated. The NWM FIM services do not incorporate the official river flood forecasts; visit water.weather.gov for the official river flood forecasts.

FIM IDSS in action: WFO Binghamton, NY: EM using services

- WFO leveraged FIM services to assist their partners during the recent mid December floods
- Leveraged NWM and FIM Services in their Flash Flood Warning decision making
- Emergency Management feedback was very favorable - from Vestal, NY EMA:
 - *The briefings were timely and accurate*
 - *The 11:00 am briefing added validation to the information we were preparing to share with the Team in the room. **We were using NWS inundation maps, radar, and local weather station for rainfall rates and accumulation. With the Town Emergency Plan we developed an action plan for possible road closures and evacuation.***
 - *As Emergency Managers we could have shared much of the information from the NWS website ourselves. Having the NWS provide and present the information helped validate and raise the level of concern for the unfolding situation.*

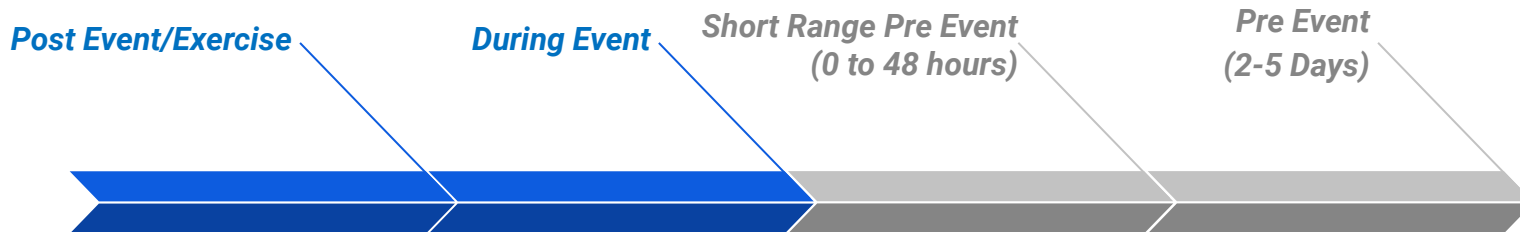


Salt Lick Creek NWM FIM inundation with a corresponding photograph taken from the Dollar General (white square on FIM map) looking east toward the trailer park, Hallstead, PA.



Tip of the Iceberg

Other Opportunities for Flood Maps to Benefit Decision Makers



Verification/Recovery

This helps new users gain confidence in the mapping. Introduce them in a non stressful situation to gain knowledge and ask doubting questions

Reactionary Response

Mapping used to help answer questions for ongoing flooding. Shows real time validation as well as provides some decision support for onsite or realtime inquiries

Proactive Response

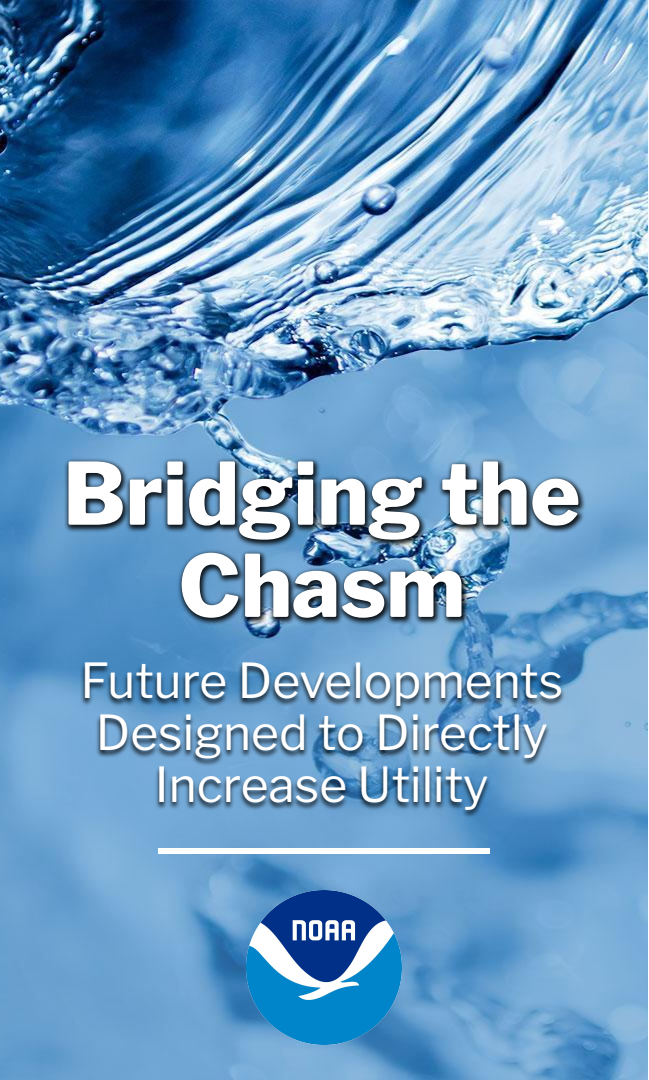
Mapping in this phase would allow decision makers to move resources to close roads, perform rescues, or even localized evacuations before the flooding arrives.

Preparation

Before an event large scale resources that may be required could be ordered and relocated. Assistance requested in advance to communities less prepared for expected flooding impacts

Some Early Success

Near Term Opportunity



Bridging the Chasm

Future Developments
Designed to Directly
Increase Utility



1. Impacts to Structures

- Message decision makers impacts from the provided mapping
- Available internally to NWS

2. Incorporating Bridges and Roads

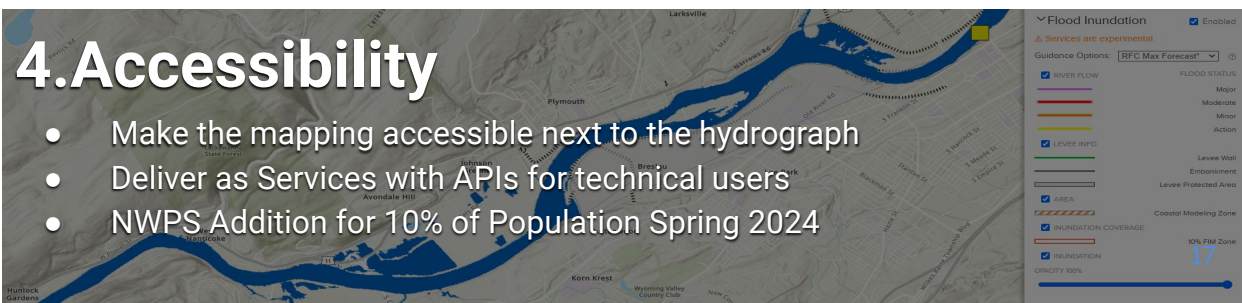
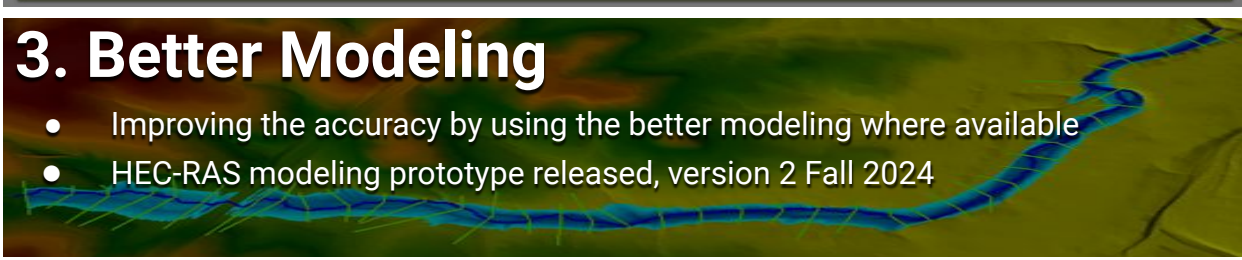
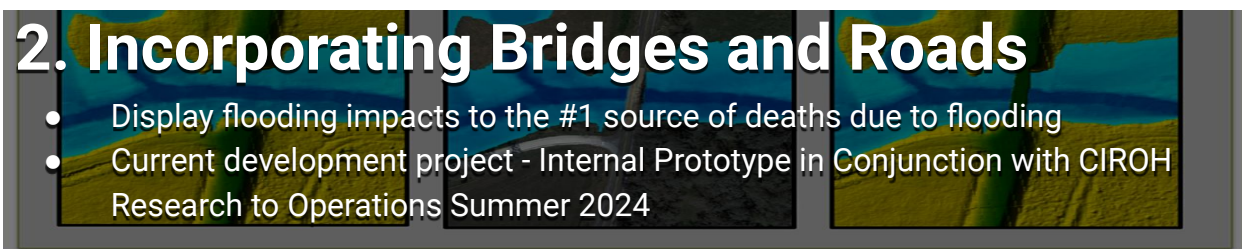
- Display flooding impacts to the #1 source of deaths due to flooding
- Current development project - Internal Prototype in Conjunction with CIROH Research to Operations Summer 2024

