



NATIONAL WEATHER SERVICE

Protecting Lives and Property for 150 Years

Using Social Science to Gather Stakeholder Feedback on the National Water Model and Hydrologic Ensemble Forecast Services

Mary Mullusky and Kate Abshire,
Water Resources Services Branch,
National Weather Service Analyze, Forecast and Support Office

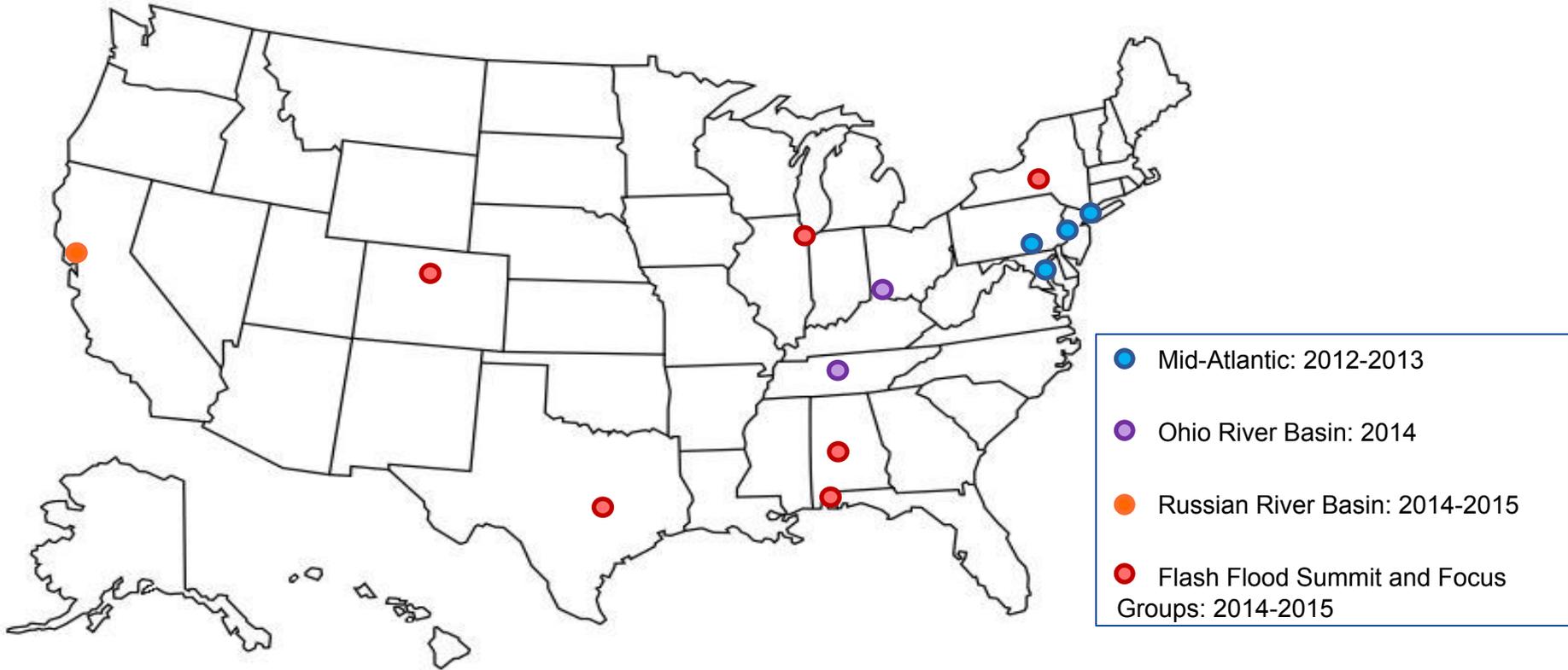


April 17, 2020

Presentation for CC CoP Webinar



Initial Stakeholder Engagement Locations



Initial Stakeholder Priorities



- ◆ Provide consistent, high resolution, integrated water analyses, predictions and data to address critical unmet information and service gaps
- ◆ Transform information into intelligence by linking hydrologic, infrastructural, economic, demographic, environmental, and political data
- ◆ Integrate Social Science to create Actionable Water Intelligence

