

# **Unit 4:**

# **Inland Hurricane Preparation in Practice**

# Unit 4 Objectives



At the end of this unit, you should be able to:

1. Compare the challenges of coastal and inland emergency managers.
2. Discuss the available planning resources to assist inland EMs in evacuation decision making.
3. Describe available flood inundation support tools.
4. Identify the purpose of the Hurricane Liaison Team.

# Discussion 1: Evacuations



Activity Time: 10 minutes

Goal: Discuss the evacuation challenges that are:

- Unique to coastal EMs/decision-makers.
- Unique to inland EMs/decision-makers.

Directions:

- Pair up with a neighbor.
- Fill out the chart in the Unit 4 Discussion Handout.
- Prepare to share with class.

# Coastal vs. Inland EM Challenges 1



Coastal EM Challenges/Advantages	Inland EM Challenges/Advantages
<p data-bbox="112 394 1235 596">Advantage: Longer lead-time and there is enough forecast confidence to enable evacs far in advance of the storm.</p>	<p data-bbox="1291 394 2430 903">Disadvantage: Flash Floods may provide little-to-no lead time. There is rarely enough confidence to enable evacs far in advance of the storm. Mainstem river flooding will have slightly more lead time, but still may prove difficult. Mainstem river forecasts will have greater confidence than flash flooding.</p>
<p data-bbox="112 1011 1149 1139">Advantage: Evacs occur prior to onset of hazards.</p>	<p data-bbox="1291 1011 2384 1372">Disadvantage: Evacs could occur during hazardous weather, posing threats to both motorists and first responders. May be harder to communicate evac orders if communications infrastructure impacted.</p>

# Coastal vs. Inland EM Challenges 2



## Coastal EM Challenges/Advantages

Disadvantage: Larger-scale evacuations (100,000s, if not millions, of evacuees), who may need to travel significant distances to get to safety/comfort. “Shadow evacuees” will contribute significantly to the evacuating pop.

Advantage: Predetermined surge evacuation zones, which can be communicated to the public during Blue Sky.

## Inland EM Challenges/Advantages

Advantage: Smaller-scale evacs (at least relative to coastal evacs), and evacuees may not need to travel far to get to safety/comfort. Few, if any, “shadow evacuees.”

Disadvantage: Not many inland communities have pre-established evac zones beyond FEMA Flood Hazard Areas (which may not cover all of the flood-prone in an extreme flood event).

# Coastal vs. Inland EM Challenges 3



Coastal EM Challenges/Advantages	Inland EM Challenges/Advantages
Advantage: Regularly updated Hurricane Evacuation Studies (HESs), including recalculated evac clearance times.	Disadvantage: There are HES-like studies for inland EMs, but they don't quite offer the same suite of tools.
Same: widespread severe impacts	Same: widespread severe impacts

# Evacuations for Inland Communities

## Basic Inland Evacuation Considerations:

- What areas are most susceptible to inland flooding?
- What structures will withstand the winds?
- Hide from the wind (mobile homes, if strong-enough winds extend far enough inland)?
- Community/neighborhood isolation (aka “evacuation islands”)?
- Resiliency of critical infrastructure?



## Inland Evacuation Timing Considerations

- Onset of hazards
- Time of day
- Ongoing Weather Hazards
- Response Time / Evacuation Departure Time (i.e. the amount of time it will take a household to respond to the evac order)
- Traffic management considerations





# Evacuation Decision Considerations



**Protective Action Decisions within a jurisdiction are frequently made by an elected official**

- Define ultimate authority
- Consensus from other elected officials
- Verification by local ordinance or state code

# Regional Considerations



Evacuation decisions by one jurisdiction may affect others

- Inland evacuations tend to be smaller-scale compared to coastal evacuations.
- Evacuees typically don't need to leave the town, county or state. But there are exceptions...

Will evacuees in your jurisdiction have to go to shelters in other jurisdictions?

What are the host jurisdiction considerations?

Blue Sky and Dark Sky coordination with those jurisdictions?

# Important Inland Planning Factors



**Widespread infrastructure impacts, that could be medium-to-long-term include:**

- **Major and secondary roads** flooded, washed out and/or impacted by mudslides/debris. Seemingly unpredictable and random pattern to the impacts.
- **Key bridges** may be washed away by the floodwaters and/or debris.
- **Power outages** caused by flooding of grid facilities.
- **Water and sewer disruptions**, including for critical facilities (e.g., hospitals).

# Important Inland Planning Factors (cont.)



- The importance of air operations given potential for severe disruption of roadway networks.
- Widespread HAZMAT threats.
- Major and potentially long-term impacts to agriculture.

# Discussion 2: Vulnerable Facilities/Populations



Time: 10 minutes

Goal: Build a list of (1) vulnerable facilities and (2) populations that need to be accounted for when developing inland flooding plans.

Directions:

- Pair up with a neighbor.
- Fill out the chart in the Unit 4 Discussion Handout.
- Prepare to share with class.

# Vulnerable Facilities



- Hospitals
- Assisted Living and Nursing Homes
- Critical Infrastructure
- Public Safety Facilities
- Industrial Facilities
- Tourist and Recreation Areas
- Mobile Homes

# Vulnerable Populations



<b>Socioeconomic Status</b>	<ul style="list-style-type: none"><li>• Below Poverty</li><li>• Unemployed</li><li>• Income</li><li>• No High School Diploma</li></ul>
<b>Household Composition &amp; Disability</b>	<ul style="list-style-type: none"><li>• Aged 65 or Older</li><li>• Aged 17 or Younger</li><li>• Civilian with a Disability</li><li>• Single-Parent Households</li></ul>
<b>Minority Status &amp; Language</b>	<ul style="list-style-type: none"><li>• Minority</li><li>• Speak English “Less than Well”</li></ul>
<b>Housing &amp; Transportation</b>	<ul style="list-style-type: none"><li>• Multi-Unit Structures</li><li>• Mobile Homes</li><li>• Crowding</li><li>• No Vehicle</li><li>• Group Quarters</li></ul>

# Hurricane Evacuation Study (HES)



- What will be wet and what stays dry?
- Who/what will be affected in your community?
- What is the Public thinking?
- What are your shelter needs?
- Where is traffic going to back up?
- Evacuations from storm surge risk
- Predominantly focused on storm surge & coastal areas, currently no inland flooding equivalent

**Inland EMs have other resources at their disposal.**



## Massachusetts Hurricane Evacuation Study

Technical Data Report

May 2016



US Army Corps  
of Engineers®  
New England District



FEMA



# Discussion 3: Planning Resources



Time: 10 minutes

Goal: In the absence of an HES for inland EMs, what resources are you aware of in your jurisdiction/state that you can use to answer these same questions?

- Determine the extent, severity, location, and duration of hazards.
- Identify areas/neighborhoods that would need to evacuate in a given scenario.
- Identify vulnerable populations/facilities.
- Estimate shelter needs.
- Assess evacuation elements (routes, timing).

Directions:

- Pair up with a neighbor.
- Fill out the chart in the Unit 4 Discussion Handout.
- Prepare to share with class.

