

# FLOOD RISK AND UNCERTAINTY

---

Assessing the National Weather Service's  
Flood Forecast and Warning Tools

Rachel Hogan Carr  
Delaware River Basin Commission  
December 3, 2014



# THE NURTURE NATURE CENTER

Nurture Nature Center is a non-profit organization in Easton, PA, that has been working to educate the public about flooding. NNC has undertaken several projects with NOAA and NWS, including its “Focus on Floods” education campaign, to understand and share information about how the public perceives and acts upon flood risk.



## What's your number?

Knowing your river's flood stage is the first step in flood preparedness.

New York  
Pennsylvania

Knowing your river's flood stage is the first step in flood preparedness.

### What's your number?

FLOOD STAGE \_\_\_\_\_ FT.

RIVER OR LAKE \_\_\_\_\_

To find the first step of your flood stage, visit the National Weather Service at: <https://water.weather.gov/whpf/>

## Floods happen. Lessen the loss.

## HAVE A PLAN

### HAVE A PLAN

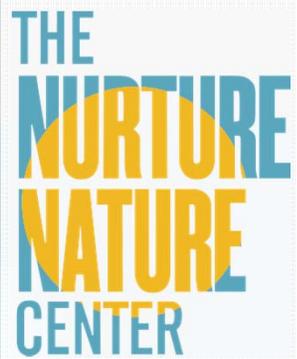
#### What's the plan?

A flood readiness plan will make you better prepared for a flood or other emergency event. Your plan can be a simple, one-page plan that lists safe evacuation routes, determines where you will meet up during a flood event (a meeting place outside your home or in a public place), and lists family and contact phone numbers. More elaborate plans also list the river level at which certain access roads to your property begin to close, and the level at which your property begins to be affected by flood waters. You should also consider how you will protect important documents, computer hard drives, and other valuables. What about your family? Make a plan to store important items in flood waters, perhaps in the attic or in a safe. Decide which items you will take with you in an emergency. Also note where you've stored your valuables, and what it contains. An inventory of your valuables is also important. In case you need to evacuate, you will often have at least...



## Social Science: A Key Step in Building a Weather-Ready Nation

- One of four social science projects awarded in 2012 to look at decision-making during extreme weather events.
- These projects support NOAA's Weather-Ready Nation Initiative.
- Projects are managed through the Office of Weather and Air Quality in the NOAA Office of Oceanic and Atmospheric Research with funding from the U.S. Weather Research Program and the NOAA National Weather Service (NWS).



## Partners:

- East Carolina University
- National Weather Service (NWS) Mid-Atlantic River Forecast Center
- (NWS) Mt. Holly, NJ Weather Forecast Office
- (NWS) Binghamton, NY Weather Forecast Office
- RMC Research Corporation (evaluators)



# What Is the Issue?

NWS flood forecast and warning tools offer tremendous amounts of timely, accurate data.

***But: People often don't respond the way they should to protect life and property.***

## FLOOD RISK AND UNCERTAINTY PROJECT



**Gary Szatkowski**

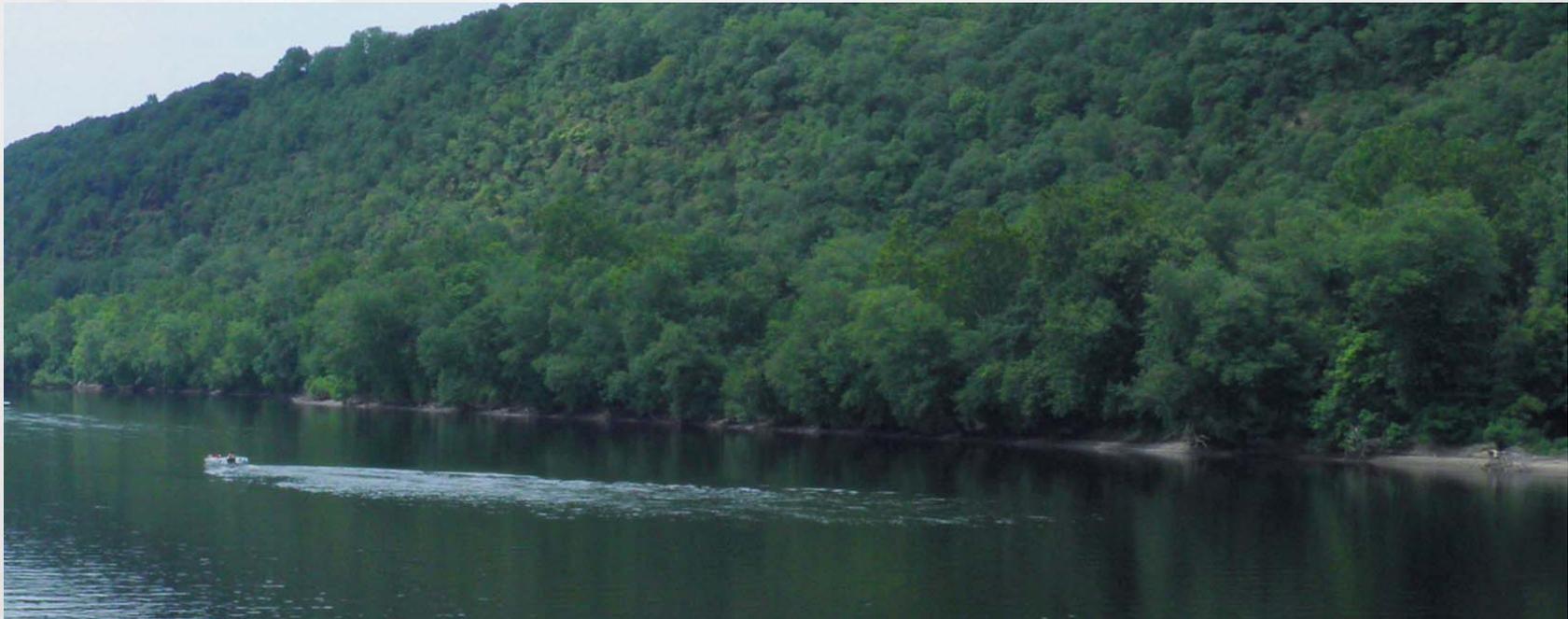
Chief Meteorologist, National Weather Service Forecast Office Mt. Holly, NJ/Philadelphia