1

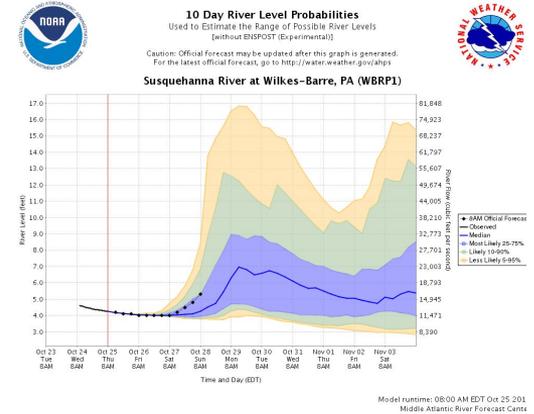
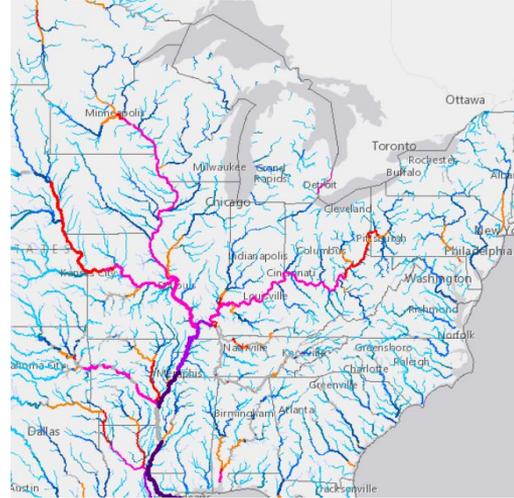
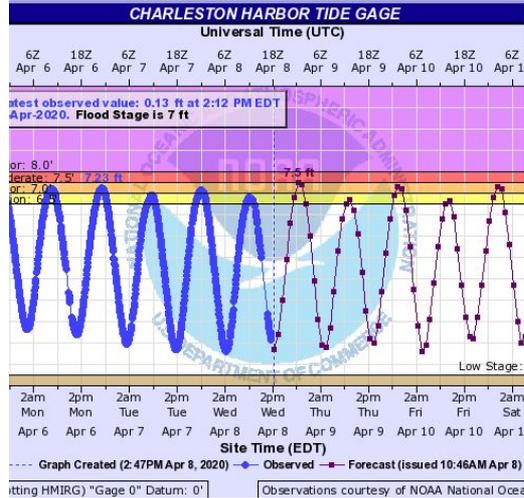


NATIONAL WEATHER SERVICE

Protecting Lives and Property for 150 Years

Building a Weather-Ready Nation // 3

Translating Needs to Development



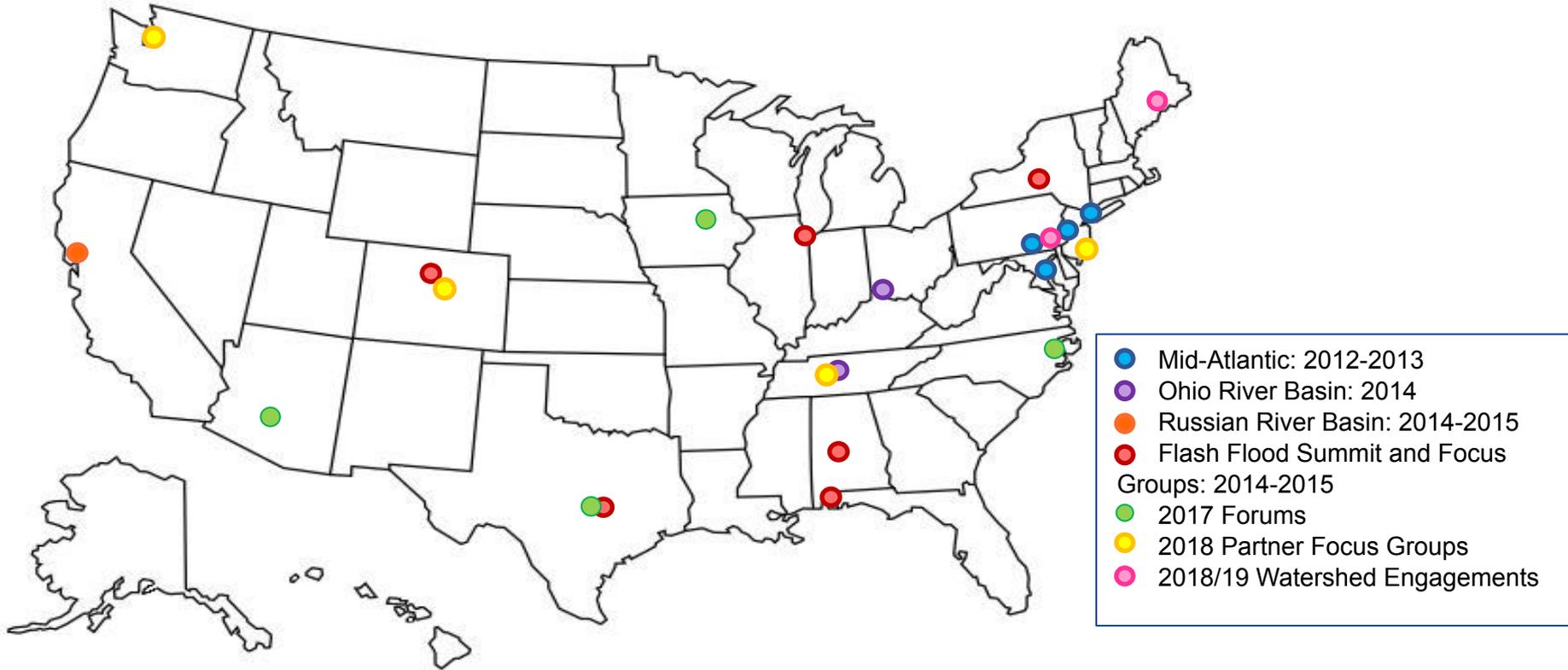
Enhance
existing
services

National Water
Model

Hydrologic
Ensemble Forecast
Service (HEFS)



Additional Stakeholder Engagement Locations



Engaging Subject Matter Experts

Stakeholder Forums (2017)

- Austin, TX (February 8)
- Phoenix, AZ (April 19)
- Greenville, NC (June 21)
- Waterloo, IA (August 10)

Internal Focus Groups (2017)

- Transportation & Navigation (February 1)
- Water Supply/Utilities (March 9)
- Water Policy, Fisheries & Recreation (May 17)
- Agriculture (May 15)
- Emergency Managers and Media (June 23)