# Flood Insurance Studies (FIS)

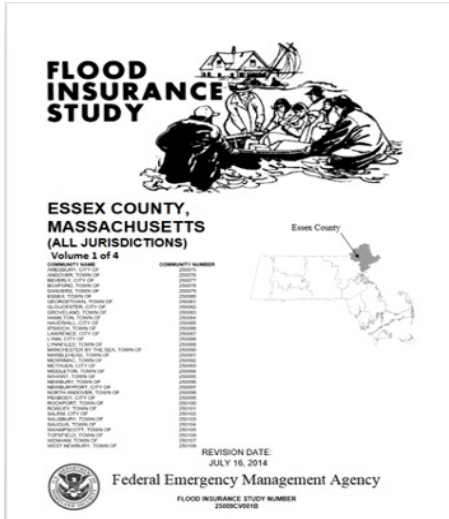
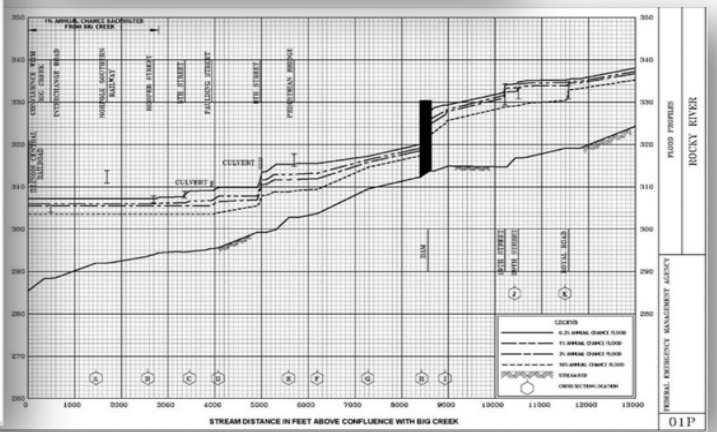


TABLE 6 - SUMMARY OF DISCHARGES - continued

PEAK DISCHARGES (CUBIC FEET PER SECOND)

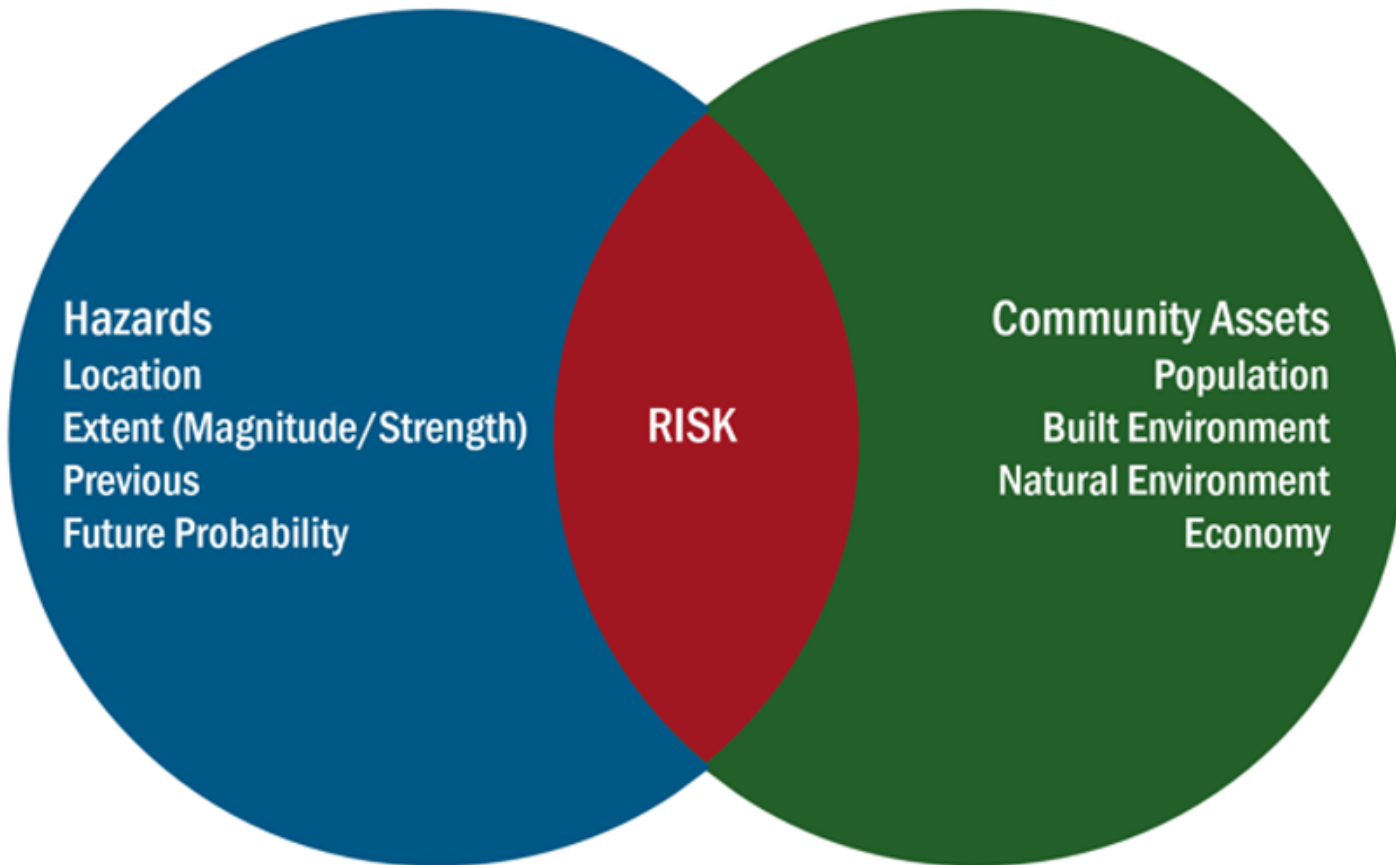
FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	10 PERCENT ANNUAL CHANCE	2 PERCENT ANNUAL CHANCE	1 PERCENT ANNUAL CHANCE	0.2 PERCENT ANNUAL CHANCE
<b>BALE MEADOW BROOK</b>					
At confluence with Merrimack River	7.70	350	580	710	1,090
At confluence with Hawkes Brook	2.70	180	320	400	620
450 feet downstream of Oak Street Hills Pond	1.10	110	190	230	370
Approximately 1800 feet upstream of North Lowell Street	0.20	34	61	80	123
<b>BARTLETT BROOK</b>					
Upstream of	6.30	310	520	630	970
<b>BATES BROOK</b>					
Upstream of	1.10	50*	112*	120*	132*
Confluence with Pillsbury Pond					
Upstream of Private Driveway	0.70	125	230	275	345
<b>BEAVER BROOK (TOWN OF DANVERS)</b>					
At mouth in Danvers	2.20	170	270	320	470
At Maple Street	1.70	130	240	290	430
Approximately 790 feet downstream of Spring Street	1.30	140	220	260	390

\*Decrease in Discharges Over Larger Drainage Area Due to Attenuation of Flow by Swamps