“What we need now is to package and communicate weather warning information so that people understand it and take the right action with the time they are given.”

Gary Szatkowski, Meteorologist in Charge of the NWS Philadelphia, PA/Mt. Holly NJ WFO

## Research Questions:

- How do people living in the Delaware River Basin understand and use NWS products and services in understanding flood risk?
- What improvements to NWS flood forecast products would better motivate people to take flood preparedness and response actions?



# What Are the Tools?

## NWS Flood Forecast and Warning Tools:

- Advanced Hydrologic Prediction Service (including hydrograph and flood inundation mapping)
- Flood Forecast Watches and Warnings (including flash flooding)
- Meteorological Model-Based Ensemble Forecasting System (demonstrate uncertainty in forecasts)

# What Methods Are We Using?

Focus group participants respond to flood tools through an extreme flood scenario akin to that of the flood of record in the region, the Flood of 1955.

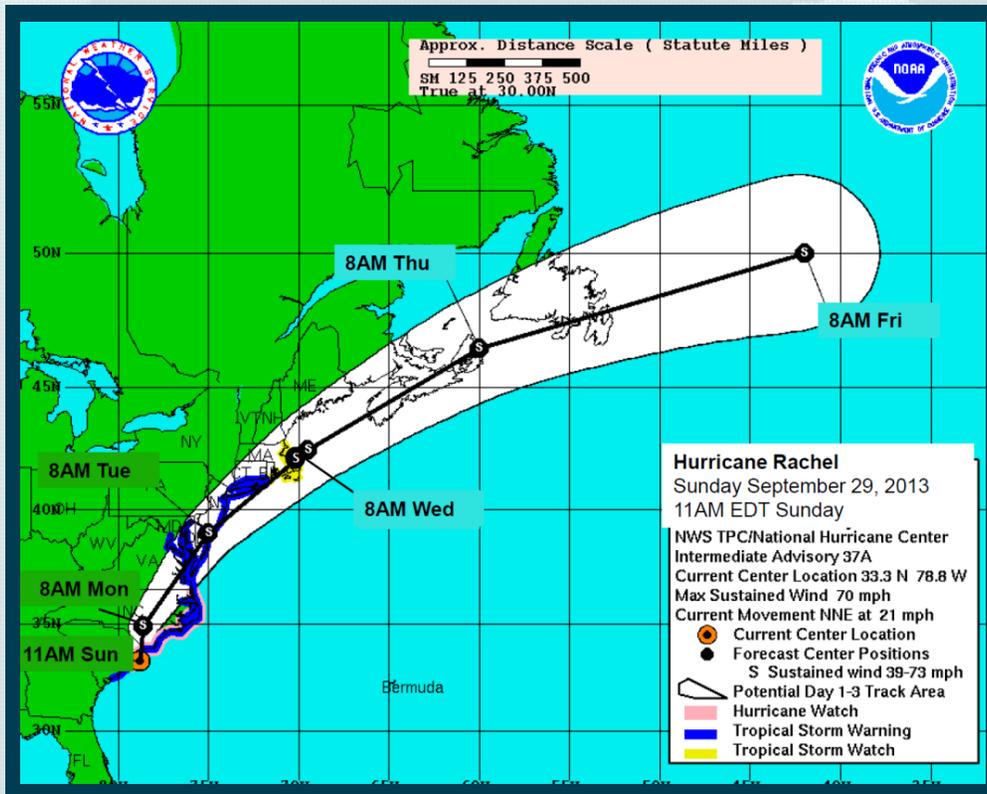


- Total of eight focus groups
- Four in urban Easton, PA area
- Four in less dense Lambertville, NJ
- Both are flood-prone communities with heavy residential impacts



EASTON, PA  
LAMBERTVILLE, NJ

# Flood Scenario: A Simulated East Coast Hurricane



The 7-day scenario includes a series of products issued by the NWS, including:

- Hurricane cones
- Hydrographs
- Significant River Flood Outlooks
- Quantitative Precipitation Forecasts
- Flood Watches and Warnings
- Ensemble forecasts showing uncertainty