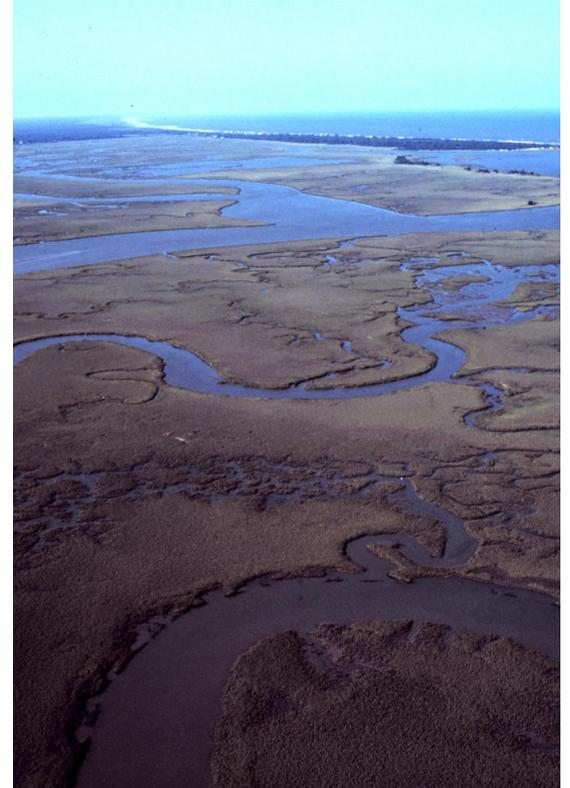
External Focus Groups (2018)

- Water Supply
 - American Water Works Association Sustainable Water Management Conference – March 25-28 in Seattle
- Emergency Managers (flood risk)
 - IAEM-USA Region 4 Conference – April 22-26 in Nashville
 - NJ Emergency Preparedness Association – May 1 in Atlantic City
 - Denver Urban Drainage and Flood Control District – May 31



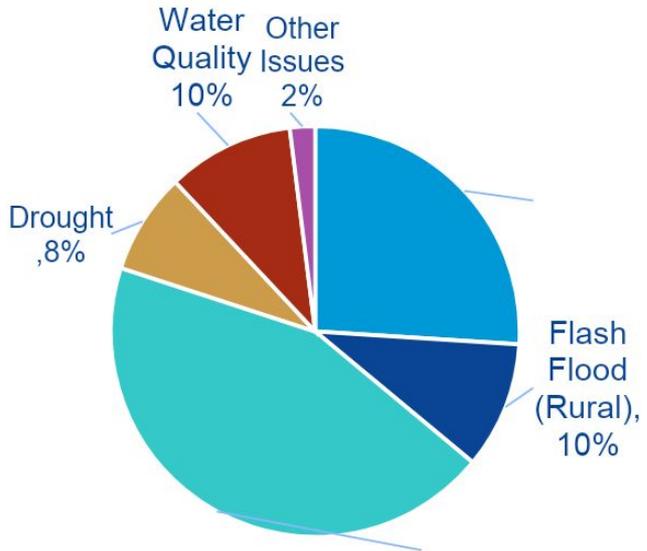
Key Stakeholder Needs Related to Coastal Coupling

- Inundation mapping coupling storm surge and river flood
- Better understanding of tidally-influenced rivers, sea level rise
- Water quality forecasting
 - Composition of water flowing into estuaries (e.g., flood, drought events)
 - Salinity forecast - short term to seasonal



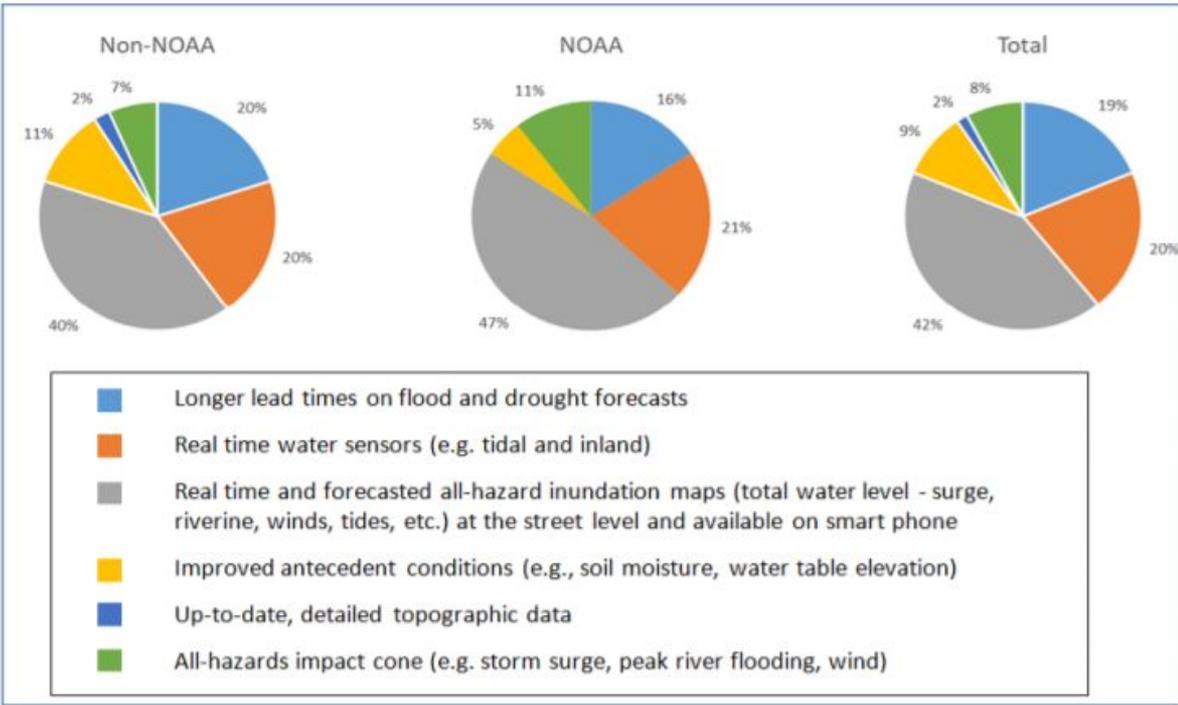
Top Needs from a Coastal-Focused Engagement