3. Better Modeling

- Improving the accuracy by using the better modeling where available
- HEC-RAS modeling prototype released, version 2 Fall 2024

4. Accessibility

- Make the mapping accessible next to the hydrograph
- Deliver as Services with APIs for technical users
- NWPS Addition for 10% of Population Spring 2024





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Thank You!



David R. Vallee
Jason Elliott



david.vallee@noaa.gov

jason.elliott@noaa.gov



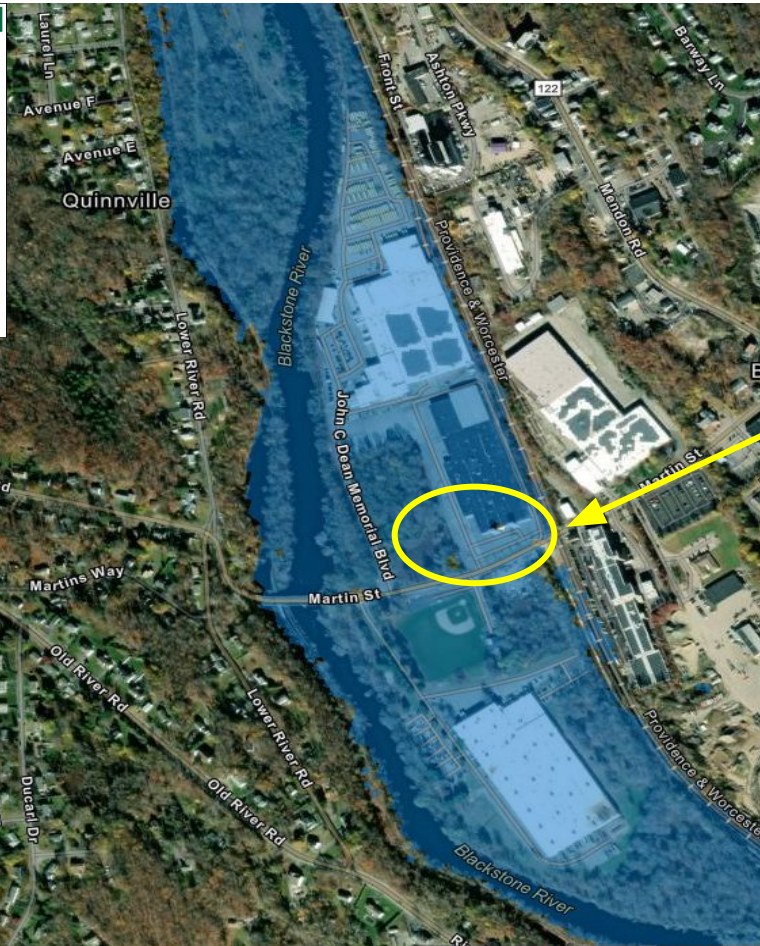
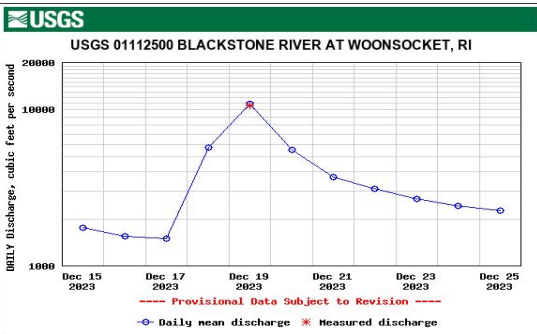
<https://water.noaa.gov>

Kaufman County:

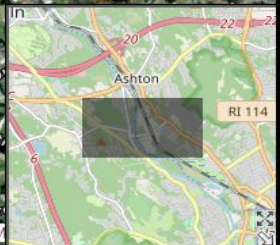
Example of the Challenge with Publicly Available Flood Mapping