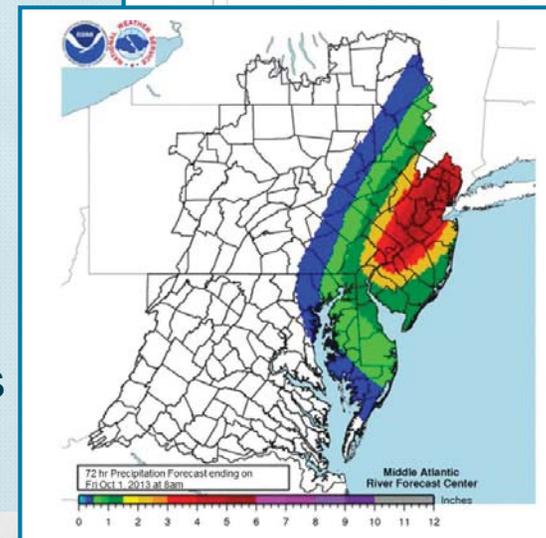
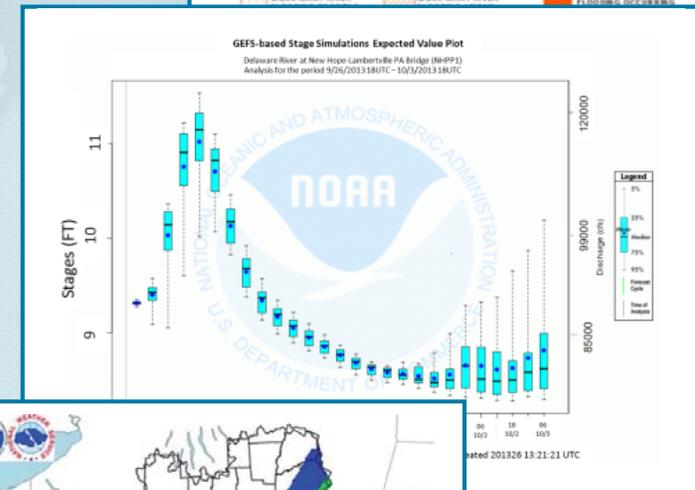
# Focus Groups:

A facilitated discussion about the tools

- 15 participants per session, average, flood-affected individuals

Participants gave feedback about:

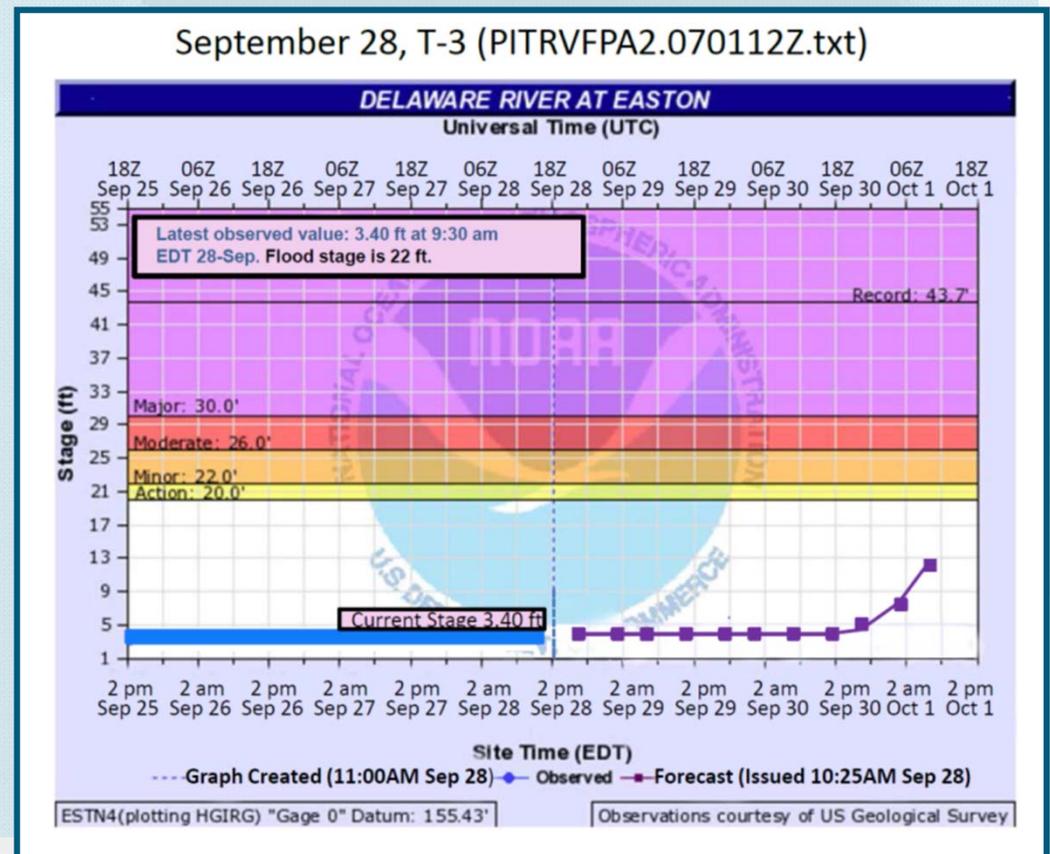
- Timing of products
- Graphic design and visual clarity
- Ways the products motivated action
- How they share the information with others



# River Levels Matter

HYDROGRAPH was the highest-ranked product:

- “Very clear, easy to read & useful.”
- High results for visual clarity, usefulness and location specificity.
- Suggestion: link every flood product to hydrograph