Top Challenges



Greenville, NC

Top Decision Support Needs



How is this similar or different from stakeholder needs you have heard?

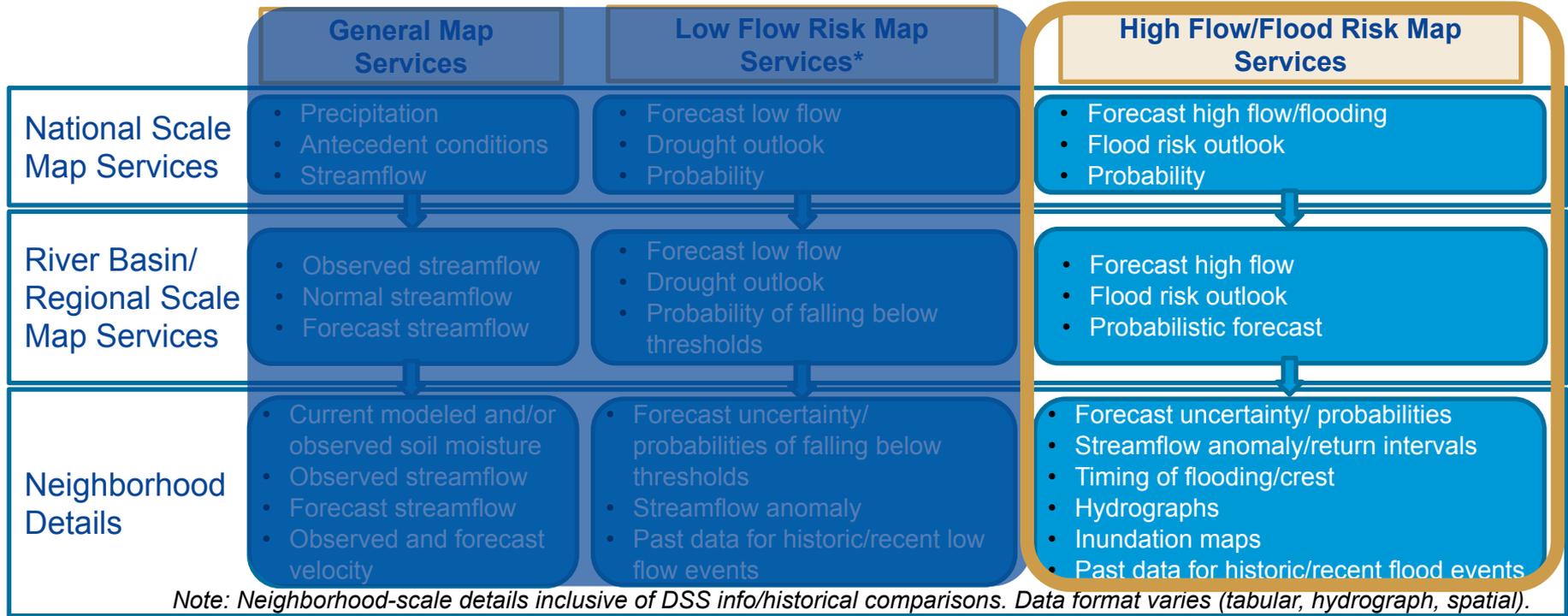
All stakeholder engagement reports available at weather.gov/water



NATIONAL WEATHER SERVICE

Protecting Lives and Property for 150 Years

Logic Model for National Weather Service Water Prediction Map Services



Temporal Navigation at All Spatial Scales

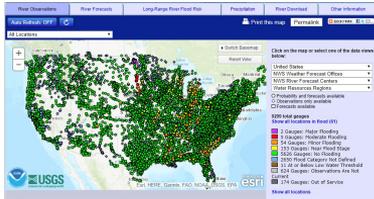


Meeting User Needs with Current and Future Services

High Flow/Flood Risk Map Services

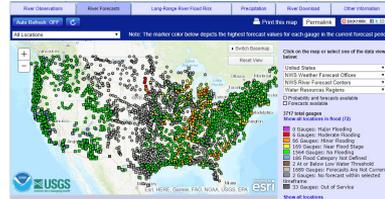
Current and Experimental National Scale Map Services