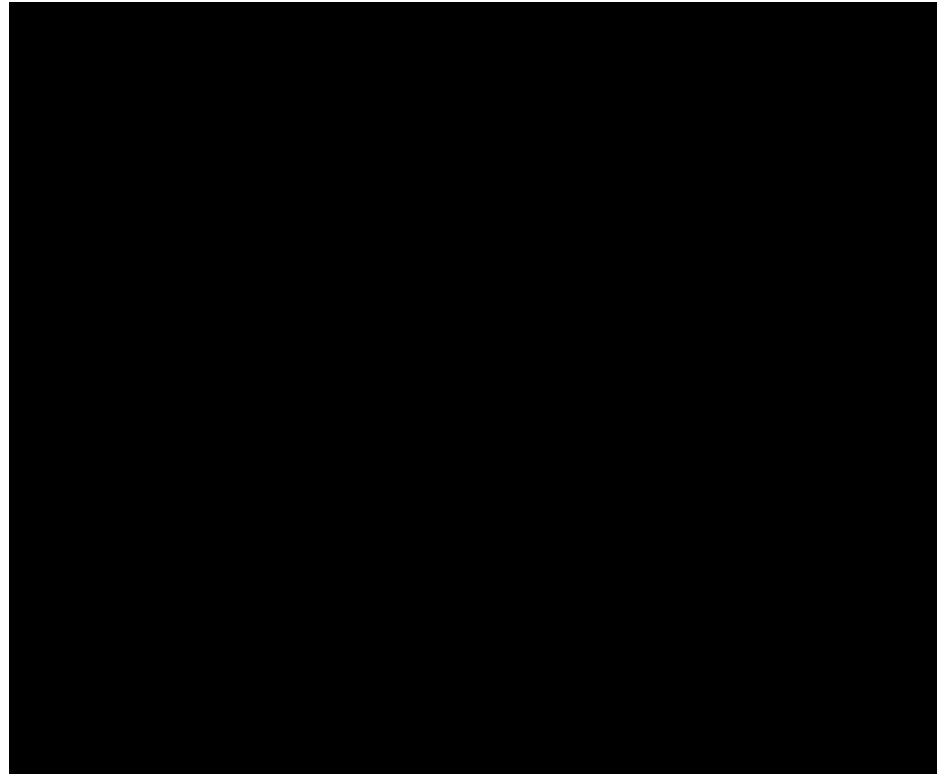
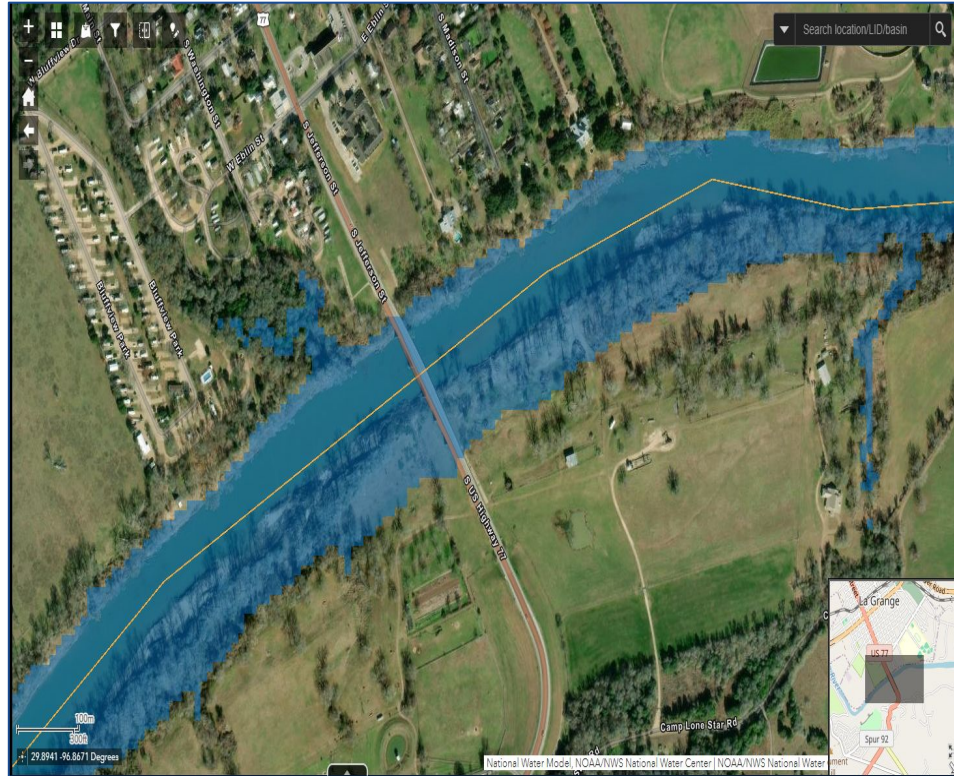
Blackstone River - Cumberland RI: Two school days lost due to flooded bus yard



200m
600ft
41.926 -71.444 Degrees



Real-time validation of FIM Services



National Water Prediction Service (NWPS)

Jason Elliott

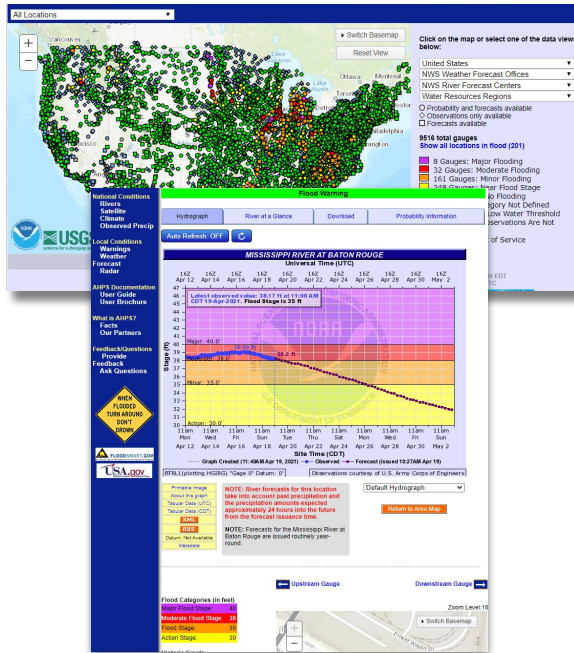
*Service Coordination Hydrologist, Water Prediction Operations Division
Office of Water Prediction | National Water Center*

Integration of NWS Hydro Program's Web Presence

AHPS
water.weather.gov

Office of Water Prediction
water.noaa.gov

NWC Experimental Products
weather.gov/owp/operations

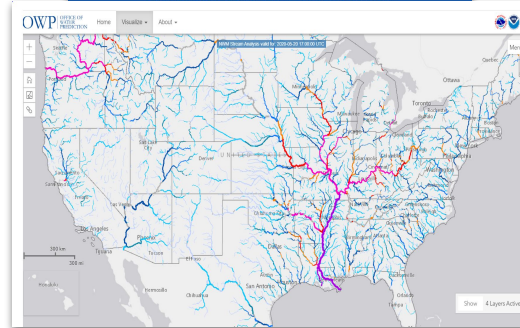


Welcome to the
Office of Water Prediction

Vision
OWP envisions a Nation strengthened by equitable and actionable intelligence that informs water-related decisions, which enhances safety, resilience, security, and our economy.

Mission
Collaboratively research, develop and deliver timely and consistent, state-of-the-science national hydrologic analyses, forecast information, data, guidance, and equitable decision-support services to inform essential emergency management and water resources decisions across all time scales.

News
Output from the National Water Model (NWM) is now available



Area Hydrologic Discussion
Experimental short range, episodic discussion and graphics which highlights locations across the nation that may be impacted by rapid-onset flooding, using National Water Model and other guidance.
MHD Product Description Document
Provide Feedback on AHD

Flood Hazard Outlook
High Level graphical depiction and key messages highlighting the potential threat of mixed flood hazards (flash, urban, small stream and riverine) and their associated impacts catastrophic, considerable, and limited to the next seven days.
FHD Product Description Document
Provide Feedback on FHO

National Hydrologic Discussion
Experimental discussion of the current and forecast hydrologic conditions across the nation, including a variety of short and medium range (Days 1-10) observed and modeled hydrologic guidance.
MHD Product Description Document
Provide Feedback on NHD

Significant River Flood Outlook
Operational flood outlook intended to provide a general outlook for significant riverine and stream river flooding. It is not intended to depict all areas of minor flooding or equi-scale events such as localized flooding and/or flash flooding.

Experimental Flood Hazard Outlook

The Experimental Flood Hazard Outlook (FHO) is intended to provide a coordinated inland hydrologic flood graphics for use in regional and national impact-based Decision-Support Services (DSS) briefings, and support broad messaging of flood threats to National Weather Service (NWS) stakeholders and Federal water partners. This experimental product combines a depiction of current flood conditions based on the latest real-time observations with an assessment of flood risk, leveraging various sources of NWS water resources forecast information. The experimental product is issued daily (D1), but will increase to twice daily (D12) and D12 during select tropical cyclone events.