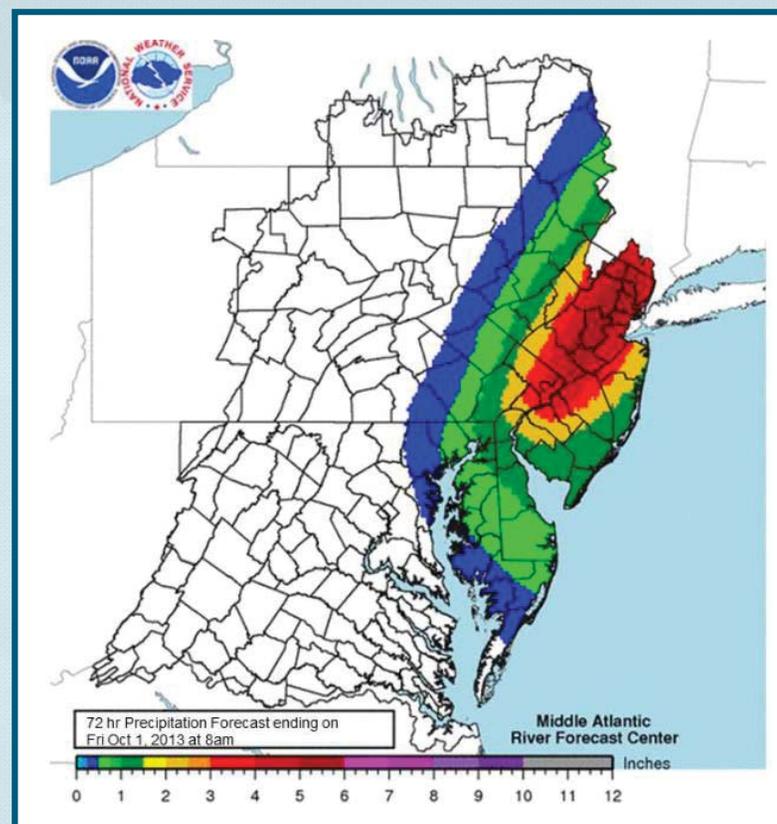


# Use Color, and Use It Carefully

**COLOR** in graphics can help or hurt people's understanding of risk.

Participants discussed:

- Positive use of color (Quantitative Precipitation Forecast)
- Confusing use of color (inundation maps and flood outlooks)
- Lack of color/font variations (Flood Watches and Warnings)



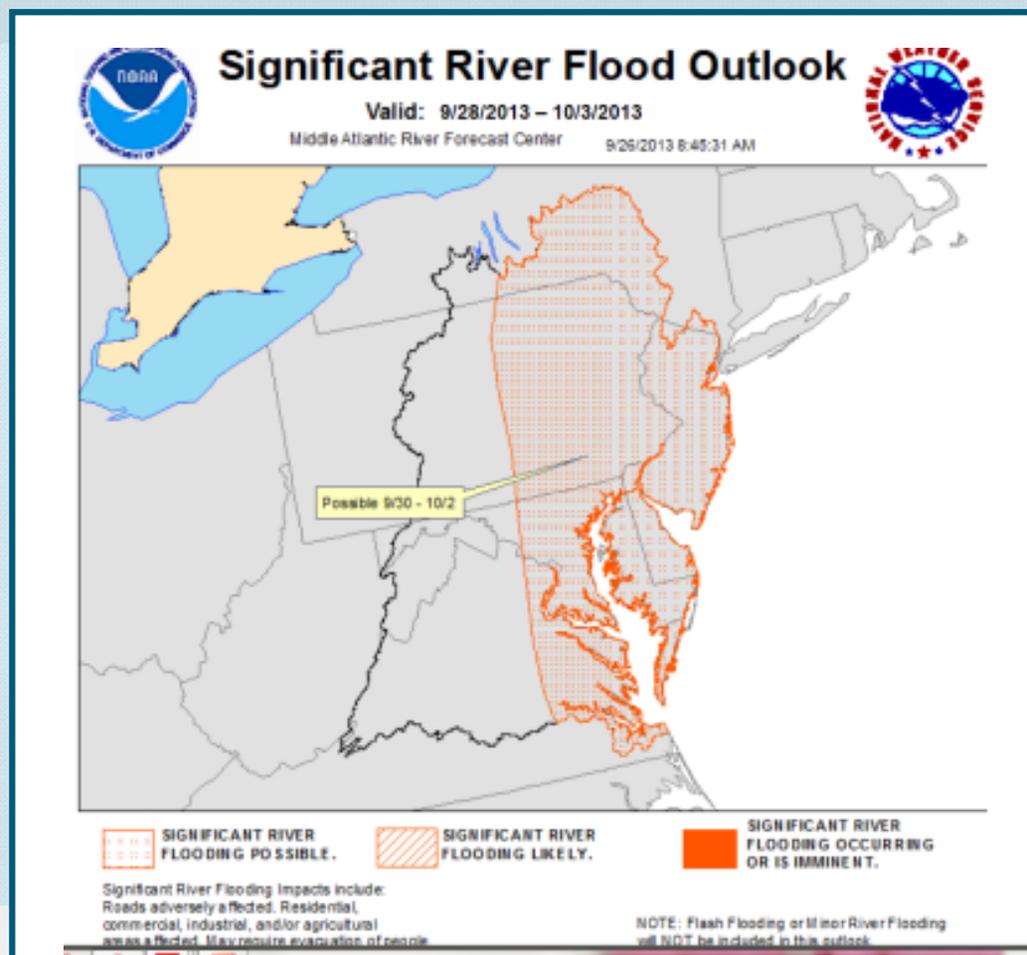
# Location Details

## GEOGRAPHIC SPECIFICITY

helps understanding of risk:

Use hyper-local info when possible

- Poor ratings for this product due to lack of location detail
- Product unhelpful; did not prompt action