Observed/Antecedent Conditions



Gauge Observations

Current/Hourly (0-24 hours)*



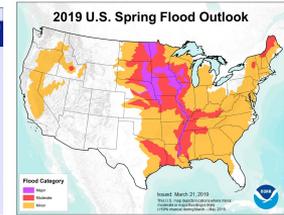
Point Forecasts

Daily (0-7 days)

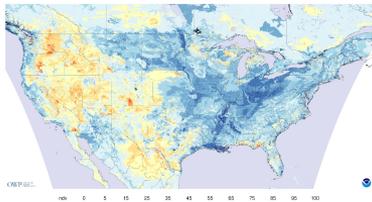


Long-Range Flood Outlook

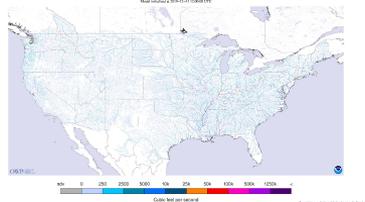
Seasonal (30 days-1 year)



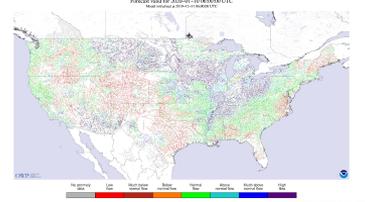
Seasonal Flood Outlook



NWM Near-Surface Soil Saturation



NWM 18-hour streamflow guidance



NWM 10-day streamflow anomaly guidance



NWM 30-day streamflow guidance



NATIONAL WEATHER SERVICE
Protecting Lives and Property for 150 Years

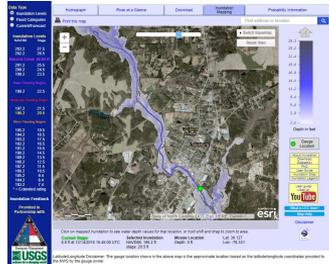
Building a Weather-Ready Nation // 1

Meeting User Needs with Current and Future Services

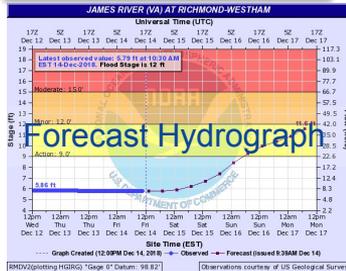
High Flow/Flood Risk Map Services

Current and Experimental Neighborhood Scale Map Services

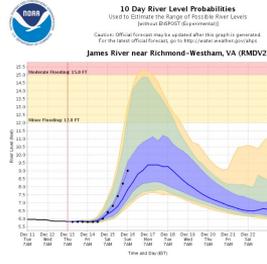
Observed/Antecedent Conditions



Current/Hourly (0-24 hours)*



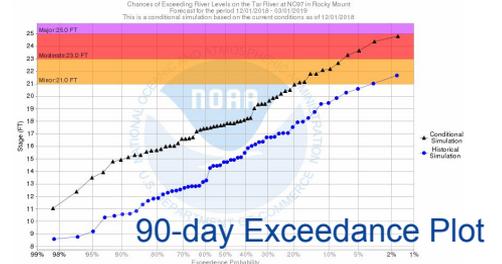
Daily (0-7 days)



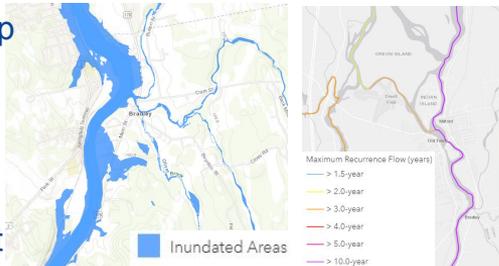
Weekly (Week 1-Week 4)

Short-Term Probabilistic Hydrograph

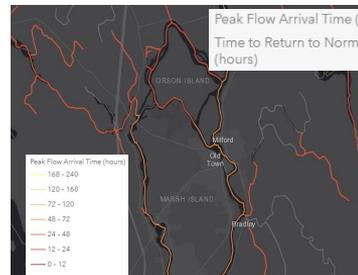
Seasonal (30 days-1 year)



Static Inundation Map



NWM 18-hour Forecast Flow Magnitude



NWM 10-day Peak Flow Arrival Time

Are these the right spatial and temporal scales for coastal needs?

All stakeholder engagement reports available at weather.gov/water



NATIONAL WEATHER SERVICE

Protecting Lives and Property for 150 Years

Building a Weather-Ready Nation //13

Cross-Partner Watershed Engagement

- NWM prototype services were tested among different core partner groups from multiple sectors through Spring 2019
 - October – Delaware River Basin (Easton, PA) – rain-driven event with a tropical component
 - March – Penobscot River Basin (Bangor, ME) – snowmelt-driven event
- Engagement Objectives included:
 - Testing prototype usefulness in watershed context
 - Determining what combination of data watershed-based users need to balance competing interests and demands
 - Identifying gaps in and recommending improvements to the logic model
 - Discussing service delivery and communication needs



Key Findings

- There is significant support for coastal coupling efforts across participant user groups.
- Stakeholders discussed a need for an expanded presentation of uncertainty, especially for inundation services.
- There is strong interest in “impact-based” forecasts from the NWM, like those currently provided by AHPS/MMEFS/HEFS that depict flood levels in terms of stage and not discharge, and reflect key impact levels (action, minor, moderate, major)
- Stakeholders are concerned about the cadence of information and do not want to be overwhelmed with new things
- End-users need NWM services placed alongside existing services and with context and definitions to make them more useful
- NWM services need to use terminology that is consistent with other products and need to clearly define what terms mean.