The NWS is accepting comments through December 31, 2022 on the Experimental FHO. For more information or to provide feedback:

https://www.weather.gov/owp/owpdocs/FHODPOD_Eng

To access the Experimental FHO GIS Service and other NWS Cloud GIS Web Services please visit: <https://www.weather.gov/owp/owpdocs/OWPdocs>

Integration of NWS Hydro Program's Web Presence

National Water Prediction Service
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Home NWC Operations More Water Information Modeling About Explore NWS Weather

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Long-Range Outlook
Data Services
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Map
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Legend

River Gauge

- Observations & Forecasts
- Long Range Flood Outlook

CATEGORIES	OBSERVATION	FORECAST
Major Flood	10	2
Moderate Flood	4	4
Minor Flood	60	70
Near Flood	81	85
No Flood	5706	0
Flood Category Not Defined	3206	0
Low Water Threshold	30	0
Data Not Current	549	0
Out of Service	148	0

Limit by boundary
Only display FIM Gauges

National Water Model
National Snow Analysis

Top Stories 0

networksolutions.com/#

<https://water.noaa.gov>

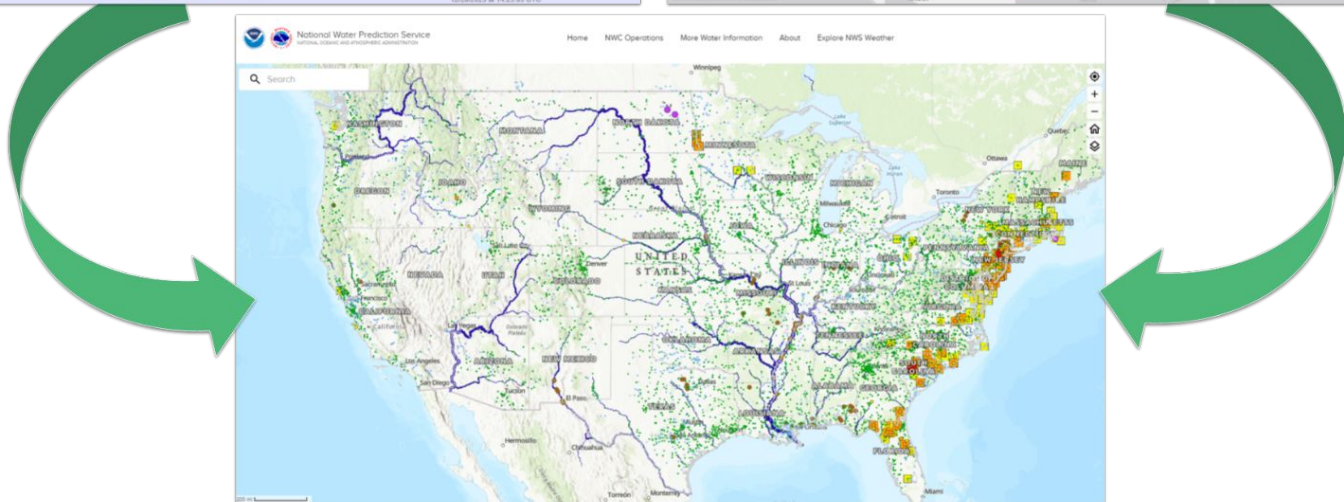
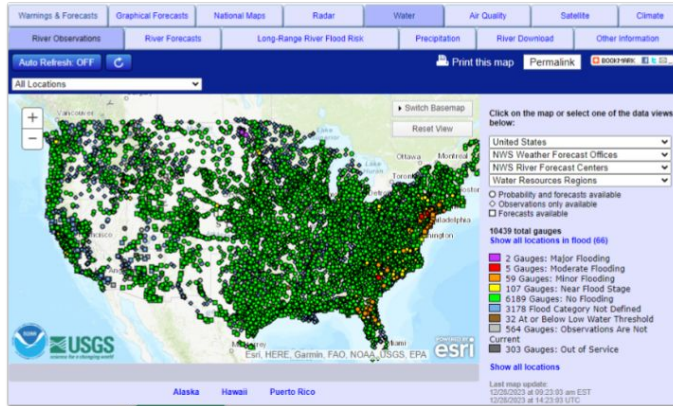
The Gateway to NWS Water Information

<https://water.noaa.gov>

This launches TODAY!