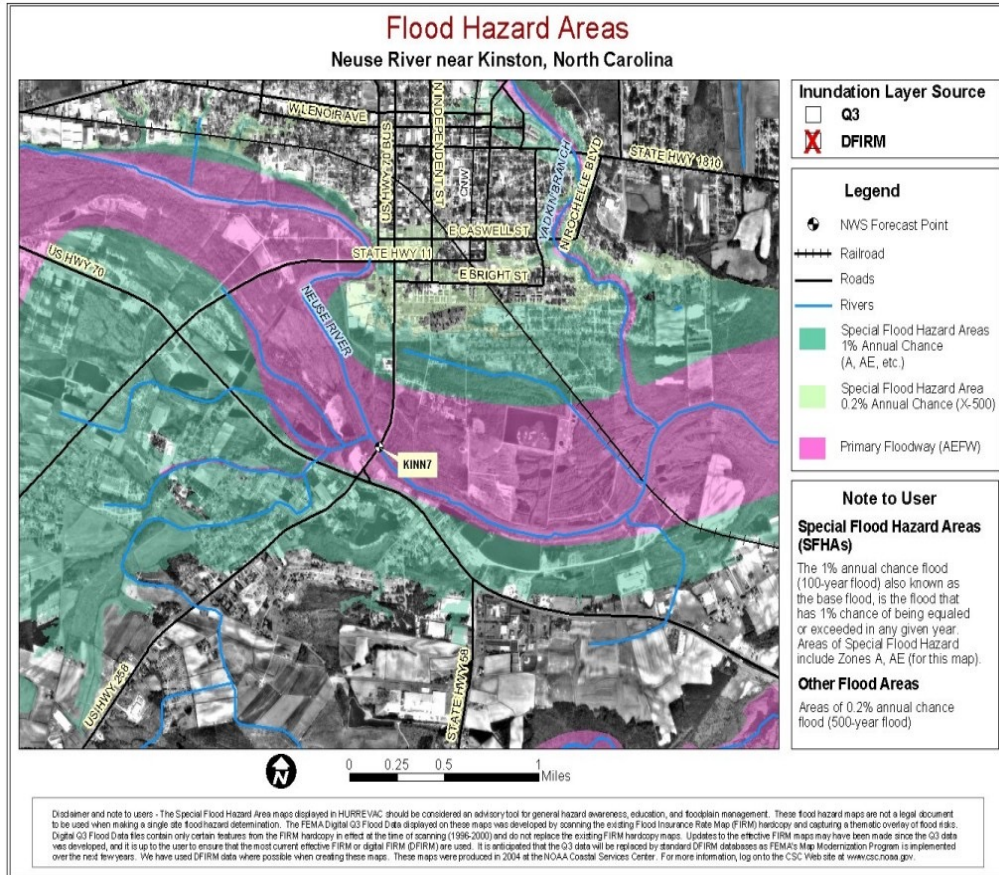
- A compilation and presentation of flood hazard areas along rivers, streams, coasts, and lakes within a community.
- A Flood Insurance Study (FIS) includes:
  - Cross sections
  - Coastal transects
  - Riverine flood profiles
  - H&H engineering
- The results of the FIS are shown on FEMA's flood maps called **Flood Insurance Rate Maps (FIRMs)**, and in the accompanying description of the study called an FIS report.

# Hazard Mitigation Plans



- Hazard mitigation planning reduces loss of life and property by minimizing the impact of disasters.
- State, tribal and local governments identify natural disaster risks and vulnerabilities that are common in their area.
- Develop long-term strategies for protecting people and property from similar events.
- Mitigation plans are key to breaking the cycle of disaster damage and reconstruction.
- Updated every five years and required to receive hazard mitigation grant funding

# FEMA Flood Hazard Area Mapping



## Flood Hazard Areas

- Map shows special flood hazard areas
- Overlay of local features
- Can be applied for GIS use

# Map Service Center



## Access Products

- FIRMs & FIS
- DFIRM Database
- LOMCs

## Access Tools

- Make a FIRMette
- National Flood Hazard Layer (NFHL)

## Resources

Live Mapping Support at the [Map Service Center](https://msc.fema.gov/portal/home)

A screenshot of the FEMA Flood Map Service Center website. The page features a dark blue header with the FEMA logo and a search bar. Below the header is a navigation menu with six categories: Plan, Prepare &amp; Mitigate; Disaster Survivor Assistance; Response &amp; Recovery; Topics &amp; Audiences; Blog, Newsroom, Videos &amp; Photos; and About FEMA. The main content area is titled "Flood Map Service Center" and includes a "Need Help?" button, a navigation bar with "MSC Home", "MSC Search", "MSC Products and Tools", "MSC How-To", and "MSC Email Subscriptions", and a map showing a flood hazard area with labels for "RUTLAND RD", "MARTIN AVE", "ZONE A", and "574.9". Below the map is a search bar with the text "Looking for a Flood Map?" and a "Search" button, and a section titled "About Flood Map Service Center" with a paragraph of text.

<https://msc.fema.gov/portal/home>

# Inundation Mapping Tool Demo



## Instructor-Led Demonstration of Inundation Mapping Tool

Activity Time: 5 minutes

Goal: Explore the [Inundation Mapping Tool](#)

1. Layout of the interface
2. Locations of key information
3. How to set inundation levels/map features.

# AHPS Flood Inundation Mapping Libraries



**National Oceanic and Atmospheric Administration's National Weather Service**

Site Map News

Local forecast by "City, St"

City, St  
Go

RSS RSS Feeds

Warnings  
Current  
By State/County...  
UV Alerts  
Observations  
Radar  
Satellite  
Snow Cover  
Surface Weather...  
Observed Precip  
Forecasts  
Local  
Graphical  
Aviation  
Marine  
Hurricanes  
Severe Weather  
Fire Weather  
Text Messages  
By State  
By Message Type  
National  
Forecast Models  
Numerical Models  
Statistical  
Models...  
MOS Prod  
GFS-LAMP Prod  
Climate  
Past Weather  
Predictions  
Weather Safety  
Weather Radio  
Hazard Assmt...  
StormReady /  
TsunamiReady  
Skywarn™  
Education/Outreach  
Information Center  
Tsunamis  
Publications...  
Contact Us  
FAQ  
Comments...

National Observations Inundation Locations

NOAA PARTNERED GUIDELINES FOR THE DEVELOPMENT OF ADVANCED HYDROLOGIC PREDICTION SERVICE FLOOD INUNDATION MAPPING

Legend: Inundation Gauges

Map Help  
Disclaimer

Latitude/Longitude Disclaimer: The gauge locations shown in the above map is the approximate location based on the latitude/longitude coordinates provided to the NWS by the gauge owner.

**National Weather Service Advanced Hydrologic Prediction Service**

Home News Organization

Spring Creek near Spring, TX (SPNT2)

National Observations Inundation Locations View Inundation Site

Weather Forecast Office Houston/Galveston, TX West Gulf River Forecast Cent

Hydrograph River at a Glance Download Inundation Mapping Probability Information

Print this map Find address or location

Data Type  
 Inundation Levels  
 Flood Categories  
 Current/Forecast

Inundation Levels  
NAVD88 Stage

Record Crest: 111.6 ft

107.6	107.6
106.6	106.6
105.6	105.6
104.6	104.6
103.6	103.6
102.6	102.6
101.6	101.6
100.6	100.6