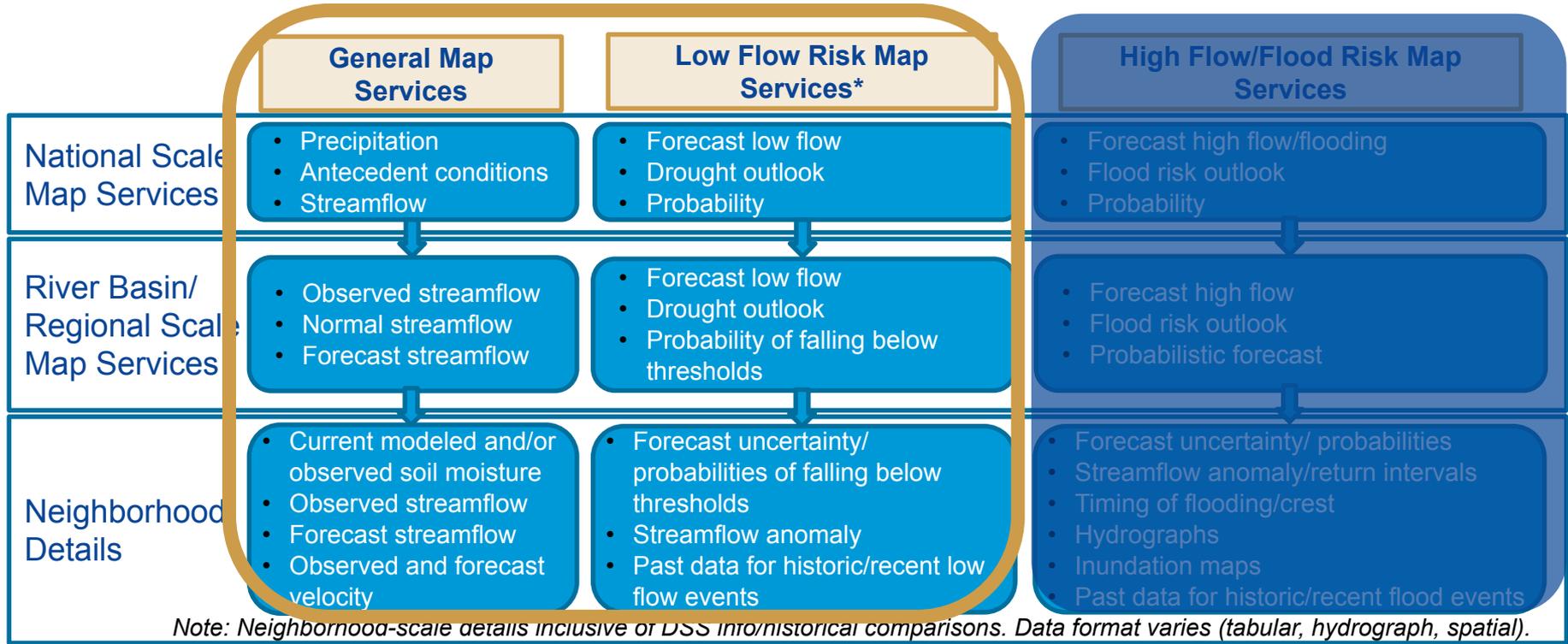


Next Steps

- Solicit feedback from NWS offices and small set of core partners on prototype NWM Visualization Services to:
 - Refine and improve the development of web services and their visualizations
 - Identify services of the highest utility which should go out for public comment and future operational implementation
- Share findings and serve as resource to science community to help connect research to operations to meet stakeholder needs



Future Work – Additional Social Science Needed



Questions?

All stakeholder engagement reports available at weather.gov/water



NATIONAL WEATHER SERVICE
Protecting Lives and Property for 150 Years

Building a Weather-Ready Nation //18

Integrated Water Resources Science and Services (IWRSS): Partners and Missions

Collaborative Science-Based Solutions to Address Societal Needs



Water Information: Collects and disseminates reliable, impartial, and timely information needed to understand the Nation's water resources to minimize loss of life and property from natural disasters



US Army Corps
of Engineers

Water Management: Strengthens our Nation's security, energizes the economy, and reduces risks from disasters



Water Prediction: Provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy.



FEMA

Response and Mitigation: Supports our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against respond to, recover from and mitigate all hazards

IWRSS Partnership
Anticipated to
expand
over time



NATIONAL WEATHER SERVICE

Protecting Lives and Property for 150 Years

Hydrologic Ensemble Forecast Service (HEFS)

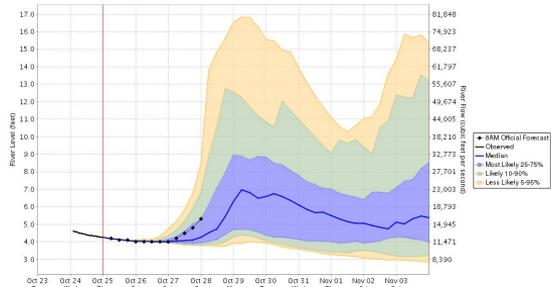


10 Day River Level Probabilities

Used to Estimate the Range of Possible River Levels
(without ENSPOST (Experimental))