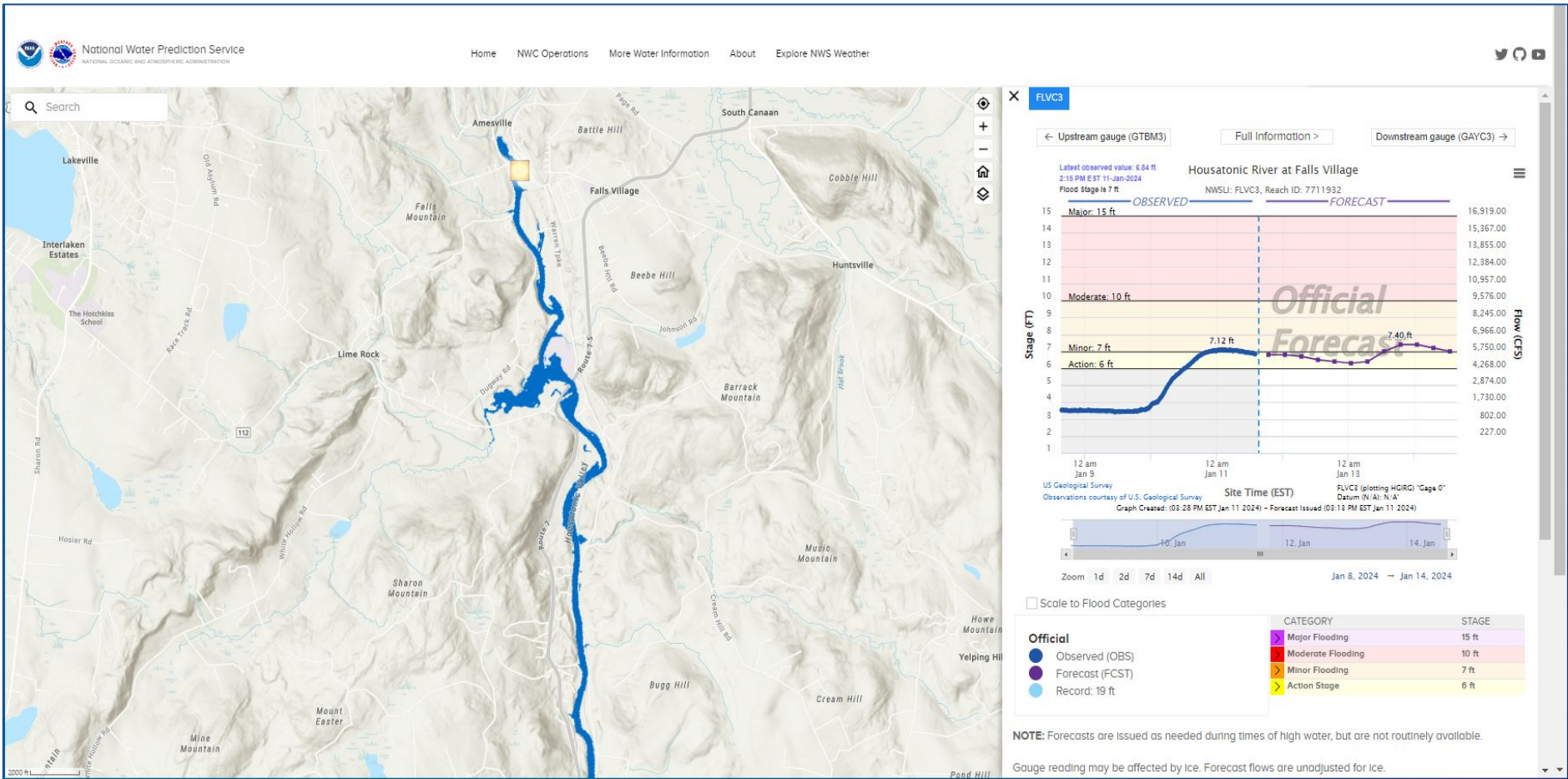


Integration of NWS Hydro Program's Web Presence



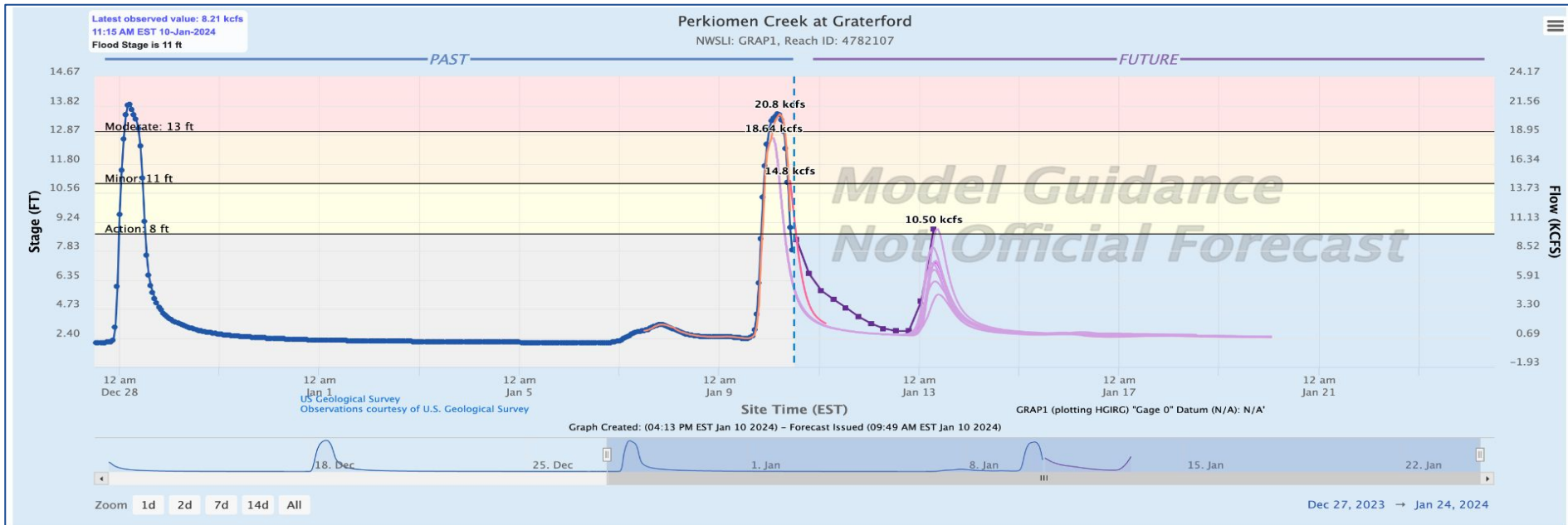
National Water Prediction Service (NWPS)

Linking RFC Forecasts and RFC FIM Services



National Water Prediction Service (NWPS)

NWM Guidance at Point Locations



Official
 ● Observed (OBS)
 ● Forecast (FCST)

CATEGORY	STAGE
Major Flooding	16 ft
Moderate Flooding	13 ft
Minor Flooding	11 ft
Action Stage	8 ft

National Water Model

- Analysis (ANA)
- Medium Range Blend (MRB)
- Short Range (SR)

▼ **Medium Range Ensembles**

- Medium Range Ensemble Mean (MRM)
- Medium Range Ensemble 1 (MR 1)
- Medium Range Ensemble 2 (MR 2)
- Medium Range Ensemble 3 (MR 3)
- Medium Range Ensemble 4 (MR 4)

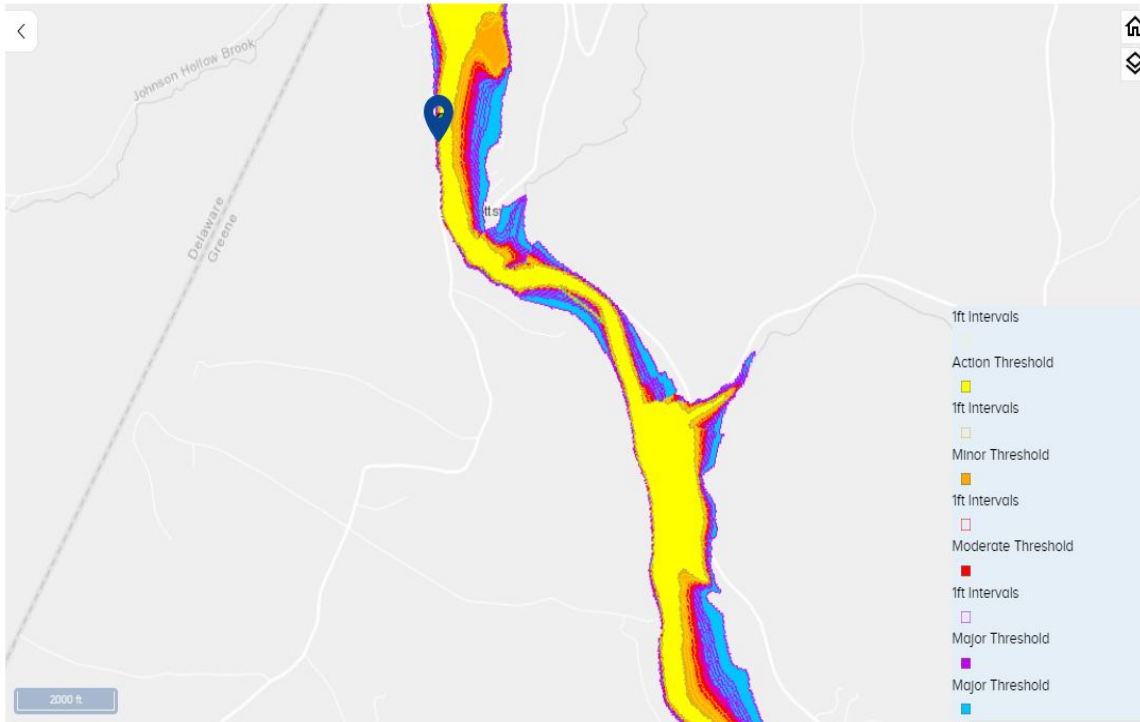
Example of NWM Guidance for Perkiomen Creek, January 10th, 2024

National Water Prediction Service (NWPS)

Example of Stage-based Categorical FIM

Gauge Location

- Action 1ft Intervals
- Action Threshold
- Minor 1ft Intervals
- Minor Threshold
- Moderate 1ft Intervals
- Moderate Threshold
- Major 1ft Intervals
- Major Threshold
- Major Threshold



- Display PTVN6 marker
- Activate PTVN6 FIM Gauge
- Deactivate PTVN6 CATFIM
- Display FEMA's National Flood Hazard Layers

Current Stage:
3.89 ft at 2023-12-01 23:22:05 UTC
Highest Forecast: 6.3 ft
Current Mouse Location

Recent Crests

- 13.85 ft on 10-26-2021 (P)
- 17.53 ft on 12-25-2020 (P)
- 13.55 ft on 10-30-2017
- 12.03 ft on 02-25-2016
- 13.71 ft on 09-07-2011