Major Flooding Begins

99.6	99.6
98.6	98.6
97.6	97.6
96.6	96.6
95.6	95.6

Moderate Flooding Begins

94.6	94.6
93.6	93.6

Minor Flooding Begins

Near Flooding Begins

Below Flooding Begins

\* = Extended rating

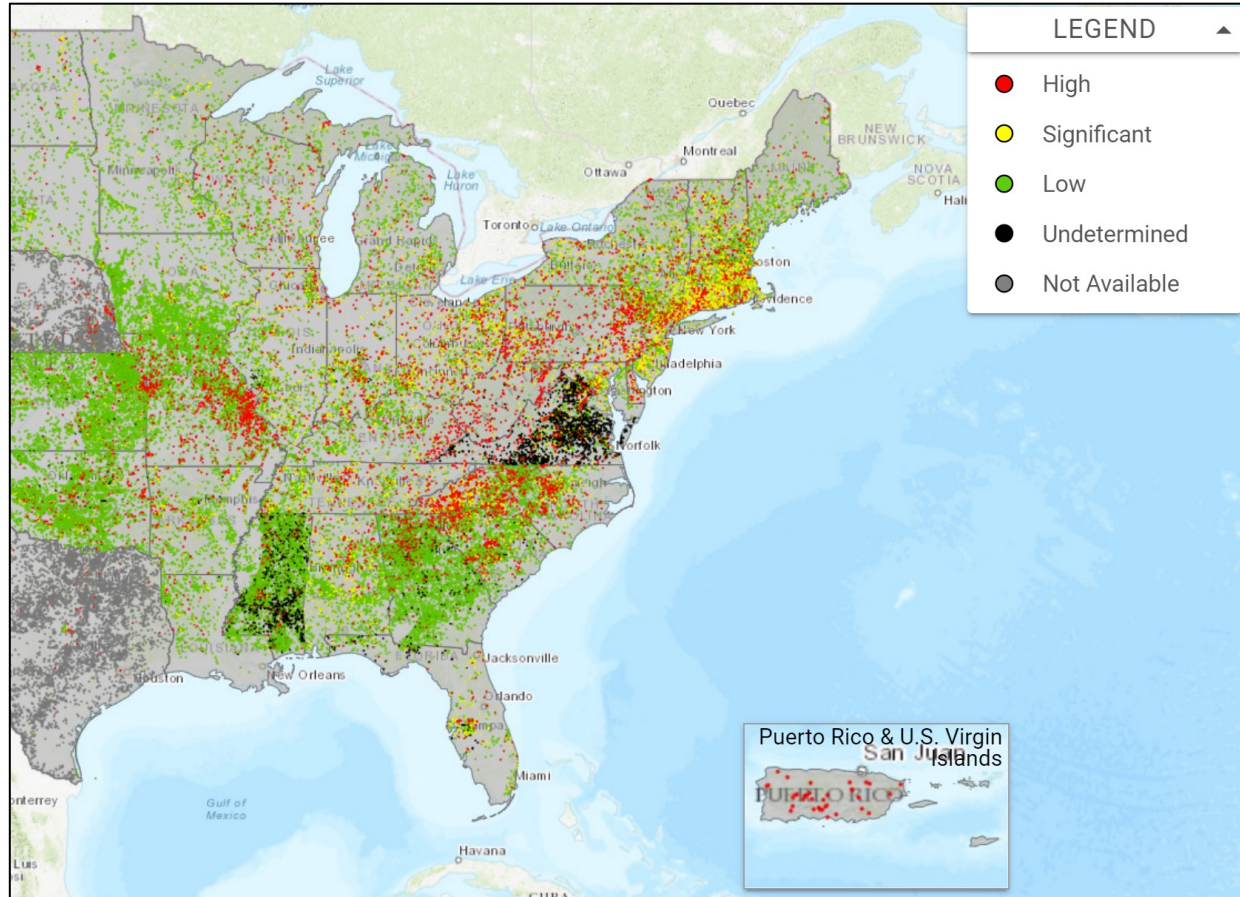
Inundation Feedback

WHEN FLOODED TURN AROUND DON'T

Legend: Gauge Location

Map Help  
Disclaimer

# USACE National Inventory of Dams



Hazard Potential Classification	Loss of Human Life	Econ, Envi, Lifeline Losses
Low	None Expected	Low and generally limited to owner
Significant	None Expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)



# Dam Hazards



Dam failure threat level terminology can vary between dam operators, which can easily cause confusion.

- Work with your dam operators in blue sky to understand their processes and language.

Dam inundation flood analysis (hasty analysis program used by some WFOs).

Exercises!

# Operational Timeframe



- Understand pre-existing conditions, hazard related or infrastructure/facilities
- Ensure internal and external communication channels are open
- Realize the operational time frame
- Anticipate staffing issues/local issues that may impact the activation.

# Execution Plan/Checklist/Timeline



Comprehensive guide to direct hurricane preparedness and decision-making for both pre-season and impending hazards.

Decisions and Actions are effective if they are based on:

- An understanding of tropical cyclones
- Hazards
- Community vulnerabilities
- Forecast products
- Good decision-making process

Public and private involvement is essential!

- Checklists are specific to each community

# Importance of an Execution Checklist/Timeline



- Prompts for timely action
- Supports decision-making accountability
- Structures documentation
- Ensures coordination and communication

# Hurricane Readiness Checklist



FEMA

Hurricane Preparedness – prior to June 1	PRIORITY LEVEL	PERSONNEL RESPONSIBLE	STATUS OF TASK	DATE/TIME COMPLETED
<b>Hurricane Planning</b>				
<ul style="list-style-type: none"> <li>Update local hurricane operation, evacuation plans and resource files</li> </ul>				
<ul style="list-style-type: none"> <li>Revise Standard Operating Procedures (SOPs)</li> </ul>				
<ul style="list-style-type: none"> <li>Review local emergency management ordinances and update</li> </ul>				
<ul style="list-style-type: none"> <li>Test HURREVAC and/or other hurricane tracking software</li> </ul>				
<ul style="list-style-type: none"> <li>Review Stafford Act Policies with State Emergency Management</li> </ul>				
<ul style="list-style-type: none"> <li>Determine evacuation decision making authority w/ line of succession</li> </ul>				
<b>Emergency Operations Center (EOC)</b>				
<ul style="list-style-type: none"> <li>Replenish supplies and check equipment</li> </ul>				
<ul style="list-style-type: none"> <li>Test communication lines</li> </ul>				
<ul style="list-style-type: none"> <li>Update activation plans and train staff</li> </ul>				
<ul style="list-style-type: none"> <li>Update HURREVAC to latest version</li> </ul>				

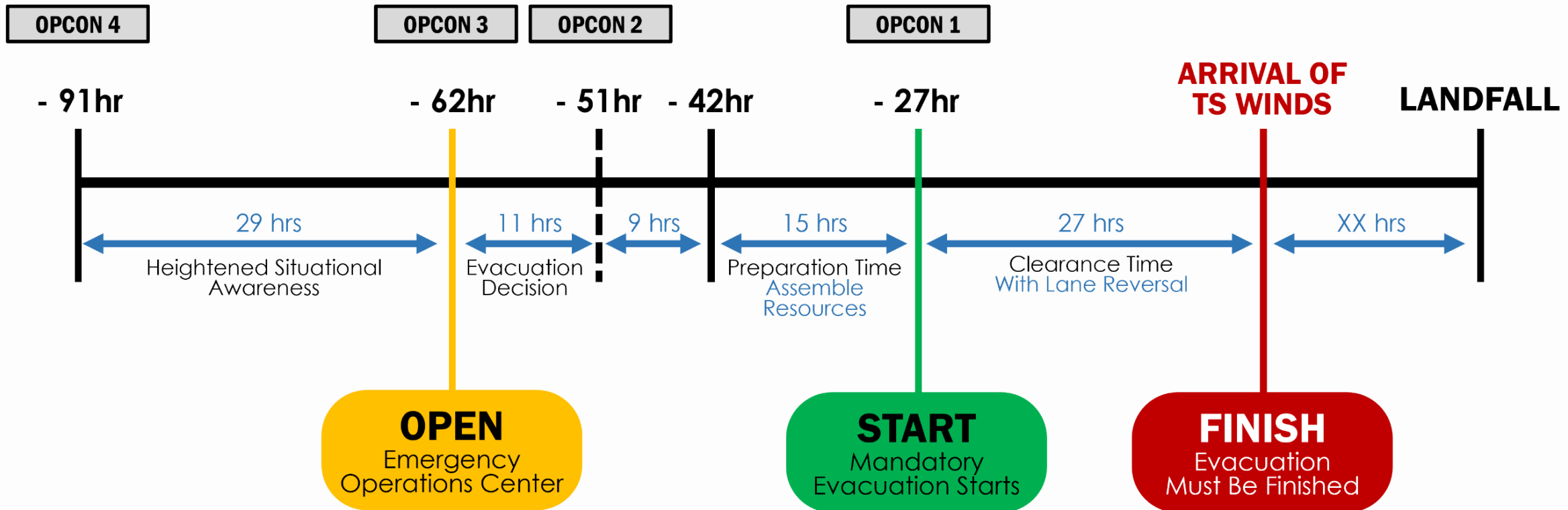
# Hurricane Readiness Checklist (cont.)