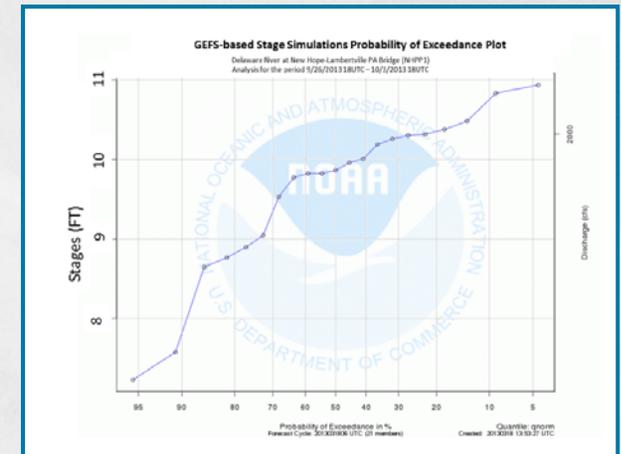
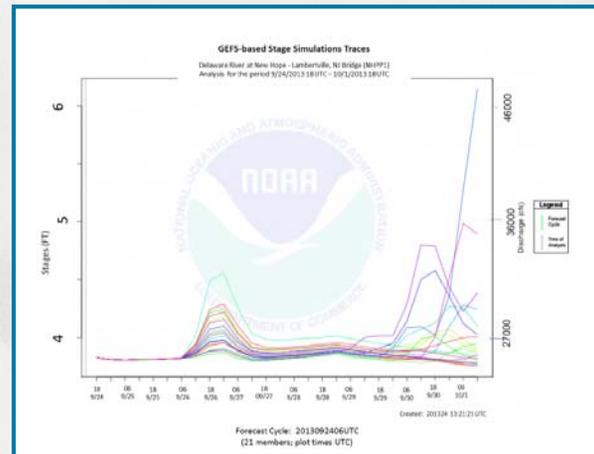
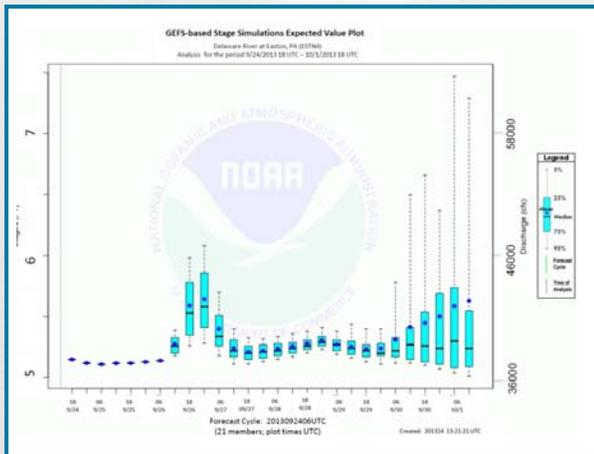


# Uncertainty

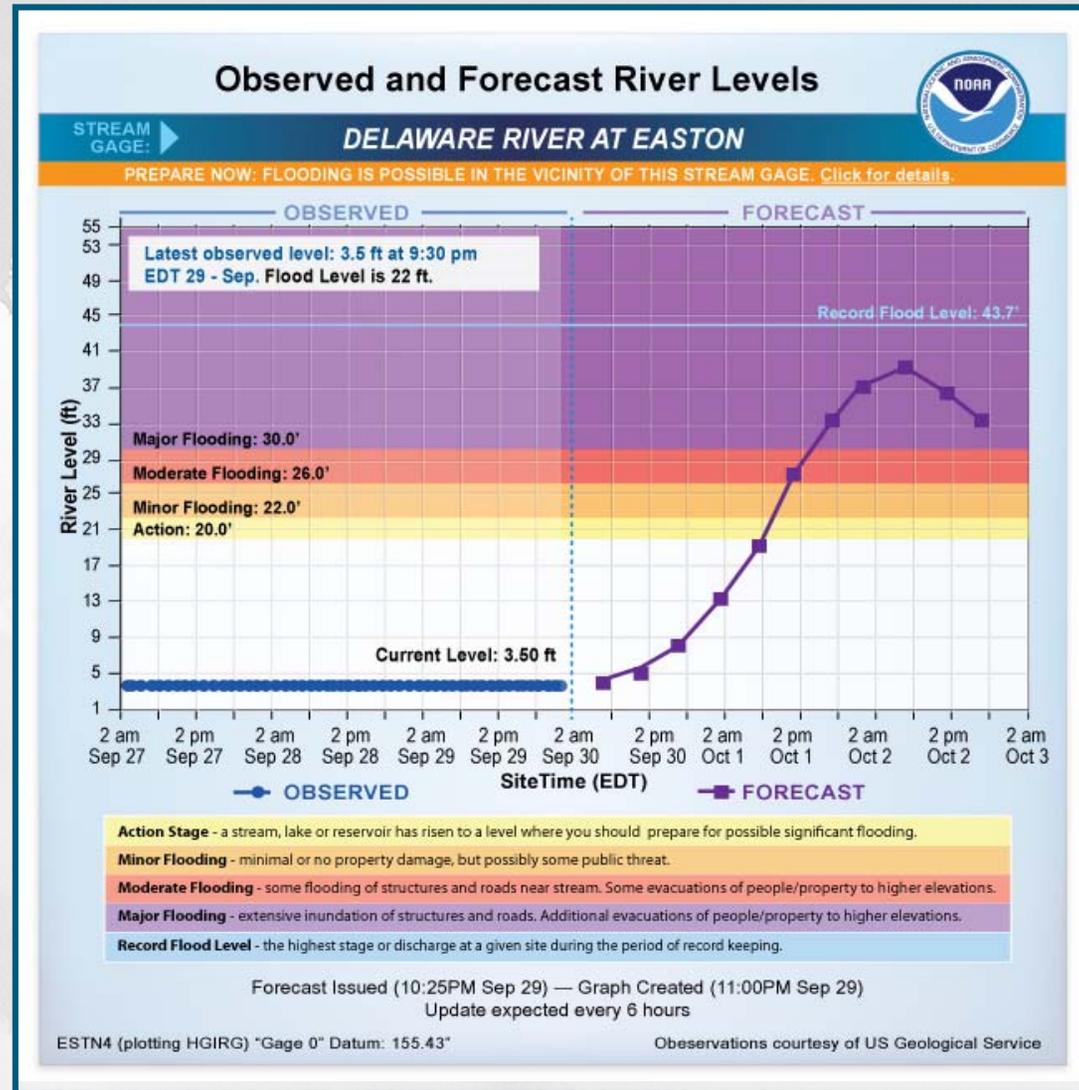
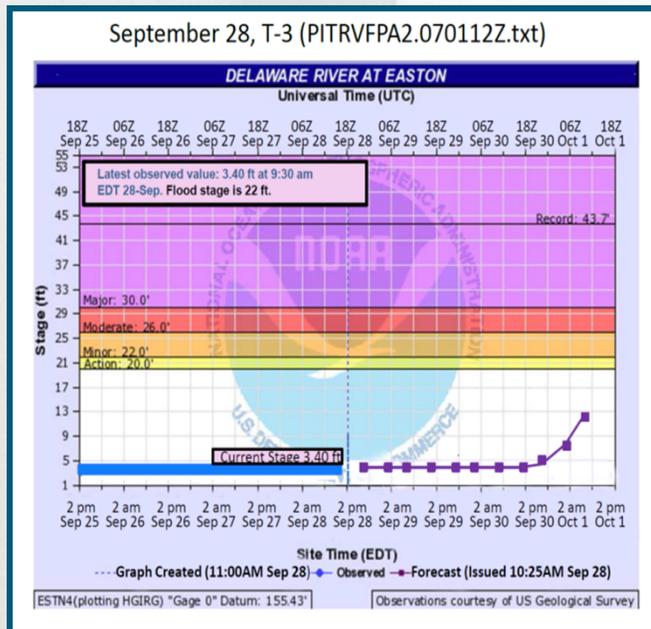
**UNCERTAINTY MESSAGES** need to be carefully considered.