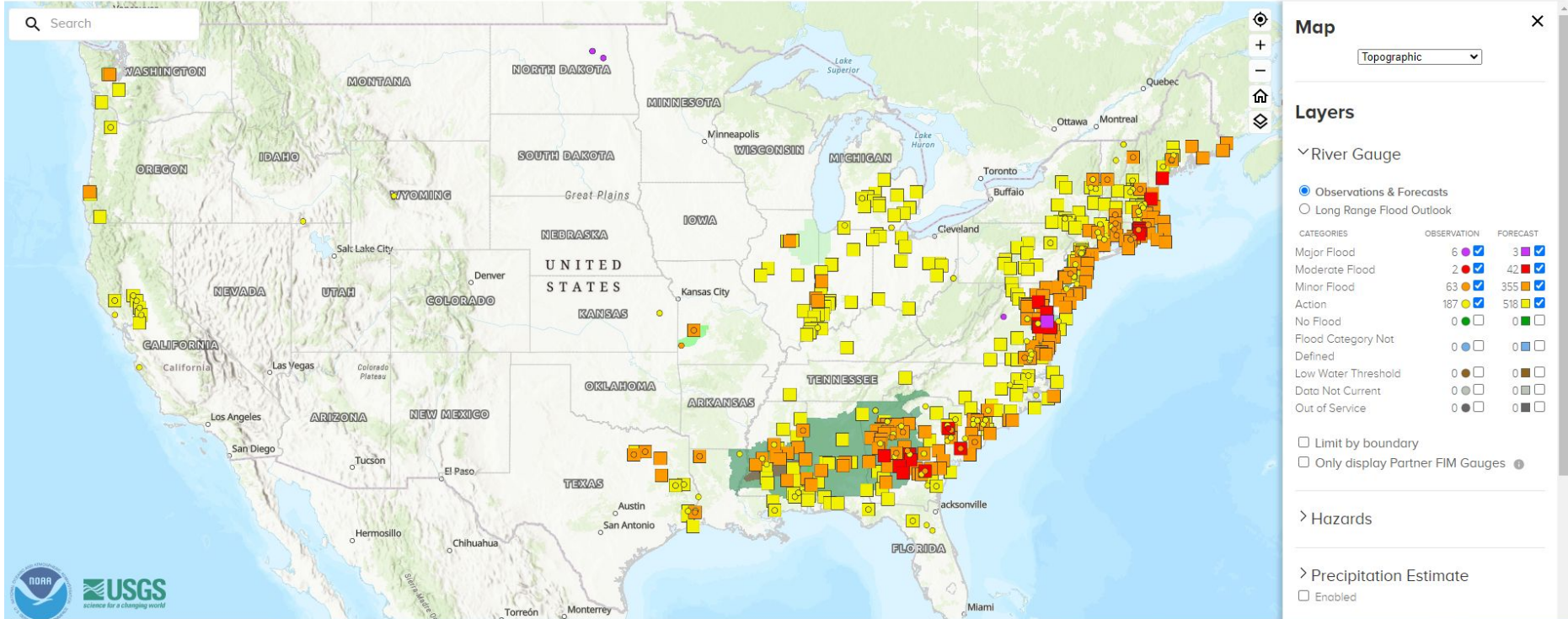
[SHOW ALL CRESTS](#)

Historic Crests

- 24.38 ft on 08-28-2011
- 19.57 ft on 03-05-1979
- 19.5 ft on 01-26-1978
- 19.39 ft on 01-19-1996
- 19.14 ft on 10-16-1955

[SHOW ALL CRESTS](#)

Let's Dive In!

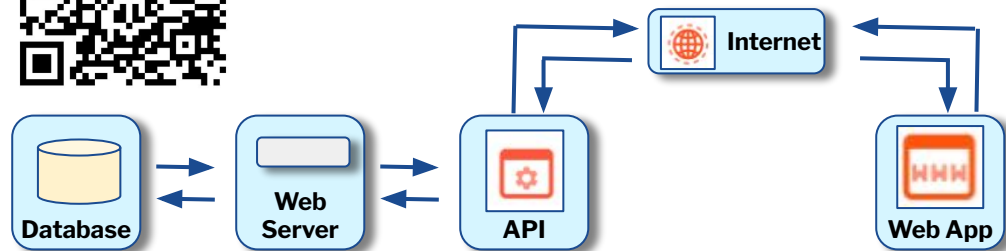


Data Driven Application Programming Interfaces (APIs)

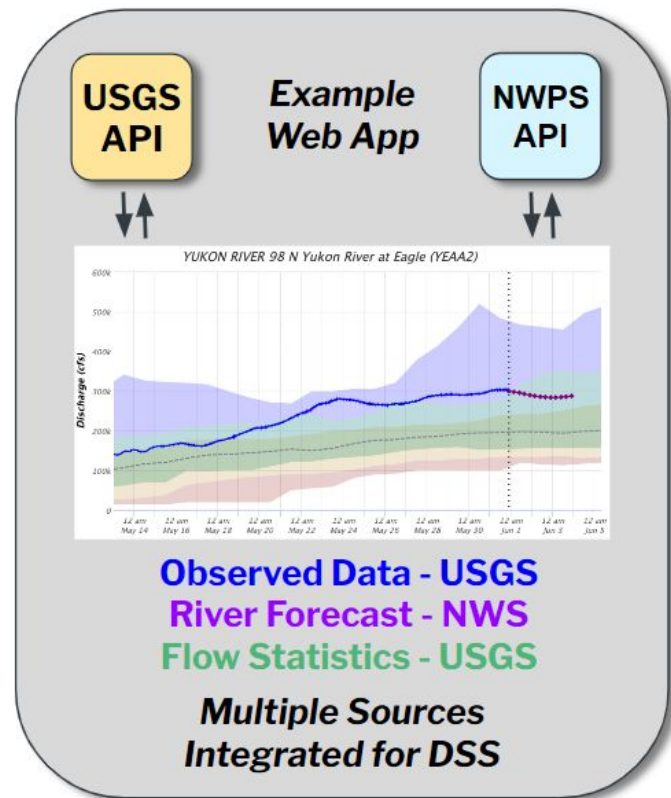
NWPS is an API driven Web App

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.

API Webinar QR Code:



API Documentation: <https://api.water.noaa.gov/nwps/v1/docs/>



Key NWPS Transition Dates

Note: Dates subject to change due to inclement weather. All dates are “on or around”.

March 27, 2024 - NWPS available at **<https://water.noaa.gov>**. NWPS API available at **<https://api.water.noaa.gov/nwps/v1/docs>**.

May 27, 2024 - AHPS (<https://water.weather.gov>) no longer available. Top level URL traffic will be redirected to **<https://water.noaa.gov>**. Bookmarks and some URLs in applications will need to be updated.

May 27, 2025 - AHPS redirects suspended. All water.weather.gov URLs will need to be updated to point to **<https://water.noaa.gov>** equivalents.

Key NWPS Transition Dates

Note: Dates subject to change due to inclement weather. All dates are “on or around”.

Additionally on May 27, 2024 - A significant number of links to services and shapefiles related to AHPS will be retired. Most will have NWPS equivalents starting today.

This includes:

<ul style="list-style-type: none">● Observed & Forecast Shapefiles	<ul style="list-style-type: none">● RSS Data Feed
<ul style="list-style-type: none">● REST service	<ul style="list-style-type: none">● River Forecast Center pages

KMZ files of certain data will no longer be available.

For full details, scan this QR code, or visit:

https://www.weather.gov/media/notification/pdf_2023_24/scn24-29_nwps_url_changes.pdf



Important URLs

NWPS Main Page: <https://water.noaa.gov>



Individual Forecast Office (replace the three-character ID in red with your local office):
<https://water.noaa.gov/wfo/ffc>

Individual River Forecast Center (replace the five-character ID in red with the local RFC):
<https://water.noaa.gov/rfc/marfc>

Info by State (replace the state abbreviation in red with your local state):
<https://water.noaa.gov/state/al>

Static Hydrograph (replace the ID in red with the gauge of interest, if the ID is known):
https://water.noaa.gov/resources/hydrographs/wasd2_hg.png



OWP | OFFICE OF
WATER
PREDICTION

View the NWPS User's Guide →



Thank You!