FEMA

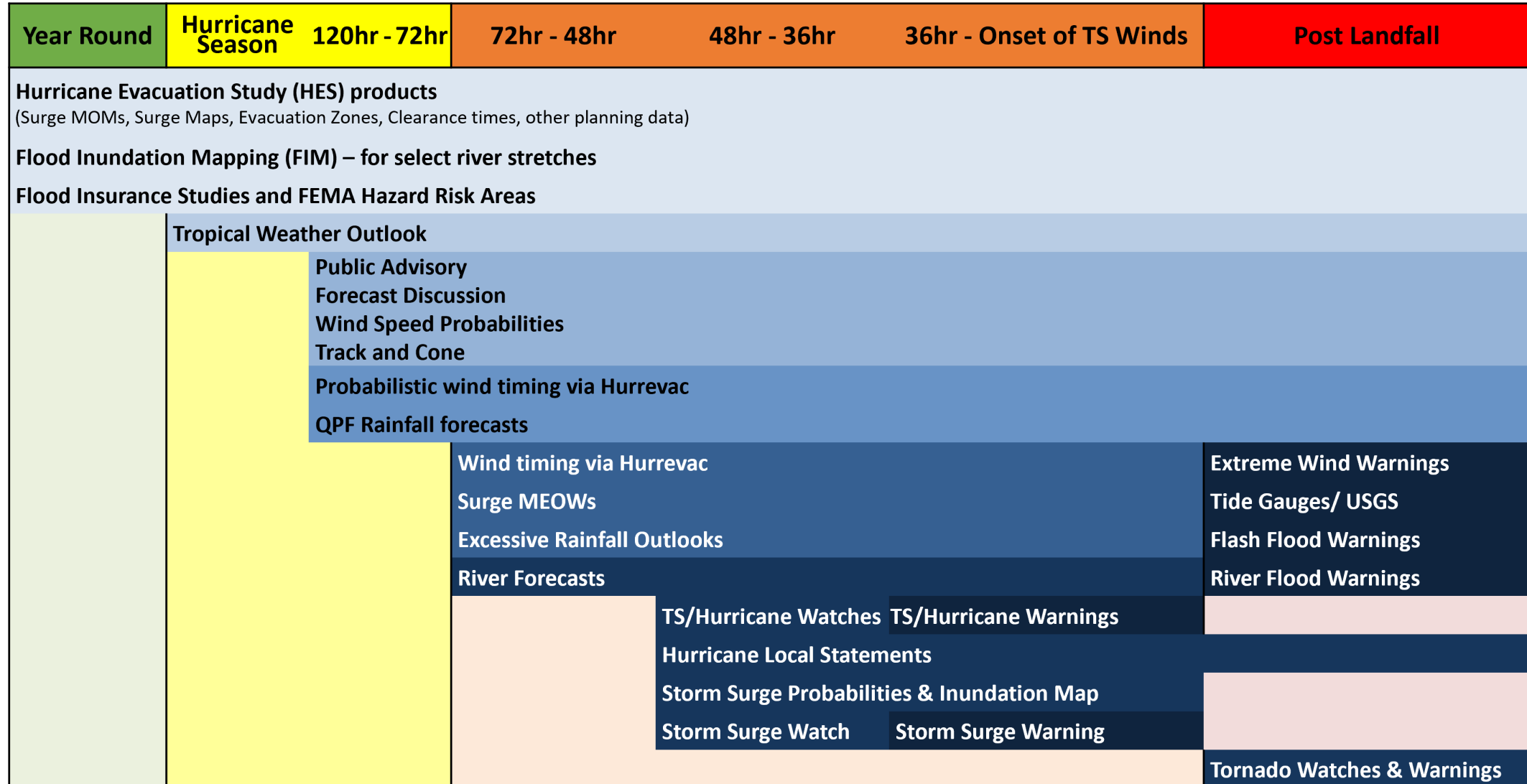
Storm Impacts Imminent (~36 hours) Hurricane Watches and Warnings Issued	PRIORITY LEVEL	PERSONNEL RESPONSIBLE	STATUS OF TASK	DATE/TIME COMPLETED
<b>Storm Watch</b>				
• Conference calls with NOAA local WFO/RFC/SPC				
• Continue to monitor HURREVAC and other systems				
• Monitor storm track and provide local government officials updates				
• Anticipate the possible arrival of rainfall and tornados				
• Monitor river stages and rainfall forecast				
<b>Emergency Operations Center (EOC)</b>				
• Activate EOC (partial or full based on clearance times and threat)				
• Request primary ESF support agencies provide EOC briefings				
• Complete and distribute EOC situation reports, as applicable				
• Prepare EOC facility- Mitigate for Winds, Water, etc.				

# Timeline Example



Horry County Evacuation Timeline for ABC Scenario

# Forecast Product Timeline



→ TIME →



# Resource Planning

Here are common items that are most likely to be needed during disasters:

- Shelf Stable Meals
- Bottled Water
- Cots
- Blankets
- Infant Toddler Kits
- Medical Equipment/Supply Kits
- Tarps
- Blue Sheeting
- Generators
- Fuel



# Resource Planning (cont.)

Prior to the storm, have a plan on how you're going to acquire critical resources, and identify specific sources.

Communicate any remaining resource gaps to stakeholders.

There are several logistical planning resources for emergency managers.