- Current ensemble forecast graphics were very confusing
- Some participants did want to receive uncertainty information
- Almost no participants could properly interpret the information from the current suite of Meteorological Model Ensemble River Forecasts (MMEFS) graphics

## MMEFS Graphics:

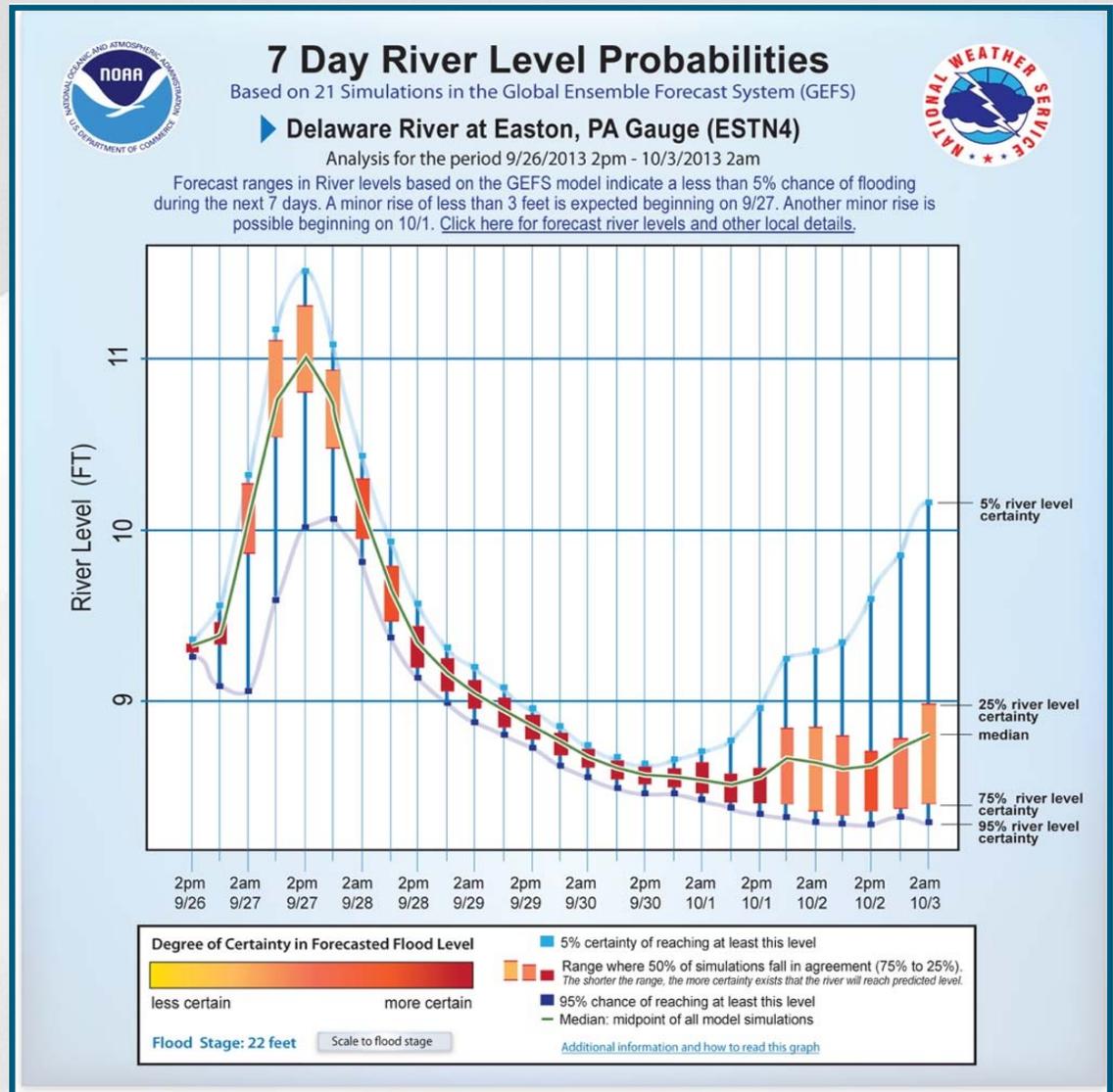
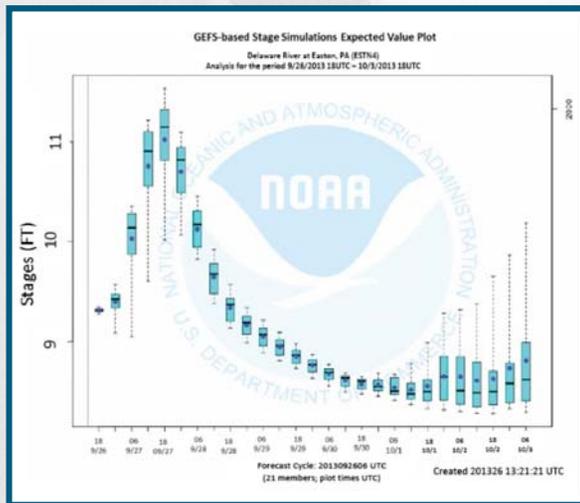