Jason Elliott



Jason.Elliott@noaa.gov



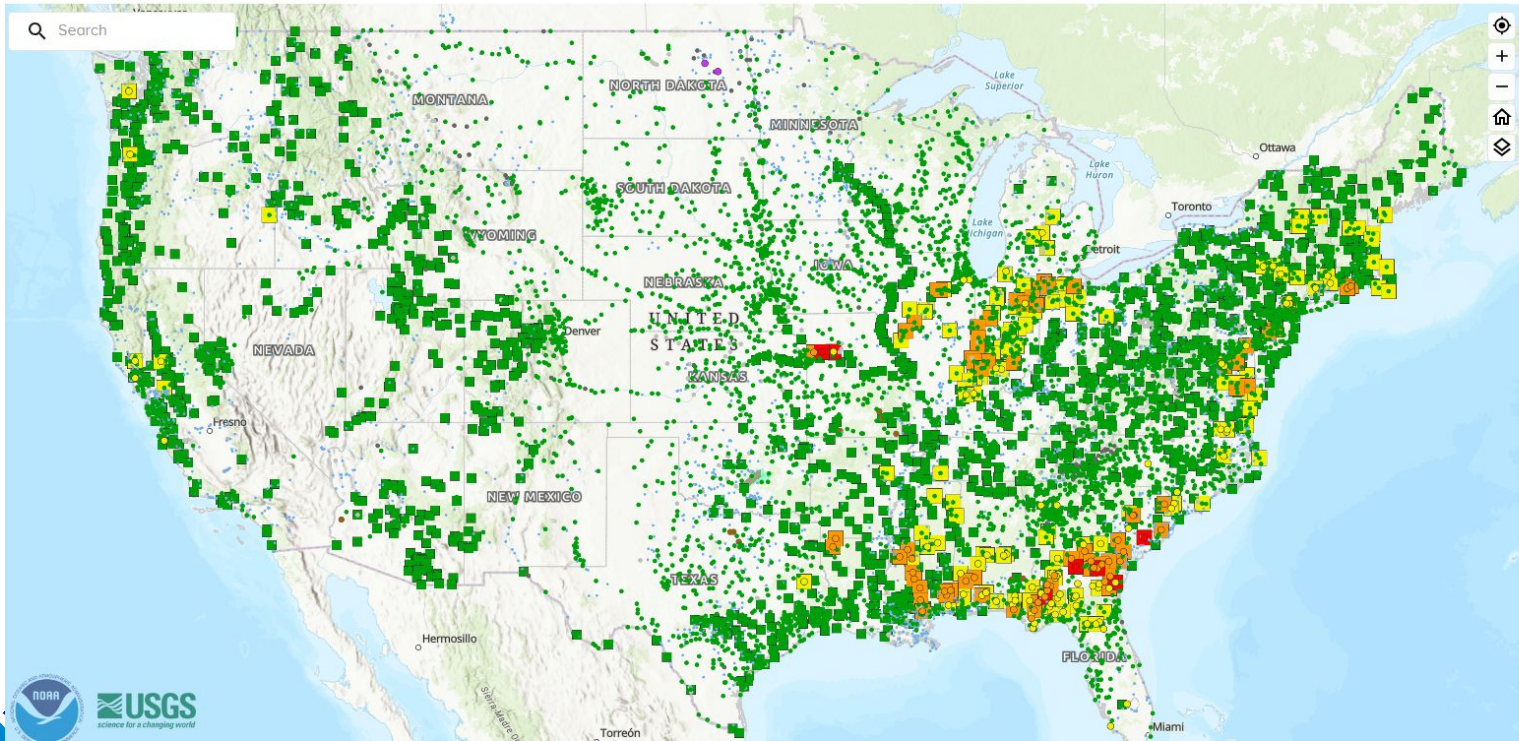
<https://water.noaa.gov>


Backup Slides in case live demo not possible






<https://storymaps.arcgis.com/stories/fce72e9168a7402dbfc49fc5b49cee2e/edit>


NWPS Main Page

Search



Map 

Topographic 

- Layers**
- > River Gauge
 - > Hazards
 - > Precipitation Estimate
 Enabled
 - > National Water Model
 - > Flood Inundation Enabled
 - > National Snow Analysis
 - > Administrative Boundaries

NWPS Menu Choices

▼ River Gauge

Observations & Forecasts

Long Range Flood Outlook

CATEGORIES	OBSERVATION	FORECAST
Major Flood	2 <input checked="" type="checkbox"/>	0 <input checked="" type="checkbox"/>
Moderate Flood	3 <input checked="" type="checkbox"/>	7 <input checked="" type="checkbox"/>
Minor Flood	45 <input checked="" type="checkbox"/>	67 <input checked="" type="checkbox"/>
Action	92 <input checked="" type="checkbox"/>	141 <input checked="" type="checkbox"/>
No Flood	6218 <input checked="" type="checkbox"/>	1651 <input checked="" type="checkbox"/>
Flood Category Not Defined	3056 <input checked="" type="checkbox"/>	0 <input type="checkbox"/>
No Forecast Available	0 <input checked="" type="checkbox"/>	0 <input type="checkbox"/>
Low Water Threshold	20 <input checked="" type="checkbox"/>	0 <input type="checkbox"/>
Data Not Current	321 <input checked="" type="checkbox"/>	0 <input type="checkbox"/>
Out of Service	136 <input checked="" type="checkbox"/>	0 <input type="checkbox"/>

Limit by boundary

Only display Partner FIM Gauges

▼ Precipitation Estimate

Enabled

Display estimated precipitation on hover

- Year
 Month
 Day

Year:

Month:

Day:

- Observed
 Normal
 Departure From Normal
 Percent of Normal

OPACITY 75%



RAINFALL (inches)

- Greater than or equal to 10
- 8 to 10
- 6 to 8
- 5 to 6

▼ National Water Model

LINE TYPE ENABLED

Stream Reach

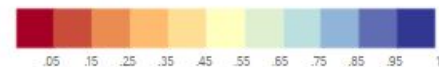
OPACITY 90%



National Soil Moisture Analysis

Updated: Mar 14, 2024, 12:00 PM CDT

Near-Surface Soil Moisture



OPACITY 90%



National Stream Analysis Anomaly

Updated: Mar 14, 2024, 12:00 PM CDT

Magnitude



OPACITY 90%



NWPS Menu Choices (continued)