## Distribution Management Plan Guide 2.0

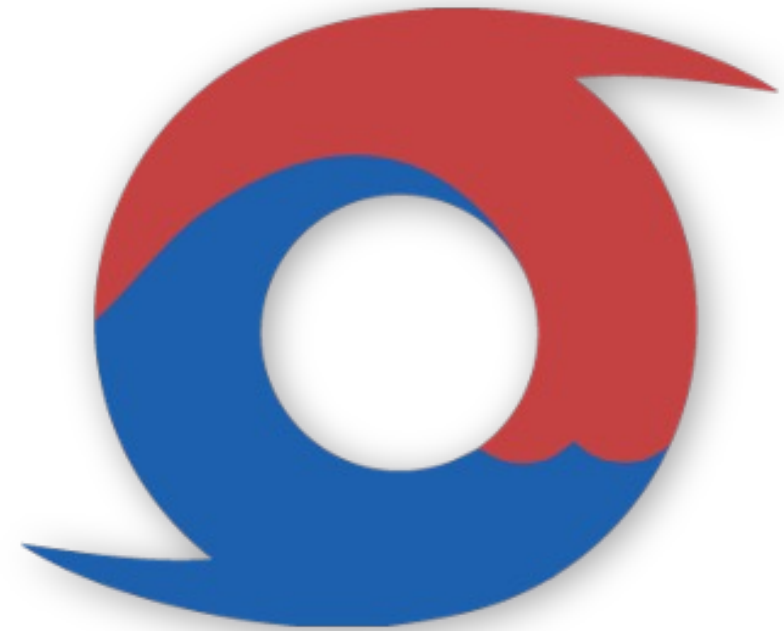
January 2022



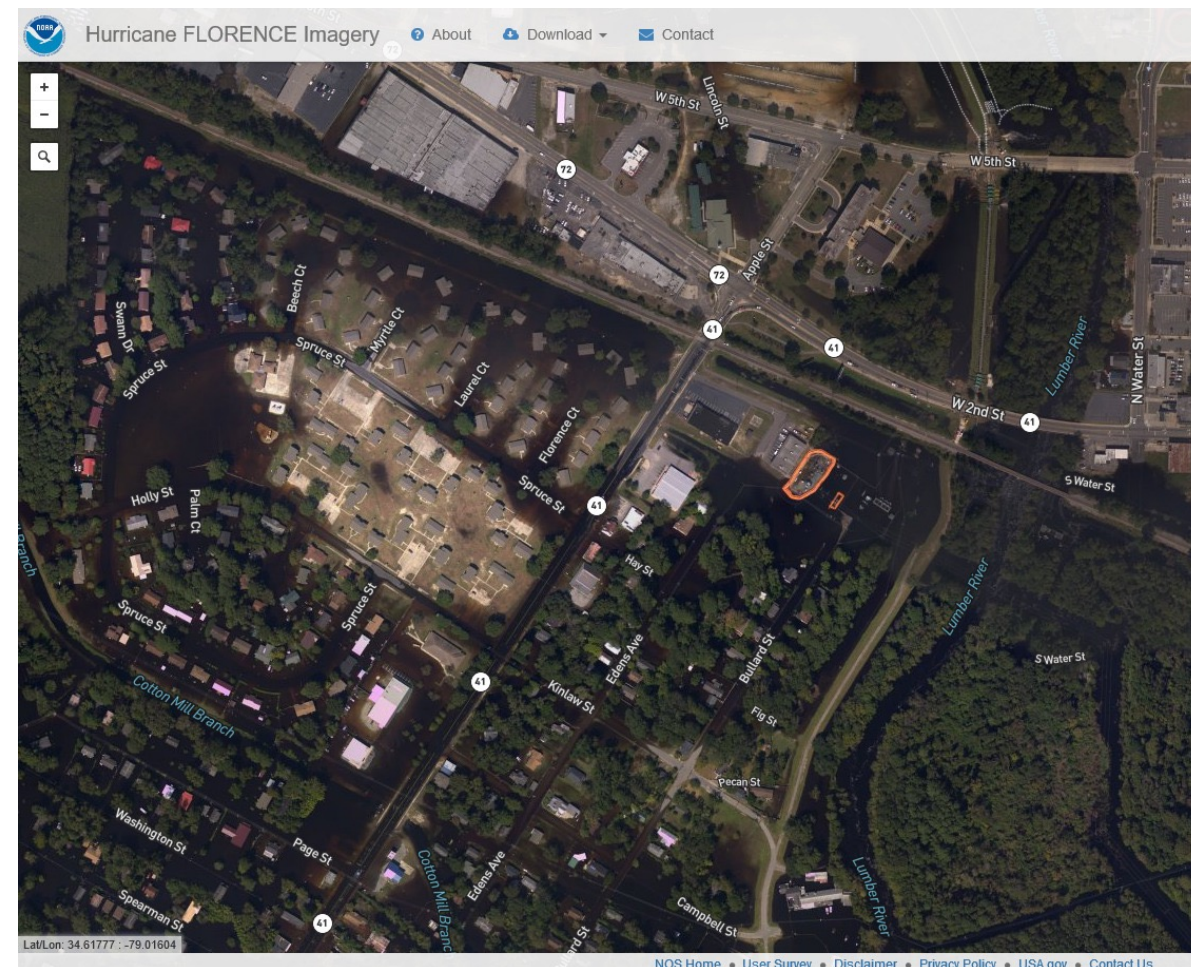
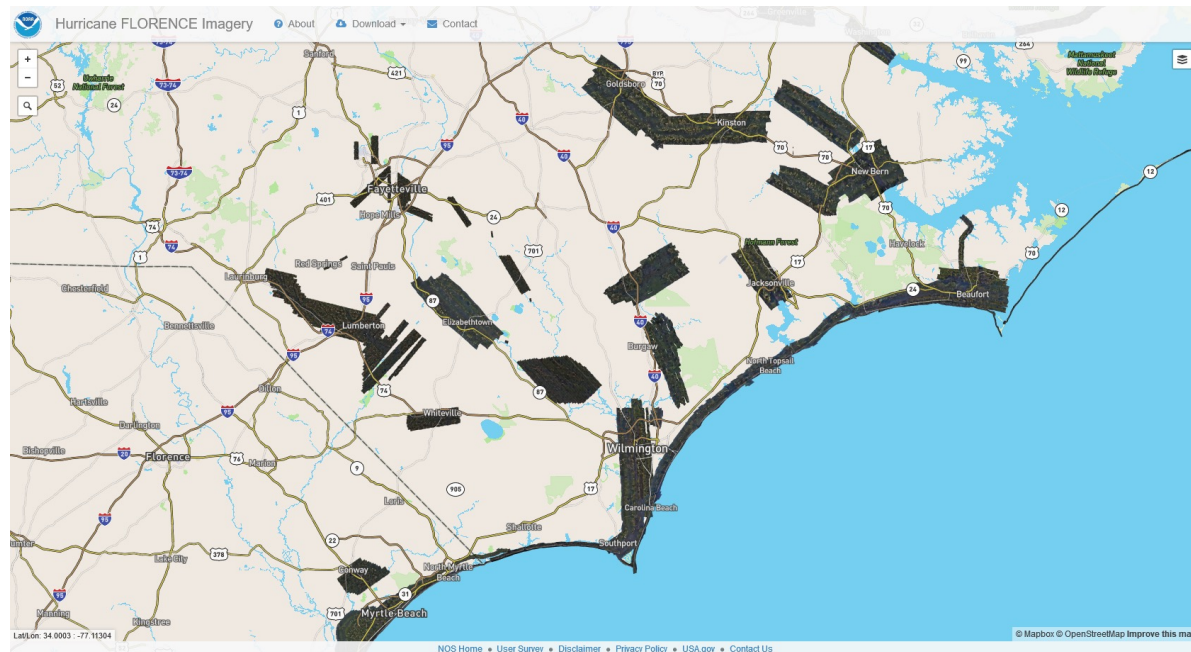
FEMA

## Hurricane tracking and decision support tool

- Tropical Weather Outlook
- Tropical Cyclone track and historical error cone
- Wind probabilities and deterministic wind fields
- Tropical Storm Wind Time of Arrival
- Rainfall Forecasts and Excessive Rainfall Outlooks
- Significant River Flooding Outlooks
- Observed and forecast flood stages along rivers (although less functionality and info than on AHPS website).



# Post-Storm Aerial and Satellite Imagery



## NWS IDSS & FEMA HLT address:

- Confidence? Contingencies?
- What is the forecast/evacuation timing?
- Can we get a briefing?

# NWS Impact-Based Decision Support Services (IDSS)



IDSS connects NWS forecasts and warnings to decision makers on the local, state, and federal levels to save lives and property.

## IDSS includes:

- Remote support with forecast advice through various means (such as phone calls, email or online webinars)
- On-site support at an emergency operations center
- On-site support at an incident or event (such as NWS deployment to a wildfire).



# Hurricane Liaison Team (HLT) Background



- Initial idea arose in the early 1990s
- Proven during response to the 1995 Hurricane Season
  - Erin and Opal
- Formalized in 1996
  - Request from Governor of Florida to FEMA and NHC Director



# HLT Mission



The Hurricane Liaison Team's mission is to improve our Nation's capability to respond to hurricanes through the rapid exchange of critical information between the National Hurricane Center and Federal, State, Local, Tribal and Territorial emergency managers.