Caution: Official forecast may be updated after this graph is generated.
For the latest official forecast, go to <http://water.weather.gov/ahps>

Susquehanna River at Wilkes-Barre, PA (WBRP1)

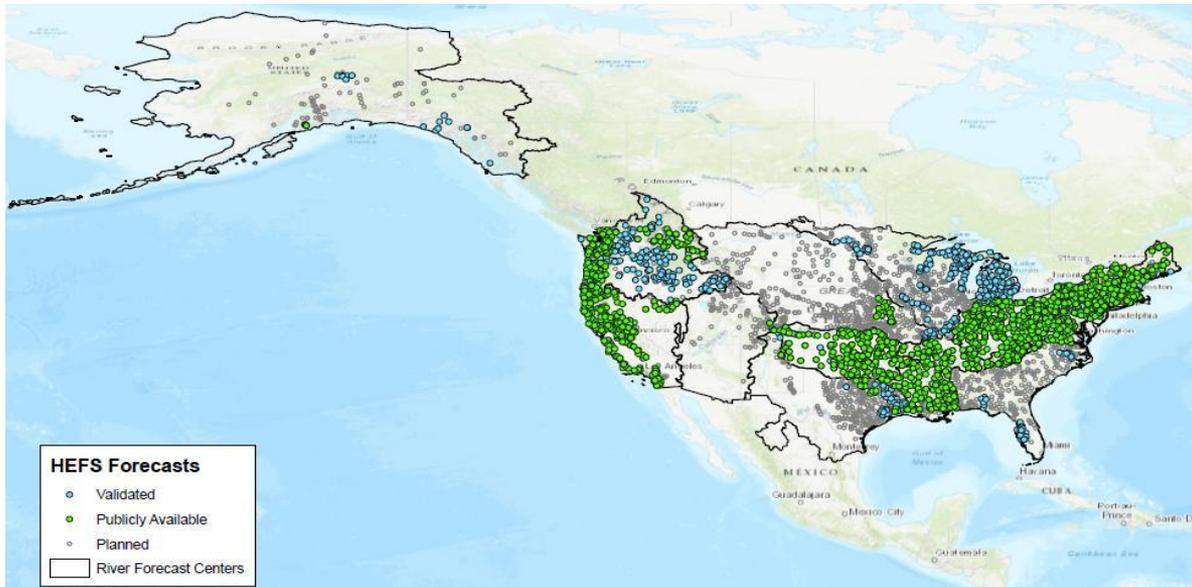
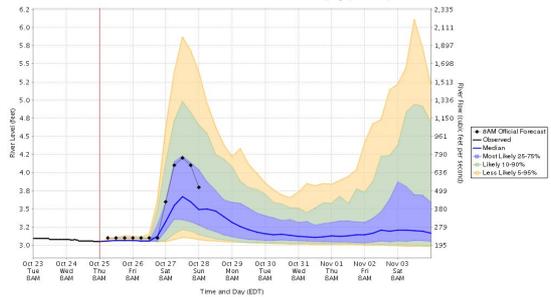


10 Day River Level Probabilities

Used to Estimate the Range of Possible River Levels
(without ENSPOST (Experimental))

Caution: Official forecast may be updated after this graph is generated.
For the latest official forecast, go to <http://water.weather.gov/ahps>

S. Br. Raritan River at Stanton, NJ (STTN4)



Model runtime: 08:00 AM EDT Oct 25 2018
Middle Atlantic River Forecast Center



National Water Model (NWM)

NWM Implementation on August 2016

- Focus on full range of water resources from droughts to floods
- Provides forecast streamflow guidance for underserved locations
- Produces spatially continuous national estimates and forecasts of hydrologic states (soil moisture, snow pack, etc.)
- Implements a modeling architecture that permits rapid infusion of new data and science and supports cross-NOAA water initiative
- **Provides a foundation for sustained growth in a nationally consistent operational hydrologic forecasting capability**
- **New versions to be released on a routine basis**

Configuration	Forcing	Cycling	Forecast Time Step	Forecast Range
CONUS				
Standard Analysis	HRRR/RAP/MRMS/MPE	Self	N/A	-3 hours
Extended Analysis	HRRR/RAP/MRMS/MPE	Self	N/A	-28 hours
Long-Range Analysis	HRRR/RAP/MRMS/MPE	Self	N/A	-12 hours
Short-Range Forecast	HRRR/RAP	Hourly	Hourly	18 hours
Medium-Range Forecast	GFS	Every 6 hours	3-Hourly	10 days
Long-Range Forecast	CFS	Every 6 hours	6-Hourly	30 days
Hawaii				
Analysis	NAM-NEST	Self	N/A	-3 hours
Short-Range Forecast	NAM-NEST	Hourly	Hourly	60 hours



Meeting User Needs with Current and Future Services

High Flow/Flood Risk Map Services

Current

Experimental

National Scale Map Services

Observed: Gauge Observations Map
Current/Hourly:
Daily: Point Forecast Map
Weekly:
Seasonal: Spring Flood Outlook; Long-Range Flood Outlook Map

Observed: NWM Streamflow Analysis; Modeled soil moisture
Current/Hourly: NWM 18-hour Forecast Streamflow, Anomaly
Daily: NWM 10-day Forecast Streamflow, Anomaly
Weekly: NWM 30-day Forecast Streamflow, Anomaly
Seasonal:

River Basin/ Regional Scale Map Services

Observed: Gauge Observations Map
Current/Hourly: Briefings and Decision Support
Daily: Point Forecast Map; Significant River Flood Outlook
Weekly:
Seasonal: Long-Range Flood Outlook Map

Observed: NWM Streamflow Analysis; Modeled soil moisture
Current/Hourly: NWM 18-hr Forecast Streamflow, Arrival Time, Magnitude
Daily: NWM 10-day Forecast Streamflow, Arrival Time, Magnitude
Weekly: NWM 30-day Forecast Streamflow
Seasonal:

Neighborhood Details

Observed: Static Inundation maps
Current/Hourly: Watches and Warnings
Daily: Forecast hydrographs
Weekly: Probabilistic short-term forecast hydrographs
Seasonal: Probabilistic long-term exceedance

Observed: NWM Streamflow Analysis Hydrograph
Current/Hourly: NWM 18-hr Forecast Streamflow Hydrograph, Arrival and Recession Time, Return Interval, Forecast Inundation
Daily: NWM 10-day Forecast Streamflow Hydrograph, Arrival and Recession Time, Return Interval, Forecast Inundation
Weekly:
Seasonal:

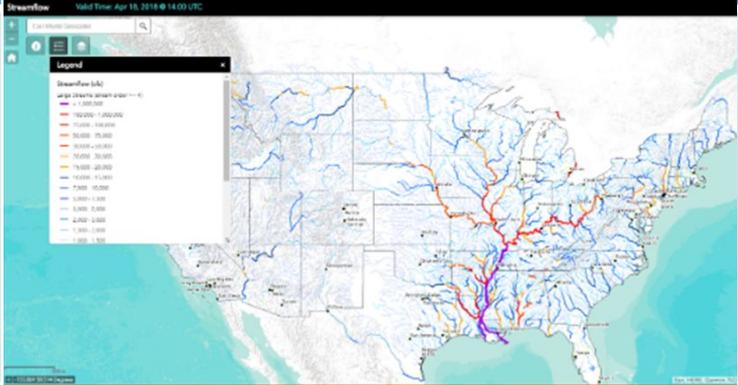


NATIONAL WEATHER SERVICE

Protecting Lives and Property for 150 Years

Building a Weather-Ready Nation /22

Prototype Services - Streamflow

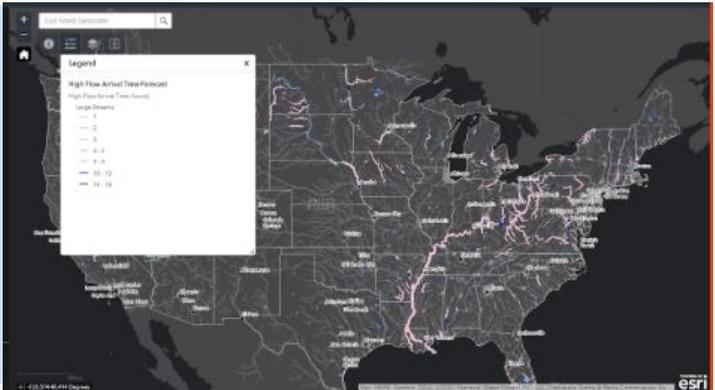
Parameter	Description	Timeframe	Image
Streamflow	Map depicts discharge measured in cubic feet per second	Current conditions	
Streamflow Anomaly	Map shows how anomalous current streamflow values are as compared to the average value for that calendar day	Current conditions	



NATIONAL WEATHER SERVICE

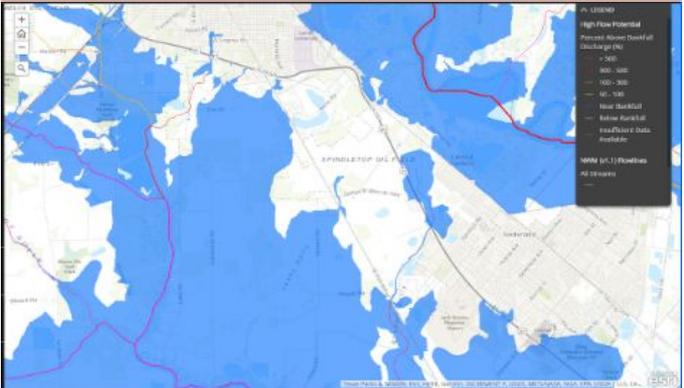
Protecting Lives and Property for 150 Years

Prototype Services - Timing

Parameter	Description	Timeframe	Image
High Flow Arrival Time	Map depicts what time a stream reach is expected to exceed estimated bankfull discharge (1.5 year recurrence interval).	Next 18 hours, Next 10 days	
Peak Flow Arrival Time	Map depicts what time a stream reach is expected to reach its maximum flow.	Next 18 hours, Next 10 days	



Prototype Services – Magnitude & Impact

Parameter	Description	Timeframe	Image
Maximum Flow Magnitude	Map shows the highest streamflow recurrence interval that is forecast to be exceeded (1.5 to >5 years)	Current conditions, Next 18 hours, Next 3 days, Next 5 days	
Maximum Inundation Extent	Map shows all areas forecast to be inundated at any point during the time period.	Current conditions, Next 18 hours, Next 3 days, Next 5 days	



NATIONAL WEATHER SERVICE

Protecting Lives and Property for 150 Years