∨ Flood Inundation Enabled

⚠ Services are experimental

Guidance Options: RFC Max Forecast* ⓘ

RIVER FLOW

FLOOD STATUS



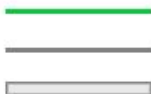
Major

Moderate

Minor

Action

LEVEE INFO



Levee Wall

Embankment

Levee Protected Area

AREA



Coastal Modeling Zone

INUNDATION COVERAGE



10% FIM Zone

INUNDATION

Updated: Mar 14, 2024, 12:50 PM CDT

OPACITY 100%

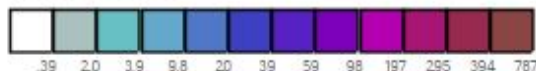


∨ National Snow Analysis

Snow Depth ⓘ

Updated: Mar 14, 2024, 4:00 AM CDT

Inches of Snow



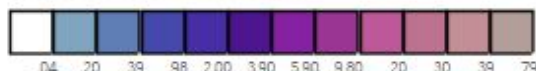
OPACITY 90%



Snow Water Equivalent ⓘ

Updated: Mar 14, 2024, 7:00 AM CDT

Inches of Water Equivalent



OPACITY 90%



∨ Administrative Boundaries

LINE TYPE ENABLED

RFC

State

OPACITY 100% COLOR

WFO

County

County

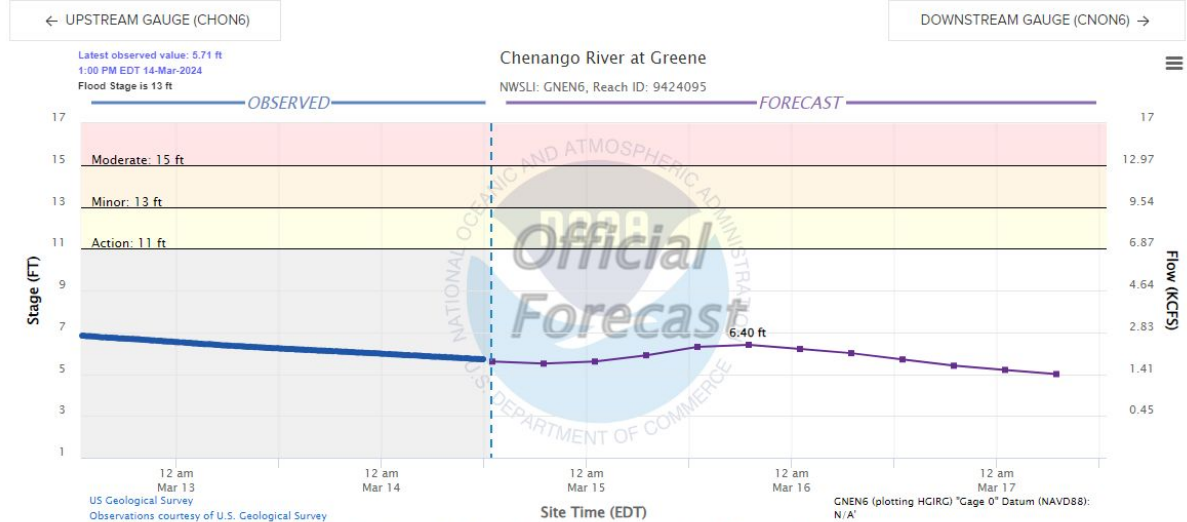
New Hydrographs

MARFC / BGM / GNEN6

Chenango River at Greene

Last updated: Mar 14, 2024, 12:26 PM CDT

Official National Water Model Guidance

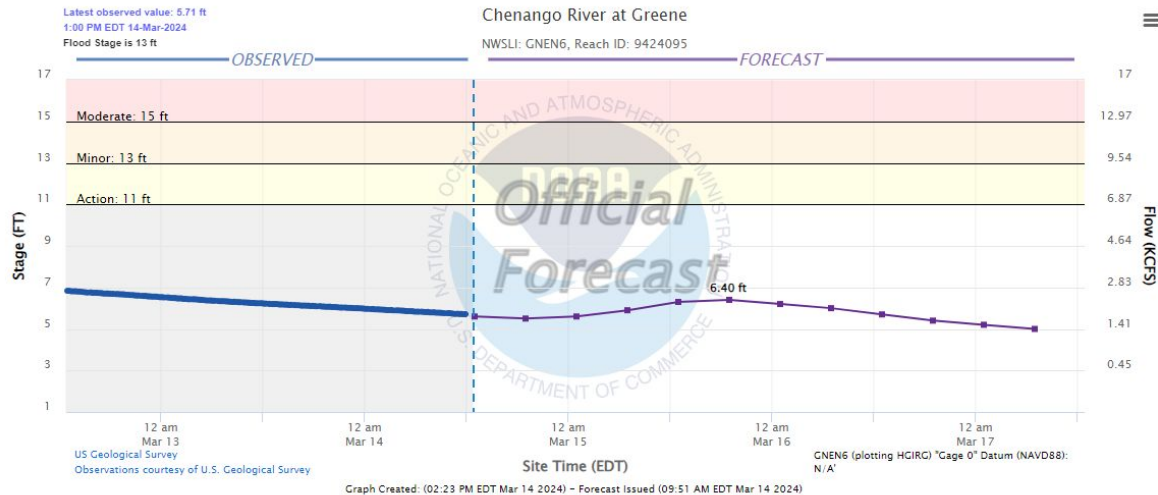


New Hydrograph Page

Official National Water Model Guidance

← UPSTREAM GAUGE (CHON6)

DOWNSTREAM GAUGE (CNON6) →



Zoom 1d 2d 7d 14d All

Mar 12, 2024 - Mar 17, 2024

Scale to Flood Categories

- Official**
- Observed (OBS)
 - Forecast (FCST)
 - Record: 21.2 ft

CATEGORY	STAGE
Major Flooding	18 ft
Moderate Flooding	15 ft
Minor Flooding	13 ft
Action	11 ft



New Hydrograph Page (continued)

Flood Impacts [®]

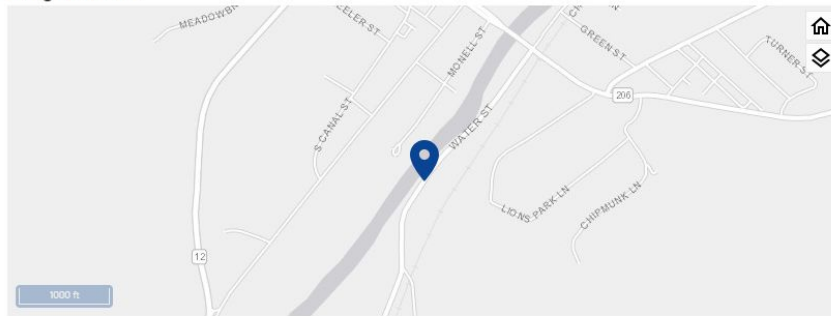
22 - Maximum estimated flood of July 8, 1935. Stage estimated by an Army Corps of Engineers hydrologic study. Widespread inundation of the village occurred from Chenango Street to the river. In addition to extreme flooding of the village, flood waters would approach the east side of Route 12, north of the Village of Greene.

214 - Height of the gage floor, and maximum stage that gauge can read.

2116 - Record flood crest as measured by the USGS stream gauge from June, 2006. Widespread flooding throughout the Village of Greene.

[SHOW MORE FLOOD IMPACTS](#)

Gauge Location



- Display GNEN6 marker
- Activate GNEN6 FIM Gauge
- Activate GNEN6 CATFIM
- Display FEMA's National Flood Hazard Layers

Current Stage:

5.71 ft at 2024-03-14 17:26:36 UTC

Highest Forecast: 6.4 ft

Current Mouse Location

Gauge Info

Coordinates	42.3244, -75.7717
RFC	MARFC
State	NY
WFO	BGM
County	Chenango
Data Provider(s)	
US Geological Survey	USGS--Water Resources of the United States
USGS	01507000

Recent Crests

- 13.26 ft on 12-19-2023 (P)
- 13.64 ft on 05-01-2023 (P)
- 14.71 ft on 12-26-2020
- 14.08 ft on 09-18-2018
- 13.62 ft on 01-24-2018

[SHOW ALL](#)

Historic Crests

- 22.00 ft on 07-08-1935
- 21.16 ft on 06-28-2006
- 21.09 ft on 09-08-2011
- 18.67 ft on 04-03-2005
- 18.33 ft on 12-31-1942

[SHOW ALL](#)

(P) - Preliminary values subject to further review
 1 - Gauge datum changed during this year



National Water Model Guidance