# Rapid Communications



## Partnership between the NWS and FEMA

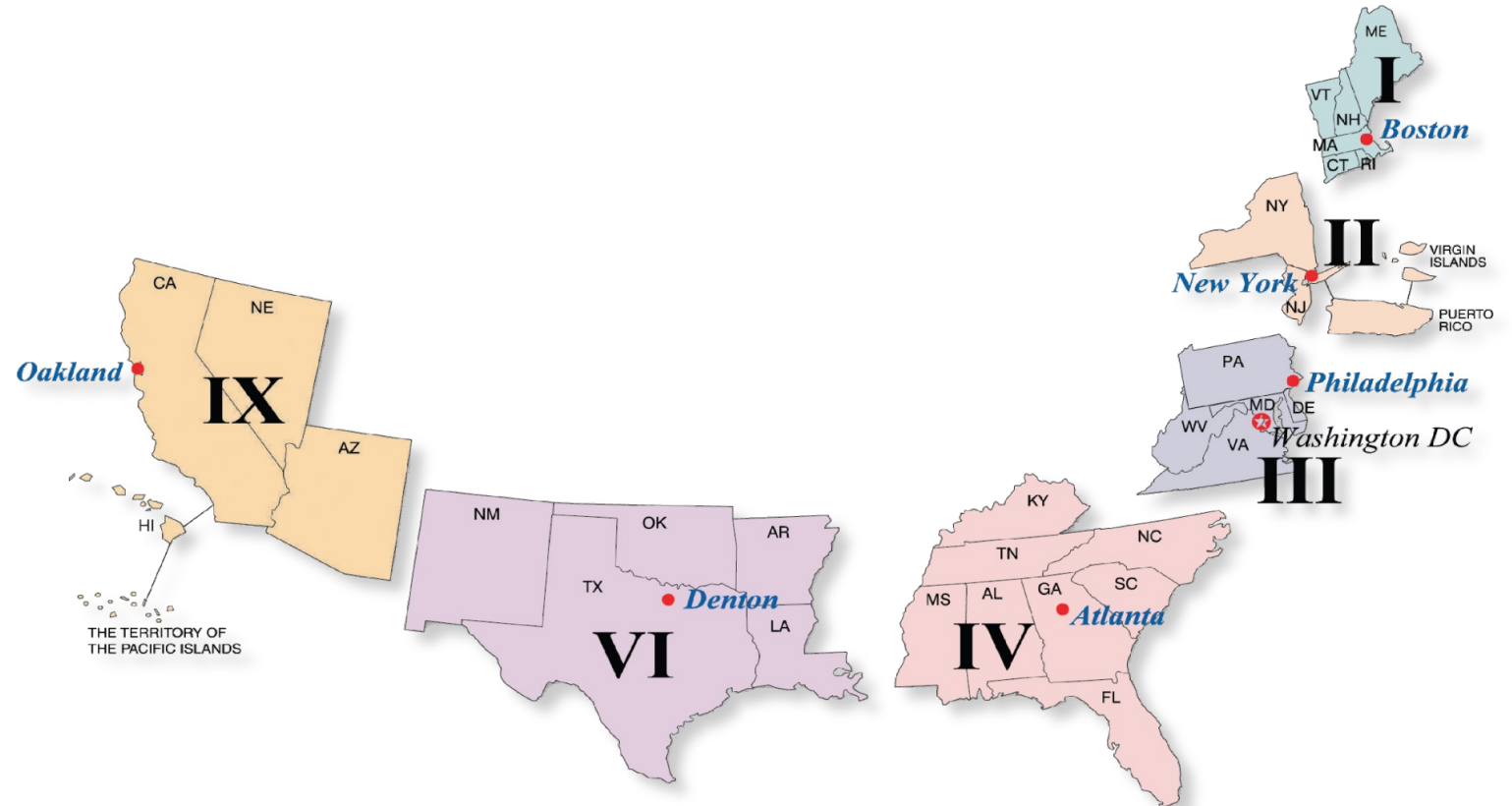
- FEMA Hurricane Program Managers
- FEMA Reservists
- FEMA Liaison to NWS National Water Center
- NWS meteorologists and hydrologists



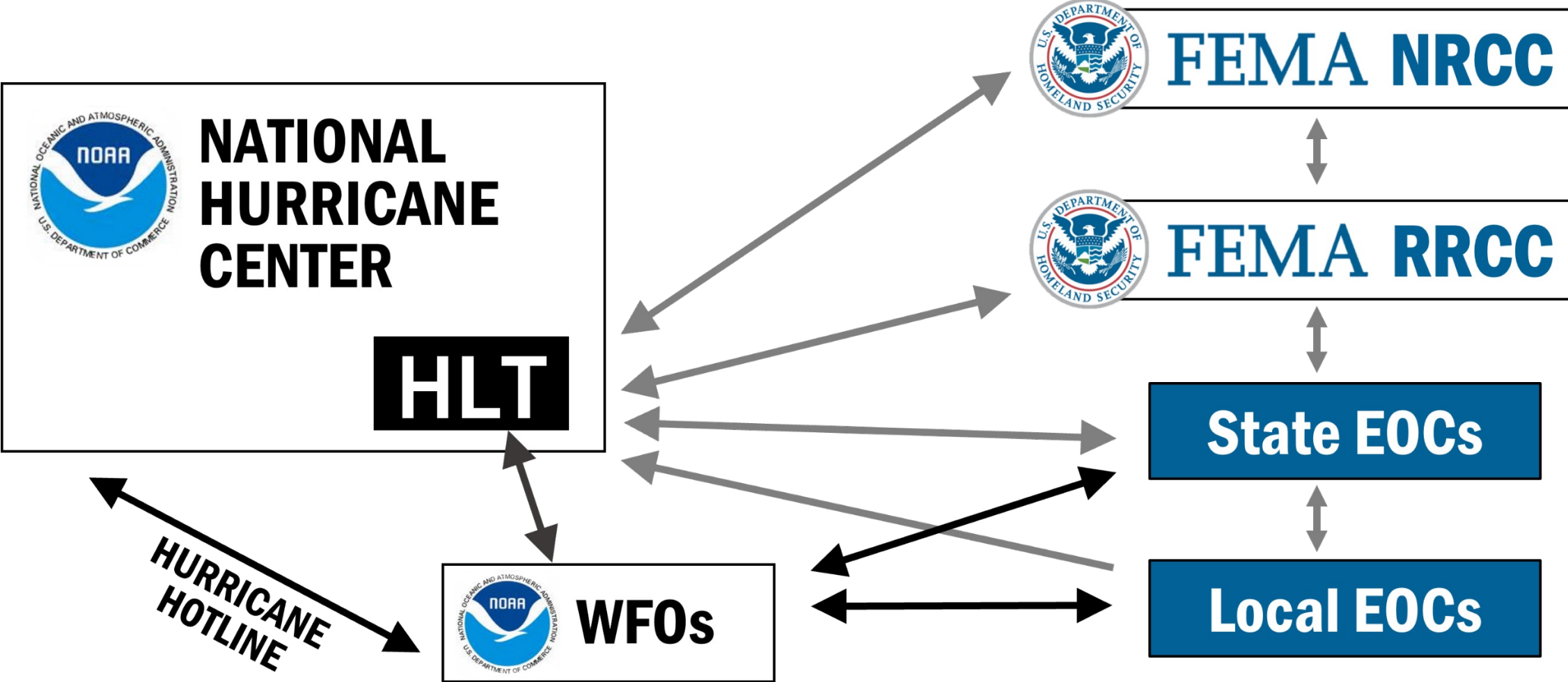
# Regional Hurricane Program Manager (RHPMs)