# Example of a Draft Mocked-up Hydrograph



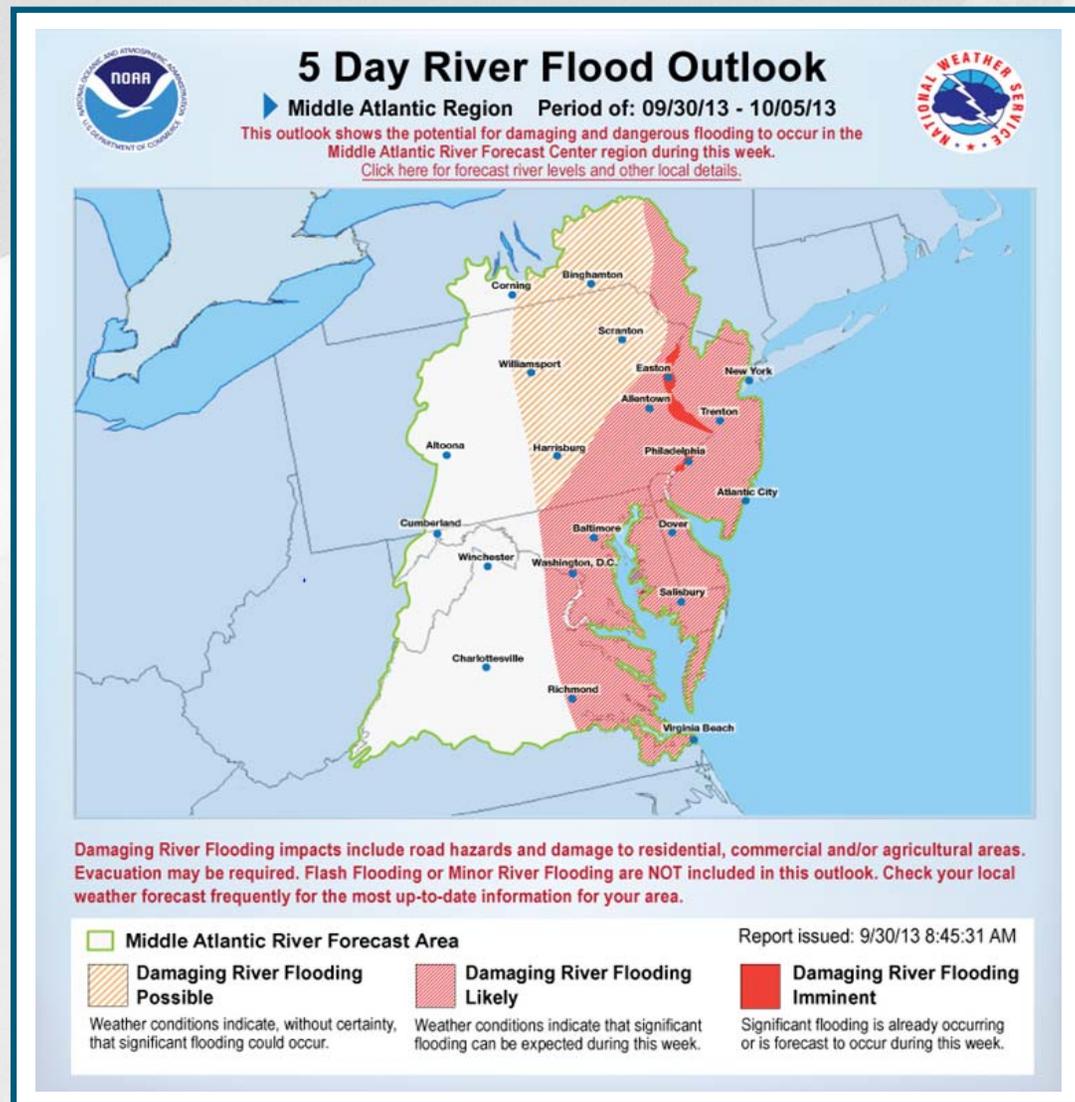
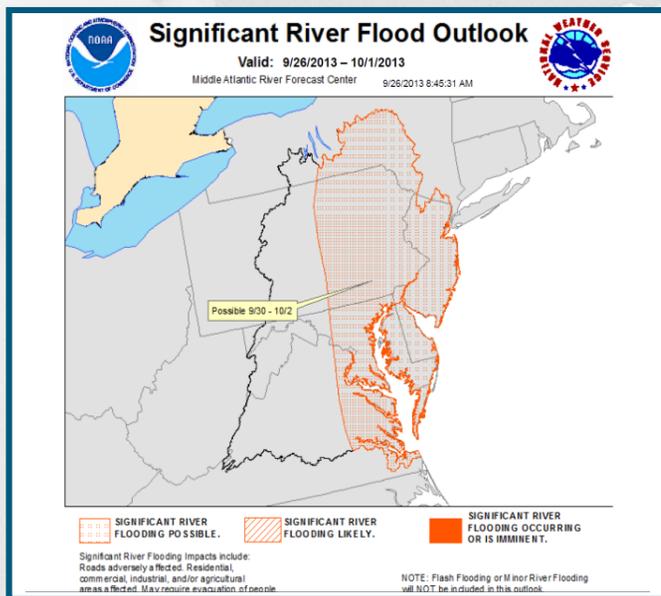
Incorporates various focus groups recommendations, including the careful use of text, and color variation