- Technical Knowledge
- State/Local Relationships
- Deploy to NHC



# Communication Flowchart



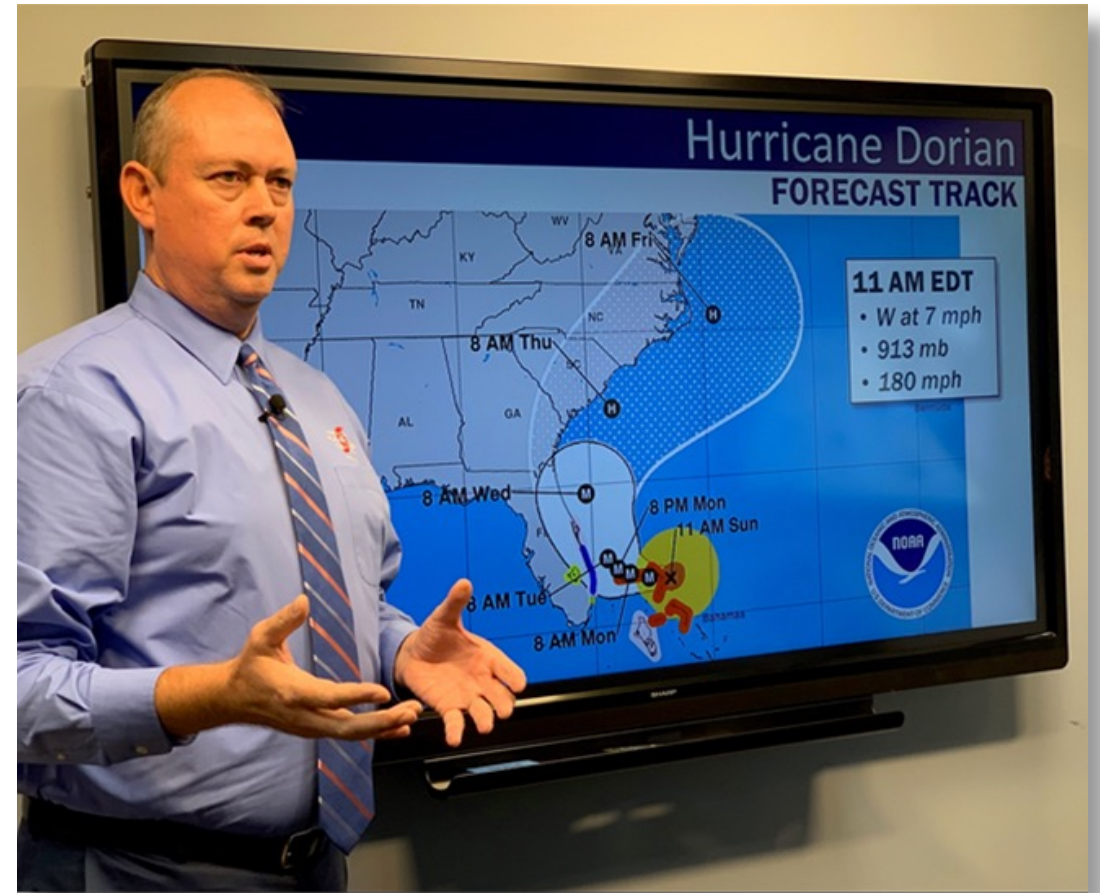
# HLT Responsibilities

- Real-time interpretation, assessment and guidance;
  - Apply NHC forecasts with Regional, State and local response evacuation plans
- Forum for EMs to ask questions,
  - Reinforce decisions;
  - Assist with use of NHC forecasts and predictive modeling
- Provide NHC visibility on State and local protective actions
  - Improve messaging



# HLT Responsibilities (cont.)

- **Facilitate two-way communications**
  - Between the NHC and EMs
  - Common forecast picture
  - Relay EM issues to improve NWS/NHC messaging
- **Video/Teleconferences**
  - NHC/NWS
  - FEMA and other Federal Agencies
  - Emergency Operations Centers (EOCs)

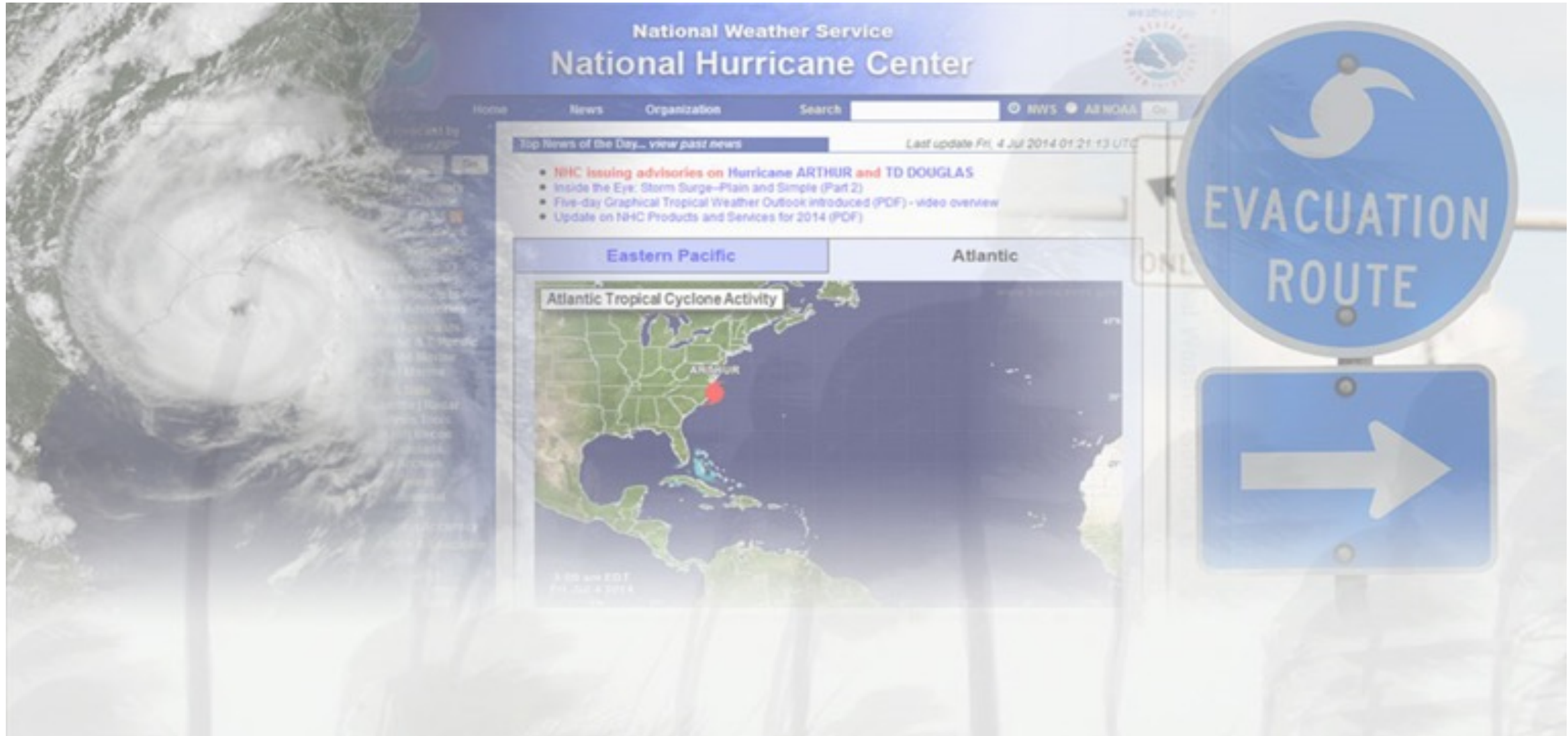


# State Meteorologists & Hurricane Programs



- In addition to NWS and FEMA HLT, your state emergency management agency may also have a State Meteorologist or Climatologist, a State Hurricane Program Manager, or State Hurricane Lead.
- These individuals often work closely with NWS and FEMA.
- They are excellent resources for state-specific tropical threats and plans.

# Questions/Comments



# Final Examination



Time: 30 minutes

Activity: Complete final exam