# Example of a Draft Mocked-up Uncertainty Graphic



Incorporates various focus groups recommendations, including the careful use of text, and color variation

# Example of a Draft Significant River Flood Outlook



Adds geographic specificity, demarcates service area boundaries, differentiates between levels of risk and provides more specific legend.

# What is Next?

From the complete analysis, we will:

- **Recommend changes to the design and implementation** of the flood forecast and warning tools
- **Author a manuscript** summarizing the findings
- Create **three 5-minute videos** summarizing the findings for NOAA/NWS audiences, emergency managers and the public
- Share findings through series of **webinars and speaking presentations**

# Socialscience.Focusonfloods.org

**THE NURTURE NATURE CENTER** FOCUS ON FLOODS SOCIAL SCIENCE

Home About Resources Reports and Findings search...

## Can Social Science Help Improve Public Use of Flood Forecast Tools?

The National Weather Service (NWS) offers many flood forecast and warning tools that individuals can use during a predicted flood event. From tools that allow users to monitor projected river heights to flood inundation maps that show which areas in the community will be underwater during floods, the capability and accuracy of flood forecasting has increased dramatically in recent years. Despite this, many people still fail to understand and respond properly to flood forecasts and warnings issued by NWS.

Beyond technological advances in forecast lead-time and accuracy already achieved, what else can NWS do to improve its flood forecast and warning tools so they better motivate flood preparedness and warning response? In partnership with Nurture Nature Center ([nurturenaturecenter.org](http://nurturenaturecenter.org)), NWS is undertaking a social science research study in the four-state Delaware River Basin. The study will ask individuals living in flood-affected communities to participate in focus group interviews to help answer two questions:

- How do people living in the Delaware River Basin use NWS flood forecast and warning tools in understanding their flood risk?
- How can these tools be improved so they better motivate flood preparedness and warning response?

"Given the frequency and intensity of flooding not only in this region, but across the country, improving how people prepare for flooding is critical to reducing losses," said NNC Director Rachel Hogan Carr. "This project provides an excellent opportunity to help NWS understand how the public uses its flood forecast and warning tools, and what further refinements might improve public preparedness as people respond to news of impending flood events."

Nurture Nature Center, Inc. is a non-profit organization in Easton, Pennsylvania, with a focus on flooding issues. NNC's social science project, "Flood Risk and Uncertainty: Assessing the National Weather Service's Forecast and Warning Tools," supports NOAA's new Weather-Ready Nation initiative, designed to help the nation become better equipped to prepare for and respond to weather events.

## Includes already:

- research bibliography on social science related to flooding
- project information

## In development:

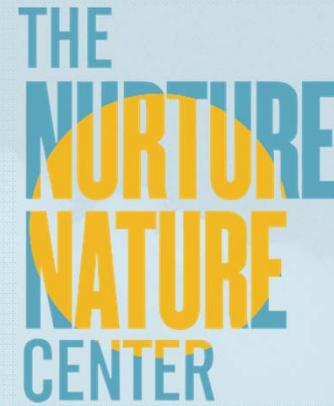
- educational materials
- final reports and papers

## Going forward:

- Second Social Science Study about Coastal Flooding tools ([Coastal.Focusonfloods.org](http://Coastal.Focusonfloods.org))

# Thank you!

**Rachel Hogan Carr**  
**Director**  
**Nurture Nature Center**  
**Easton, PA**



[www.nurturenaturecenter.org](http://www.nurturenaturecenter.org)

[www.focusonfloods.org](http://www.focusonfloods.org)

[socialscience.focusonfloods.org](http://socialscience.focusonfloods.org)

[rhogan@nurturenature.org](mailto:rhogan@nurturenature.org)

610-253-4432